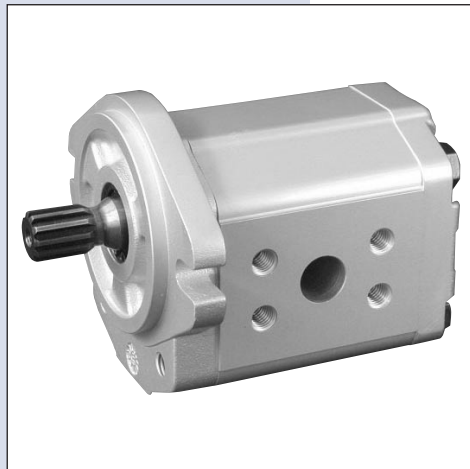
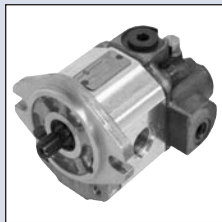
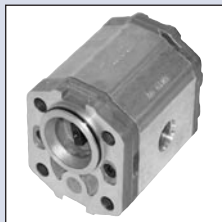


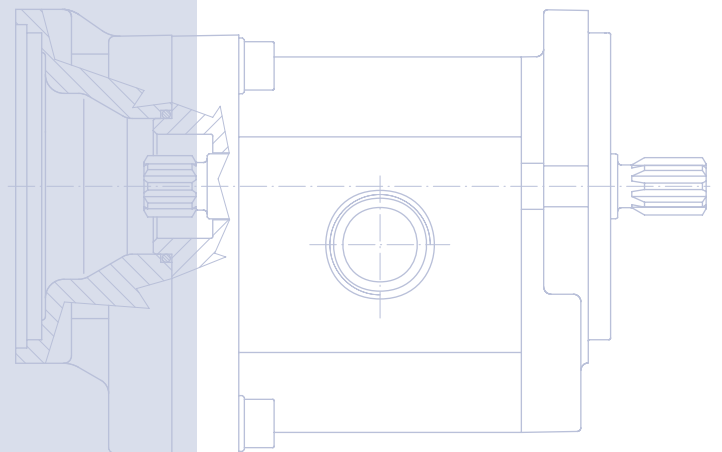
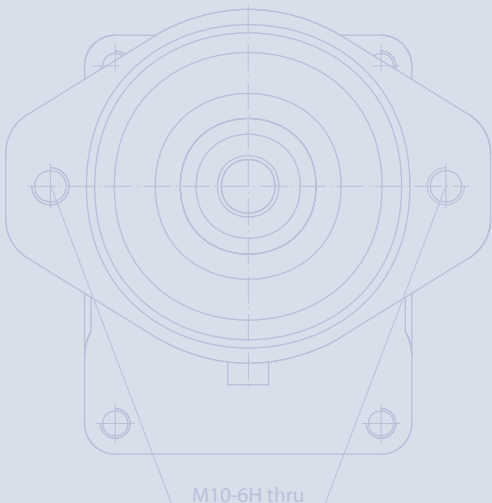


Group 2 Gear Pumps

Technical Information



SAE A Pad



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Front cover illustrations: F000 792, F000 793, F000 794, F005 105

INTRODUCTION

Sauer-Danfoss high performance gear pumps are fixed displacement pumps which consist of the pump housing, drive gear, driven gear, DU bushings, rear cover and front flange, shaft seal and inner / outer seals, as shown in *the section drawing on page 6*. The pressure balanced design of the pumps provides high efficiency for the entire series.

The standard SNP2 pumps are offered throughout the given range of displacements. There are also two special versions, the SHP 2 and the SKP 2. The SHP uses longer journal bearings to achieve a higher pressure capability in the larger displacements. The SKP is designed to accommodate an SAE 11 tooth splined shaft for higher torque applications.

- Large displacement range (from 4 to 25 cm³)
- High performance at low cost
- Efficient pressure balanced design
- Proven reliability and performance
- Optimum product configurations
- Full range of auxiliary features
- Compact, lightweight
- Modular product design
- Quiet operation
- Worldwide sales and service

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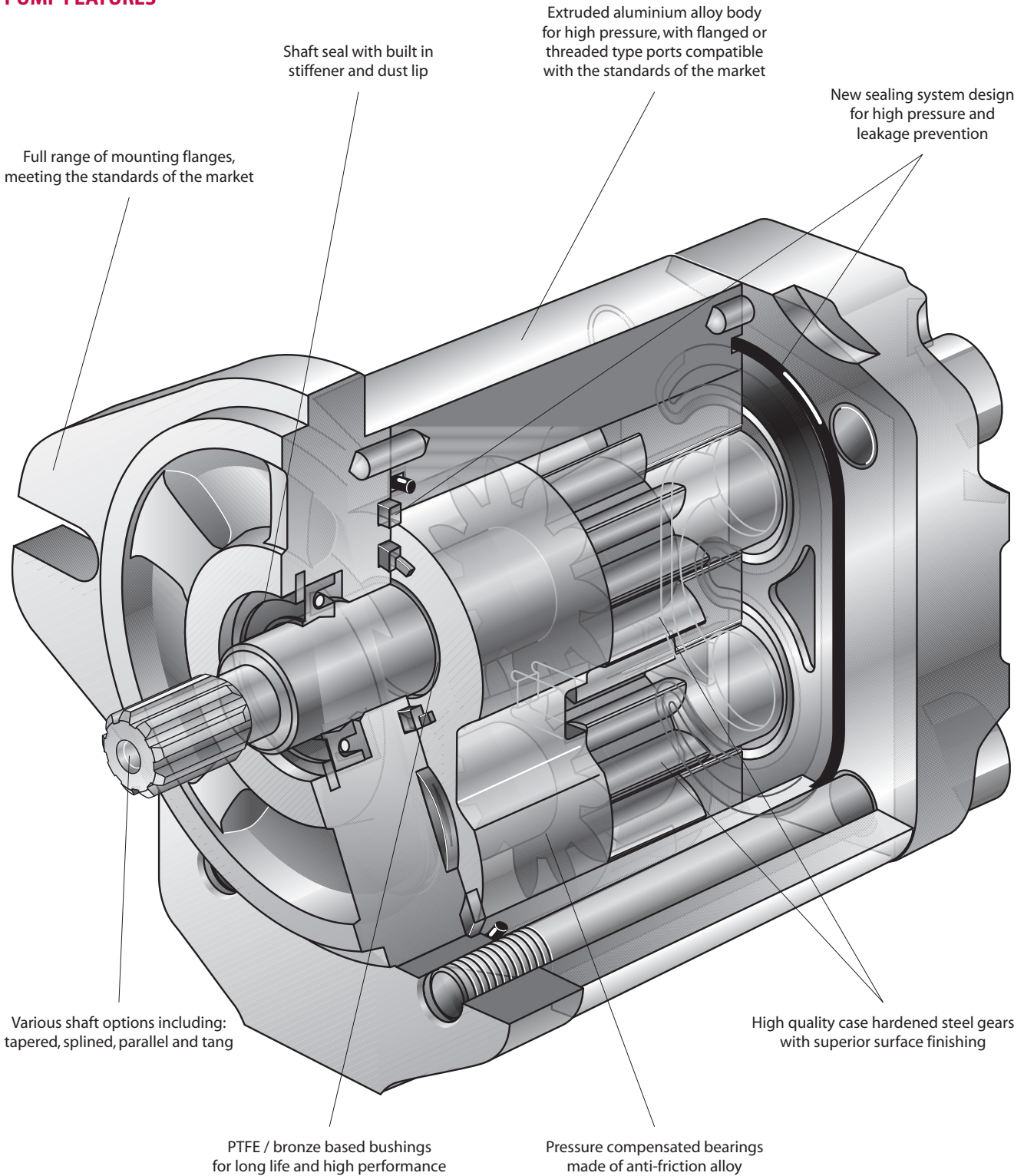
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PRODUCT DIMENSIONAL
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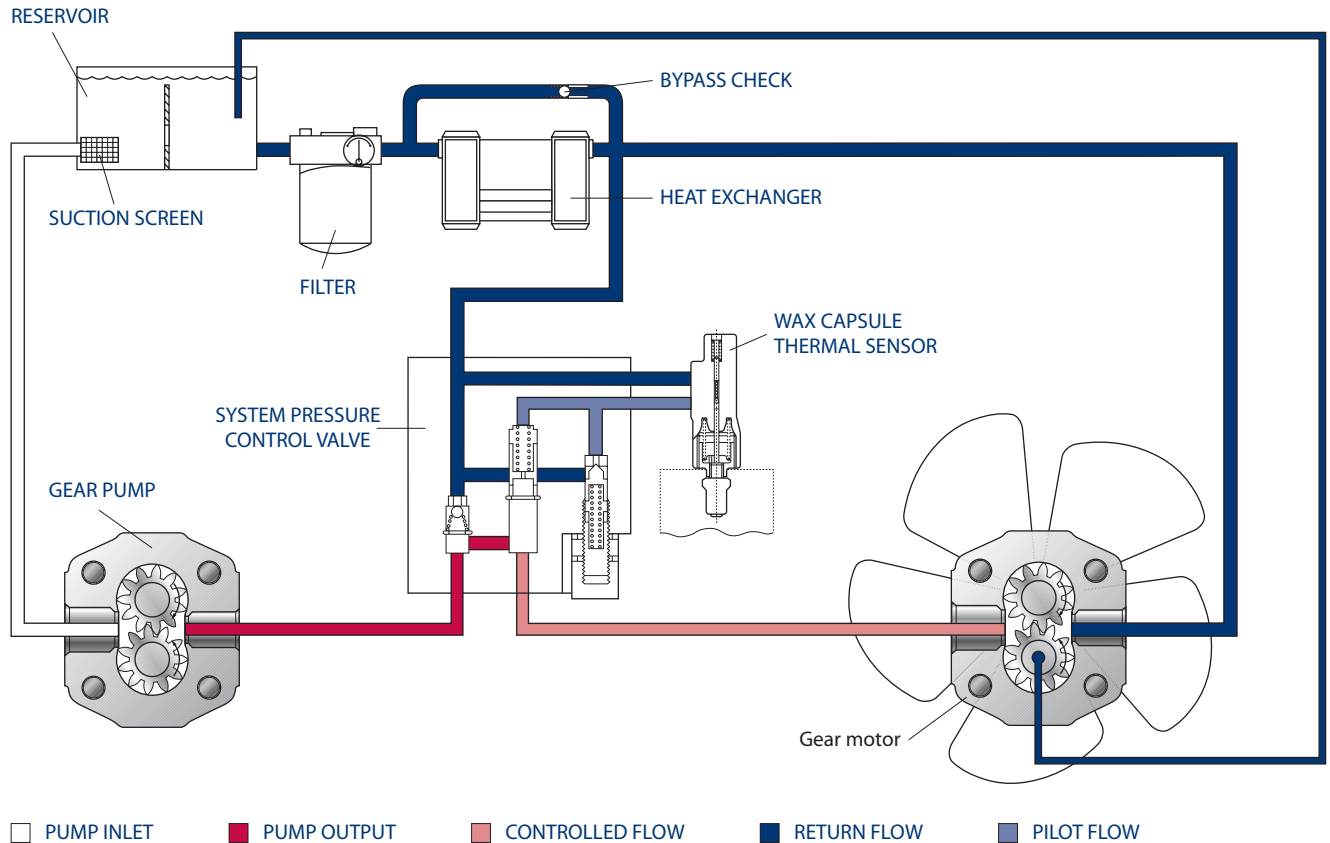
SC01 / CI01 / CO0135
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PUMP FEATURES



P101 000

TYPICAL GEAR PUMP CIRCUIT



P101 001E

This circuit shows an SNP 2 **gear pump** driving an SNM 2 **gear motor** through a **system pressure control valve**. The system pressure control valve regulates motor speed based on input from the **wax capsule thermal sensor**. Discharge from the gear motor is then returned to the **reservoir** through a **heat exchanger**, which is equipped with a **bypass check valve**. Oil in this circuit is cleaned by a return line **filter** placed between the heat exchanger and the reservoir. A **suction screen** in the reservoir covers the inlet line.

Specifications for Group 2 pumps are listed on these two pages.
 For definition and explanation of the various terms, see [page 12](#).

HARDWARE SPECIFICATIONS

Pump model		4	6	8	11	14	17	19	22	25
Displacement	cm ³ [in ³]	3.9 [0.24]	6.0 [0.37]	8.4 [0.51]	10.8 [0.66]	14.4 [0.88]	16.8 [1.02]	19.2 [1.17]	22.8 [1.39]	25.2 [1.54]
SNP										
Peak pressure	bar [psi]	280 [4060]	280 [4060]	280 [4060]	280 [4060]	280 [4060]	280 [4060]	230 [3335]	200 [2900]	175 [2538]
Rated pressure	bar [psi]	250 [3625]	250 [3625]	250 [3625]	250 [3625]	250 [3625]	250 [3625]	210 [3045]	180 [2610]	160 [2320]
Minimum speed at 0-100 bar	min ⁻¹ (rpm)	600	600	600	500	500	500	500	500	500
Minimum speed at 100-180 bar	min ⁻¹ (rpm)	1200	1200	1000	800	750	750	700	700	700
Minimum speed at 180 bar to rated pressure	min ⁻¹ (rpm)	1400	1400	1400	1200	1000	1000	1000	-	-
Maximum speed	min ⁻¹ (rpm)	4000	4000	4000	4000	3500	3000	3000	3000	3000
SKP										
Peak pressure	bar [psi]	280 [4060]	280 [4060]	280 [4060]	280 [4060]	280 [4060]	280 [4060]	260 [3770]	230 [3335]	200 [2900]
Rated pressure	bar [psi]	250 [3625]	250 [3625]	250 [3625]	250 [3625]	250 [3625]	250 [3625]	240 [3480]	210 [3045]	190 [2755]
Minimum speed at 0-100 bar	min ⁻¹ (rpm)	600	600	600	500	500	500	500	500	500
Minimum speed at 100-180 bar	min ⁻¹ (rpm)	1200	1200	1000	800	750	750	700	700	700
Minimum speed at 180 bar to rated pressure	min ⁻¹ (rpm)	1400	1400	1400	1200	1000	1000	1000	800	800
Maximum speed	min ⁻¹ (rpm)	4000	4000	4000	4000	3500	3000	3000	3000	3000
SHP										
Peak pressure	bar [psi]							260 [3770]	230 [3335]	200 [2900]
Rated pressure	bar [psi]							240 [3480]	210 [3045]	190 [2755]
Minimum speed at 0-100 bar	min ⁻¹ (rpm)							600	600	600
Minimum speed at 100-180 bar	min ⁻¹ (rpm)							800	800	800
Minimum speed at 180 bar to rated pressure	min ⁻¹ (rpm)							1000	1000	1000
Maximum speed	min ⁻¹ (rpm)							3000	3000	3000
ALL										
The data below represent mean values for standard configured pumps										
Weight	kg [lb]	2.3 [5.1]	2.4 [5.3]	2.5 [5.5]	2.7 [5.8]	2.9 [6.3]	3.0 [6.5]	3.1 [6.7]	3.2 [7.0]	3.3 [7.3]
Moment of inertia of rotating components	x 10 ⁻⁶ kg m ² [x 10 ⁻⁶ lbf ft ²]	21.3 [505]	26.5 [629]	32.4 [769]	38.4 [911]	47.3 [1122]	53.3 [1265]	59.2 [1405]	68.1 [1616]	74.1 [1758]
Theoretical flow at maximum speed	l/min [US gal/min]	15.6 [4.12]	24.0 [6.34]	33.6 [8.87]	43.2 [11.4]	50.4 [13.3]	50.4 [13.3]	57.6 [15.2]	68.4 [18.0]	75.6 [20.0]

Caution: Allowable pressure may be limited by shaft torque capability. Refer to [page 23](#).

