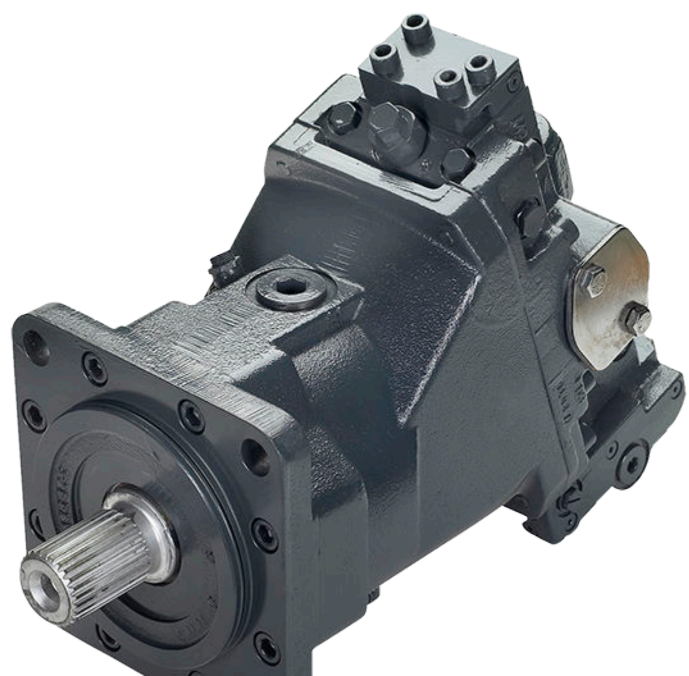
ENGINEERING TOMORROW

Technical Information

Bent Axis Variable Displ. Motors
Series 51 and 51-1



Revision history

Table of revisions

Date	Changed	Rev
October 2017	Modified theor. corner power ratings and updated to Engineering Tomorrow	0401
March 2015	Major update. Corrected DITA CMS structure, layout, colors and all tables.	CA
Jan 2014	Converted to Danfoss layout - DITA CMS	BA
Jun 2005	First version	AA

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Series 51 general information

Series 51 and 51-1 variable displacement motors are bent axis design units, incorporating spherical pistons.

These motors are designed primarily to be combined with other products in closed circuit systems to transfer and control hydraulic power. Series 51 and 51-1 motors have a large maximum / minimum displacement ratio (5:1) and high output speed capabilities. SAE, cartridge, and DIN flange configurations are available.

A complete family of controls and regulators is available to fulfill the requirements of a wide range of applications.

Motors normally start at maximum displacement. This provides maximum starting torque for high acceleration.

The controls may utilize internally supplied servo pressure. They may be overridden by a pressure compensator which functions when the motor is operating in motor and pump modes. A defeat option is available to disable the pressure compensator override when the motor is running in pump mode.

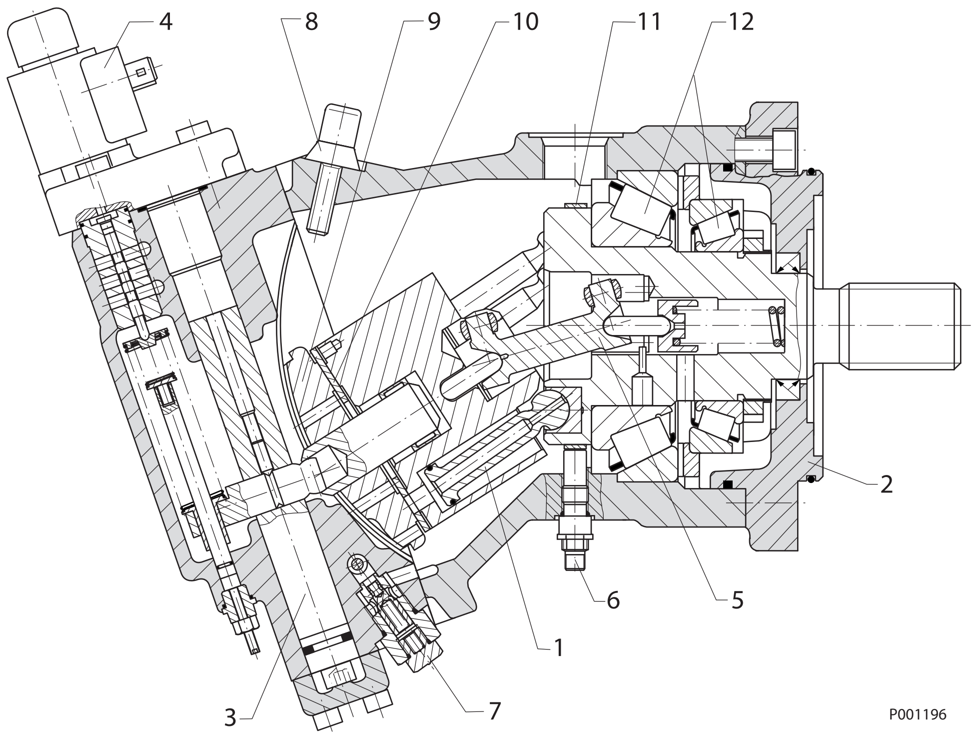
The pressure compensator option features a low pressure rise (short ramp) to ensure optimal power utilization throughout the entire displacement range of the motor. The pressure compensator is also available as a stand-alone regulator.

- The series 51 and 51-1 motors – Advanced technology
- The most technically advanced hydraulic units in the industry
- SAE, cartridge, and DIN flange motors
- Cartridge motors designed for direct installation in compact planetary drives
- Large displacement ratio (5:1)
- Complete family of control systems
- Proven reliability and performance
- Optimum product configurations
- Compact, lightweight

Series 51 general information

Sectional view of Series 51, proportional control

Series 51 with electric proportional control



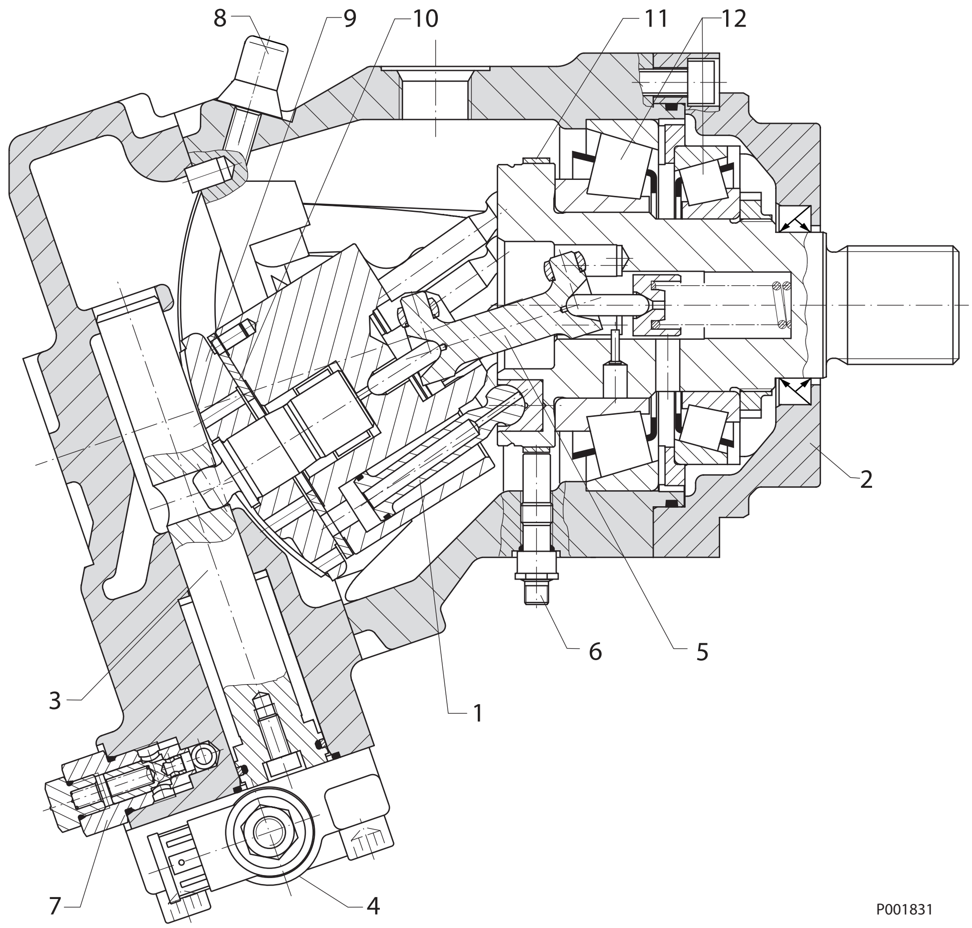
Legend:

1 – Piston
2 – Flange
3 – Servo piston
4 – Electric proportional control
5 – Synchronizing shaft
6 – Speed sensor
7 – Charge pressure relief valve
8 – Minimum displacement limiter
9 – Valve segment
10 – Bearing plate
11 – Speed pickup ring
12 – Tapered roller bearings

Series 51 general information

Sectional view of Series 51-1, two-position control

Series 51 with electrohydraulic two-position control



Legend:

