# Danfoss GearMe tandem hydraulic gear pump 83127954

Manufacturer: Danfoss

Manufacturer part number / published order designation: 83127954

Published model: PRN---038-/-019-R-1-07-SL-P1-E9-E8-NN-E6-E5-NN-N-N-/-NNN-N-N

## About this compilation

Prepared by Hydmaster from selected manufacturer documentation. Original technical pages follow without cropped drawings, rewritten data or altered units. This cover and index are Hydmaster editorial material, not a manufacturer-issued exact-execution datasheet.

Coverage: applicable family/component reference. Exact execution documentation remains incomplete. Do not treat standard component or stage drawings as approval of the complete custom assembly.

## Execution notes and conditions

Exact manufacturer general arrangement and combined duty-limit document for published full factory code this execution.

## Source-page index

Source page numbers below are physical pages of each complete original PDF. The original printed page labels and technical content remain unchanged. Compiled page numbers count this cover/index.

## Source A: Danfoss Gearme Group Three Gear Pumps Technical Information

| Original pages | Compiled pages | Relevant content |
|---|---|---|
| 8-17 | 3-12 | Group3 stage code definitions including direction and project version; Group3 shaft/flange definitions; Group3 stage port codes including E9/E8 and CA; Group3 seal/screw definitions; Inlet/case pressure requirements and pressure definition; Pressure/speed duty envelope and minimum-speed conditions; Viscosity, hydraulic fluid and temperature requirements; Reservoir and filtration/cleanliness recommendations; Drive/coupling installation, radial/axial loading and alignment; Continued shaft-loading/application limits |
| 24-25 | 13-14 | Group3 first-drive shaft torque constraints; Group3 shaft-torque caution |

## Source B: Danfoss Gearme Group Two Gear Pumps Technical Information

Supplemental stage/component reference; not a complete assembly drawing.

| Original pages | Compiled pages | Relevant content |
|---|---|---|
| 12 | 15 | Group2 stage type and displacement definitions |
| 14-15 | 16-17 | Actual E6/E5/E4/C7/C3 stage port and P1 cover code references; Stage seal and no-valve codes |
| 18-23 | 18-23 | Inlet pressure and pressure definitions; Pressure/speed duty-envelope conditions; Fluid viscosity, temperature and fluid requirements; Reservoir, cleanliness and filtration; Drive/coupling, shaft loading and mounting; Continued loading/application limits |

## Source C: Danfoss Gearme Group One Gear Pumps Technical Information

Supplemental stage/component reference; not a complete assembly drawing.

| Original pages | Compiled pages | Relevant content |
|---|---|---|
| 15-19 | 24-28 | Group1 stage nominal size versus geometric data with no overall assembly rating; Group1 threaded-port derating conditions; Group1 stage-family and nominal size code; Group1 stage flange/cover definitions; Actual E5/E4/E3/C2 stage port definitions and NBR seal code |
| 22-27 | 29-34 | Inlet pressure and pressure definitions; Pressure/speed duty-envelope conditions; Fluid viscosity, temperature and fluid requirements; Reservoir, cleanliness and filtration; Drive/coupling and mounting requirements; Continued shaft-loading/application limits |
| 32 | 35 | Group1 shaft torque/port context |

## Product Coding

### Model code

#### A Family

| A | | | | | | | B | | | C | D | E | | F | | G | | H | | I | | J | | K | L | | M | | | N | O |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
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| | |
|---|---|
| **SNP3NN** | Std Gr3 Pump |

#### B Displacement

| A | | | | | | | B | | | C | D | E | | F | | G | | H | | I | | J | | K | L | | M | | | N | O |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
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| | |
|---|---|
| **022** | 22,1 cc |
| **026** | 26,2 cc |
| **033** | 33,1 cc |
| **038** | 37,9 cc |
| **044** | 44,1 cc |
| **048** | 48,3 cc |
| **055** | 55,2 cc |
| **063** | 63,4 cc |
| **075** | 74,4 cc |
| **090** | 88,2 cc |

#### C Rotation

| A | | | | | | | B | | | C | D | E | | F | | G | | H | | I | | J | | K | L | | M | | | N | O |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
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| | |
|---|---|
| **L** | Left rotation |
| **R** | Right rotation |

#### D Project version

| A | | | | | | | B | | | C | D | E | | F | | G | | H | | I | | J | | K | L | | M | | | N | O |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
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| | |
|---|---|
| **N** | Std Version of Project |

#### E Mounting flange

| A | | | | | | | B | | | C | D | E | | F | | G | | H | | I | | J | | K | L | | M | | | N | O |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | / | | | | | | • | • | | | | | | | | | | | | | / | | | | | |

| Code | Description (Type of flange • Type of drive gear • Preferred ports for configuration) |
|---|---|
| **01** | European four bolt flange (98,4x128,1) - Pilot Ø50,8 |
| **02** | European four bolt flange (98,4x137) - Pilot Ø50,8 |
| **03** | European four bolt flange (114,3x149,5) - Pilot Ø60,3 |

## Product Coding

| Code | Description (Type of flange • Type of drive gear • Preferred ports for configuration) |
|---|---|
| **06** | German four bolt flange (102,0x145,0) - Pilot Ø105 |
| **07** | SAE B-Pilot Ø101,6+2 holes |
| **08** | SAE C-Pilot Ø127+4 holes |
| **09** | SAE A-Pilot Ø82,55+2 holes |
| **91** | Outrigger bearing with European four bolt flange Pilot Ø50,8 -Taper 1:8 M14x1,5 key 4x7,5 |
| **D7** | SAE B-Pilot Ø101,6+2 holes+special for double shaft seal - Special |

### F Drive gear

| A | | B | C | D | E | F | G | H | I | J | K | L | | M | N | O |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | / | | | | | • • | | | | | | | / | | | |

| | |
|---|---|
| **AA** | Taper 1:5-M16x1,5-Key 5 |
| **BA** | Taper 1:8-M14x1,5-Key 4 |
| **BB** | Taper 1:8-M16x1,5-Key 4,79 |
| **CA** | Tang 8xØ22,2 - Special |
| **DA** | DIN 5482 B22x19 L24 (for flange 01) |
| **DD** | DIN 5482 B28x25 L28 (for flange 06) |
| **FA** | ParallelØ20-Key 5x5 L30 (for flange 01-02) |
| **FB** | Parallel Ø22-Key 5x5 L40 (for flange 03) |
| **GA** | ParallelØ22,225 x L25,4-Key 6,375x6,375 L25,4 |
| **SA** | SAE J498-13T-16/32-SAE B |
| **SB** | SAE J498-13T-16/32-SAE A (for flange 09) |
| **RA** | SAEJ498-14T-12/24-SAE C-4 bolt (for flange 08) |
| **SH** | SAE J498-15T-16/32-SAE B - Special |

### G Rear cover

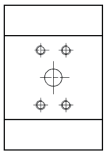
| A | | B | C | D | E | F | G | H | I | J | K | L | | M | N | O |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | / | | | | | | • • | | | | | | / | | | |

| | |
|---|---|
| **P1** | Standard cover for pump |

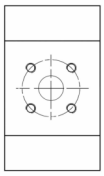
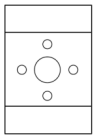
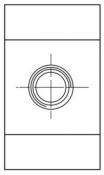
### H Inlet size; I Outlet size

