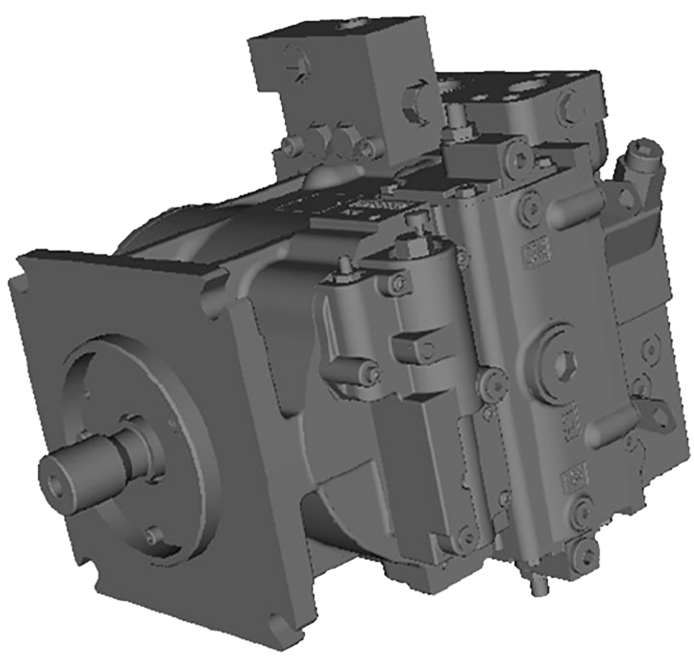
ENGINEERING TOMORROW

Technical Information

Concrete Pumps
Series 90



Revision history

Table of revisions

Date	Changed	Rev
January 2023	minor edits - modify incorrect reference and Changed document number from 'BC00000360' to 'BC187186484863'	0203
February 2016	minor edits - new installation drawings	0202
June 2014	Converted to Danfoss layout – DITA CMS	BA
February 2014	First Edition	AA

Contents

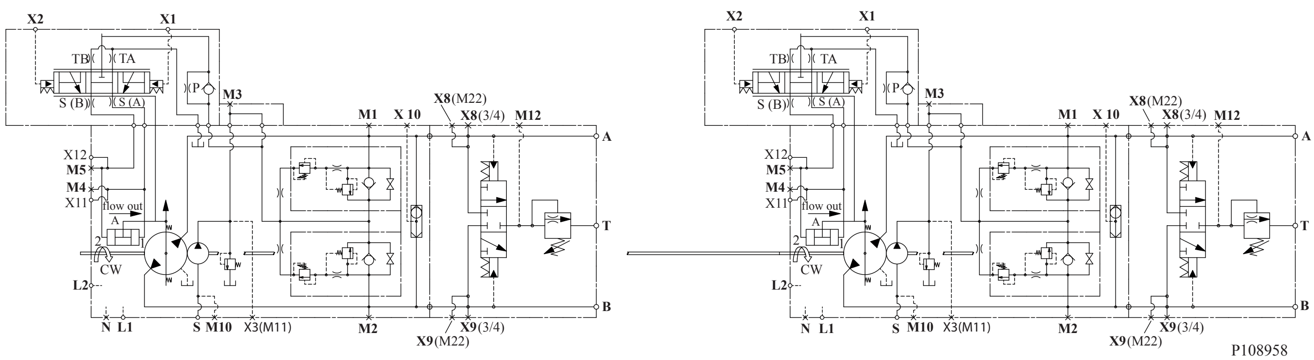
General Description

Series 90 Concrete Pumps

The S90 concrete pumps are designed for 2 cylinder concrete pump applications. This Technical Infomation only describes concrete pump specific information - General information about Series 90 pumps can be found in *Series 90 Axial Piston Pumps Technical Information* **BC152886483413**.

The concrete pump system can be built up as Series 90 single or tandem pumps. Each pump can be equipped with a loop flushing valve (LFV).

System Schematic



Technical specifications

General Specifications

Design	Axial piston pump of cradle swashplate design with variable displacement
Direction of rotation	Clockwise, counterclockwise
Pipe connections	Main pressure ports: ISO split flange boss
	Remaining ports: SAE straight thread O-ring boss
Recommended installation position	Pump installation position is discretionary, however the recommended control position is on the top or at the side, with the top position preferred. Vertical input shaft installation is acceptable. If input shaft is at the top 1 bar case pressure must be maintained during operation. The pump housing must be filled with hydraulic fluid under all conditions; including after a long period of shutdown. Before operating the machine, ensure the pump housing and case drain lines are free of air. Recommended mounting for a multiple pump stack is to arrange the highest power flow towards the input source. Consult Danfoss for nonconformance to these guidelines.
Auxiliary cavity pressure	Will be inlet pressure with internal charge pump. For reference see Operating Parameters. Will be case pressure with external charge supply. Please verify mating pump shaft seal capability.

Features and Options

Feature	Unit	Frame	
		130	180
Displacement	cm^3/rev. [in^3]/rev.	130 [7.93]	180 [10.98]
Flow at rated speed (theoretical)	l/min. [US gal/min.]	403 [106]	468 [124]
Torque at maximum displacement (theoretical)	N•m/bar [lbf•in/1000 psi]	2.07 [1260]	2.87 [1750]
Mass moment of inertia of rotating components	kg•m^2 [slug•ft^2]	0.023 [0.0170]	0.0380 [0.0280]
Weight (with control opt. MA)	kg [lb]	88 [195]	136 [300]
Mounting (per ISO 3019-1)		Flange 152-4 (SAE D)	Flange 165-4 (SAE E)
Rotation			
Main ports: 4-bolt split-flange (per SAE J518 code 62)	mm [in]	31.75 [1.25]	31.75 [1.25]
Main port configuration		Twin port	
Case drain ports (SAE O-ring boss)	UNF thread (in.)	1.3125–12	1.625–12
Other ports		SAE O-ring boss	
Shafts		Splined, and tapered shafts available	
Auxiliary mounting		SAE-A, B, C, D	SAE-A, B, C, D, E

Technical specifications

Operating Parameters

Parameter	Unit	Frame	
		130	180
Input speed			
Minimum	min^{-1}(rpm)	500	500
Rated Speed		3100	2600
Maximum		3400	2850

Operating parameters

System pressure	Maximum working pressure	bar	[psi]	450	[6525]
	Maximum pressure			480	[6960]
	Maximum low loop			45	[650]
	Minimum low loop pressure			10	[145]
Charge pressure	Minimum	bar	[psi]	18	[261]
	Maximum			34	[493]
Control pressure	Minimum (at corner power for HDC)	bar	[psi]	14	[203]
	Maximum			40	[580]
Charge pump inlet pressure	Rated	bar (absolute)	[in Hg vacuum]	0.7	[9]
	Minimum (cold start)			0.2	[24]
	Maximum	bar	[psi]	4.0	[58]
Case pressure	Rated	bar	[psi]	3.0	[44]
	Maximum			12	[174]
Lip seal external pressure	Maximum	bar	[psi]	0.4	[5.8]

Fluid Specifications

Feature		Unit			
Viscosity	Intermittent 1)	mm^2/s	[SUS]	5	[42]
	Minimum			7	[49]
	Recommended range			12-80	[66-370]
	Maximum			1600	[7500]
Temperature range 2)	Minimum (cold start) 3)	°C	[°F]	-40	[-40]
	Recommended range			60-85	[140-185]
	Rated			104	[220]
	Maximum intermittent 1)			115	[240]
Filtration (recommended minimum)	Cleanliness per ISO 4406-1999			22/18/13	
	Efficiency (charge pressure filtration)	β-ratio		$\beta_{15\text{-}20} = 75$ ($\beta_{10} \geq 10$)	
	Efficiency (suction and return line filtration)			$\beta_{35\text{-}45} = 75$ ($\beta_{10} \geq 2$)	
	Recommended inlet screen mesh size	µm		100 – 125	
1) Intermittent = Short term t < 1min per incident and not exceeding 2 % of duty cycle based load-life 2) At the hottest point, normally case drain port 3) Cold start = Short term t < 3min, p ≤ 50 bar [725 psi], n ≤ 1000 min-1(rpm)					T000 129E

Operating Parameters

Overview

This section defines the operating parameters and limitations for Series 90 pumps with regard to input speeds and pressures. For actual parameters, refer to the operating parameters for each displacement.

