



GEAR PUMPS

Member of the Danfoss Group

TUROLLA 
fast forward thinking

GEAR PUMPS

Group 2 | Technical Information





History of revisions

Date	Page	Changed	Rev.
28, June 2010	-	First edition	A
24, Feb 2011	1, 2, 12, 44	Covers to blue color, Turolla brand name, Biofluids deleted.	B
30, Sept 2013	ALL	Layout and options lists	C

Reference documents

Title	Type	Order number
General Aluminum Gear Pumps and Motors	Technical Information	L1016238
Group 1 Gear Pumps	Technical Information	L1016399
Group 3 Gear Pumps	Technical Information	L1016456
Group 1, 2 and 3 Gear Motors	Technical Information	L1016082
Hydraulic Fluids and Lubricants	Technical Information	L1021414

© 2013 Turolla™. All rights reserved.

Turolla accepts no responsibility for possible errors in catalogs, brochures and other printed material. Turolla reserves the right to alter its products without prior notice. This also applies to products already ordered provided that such alterations can be made without affecting agreed specifications. All trademarks in this material are properties of their respective owners. Danfoss, Turolla, Turolla OpenCircuitGear, OpenCircuitGear, Fast Lane and PLUS+1 are trademarks of the Danfoss Group.



Index

General Information

- 4 Overview
- 5 Pump design
- 5 Features and benefits
- 5 Pump displacements
- 6 Gear pump in circuit

Technical Data

- 7 Technical data

Product Code

- 8 Model code

Determination of Nominal Pump Sizes

- 14 Based on SI units/Based on US units

System Requirements

- 15 Pressure
- 15 Speed
- 16 Hydraulic fluids
- 16 Temperature and viscosity
- 17 Filtration
- 17 Filters
- 17 Selecting a filter
- 18 Reservoir
- 18 Line sizing
- 19 Pump drive
- 20 Pump drive data form
- 21 Pump life
- 22 Sound levels

Pump Performance

- 23 Performance graphs

Product Options

- 26 Flange, shaft and ports configurations
- 28 Mounting flanges
- 29 Shaft options
- 30 Pumps with integral relief valve • SNP2EN and SNP2IN
- 30 Integral relief valve schematics
- 31 Variant codes for ordering integral relief valves
- 32 Integral relief valve covers SNP2IN
- 33 Outrigger bearing
- 33 Available configurations
- 34 Outrigger bearing assembly
- 36 Auxiliary mounting pads
- 38 Pump ports

Dimensions

- 39 SNP2NN – 01DA, 01FA and 01BA
- 40 SNP2NN – 02DB and 02AA
- 41 SNP2NN – 03CA
- 42 SNP2NN – 04/05DB and 04/05AA
- 43 SKP2NN – 06SB and SNP2NN – 06SA, 06GA
- 44 SNP2NN – 06SA..BxBxYY../.....
- 45 SNP2NN – 09BJ
- 46 SNP2NN – A9BJ



General information

Overview

Turolla aluminum gear pumps are ideal for a wide range of applications for:

- **Small vehicles**, such as aerial lifts, greens and fairway mowers and electric forklifts. These needs are served by the pumps in the SKP2NN range with integral valves and pressure balanced design for high efficiency, and extruded aluminum bodies for high strength.
- **Medium and large off-highway vehicles**, like tractors, backhoe loaders, dumpers, and telescopic handlers, we offer the SNP2NN.

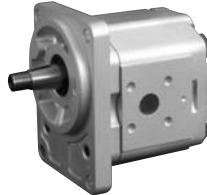
Many combinations of the pumps mentioned are available as multiple units made to fit any need. Turolla provides standard pumps for use in industrial applications, including power packs.

Group 2 gear pumps representatives:

SKP2NN 06SA



SNP2NN 02AA



SNP2NN 04DA



SNP2NN 03CA



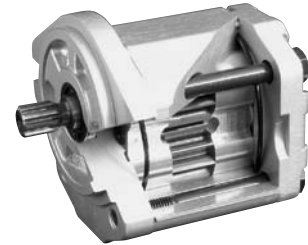


Pump design

Turolla 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 image below](#). The pressure balanced design of the pumps provides high efficiency for the entire series.

The SNP2NN pump accommodates SAE 9-tooth and the SKP2NN is a special version of the SNP2NN. It is designed to accommodate an SAE 11T 16/32 DP tooth splined shaft for higher torque applications.