1 – Piston
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3 – Servo piston
4 – Electrohydraulic two-position control
5 – Synchronizing shaft
6 – Speed sensor
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8 – Minimum displacement limiter
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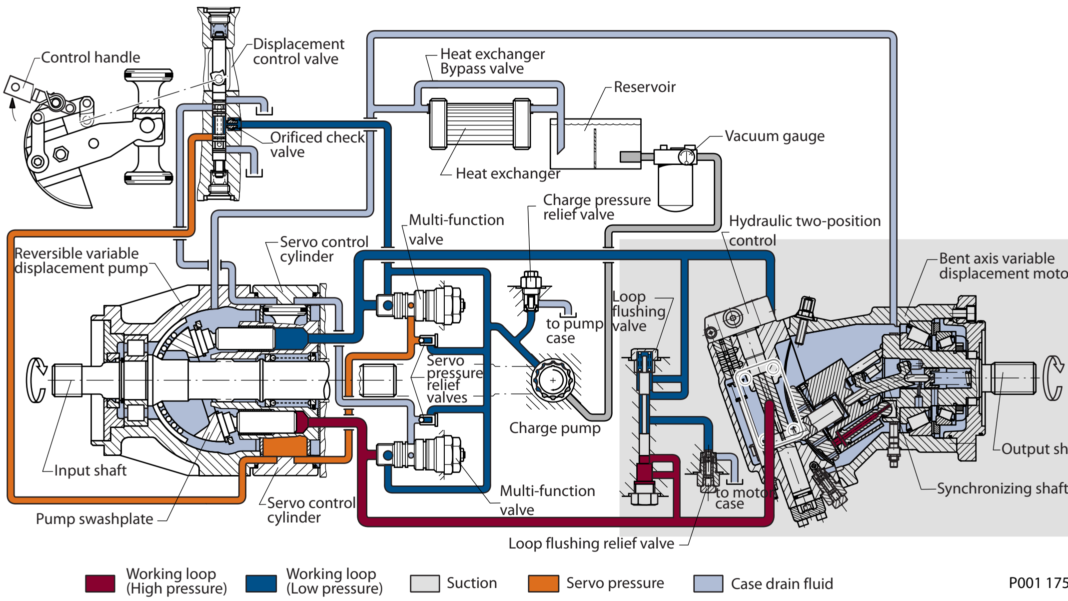
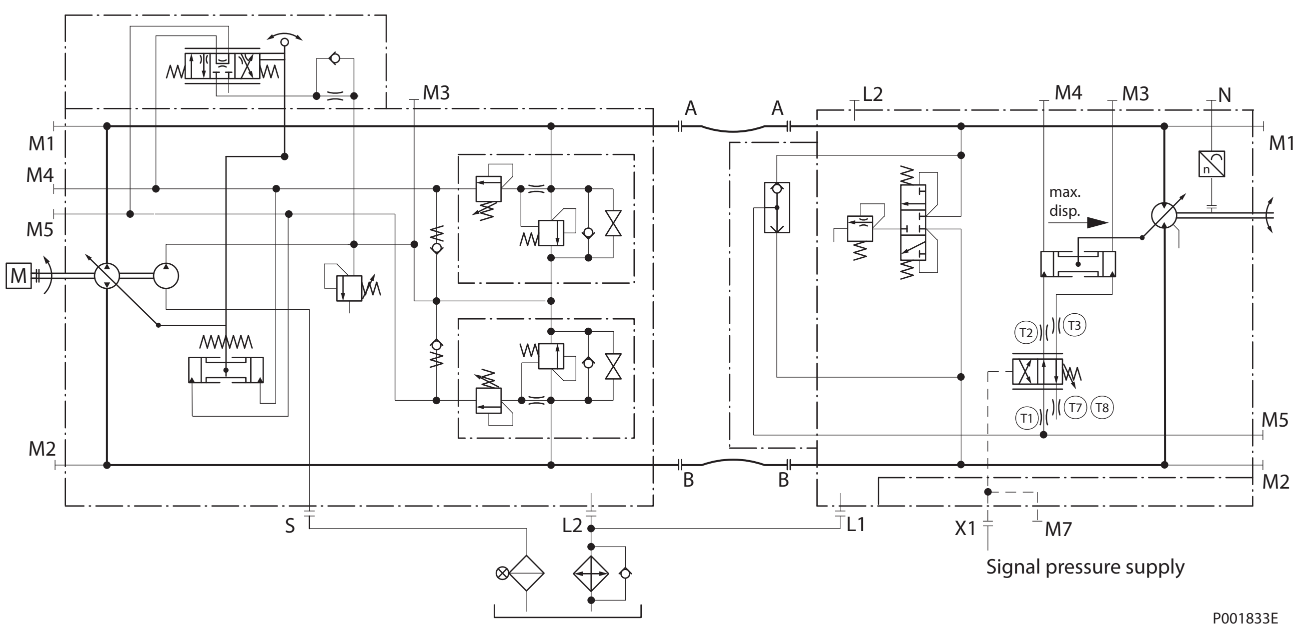
Series 51 general information

Pictorial diagram



System circuit diagram

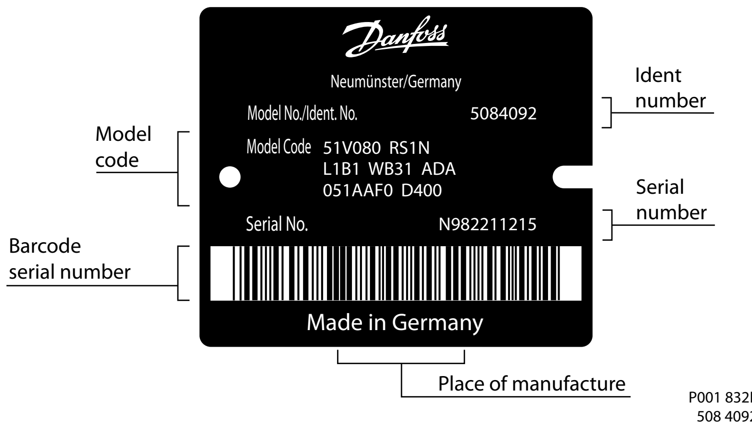


Above schematic shows the function of a hydrostatic transmission using a Series 90 Axial Piston Variable Displacement Pump with manual displacement control (MA) and a Series 51 Bent Axis Variable Displacement Motor with hydraulic two-position control (HZ).

Series 51 general information

Series 51/51-1 name plates

Series 51 name plate



Series 51-1 name plate

Technical specifications

General specifications

Most specifications for bent axis variable displacement motors are listed on these pages. For definitions of the various specifications, see the related pages in this publication. Not all hardware options are available for all configurations; consult the series 51 and 51-1 model code supplement or price book for more information.

General specifications

Design	Axial piston motor with variable displacement, bent axis design
Direction of rotation	Clockwise and counter-clockwise (bi-directional)
Recommended installation	Discretionary, the housing must always be filled with hydraulic fluid
Other system requirements	Independet braking system, circuit overpressure protection, suitable reservoir

Specific data

Physical properties

Features		**Unit**	**Size**				
			060	**080**	**110**	**160**	**250**
Displacement	**Maximum**	cm^3 [in^3]	60.0 [3.66]	80.7 [4.92]	109.9 [6.71]	160.9 [9.82]	250 [15.26]
	Minimum		12 [0.73]	16.1 [0.98]	22 [1.34]	32.2 [1.96]	50.0 [3.05]
Theor. flow at max. displ.	**at rated speed**	l/min [US gal/min]	216 [57]	250 [66]	308 [81]	402 [106]	550 [145]
	at max. speed		264 [71]	323 [85]	396 [105]	515 [136]	675 [178]
Theor. corner power at rated speed and max. working pressure (Δp = 450 bar [6527 psi])		kW [hp]	252 [338]	300 [402]	371 [498]	480 [644]	638 [856]
Theoretical torque	**at max. displ.**	N•m/bar [lbf•in/1000 psi]	0.95 [583]	1.28 [784]	1.75 [1067]	2.56 [1563]	3.98 [2428]
	at min. displ.		0.19 [117]	0.26 [156]	0.35 [214]	0.51 [313]	0.80 [486]
Mass moment of inertia of rotating components		kg•m^2 [slug•ft^2]	0.0046 [0.1092]	0.0071 [0.1685]	0.0128 [0.3037]	0.0234 [0.5553]	0.0480 [1.1580]
Rated speed	**at max. displ.**	min^{-1}(rpm)	3600	3100	2800	2500	2200
	at min. displ.		5600	5000	4500	4000	3400
Maximum speed*	**at max. displ.**		4400	4000	3600	3200	2700
	at min. displ.		7000	6250	5600	5000	4250

* Contact Danfoss representative for max. speed at displacements between max. and min. displacement.

Technical specifications

System and case pressure

Parameter		Unit	All sizes
System pressure	Maximum delta	bar [psi]	480 [7000]
	Maximum		510 [7400]
	Minimum low		10 [145]
Case pressure	Rated		3 [44]
	Maximum (cold start)		5 [73]
	Minimum (at rated speed)		0.3 [4.35]

Fluid specifications

Fluid specifications

Features		Unit	All sizes
Viscosity	Minimum intermittent	mm^2/s [SUS]	7 [49]
	Recommended range		12-80 [66-366]
	Maximum intermittent		1600 [7416]
Temperature range[1)2)]	Minimum	°C [°F]	-40 [-40]
	Rated		104 [220]
	Maximum intermittent		115 [240]
Cleanliness and Filtration	Required cleanliness per ISO 4406	-	22/18/13
	Efficiency (charge pressure filtration)	β-ratio	$\beta_{15-20} = 75$ ($\beta_{10} \geq 10$)
	Efficiency (suction / return line filtration)		$\beta_{35-45} = 75$ ($\beta_{10} \geq 2$)
	Recommended inlet screen mesh size	µm	100 – 125

1) At the hottest point, normally case drain port.

2) Minimum: cold start, short term t<3 min, p<50 bar, n<1000 rpm.

Technical specifications

Determination of nominal motor size

Based on SI units

$$Q_e = \frac{V_g \cdot n}{1000 \cdot \eta_v}$$

$$M_e = \frac{V_g \cdot \Delta p \cdot \eta_{mh}}{20 \cdot \pi}$$

$$P_e = \frac{M_e \cdot n}{9550} = \frac{Q_e \cdot \Delta p \cdot \eta_t}{600}$$

$$n = \frac{Q_e \cdot 1000 \cdot \eta_v}{V_g}$$

Where:

Q_e	Input flow (l/min)
M_e	Output torque (N•m)
P_e	Output power (kW)
n	Speed (min^{-1})
V_g	Motor displacement per rev. (cm^3/rev)
p_{high}	High pressure (bar)
p_{low}	Low pressure (bar)
Δp	High pressure minus Low pressure (bar)
η_v	Motor volumetric efficiency
η_{mh}	Mechanical-hydraulic efficiency
η_t	Motor total efficiency ($\eta_v \cdot \eta_{mh}$)

Based on US units

$$Q_e = \frac{V_g \cdot n}{231 \cdot \eta_v}$$

$$M_e = \frac{V_g \cdot \Delta p \cdot \eta_{mh}}{2 \cdot \pi}$$

$$P_e = \frac{V_g \cdot n \cdot \Delta p \cdot \eta_t}{396\,000}$$

$$n = \frac{Q_e \cdot 231 \cdot \eta_v}{V_g}$$

Where:

Q_e	Input flow [US gal/min]
M_e	Output torque [lb•in]
P_e	Output power [hp]
n	Speed [rpm]
V_g	Motor displacement per rev. [in^3/rev]
p_{high}	High pressure [psi]
p_{low}	Low pressure [psi]
Δp	High pressure minus Low pressure [psi]
η_v	Motor volumetric efficiency
η_{mh}	Mechanical-hydraulic efficiency
η_t	Motor total efficiency ($\eta_v \cdot \eta_{mh}$)

General technical specifications

Case pressure

Under normal operating conditions, case pressure must not exceed the rated pressure. Momentary case pressure exceeding this rating is acceptable under cold start conditions, but still must stay below the maximum pressure rating.