Input Speed

Minimum speed is the lowest input speed recommended during engine idle condition. Operating below minimum speed limits the pump's ability to maintain adequate flow for lubrication and power transmission.

Rated speed is the highest input speed recommended at full power condition. Operating at or below this speed should yield satisfactory product life.

Maximum speed is the highest operating speed permitted. Exceeding maximum speed reduces product life and can cause loss of hydrostatic power and braking capacity. Never exceed the maximum speed limit under any operating conditions.

Operating conditions between Rated speed and Maximum speed should be restricted to less than full power and to limited periods of time.

For more information consult *Pressure and Speed Limits*, BC152886484313, when determining speed limits for a particular application.

System Pressure

System pressure is the differential pressure between high pressure system ports. It is the dominant operating variable affecting hydraulic unit life. High system pressure, which results from high load, reduces expected life. Hydraulic unit life depends on the speed and normal operating, or weighted average, pressure that can only be determined from a duty cycle analysis.

Application pressure is the high pressure relief or pressure limiter setting normally defined within the order code of the pump. This is the applied system pressure at which the drive-line generates the maximum calculated pull or torque in the application.

Maximum working pressure is the highest recommended Application pressure. Maximum working pressure is not intended to be a continuous pressure. Propel systems with application pressures at, or below, this pressure should yield satisfactory unit life given proper component sizing.

Maximum pressure is the highest allowable Application pressure under any circumstance. Application pressures above maximum working Pressure will only be considered with duty cycle analysis and factory approval.

Pressure spikes are normal and must be considered when reviewing maximum working pressure.

Minimum low loop pressure must be maintained under all operating conditions to avoid cavitation.

All pressure limits are differential pressures referenced to low loop (charge) pressure. Subtract low loop pressure from gauge readings to compute the differential.

Servo Pressure

Servo pressure is the pressure in the Servo-system needed to position and hold the pump on stroke. It depends on system pressure and speed.

At **minimum** servo pressure the pump will run at reduced stroke depending on speed and pressure.

Minimum servo pressure at corner power holds the pump on full stroke at max speed and max pressure.

Maximum servo pressure is the highest pressure typically given by the charge pressure setting.

Operating Parameters

Charge Pressure

An internal charge relief valve regulates charge pressure. Charge pressure supplies the control with pressure to operate the swashplate and to maintain a minimum pressure in the low side of the transmission loop. The charge pressure setting listed in the order code is the set pressure of the charge relief valve with the pump in neutral, operating at 1800 min^{-1} [rpm], and with a fluid viscosity of 32 mm^2/s [150 SUS]. Pumps configured with no charge pump (external charge supply) are set with a charge flow of 30 l/min. [7.93 US gal/min.] and a fluid viscosity of 32 mm2/s [150 SUS].

The charge pressure setting is referenced to case pressure. Charge pressure is the differential pressure above case pressure.

Minimum charge pressure is the lowest pressure allowed to maintain a safe working condition in the low side of the loop. Minimum control pressure requirements are a function of speed, pressure, and swashplate angle, and may be higher than the minimum

charge pressure shown in the Operating parameters tables.

Maximum charge pressure is the highest charge pressure allowed by the charge relief adjustment, and which provides normal component life. Elevated charge pressure can be used as a secondary means to reduce the swashplate response time.

At normal operating temperature charge inlet pressure must not fall below **rated charge inlet pressure (vacuum)**.

Minimum charge inlet pressure is only allowed at cold start conditions. In some applications it is recommended to warm up the fluid (e.g. in the tank) before starting the engine and then run the engine at limited speed.

Maximum charge pump inlet pressure may be applied continuously.

Case Pressure

Under normal operating conditions, the **rated case pressure** must not be exceeded. During cold start case pressure must be kept below maximum intermittent case pressure. Size drain plumbing accordingly.

Auxiliary Pad Mounted Pumps. The auxiliary pad cavity of S90 pumps configured without integral charge pumps is referenced to case pressure. Units with integral charge pumps have auxiliary mounting pad cavities referenced to charge inlet (vacuum).

Caution

Possible component damage or leakage

Operation with case pressure in excess of stated limits may damage seals, gaskets, and/or housings, causing external leakage. Performance may also be affected since charge and system pressure are additive to case pressure.

External Shaft Seal Pressure

In certain applications the input shaft seal may be exposed to external pressure. In order to prevent damage to the shaft seal the maximum differential pressure from external sources must not exceed 0.4 bar (5.8 psi) over pump case pressure.

The case pressure limits of the pump must also be followed to ensure the shaft seal is not damaged.

Caution

Regardless of the differential pressure across the shaft seal, the shaft seal has been known to pump oil from the external source (e. g. gear box) into the pump case.

Operating Parameters

Temperature and Viscosity

Temperature

The high temperature limits apply at the hottest point in the transmission, which is normally the motor case drain. The system should generally be run at or below the quoted **rated temperature**.

The **maximum intermittent temperature** is based on material properties and should never be exceeded.

Cold oil will generally not affect the durability of the transmission components, but it may affect the ability of oil to flow and transmit power; therefore temperatures should remain 16 °C [30 °F] above the pour point of the hydraulic fluid.

The **minimum temperature** relates to the physical properties of component materials.

Size heat exchangers to keep the fluid within these limits. Danfoss recommends testing to verify that these temperature limits are not exceeded.

Viscosity

For maximum efficiency and bearing life, ensure the fluid viscosity remains in the **recommended range**.

The **minimum viscosity** should be encountered only during brief occasions of maximum ambient temperature and severe duty cycle operation.

The **maximum viscosity** should be encountered only at cold start.

System Design Parameters

Filtration System

To prevent premature wear, ensure only clean fluid enters the hydrostatic transmission circuit. A filter capable of controlling the fluid cleanliness to ISO 4406 class 22/18/13 (SAE J1165) or better, under normal operating conditions, is recommended.

These cleanliness levels can not be applied for hydraulic fluid residing in the component housing/case or any other cavity after transport.

Filter efficiency can be measured with a Beta ratio (β_X). For suction filtration, a filter with a β-ratio within the range of $\beta_{35\text{-}45} = 75$ ($\beta_{10} \geq 2$) or better has been found to be satisfactory.

Filter βx-ratio is a measure of filter efficiency defined by ISO 4572. It is defined as the ratio of the number of particles greater than a given diameter ("x" in microns) upstream of the filter to the number of these particles downstream of the filter.

Because each system is unique, only a thorough testing and evaluation program can fully validate the filtration system. Please see *Design Guidelines for Hydraulic Fluid Cleanliness Technical Information*, **BC152886482150** for more information.

Filtration Options

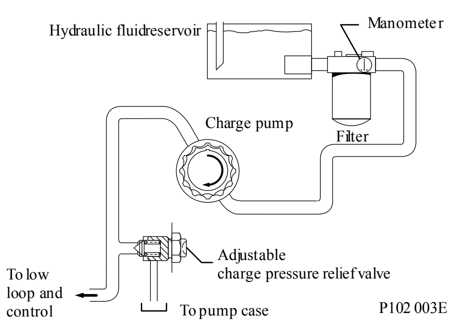
Suction filtration – Option S

Suction filtration is the only option available for concrete pumps.