SNP2NN 06SA cut-away

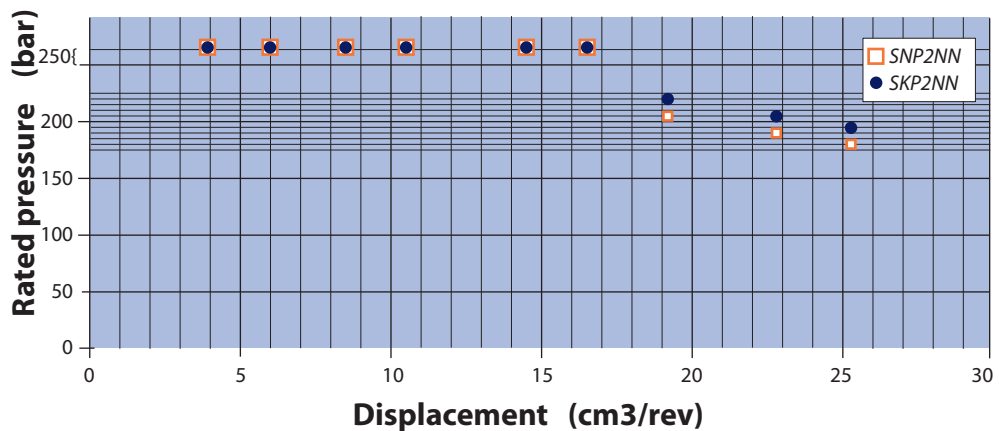


Features and benefits

- Wide range of displacements from 3.9 to 25.2 cm³/rev [from 0.24 to 1.54 in³/rev]
- Continuous pressure rating up to 250 bar [3625 psi]
- Speeds up to 4000 min⁻¹ (rpm)
- SAE, DIN and European standard mounting flanges and shafts
- Compact, lightweight
- Multiple pump configurations in combination with SNP1NN, SNP2NN and SNP3NN
- Quiet operation
- Available with integral relief valve

Pump displacements

Quick reference chart for pump displacements vs. rated pressure

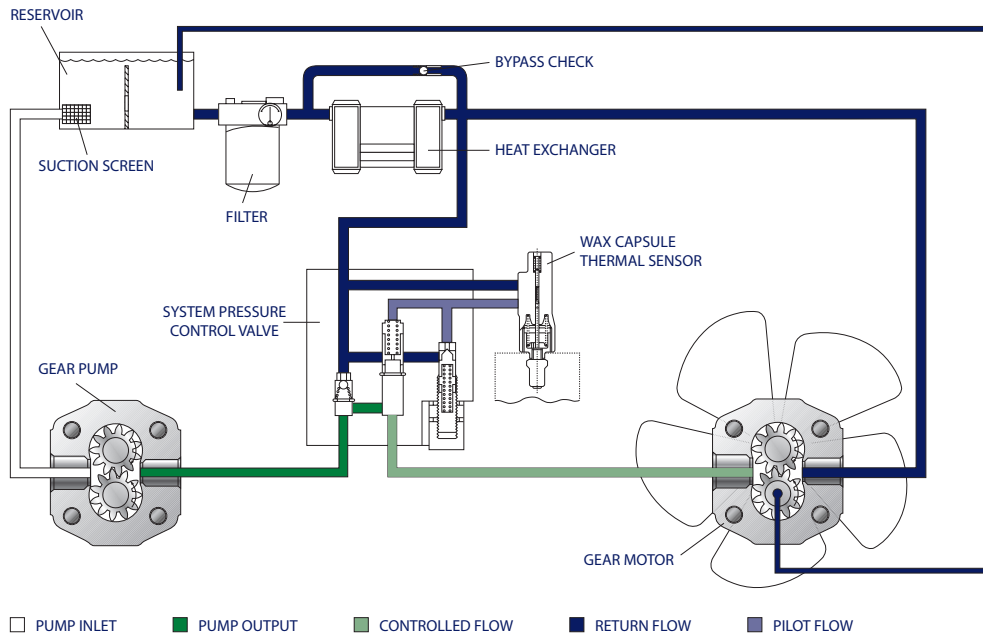




Gear pump in circuit

This typical circuit shows an SNP2NN gear pump driving an SNM2NN 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.