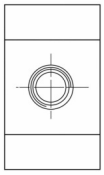
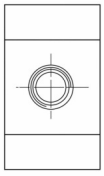
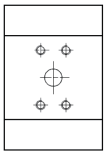
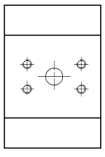
| A | | B | C | D | E | F | G | H | I | J | K | L | | M | N | O |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | / | | | | | | | • • | • • | | | | / | | | |

| | |
|---|---|
| **A2** | 18,5x22,23x47,63x3/8-16UNC |
| **A3** | 25x26,19x52,37x3/8-16UNC |
| **A4** | 31x30,18x58,72x7/16-14UNC |
| **A5** | 37,5/27x35,71x69,85x1/2-13UNC |



## Product Coding

| | | |
|---|---|---|
| **BA** | 18x55xM8 |  |
| **BB** | 27x55xM8 | |
| **BC** | 36/27x55xM8 | |
| **C7** | 20x40xM8 |  |
| **CA** | 27x51xM10 | |
| **CD** | 36x62xM10 | |
| **E6** | 1-1/16-12UN |  |
| **E8** | 1-5/16-12UN | |
| **E9** | 1-5/8-12UN | |
| **EA** | 1-7/8-12UN | |

| | | |
|---|---|---|
| **H8** | M27x2-ISO6149 |  |
| **H9** | M33x2-ISO6149 | |
| **HA** | M42x2-ISO6149 | |
| **F5** | BSP 3/4 GAS |  |
| **F6** | BSP 1 GAS | |
| **F7** | BSP 1-1/4 GAS | |
| **M5** | 25x52,37x26,19xM10 |  |
| **M6** | 31x30,18x58,72xM10 | |
| **M7** | 37,5x35,71x69,85xM12 | |
| **MG** | 25/20x52,37x26,19xM10(=) - Special |  |
| **MH** | 31x30,18x58,72xM10 deep18 (=) | |
| **MN** | 31x30,18x58,72xM10 deep12 (=) | |
| **MR** | 37,5x35,71x69,85xM12 deep20 (=) | |

### J Ports positions & Special body

| A | | | | | | | B | | | C | D | E | | F | | G | | H | | I | | J | | K | L | | M | | | N | O |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
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| | |
|---|---|
| **NN** | Std from catalogue |
| **ZZ** | Port type Bx-Bx in the center of the body |

## Product Coding

### K Seals

| A | | | | | | | B | | | C | D | E | | F | | G | | H | | I | | J | K | L | | M | | | N | O |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | / | | | | | | | | | | | | | | | | | • | | / | | | | | |

| | |
|---|---|
| **N** | Standard NBR seals |
| **D** | NBR seals + VITON shaft seal with dust lip |
| **I** | Two opposite shaft seal |

### L Screws

| A | | | | | | | B | | | C | D | E | | F | | G | | H | | I | | J | K | L | | M | | | N | O |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | / | | | | | | | | | | | | | | | | | | • | / | | | | | |

| | |
|---|---|
| **N** | Std burnished screws |
| **B** | Anticorrosion screws |

### M Set valve

| A | | | | | | | B | | | C | D | E | | F | | G | | H | | I | | J | K | L | | M | | | N | O |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | / | | | | | | | | | | | | | | | | | | | / | • | • | • | | |

| | |
|---|---|
| **NNN** | No valve |

### N Type mark

| A | | | | | | | B | | | C | D | E | | F | | G | | H | | I | | J | K | L | | M | | | N | O |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | / | | | | | | | | | | | | | | | | | | | / | | | | • | |

| | |
|---|---|
| **N** | Standard Danfoss Marking |
| **A** | Standard Danfoss Marking+Customer Code |
| **Z** | Without Marking |

### O Mark position

| A | | | | | | | B | | | C | D | E | | F | | G | | H | | I | | J | K | L | | M | | | N | O |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | / | | | | | | | | | | | | | | | | | | | / | | | | | • |

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

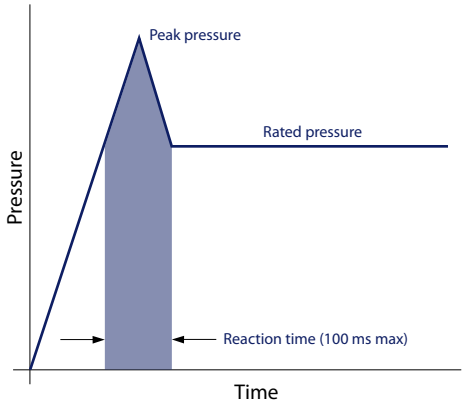
## System Requirements

### 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.

| | | |
|---|---|---|
| **Max. continuous vacuum** | bar abs. [in. Hg] | 0.8 [23.6] |
| **Max. intermittent vacuum** | | 0.6 [17.7] |
| **Max. pressure** | | 4.0 [118.1] |

**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 accompanying illustration 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.

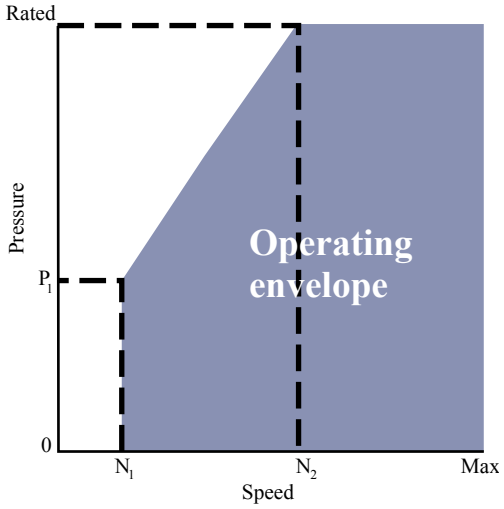
### Speed

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

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

## System Requirements

*Speed versus pressure*




Where:

$N_1$ = Minimum speed at 100 bar

$N_2$ = Minimum speed at 180 bar

### Hydraulic fluids

Ratings and data for SNP3NN and SHP3NN gear pumps are based on operating with premium hydraulic fluids containing oxidation, rust, and foam inhibitors. These fluids must possess good thermal and hydrolytic stability to prevent wear, erosion, and corrosion of internal components. They include:

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

Use only clean fluid in the pump and hydraulic circuit.

**Caution**

Never mix hydraulic fluids.

### 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.

## System Requirements

*Fluid viscosity*

| | | |
|---|---|---|
| **Maximum (cold start)** | $mm^2/s$ [SUS] | 1000 [1600] |
| **Recommended range** | | 12-60 [66-290] |
| **Minimum** | | 10 [60] |

*Temperature (with standard NBR seals)*

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

## Filtration

### Filters

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

### Selecting a filter

When selecting a filter, please consider:

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

Measure filter efficiency with a Beta ratio ($\beta_X$). For:

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

$\beta_x$ 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 $\beta_x$ ratio*

| | |
|---|---|
| **Fluid cleanliness level (per ISO 4406)** | Class 22/18/13 or better |
| **$\beta_x$ ratio (suction filtration)** | $\beta_{35-45} = 75$ and $\beta_{10} = 2$ |
| **$\beta_x$ 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 deaeration of the fluid as it passes through, and accommodates a fluid dwell-time between 60 and 180 seconds, allowing entrained air to escape.

## System Requirements

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

Install the suction line above the bottom of the reservoir to take advantage of gravity separation and prevent large foreign particles from entering the line. Cover the line with a 100-125 micron screen. The pump should be below the lowest expected fluid level. Put the return-line below the lowest expected fluid level to allow discharge into the reservoir for maximum dwell and efficient deaeration. A baffle (or baffles) between the return and suction lines promotes deaeration and reduces fluid surges.