The suction filter is placed in the circuit between the reservoir and the inlet to the charge pump, as shown below.

The use of a filter contamination monitor is recommended.

Suction filtration



Caution

Clogged filters can cause cavitation, which damages the charge pump. We recommend a filter bypass with a filter bypass sensor to prevent damage due to blocked suction filters.

Fluid Selection

Ratings and performance data are based on operating with hydraulic fluids containing oxidation, rust and foam inhibitors. These fluids must possess good thermal and hydrolytic stability to prevent wear, erosion, and corrosion of pump components.

Never mix hydraulic fluids of different types.

System Design Parameters

Reservoir

The hydrostatic system reservoir should accommodate maximum volume changes during all system operating modes and promote de-aeration of the fluid as it passes through the tank. A suggested minimum total reservoir volume is 5⁄8 of the maximum charge pump flow per minute with a minimum fluid volume equal to ½ of the maximum charge pump flow per minute. This allows 30 seconds fluid dwell for removing entrained air at the maximum return flow. This is usually adequate to allow for a closed reservoir (no breather) in most applications.

Locate the reservoir outlet (charge pump inlet) above the bottom of the reservoir to take advantage of gravity separation and prevent large foreign particles from entering the charge inlet line. A 100-125 µm screen over the outlet port is recommended. Position the reservoir inlet (fluid return) to discharge below the normal fluid level, toward the interior of the tank. A baffle (or baffles) will further promote de-aeration and reduce surging of the fluid.

Case Drain

All single S90 pumps are equipped with multiple drain ports. Port selection and case drain routing must enable the pump housing to maintain a volume of oil not less than half full and normal operating case pressure limits of the unit are maintained. Case drain routing and design must consider unit case pressure ratings.

A case drain line must be connected to one of the case outlets to return internal leakage to the system reservoir.

Do not over torque the fitting on case drain port L2 (located on the side cover). The proper torque is 100 N•m [74 lbf•ft] maximum. Over torquing the fitting may change the neutral position of the swashplate.

Pump Life

Pump life depends on several factors, such as speed, pressure, and swashplate angle. For detailed product life calculation, please contact your Danfoss representative.

Understanding and Minimizing System Noise

Noise is transmitted in fluid power systems in two ways: as fluid borne noise, and structure borne noise.

Fluid-borne noise (pressure ripple or pulsation) is created as pumping elements discharge oil into the pump outlet. It is affected by the compressibility of the oil, and the pump's ability to transition pumping elements from high to low pressure. Pulsations travel through the hydraulic lines at the speed of sound (about 1400 m/s [4600 ft/sec] in oil) until there is a change (such as an elbow) in the line. Thus, amplitude varies with overall line length and position.

Structure born noise is transmitted wherever the pump casing connects to the rest of the system. The way system components respond to excitation depends on their size, form, material, and mounting.

System lines and pump mounting can amplify pump noise.

Follow these suggestions to help minimize noise in your application:
- Use flexible hoses.
- Limit system line length.
- If possible, optimize system line position to minimize noise.
- If you must use steel plumbing, clamp the lines.
- If you add additional support, use rubber mounts.
- Test for resonants in the operating range; if possible avoid them.

System Design Parameters

Sizing Equations

The following equations are helpful when sizing hydraulic pumps. Generally, the sizing process is initiated by an evaluation of the machine system to determine the required motor speed and torque to perform the necessary work function. Refer to *Selection of drive line components*, **BC157786484430**, for a more complete description of hydrostatic drive line sizing. First, the motor is sized to transmit the maximum required torque. The pump is then selected as a flow source to achieve the maximum motor speed.

SI units

Output flow $Q = \frac{V_g \bullet n \bullet \eta_v}{1000}$ (l/min.)

Input torque $M = \frac{V_g \bullet \Delta p}{20 \bullet \pi \bullet \eta_m}$ (N•m)

Input power $P = \frac{M \bullet n \bullet \pi}{30\,000} = \frac{Q \bullet \Delta p}{600 \bullet \eta_t}$ (kW)

V_g = Displacement per revolution (cm^3/rev)
Δp = $p_O - p_i$ (system pressure) (bar)
n = Speed (min^{-1}(rpm))
η_v = Volumetric efficiency
η_m = Mechanical efficiency
η_t = Overall efficiency ($\eta_v \bullet \eta_m$)

US units

Output flow $Q = \frac{V_g \bullet n \bullet \eta_v}{231}$ (US gal/min.)

Input torque $M = \frac{V_g \bullet \Delta p}{2 \bullet \pi \bullet \eta_m}$ (lbf•in)

Input power $P = \frac{M \bullet n \bullet \pi}{198\,000} = \frac{Q \bullet \Delta p}{1714 \bullet \eta_t}$ (hp)

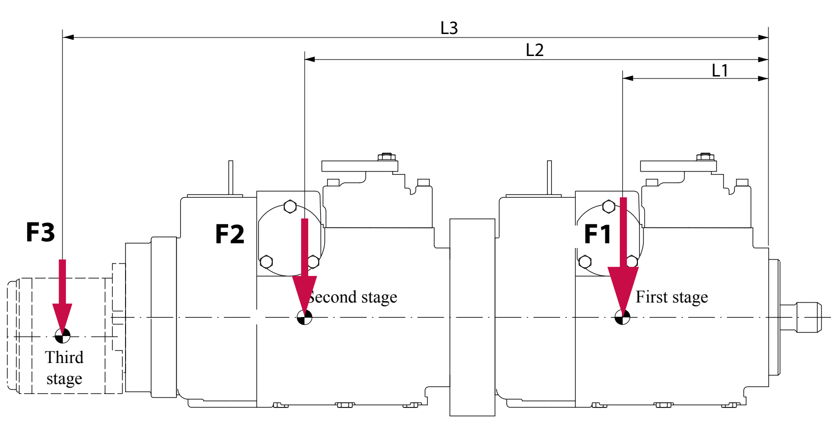
V_g = Displacement per revolution (in^3/rev)
Δp = $p_O - p_i$ (system pressure) (psi)
n = Speed (min^{-1}(rpm))
η_v = Volumetric efficiency
η_m = Mechanical efficiency
η_t = Overall efficiency ($\eta_v \bullet \eta_m$)

Mounting Flange Loads

Adding tandem mounted auxiliary pumps and/or subjecting pumps to high shock loads may result in excessive loading of the mounting flange.

Applications which experience extreme resonant vibrations or shock may require additional pump support. The overhung load moment for multiple pump mounting may be estimated using the formula below.

Overhung load example



Estimated maximum and rated acceleration factors for some typical applications are shown in the table below.

System Design Parameters

Estimating overhung load moments
Based on SI units
W = Mass of pump kg
L = Distance from mounting fange to pump center of gravity
(refer to Installation drawings section)

$M_R = g \cdot G_R (W_1L_1 + W_2L_2 + ... + W_nL_n)$
$M_S = g \cdot G_S (W_1L_1 + W_2L_2 + ... + W_nL_n)$

Where:
M_R = Rated load moment N•m
M_S = Shock load moment N•m
g = Gravity 9.81 m/s²
G_R = Calculation factor for rated (vibratory) acceleration (G's)*
G_S = Calculation factor for maximum shock acceleration (G's)*

Based on US units
W = Weight of pump [lb]
L = Distance from mounting fange [in] to pump center of gravity

$M_R = G_R (W_1L_1 + W_2L_2 + ... + W_nL_n)$
$M_S = G_S (W_1L_1 + W_2L_2 + ... + W_nL_n)$

Where:
M_R = Rated load moment N•m
M_S = Shock load moment N•m

* This factor depends on the application (see next page).