Hydraulic schematic example





Technical Data

Technical Data

Frame size		4,0	6,0	8,0	011	014	017	019	022	025
Displacement	cm ³ /rev	3.9	6.0	8.4	10.8	14.4	16.8	19.2	22.8	25.2
	[in ³ /rev]	[0.24]	[0.37]	[0.51]	[0.66]	[0.88]	[1.02]	[1.17]	[1.39]	[1.54]
SNP2NN										
Peak pressure	bar [psi]	280	280	280	280	280	280	230	200	175
		[4060]	[4060]	[4060]	[4060]	[4060]	[4060]	[3335]	[2900]	[2638]
Rated pressure	bar [psi]	250	250	250	250	250	250	210	180	160
		[3625]	[3625]	[3625]	[3625]	[3625]	[3625]	[3045]	[2610]	[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		1200	1200	1000	800	750	750	700	700	700
Min. speed at 180 bar to rated pressure		1400	1400	1400	1200	1000	1000	1000	800	–
Maximum speed		4000	4000	4000	4000	3500	3000	3000	3000	3000
SKP2NN										
Peak pressure	bar [psi]	280	280	280	280	280	280	260	230	200
		[4060]	[4060]	[4060]	[4060]	[4060]	[4060]	[3770]	[3335]	[2900]
Rated pressure	bar [psi]	250	250	250	250	250	250	240	210	190
		[3625]	[3625]	[3625]	[3625]	[3625]	[3625]	[3480]	[3045]	[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		1200	1200	1000	800	750	750	700	700	700
Min. speed at 180 bar to rated pressure		1400	1400	1400	1200	1000	1000	1000	800	800
Maximum speed		4000	4000	4000	4000	3500	3000	3000	3000	3000
Both (SNP2NN, SKP2NN)										
Weight	kg [lb]	2.3	2.4	2.5	2.7	2.9	3.0	3.1	3.2	3.3
		[5.1]	[5.3]	[5.5]	[5.8]	[6.3]	[6.5]	[6.7]	[7.0]	[7.3]
Moment of inertia of rotating components	x 10 ⁻⁶	21.3	26.5	32.4	38.4	47.3	53.3	59.2	68.1	74.1
	kg·m ² [x 10 ⁻⁶ lb·ft ²]	[505]	[629]	[769]	[911]	[1122]	[1265]	[1405]	[1616]	[1758]
Theoretical flow at maximum speed	l/min	15.6	24.0	33.6	43.2	50.4	50.4	57.6	68.4	75.6
	[US gal/min]	[4.1]	[6.3]	[8.9]	[11.4]	[13.3]	[13.3]	[15.2]	[18.0]	[20.0]

1 kg·m² = 23.68 lb·ft²

⚠ 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 Turolla representative.



Product code

Model code

A																			

A Family

SEP2NN	Low-cost Gr2 Pump
SNP2NN	Std Group 2 Pump
SNP2EN	Std Group 2 Pump + External Drain RV
SNP2IN	Std Group 2 Pump + Internal Drain RV
SNP2KS	Std Group 2 Pump + Priority Flow Divider + Dynamic Load Sensing, Inlet on body-Outlet on cover + drain on cover driven side - special (project not 100% complete)
SNC2NN	Std Group 2 Pump Inlet & Outlet in the Cover
SND2NN	Std Group 2 Pump Inlet on body outlet on cover
SKP2NN	High Torque Group 2 Pump

SKP2EN	High Torque Group 2 Pump + Ext.Drain RV
SKP2IN	High Torque Group 2 Pump + Int.Drain RV
SKC2NN	High Torque Group 2 Pump Inlet & Outlet on Cover
SHP2NN	High Pressure Group 2 Pump
SHP2EN	High Pressure Group 2 Pump + Ext.Drain RV - never released, but feasible
SHP2IN	High Pressure Group 2 Pump + Int.Drain RV
SNZ2NN	Std Group 2 Pump inlet on body-outlet on cover+RV int.drain on cover - special
XEP2NN	Economic Spare Product Gr2 Pump

B Displacement

3,0	Displacement 3,0cc - special
4,0	Displacement 4,0cc
5,5	Displacement 5,5cc - special
6,0	Displacement 6,0cc
6,5	Displacement 6,5cc - special
7,0	Displacement 7,0cc - special
7,5	Displacement 7,5cc - special
8,0	Displacement 8,0cc
8,7	Displacement 8,7cc - special

9,0	Displacement 9,0cc - special
9,5	Displacement 9,5cc - special
011	Displacement 11cc
012	Displacement 12cc - special
014	Displacement 14cc
016	Displacement 16cc - special
017	Displacement 17cc
019	Displacement 19cc
021	Displacement 21cc - special

022	Displacement 22cc
025	Displacement 25cc
028	Displacement 28cc - special

C Rotation

R	Right (Clockwise)
L	Left (Counterclockwise)