### Line sizing

Choose pipe sizes that accommodate minimum fluid velocity to reduce system noise, pressure drops, and overheating. This maximizes system life and performance.

Design inlet piping that maintains continuous pump inlet pressure above 0.8 bar absolute during normal operation. The line velocity should not exceed the values in this table:

*Maximum line velocity*

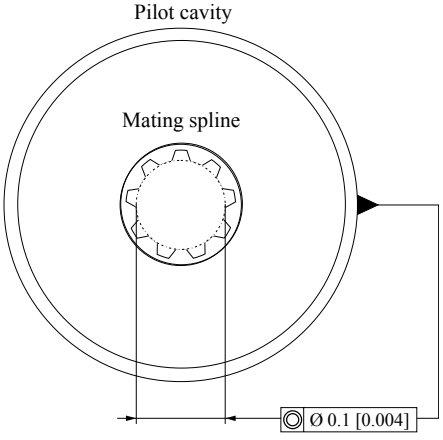
| | | |
|---|---|---|
| **Inlet** | m/s [ft/sec] | 2.5 [8.2] |
| **Outlet** | | 5.0 [16.4] |
| **Return** | | 3.0 [9.8] |

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

### Pump drive

Shaft options for Group 3 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.

## System Requirements

**Caution**

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

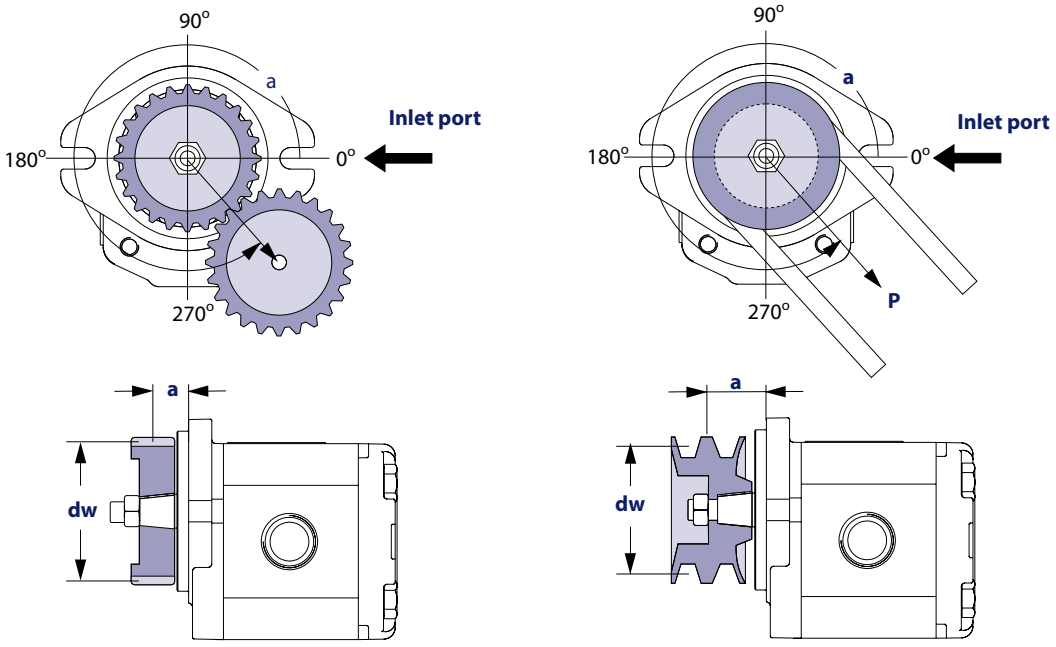
Allowable **radial shaft loads** are a function of the load position, load orientation, and operating pressure of the hydraulic pump. All external shaft loads have an effect on bearing life, and may affect pump performance.

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.

## Pump drive data form

Contact Danfoss if continuously applied external radial or thrust loads occur. Fill out this page and send the complete form to your Danfoss representative for an assistance in applying pumps with belt or gear drive. This illustration shows a pump with counterclockwise orientation:

*Optimal radial load position*




*Application data*

| Item | | Value | Unit |
|---|---|---|---|
| Pump displacement | | | $cm^3$/rev [$in^3$/rev] |
| Rated system pressure | | | bar psi |
| Relief valve setting | | | |
| Pump shaft rotation | | | left right |
| Pump minimum speed | | | $min^{-1}$ (rpm) |
| Pump maximum speed | | | |
| Drive gear helix angle (gear drive only) | | | degree |
| Belt type (gear drive only) | | | V notch |
| Belt tension (gear drive only) | **P** | | N lbf |

## System Requirements

*Application data (continued)*

| Item | | Value | Unit |
|---|---|---|---|
| Angular orientation of gear or belt to inlet port | **α** | | degree |
| Pitch diameter of gear or pulley | **dw** | | mm in |
| Distance from flange to center of gear or pulley | **a** | | |

### Pump Life

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

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

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

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

### Sound levels

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 SNP3NN 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 Danfoss representative for assistance with system noise control.

## Product Options

| Code | Description |
|---|---|
| **06** | German 105 mm [4.134 in] 4-bolt |
| **07/D7** | SAE B 2-bolt |
| **08** | SAE C 4-bolt |
| **09** | SAE A-Pilot Ø82,55+2 holes |

### Shaft options

Direction is viewed facing the shaft. Group 3 pumps are available with a variety of splined, parallel, and tapered shaft ends. Not all shaft styles are available with all flange styles.

| A | | | | | | | B | | | C | D | E | | F | | G | | H | | I | | J | K | L | | M | | | N | O |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | / | | | | | | | | • | • | | | | | | | | | | / | | | | | |

| Shaft | | Mounting flange code with maximum torque in Nm [lb•in] | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Code** | **Description** | **01** | **02** | **03** | **06** | **07** | **08** | **09** | **D7** |
| **AA** | Taper 1:5-M16x1,5-Key 5 | | | | 300 | | | | |
| **BA** | Taper 1:8-M14x1,5-Key 4 | 350 | 350 | | | | | | |
| **BB** | Taper 1:8-M16x1,5-Key 4,79 | | | 500 | | | | | |
| **BC** | Taper 1:8-5/8-18UNF-2A-Key 6,375 | | | | | 300 | | | |
| **BD** | Taper 1:8-M14x1,5-Key 4 + thd hole M8 - Special | | | | | 300 | | | |
| **BP** | Taper 1:8-5/8-18UNF-2A-Key 6,375 with NUT & WASHER (for SAE B flange) | | | | | 300 | | | |
| **CA** | Tang 8xØ22,2 - Special | | | | 90 | | | | |
| **DA** | DIN 5482 B22x19 L=24 (for flange 01) | 290 | 290 | | | | | | |
| **DD** | DIN 5482 B28x25 L28 (for flange 06) | | | | 450 | | | | |
| **FA** | Parallel Ø20-Key 5x5 L30 (for flange 01-02) | 210 | 210 | | | | | | |
| **FB** | Parallel Ø22-Key 5x5 L40 (for flange 03) | | | 300 | | | | | |
| **GA** | Parallel Ø22,225 x L25,4-Key 6,375x6,375 L25,4 | | | | | 230 | | | |
| **GB** | Parallel Ø22,225xL25,4-Key 6,375x6,375x25,4+thd hole:1/4- 20UNC-2B | | | | | 230 | | | |
| **GC** | Parallel Ø22,225xL25,4-Key 6,375x6,375x25,4+thd hole:5/16- 18UNC-2B - Special | | | | | 230 | | | |
| **SA** | SAE J498-13T-16/32-SAE B | | | | | 270 | | | 270 |
| **SB** | SAE J498-13T-16/32-SAE A (for flange 09) | | | | | | | 270 | |
| **RA** | SAE J498-14T-12/24-SAE C-4 bolt (for flange 08) | | | | | | 400 | | |
| **SH** | SAE J498-15T-16/32-SAE B - Special | | | | | 400 | | | |

Danfoss recommends mating splines conform to SAE J498 or DIN 5482. Danfoss external SAE splines have a flat root side fit with circular tooth thickness reduced by 0.127 mm [0.005 in] in respect to class 1 fit. Dimensions are modified to assure a clearance fit with the mating spline.