SYSTEM SPECIFICATIONS

Inlet pressure - bar absolute

Recommended range: 0.8 to 3.0
 Minimum (cold start): 0.6

Fluid viscosity - mm²/s [SUS]

Minimum: 10 [60]
 Recommended range: 12 to 60 [66 to 280]
 Maximum (cold start): 1600 [7500]

Temperature - °C [°F]

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

Fluid cleanliness level and β_x ratio

Fluid cleanliness level (per ISO 4406): Class 18/13 or better
 β_x ratio (suction filtration): β₃₅₋₄₅ = 75 and β₁₀ = 2
 β_x ratio (pressure or return filtration): β₁₀ = 75
 Recommended inlet screen size: 100-125 μm

**DETERMINATION OF
 NOMINAL PUMP SIZE**

Unit:	Metric system:		Inch system	
Output flow	$Q = \frac{V_g \cdot n \cdot \eta_v}{1000}$	l/min	$Q = \frac{V_g \cdot n \cdot \eta_v}{231}$	[US gal/min]
Input torque	$M = \frac{V_g \cdot \Delta p}{20 \cdot \pi \cdot \eta_m}$	Nm	$M = \frac{V_g \cdot \Delta p}{2 \cdot \pi \cdot \eta_m}$	[lbf·in]
Input power	$P = \frac{V_g \cdot n \cdot \Delta p}{600\,000 \cdot \eta_m}$	kW	$P = \frac{V_g \cdot n \cdot \Delta p}{396\,000 \cdot \eta_m}$	[hp]

- V_g = Pump displacement per revolution cm³ [in³]
- n = Pump speed min⁻¹ (rpm)
- Δp = System pressure bar [psi]
- Δp = p_o - p_i
- η_v = Pump volumetric efficiency
- η_m = Pump mechanical efficiency
- η_t = Pump overall efficiency
- η_t = η_v · η_m
- p_o = Outlet pressure bar [psi]
- p_i = Inlet pressure bar [psi]

MODEL CODE



Type

- SNP 2** = Standard Gear Pump
- SKP 2** = High Torque Gear Pump
- SHP 2** = High Pressure Gear Pump
- SNI 2** = Gear Pump with Internal Drain Relief Valve
- SNE 2** = Gear Pump with External Drain Relief Valve

Valve (omit when not used)

- U** = Priority Flow Divider with Pilot Relief Valve
- L** = Priority Flow Divider with Pilot Relief Valve and Static Load Sensing
- N** = Priority Flow Divider with Pilot Relief Valve and Dynamic Load Sensing
- P** = Priority Flow Divider with Full Flow Relief Valve
- R** = Priority Flow Divider with Full Flow Relief Valve and Static Load Sensing
- V** = Priority Flow Divider with Full Flow Relief Valve and Dynamic Load Sensing

Valve Port Position (omit when not used)

- S** = Side Ports
- F** = Rear Ports

Displacement – cm³/rev [in³/rev]

- 4** = 3.9 [0.24]
- 6** = 6.0 [0.37]
- 8** = 8.4 [0.51]
- 11** = 10.8 [0.66]
- 14** = 14.4 [0.88]
- 17** = 16.8 [1.03]
- 19** = 19.2 [1.17]
- 22** = 22.8 [1.39]
- 25** = 25.2 [1.54]

Direction of Rotation

- D** = Right (Clockwise)
- S** = Left (Anti-clockwise)

Input Shaft / Mounting Flange / Port Configuration

CO Tapered shafts, 1:5 or 1:8

- CO01** = 1:8 tapered shaft / European four bolt flange / European flanged ports
- CO02** = 1:5 tapered shaft / German four bolt PTO flange / German standard ports
- CO04** = 1:5 tapered shaft / German two bolt PTO flange (Deutz) / German standard ports
- CO05** = 1:5 tapered shaft / German two bolt PTO flange (Deutz) / German standard ports
- CO09** = 1:8 tapered shaft / Perkins 4.236 timing case flange / European flanged ports
- CO09** = (variant BBM) 1:8 tapered shaft / Perkins 900 series flange / German standard ports
- CO0B** = 1:8 tapered shaft / Perkins 1000 series left side PTO flange / European flanged ports
- CO91** = (variant LBD) 1:8 tapered shaft / European four bolt flange / European flanged ports / equipped with outrigger bearing
- CO94** = 1:5 tapered shaft / German two bolt PTO flange (Deutz) / German standard ports / equipped with outrigger bearing

CI Parallel shafts, 15mm or 15.875mm

- CI01** = 15mm [0.591 in] parallel shaft / European four bolt flange / European flanged ports
- CI06** = 15.875mm [0.625 in] parallel shaft / SAE "A" flange / SAE O-ring boss ports
- CI96** = (variant LEP) 19.05mm [0.750 in] parallel shaft / SAE "A" flange / SAE O-ring boss ports / equipped with outrigger bearing

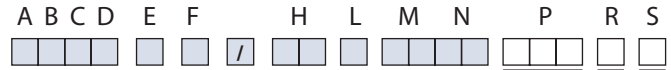
SC Splined shafts, DIN B17x14, SAE 9T 16/32p, or SAE 11T 16/32p (SKP 2 only)

- SC01** = DIN splined shaft / European four bolt flange / European flanged ports
- SC02** = DIN splined shaft / German four bolt PTO flange / German standard ports
- SC04** = DIN splined shaft / German two bolt PTO flange (Deutz) / German standard ports
- SC05** = DIN splined shaft / German two bolt PTO flange (Deutz) / German standard ports
- SC06** = SAE splined shaft / SAE A flange / SAE O-ring boss ports
- SC36** = SAE splined shaft / SAE A flange plus SAE A auxiliary mounting pad / SAE O-ring boss ports

FR Sauer-Danfoss tang shaft

- FR03** = Sauer-Danfoss tang shaft / flanged for multiple configuration / German standard ports

MODEL CODE (continued)



Variant Code (Three letter code describes valve settings or other variants to standard configuration)

- BBM** = Variation on 09 flange to accommodate Perkins 900 series engine mounting
- LEP** = Variant on standard straight shaft used with C196 outrigger bearing option
- LBD** = Variant on standard tapered shaft used on CO91 outrigger bearing option
- U**** Integral flow divider
 - Pressure setting at controlled flow – bar [psi]

L = 60 [870]	T = 140 [2031]
M = 70 [1015]	C = 150 [2176]
N = 80 [1160]	U = 160 [2321]
O = 90 [1305]	D = 170 [2466]
P = 100 [1450]	V = 180 [2611]
Q = 110 [1595]	E = 190 [2756]
R = 120 [1740]	X = 200 [2901]
S = 130 [1885]	

- Controlled flow – l/min [US gal/min]

M = 8 [2.11]	J = 18 [4.75]
F = 10 [2.64]	Q = 20 [5.28]
N = 12 [3.17]	K = 22 [5.81]
O = 14 [3.70]	R = 24 [6.34]
P = 16 [4.23]	I = 26 [6.86]

- V**** Integral relief valve
 - Pressure setting – bar [psi]

A = No setting	O = 90 [1305]
B = No valve	P = 100 [1450]
C = 18 [261]	Q = 110 [1595]
D = 25 [363]	R = 120 [1740]
E = 30 [435]	S = 130 [1885]
F = 35 [508]	T = 140 [2031]
G = 40 [580]	U = 160 [2321]
K = 50 [725]	V = 170 [2466]
L = 60 [870]	W = 180 [2611]
M = 70 [1015]	X = 210 [3046]
N = 80 [1160]	Z = 250 [3626]

- Pump speed for relief valve 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

Version (Value representing a change to the initial project)

- . = Initial project
- 1..9 A..Z** = Reserved to

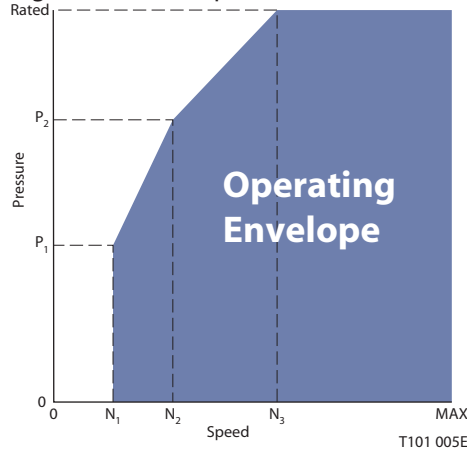
Port Type (If other than standard)

- . = Standard port for the flange type specified
- 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)
- E** = Threaded SAE o-ring boss port
- F** = Threaded Gas port (BSP)
- G** = Flanged port with threaded holes in "X" pattern (German standard ports), offset from center of body

DEFINITION AND EXPLANATION OF TECHNICAL TERMS

Maximum speed is the speed limit recommended when operating at rated pressure. It is the highest speed at which normal life can be expected.

Minimum speed is the lower limit of operating speed. It is the lowest speed at which normal bearing life can be expected. It is important to note that the minimum speed increases as operating pressure increases. When operating under higher pressures, a higher minimum speed must be maintained (see *graph below*).



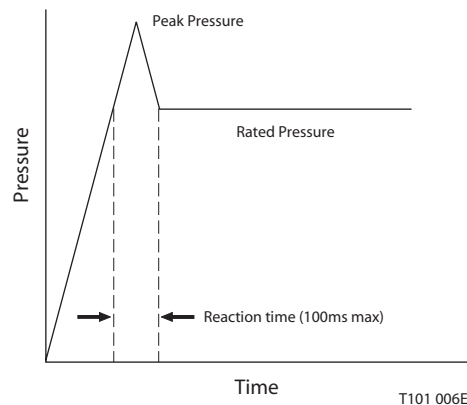
Where:

- N₁ = Minimum speed at 100 bar
- N₂ = Minimum speed at 180 bar
- N₃ = Minimum speed at rated pressure

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

Rated pressure is the average, regularly occurring operating pressure that should yield satisfactory product life. It can be determined by the maximum machine load demand. For all systems the load should move below this pressure.

Peak pressure is the highest intermittent pressure allowed, and is determined by the relief valve over shoot (reaction time). Peak pressure is assumed to occur for less than 100 ms in duration.



Inlet pressure – bar absolute	
Recommended range	0.8 to 3.0
Minimum (cold start)	0.6

Inlet pressure must be controlled in order to achieve expected life and performance. A continuous inlet pressure less than those shown in the table above would indicate inadequate inlet design or a restricted inlet screen. Lower inlet pressures during cold start should be expected, but should improve quickly as the fluid warms.



Group 2 – Gear Pumps
Technical Information
Notes

HYDRAULIC FLUID

Ratings and data for Group 2 gear pumps are based on operation 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.

For more information on fluid selection, see Sauer-Danfoss publication *Hydraulic Fluids and Lubricants*. For information relating to biodegradable fluids, see Sauer-Danfoss publication *Experience with Bio Fluids*.

Never mix hydraulic fluids.

These include:

- Hydraulic fluids per DIN 51524, part 2 (HLP) and part 3 (HVLP)
- API CD engine oils per SAE J183
- M2C33F or G automatic transmission fluids
- Dexron II, IIE, and III meeting Allison C3 or Caterpillar TO-2
- Certain agricultural tractor fluids

TEMPERATURE AND VISCOSITY

Temperature and viscosity requirements must be concurrently satisfied. The data shown assumes petroleum / mineral based fluids. The high temperature limits apply at the inlet port to the pump. The pump should generally be run at or below the **maximum continuous temperature**. The **peak temperature** is based on material properties and should never be exceeded. Cold oil will generally not affect the durability of the pump components, but it may affect the ability to flow oil and transmit power, therefore temperatures should remain 16 °C (30 °F) above the pour point of the hydraulic fluid. The **intermittent (minimum) temperature** relates to the physical properties of component materials. For maximum unit efficiency and bearing life the fluid viscosity should remain in the **recommended viscosity range**. The **minimum viscosity** should be encountered only during brief occasions of maximum ambient temperature and severe duty cycle operation. The **maximum viscosity** should be encountered only at cold start. During this condition speeds should be limited until the system warms up. Heat exchangers should be sized to keep the fluid within these limits. Testing is recommended to verify that these temperature and viscosity limits are not exceeded.

Fluid viscosity – mm ² /s [SUS]	
Minimum	10 [60]
Recommended range	12 to 60 [66 to 290]
Maximum (cold start)	1600 [7500]

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

INLET DESIGN

Hydraulic oil used in the majority of systems contains about 10% dissolved air by volume. Under conditions of high inlet vacuum, bubbles are released from the oil. These bubbles collapse when subjected to pressure, which results in cavitation, which causes erosion of the adjacent material. Because of this, the greater the air content within the oil, and the greater the vacuum in the inlet line, the more severe will be the resultant erosion. The main causes of over-aeration are air leaks on the inlet side of the pump, and flow line restrictions. These may include inadequate pipe sizes, sharp bends, or elbow fittings causing a reduction of flow line cross sectional area. Providing pump inlet vacuum and rated speed requirements are maintained, and reservoir size and location are adequate, no cavitation problems should occur.

FLUIDS AND FILTRATION

To prevent premature wear, it is imperative that only clean fluid enter the pump and hydraulic circuit. A filter capable of controlling the fluid cleanliness to Class 18/13 per ISO 4406 or better under normal operating conditions is recommended.

The filter may be located on the pump outlet (pressure filtration), inlet (suction filtration), or the reservoir return (return line filtration).

The selection of a filter depends on a number of factors including the contaminant ingress rate, the generation of contaminants in the system, the required fluid cleanliness, and the desired maintenance interval. Contaminant ingress rate is determined (among other things) by the type of actuators used in the system. Hydraulic cylinders normally cause higher levels of contamination to enter the system.

Filters are selected to meet these requirements using rating parameters of efficiency and capacity. Filter efficiency may be measured with a Beta ratio¹ (β_x). For suction filtration, with controlled reservoir ingress, a filter with $\beta_{35-45} = 75$ (and $\beta_{10} = 2$) or better has been found to be satisfactory. For return or pressure filtration, filters with an efficiency of $\beta_{10} = 75$ are typically required.

Since each system is unique, the filtration requirements for that system will be unique and must be determined by test in each case. Filtration system acceptability should be judged by monitoring of prototypes, evaluation of components, and performance throughout the test program.

See Sauer-Danfoss publications *Hydraulic Fluids and Lubricants* and *Experience with Bio Fluids* for more information.

(1) Filter β_x ratio is a measure of filter efficiency defined by ISO 4572. It is defined as 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 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]

RESERVOIR

The function of the reservoir is to provide clean fluid, dissipate heat, remove entrained air, and allow for fluid volume changes associated with fluid expansion and cylinder differential volumes.

The reservoir should be designed to accommodate maximum volume changes during all system operating modes and to promote deaeration of the fluid as it passes through the tank. The design should accommodate a fluid dwell time between 60 and 180 seconds to allow entrained air to escape.

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

The suction line should be located above the bottom of the reservoir to take advantage of gravity separation and prevent large foreign particles from entering the line. A 100-125 μm [0.004-0.005 in] screen covering the suction line is recommended. To minimize vacuum at the pump inlet, it is recommended that the pump be located below the lowest expected fluid level.

The return line should be positioned to allow discharge below the lowest fluid level, and directed into the interior of the reservoir for maximum dwell and efficient deaeration. A baffle (or baffles) between the return line and suction line will promote deaeration and reduce surging of the fluid.

LINE SIZING

The choice of piping size and installation should always be consistent with maintaining minimum fluid velocity. This will reduce system noise, pressure drops and overheating, thereby maximizing system life and performance. Inlet piping should be designed to maintain continuous pump inlet pressures above 0.8 bar absolute during normal operation. The inlet line velocity should not exceed 2.5 m/s. Pump outlet line velocity should not exceed 5 m/s. System return lines should be limited to 3 m/s.

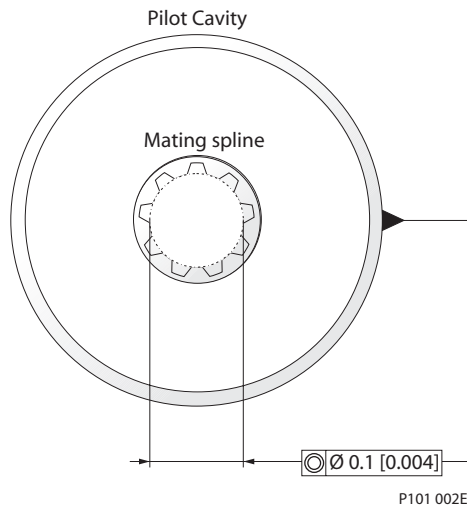
PUMP DRIVE

With a choice between tapered, splined, or parallel shafts, Sauer-Danfoss gear pumps are suitable for a wide range of direct and indirect drive applications. Typically these applications use a plug-in, belt, or gear to drive the pump input shaft. Group 2 pumps are designed with bearings that can accept some incidental external radial and thrust loads. However, any amount of external load may reduce the expected bearing life. An outrigger bearing is available to accommodate these loads and is shown on [page 33](#). For in-line drive applications, it is recommended that a three piece coupling be used to minimize radial or thrust shaft loads. Plug-in drives, acceptable only with spline shaft configurations, can impose severe radial loads on the pump shaft when the mating spline is rigidly supported. Increased spline clearance does not alleviate this condition. The use of plug in drives is permissible providing that the concentricity between the mating spline and pilot diameter is within 0.1 mm [0.004 in]. The drive should be lubricated by flooding with oil.

The allowable **radial shaft loads** are a function of the load position, the load orientation, and the operating pressure of the hydraulic pump. All external shaft loads will have an effect on bearing life and may affect pump performance. In applications where external shaft loads cannot be avoided, the impact on the pump can be minimized by optimizing the orientation and magnitude of the load. A tapered input shaft is recommended for applications where radial shaft loads are present. Spline shafts are **not recommended** for belt or gear drive applications. For belt drive applications, a spring loaded belt tension device is recommended to avoid excessive belt tension.

Thrust (axial) loads in either direction should be avoided. If continuously applied external radial or thrust loads are known to occur, contact Sauer- Danfoss for evaluation.

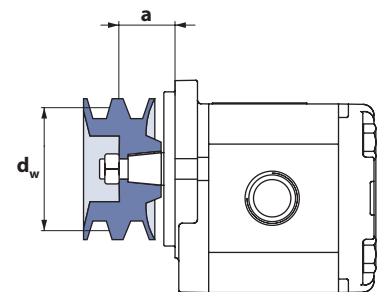
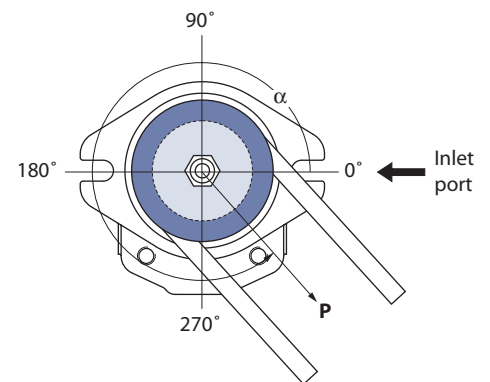
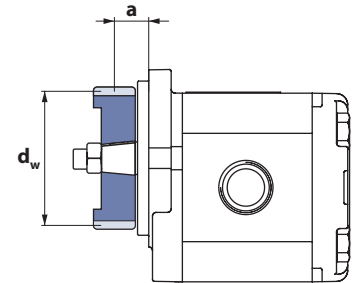
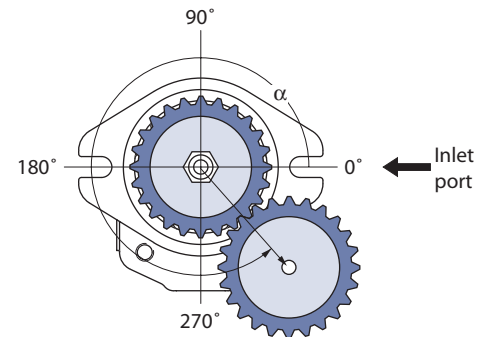
Contact your Sauer-Danfoss representative for assistance when applying pumps with radial or thrust loads.