D Project version

N	Standard gear pump
6	Short version - special

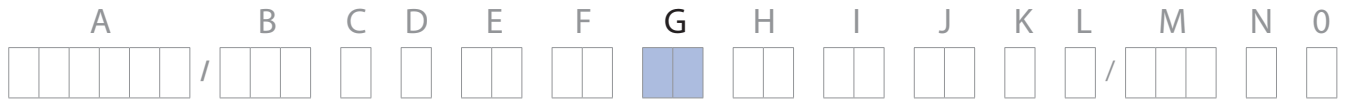


E Mounting flange

Code	Description (Type of flange • Type of drive gear • Preferred ports for configuration)
01	pilot Ø36,5+4 holes
02	pilot Ø80+4 holes
03	pilot Ø52+O-ring+4 holes through body
04	pilot Ø50+2 holes through body
A4	pilot Ø50+2 holes through body+seal on pilot
05	pilot Ø50+2 holes through body
06	SAE A pilot Ø82,55+2 holes
A6	SAE A pilot Ø82,55+2 holes+seal on pilot
09	pilot Ø52,34+2 threaded holes
91	Outrig. Type 01+taper shaft 1:8-M12x1,25-Key4 - Outrigger bearing
94	Outrig. Type 04+taper shaft 1:5-M12x1,25-Key3 - Outrigger bearing
9A	Outrig. Type 01+taper shaft 1:8-M12x1,25-Key3.2 - Outrigger bearing
9B	Outrig. Type 01+taper shaft 1:8-M12x1,25-Key4+pilot Ø50,8 - Outrigger bearing
9C	Outrig. Type 01+taper shaft 1:8-M12x1,25-Key3.2+radial roller bearing - Outrigger bearing
9F	Outrig. Type 02+taper shaft 1:5-M14x1,5-Key4+special shaft seal - Outrigger bearing
9J	Outrig. Type 06 with parallel shaft Ø3/4 (Ø19.05 mm) - Outrigger bearing
9L	Outrig. Type 01 parallel shaft Ø22 pilot Ø50,8 - Outrigger bearing
9M	Outrig. Type 01 parallel shaft Ø18 pilot Ø36,5 - Outrigger bearing

F Drive gear

AA	Taper 1:5-M12x1,25-Key 3
AB	Taper 1:5-M12x1,5-Key 3
AC	Taper 1:5-M14x1,5-Key 4
AD	Taper 1:5-M12X1,25-Key 3-Special
AM	Taper 1:5-M12X1,25-Key 3-without nut and washer
B1	Taper 1:8-M12x1,25-Key 4/6 lowered
B2	Taper 1:8-M12x1,5-Key 4/ 3,2-w/o nut and washer
BA	Taper 1:8-M12x1,25-Key 4
BB	Taper 1:8-M12x1,25-Key 4/3,2
BC	Taper 1:8-M12x1,5-Key 4/3,2
BJ	Taper 1:8-M12x1,25-Key 4/3 black steel
CA	Tang 8x17,8xL6,5 FR03
CD	Tang 8x Ø17,8xL6,5 Short - Special
CF	Tang 8x Ø17,46xL9,6-Special
DA	Spline DIN 5482 B17x14-L10
DB	Spline DIN 5482 B17x14-L14
DF	Spline DIN 5482 B17x14 - Special
FA	Parallel Ø15-L30+Key 4x25
GA	Parallel SAE Ø15,875-L23,8-Key 4x18
GB	Parallel SAE Ø15,875-L50,8-Key 4x40
SA	Spline SAE J498-9T-16/32
SB	Spline SAE J498-11T-16/32
SF	Spline SAE J498-9T-16/32-reinforced fillet
SG	Spline SAE J498-11T-16/32-Special



G Rear cover

C1	Cover pump front BSP ports : Inlet 3/4 Gas ; Outlet 1/2 Gas
C6	Cover pump front SAE Thred ports:In.1-1/16-12UN;Out.7/8-14UNF
C7	Cover pump front SAE Thred ports:In.3/4-16UNF-2B;Out.3/4-16UNF-2B
D1	Cover pump with Outlet port 1/2 Gas
D6	Cover pump with Outlet port 7/8-14UNF-2B
E1	Cover pump with relief valve with external drain 3/8 Gas
E2	Cover pump for RV with ext. drain M12x1.5-CCW rot.idle side;CW rot. drive side
E3	Cover pump for RV with ext. drain 3/8 Gas with M5 Holes
E4	Cover pump for RV with ext. drain 3/4-16UNF-2B with M5 Holes
E6	Cover pump for RV with ext. drain 3/4-16UNF-2B
I1	Cover pump for RV with int. drain
I3	Cover pump for RV with int. drain with M5 Holes
K1	Cover pump for Priority divisor flow with Dynamic Load Sensing - Special for PFD only
P1	Standard cover for pump
P3	Standard cover for pump with M5 Holes
Z1	Cover pump per RV with Outlet port M18x1,5 - Special



H Inlet size **I Outlet size**

B5	15x35xM6	
B6	15x40xM6	
C3	13,5x30xM6	
C5	13,5x40xM8	
C7	20x40xM8	
D5	M18x1,5	
D7	M22x1,5	
E4	3/4-16UNF	
E5	7/8-14UNF	
E6	1-1/16-12UN	
F3	3/8 GAS	
F4	1/2 GAS	
F5	3/4 GAS	
H5	M18x1,5-ISO6149	
H7	M22x1,5-ISO6149	
H8	M27x2-ISO6149	
H9	M33x2-ISO6149	

M1	12x17,48x38,1xM6	
M2	12x17,48x38,1xM8	
M3	18,5x17,48x38,1xM8	
MB	12x38,1x17,48xM8(=)	
MC	18,5x47,63x22,23xM6(=)	
MD	18,5x47,63x22,23xM8(=)	
ME	18,5x47,63x22,23xM10(=)	
MG	25/20x52,37x26,19xM10(=)	
MH	31/25x58,72x30,18xM10(=)	
NN	Without outlet port	



A B C D E F G H I J K L M N O
 [][][][][][] / [][][] [] [] [][] [][] [][] [][] [][] [][] [][] [][] [][] [][] [][] [][] [][]