The minimum pressure provides proper lubrication at high speeds.

Operation with case pressure in excess of these limits may result in external leakage due to damage to seals, gaskets, and/or housings.

Case pressure

Parameter		Unit	All sizes
Case pressure	Rated	bar [psi]	3 [44]
	Maximum (cold start)		5 [73]
	Minimum (at rated speed)		0.3 [4.35]

Speed range

Rated speed is the speed limit recommended at full power condition and is the highest value at which normal life can be expected.

Maximum speed is the highest operating speed permitted and cannot be exceeded without reduction in the life of the product or risking immediate failure and loss of driveline power (which may create a safety hazard). In the range between rated and maximum speed please contact your Danfoss Power Solutions representative.

Warning

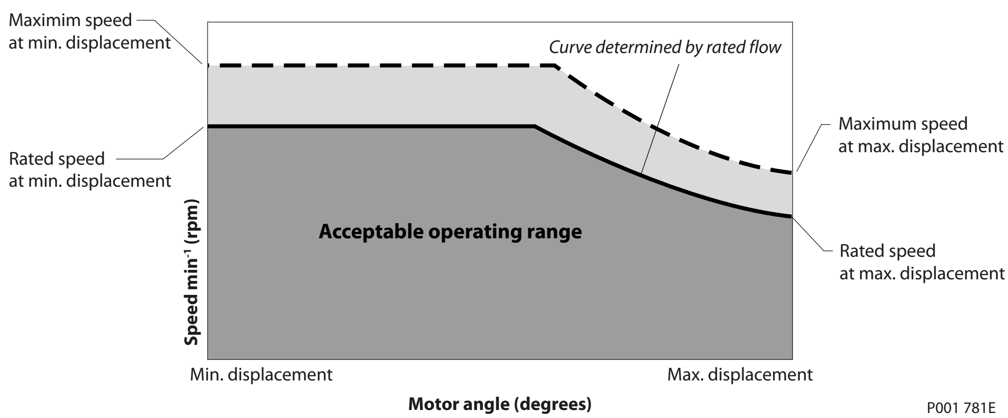
The loss of hydrostatic drive line power in any mode of operation (e.g., forward, reverse, or “neutral”) may cause the loss of hydrostatic braking capacity. A braking system, redundant to the hydrostatic transmission must, therefore, be provided which is adequate to stop and hold the system should the condition develop.

Speed limits

Features		Unit	Size				
			060	080	110	160	250
Rated speed	at max. displ.	min^{-1}(rpm)	3600	3100	2800	2500	2200
	at min. displ.		5600	5000	4500	4000	3400
Maximum speed	at max. displ.		4400	4000	3600	3200	2700
	at min. displ.		7000	6250	5600	5000	4250

General technical specifications

Speed limits



For operation within the range above the acceptable range contact Danfoss Power Solutions representative.

Pressure limits

System pressure is the dominant operating variable affecting hydraulic unit life. High pressure, which results from high load, reduces expected life in a manner similar to the affects of high load on other mechanical assemblies such as engines and gear boxes. There are load-to-life relationships for the rotating group and for the shaft anti-friction bearings.

Continuous pressure is the pressure at which the hydrostatic system could operate continuously and still achieve acceptable hydrostatic life. This pressure level varies depending on operating speed, and on the life requirements for a particular application. While most mobile applications require system pressure to vary widely during operation, a “weighted average” pressure can be derived from a machine duty cycle. (A duty cycle is a means of quantifying the pressure and speed demands of a particular system on a percent time basis). Once a duty cycle has been determined or estimated for a specific application, contact your Danfoss representative for system life ratings for the application.

Maximum delta pressure is the highest intermittent pressure allowed, and is the relief valve setting. It is determined by the maximum machine load demand. For most systems, the load should move at this pressure.

Maximum pressure is assumed to occur a small percentage of operating time, usually less than 2 % of the total. Both the continuous and maximum pressure limits must be satisfied to achieve the expected life.

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

System pressure range, input

Maximum delta pressure	Minimum low pressure	Maximum pressure
480 [7000 psi]	10 [145 psi]	510 [7400 psi]

General technical specifications

Loop flushing

An integral non-adjustable loop flushing valve is incorporated into all these motors. Installations that require fluid to be removed from the low pressure side of the system circuit because of cooling requirements or contamination removal will benefit from loop flushing.

The integral loop flushing valve is equipped with an orificed charge pressure relief valve designed with a cracking pressure of 16 bar [232 psi].

Valves are available with several orifice sizes to meet the flushing flow requirements of all system operating conditions.

The total system charge pump flow should be of sufficient volume to accommodate:

- The number of motors in the system
- System efficiency under worst case conditions
- Pump control requirements
- External needs

Although charge pump sizing requires the consideration of many system variables, the following table gives a recommendation of what charge pump displacement may be required to accommodate the flushing flow of each available charge relief valve orifice.

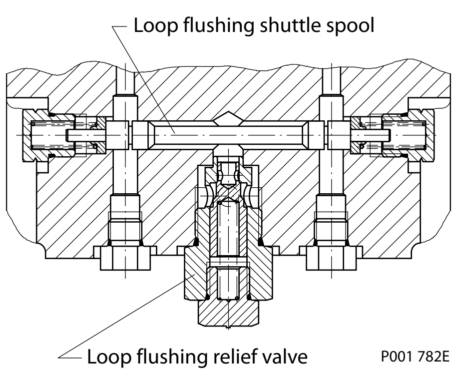
Recommended charge pump displacement

Loop flushing valve	**E4, E6**	**F0**	**F3**	**G0**	**G3**	**H0**
Charge pump size (cm^3)	8	11	14	17 or 20	26	34, 47 or 65

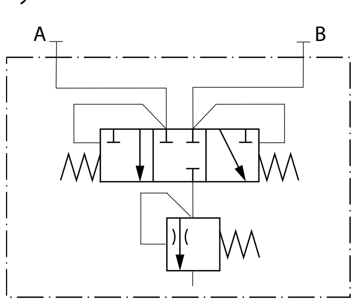
Warning

The loss of hydrostatic drive line power in any mode of operation (e.g., forward, reverse, or "neutral" mode) may cause the loss of hydrostatic braking capacity. A braking system, redundant to the hydrostatic transmission must, therefore, be provided which is adequate to stop and hold the system should the condition develop.

Loop flushing valve

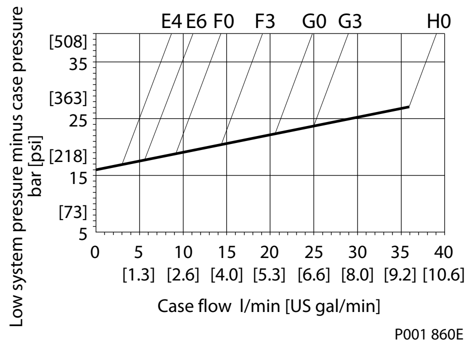


Hydraulic schematic



General technical specifications

Case flow characteristic



Equation:

$$Q_{Flush} = \frac{Q_{Charge} - Q_{Leak}}{2 \cdot k_{Mo}}$$

Where:

Q_{Flush} – flushing flow per motor
Q_{Charge} – charge flow at operating speed
k_{Mo} – number of motors feeded by one pump
Q_{Leak} – sum of external leakages

Q_{Leak} includes:

- motor leakage
- pump leakage + internal consumers:
  - 8 l/min [2.11 US gal/min] for displacement control pumps **or**
  - for non-feedback controlled pumps at 200 bar [2900 psi]
- external consumers:
  - e.g. brakes, cylinders, and other pumps

Minimum displacement limiter

All Series 51 and 51-1 motors incorporate mechanical displacement limiters.

The minimum displacement of the motor is preset at the factory with a set screw in the motor housing. A tamper-proof cap is provided.

Hydraulic fluids

Ratings and 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 the internal components.

Fire resistant fluids are also suitable at modified operating conditions. Please see Danfoss literature Technical Information *Hydraulic Fluids and Lubricants* for more information.

For more information contact your Danfoss representative.

Caution

It is not permissible to mix hydraulic fluids.

Suitable hydraulic fluids:

General technical specifications

- Hydraulic fluids per DIN 51 524, part 2 (HLP)
- Hydraulic fluids per DIN 51 524, part 3 (HVLP)
- API CD, CE and CF engine fluids per SAE J183
- M2C33F or G automatic transmission fluids (ATF)
- Agricultural multi purpose oil (STOU)
- Premium turbine oils (for Premium turbine oils contact your Danfoss representative).

Temperature and viscosity

Temperature and viscosity requirements must be concurrently satisfied. The data shown in the tables assume petroleum-based fluids, are used.

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 **rated temperature**. The **maximum 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 to flow oil 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.

For maximum unit efficiency and bearing life the fluid viscosity should remain in the **recommended operating 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.

Heat exchangers should be sized to keep the fluid within these limits. Testing to verify that these temperature limits are not exceeded is recommended.

Viscosity and temperature range

Features		Unit	All sizes
Viscosity	Minimum intermittent	mm^2/s [SUS]	7 [49]
	Recommended range		12-80 [66-366]
	Maximum intermittent		1600 [7416]
Temperature range[1)2)]	Minimum	°C [°F]	-40 [-40]
	Rated		104 [220]
	Maximum intermittent		115 [240]

1) At the hottest point, normally case drain port.

2) Minimum: cold start, short term t<3 min, p<50 bar, n<1000 rpm.

Filtration system

To prevent premature wear, ensure that 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 cannot be applied for hydraulic fluid residing in the component housing/case or any other cavity upon delivery from the factory.

The filter may be located on the pump (integral) or in another location (remote or suction). The integral filter has a filter bypass sensor to signal the machine operator when the filter requires changing. Filtration strategies include suction or pressure filtration. The selection of the filter strategy depends on a number of factors including the contaminant ingression rate, the generation of contaminants in the system, the required fluid cleanliness, and the desired maintenance interval. Filters are selected to meet the above requirements using rating parameters of efficiency and capacity.