PUMP DRIVE (continued) Pump drive data form

Photo copy this page and fax the completed form to your Sauer-Danfoss representative for assistance in applying pumps with belt or gear drive.

Application data		
Pump displacement		cc/rev
Rated system pressure		<input type="checkbox"/> bar <input type="checkbox"/> psi
Relief valve setting		<input type="checkbox"/> bar <input type="checkbox"/> psi
Pump shaft rotation		<input type="checkbox"/> left <input type="checkbox"/> right
Pump minimum speed		min ⁻¹ (rpm)
Pump maximum speed		min ⁻¹ (rpm)
Drive gear helix angle (gear drive only)		deg.
Belt type (belt drive only)		<input type="checkbox"/> V <input type="checkbox"/> Notch
Belt tension (belt drive only)	P	<input type="checkbox"/> N <input type="checkbox"/> lbf
Angular orientation of gear or belt to inlet port	α	deg.
Pitch diameter of gear	d_w	<input type="checkbox"/> mm <input type="checkbox"/> in
Distance from flange to center of gear or pulley	a	<input type="checkbox"/> mm <input type="checkbox"/> in



P101 003E

PUMP LIFE

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

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

Pump life is defined as the life expectancy of the hydraulic components and is a function of speed, system pressure, and other system parameters such as oil cleanliness. High pressure, which results from high load, reduces expected life in a manner similar to many mechanical assemblies such as engines and gearboxes. When reviewing an application, it is desirable to have projected machine duty cycle data, which includes percentages of time at various loads and speeds.

Prototype testing programs to verify operating parameters and their impact on life expectancy are strongly recommended prior to finalizing any system design.

SOUND LEVELS

Fluid power systems are inherent generators of noise. As with many high power density devices, noise is an unwanted side affect. However, there are many techniques available to minimize noise from fluid power systems. To apply these methods effectively, it is necessary to understand how the noise is generated and how it reaches the listener. The noise energy can be transmitted away from its source as either fluid borne noise (pressure ripple) or as structure borne noise.

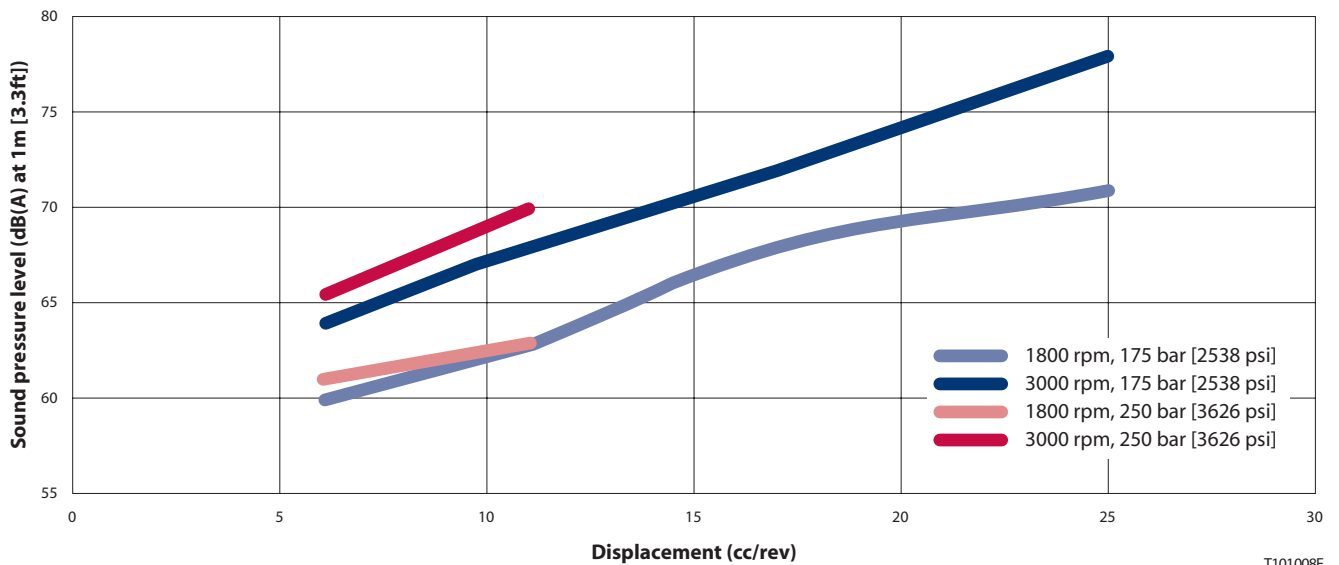
Pressure ripple is the result of the number of pumping elements (gear teeth) delivering oil to the outlet and the pump’s ability to gradually change the volume of each pumping element from low to high pressure. In addition, the pressure ripple is affected by the compressibility of the oil as each pumping element discharges into the outlet of the pump. Pressure pulsations will travel along the hydraulic lines at the speed of sound (about 1400 m/s in oil) until affected by a change in the system such as 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 manner in which one circuit component responds to excitation will depend on its size, form, and manner in which it is mounted or supported. Because of this excitation, a system line may actually have a greater noise level than the pump. To reduce this excitation, use flexible hoses in place of steel plumbing.

If steel plumbing must be used, clamping of lines is recommended. To minimize other structure borne noise, use flexible (rubber) mounts.

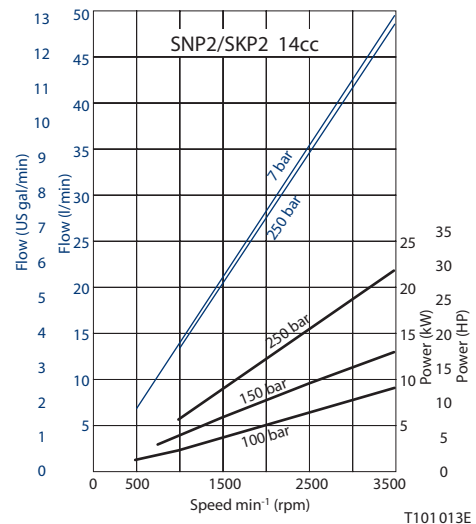
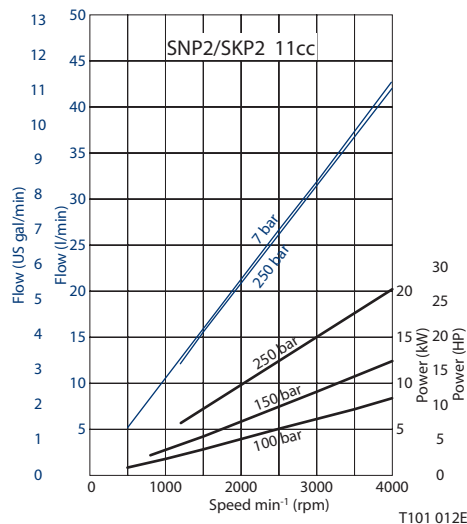
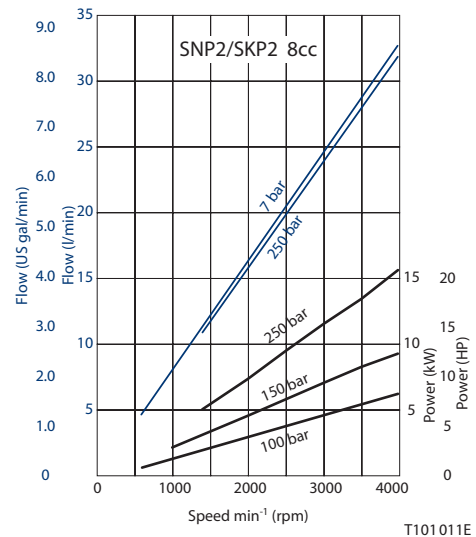
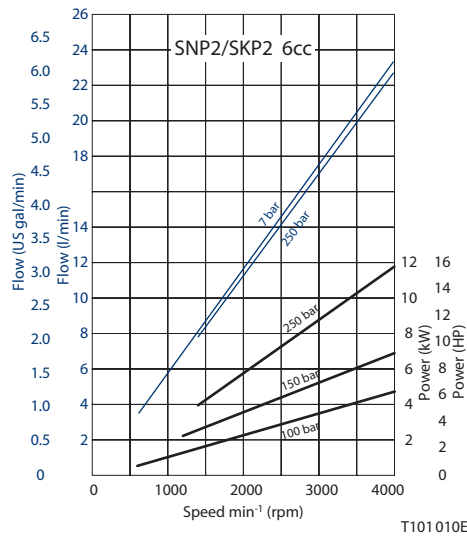
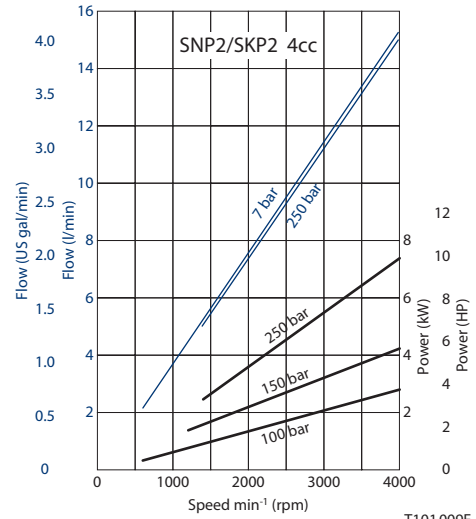
The accompanying graph shows typical sound pressure levels for SNP 2 pumps (with SAE A flange, and spline shaft in plug in drive) measured in dB(A) at 1 meter [3.28 ft.] from the unit in a semi-anechoic chamber. Anechoic levels can be estimated by subtracting 3 dB(A) from these values.

Contact your Sauer-Danfoss representative for assistance with system noise control.

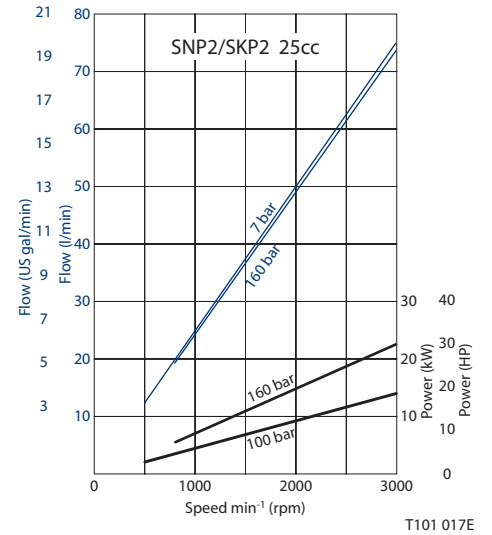
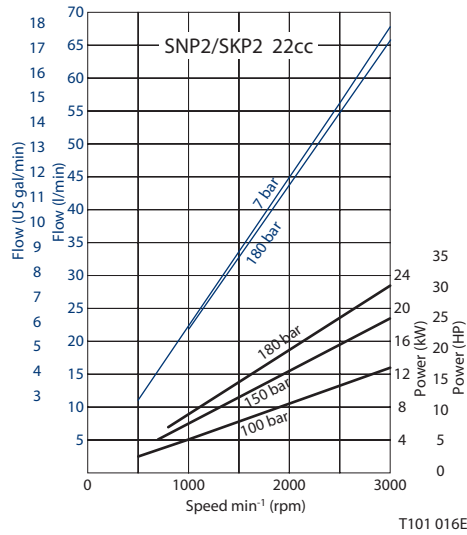
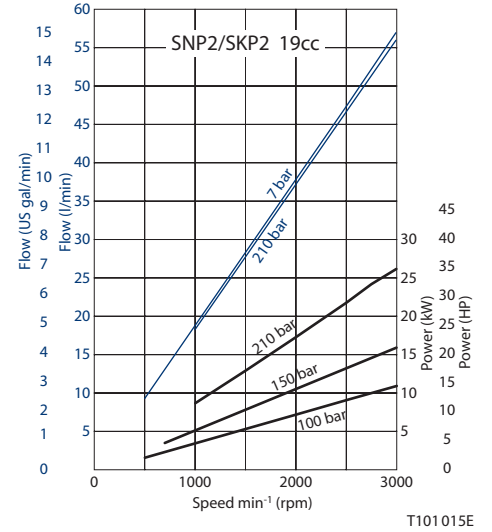
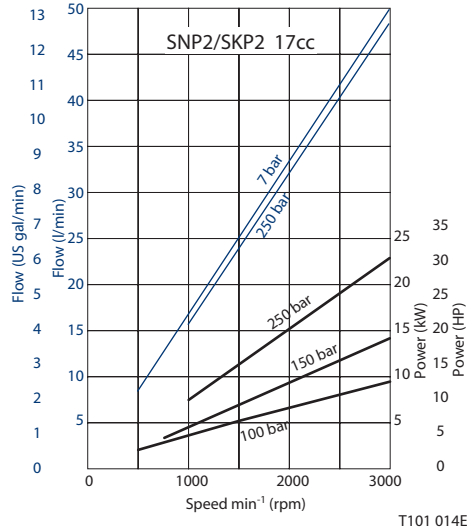


PUMP PERFORMANCE

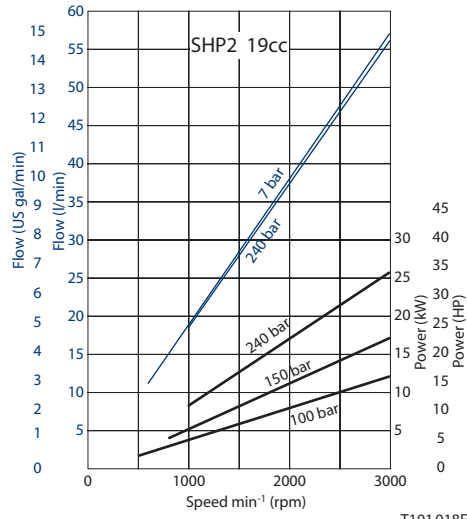
The following performance graphs provide typical output flow and input power for Group 2 pumps at various working pressures. Data was taken using ISO VG46 petroleum / mineral based fluid at 50 °C [122 °F] (viscosity = 28 mm²/s [132 SUS]).



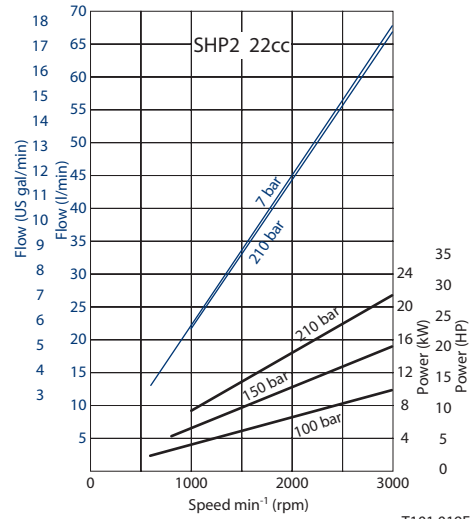
PUMP PERFORMANCE
 (continued)



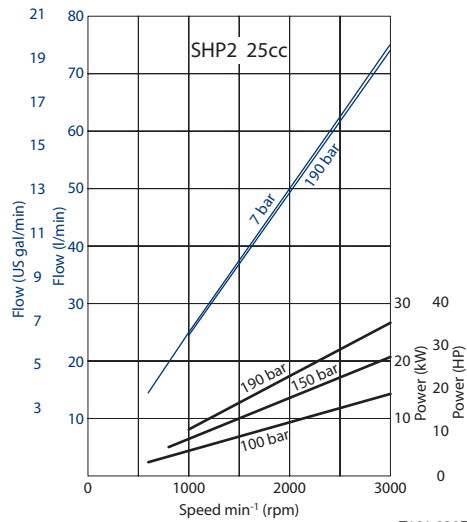
PUMP PERFORMANCE
 (continued)



T101 018E



T101 019E



T101 020E

SHAFT OPTIONS

Group 2 pumps are available with a variety of splined, parallel, and tapered shaft ends. Not all shaft styles are available with all flange styles. Valid combinations and nominal torque ratings are shown in the table below. Torque ratings assume no external radial loading. Applied torque must not exceed these limits regardless of pressure parameters stated earlier. Maximum torque ratings are based on shaft torsional fatigue strength. Recommended mating splines for Group 2 splined output shafts should be in accordance with SAE J498 or DIN 5482. Sauer-Danfoss external SAE splines are flat root side fit with circular tooth thickness reduced by 0.127 mm [0.005 in] in respect to class 1 fit. The external DIN splines have an offset increased by 0.1 mm [0.004 in.] These dimensions are modified in order to assure a clearance fit with the mating spline.