J Ports positions & Special body

NN	Std from catalogue
YY	Port Bx-Bx with flange SAE-A; off-set to rear cover to install fitting screws
EU	Dist. from front flange=58,5 - Special
F9	Dist. from front flange=69 - Special
TD	Nr.4 milling D.27 tigh.16 flange side - Special
TE	Nr.4 milling D.27 tigh.20 flange side - Special
ZZ	Port Bx-Bx in the center of the body - Option

K Seals

N	Standard NBR seals
B	VITON seals
D	VITON shaft seal with dust lip

L Screws

N	Std burnished screws
A	Zinc plated screws
B	Geomet screws



M Set valve

NNN	No valve
V**	Integral relief valve pressure setting

**For details go to page 31

N Type mark

N	Standard Turolla Marking
A	Standard Turolla Marking+Customer Code
Z	Without Marking

O Mark position

N	Std Marking position (on top)
A	Special Marking position on the bottom



Determination of Nominal Pump Sizes

Based on SI units/Based on US units

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

Based on SI units

Output flow $Q = \frac{V_g \cdot n \cdot \eta_v}{1000}$ l/min

Input torque $M = \frac{V_g \cdot \Delta p}{20 \cdot \pi \cdot \eta_m}$ N·m

Input power $P = \frac{M \cdot n}{9550} = \frac{Q \cdot \Delta p}{600 \cdot \eta_t}$ kW

Based on US units

Output flow $Q = \frac{V_g \cdot n \cdot \eta_v}{231}$ [US gal/min]

Input torque $M = \frac{V_g \cdot \Delta p}{2 \cdot \pi \cdot \eta_m}$ [lbf·in]

Input power $P = \frac{M \cdot n}{63.025} = \frac{Q \cdot \Delta p}{1714 \cdot \eta_t}$ [hp]

Variables: *SI units [US units]*

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



System Requirements

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.

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 of pressure 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.

Speed

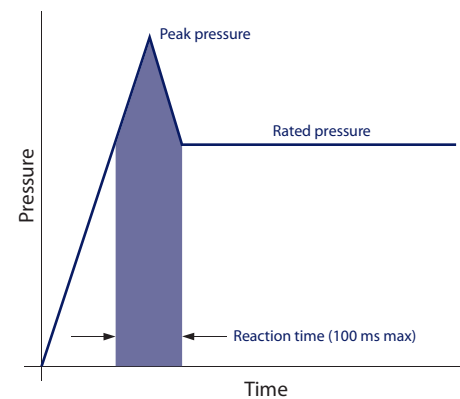
Maximum speed is the limit recommended by Turolla for a particular gear pump when operating at rated pressure. It is the highest speed at which normal life can be expected.

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.

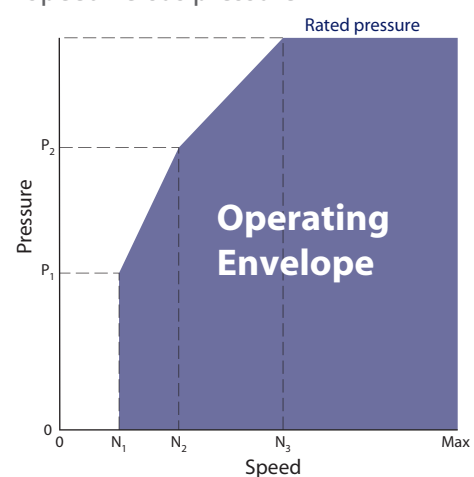
Inlet pressure

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

Time versus pressure



Speed versus pressure



Where:

N_1 = Minimum speed at 100 bar

N_2 = Minimum speed at 180 bar

N_3 = Minimum speed at rated pressure



Hydraulic fluids

Ratings and data for SNP2NN, SHP2NN and SKP2NN 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 (HVL) 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 Turolla publication [Hydraulic Fluids and Lubricants Technical Information, L1021414](#) for more information.

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)		1000 [4600]
Recommended range	mm ² /s [SUS]	12-60 [66-290]
Minimum		10 [60]

Temperature

Minimum (cold start)		-20 [-4]
Maximum continuous	°C [°F]	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 ingress 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 ingress, 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 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 de-aeration 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		2.5 [8.2]
Outlet	m/s [ft/sec]	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.

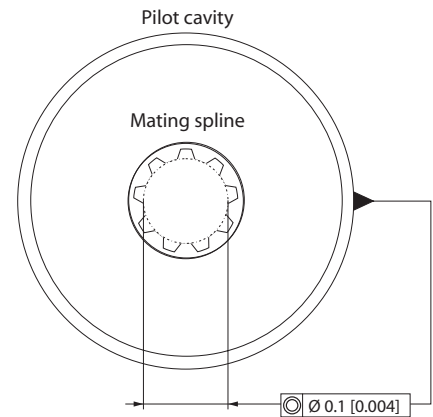


Pump drive

Shaft options for Group 2 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.