Filter efficiency can be measured with a Beta ratio (β_X). For simple suction-filtered closed circuit transmissions and open circuit transmissions with return line filtration, a filter with a β-ratio within the

General technical specifications

range of $\beta_{35\text{-}45} = 75$ ($\beta_{10} \geq 2$) or better has been found to be satisfactory. For some open circuit systems, and closed circuits with cylinders being supplied from the same reservoir, a higher filter efficiency is recommended. This also applies to systems with gears or clutches using a common reservoir. For these systems, a charge pressure or return filtration system with a filter β-ratio in the range of $\beta_{15\text{-}20} = 75$ ($\beta_{10} \geq 10$) or better is typically required.

Because each system is unique, only a thorough testing and evaluation program can fully validate the filtration system. For more information, see *Design Guidelines for Hydraulic Fluid Cleanliness, Technical Information* **BC00000095**.

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

Filtration, cleanliness level and β_x-ratio (recommended minimum)

Cleanliness per ISO 4406	22/18/13
Efficiency β_x (charge pressure filtration)	$\beta_{15\text{-}20} = 75$ ($\beta_{10} \geq 10$)
Efficiency β_x (suction and return line filtration)	$\beta_{35\text{-}45} = 75$ ($\beta_{10} \geq 2$)
Recommended inlet screen mesh size	100 – 125 µm

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 motor components.

Caution

Never mix hydraulic fluids of different types.

Fire resistant fluids are also suitable at modified operating conditions. For more information, see *Hydraulic Fluids and Lubricants, Technical Information* **BC00000093**.

Reservoir

The function of the reservoir is to remove air and to provide make up fluid for volume changes associated with fluid expansion or contraction, possible cylinder flow, and minor leakage.

The reservoir should be designed to accommodate maximum volume changes during all system operating modes and to promote deaeration of the fluid as it passes through the tank.

A minimum reservoir volume equal to 1/2 to 1 1/2 times charge pump flow/min is suggested. 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. The reservoir outlet to the charge pump inlet should be above the bottom of the reservoir to take advantage of gravity separation and prevent large foreign particles from entering the charge inlet line.

The reservoir inlet (fluid return) should be positioned so that the flow to the reservoir is discharged below the normal fluid level, and also directed into the interior of the reservoir for maximum dwell and efficient deaeration.

Independent braking system

Warning

The loss of hydrostatic drive line power in any mode of operation (e.g., forward, reverse, or "neutral" mode) may cause the loss of hydrostatic braking capacity. A braking system, redundant to the hydrostatic transmission must, therefore, be provided which is adequate to stop and hold the system should the condition develop.

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Motor bearing life

The rated motor bearing life L_{h10} shown in the table below is based on a 90 % survival rate of shaft bearings, when operating at a speed of n = 1500 min^{-1} (rpm) with a charge pressure of 20 bar [290 psi] and without external shaft load.

The rated motor bearing life L_{h10} (hours)

Frame Size	Effective Δ pressure bar [psi]	Motor angle		
		6°	15°	32°
060	140 [2030]	19 800	18 530	16 370
	210 [3050]	6320	5960	5340
	280 [4060]	2740	2600	2350
080	140 [2030]	14 420	13 580	12 120
	210 [3050]	4610	4370	3960
	280 [4060]	2000	1910	1750
110	140 [2030]	15 800	14 890	13 330
	210 [3050]	5040	4790	4350
	280 [4060]	2180	2090	1920
160	140 [2030]	15 670	14 770	13 200
	210 [3050]	5005	4750	4300
	280 [4060]	2170	2070	1900
250	140 [2030]	11 760	11 130	10 020
	210 [3050]	3750	3580	3260
	280 [4060]	1630	1560	1440

Lifetimes for speeds other than 1500 min^{-1} (rpm) can be calculated from:

$$L_2 = \frac{L_1 \cdot 1500}{n_2} \quad \text{hours}$$

Where:			*Units:*
L_1	=	Rated L_{10} life at 1500 min^{-1} (rpm)	hours
n_2	=	Operating speed	min^{-1} (rpm)

Contact your Danfoss Power Solutions representative for bearing life values at other pressure and angle.

General technical specifications

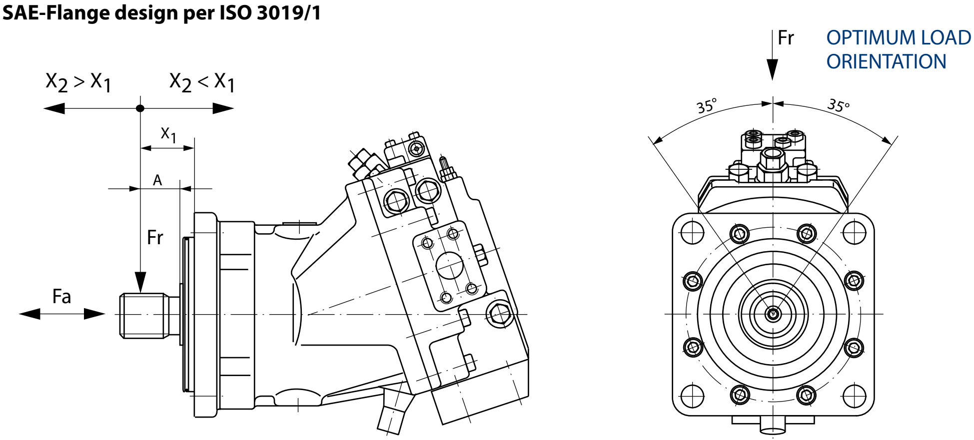
External shaft loads

Series 51 and 51-1 motors are designed with bearings that can accept external radial and thrust loads.

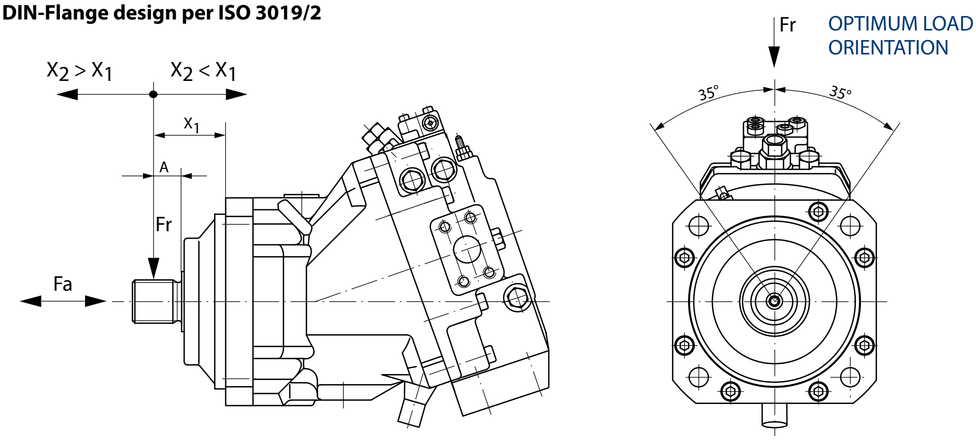
The external radial shaft load limits are a function of the load position, the load orientation, and operating conditions of the unit.

External shaft load orientation

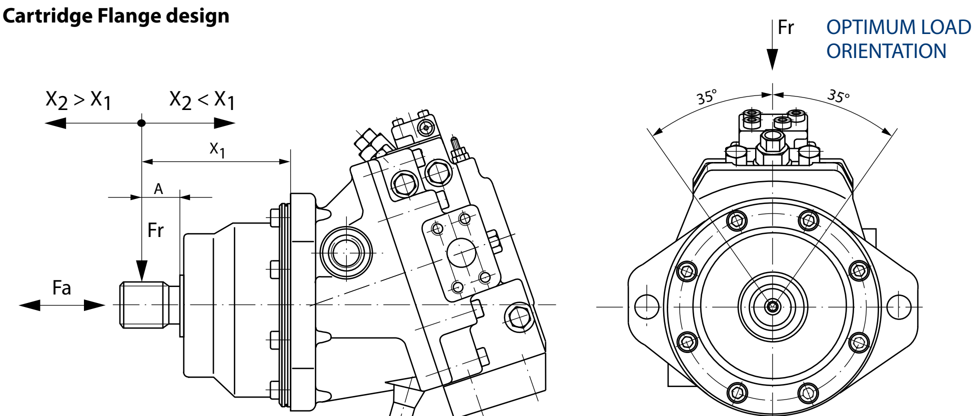
SAE-Flange design per ISO 3019/1



DIN-Flange design per ISO 3019/2



Cartridge Flange design



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General technical specifications

Radial and thrust loads to the output shaft

The table below provides the following information:

- The maximum allowable radial load (**Fr**) based on the distance (**X_1**) from the mounting flange to the load.
- The maximum allowable axial load (**Fa**).
- The actual distance of Fr for a given application from the mounting flange to the load (**X_2**).
- The basic distance (**A**).
- **Fa/Δp** ratio of allowable axial load, dependent upon the system pressure.

Radial and thrust loads to the output shaft

Feature	Symbol	Unit	Frame Size				
			060	080	110	160	250
Maximum allowable radial load	Fr	N [lb]	10 000 [2248]	12 000 [2698]	14 000 [3147]	18 000 [4047]	26 000 [5845]
Max. allow. axial load at zero rpm, or running in the idle pressure	Fa	N [lb]	1100 [247]	1400 [315]	1800 [405]	2500 [562]	4500 [1012]
Max. allowable bending moment	M	N•m [lb•in]	252 [2230]	307 [2717]	766 [6780]	805 [7125]	970 [8585]
Max. allowable axial load at pressure	Fa/Δp	N/bar [lb/1000 psi]	10.4 [161]	12.6 [195]	15.2 [236]	19.2 [298]	26.4 [409]
Distance SAE mounting flange	X_1	mm [in]	33.6 [1.32]	33.6 [1.32]	62.7 [2.47]	52.7 [2.07]	45.3 [1.78]
Distance DIN mounting flange	X_1	mm [in]	57.2 [2.25]	57.6 [2.27]	94.7 [3.73]	84.7 [3.33]	–
Distance Cartridge mount. flange	X_1	mm [in]	117.6 [4.63]	136.1 [5.36]	177.5 [7.0]	–	–
Basic distance	A	mm [in]	25.2 [0.99]	25.6 [1.01]	54.7 [2.15]	44.7 [1.76]	37.3 [1.47]

– = not available

The values in the table are maximum values and are not allowed under continuous load conditions.