## Product Options

**Caution**

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

## Product Code

### Model code

#### A Family

| A | | | | | | | B | | | C | D | E | | F | | G | | H | | I | | J | | K | L | | M | | | N | O |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| • | • | • | • | • | • | / | | | | | | | | | | | | | | | | | | | | / | | | | | |

| | |
|---|---|
| **SNP2NN** | Std Group 2 Pump |
| **SNP2EN** | Std Group 2 Pump + External Drain RV |
| **SNP2IN** | Std Group 2 Pump + Internal Drain RV |
| **SNC2NN** | StdGroup 2 Pump Inlet & Outlet in the Cover |
| **SKP2NN** | HighTorque Group 2 Pump |
| **SKP2EN** | HighTorque Group 2 Pump + Ext.Drain RV |
| **SKP2IN** | HighTorque Group 2 Pump + Int.Drain RV |
| **SKC2NN** | HighTorque Group 2 Pump Inlet & Outlet on Cover |

#### B Displacement

| A | | | | B | | | C | D | | E | | F | | G | | H | | I | | | L | M | N | O | | | P | Q | R |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | • | • | • | | | | | | | | | | | | | | | | | | | | | | | |

| | |
|---|---|
| **4,0** | Displacement 3,9 cc |
| **6,0** | Displacement 6,0cc |
| **8,0** | Displacement 8,4 cc |
| **011** | Displacement 10,8 cc |
| **014** | Displacement 14,4 cc |
| **017** | Displacement 16,8 cc |
| **019** | Displacement 19,2 cc |
| **022** | Displacement 22,8 cc |
| **025** | Displacement 25,2 cc |

Other frame sizes and displacements are available upon request.

#### C Rotation

| A | | | | B | | | C | D | | E | | F | | G | | H | | I | | | L | M | N | O | | | P | Q | R |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | • | | | | | | | | | | | | | | | | | | | | | | |

| | |
|---|---|
| **R** | Right (Clockwise) |
| **L** | Left (Counterclockwise) |

#### D Project version

| A | | | | | | | B | | | C | D | E | | F | | G | | H | | I | | J | | K | L | | M | | | N | O |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | / | | | | | • | | | | | | | | | | | | | | | / | | | | | |

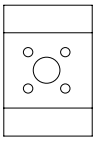
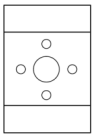
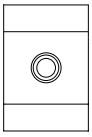
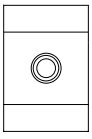
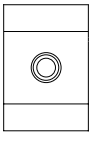
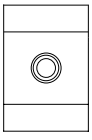
| | |
|---|---|
| **N** | Standard gear pump |

## Product Code

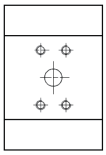
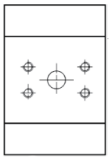
| | |
|---|---|
| **C1** | Cover pump front BSP ports : Inlet 3/4 Gas ; Outlet 1/2 Gas |
| **C6** | Cover pump front SAE Thred ports:In.1-1/16-12UN;Out.7/8-14UNF |
| **C7** | Cover pump front SAE Thred ports:In.3/4-16UNF-2B;Out.3/4-16UNF-2B |
| **D1** | Cover pump with Outlet port 1/2 Gas |
| **D6** | 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 |
| **P1** | Standard cover for pump |
| **P3** | Standard cover for pump with M5 Holes |

### H Inlet size; I Outlet size

| A | | | | | | | B | | | C | D | E | | F | | G | | H | | I | | J | | K | L | | M | | | N | O |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | / | | | | | | | | | | | | • | • | • | • | | | | | / | | | | | |

| | | |
|---|---|---|
| **B5** | 15x35xM6 |  |
| **B6** | 15x40xM6 | |
| **B7** | 20x40xM6 | |
| **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 | |

## Product Code

| | | |
|---|---|---|
| **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, 19xM19 (=) | |
| **NN** | Without outlet port | |

### J Ports positions & Special body

| A | | | | | | | B | | | C | D | E | | F | | G | | H | | I | | J | | K | L | | M | | | N | O |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | / | | | | | | | | | | | | | | | | ● | ● | | | / | | | | | | |

| | |
|---|---|
| **NN** | Std from catalogue |
| **YY** | PortBx-Bx with flange SAE-A;off-set to rear cover to install fitting screws |
| **ZZ** | Port Bx-Bx in the center of the body - Option |

### K Seals

| A | | | | | | | B | | | C | D | E | | F | | G | | H | | I | | J | | K | L | | M | | | N | O |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | / | | | | | | | | | | | | | | | | | | ● | | / | | | | | | |

| | |
|---|---|
| **N** | Standard NBR seals |
| **B** | VITON seals (Only for SNP2 pumps) |
| **D** | VITON shaft seal with dust lip |

### L Screws

| A | | | | | | | B | | | C | D | E | | F | | G | | H | | I | | J | | K | L | | M | | | N | O |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | / | | | | | | | | | | | | | | | | | | | ● | / | | | | | | |

| | |
|---|---|
| **N** | Std burnished screws |
| **A** | Zinc plated screws |
| **B** | Geomet screws |

### M Set valve

| A | | | | | | | B | | | C | D | E | | F | | G | | H | | I | | J | | K | L | | M | | | N | O |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | / | | | | | | | | | | | | | | | | | | | | / | ● | ● | ● | | | |

| | |
|---|---|
| **NNN** | No valve |
| **V*** | Integral relief valve pressure setting |

* For details see *Variant codes for ordering integral relief valves* on page 30

## System Requirements

### Pressure

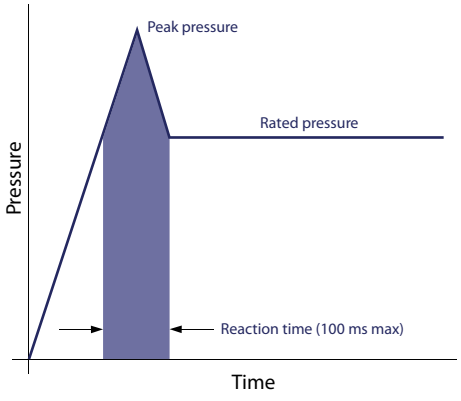
The inlet vacuum must be controlled in order to realize expected pump life and performance. The system design must meet inlet pressure requirements during all modes of operation. Expect lower inlet pressures during cold start. It should improve quickly as the fluid warms.

| | | |
|---|---|---|
| **Max. continuous vacuum** | bar abs. [in. Hg] | 0.8 [23.6] |
| **Max. intermittent vacuum** | | 0.6 [17.7] |
| **Max. pressure** | | 4.0 [118.1] |

#### Peak pressure

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 following illustration shows peak pressure in relation to rated pressure and reaction time (100 ms maximum).