! Caution

In order to avoid spline shaft damages it is recommended to use carburized and hardened steel couplings with 80-82 HRA surface hardness.

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.

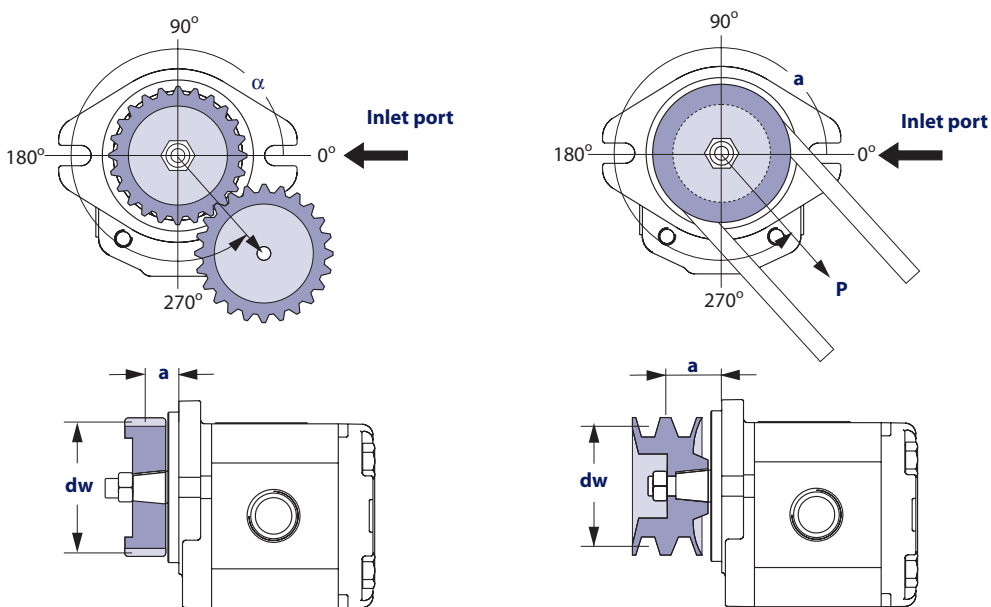
In applications where external shaft loads can't be avoided, minimize the impact on the pump by optimizing the orientation and magnitude of the load. Use a tapered input shaft; don't use splined shafts for belt or gear drive applications. A spring-loaded belt tension-device is recommended for belt drive applications to avoid excessive tension. Avoid thrust loads in either direction. Contact Turolla if continuously applied external radial or thrust loads occur.



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

Pump drive data form

Optimal radial load position



Application data

Item	Value	Unit
Pump displacement		cm ³ /rev [in ³ /rev]
Rated system pressure		<input type="checkbox"/> bar <input type="checkbox"/> psi
Relief valve setting		<input type="checkbox"/> left <input type="checkbox"/> right
Pump minimum speed		min ⁻¹ (rpm)
Pump maximum speed		
Drive gear helix angle (gear drive only)		degree
Belt type (gear drive only)		<input type="checkbox"/> V <input type="checkbox"/> notch
Belt tension (gear drive only)	P	<input type="checkbox"/> N <input type="checkbox"/> lbf
Angular orientation of gear or belt to inlet port	α	degree
Pitch diameter of gear or pulley	d_w	<input type="checkbox"/> mm <input type="checkbox"/> 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 Turolla 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

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.

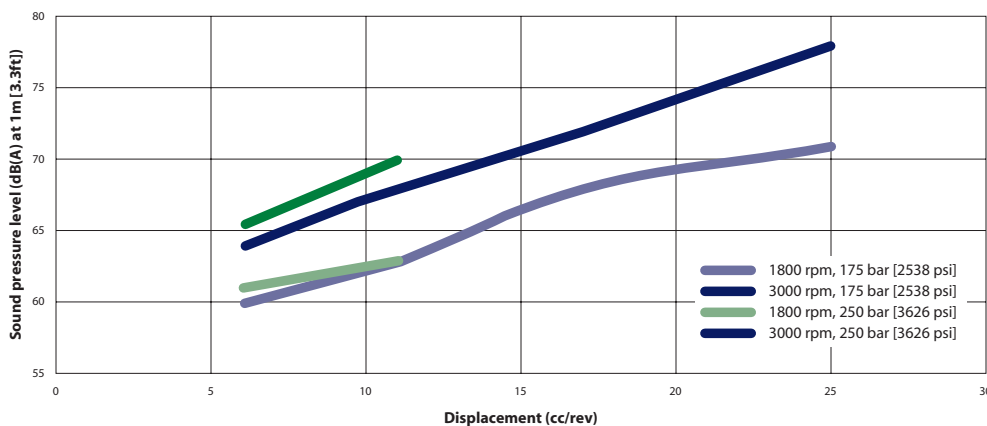
Pressure ripple is the result of the number of pumping elements (gear teeth) delivering oil to the outlet and the pump's ability to gradually change the volume of each pumping element from low to high pressure. In addition, the pressure ripple is affected by the compressibility of the oil as each pumping 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 depends 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 SNP2NN pumps (with SAE A flange, and spline shaft in plug in drive) measured in dB (A) at 1 m [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 Turolla representative for assistance with system noise control.