Allowable external shaft load, when shaft load distance is different from standard

Use this formula to calculate maximum allowable radial load when max. shaft load distance **X_2** is different from **X_1**:

Metric system:	Inch system:
$X_2 > X_1 \quad Fr = \frac{M \cdot 10^3}{A - X_1 + X_2}$ N	$X_2 > X_1 \quad Fr = \frac{M \cdot 12}{A - X_1 + X_2}$ lbf

Metric or Inch system:

$X_2 > X_1$ Fr = Fr $_{max}$ N [lbf]

X_2 is the actual distance of **Fr** from the mounting flange to the load for a given application. If **$X_2 < X_1$**, **Fr** could also be calculated by the first equation, but in addition the bearing life has to be checked.

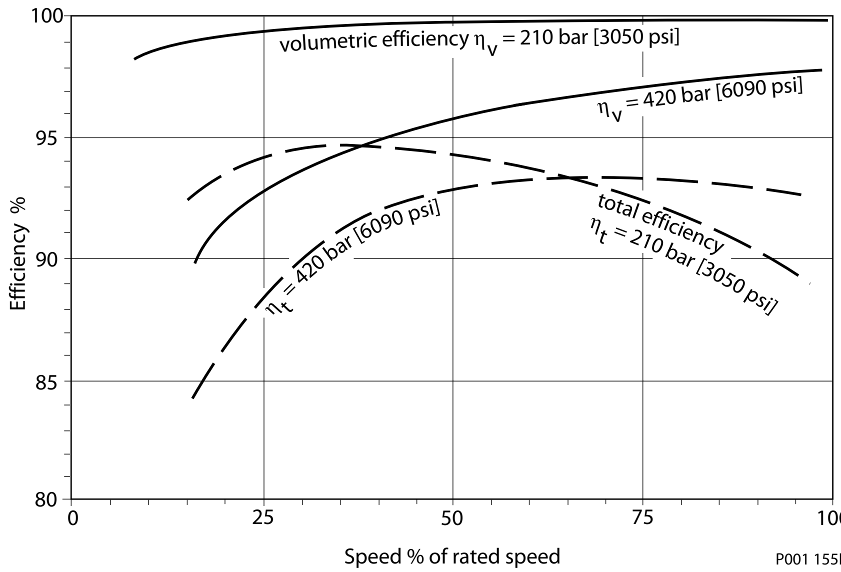
Contact your Danfoss representative for load ratings of specific shafts or when the load orientation deviates more than 35° in either direction from the optimum.

General technical specifications

Efficiency graphs and maps

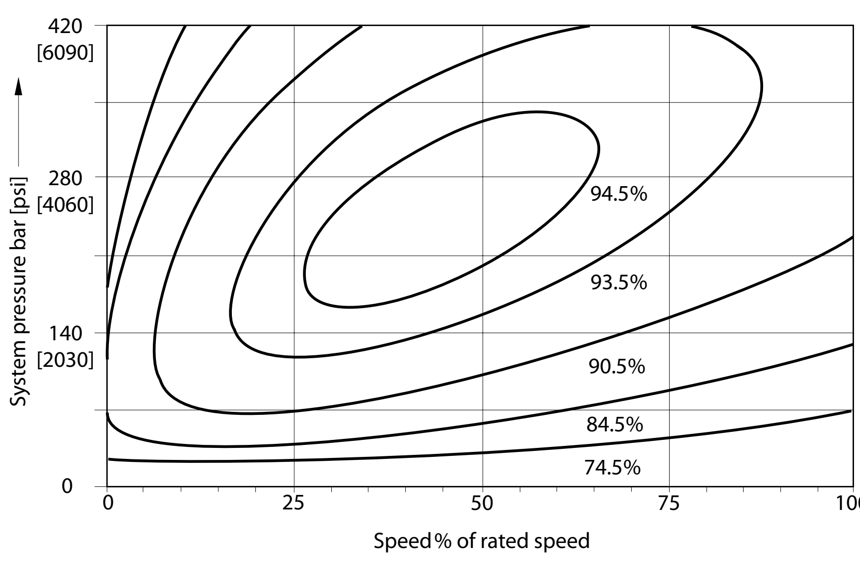
This graph provides the volumetric and overall efficiencies for a typical Series 51 and 51-1 motor operating at maximum displacement, system pressures of 210 and 420 bar [3050 and 6090 psi], and a fluid viscosity of 8.2 mm²/s [53 SUS]. These efficiencies can be used for all frame sizes.

Overall and volumetric efficiency at maximum displacement



This graph shows typical overall efficiencies for Series 51 and 51-1 motors operating at maximum displacement and system pressures up to 420 bar [6090 psi], and a fluid viscosity of 8.2 mm²/s [53 SUS]. These efficiencies can be used for all frame sizes.

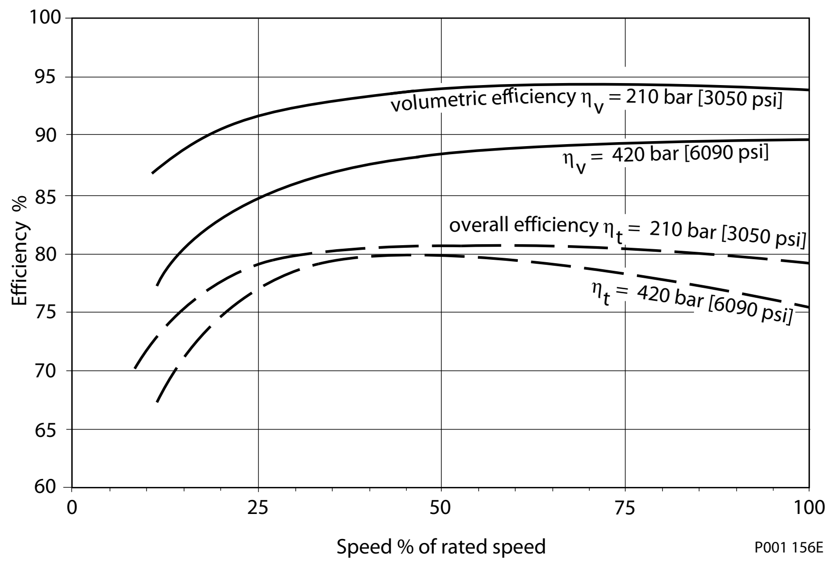
Overall efficiency at maximum displacement



This graph shows typical overall efficiencies for Series 51 and 51-1 motors operating at 30% of maximum displacement and system pressures up to 420 bar [6090 psi], and a fluid viscosity of 8.2 mm²/s (53 SUS). These efficiencies can be used for all frame sizes.

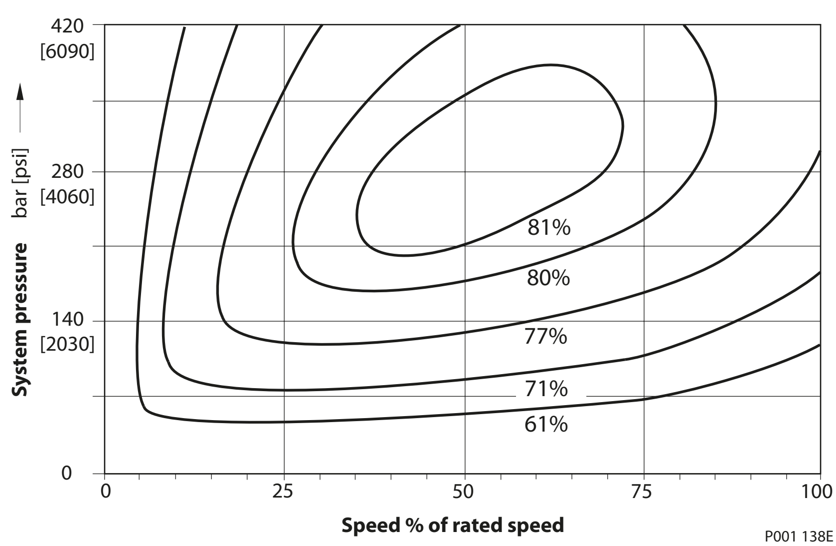
General technical specifications

Overall and volumetric efficiency at 30% of maximum displacement



This graph shows typical overall efficiencies for Series 51 and 51-1 motors operating at 30% of maximum displacement and system pressures up to 420 bar [6090 psi], and a fluid viscosity of 8.2 mm²/s (53 SUS). These efficiencies can be used for all frame sizes.

Overall efficiency at 30% of maximum displacement



General technical specifications

Speed sensor

An optional speed sensor for direct measurement of speed is available. This sensor may also be used to sense the direction of rotation. A special magnetic speed pick-up ring is pressed onto the outside diameter of the shaft and a Hall effect sensor is located in the motor housing. The sensor accepts supply voltage and outputs a digital pulse signal in response to the speed of the ring. The output changes its high/low state as the north and south poles of the permanently magnetized speed ring pass by the face of the sensor. The digital signal is generated at frequencies suitable for microprocessor based controls. The sensor is available with different connectors (see below). The SAE and DIN flange motors use a flat end speed sensor. The cartridge flange motors use a conical end speed sensor.

Data magnetic speed pick-up ring

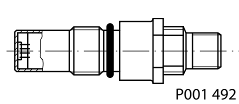
Frame size	060	080	110	160	250
Pulze/Rev	45	49	54	61	71

Speed sensor technical data

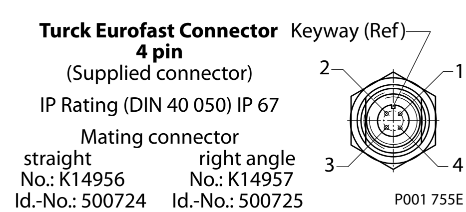
Supply voltage[1)]	4.5 – 8.5 V_{DC}
Supply voltage regulated	15 V_{DC} max.
Required current	12 mA at 5 V_{DC} (no load)
Maximum current	20 mA at 5 V_{DC} and 1 Hz
Maximum frequency	15 kHz
Voltage "high"	Supply voltage -0.5 V_{DC} min.
Voltage "low"	0.5 V_{DC} max.
Temperature range	-40 to 110 °C [-40 to 230 °F]

[1)] It is not acceptable to energize the 4.5-8.5 V_{DC} speed sensor with 12 V_{DC} battery voltage; it must be energized by a regulated power supply. If it is desirable to energize the sensor with battery voltage, contact your Danfoss representative for an optional speed sensor.