*Time versus pressure*




#### Rated pressure

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

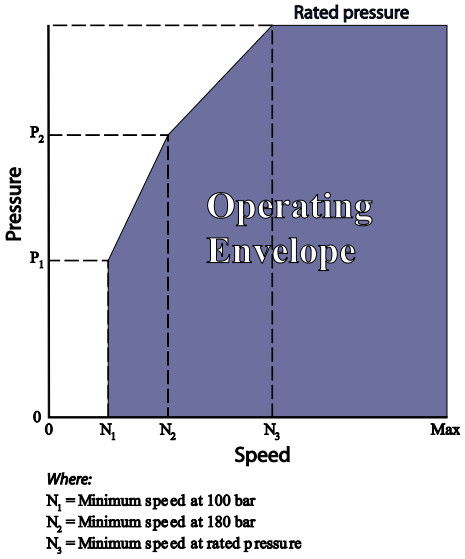
System pressure is the differential of pressure between the outlet and inlet ports. It is a dominant operating variable affecting hydraulic unit life. High system pressure, resulting from high load, reduces expected life. System pressure must remain at, or below, rated pressure during normal operation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

### Speed

Maximum speed is the limit recommended by Danfoss for a particular gear pump when operating at rated pressure. It is the highest speed at which normal life can be expected. The lower limit of operating speed is the minimum speed. It is the lowest speed at which normal life can be expected. The minimum speed increases as operating pressure increases. When operating under higher pressures, a higher minimum speed must be maintained, as illustrated to the right.

## System Requirements

*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 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 (HVLP) specifications
- API CD engine oils conforming to SAE J183
- M2C33F or G automatic transmission fluids
- Certain agricultural tractor fluids

Use only clean fluid in the pump and hydraulic circuit.

**Caution**

Never mix hydraulic fluids.

### 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

## System Requirements

*Fluid viscosity*

| | | |
|---|---|---|
| **Maximum (cold start)** | mm2/s [SUS] | 1600 [7273] |
| **Recommended range** | | 12-100 [66-456] |
| **Minimum** | | 10 [60] |

*Temperature (with standard NBR seals)*

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

## Filtration

### Filters

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

### Selecting a filter

When selecting a filter, please consider:

- Contaminant ingression rate (determined by factors such as the number of actuators used in the system)
- Generation of contaminants in the system
- Required fluid cleanliness
- Desired maintenance interval
- Filtration requirements of other system components

Measure filter efficiency with a Beta ratio ($\beta_x$). For:

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

βx 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 βx ratio*

| | |
|---|---|
| **Fluid cleanliness level (per ISO 4406)** | Class 22/18/13 or better |
| **$\beta_x$ ratio (suction filtration)** | $\beta_{35\text{-}45} = 75$ and $b_{10} = 2$ |
| **$\beta_x$ ratio (pressure or return filtration)** | $\beta_{10} = 75$ |
| **Recommended inlet screen size** | 100-125 mm [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 deaeration of the fluid as it passes through, and accommodates a fluid dwell-time between 60 and 180 seconds, allowing entrained air to escape.

## System Requirements

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

Install the suction line above the bottom of the reservoir to take advantage of gravity separation and prevent large foreign particles from entering the line. Cover the line with a 100-125 micron screen. The pump should be below the lowest expected fluid level. Put the return-line below the lowest expected fluid level to allow discharge into the reservoir for maximum dwell and efficient deaeration. A baffle (or baffles) between the return and suction lines promotes deaeration and reduces fluid surges.

### Line sizing

Choose pipe sizes that accommodate minimum fluid velocity to reduce system noise, pressure drops, and overheating. This maximizes system life and performance.

Design inlet piping that maintains continuous pump inlet pressure above 0.8 bar absolute during normal operation. The line velocity should not exceed the values in this table:

*Maximum line velocity*

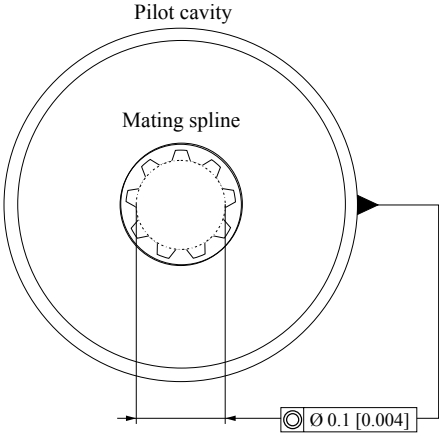
| | | |
|---|---|---|
| **Inlet** | m/s [ft/sec] | 2.5 [8.2] |
| **Outlet** | | 5.0 [16.4] |
| **Return** | | 3.0 [9.8] |

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

### Pump drive

Shaft options for Group 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.

## System Requirements

**Caution**

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

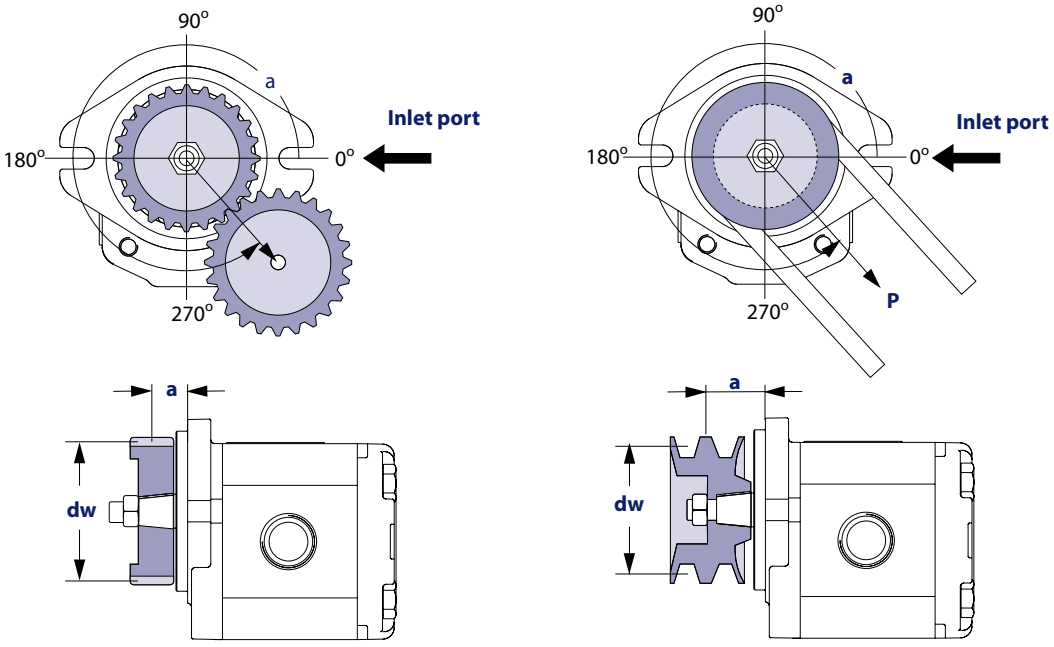
Allowable radial shaft loads are a function of the load position, load orientation, and operating pressure of the hydraulic pump. All external shaft loads have an effect on bearing life, and may affect pump performance.

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 Danfoss if continuously applied external radial or thrust loads occur.

Photocopy this page and fax the complete form to your Danfoss representative for an assistance in applying pumps with belt or gear drive.