Allowable overhung load moment values are shown in the following table.

Allowable overhung load moments

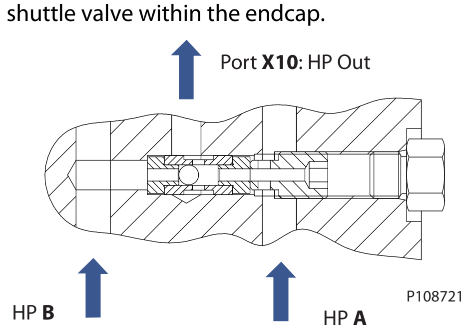
Frame size	Rated moment (MR)		Shock load moment (MS)	
	N•m	lbf•in	N•m	lbf•in
130	3160	28 000	10 730	95 000
180	6070	54 000	20 600	182 000

Accumulator

Typical for concrete pump systems is a significant pressure drop on the low pressure side. The gage port M3 can be used to conncet an accumulator on to the system. The accumulator has to be connected to port M3. The volume size of the accumulator has to be at least 1.6 liters or larger. The preliminary charge pressure is at least 2 bar.

High Pressure Signal Output Port X10

This port provides a high pressure signal from side **A** or **B** of the working loop controlled by a 2-way-shuttle valve within the endcap.



This port can be used for a torque limiter control.

Master Model Code

Master Model Code

	R	Size	M	P	J	G	N	F	L	H	T	W	Y	Z	K
S90															

R - Type and Rotation

Code	Description	130	180
R	Right Hand [CW]	O	O
L	Left Hand [CCW]	O	O

Size

Code	Description	130	180
130	130 cc [7.93 in^3] max. displacement per revolution	O	
180	180 cc [10.98 in^3] max. displacement per revolution		O

M - Controls

Code	Description	130	180
HD	HDC, standard porting, 6 - 18 bar (88 - 264 PSI), UNF thread ports	O	O
H9	Standard porting, 6.0-18.0 bar (88-264 psi), metric thread ports		O

P - High Pressure Regulation

Code	Description	130	180
D	high pressure relief valves for port A and B (240-350 bar)	O	O

J - Auxiliary Mounting Pad

Code	Description	130	180
AB	SAE-A with sealed cover, 9 teeth coupling	O	O
BB	SAE-BB with sealed cover, 15 teeth coupling	O	O
BC	SAE-B with sealed cover, 13 teeth coupling	O	O
CD	SAE-C with sealed cover, 4 bolt adapter, 14 teeth coupling, (2) ½-13 UNC	O	O
DE	SAE-D with sealed cover, 13 teeth coupling	O	O
EF	SAE-E with sealed cover, 13 teeth coupling		O
NN	no auxiliary mounting pad	O	O

G - Endcap Ports

Code	Description	130	180
8C	twin ports with high pressure shuttle valve, HD measurement port, UNF thread ports, loop flushing valve	O	O
9C	twin ports with high pressure shuttle valve, HD measurement port, metric thread ports, loop flushing valve		O

N - Filtration

Code	Description	130	180
S	suction filtration	O	O
K	suction filtration with metric port		O

Master Model Code

F - Displacement Limitation

Code	Description	130	180
C	no limiters, only for 180 cc		O
M	limitation both sides, only for 180 cc		O
3	no limiters	O	
4	limitation both sides	O	
E	limitation both sides, spec. servo cylinder with gage ports	O	O

L - Shaft Options

Code	Description	130	180
C8	splined shaft, 27 teeth, pitch = 16 / 32	O	O
F1	splined shaft, 13 teeth, pitch = 8 / 16	O	O
D5	Splined shaft, W50x2x30x24x9g per DIN 5480		O

H - Charging System

Code	Description	130	180
F	nominal flow = 26 cc / rev	O	
H	nominal flow = 34 cc / rev	O	O
J	nominal flow = 47 cc / rev		O

T - Control Orifice Options

Code	Description						
HDC							
	inlet P	drain TA	drain TB	servo A	servo B	**130**	**180**
00	n/o	1.3	1.3	n/o	n/o	O	O

W - Special Hardware Features

Code	Description	130	180
GBA	CP15 +0,5° valve plate	O	
NNN	180cc: CP15 +0,5° valve plate		O
	250cc: CP15 +0,5° valve plate , nested T- bar springs		
GCE	CP15 +1,5° valve plate, metric ports, special plate retainer		O
GCF	CP15 +1,5° valve plate, metric ports		O

Y - High Pressure Setting A

Code	Description	130	180
32	320 bar	O	O
35	350 bar	O	O

Master Model Code

*Z - High Pressure Setting **B***

Code	Description	130	180
32	320 bar	O	O
35	350 bar	O	O

K - Charge Pressure Setting

Code	Description	130	180
20	20 bar	O	O
22	22 bar	O	O
24	24 bar	O	O
26	26 bar	O	O
28	28 bar	O	O
30	30 bar	O	O
32	32 bar	O	O
34	34 bar	O	O

Control Options

Hydraulic Displacement Control (HDC), Option HD; H9

Warning

Avoid designing a system which puts swashplate into full stroke when control operation is blocked by contamination.

Operation

The hydraulic displacement control uses a hydraulic input signal to operate a 4-way servo valve, which ports hydraulic pressure to either side of a double acting servo piston. The servo piston tilts the cradle swashplate, thus varying the pump's displacement from full displacement in one direction to full displacement in the opposite direction.

The control has a mechanical feedback mechanism which moves the servo valve in relation to the input signal and the angular rotation of the swashplate. The hydraulic displacement control is designed so the angular position of the swashplate (pump displacement) is proportional to the hydraulic input signal pressure. Due to normal operating force changes, the swashplate tends to drift from the position preset by the machine operator. Drift, sensed by feedback linkage system connecting the swashplate to the control valve, activates the valve to supply pressure to the servo piston, maintaining the swashplate in its preset position.

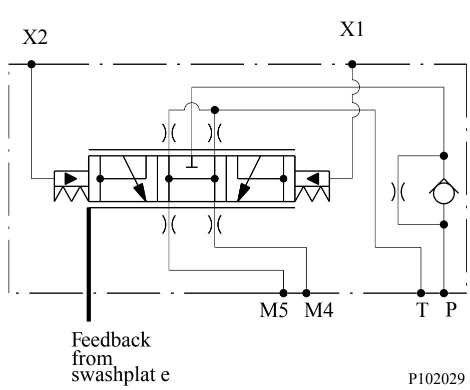
Features and Benefits

- The hydraulic displacement control is a high gain control: With only small change of the input signal, the servo valve moves to a full open position porting maximum flow to the servo cylinder.
- Internal mechanical stops on the servo valve allow rapid changes in input signal pressure without damaging the control mechanism.
- Precision parts provide repeatable, accurate displacement settings with a given input signal.
- The swashplate is coupled to a feedback mechanism. The control valve drains the ends of the servo piston when an input signal is not present.

Benefits:

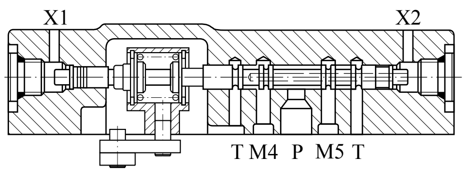
- Simple - low cost design.
- Pump returns to neutral after prime mover shuts down.
- Pump returns to neutral if there is a loss of input signal pressure or if there is a loss of charge pressure.

Hydraulic displacement control schematic



Control Options

Cross-section



Warning

Maximum allowable signal pressure is 60 bar [870 psi]. Exceeding allowable signal pressure will cause damage to the control.