Other shaft options may exist. Contact your Sauer- Danfoss representative for availability.

Shaft availability and torque capacity



Shaft		Mounting flange code Max torque					Nm [lbf•in]			
Description	Code	01	02	03	04	05	06	09	0B	
Taper 1:5	CO	-	140 [1239]	-	140 [1239]	140 [1239]	-	-	-	
Taper 1:8	CO	150 [1328]	-	-	-	-	-	150 [1328]	150 [1328]	
DIN spline B17x14	SC	90 [797]	130 [1151]	-	130 [1151]	130 [1151]	-	-	-	
SAE spline 9T 16/32p	SC	-	-	-	-	-	75 [664]	-	-	
SAE spline 11T 16/32p	SC	-	-	-	-	-	150 [1328]	-	-	
Parallel 15 mm	CI	90 [797]	-	-	-	-	-	-	-	
Parallel 15.875 mm	CI	-	-	-	-	-	80 [708]	-	-	
Sauer-Danfoss tang	FR	-	-	70 [620]	-	-	-	-	-	

T101 021E

MOUNTING FLANGES

Many types of industry standard and special engine mounting flanges are available. The following table shows order codes for each mounting flange and its intended use. See *product dimensional information (page 35)* for outline drawings of pumps and the various mounting flanges. Contact your Sauer-Danfoss representative for more information on specific flanges.

Available mounting flanges



Flange code	Intended use	Variant code
01	European four bolt	-
02	German PTO	-
03	Sauer-Danfoss standard tang drive	-
04	German engine PTO	-
05	German engine PTO	-
06	SAE A	-
09	Perkins 4.236 timing case (used on 4.236 and 1000 series hybrids)	-
09	Perkins 9000 series three cylinder engine	BBM
0B	Perkins 1000 series four cylinder engine - left side PTO	-

T101 022E

NONSTANDARD PORT CONFIGURATIONS

Various port configurations are available on group 2 pumps including:

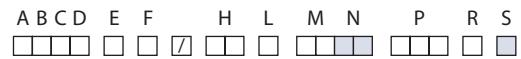
- European standard flanged port
- German standard flanged port
- Gas threaded port (BSPP)
- O-ring boss per SAE J1926/1 [ISO 11926-1] (UNF threads)

Standard porting offered with each mounting flange type is listed in the table below. If porting other than standard is desired, use the order codes shown.

See *product dimensional information on page 43* for outline drawings and dimensions of the ports listed here.

Other ports are available on special order. Contact your Sauer-Danfoss representative for types and availability.

Available porting options



Code	Description	This port configuration is standard on these flanges
•	Standard port for the flange type specified	-
B	Flanged port with threaded holes in "X" pattern (German standard ports), centered on the body	non standard
C	Flanged port with threaded holes in "+" pattern (European standard)	01, 0B
E	Threaded SAE o-ring boss port	06
F	Threaded gas port (BSPP)	non standard
G	Flanged port with threaded holes in "X" pattern (German standard ports), offset from center of body	02, 03, 04, 05, 09

* Use only if porting is nonstandard for the flange type ordered.

T101 023E

**INTEGRAL PRIORITY
 FLOW DIVIDER VALVE**

Group 2 pumps are offered with an optional priority flow divider valve integrated into the rear cover. The priority flow divider cover includes the following options:

- Standard Priority Flow Divider Valve
- Static Load Sense Priority Flow Divider Valve
- Dynamic Load Sense Priority Flow Divider

In addition, the following choices exist for each of the above valves:

- Pilot Relief Valve or Full Flow Relief Valve
- Rear O-ring boss ports or side O-ring boss ports

Schematic diagrams and cross sectional drawings showing operation of each of these valves are shown.

Please refer to *Product dimensional information (page 44)* for port location and installation dimensions.

Standard ports only for SAE A flange pumps are:

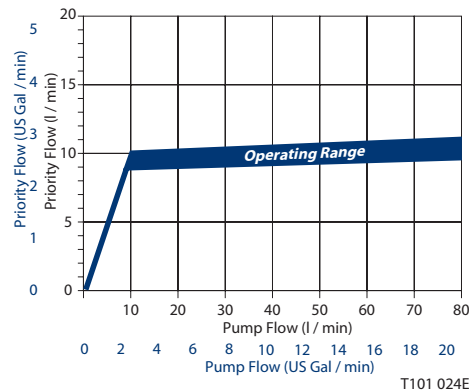
NPF 7/8-14 UNF-2B O-ring boss

PF 9/16-18 UNF-2B O-ring boss

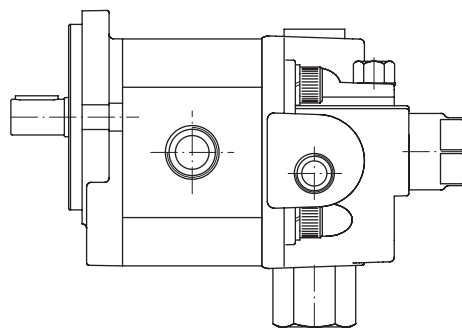
LS 7/16-20 UNF-2B O-ring boss

Refer to *pages 26-30* for NPF, PF and LS meanings.

Other ports are available. Contact your Sauer-Danfoss representative for more information.



This graph shows typical flow characteristics with priority flow set at 10 l/min [2.64 US gal/min]. Priority flow rate varies $\pm 10\%$ due to changes in pump flow and system pressure.



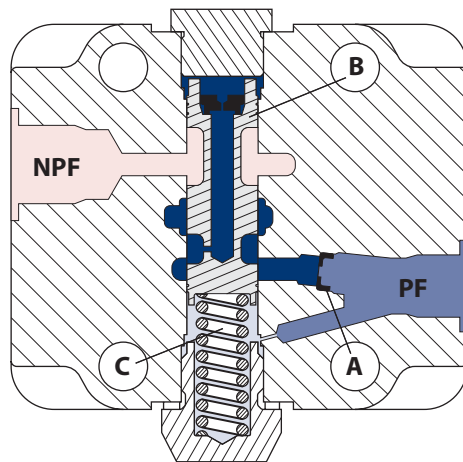
P101 035

**INTEGRAL PRIORITY
 FLOW DIVIDER VALVE
 (continued)**

Valve operation and performance

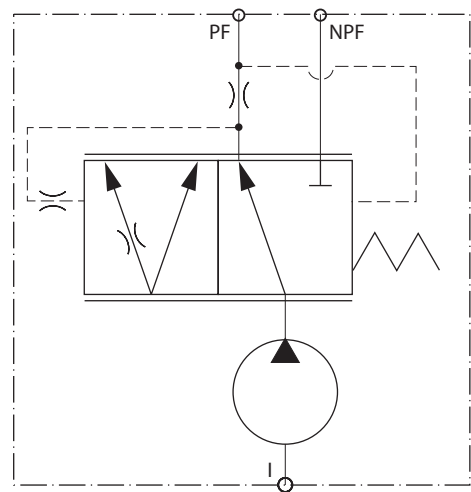
The **standard priority flow divider valve** will supply flow to the priority port (PF) within 10% of its setting regardless of operating pressure, assuming adequate pump speed (and flow) is attained. All excess pump flow is directed to the non-priority port (NPF).

The priority flow rate is controlled by the combination of priority orifice diameter 'A' and spring force 'C'. The spring end of spool 'B' sees the pressure downstream of priority orifice 'A' and the force of spring 'C'. The non-spring end of the spool 'B' sees the pressure upstream of priority orifice 'A'. By default, all flow is directed to port 'PF'. As flow at the priority port approaches the desired rate, the delta pressure across orifice 'A' increases. This delta pressure is applied to spool 'B'. When this delta pressure overcomes the force of spring 'C', the spool shifts, diverting oil to port 'NPF'. Load pressure at port 'PF' is referenced to the spring end of spool 'B', allowing the system to deliver flow at the desired rate independent of load pressure.



- Priority Flow PF
- Non Priority Flow NPF
- Inlet I
- Pump Output

P101 004

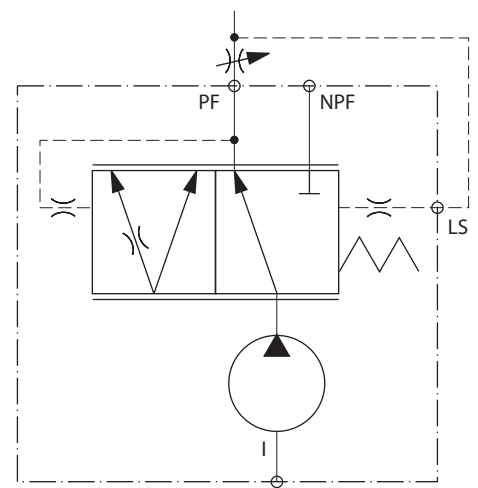
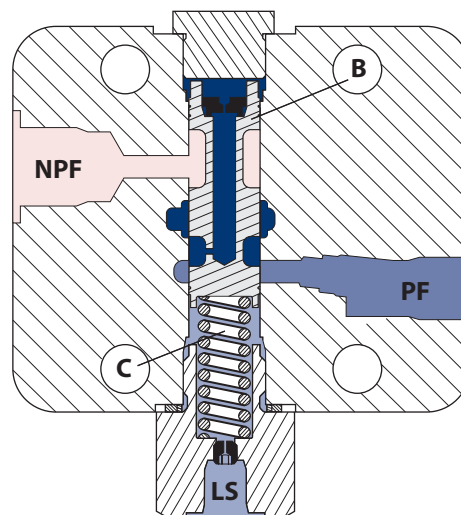


P101 006

**INTEGRAL PRIORITY
 FLOW DIVIDER VALVE
 (continued)**

The objective of the **static load sense priority flow divider** valve is to deliver flow on demand to the priority port ('PF'), while compensating for pressure changes in the load. Therefore, the load sense priority flow divider valve does not maintain a constant flow, it maintains a constant pressure between port 'PF' and the load sense port ('LS') which is connected to the spring end of spool 'B'. To perform this function, port 'LS' is connected to a point downstream of an external control valve that serves as a variable orifice. The flow divider valve can vary flow from zero to maximum available flow depending on the delta pressure across the external control valve (Δ PF-LS).

This configuration operates essentially the same as the standard priority flow divider except that the priority orifice is replaced by an external variable flow control valve. To maintain load pressure compensation, the spring end of spool 'B' is now referenced to load pressure through the load sense port, which must be connected to a point between the external control valve and the load.



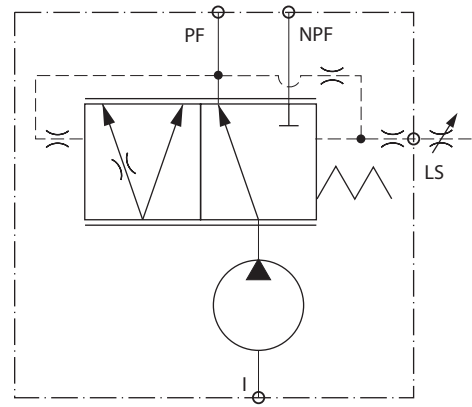
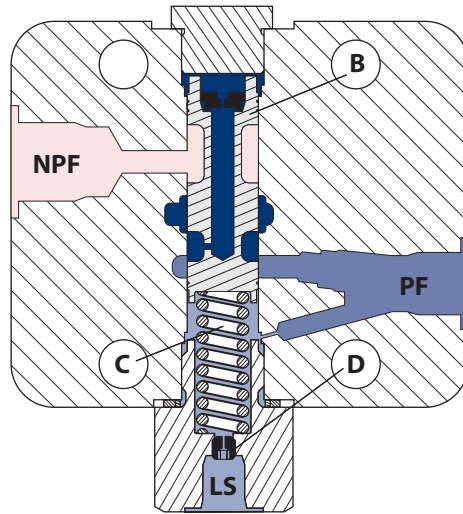
P101 009

- Priority flow **PF**
- Non priority flow **NPF**
- Load sense **LS**
- Inlet **I**
- Pump output

P101 007

**INTEGRAL PRIORITY
FLOW DIVIDER VALVE
(continued)**

The **dynamic load sense priority flow divider** employs a bleed orifice 'D' which allows a constant leakage of about 1 l/min [0.26 US gal/min] or typically less, away from the spring end of spool 'B'. This orifice is sized to maintain pressure at the spring end of spool 'B' sufficient to keep the spool in balance. In the applied circuit, this leakage is metered by an external valve, which in effect controls the flow at port 'PF'. When used with close tolerance rotary valving, this system can prevent valve locking due to sudden thermal shock. An additional benefit of this system is that the spool 'B' is maintained in a constant metering condition before any signal input is received, thus resulting in a faster response.



P101 011

- Priority flow PF
- Non priority flow NPF
- Load sense LS
- Inlet I
- Pump output

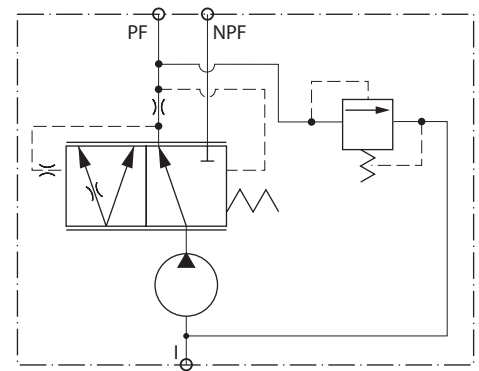
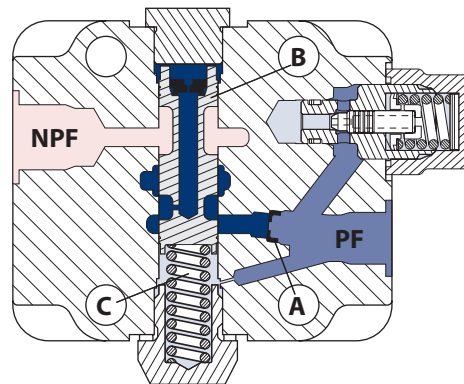
P101 010

**INTEGRAL PRIORITY
 FLOW DIVIDER VALVE
 (continued)**

With the integral priority flow divider, two types of relief valves are available to protect port 'PF' from over-pressurization. The valves will act at a specific pressure setting as seen at port 'PF'.

The **full flow relief valve** option is a direct acting relief valve which allows flow to bypass from the priority flow port 'PF' to the pump inlet when pressure at 'PF' reaches the setting. This valve is used when fast action is required.

CAUTION: When the relief valve is operating in bypass condition, rapid heat generation will occur. If this bypass condition is maintained, premature pump failure will result.



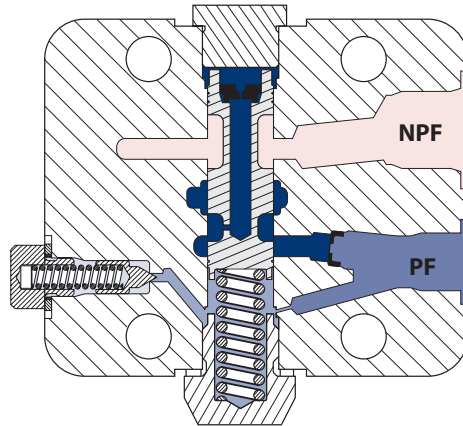
- Priority Flow **PF**
- Non Priority Flow **NPF**
- Inlet **I**
- Pump Output

P101 012

P101 013

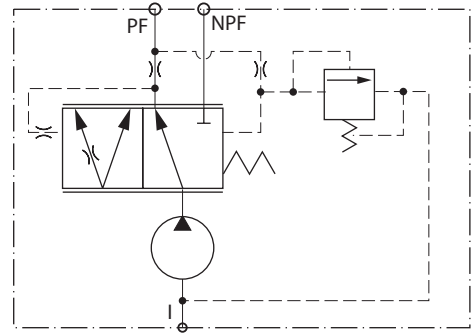
**INTEGRAL PRIORITY
 FLOW DIVIDER VALVE
 (continued)**

The **pilot relief valve** option opens to relieve the pilot pressure from the spring end of spool 'B' when the setting is reached. This causes the spool to shift and direct all flow to the non-priority port 'NPF'. It is important to note that the pressure setting of the pilot relief valve is not referenced to port 'NPF'. It is also important to note that the pilot relief valve option does not relieve port 'PF'; it only redirects pump flow. When the pilot relief valve is operating, flow at port 'NPF' will increase. Additional circuit pressure protection in the 'NPF' line may be required in some applications.



- Priority Flow **PF**
- Non Priority Flow **NPF**
- Inlet **I**
- Pump Output

P101 014



P101 015

**INTEGRAL PRIORITY
 FLOW DIVIDER VALVE
 (continued)**

Order codes for integral priority flow divider

The table below shows order coding necessary to specify the desired options and porting locations. Refer to *the model code (pages 10, 11)* for more information.