Sound levels graph



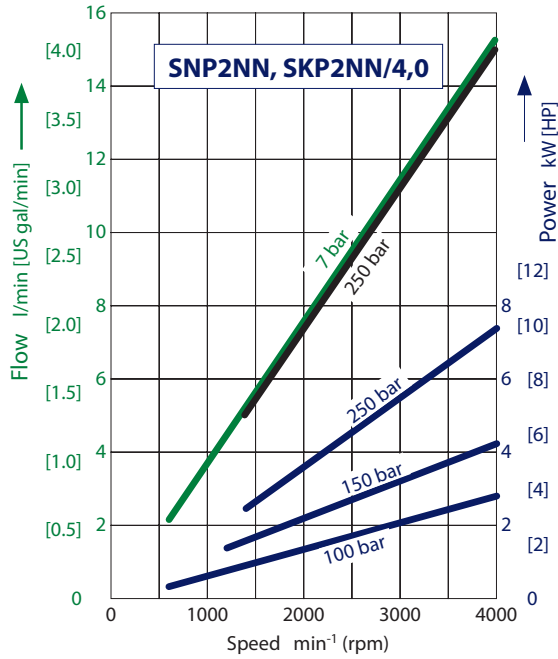


Pump Performance

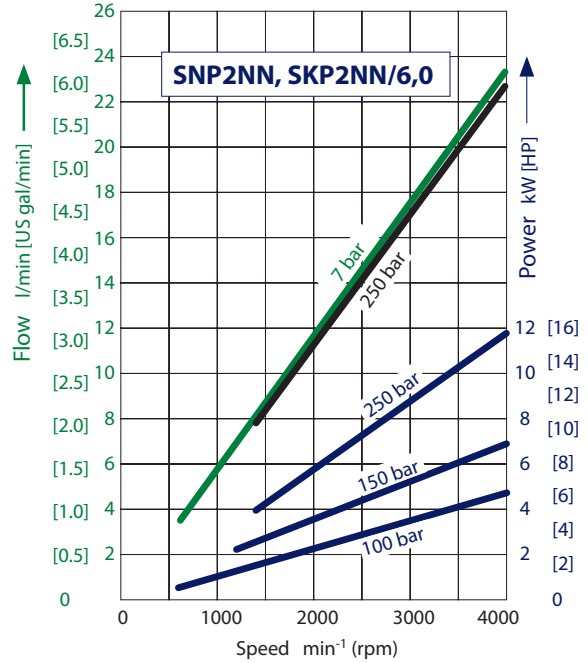
Performance graphs

The graphs on the next pages provide typical output flow and input power for Group 2 pumps at various working pressures. Data were taken using ISO VG46 petroleum /mineral based fluid at 50 °C (viscosity at 28 mm²/s [cSt]).