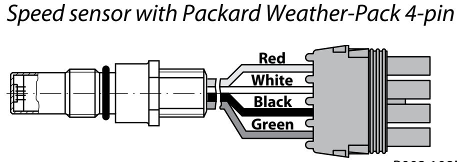
Speed sensor with Turck Eurofast 4-pin connector



Pin 1 or A: Supply voltage
Pin 2 or B: Direction of rotation
Pin 3 or C: Speed signal, digital
Pin 4 or D: Ground common



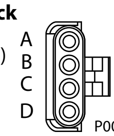
Speed sensor with Packard Weather-Pack 4-pin connector



General technical specifications

Packard Weather-Pack
4 pin
(Supplied Connector)

Mating Connector
No.: K03379
Id.-No.: 505341



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Contact your Danfoss representative for more information.

Typical control and regulator applications

Application	Control / Regulators														
	without PCOR						with PCOR				with PCOR and BPD				
	N1	HZ	E1, E2, E7	EP, EQ	F1, F2	L1, L2, L7	TA	T1, T2	TH	HS	TA	T1, T2	EP, EQ	D7, D8	HS
Wheel loader[1]			●		●	●	●	●	●		●	●		●	
Roller compactor[1]	●	●	●		●										
Paver wheeled[1]	●		●		●										
Paver tracked[1]	●		●	●	●	●						●			
Sweeper[1]		●												●	●
Trencher[1]	●	●	●												●
Excavator wheeled[1]									●					●	●
Fork lift truck[1]						●								●	
Agricultural[1]				●		●							●	●	
Forestry[1]								●	●	●		●	●	●	●
Telehandler[1]							●		●		●	●		●	
Railroad[1]				●		●						●	●	●	
Snow groomer[1]	●	●	●	●		●									
Snow blower[2]			●										●	●	
Crane[3]			●												

● Suitable configuration

[1] Propel function

[2] Blow drive function

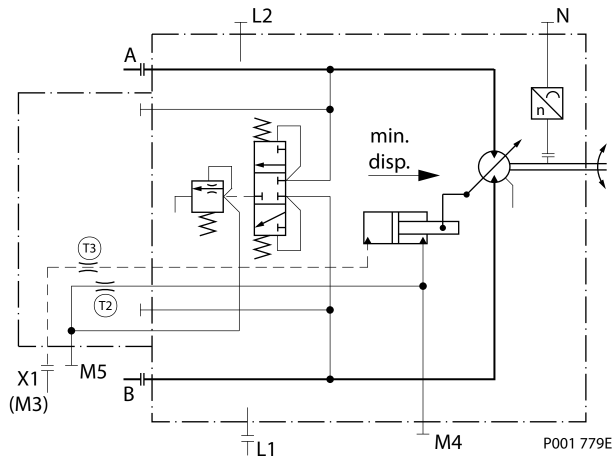
[3] Winch function

The table above is provided to assist in selecting controls and regulators for various applications. These recommendations are based on experience with a wide range of applications.

Contact your Danfoss Power Solutions representative for more information on control selection.

Controls circuit diagram – nomenclature – description

Option N1NN – hydraulic two-position control for 51-1 (frame size: 060, 080, 110)



A, B = Main pressure lines
L1, L2 = Drain lines
M4 = Gauge port servo pressure
M5 = Gauge port servo supply pressure
X1 (M3) = Control pressure
T1, T2, T3 = Optional orifices
N = Speed sensor

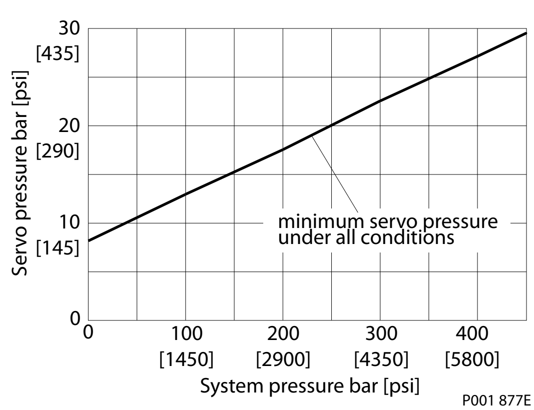
Displacement changes from maximum displacement to minimum displacement position, under load, as control pressure at port X1 (M3) is equal to low pressure or higher.

Control pressure on port X1 (M3)

No pressure on port = maximum displacement
Control pressure on port = minimum displacement
Maximum control pressure = 50 bar [725 psi]

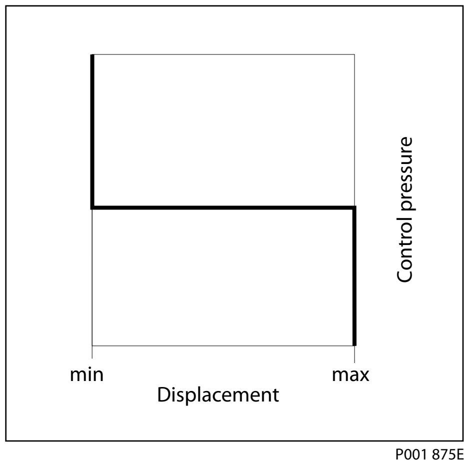
The graph shows the necessary external and internal (= low system pressure) control pressure X1, which is needed to stroke the motor depending on high system pressure.

Control N1NN necessary control pressure



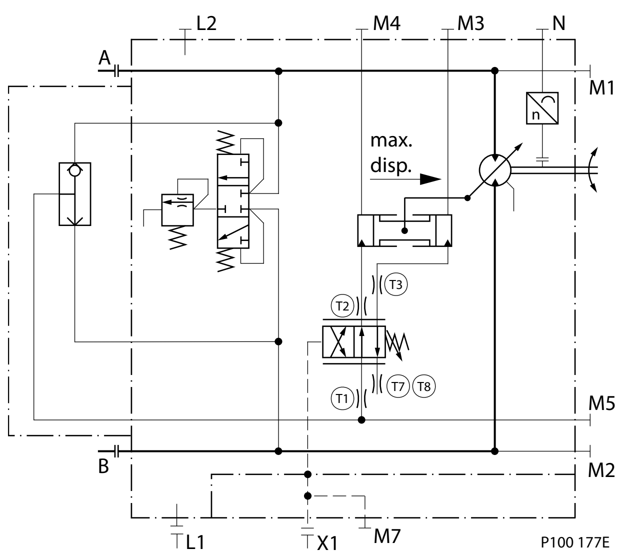
Controls circuit diagram – nomenclature – description

Control operation N1NN



Not all control options are shown in this Technical Information.
Contact your Danfoss representative for special control functions.

Option HZB1 – hydraulic two-position control for 51 (frame size: 160, 250)



A, B = Main pressure lines
L1, L2 = Drain lines
M1, M2 = Gauge port for A and B
M3, M4 = Servo pressure
M5 = Gauge port servo supply pressure internal
M7 = Gauge port control pressure
X1 = Control pressure
T1, T2, T3, T7, T8 = Optional orifices
N = Speed sensor

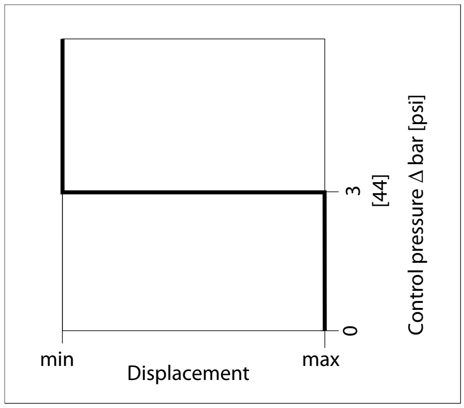
Displacement can be changed hydraulically under load from minimum displacement to maximum displacement and vice versa by control pressure to port X1. For proportional control see *Option HZB1 – hydraulic proportional control for 51 (all frame sizes)* on page 62

Control pressure on port X1

Controls circuit diagram – nomenclature – description

No pressure on port = maximum displacement
Control pressure on port = minimum displacement
Maximum control pressure = 50 bar [725 psi]
The standard control start point setting = 3 bar [44 psi]

Control operation HZB1



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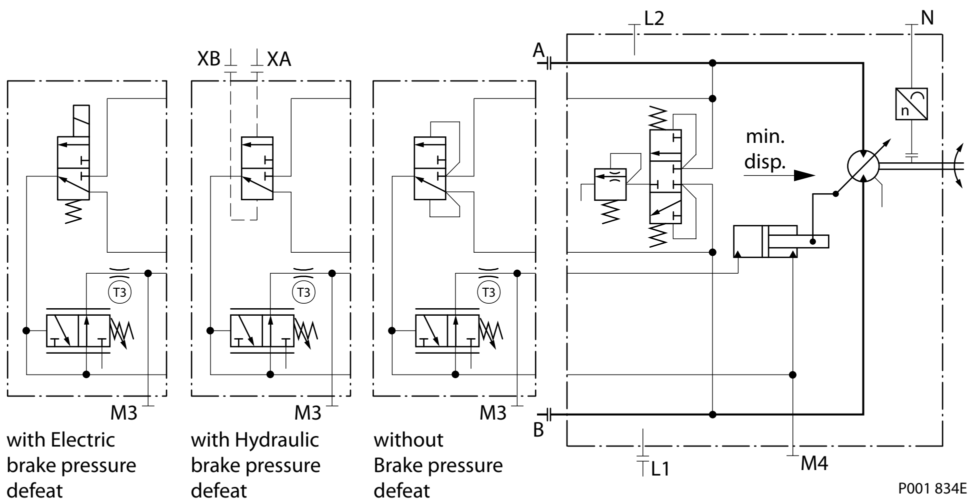
Not all control options are shown in this Technical Information.
Contact your Danfoss representative for special control functions.

Controls circuit diagram – nomenclature – description

Options TA** – pressure compensator control for 51-1 (frame size: 060, 080, 110)

*Circuit diagram–motor with pressure compensator control TA***



P001 834E

Ports:

- **A, B** = Main pressure lines
- **L1, L2** = Drain lines
- **M3, M4** = Servo pressure
- **XA, XB** = Control pressure port brake pressure defeat (BPD)
- **T3** = Orifice
- **N** = Speed sensor

Displacement is regulated automatically between minimum and maximum displacement in response to system pressure.

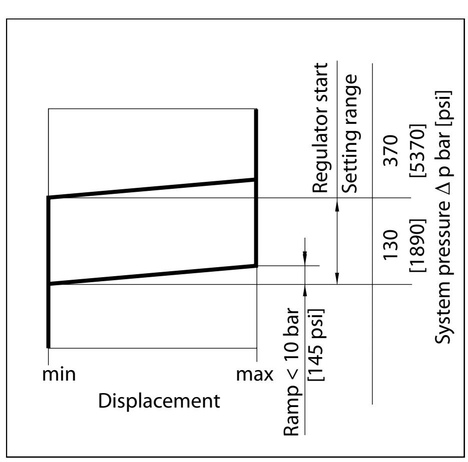
Regulator start = minimum displacement

Regulator end = maximum displacement

Regulator start pressure is adjustable from 130 to 370 bar [1890 to 5370 psi].