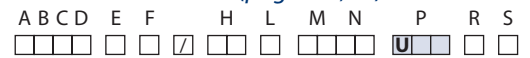
Order codes:



Code	PDF configuration	Port location
U F	Priority flow divider with pilot relief valve	Rear facing ports
U S	Priority flow divider with pilot relief valve	Side facing ports
L F	Priority flow divider with pilot relief valve and static load sensing	Rear facing ports
L S	Priority flow divider with pilot relief valve and static load sensing	Side facing ports
N F	Priority flow divider with pilot relief valve and dynamic load sensing	Rear facing ports
N S	Priority flow divider with pilot relief valve and dynamic load sensing	Side facing ports
P F	Priority flow divider with full flow relief valve	Rear facing ports
P S	Priority flow divider with full flow relief valve	Side facing ports
R F	Priority flow divider with full flow relief valve and static load sensing	Rear facing ports
R S	Priority flow divider with full flow relief valve and static load sensing	Side facing ports
V F	Priority flow divider with full flow relief valve and dynamic load sensing	Rear facing ports
V S	Priority flow divider with full flow relief valve and dynamic load sensing	Side facing ports

Variant codes:

The tables to the right show applicable variant codes for ordering pumps with integral priority flow divider. These codes are necessary to specify the priority flow rate and the pressure at which that flow rate applies. Refer to *the model code (pages 10, 11)* for more information.



Controlled flow l/min [US gal/min]	Code
8 [2.11]	M
10 [2.64]	F
12 [3.17]	N
14 [3.70]	O
16 [4.23]	P
18 [4.75]	J
20 [5.28]	Q
22 [5.81]	K
24 [6.34]	R
26 [6.86]	I

Pressure setting bar [psi]	Code
60 [870]	L
70 [1015]	M
80 [1160]	N
90 [1305]	O
100 [1450]	P
110 [1595]	Q
120 [1740]	R
130 [1885]	S
140 [2031]	T
150 [2176]	C
160 [2321]	U
170 [2466]	D
180 [2611]	V
190 [2755]	E
200 [2901]	X

**INTEGRAL RELIEF VALVE
 (SNE 2 / SNI 2)**

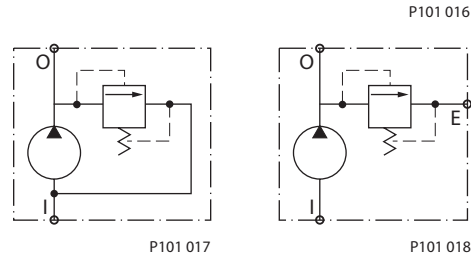
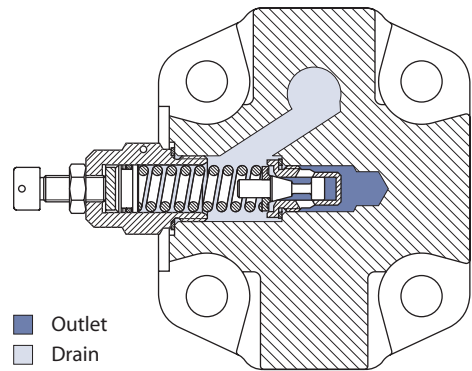
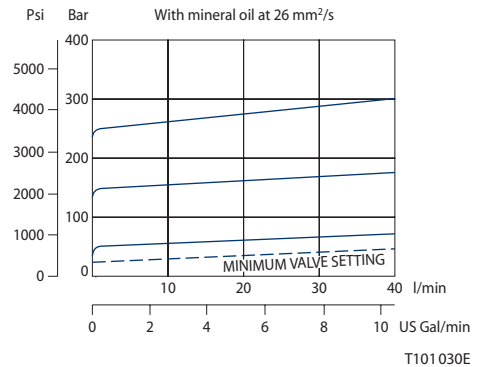
Group 2 pumps are offered with an optional **integral relief valve** in the rear cover. This valve can have an internal (SNI 2) or external (SNE 2) drain. This valve opens directing all flow from the pump outlet to the internal or external drain when the pressure at the outlet reaches the valve setting. This valve can be ordered preset to the pressures shown in the table below. Valve schematic, performance curve, and rear cover cross section are shown here.

CAUTION: When the relief valve is operating in bypass condition, rapid heat generation will occur. If this bypass condition is maintained, premature pump failure will result. When frequent operation is required, external drain option (SNE 2) must be used.

For pressures higher than 210 bar [3046 psi] and lower than 40 bar [580 psi] apply to your Sauer-Danfoss representative.

Variant codes for ordering integral relief valve

Pump speed for RV setting min ⁻¹ (rpm)	Code	Pressure setting bar [psi]	Code
Not defined	A	No setting	A
500	C	No valve	B
1000	E	18 [261]	C
1250	F	25 [363]	D
1500	G	30 [435]	E
2000	K	35 [508]	F
2250	I	40 [580]	G
2500	L	50 [725]	K
2800	M	60 [870]	L
3000	N	70 [1015]	M
3250	O	80 [1160]	N
		90 [1305]	O
		100 [1450]	P
		110 [1595]	Q
		120 [1740]	R
		130 [1885]	S
		140 [2030]	T
		160 [2321]	U
		170 [2466]	V
		180 [2611]	W
		210 [3046]	X
		250 [3626]	Z



I = Inlet
 O = Outlet
 E = External drain

The tables to the left show applicable variant codes for ordering pumps with integral relief valve. Refer to *the Model Code (pages 10, 11)* for more information.

OUTRIGGER BEARING ASSEMBLY

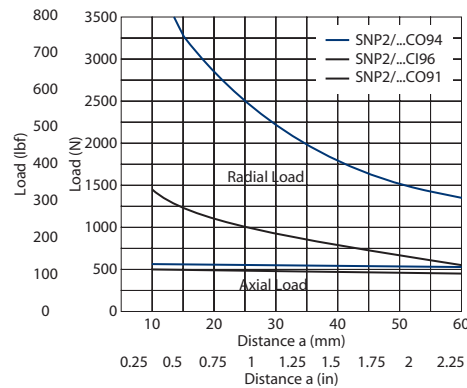
An Outrigger Bearing is available for applications with high radial or thrust loads on the shaft. This option is used primarily for applications with high shaft loads such as to belt or chain drives. The design utilizes roller bearings in the front mounting flange. These bearings absorb the radial and thrust loads on the shaft so that the life of the pump is not affected. The use of roller bearings allows life to be described in B10 ours. The graph to the right shows allowable shaft loads for 1000-hour life at 1500 min⁻¹ versus distance from flange face to center of radial load.

Available configurations

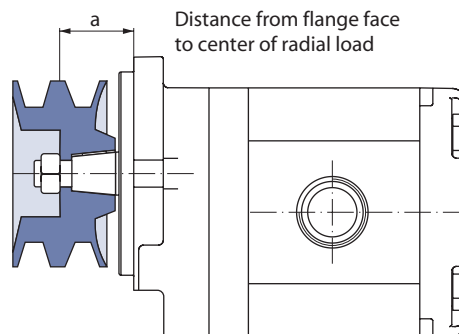


Code	Shaft	Mounting flange	Variant
CO91	Taper 1: 8	European four bolt	LBD
CO92	Taper 1: 5	German PTO	RBZ
CO94	Taper 1: 5	German four bolt	...
CO96	Taper 1: 8	SAE A	LEA
CI96	Parallel	SAE A	LEP

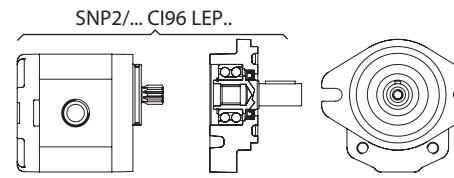
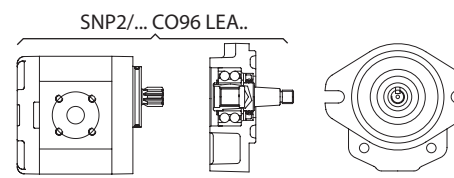
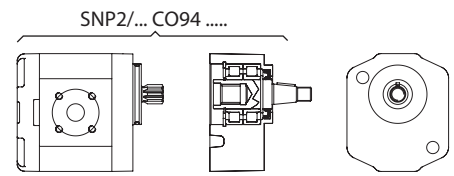
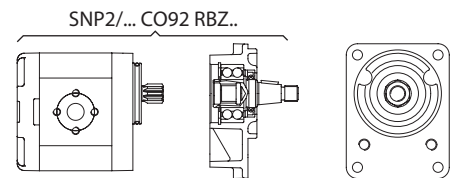
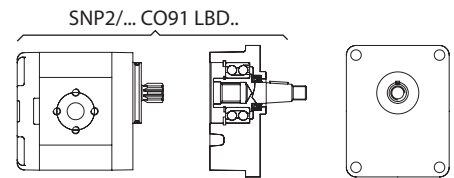
Codes CO91, CO92, CO94, CO96 and CI96 represent assembly (pump complete with outrigger bearing).



T101 031E



P101 036E



P101 019

AUXILIARY MOUNTING PADS

SAE “A” auxiliary mounting pads are available for all group 2 pumps with SAE front flanges. These pads are used for mounting auxiliary hydraulic pumps or creating special tandem gear pumps. (For standard multiple pumps, see *Multiple Pump Technical Manual*.)

To order pumps with SAE “A” auxiliary mounting flange:

- Specify SC36 in fields M and N of the model code as shown below.
- Order the auxiliary mounting pad kit, part number 818.20.079.0K

A B C D E F H L M N P R S
 □ □ □ □ □ □ □ □ **SC36** □ □ □ □ □ □ □ □

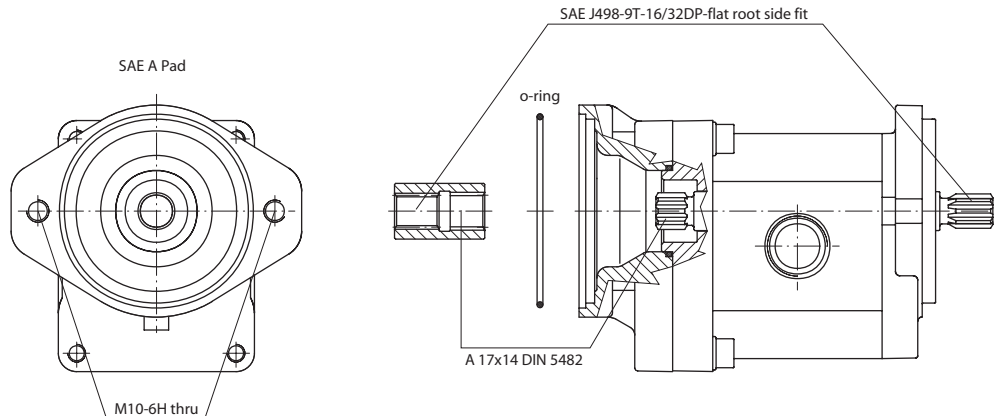
Since the drive coupling is lubricated with oil from the main pump inlet, an O-ring must be used to seal the auxiliary pump-mounting flange to the pad. Specifications and torque ratings are shown in the accompanying table.

- The combination of auxiliary mounting pad shaft torque, plus the main pump torque should not exceed the maximum pump input shaft rating shown in the table on [page 23](#).
- All torque values assume a 58 HRC shaft spline hardness on mating pump shaft.

See [product dimensional information \(page 47\)](#) for outline drawings with the dimensions of the auxiliary pump mounting flange and shaft.

Auxiliary mounting pad specifications

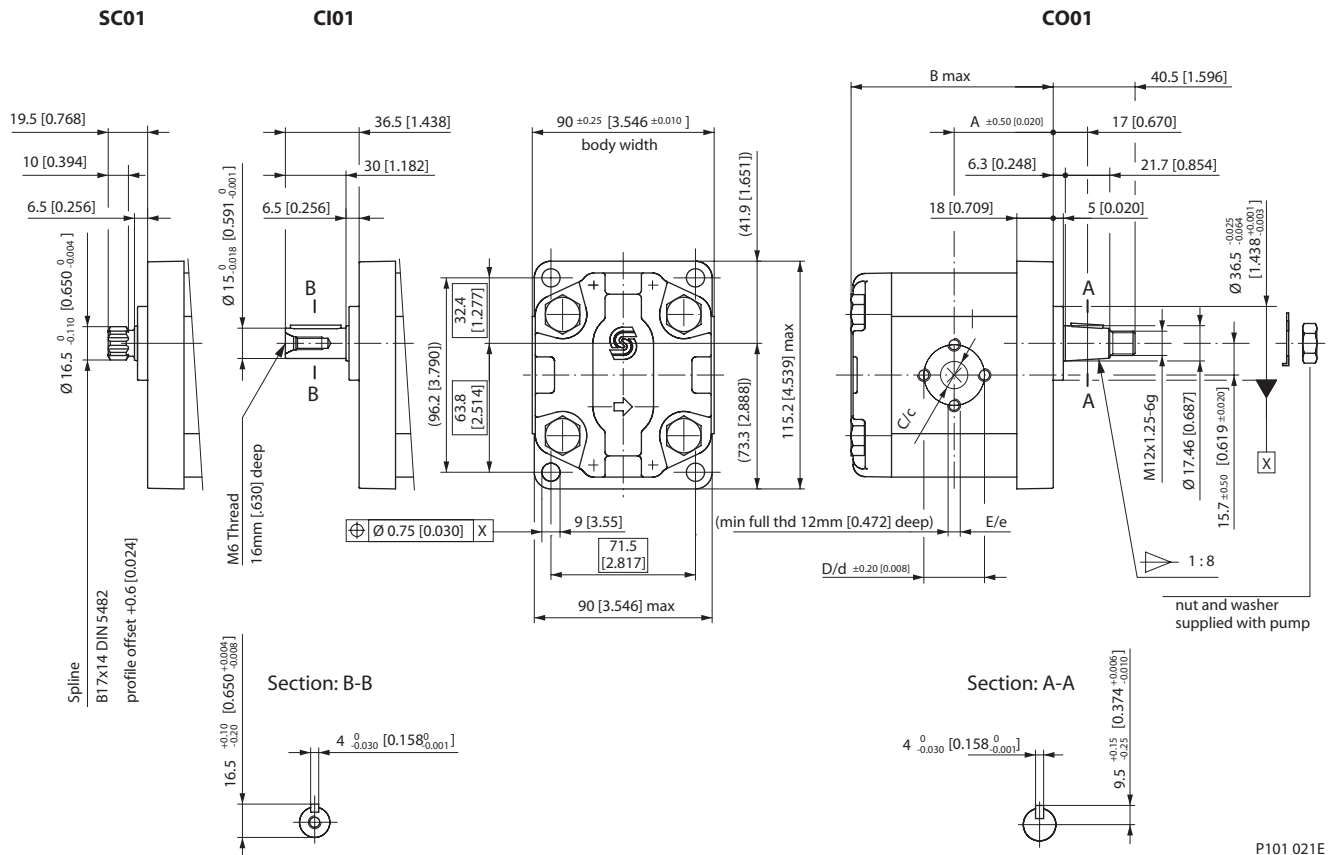
Auxiliary pad type	Coupling type	Maximum torque rating Nm [lbf·in]
SAE A	9 teeth 16/32 pitch	75 [664]



P101 020E

SC01 / CI01 / CO01

Standard porting and rear cover shown. See [page 43](#) for additional porting options. See [page 44](#) for valve options. See [page 45](#) for outrigger bearing options.



P101 021E

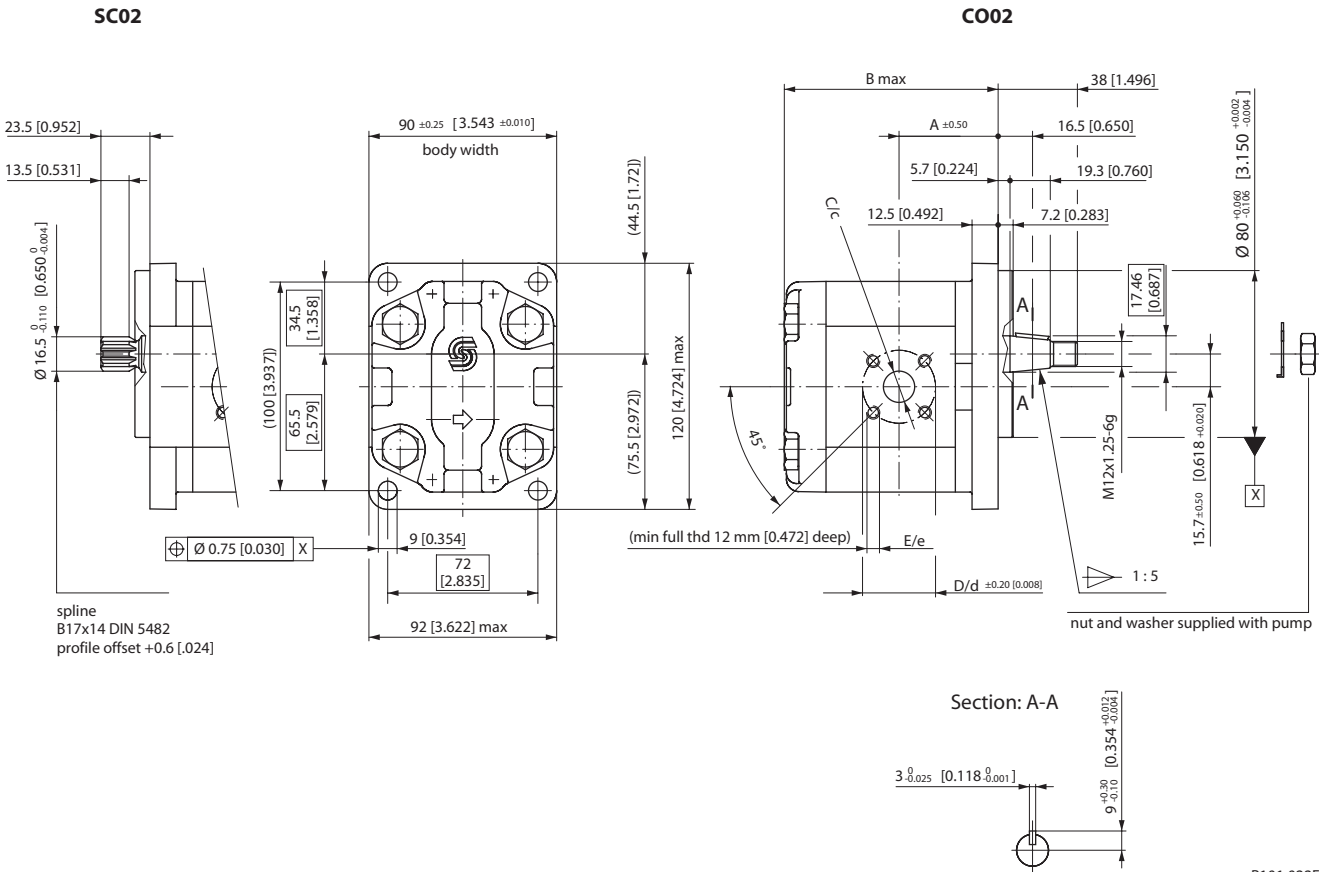
Type (displacement)		4	6	8	11	14	17	19	22	25
Dimensions	A*	43.25 [1.703]	45 [1.772]	45 [1.772]	49 [1.929]	52 [2.047]	52 [2.047]	56 [2.205]	59 [2.323]	59 [2.323]
	B**	90.0 [3.543]	93.0 [3.681]	97.5 [3.839]	101.5 [3.996]	107.5 [4.232]	111.5 [4.390]	115.5 [4.574]	121.5 [4.783]	125.5 [4.941]
Inlet	C	13.5 [0.531]	13.5 [0.531]	13.5 [0.531]	13.5 [0.531]	20 [0.787]	20 [0.787]	20 [0.787]	20 [0.787]	20 [0.787]
	D	30 [1.181]	30 [1.181]	30 [1.181]	30 [1.181]	40 [1.575]	40 [1.575]	40 [1.575]	40 [1.575]	40 [1.575]
	E	M6	M6	M6	M6	M8	M8	M8	M8	M8
Outlet	c	13.5 [0.531]	13.5 [0.531]	13.5 [0.531]	13.5 [0.531]	13.5 [0.531]	13.5 [0.531]	13.5 [0.531]	13.5 [0.531]	20 [0.787]
	d	30 [1.181]	30 [1.181]	30 [1.181]	30 [1.181]	30 [1.181]	30 [1.181]	30 [1.181]	30 [1.181]	40 [1.575]
	e	M6	M6	M6	M6	M6	M6	M6	M6	M8

* Add 3 mm [0.118 in] for SHP 2 pumps.