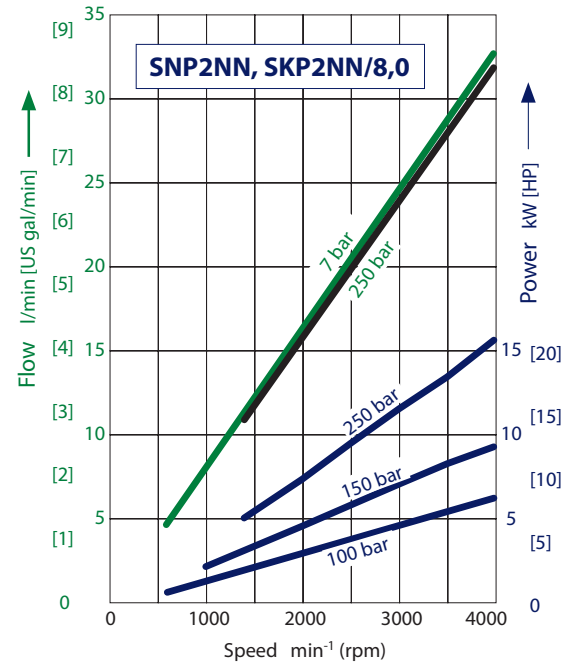
Performance graph for 4,0 frame size



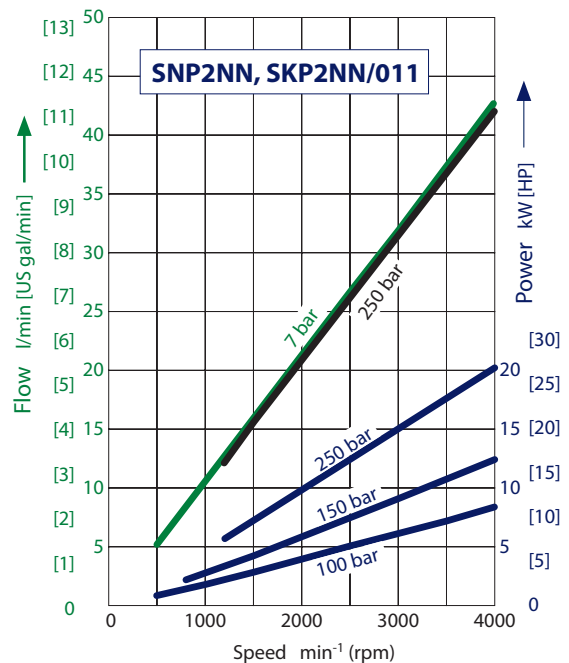
Performance graph for 6,0 frame size



Performance graph for 8,0 frame size

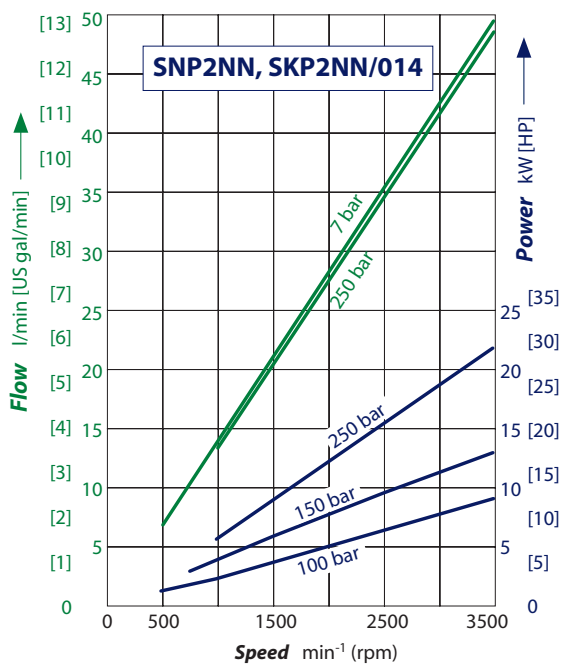


Performance graph for 011 frame size

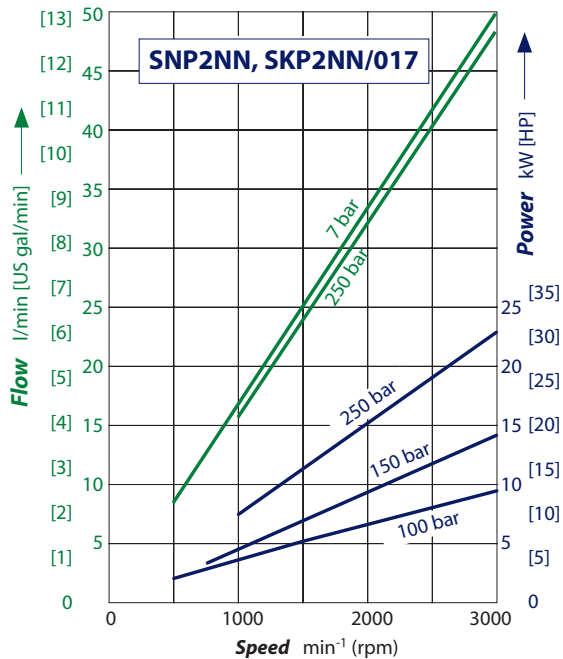




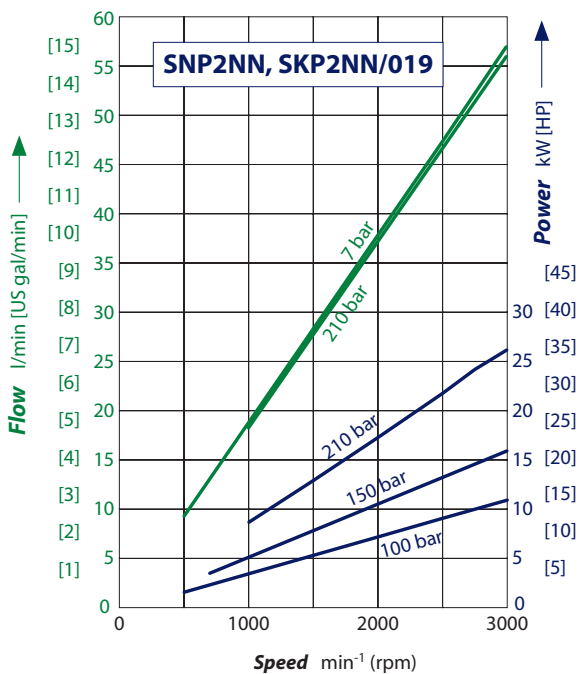
Performance graph for 014 frame size



Performance graph for 017 frame size



Performance graph for 019 frame size



Performance graph for 022 frame size