Pressure ramp from regulator start pressure (with motor at minimum displacement) until maximum displacement is reached is less than 10 bar [145 psi]. This ensures optimal power utilization throughout the entire displacement range of the motor.

*Control operation TA***



P001 173E

Controls circuit diagram – nomenclature – description

Option TACA: pressure compensator configuration with hydraulic Brake Pressure Defeat

A shuttle valve ahead of the pressure compensator prevents operation in the deceleration direction (when motor is running in pump mode). This is designed to prevent rapid or uncontrolled deceleration while the vehicle/machine is slowing down. Pressure compensator override with brake pressure defeat is mainly used in systems with pumps having electric or hydraulic proportional controls or automotive controls.

The shuttle valve must be controlled by a 2-line external signal, based on direction of motor rotation, based on the following table:

Motor rotation	High pressure port	Control pressure on port*	PCOR function
CW	A	XA	yes
CW	A	XB	no
CCW	B	XA	no
CCW	B	XB	yes

* Differencial control pressure between port XA/XB:
Δp_{min} = 0.5 bar [7 psi]
Δp_{max} = 50 bar [725 psi]

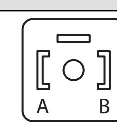
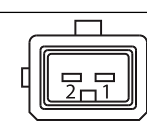
Options TAD1, TAD2, TAD7: pressure compensator configuration with electric BPD

A solenoid-switched valve ahead of the pressure compensator prevents operation in the deceleration direction (when motor is running in pump mode). This is designed to prevent rapid or uncontrolled deceleration while the vehicle/machine is slowing down.

The solenoid valve must be controlled by an external electric signal, based on direction of motor rotation, see the following table:

Motor rotation	High pressure port	Solenoid	PCOR function
CW	A	energized	yes
CW	A	non energized	no
CCW	B	energized	no
CCW	B	non energized	yes

TAD solenoid connectors*

Configuration	Voltage / Electric power	Connector (supplied)	
TAD1	12 V_{DC} / 34 W	Solenoid plug face for DIN 46350 Mating connector No.: K09129 Id. No.: **514117**	 P001752
TAD2	24 V_{DC} / 34 W		
TAD7	12 V_{DC} / 34 W	AMP Junior Timer two-pin Mating connector No.: K19815 Id. No.: **508388**	 P001751

Option TAC2: pressure compensator configuration without Brake Pressure Defeat

Pressure compensator functions when the motor is running in motor mode as well as in pump (deceleration) mode.

Configuration option	High pressure port	PCOR function
TAC2	A and B	yes

Controls circuit diagram – nomenclature – description

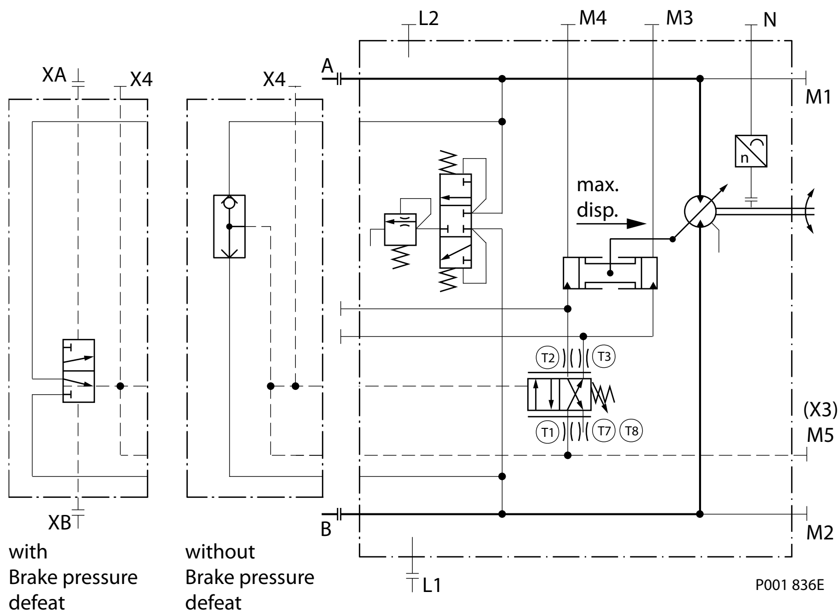
Not all control options are shown in this Technical Information.

Contact your Danfoss representative for special control functions.

Controls circuit diagram – nomenclature – description

Options TA** – pressure compensator controls for 51 (frame size 160, 250)

*Circuit Diagram–Motor with Pressure Compensator Control TA***



Ports:

- **A, B** = Main pressure lines
- **L1, L2** = Drain lines
- **M1, M2** = Gauge port for A and B
- **M3, M4** = Gauge port servo pressure
- **M5 (X3)** = Gauge port servo supply
- **XA, XB** = Control pressure ports, brake pressure defeat
- **X4** = Gauge port pressure compensator
- **T1, T2, T3, T7, T8** = Optional orifices
- **N** = Speed sensor

Displacement is regulated automatically between minimum and maximum displacement in response to system pressure.

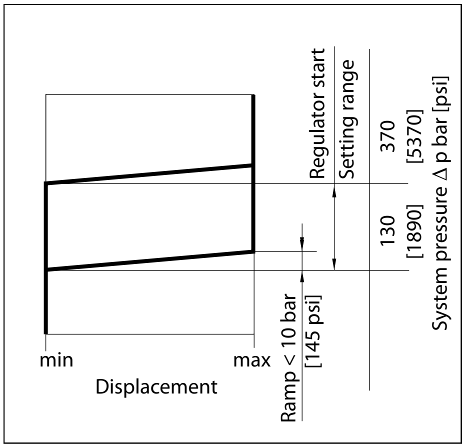
Regulator start = minimum displacement
Regulator end = maximum displacement

Regulator start pressure is adjustable from 130 to 370 bar [1890 to 5370 psi].

Pressure ramp from regulator start pressure (with motor at minimum displacement) until maximum displacement is reached is less than 10 bar [145 psi]. This ensures optimal power utilization throughout the entire displacement range of the motor.

Controls circuit diagram – nomenclature – description

*Control operation TA***



P001 173E

Option TAC0: pressure compensator configuration with hydraulic Brake Pressure Defeat

A shuttle valve ahead of the pressure compensator prevents operation in the deceleration direction (when motor is running in pump mode). This is designed to prevent rapid or uncontrolled deceleration while the vehicle/machine is slowing down.

Pressure compensator override with brake pressure defeat is mainly used in systems with pumps having electric or hydraulic proportional controls or automotive controls.

The shuttle valve must be controlled by a 2-line external signal, based on direction of motor rotation, see the following table.

Motor rotation	High pressure port	Control pressure on port*	PCOR function
CW	A	XA	no
CW	A	XB	yes
CCW	B	XA	yes
CCW	B	XB	no

* Differencial control pressure between port XA/XB:
Δp_{min} = 0.5 bar [7 psi]
Δp_{max} = 50 bar [725 psi]

Option TAC2: pressure compensator configuration without Brake Pressure Defeat

Pressure compensator functions when the motor is running in motor mode as well as in pump (deceleration) mode.

Configuration option	High pressure port	PCOR function
TAC2	A and B	yes

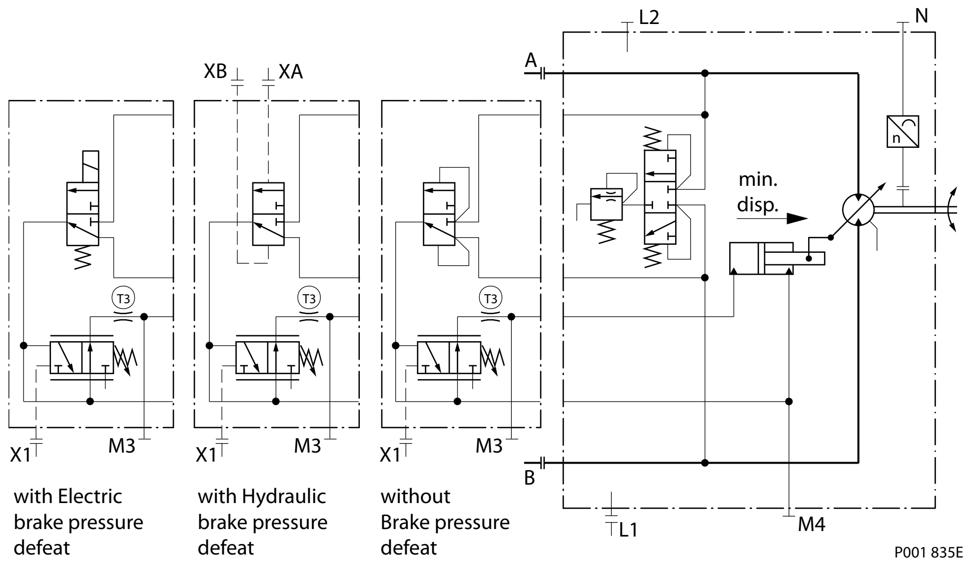
Not all control options are shown in this Technical Information.

Contact your Danfoss representative for special control functions.

Controls circuit diagram – nomenclature – description

Options TH** – hydraulic two-position control for 51-1 (frame size: 060, 080, 110)

*Circuit diagram – motor with two-position control TH***



Ports:

A, B = Main pressure lines
L1, L2 = Drain lines
M1, M2 = Gauge port for A and B
M3, M4 = Gauge port servo pressure
M5 (X3) = Gauge port servo supply
XA, XB = Control pressure ports, brake pressure defeat
X1 = Hydraulic two-position signal
X4 = Gauge port pressure compensator
T1, T2, T3, T7, T8 = Optional orifices
N = Speed sensor

Displacement can be changed hydraulically under load from minimum displacement to maximum displacement and vice versa.

Pressure on port X1 must be equal to the pressure of the motor case ± 0.2 bar [3.0 psi] this keeps the motor at minimum displacement.

Pressure from 10 bar [145 psi] to 35 bar [510 psi] above case pressure on port X1 strokes the motor to maximum displacement.