** Add 6 mm [0.236 in] for SHP 2 pumps.

SC02 / CO02

Standard porting and rear cover shown. See [page 43](#) for additional porting options.
 See [page 44](#) for valve options.



P101 022E

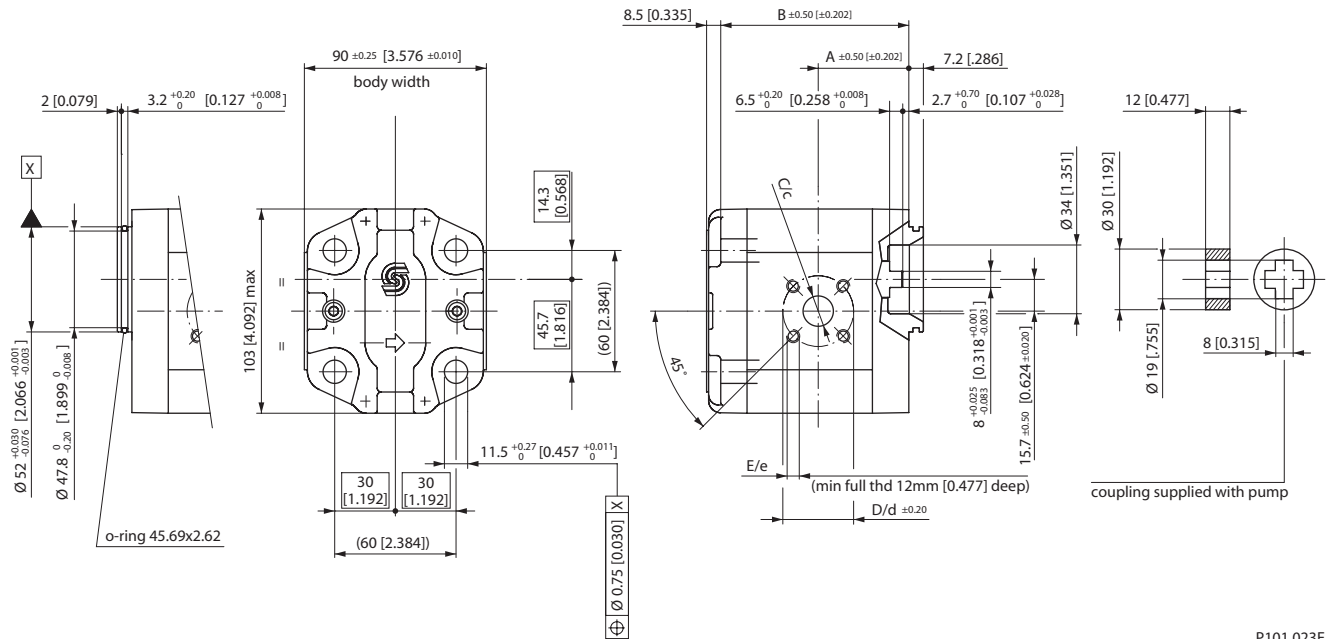
Type (displacement)		4	6	8	11	14	17	19	22	25
Dimensions	A*	39.8 [1.567]	41.1 [1.618]	43.1 [1.697]	47.5 [1.870]	47.5 [1.870]	47.5 [1.870]	47.5 [1.870]	55 [2.165]	64.5 [2.539]
	B**	92.5 [3.642]	96 [3.780]	100 [3.937]	104 [4.094]	110 [4.331]	114 [4.488]	118 [4.646]	124 [4.882]	128 [5.039]
Inlet	C	15 [0.591]	15 [0.591]	20 [0.787]	20 [0.787]	20 [0.787]	20 [0.787]	20 [0.787]	20 [0.787]	20 [0.787]
	D	40 [1.575]								
	E	M6								
Outlet	c	15 [0.591]								
	d	35 [1.378]								
	e	M6								

* Add 3 mm [0.118 in] for SHP 2 pumps.

** Add 6 mm [0.236 in] for SHP 2 pumps.

FR03

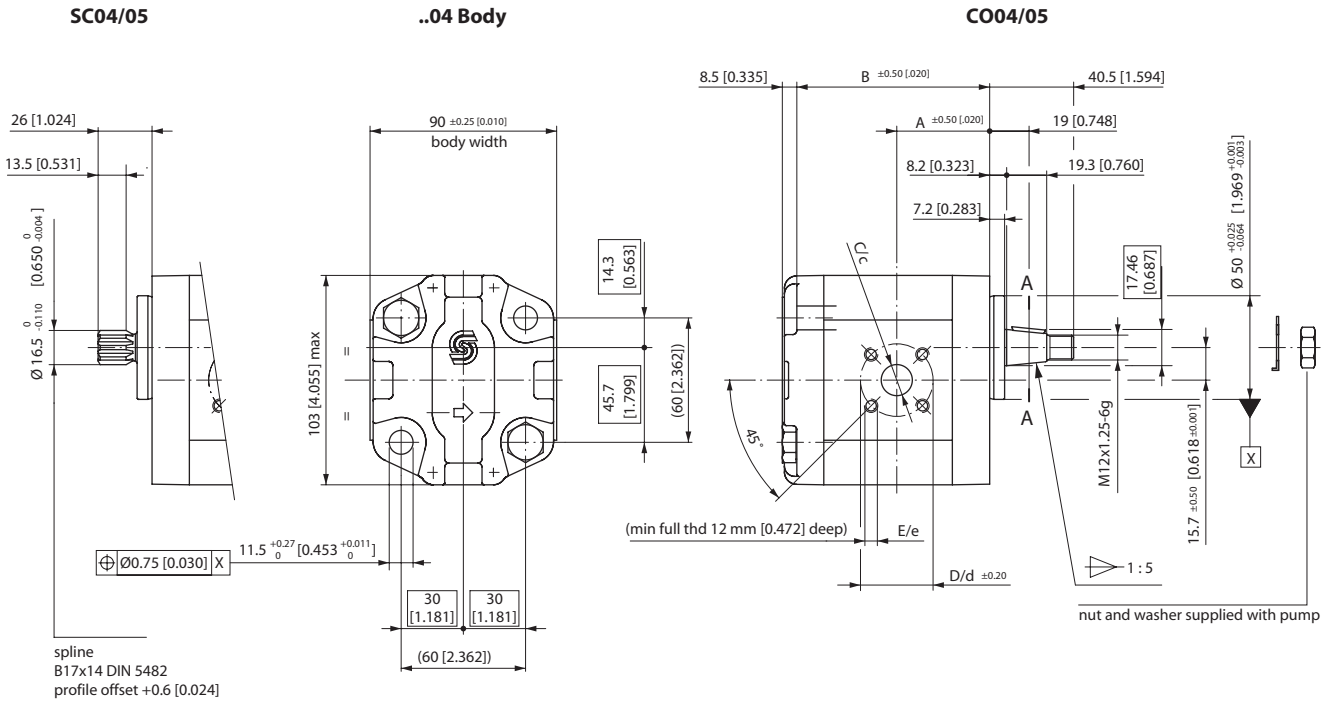
Standard porting and rear cover shown. See [page 43](#) for additional porting options. See [page 44](#) for valve options.



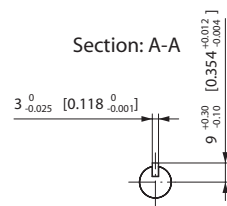
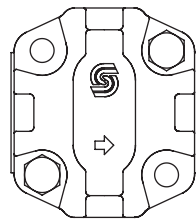
P101 023E

Type (displacement)		4	6	8	11	14	17	19	22	25
Dimensions	A	37.3 [1.469]	38.6 [1.520]	40.6 [1.598]	45 [1.772]	45 [1.772]	45 [1.772]	45 [1.772]	52.5 [2.067]	62 [2.441]
	B	81.5 [3.209]	85 [3.346]	89 [3.504]	93 [3.661]	99 [3.897]	103 [4.055]	107 [4.212]	113 [4.448]	117 [4.606]
Inlet	C	15 [0.591]	15 [0.591]	20 [0.787]	20 [0.787]	20 [0.787]	20 [0.787]	20 [0.787]	20 [0.787]	20 [0.787]
	D	40 [1.575]								
	E	M6								
Outlet	c	15 [0.591]								
	d	35 [1.378]								
	e	M6								

SC04 / SC05 / CO04 / CO05 Standard porting and rear cover shown. See [page 43](#) for additional porting options. See [page 44](#) for valve options. See [page 45](#) for outrigger bearing options.



..05 Body



P101 024E

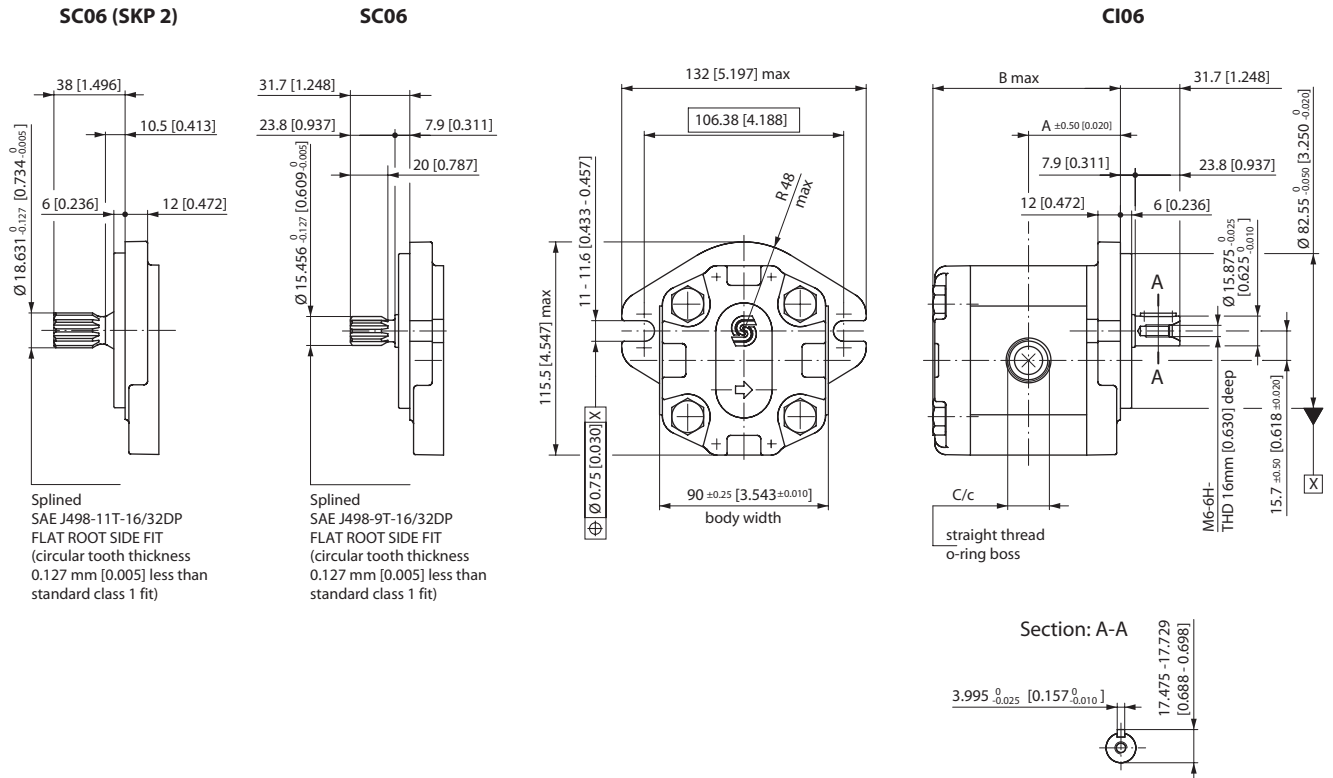
04 and 05 flanges differ only in their mounting bolt positions. All other dimensions are common. Special limitations may apply when used with gear drive (see [page 16](#)).

Type (displacement)	4	6	8	11	14	17	19	22	25	
Dimensions	A	37.3 [1.469]	38.6 [1.520]	40.6 [1.598]	45 [1.772]	45 [1.772]	45 [1.772]	45 [1.772]	52.5 [2.067]	62 [2.441]
	B**	81.5 [3.208]	85 [3.364]	89 [3.503]	93 [3.661]	99 [3.897]	103 [4.055]	107 [4.212]	113 [4.448]	117 [4.606]
Inlet	C	15 [0.591]	15 [0.591]	20 [0.787]	20 [0.787]	20 [0.787]	20 [0.787]	20 [0.787]	20 [0.787]	20 [0.787]
	D	40 [1.575]								
	E	M6								
Outlet	c	15 [0.591]								
	d	35 [1.378]								
	e	M6								

** Add 6 mm [0.236 in] for SHP 2 pumps.

SC06 / CI06

Standard porting and rear cover shown. See [page 43](#) for additional porting options. See [page 44](#) for valve options. See [page 45](#) for outrigger bearing options.

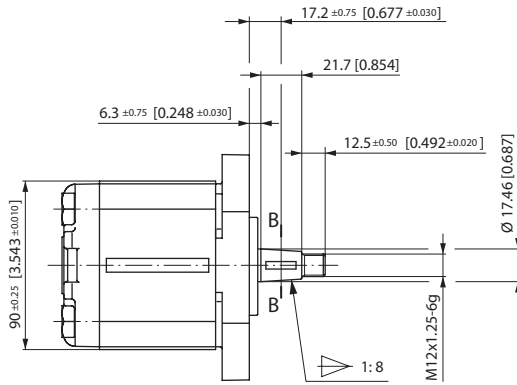


P101 025E

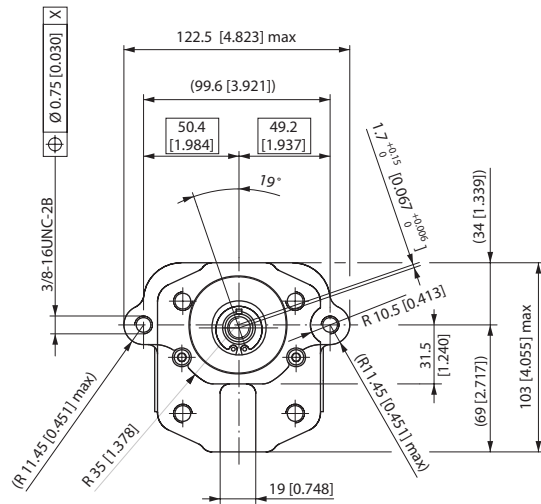
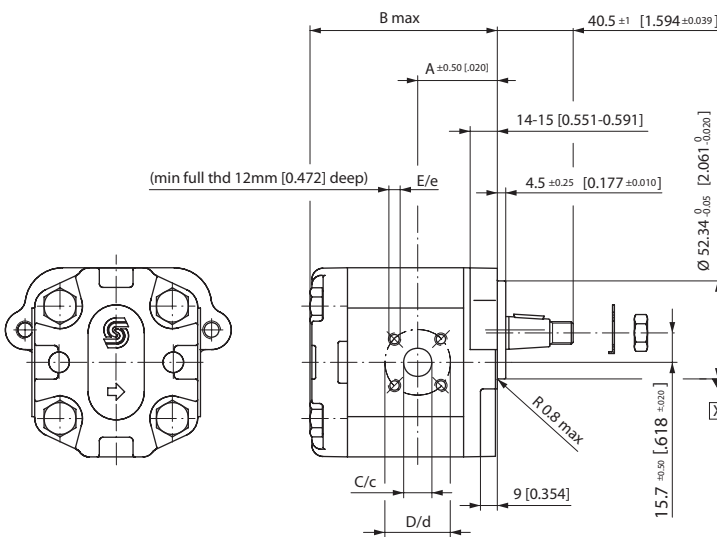
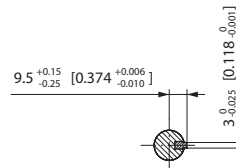
Type (displacement)		4	6	8	11	14	17	19	22	25
Dimensions	A	43.25 [1.703]	45 [1.772]	47 [1.850]	49 [1.920]	52 [2.047]	54 [2.205]	56 [2.205]	59 [2.323]	61 [2.402]
	B	90 [3.543]	93.5 [3.681]	97.5 [3.839]	101.5 [3.996]	107.5 [4.232]	111.5 [4.390]	115.5 [4.547]	121.5 [4.783]	125.5 [4.941]
Inlet	C	1 1/16 - 12UN - 2B 18 mm [0.709] deep								
Outlet	c	7/8 - 14UNF - 2B 16.7 mm [0.658] deep								

CO09

Standard porting and rear cover shown. See [page 43](#) for additional porting options.
 See [page 44](#) for valve options.