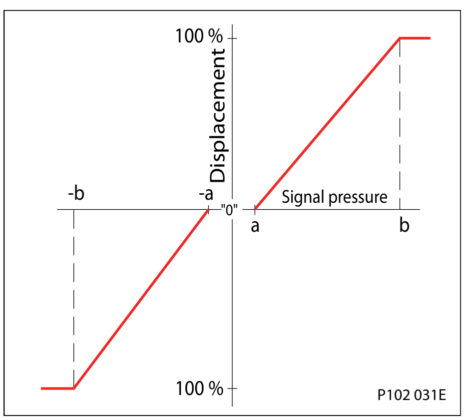
Hydraulic signal pressure range

a	6 ± 0.5 bar	[88 ± 6 psi]
b	18 ± 0.5 bar	[264 ± 6 psi]

Stroking time from A to B

130cc	300 ms
180cc	300 ms

Pump displacement vs. signal pressure



Pump output flow direction vs. control pressure

Pump output flow direction vs. control pressure

Input shaft rotation	CW		CCW	
Control pressure to port	X1	X2	X1	X2
Port A flow (M1)	Out	In	In	Out
Port B flow (M2)	In	Out	Out	In
Servo cylinder (side)	M5 (2)	M4 (1)	M5 (2)	M4 (1)

Refer to Installation Drawings for port locations.

Features and Options

Multi-Function Valves

Overpressure protection

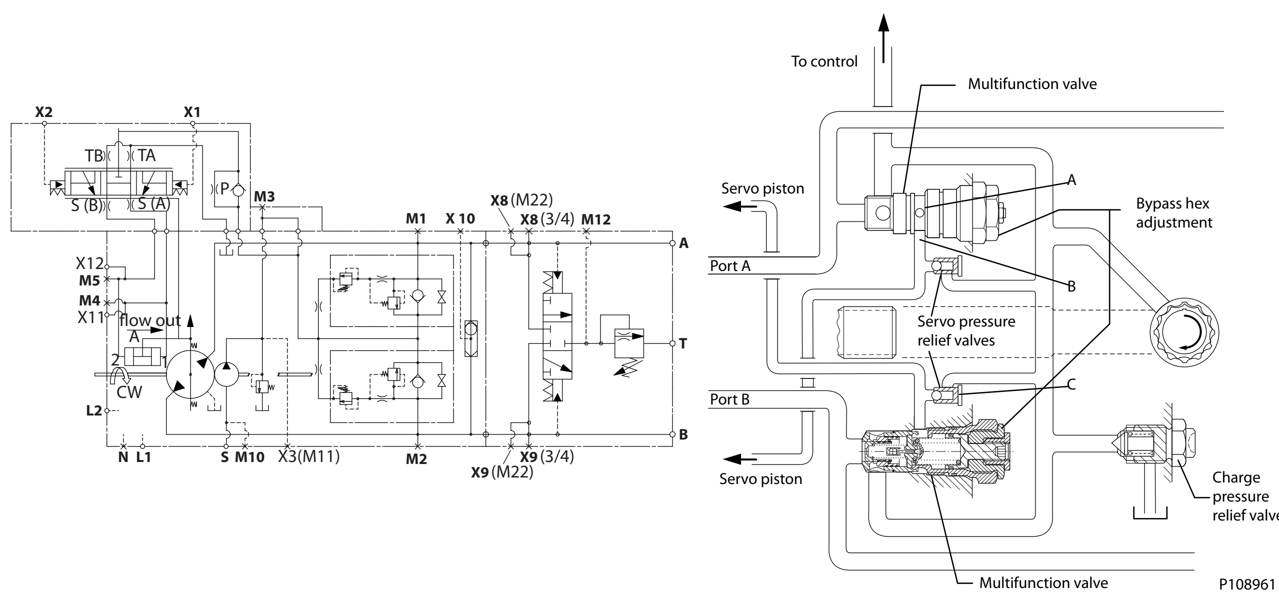
Series 90 concrete pumps are only designed with high pressure relief valves.

The relief valve is built into the multi-function valve located in the pump endcap. The high pressure relief valve system in the Series 90 provides an advanced design of overpressure protection.

Because the relief valves open only during extremely fast pressure spike conditions, heat generation is minimized during the short time that they might be open. The relief response is approximately 20 ms whether used with or without the pressure limiter function.

HPRVs are factory set at a low flow condition. Any application or operating condition which leads to elevated HPRV flow will cause a pressure rise with flow above a valve setting. Consult factory for application review. Excessive operation of the HPRV will generate heat in the closed loop and may cause damage to the internal components of the pump.

Multifunction valve, pressure regulation



Bypass Function

In some applications it is desirable to bypass fluid around the variable displacement pump when pump shaft rotation is either not possible or not desired. For example, an inoperable vehicle may be moved to a service or repair location or winched onto a trailer without operating the prime mover. To provide for this, Series 90 pumps are designed with a bypass function.

The bypass is operated by mechanically rotating the bypass hex on both multifunction valves three (3) turns counterclockwise (CCW). This connects working loop A and B and allows fluid to circulate without rotating the pump and prime mover.

Warning

Excessive speeds and extended load/vehicle movement must be avoided while moving in bypass function. The load or vehicle should be moved not more than 20 % of maximum speed and for a duration not exceeding 3 minutes. Damage to drive motor(s) is possible. When the bypass function is no longer needed care should be taken to re-seat the HPRV hex plugs to the normal operating position.

Features and Options

Warning

Possible pump and/or motor damage.

Bypass valves are intended for moving a machine or vehicle for very short distances at very slow speeds. They are NOT intended as tow valves.

Auxiliary Mounting Pads

Auxiliary mounting pad specifications

Mounting pad	Option code	Spline coupling	Frame size/Maximum torque N•m [lbf•ft]	
			130	180
SAE A	AB	9T 16/32	106 [78]	120 [89]
SAE B	BC	13T 16/32	334 [246]	324 [239]
SAE B-B	BB	15T 16/32	368 [271]	368 [271]
SAE C	CD	14T 12/24	741 [546]	628 [463]
SAE D	DE	13T 8/16	741 [546]	1070 [789]
SAE E	EF	13T 8/16	n/a	1070 [789]
SAE E	EG	27T 16/32	n/a	1220 [900]

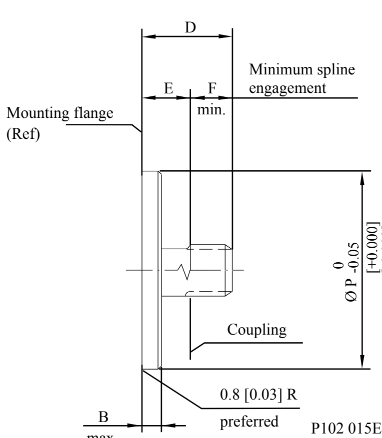
Mating pump requirements

The accompanying drawing provides the dimensions for the auxiliary pump mounting flange and shaft.

Pump mounting flanges and shafts with the dimensions noted below are compatible with the auxiliary mounting pads on the Series 90 pumps. An O-ring is required when a pump is bolted to an aux pad. Refer to outline drawings for more details and O-ring dimensions.

The auxiliary flange cover seal is only used for product transportation. If there is no tandem pumps requirement, it is recommended to use pump without auxiliary flange option. If you need to use pump with auxiliary flange but not rear pump for a long time, Please contact Danfoss technical personnel.