### Pump drive data form

*Optimal radial load position*




*Application data*

| Item | | Value | Unit |
|---|---|---|---|
| Pump displacement | | | cm3/rev [in3/rev] |
| Rated system pressure | | | ☐bar ☐psi |
| Relief valve setting | | | |
| Pump shaft rotation | | | ☐left ☐right |
| Pump minimum speed | | | min-1 (rpm) |
| Pump maximum speed | | | |
| Drive gear helix angle (gear drive only) | | | degree |
| Belt type (gear drive only) | | | ☐V ☐notch |
| Belt tension (gear drive only) | P | | ☐N ☐lbf |

## System Requirements

*Application data (continued)*

| Item | | Value | Unit |
|---|---|---|---|
| Angular orientation of gear or belt to inlet port | **a** | | degree |
| Pitch diameter of gear or pulley | $\mathbf{d_w}$ | | ☒mm ☒in |
| Distance from flange to center of gear or pulley | **a** | | |

### Pump life

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

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

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

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

### Sound levels

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 Danfoss representative for assistance with system noise control.

## General Information

### Technical data

| | | Frame size | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1,2 | 1,7 | 2,2 | 2,6 | 3,2 | 3,8 | 4,3 | 6,0 | 7,8 | 010 | 012 |
| **Displacement** | $cm^3/rev$ [$in^3/rev$] | 1.18 [0.072] | 1.57 [0.096] | 2.09 [0.128] | 2.62 [0.160] | 3.14 [0.192] | 3.66 [0.223] | 4.19 [0.256] | 5.89 [0.359] | 7.59 [0.463] | 9.94 [0.607] | 12.00 [0.732] |
| **SNP1NN** | | | | | | | | | | | | |
| **Peak pressure** | bar [psi] | 270 [3915] | 270 [3915] | 270 [3915] | 270 [3915] | 270 [3915] | 270 [3915] | 270 [3915] | 210 [3045] | 170 [2465] | – | – |
| **Rated pressure** | | 250 [3625] | 250 [3625] | 250 [3625] | 250 [3625] | 250 [3625] | 250 [3625] | 250 [3625] | 190 [2760] | 150 [2175] | | |
| **Minimum speed at 0-150 bar** | $min^{-1}$ (rpm) | 800 | 800 | 600 | 600 | 600 | 600 | 500 | 500 | 500 | | |
| **Min. speed at 150 bar to rated pressure** | | 1200 | 1200 | 1000 | 1000 | 1000 | 1000 | 800 | 800 | 800 | | |
| **Maximum speed** | | 4000 | 4000 | 4000 | 4000 | 4000 | 4000 | 3000 | 3000 | 3000 | | |
| **SKP1NN*** | | | | | | | | | | | | |
| **Peak pressure** | bar [psi] | 270 [3915] | 270 [3915] | 270 [3915] | 270 [3915] | 270 [3915] | 270 [3915] | 270 [3915] | 250 [3625] | 220 [3190] | 170 [2465] | 140 [2030] |
| **Rated pressure** | | 250 [3625] | 250 [3625] | 250 [3625] | 250 [3625] | 250 [3625] | 250 [3625] | 250 [3625] | 230 [3335] | 200 [2900] | 150 [2175] | 120 [1740] |
| **Minimum speed at 0-150 bar** | $min^{-1}$ (rpm) | 800 | 800 | 800 | 800 | 800 | 800 | 600 | 600 | 600 | 600 | 600 |
| **Min. speed at 150 bar to rated pressure** | | 1200 | 1200 | 1000 | 1000 | 1000 | 1000 | 1000 | 800 | 800 | 800 | – |
| **Maximum speed** | | 4000 | 4000 | 4000 | 4000 | 4000 | 4000 | 3000 | 3000 | 3000 | 2000 | 2000 |
| **All (SNP1NN, SKP1NN)** | | | | | | | | | | | | |
| **Weight** | kg [lb] | 1.02 [2.26] | 1.05 [2.31] | 1.09 [2.40] | 1.11 [2.45] | 1.14 [2.51] | 1.18 [2.60] | 1.20 [2.65] | 1.30 [2.87] | 1.39 [3.06] | 1.55 [3.42] | 1.65 [3.64] |
| **Moment of inertia of rotating components** | x $10^{-6}$ $kg•m^2$ [x $10^{-6}$ $lb•ft^2$] | 3.2 [77] | 3.7 [89] | 4.4 [105] | 5.1 [120] | 5.7 [136] | 6.4 [152] | 7.1 [168] | 9.3 [220] | 11.4 [271] | 14.6 [347] | 17.1 [407] |
| **Theoretical flow at maximum speed** | l/min [US gal/min] | 4.72 [1.25] | 6.28 [1.66] | 8.36 [2.21] | 10.48 [2.77] | 12.56 [3.32] | 14.64 [3.87] | 12.57 [3.32] | 17.67 [4.67] | 22.77 [6.02] | 19.88 [5.25] | 24 [6.34] |

* SKP1NN is a special version of the SNP1NN. It is designed to accommodate an SAE 9T 20/40 DP tooth splined shaft for higher torque applications.

1 $kg•m^2$ = 23.68 $lb•ft^2$

## General Information

**Caution**

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

## Product Code

### Model code

#### A Family

| A | | | | | | | B | | | C | D | E | | F | | G | | H | | I | | J | | K | L | | M | | | N | O |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| • | • | • | • | • | • | / | | | | | | | | | | | | | | | | | | | | / | | | | | |

| | |
|---|---|
| **SNB1NN** | Gear pump with inlet port on cover and outlet port on flange |
| **SNP1NN** | Standard gear pump |
| **SNC1NN** | Gear pump with inlet and outlet ports on rear cover |
| **SNP1IN** | Gear pump with internal drain relief valve |
| **SKP1NN** | High torque gear pump |
| **SKP1IN** | High torque gear pump with internal drain relief valve |

#### B Displacement

| A | | | | | | | B | | | C | D | E | | F | | G | | H | | I | | J | | K | L | | M | | | N | O |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | / | • | • | • | | | | | | | | | | | | | | | | | / | | | | | |

| | |
|---|---|
| **1,2** | 1,18 cc |
| **1,7** | 1,57 cc |
| **2,2** | 2,09 cc |
| **2,6** | 2,62 cc |
| **3,2** | 3,14 cc |
| **3,8** | 3,66 cc |
| **4,3** | 4,19 cc |
| **6,0** | 5,89 cc |
| **7,8** | 7,59 cc |
| **010** | 9,94 cc |
| **012** | 12,00 cc |

#### C Rotation

| A | | | | | | | B | | | C | D | E | | F | | G | | H | | I | | J | | K | L | | M | | | N | O |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | / | | | | • | | | | | | | | | | | | | | | | / | | | | | |

| | |
|---|---|
| **L** | Left rotation |
| **R** | Right rotation |

#### D Project version

| A | | | | | | | B | | | C | D | E | | F | | G | | H | | I | | J | | K | L | | M | | | N | O |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | / | | | | | • | | | | | | | | | | | | | | | / | | | | | |

| | |
|---|---|
| **N** | Standard gear pump |

## Product Code

### E Mounting flange

| A | | | | | | | B | | | C | D | E | | F | | G | | H | | I | | J | | K | L | | M | | | N | O |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | / | | | | | | • | • | | | | | | | | | | | | | / | | | | | |

| Code | Description (Type of flange • Type of drive gear • Preferred ports for configuration) |
|---|---|
| **01** | pilot Ø25,4+4 holes |
| **02** | pilot Ø30+4 holes |
| **03** | pilot Ø32+O-ring+2 holes through body |
| **04** | pilot Ø32+2 holes through body |
| **06** | SAE A-A pilot Ø50,8+ 2 holes |