Section: B - B



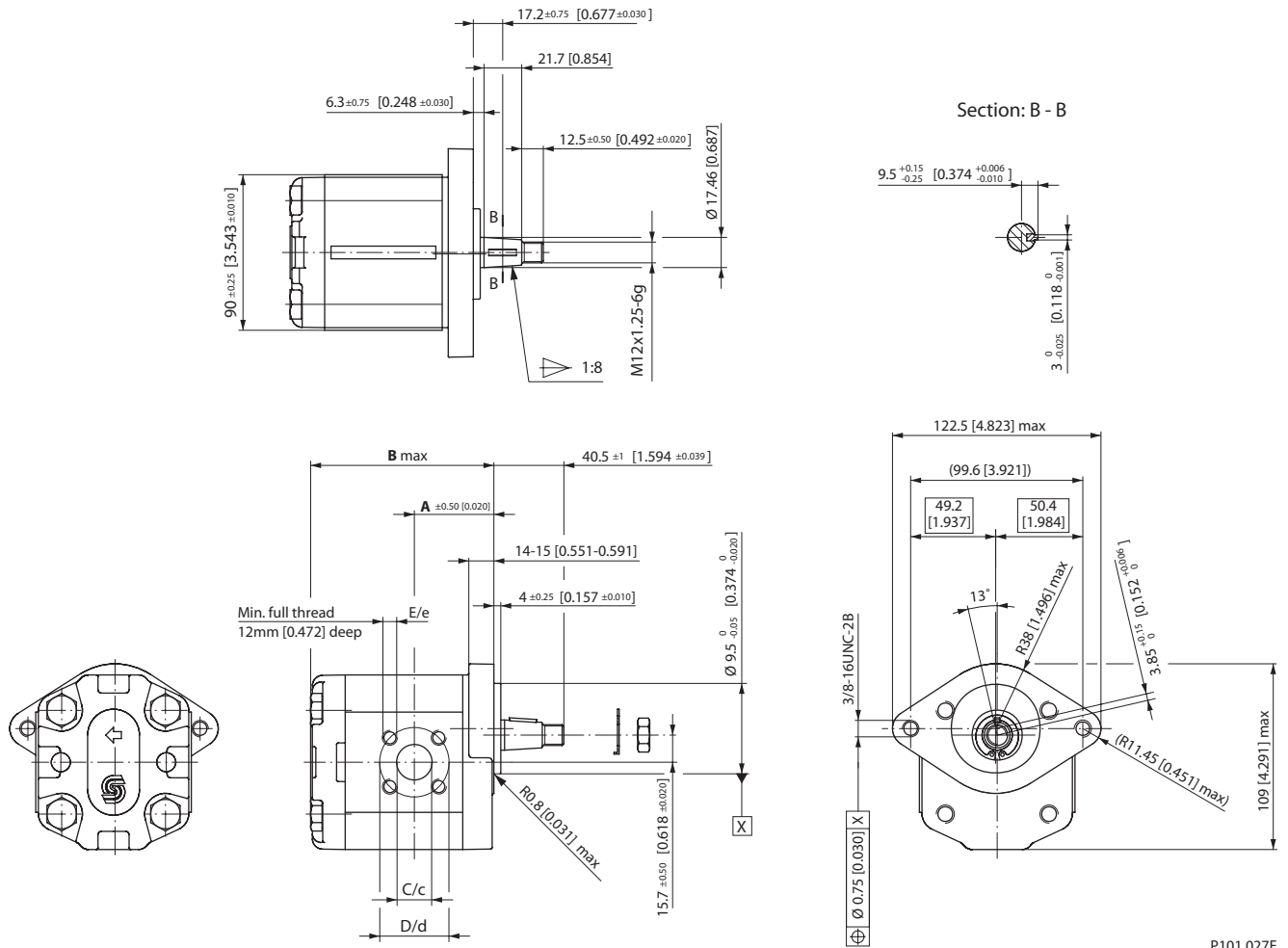
P101 026E

Special limitations may apply when used with gear drive (see [page 16](#)).

Type (displacement)		4	6	8	11	14	17	19	22	25
Dimensions	A	37.3 [1.469]	38.6 [1.520]	40.6 [1.598]	45 [1.772]	45 [1.772]	45 [1.772]	45 [1.772]	52.5 [2.067]	62 [2.441]
	B	90 [3.543]	93.5 [3.681]	97.5 [3.839]	101.5 [3.996]	107.5 [4.232]	111.5 [4.390]	115.5 [4.547]	121.5 [4.783]	125.5 [4.941]
Inlet	C	15 [0.591]	15 [0.591]	20 [0.787]	20 [0.787]	20 [0.787]	20 [0.787]	20 [0.787]	20 [0.787]	20 [0.787]
	D	40 [1.575]								
	E	M6								
Outlet	c	15 [0.591]								
	d	35 [1.378]								
	e	M6								

CO09 (VARIANT BBM)

Standard porting and rear cover shown. See [page 43](#) for additional porting options. See [page 44](#) for valve options.



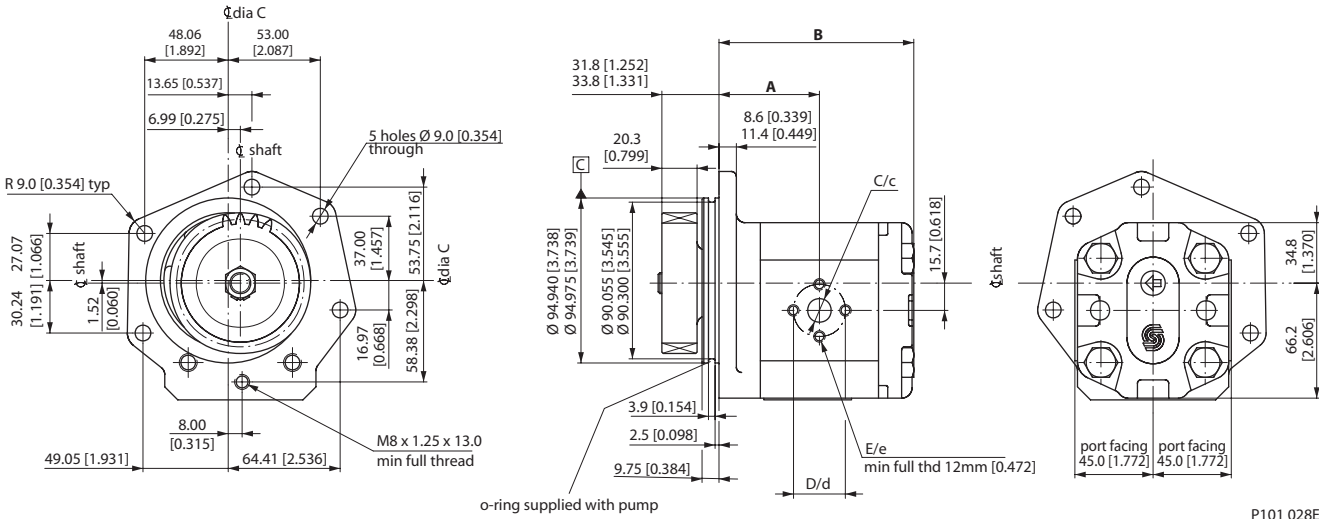
P101 027E

Special limitations may apply when used with gear drive (see [page 16](#)).

Type (displacement)		4	6	8	11	14	17	19	22	25
Dimensions	A	37.3 [1.469]	38.6 [1.520]	40.6 [1.598]	45 [1.772]	45 [1.772]	45 [1.772]	45 [1.772]	52.5 [2.067]	62 [2.441]
	B	90 [3.543]	93.5 [3.681]	97.5 [3.839]	101.5 [3.996]	107.5 [4.232]	111.5 [4.390]	115.5 [4.547]	121.5 [4.783]	125.5 [4.941]
Inlet	C	15 [0.591]	15 [0.591]	20 [0.787]	20 [0.787]	20 [0.787]	20 [0.787]	20 [0.787]	20 [0.787]	20 [0.787]
	D	40 [1.575]								
	E	M6								
Outlet	c	15 [0.591]								
	d	35 [1.378]								
	e	M6								

CO0B

Standard porting and rear cover shown. See [page 43](#) for additional porting options.
 See [page 44](#) for valve options.

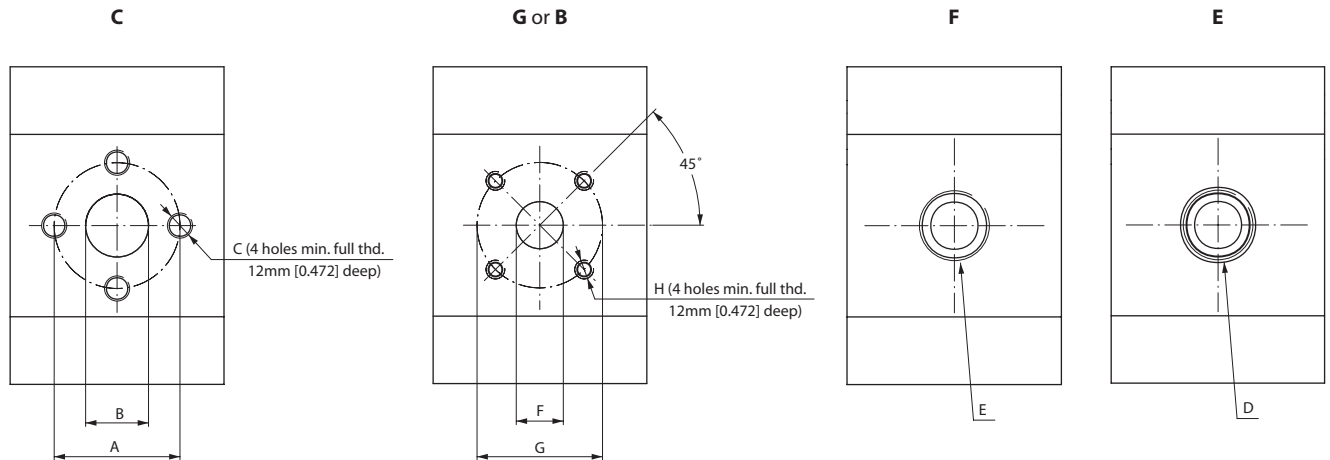


P101 028E

External gear data	
Number of teeth	28
Module normal	2.54 [0.100]
Module transverse	2.618 [0.103]
Pressure angle normal	20°
Pressure angle transverse	20.5727°
Pitch circle diameter	73.34 [2.887]
Helix angle	14.133°
Hand of helix	Left hand
Full tooth depth	5.97 [0.235]
Base circle diameter	68.663 [2.702]
Dimension over 4 teeth	28.207-28.168 [1.111-1.109]

Type (displacement)		4	6	8	11	14	17	19	22	25
Dimensions	A	49.05 [1.931]	50.8 [2.000]	50.8 [2.000]	54.8 [2.157]	57.8 [2.276]	57.8 [2.276]	61.8 [2.433]	61.8 [2.433]	64.8 [2.551]
	B	95.3 [3.752]	98.8 [3.890]	102.8 [4.047]	106.8 [4.205]	112.8 [4.441]	116.8 [4.598]	120.8 [4.756]	126.8 [4.992]	130.0 [5.118]
Inlet	C	13.5 [0.531]	13.5 [0.531]	13.5 [0.531]	13.5 [0.531]	20 [0.787]	20 [0.787]	20 [0.787]	20 [0.787]	20 [0.787]
	D	30 [1.181]	30 [1.181]	30 [1.181]	30 [1.181]	40 [1.575]	40 [1.575]	40 [1.575]	40 [1.575]	40 [1.575]
	E	M6	M6	M6	M6	M8	M8	M8	M8	M8
Outlet	c	13.5 [0.531]								
	d	30 [1.181]								
	e	M6								