Auxiliary pump mounting flange and shaft



Features and Options

Auxiliary pump dimensions

Flange size	Units	P diameter	B maximum	D	F minimum
SAE A	mm [in]	82.55 [3.25]	7.4 [0.29]	32 [1.26]	13.5 [0.53]
SAE B		101.6 [4.00]	10.7 [0.42]	41 [1.61]	14.2 [0.56]
SAE B-B		101.6 [4.00]	10.7 [0.42]	46 [1.81]	16.1 [0.63]
SAE C		127.0 [5.00]	14.3 [0.56]	56 [2.20]	18.3 [0.72]
SAE D		152.4 [6.00]	14.3 [0.56]	75 [2.95]	20.8 [0.82]
SAE E 13 teeth		165.1 [6.50]	18.0 [0.71]	75 [2.95]	20.8 [0.82]
SAE E 27 teeth		165.1 [6.50]	18.0 [0.71]	75 [2.95]	27.0 [1.06]

Displacement Limiter

All Series 90 pumps are designed with optional mechanical displacement (stroke) limiters.

The maximum displacement of the pump can be set independently for forward and reverse using the two adjustment screws.

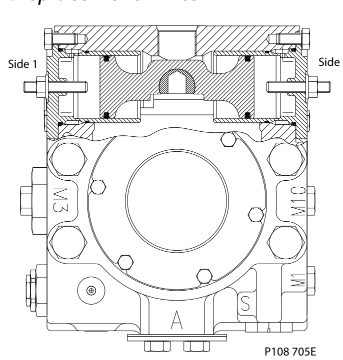
Warning

Adjusting the displacement limiter with the machine running may result in leakage. If backed out too far, the adjustment screw will come completely out of its threaded bore.

Displacement limiter location

Pump rotation	Displacement limiter mounted on servo side	Displacement limitation at high pressure side
Right [CW]	1	A
	2	B
Left [CCW]	1	B
	2	A

Displacement limiter



Features and Options

Frame size	Lock nut wrench size and torque	Adjusting screw wrench size internal hex	Approximate displacement change per revolution of adjusting screw
130	17 mm 48 N•m [35 lbf•ft]	5 mm	8.8 cm^3/rev [0.53 in^3/rev]
180	19 mm 125 N•m [92 lbf•ft]	6 mm	12.5 cm^3/rev [0.76 in^3/rev]

The servo cylinders are equipped with gage port X11 and X12. These ports provide the possibility to connect the servo system of the pump to the system loop. This feature connects the high pressure lines with the servo system over check valves and provides a smooth concrete flow.

Shaft Torque

Shaft torque and spline lubrication

The **rated torque** is a measure of tooth wear and is the torque level at which a normal spline life of 2x109 shaft revolutions can be expected. The rated torque presumes a regularly maintained minimum level of lubrication via a moly-disulfide grease in order to reduce the coefficient of friction and to restrict the presence of oxygen at the spline interface. It is also assumed that the mating spline has a minimum hardness of Rc 55 and full spline depth. The rated torque is proportional to the minimum active spline length.

Maximum torque ratings are based on torsional fatigue strength considering 100.000 full load reversing cycles. However, a spline running in oil-flooded environment provides superior oxygen restriction in addition to contaminant flushing. The rated torque of a flooded spline can increase to that of the maximum published rating. A flooded spline would be indicative of a pump driven by a pump drive or plugged into an auxiliary pad of a pump.

Maintaining a spline engagement at least equal to the Pitch Diameter will also maximize spline life. Spline engagements of less than ¾ Pitch Diameter are subject to high contact stress and spline fretting.

Shaft torque for tapered shafts

The **rated torque** is based on the contact pressure between the shaft and hub surfaces with poor surface contact areas. With an increased quality of the contact areas, the contact pressure between the shaft and hub is increased and allows higher torque to be transmitted.

When a key is used for orientation of the hub on the shaft in conjunction with poor quality contact surfaces, the transmitted torque will drop significantly. This is due to the key carrying the torque, which limits the shaft torque carrying capability.

Maximum torque rating is based on an ideal contact area of 100 % and the retaining nut properly torqued. This allows for the highest contact pressure between the shaft and the hub.

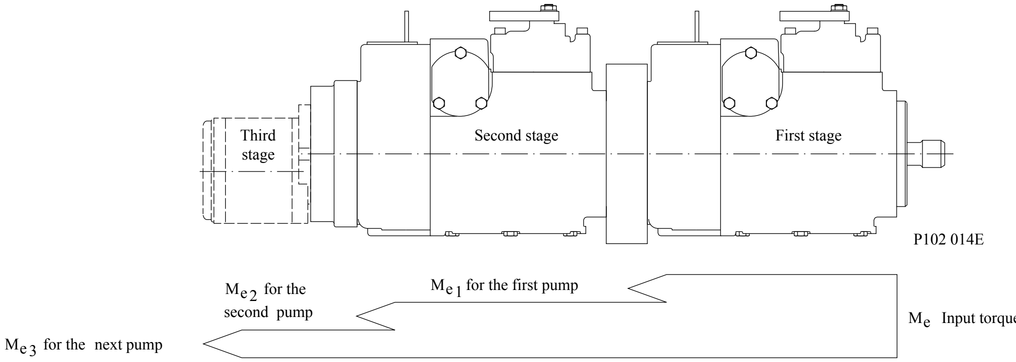
Shaft Availibility and Torque Ratings

Alignment between the mating spline's pitch diameters is another critical feature in determining the operating life of a splined drive connection. Plug-in, or rigid spline drive installations can impose severe radial loads on the shafts. The radial load is a function of the transmitted torque and shaft eccentricity. Increased spline clearance will not totally alleviate this condition; but, increased spline clearance will prevent mechanical interference due to misalignment or radial eccentricity between the pitch diameters of the mating splines. Spline life can be maximized if an intermediate coupling is introduced between the bearing supported splined shafts.

For multiple pump installations, consider load of the entire pump stack. All torques are additive. Include charge pumps loads when calculating torques.

Features and Options

Through torque diagram



Refer to the outline drawings for shaft dimensions.

Torque required by auxiliary pumps is additive. Ensure requirements don't exceed shaft torque ratings.

Shaft availability and maximum input torque - splined shafts

Option code	Customer end	Frame size/Maximum torque N•m [lbf•ft]	
		130	180
C8	27T 16/32	2693 [1986]	3125 [2304]
F1	13T 8/16	2303 [1700]	2303 [1700]
D5	W50x2x30x24x9g	-	3788 [2794]

Charge Pump

Charge flow is required on all Series 90 pumps applied in closed circuit installations. The charge pump provides flow to make up internal leakage, maintain a positive pressure in the main circuit, provide flow for cooling and filtration, replace any leakage losses from external valving or auxiliary systems, and to provide flow and pressure for the control system.

Many factors influence the charge flow requirements. These factors include system pressure, pump speed, pump swashplate angle, type of fluid, temperature, size of heat exchanger, length and size of hydraulic lines, control response characteristics, auxiliary flow requirements, hydrostatic motor type, etc.

Unusual application conditions may require a more detailed review of charge pump sizing. Charge pressure must be maintained at a specified level under all operating conditions to prevent damage to the transmission. Danfoss recommends testing under actual operating conditions to verify this.

Charge pump sizing/selection

In most applications a general guideline is that the charge pump displacement should be at least 10% of the total displacement of all components in the system. Unusual application conditions may require a more detailed review of charge flow requirements. Refer to *Selection of Drive line Components* **BC157786484430**, for a detailed procedure.

System features and conditions which may invalidate the 10% guideline include (but are not limited to):

- Continuous operation at low input speeds (< 1500 min^{-1} (rpm))
- High shock loading
- Excessively long system lines (> 3m [9.8 ft])
- Auxiliary flow requirements
- Use of low speed high torque motors
- High flushing flow

Features and Options

Contact your Danfoss representative for application assistance if your application includes any of these conditions.