### F Drive gear

| A | | | | | | | B | | | C | D | E | | F | | G | | H | | I | | J | | K | L | | M | | | N | O |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | / | | | | | | | | • | • | | | | | | | | | | | / | | | | | |

| | |
|---|---|
| **AA** | Taper 1:5-M6-Key 2 |
| **BA** | Taper 1:8-M7-Key 2,41 |
| **BB** | Taper 1:8-M10x1-Key 3 |
| **CA** | Tang 5x Ø10 |
| **CE** | Tang 6,63x Ø11 - for SKP1xN |
| **CM** | Tang 5x Ø10-type 03 + w/o coupling |
| **DA** | SplinedZ15-m0,75-alfa 30°-L14 - for SNP1xx |
| **DB** | SplinedZ15-m0,75-alfa 30°-L14 - for SKP1xx |
| **FA** | Parallel Ø12-Thread M10x1-Key 3 |
| **GA** | Parallel Ø12,7-Key 3.2 |
| **SA** | SAE spline J498-9T-20/40 |

### G Rear cover

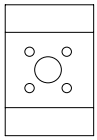
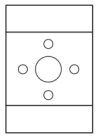
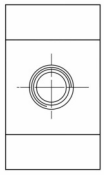
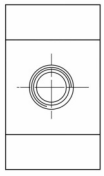
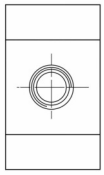
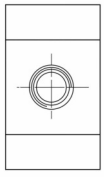
| A | | | | | | | B | | | C | D | E | | F | | G | | H | | I | | J | | K | L | | M | | | N | O |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | / | | | | | | | | | | • | • | | | | | | | | | / | | | | | |

| | |
|---|---|
| **03** | Cover 03 (used with flange 03-04) |
| **08** | Cover 08 with Inlet port 3/8" Gas |
| **C1** | Cover pump with front GAS Thread Inlet 3/8 ; Outlet 3/8 |
| **I1** | Cover pump with relief valve |
| **I3** | Cover 03 with relief valve (used with flange 03) |
| **P1** | Std Cover pump |

### H Inlet size; I Outlet size

| A | | | | | | | B | | | C | D | E | | F | | G | | H | | I | | J | | K | L | | M | | | N | O |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | / | | | | | | | | | | | | • | • | • | • | | | | | / | | | | | |

## Product Code

| | | |
|---|---|---|
| **NN** | Without inlet | |
| **B1** | 8x30xM6 |  |
| **B2** | 13x30xM6 | |
| **C1** | 8x26xM5 |  |
| **C2** | 12x26xM5 | |
| **C3** | 13, 5x30xM6 | |
| **D3** | M14x1,5 |  |
| **D5** | M18x1,5 | |
| **D7** | M22x1,5 | |
| **E3** | 9/16-18UNF |  |
| **E4** | ¾-16UNF | |
| **E5** | 7/8-14UNF | |
| **F2** | ¼ GAS |  |
| **F3** | 3/8 GAS | |
| **F4** | ½ GAS | |
| **H2** | 10xM12x1,5-ISO6149 |  |
| **H4** | 12xM16x1,5-ISO6149 | |
| **H5** | 12xM18x 1, 5-ISO6149 | |
| **H7** | 13, 5xM22x 1, 5-ISO6149 | |

### J Ports positions & Special body

| A | | | | | | | B | | | C | D | E | | F | | G | | H | | I | | J | | K | L | | M | | | N | O |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | / | | | | | | | | | | | | | | | | • | • | | | / | | | | | | |

| | |
|---|---|
| **NN** | Std from catalogue |

### K Seals

| A | | | | | | | B | | | C | D | E | | F | | G | | H | | I | | J | | K | L | | M | | | N | O |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | / | | | | | | | | | | | | | | | | | | • | | / | | | | | | |

| | |
|---|---|
| **N** | Standard NBR seal |
| **A** | Without shaft seal |
| **B** | With VITON seals |

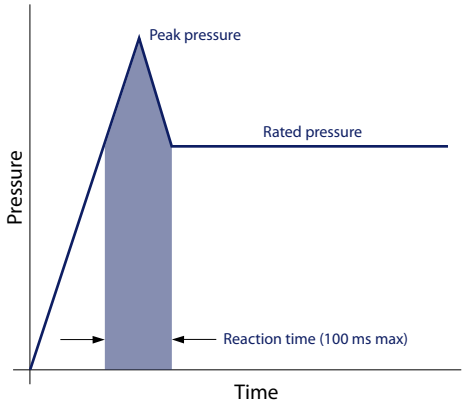
## System Requirements

### 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.

| | | |
|---|---|---|
| **Max. continuous vacuum** | bar abs. [in. Hg] | 0.8 [23.6] |
| **Max. intermittent vacuum** | | 0.6 [17.7] |
| **Max. pressure** | | 4.0 [118.1] |

**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 accompanying illustration 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.

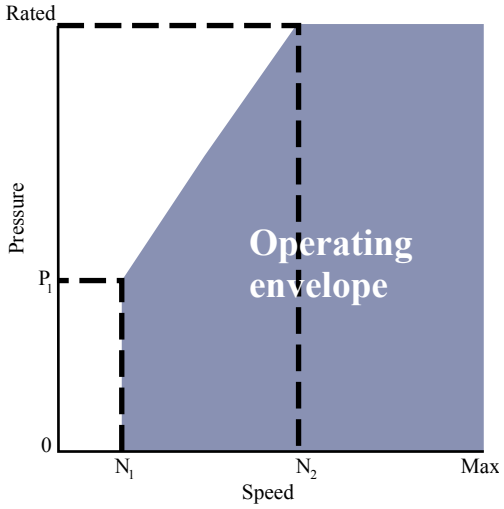
### Speed

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

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

## System Requirements

*Speed versus pressure*




Where:

$N_1$ = Minimum speed at 100 bar

$N_2$ = Minimum speed at 180 bar

### Hydraulic fluids

Ratings and data for SNP1NN, and SKP1NN gear pumps are based on operating with premium hydraulic fluids containing oxidation, rust, and foam inhibitors. These fluids must possess good thermal and hydrolytic stability to prevent wear, erosion, and corrosion of internal components. They include:

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

Use only clean fluid in the pump and hydraulic circuit.

**Caution**

Never mix hydraulic fluids.

### 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.

## System Requirements

*Fluid viscosity*

| | | |
|---|---|---|
| **Maximum (cold start)** | $mm^2/s$ [SUS] | 1000 [1600] |
| **Recommended range** | | 12-60 [66-290] |
| **Minimum** | | 10 [60] |

*Temperature (with standard NBR seals)*

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

## Filtration

### Filters

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

### Selecting a filter

When selecting a filter, please consider:

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

Measure filter efficiency with a Beta ratio ($\beta_X$). For:

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

$\beta_x$ 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 $\beta_x$ ratio*

| | |
|---|---|
| **Fluid cleanliness level (per ISO 4406)** | Class 22/18/13 or better |
| **$\beta_x$ ratio (suction filtration)** | $\beta_{35-45} = 75$ and $\beta_{10} = 2$ |
| **$\beta_x$ 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 deaeration of the fluid as it passes through, and accommodates a fluid dwell-time between 60 and 180 seconds, allowing entrained air to escape.