NONSTANDARD PORT CONFIGURATIONS



P101 029E

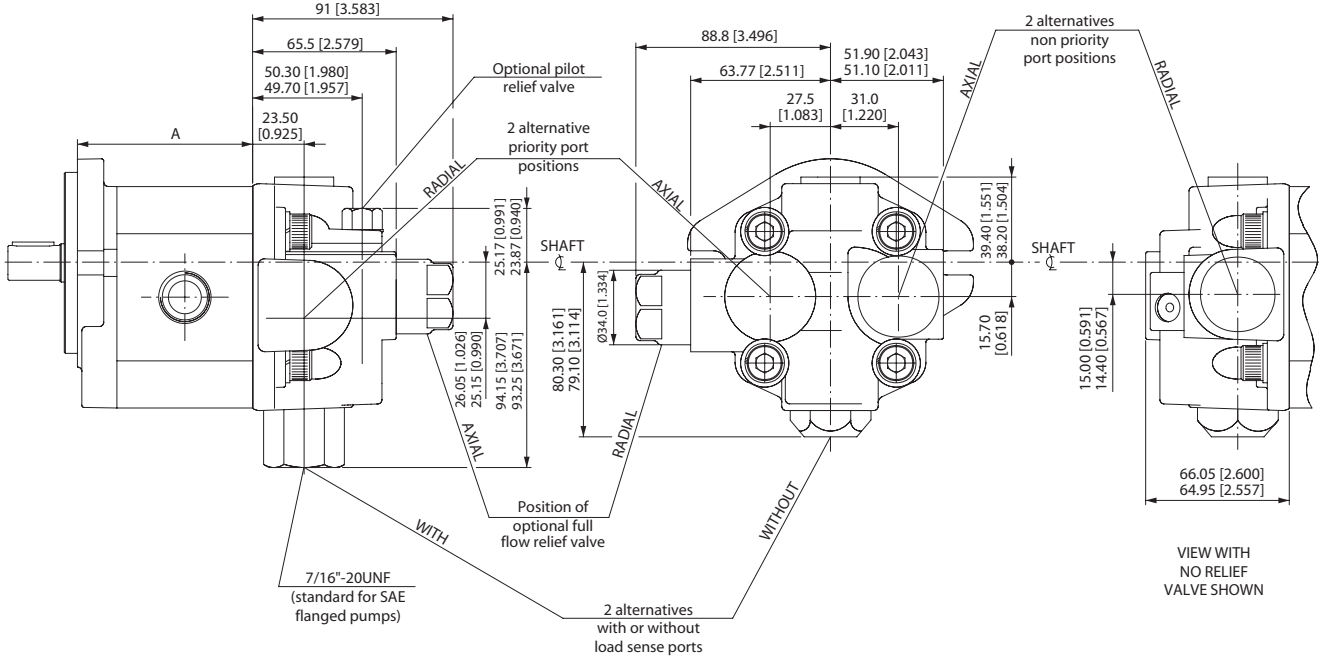
Dimensions

Model code *	C			G **			B			F	E	
Standard port for flange code	01			02/03/04/05/09 0B/09..BBM			non standard (Ports centered on body)			non standard	06	
Type (displacement)	A	B	C	F	G	H	F	G	H	E	D	
4	Inlet	30 [1.181]	13.5 [0.531]	M6	15 [0.591]	40 [1.575]	M6	15 [0.591]	40 [1.575]	M6	1/2 Gas (BSPP)	1 1/16-12UN-2B
	Outlet	30 [1.181]	13.5 [0.531]	M6	15 [0.591]	35 [1.378]	M6	15 [0.591]	35 [1.378]	M6	1/2 Gas (BSPP)	7/8-14UNF-2B
6	Inlet	30 [1.181]	13.5 [0.531]	M6	15 [0.591]	40 [1.575]	M6	15 [0.591]	40 [1.575]	M6	1/2 Gas (BSPP)	1 1/16-12UN-2B
	Outlet	30 [1.181]	13.5 [0.531]	M6	15 [0.591]	35 [1.378]	M6	15 [0.591]	35 [1.378]	M6	1/2 Gas (BSPP)	7/8-14UNF-2B
8	Inlet	30 [1.181]	13.5 [0.531]	M6	20 [0.787]	40 [1.575]	M6	20 [0.787]	40 [1.575]	M6	1/2 Gas (BSPP)	1 1/16-12UN-2B
	Outlet	30 [1.181]	13.5 [0.531]	M6	15 [0.591]	35 [1.378]	M6	15 [0.591]	35 [1.378]	M6	1/2 Gas (BSPP)	7/8-14UNF-2B
11	Inlet	30 [1.181]	13.5 [0.531]	M6	20 [0.787]	40 [1.575]	M6	20 [0.787]	40 [1.575]	M6	3/4 Gas (BSPP)	1 1/16-12UN-2B
	Outlet	30 [1.181]	13.5 [0.531]	M6	15 [0.591]	35 [1.378]	M6	15 [0.591]	35 [1.378]	M6	1/2 Gas (BSPP)	7/8-14UNF-2B
14	Inlet	40 [1.575]	20 [0.787]	M8	20 [0.787]	40 [1.575]	M6	20 [0.787]	40 [1.575]	M6	3/4 Gas (BSPP)	1 1/16-12UN-2B
	Outlet	30 [1.181]	13.5 [0.531]	M6	15 [0.591]	35 [1.378]	M6	15 [0.591]	35 [1.378]	M6	1/2 Gas (BSPP)	7/8-14UNF-2B
17	Inlet	40 [1.575]	20 [0.787]	M8	20 [0.787]	40 [1.575]	M6	20 [0.787]	40 [1.575]	M6	3/4 Gas (BSPP)	1 1/16-12UN-2B
	Outlet	30 [1.181]	13.5 [0.531]	M6	15 [0.591]	35 [1.378]	M6	15 [0.591]	35 [1.378]	M6	1/2 Gas (BSPP)	7/8-14UNF-2B
19	Inlet	40 [1.575]	20 [0.787]	M8	20 [0.787]	40 [1.575]	M6	20 [0.787]	40 [1.575]	M6	3/4 Gas (BSPP)	1 1/16-12UN-2B
	Outlet	30 [1.181]	13.5 [0.531]	M6	15 [0.591]	35 [1.378]	M6	15 [0.591]	35 [1.378]	M6	1/2 Gas (BSPP)	7/8-14UNF-2B
22	Inlet	40 [1.575]	20 [0.787]	M8	20 [0.787]	40 [1.575]	M6	20 [0.787]	40 [1.575]	M6	3/4 Gas (BSPP)	1 1/16-12UN-2B
	Outlet	30 [1.181]	13.5 [0.531]	M6	15 [0.591]	35 [1.378]	M6	15 [0.591]	35 [1.378]	M6	1/2 Gas (BSPP)	7/8-14UNF-2B
25	Inlet	40 [1.575]	23.5 [0.925]	M8	20 [0.787]	40 [1.575]	M6	20 [0.787]	40 [1.575]	M6	1 Gas (BSPP)	1 1/16-12UN-2B
	Outlet	40 [1.575]	20 [0.787]	M8	15 [0.591]	35 [1.378]	M6	15 [0.591]	35 [1.378]	M6	3/4 Gas (BSPP)	7/8-14UNF-2B

* Mark only if desired porting is non-standard for the flange code selected. Otherwise mark “.”

** Ports G are offset from center of the body. See *outline drawings from page 35 to page 42* for details.

INTEGRAL PRIORITY FLOW DIVIDER COVER AND INTEGRAL RELIEF VALVE COVER

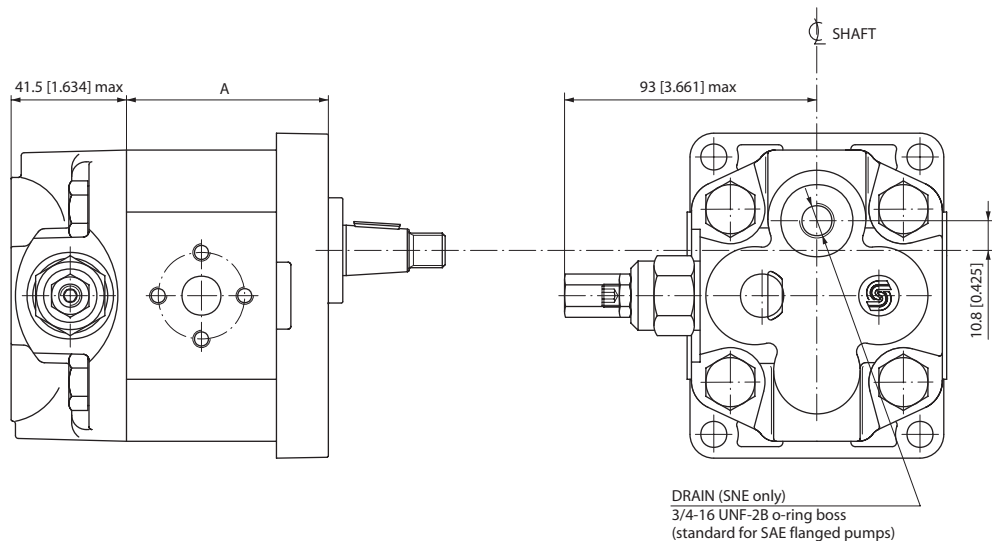


P101 030E

Dimensions

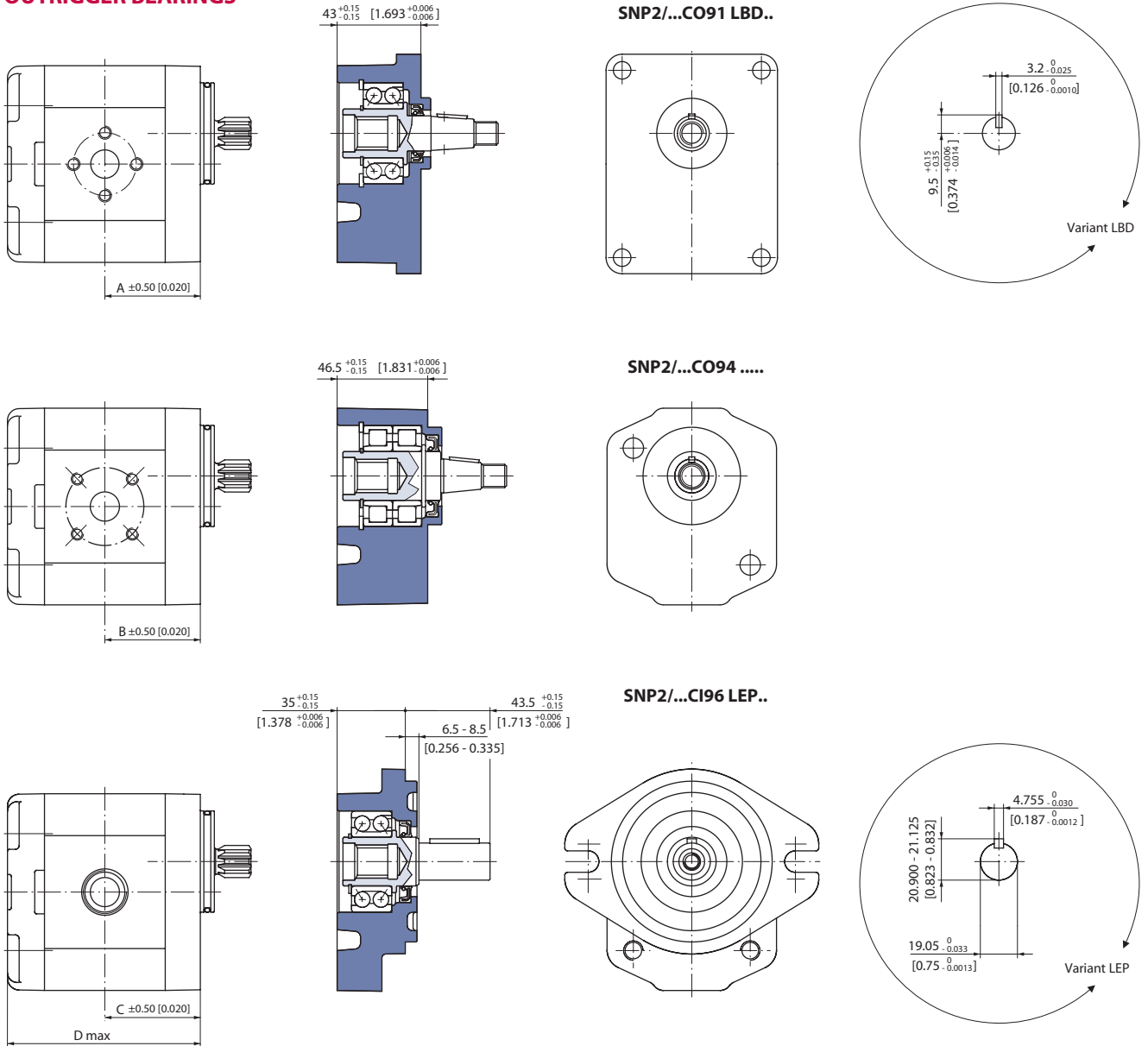
Type (displacement)		4	6	8	11	14	17	19	22	25
SNP2 / SKP2	A*	68 [2.697]	72 [2.835]	76 [2.992]	80 [3.150]	86 [3.386]	90 [3.543]	94 [3.701]	100 [3.937]	104 [4.094]
	A							100 [3.937]	106 [4.173]	110 [4.331]

* For O2 flange add 2.5 mm [0.098 in]



P101 031E

OUTRIGGER BEARINGS

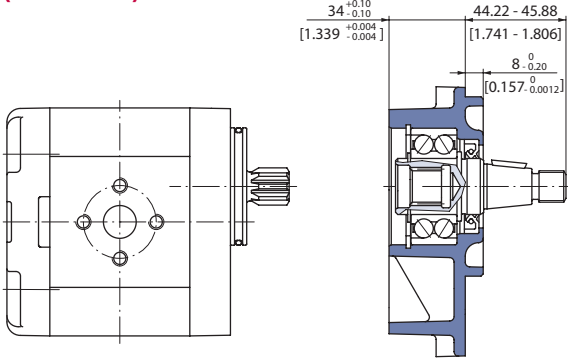


P101 032E

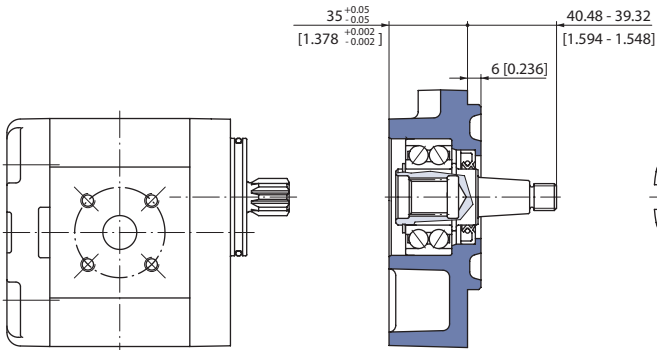
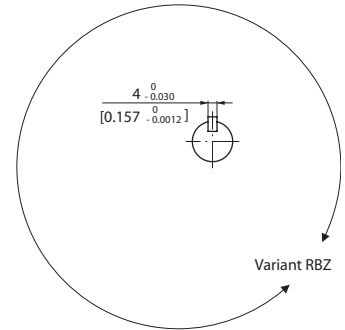
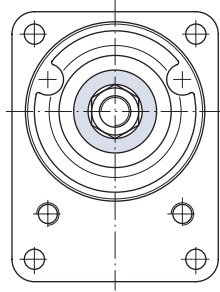
Dimensions

Type (displacement)	4	6	8	11	14	17	19	22	25
A	43.25 [1.703]	45 [1.772]	45 [1.772]	49 [1.929]	52 [2.047]	52 [2.047]	56 [2.205]	59 [2.323]	59 [2.323]
B	37.3 [1.469]	38.6 [1.520]	40.6 [1.598]	45 [1.772]	45 [1.772]	45 [1.772]	45 [1.772]	52.5 [2.067]	62 [2.441]
C	43.25 [1.703]	45 [1.772]	47 [1.850]	49 [1.929]	52 [2.047]	54 [2.126]	56 [2.205]	59 [2.323]	61 [2.402]
D	90 [3.543]	93.5 [3.681]	97.5 [3.839]	101.5 [3.996]	107.5 [4.232]	111.5 [4.390]	115.5 [4.574]	121.5 [4.783]	125.5 [4.941]

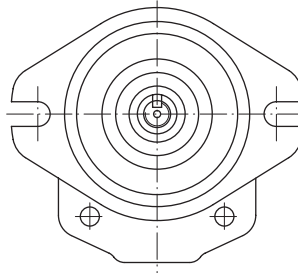
**OUTRIGGER BEARINGS
 (continued)**



SNP2/...CO92 RBZ..



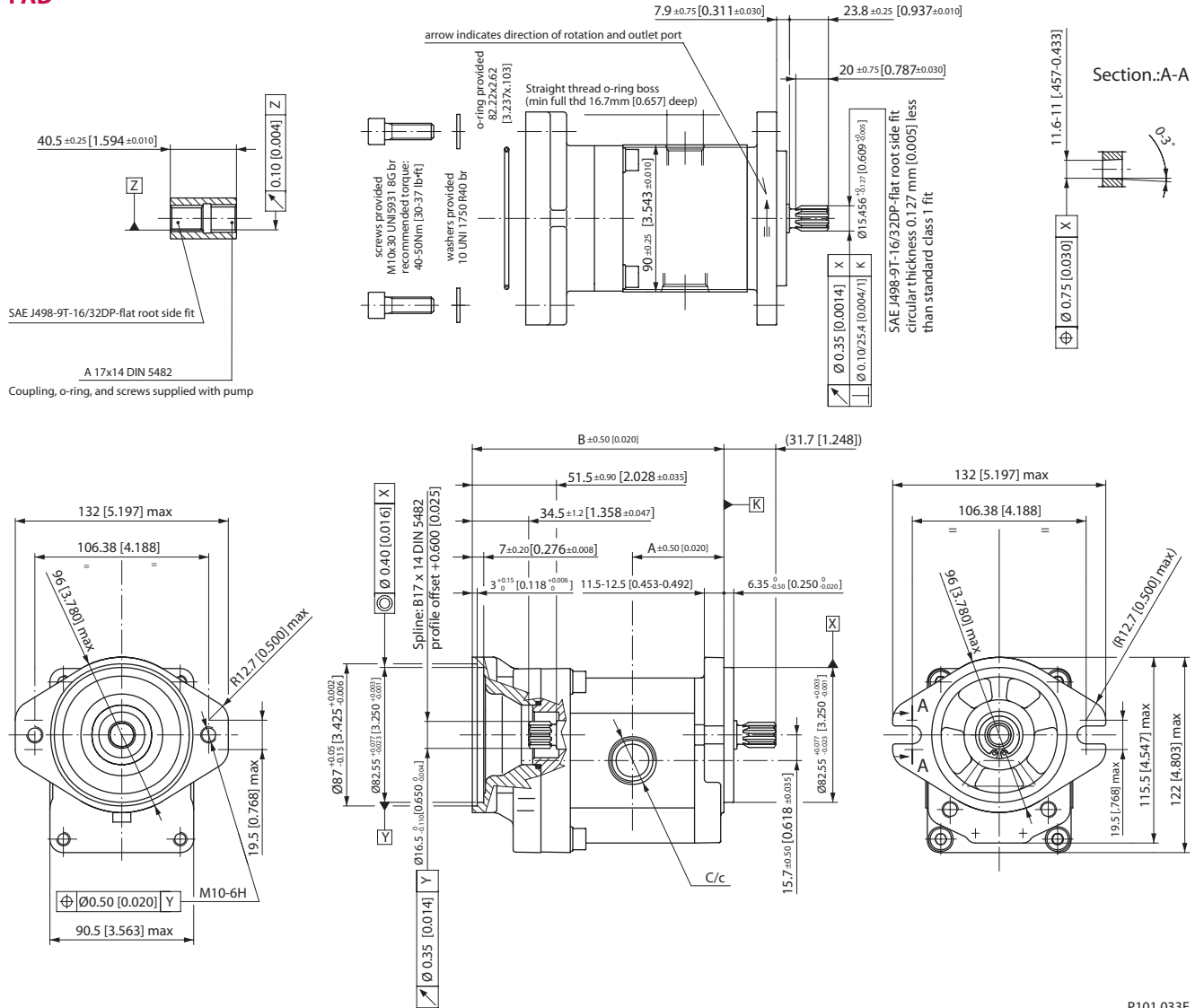
SNP2/...CO96 LEA..



P101 032E_2

AUXILIARY MOUNTING PAD

SNP2/...SC36 pump shown with auxiliary mounting pad kit installed.



P101 033E

Dimensions

Type (displacement)	4	6	8	11	14	17	19	22	25
A	43.25 [1.703]	45 [1.772]	47 [1.850]	49 [1.929]	52 [2.047]	54 [2.126]	56 [2.205]	59 [2.323]	61 [2.402]
B	128.5 [5.059]	132 [5.197]	136 [5.354]	140 [5.512]	146 [5.748]	150 [5.906]	154 [6.063]	160 [6.299]	164 [6.457]
Inlet C	1.063 (1 1/16) 12UN - 2B 18 mm [0.709] deep								
Outlet c	0.875 (7/8) - 14UNF - 2B 16.7 mm [0.658] deep								



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