Available charge pump sizes and speed limits

Code	Charge pump size cm³ [in³]	Rated speed min-1 (rpm)
B	11 [0.69]	4200
C	14 [0.86]	4200
D	17 [1.03]	3900
E	20 [1.20]	3600
F	26 [1.60] (only for 130cc)	3300
H	34 [2.07]	3100
J	47 [2.82] (only for 180cc)	2600
K	65 [3.90]	2300

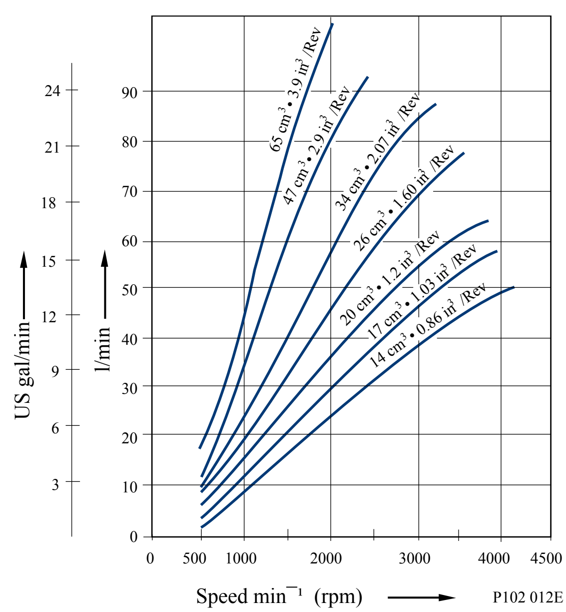
Charge pump flow and power curves

Charge pressure: 20 bar [350 psi]

Case drain: 80 °C (8.2 cSt) 180 °F (53 SUS)

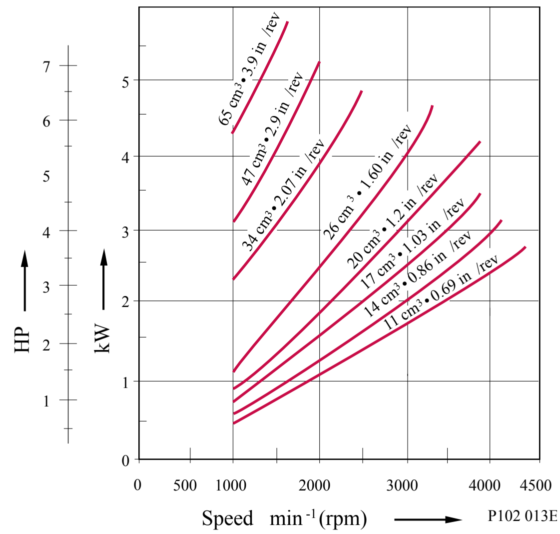
Reservoir temperature: 70 °C (11 cSt) 160 °F (63 SUS)

Charge pump output flow



Features and Options

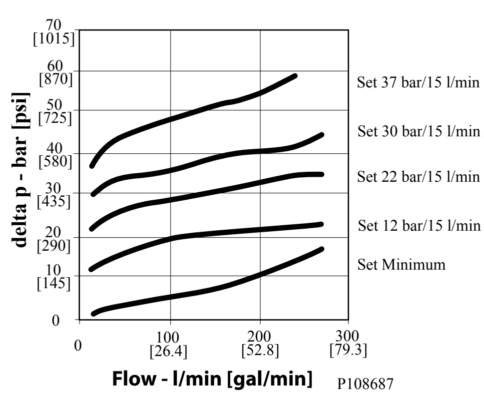
Charge pump power requirements



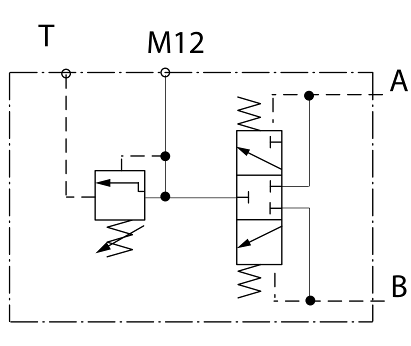
Loop Flushing Valve

For cooling and cleaning the fluid of the concrete pump system a loop flushing valve is available. This valve is mounted directly on to the pump. To order a concrete pump with a loop flushing valve contact your Danfoss representative.

Flushing characteristic (80°C) Manifold block



Loop Flushing Valve Schematic



Features and Options

Loop Flushing Valve Setting Capability

Loop flushing factory setting: 15 L/min to 22bar

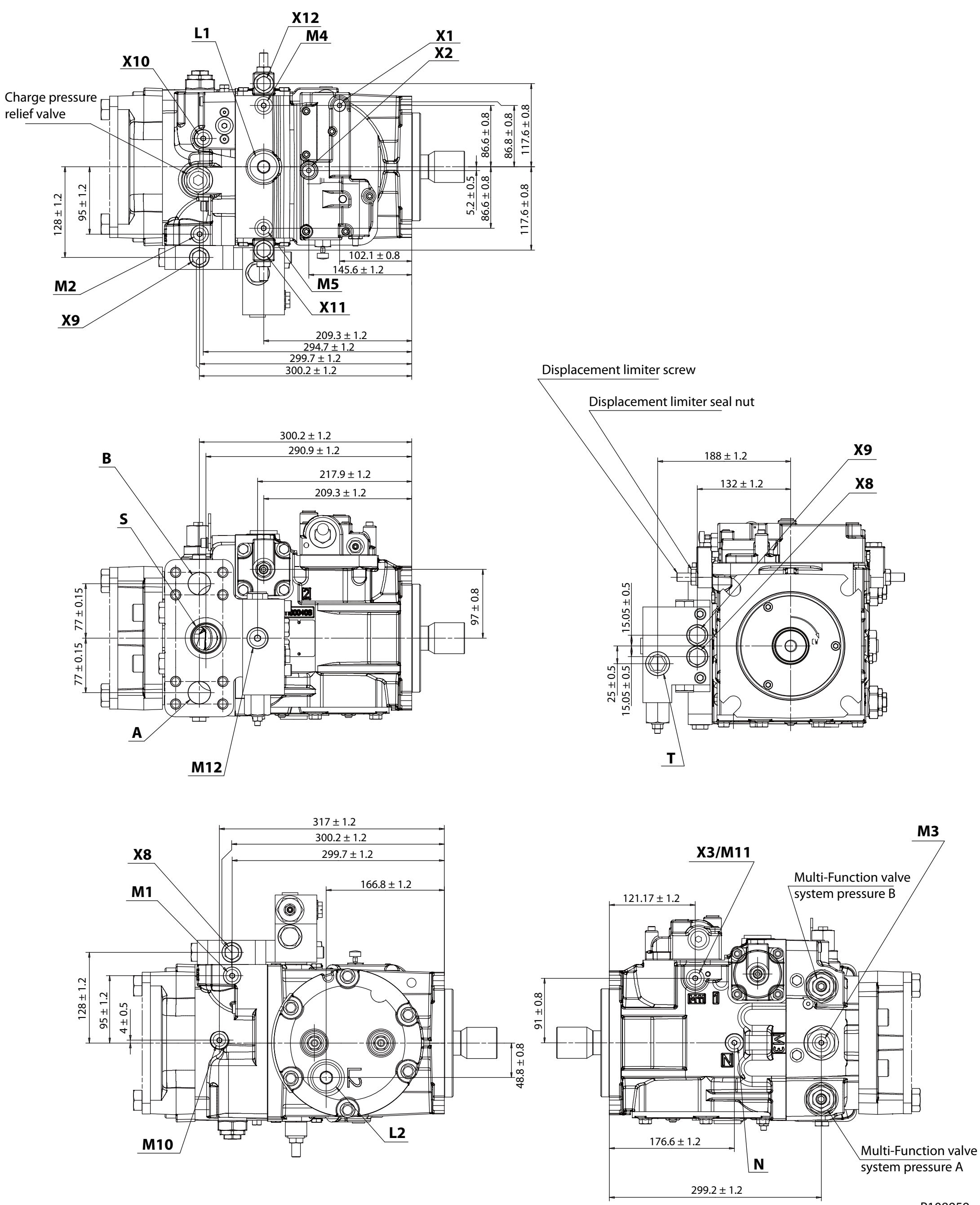
The flushing valve is adjustable within the shown range.