## System Requirements

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

Install the suction line above the bottom of the reservoir to take advantage of gravity separation and prevent large foreign particles from entering the line. Cover the line with a 100-125 micron screen. The pump should be below the lowest expected fluid level. Put the return-line below the lowest expected fluid level to allow discharge into the reservoir for maximum dwell and efficient deaeration. A baffle (or baffles) between the return and suction lines promotes deaeration and reduces fluid surges.

### Line sizing

Choose pipe sizes that accommodate minimum fluid velocity to reduce system noise, pressure drops, and overheating. This maximizes system life and performance.

Design inlet piping that maintains continuous pump inlet pressure above 0.8 bar absolute during normal operation. The line velocity should not exceed the values in this table:

*Maximum line velocity*

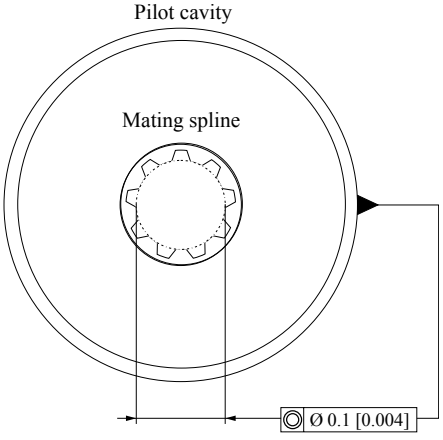
| | | |
|---|---|---|
| **Inlet** | m/s [ft/sec] | 2.5 [8.2] |
| **Outlet** | | 5.0 [16.4] |
| **Return** | | 3.0 [9.8] |

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

### Pump drive

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

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




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

## System Requirements

**Caution**

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

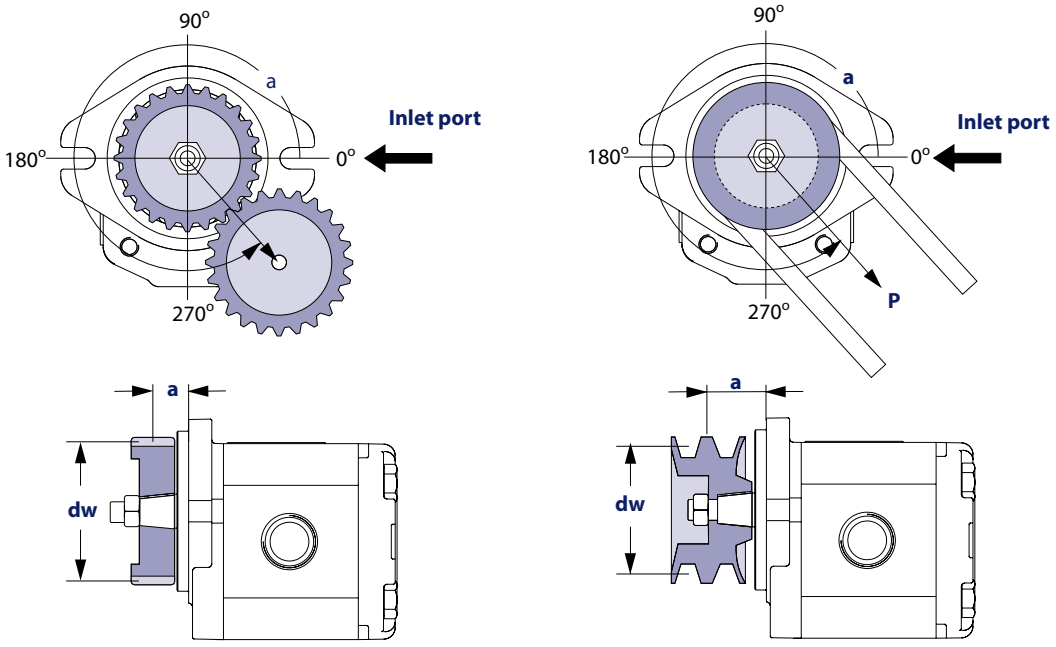
Allowable **radial shaft loads** are a function of the load position, load orientation, and operating pressure of the hydraulic pump. All external shaft loads have an effect on bearing life, and may affect pump performance.

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.

## Pump drive data form

Contact Danfoss if continuously applied external radial or thrust loads occur. Fill out this page and send the complete form to your Danfoss representative for an assistance in applying pumps with belt or gear drive. This illustration shows a pump with counterclockwise orientation:

*Optimal radial load position*




*Application data*

| Item | | Value | Unit |
|---|---|---|---|
| Pump displacement | | | $cm^3$/rev [$in^3$/rev] |
| Rated system pressure | | | bar psi |
| Relief valve setting | | | |
| Pump shaft rotation | | | left right |
| Pump minimum speed | | | $min^{-1}$ (rpm) |
| Pump maximum speed | | | |
| Drive gear helix angle (gear drive only) | | | degree |
| Belt type (gear drive only) | | | V notch |
| Belt tension (gear drive only) | **P** | | N lbf |

## System Requirements

*Application data (continued)*

| Item | | Value | Unit |
|---|---|---|---|
| Angular orientation of gear or belt to inlet port | **α** | | degree |
| Pitch diameter of gear or pulley | **dw** | | mm in |
| Distance from flange to center of gear or pulley | **a** | | |

### Pump Life

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

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

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

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

### Sound levels

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

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

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

The way circuit components respond to excitation depends on their size, form, and mounting. Because of this, a system line may actually have a greater noise level than the pump. To minimize noise, use:

- flexible hoses (if you must use steel plumbing, clamp the lines).
- flexible (rubber) mounts to minimize other structure borne noise.

## Product Options

| Shaft | | Mounting flange code with maximum torque in Nm [lb•in] | | | | |
|---|---|---|---|---|---|---|
| Code | Description | 01 | 02 | 03 | 04 | 06 |
| AA | Taper 1:5-M6 | | | | 25 [221] | |
| BA | Taper 1:8-M7 | 25 [221] | | | | |
| BB | Taper 1:8-M10 | | 50 [442] | | | |
| CA | Tang 5x Ø10 | | | 14 [124] | | |
| CE | Tang 6,63x Ø11 | | | | | 21 [186] |
| CM | Tang 5x Ø10-type 03 + w/o coupling | | | 14 [124] | | |
| DA | Splined Z15-m0,75-alfa 30°-L14 | 35 [309] | | | | |
| DB | Splined Z15-m0,75-alfa 30°-L14 | | 35 [309] | | | |
| FA | Parallel Ø12-Thread M10x1 | | 24 [212] | | | |
| GA | Parallel Ø12,7-Key 3.2 | | | | | 32 [283] |
| SA | SAE spline J498-9T-20/40 | | | | | 34 [301] |

Danfoss recommends mating splines conform to SAE J498 or DIN 5482.

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

**Caution**

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

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

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

For a table of dimensions, see *Ports* on page 33.

### Inlet/Outlet port configurations

| A | | | | | | | B | | | C | D | E | | F | | G | | H | | I | | J | | K | L | | M | | | N | O |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | / | | | | | | | | | | | | • | • | • | • | | | | | / | | | | | |

| | | |
|---|---|---|
| B1 | 8x30xM6 | Flanged port with threaded holes in **X** pattern, in center of body |
| B2 | 13x30xM6 | |
| C1 | 8x26xM5 | Flanged port with threaded holes in **+** pattern (European standard ports) |
| C2 | 12x26xM5 | |
| C3 | 13,5x30xM6 | |
| D3 | M14x1,5 | Threaded metric port |
| D5 | M18x1,5 | |
| D7 | M22x1,5 | |