Installation Drawings

Frame Size 130

Ports and port dimensions

Further dimensions can be found in *Series 90 Axial Piston Pumps Technical Information* **BC152886483413**



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Installation Drawings

Port description

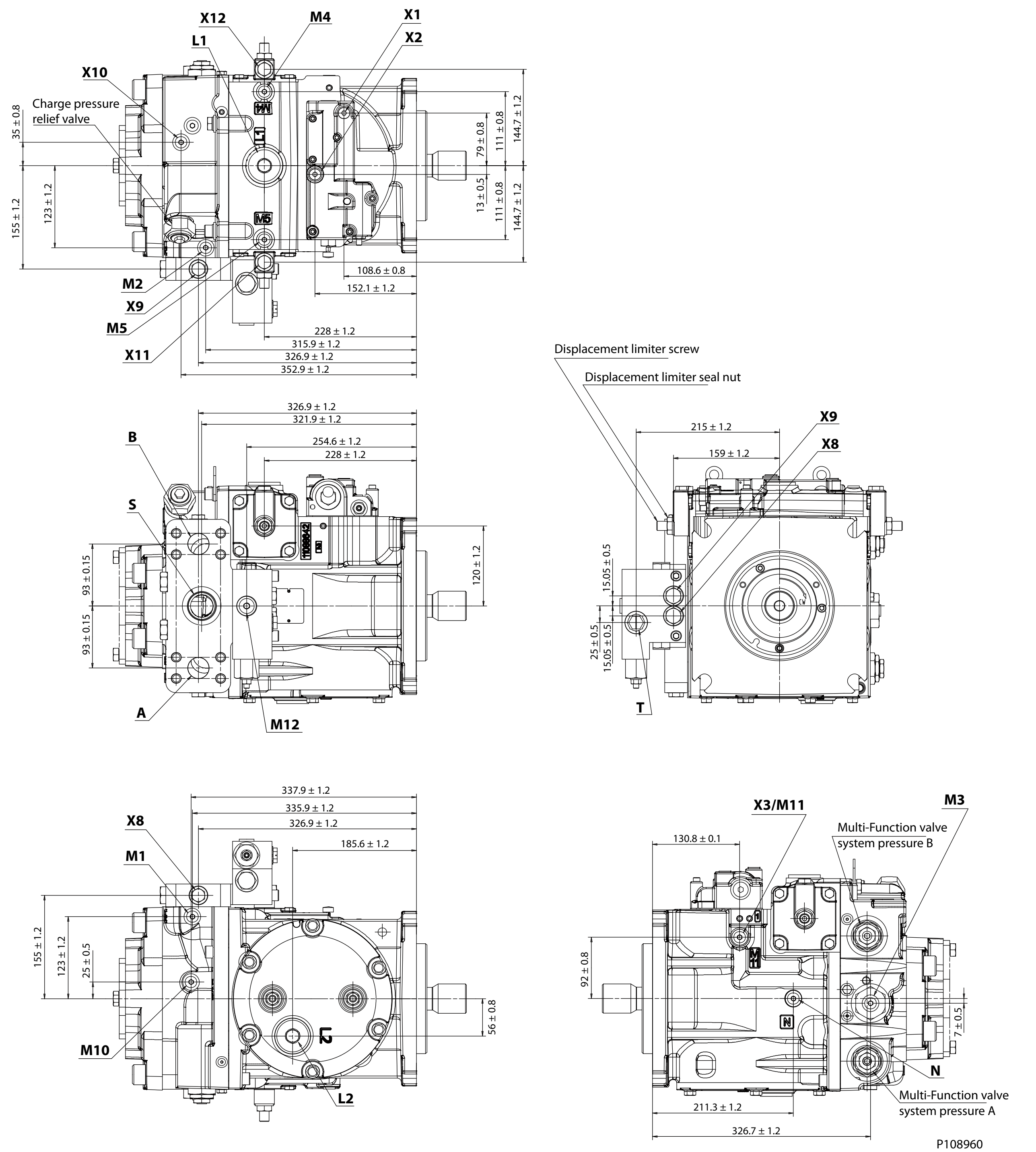
Port	Description	Port Size UNF
A/B	System Ports	-
S	Charge Inlet	ISO 11926-1, 1-1/16-12
M2	System B Gauge	ISO 11926-1, 9/16-18
M1	System A Gauge	ISO 11926-1, 9/16-18
X9	System B Gauge	ISO 11926-1, ¾-16/ISO 11926-1, 7/8-14
X8	System A Gauge	ISO 11926-1, ¾-16/ISO 11926-1, 7/8-14
L1/L2	Case Drain	ISO 11926-1, 1-5/16-12
T	Case Drain	ISO 11926-1, 7/8-14
M4/M5	Servo Gauge	ISO 11926-1, 9/16-18
M3	Charge Pressure Gauge, accumulator	ISO 11926-1, 9/16-18
X3/M11	Charge Gauge	ISO 11926-1, 9/16-18
X1/X2	Control Signal Pressure Inlet	ISO 11926-1, 9/16-18
X10	High Pressure Signal Output	ISO 11926-1, 9/16-18
X11/X12	External Control Inlet	DIN 3852-1, M22 x 1,5
M10	Charge Inlet Gauge	ISO 11926-1, 9/16-18
M12	Charge Flush Gauge	ISO 11926-1, ¾-16
N	Case gauge	ISO 11926-1, 9/16-18

Installation Drawings

Frame Size 180

Ports and port dimensions

Further dimensions can be found in *Series 90 Axial Piston Pumps Technical Information* **BC152886483413**



Installation Drawings

Port description

Port	Description	Port size Metric	Port size UNF
A/B	System Ports	-	-
S	Charge Pump Inlet	M48	ISO 11926-1, 1-1/16-12
M2	System B Gauge	M22	ISO 11926-1, 9/16-18
M1	System A Gauge	M22	ISO 11926-1, 9/16-18
X9	System B Gauge	M22	ISO 11926-1, ¾-16/DIN 3852-1, M22 x 1,5
X8	System A Gauge	M22	ISO 11926-1, ¾-16/DIN 3852-1, M22 x 1,5
L1/L2	Case Drain	M42	ISO 11926-1, 1 5/8-12
T	Case Drain	M22	ISO 11926-1, 7/8-14
M4/M5	Servo Gauge	M14	ISO 11926-1, 9/16-18
M3	Charge Pressure Gauge	M22	ISO 11926-1, 9/16-18
X3/M11	Charge Gauge	M14	ISO 11926-1, 9/16-18
X1/X2	Control Signal Pressure Inlet	M14	ISO 11926-1, 9/16-18
X10	High Pressure Signal Output	M14	ISO 11926-1, 9/16-18
X11/X12	External Control Inlet	M22	DIN 3852-1, M22 x 1,5
M10	Charge Inlet Gauge	M14	ISO 11926-1, 9/16-18
M12	Charge Flush Gauge	M14	ISO 11926-1, ¾-16
N	Case Gauge	M14	ISO 11926-1, 9/16-18

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