Pressure Compensator OverRide (PCOR)

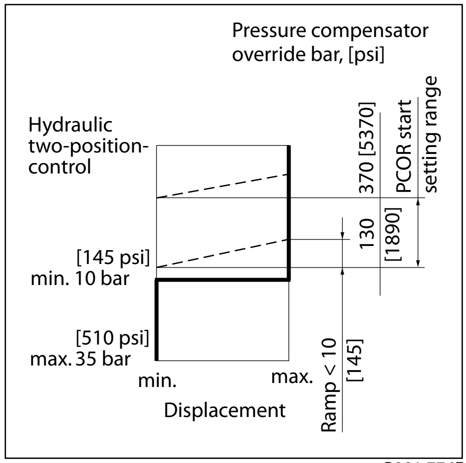
The control can be overridden by PCOR using high loop pressure.

When the PCOR activates, the motor displacement increases toward maximum. Pressure ramp from PCOR start pressure (with motor at minimum displacement) until maximum displacement is reached is less than 10 bar [145 psi]. This ensures optimal power utilization throughout the entire displacement range of the motor.

PCOR start pressure is adjustable from 130 to 370 bar [1890 to 5370 psi].

Controls circuit diagram – nomenclature – description

*Control operation TH***



P001 776E

Option THCA: pressure compensator configuration with hydraulic Brake Pressure Defeat

A shuttle valve ahead of the pressure compensator prevents operation in the deceleration direction (when motor is running in pump mode). This is designed to prevent rapid or uncontrolled deceleration while the vehicle/machine is slowing down. Pressure compensator override with brake pressure defeat is mainly used in systems with pumps having electric or hydraulic proportional controls or automotive controls. The shuttle valve must be controlled by a 2-line external signal, based on direction of motor rotation, based on the following table:

Pressure compensator operation

Motor rotation	High pressure port	Control pressure on port*	PCOR function
CW	A	XA	yes
CW	A	XB	no
CCW	B	XA	no
CCW	B	XB	yes

* Differencial control pressure between port XA / XB:
Δp_{min} = 0.5 bar [7 psi];
Δp_{max} = 50 bar [725 psi]

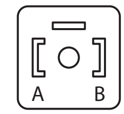
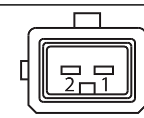
Options THD1, THD2, THD7: pressure compensator configuration with electric BPD

A solenoid-switched valve ahead of the pressure compensator prevents operation in the deceleration direction (when motor is running in pump mode). This is designed to prevent rapid or uncontrolled deceleration while the vehicle/machine is slowing down. The solenoid valve must be controlled by an external electric signal, based on direction of motor rotation, see the following table:

Motor rotation	High pressure port	Solenoid	PCOR function
CW	A	energized	yes
CW	A	non energized	no
CCW	B	energized	no
CCW	B	non energized	yes

Controls circuit diagram – nomenclature – description

THD* solenoid connectors

Configuration	Voltage / Electric power	Connector (supplied)	
THD1	12 V_{DC} / 34 W	Solenoid plug face for DIN 46350 Mating connector No.: K09129 Id. No.: **514117**	 P001752
THD2	24 V_{DC} / 34 W		
THD7	12 V_{DC} / 34 W	AMP Junior Timer two-pin Mating connector No.: K19815 Id. No.: **508388**	 P001751

Option THC2: pressure compensator configuration without Brake Pressure Defeat

Pressure compensator functions when the motor is running in motor mode as well as in pump (deceleration) mode.

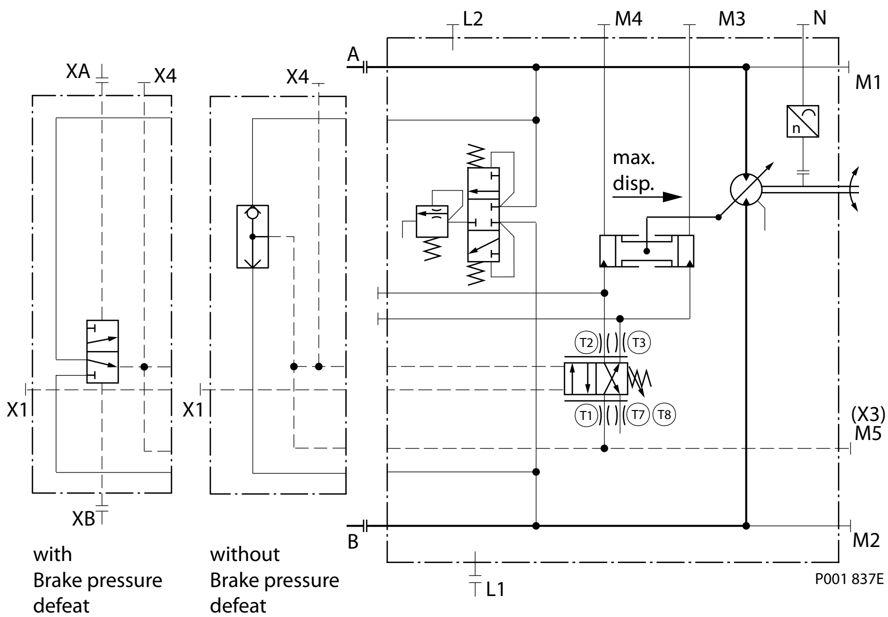
Configuration option	High pressure port	PCOR function
THC2	A and B	yes

Not all control options are shown in this Technical Information.
Contact your Danfoss representative for special control functions.

Controls circuit diagram – nomenclature – description

Options TH** – hydraulic two-position control for 51 (frame size 160, 250)

*Circuit diagram – motor with two-position control TH***



Ports:

A, B = Main pressure lines
L1, L2 = Drain lines
M1, M2 = Gauge port for A and B
M3, M4 = Gauge port servo pressure
M5 (X3) = Gauge port servo supply
XA, XB = Control pressure ports, brake pressure defeat
X1 = Hydraulic two-position signal
X4 = Gauge port pressure compensator
T1, T2, T3, T7, T8 = Optional orifices
N = Speed sensor

Pressure Compensator OverRide (PCOR)

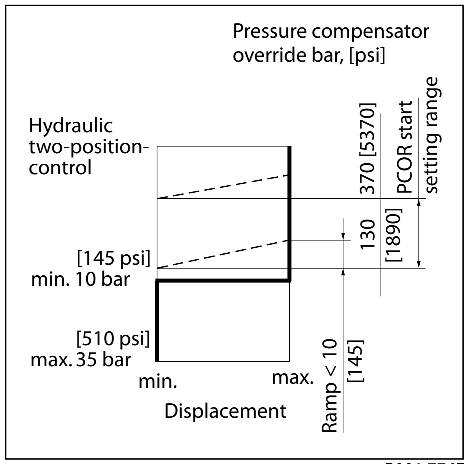
The control can be overridden by PCOR using high loop pressure.

When the PCOR activates, the motor displacement increases toward maximum. Pressure ramp from PCOR start pressure (with motor at minimum displacement) until maximum displacement is reached is less than 10 bar [145 psi]. This ensures optimal power utilization throughout the entire displacement range of the motor.

PCOR start pressure is adjustable from 130 to 370 bar [1890 to 5370 psi].

Controls circuit diagram – nomenclature – description

*Control operation TH***



P001 776E

Option THC0: pressure compensator configuration with hydraulic BPD

A shuttle valve ahead of the pressure compensator prevents operation in the deceleration direction (when motor is running in pump mode). This is designed to prevent rapid or uncontrolled deceleration while the vehicle/machine is slowing down. Pressure compensator override with brake pressure defeat is mainly used in systems with pumps having electric or hydraulic proportional controls or automotive controls.

The shuttle valve must be controlled by a 2-line external signal, based on direction of motor rotation, see the following table:

Pressure compensator operation

Motor rotation	High pressure port	Control pressure on port*	PCOR function
CW	A	XA	no
CW	A	XB	yes
CCW	B	XA	yes
CCW	B	XB	no

* Differencial control pressure between port XA / XB:
Δp_{min} = 0.5 bar [7 psi]
Δp_{max} = 50 bar [725 psi]

Option THC2: pressure compensator configuration without Brake Pressure Defeat

Pressure compensator functions when the motor is running in motor mode as well as in pump (deceleration) mode.

Configuration option	High pressure port	PCOR function
THC2	A and B	yes

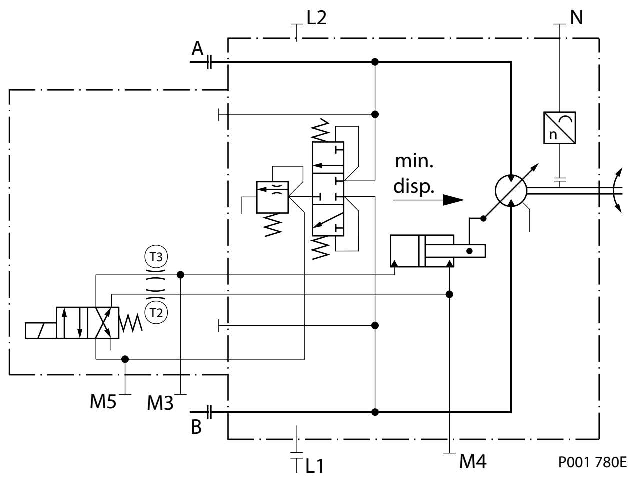
Not all control options are shown in this Technical Information.

Contact your Danfoss representative for special control functions.

Controls circuit diagram – nomenclature – description

Options E1B1, E2B1, E7B1 – electrohydraulic two-position control for 51-1 (frame size 060, 080, 110)

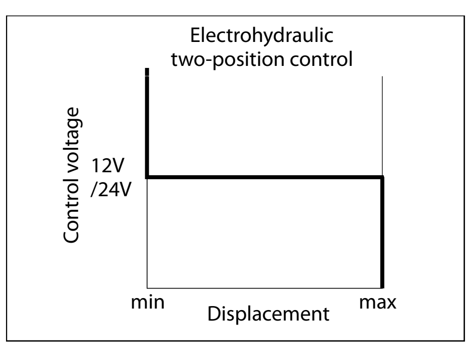
Circuit diagram – motor with EH two-position control E1B1, E2B1, E7B1



A, B = Main pressure lines
L1, L2 = Drain lines
M3, M4 = Servo pressure
M5 = Gauge port servo supply pressure internal
T2, T3 = Optional orifices
N = Speed sensor

Displacement can be changed electrohydraulically under load from maximum displacement to minimum displacement and vice versa, by using a built-in solenoid valve.

Control operation E1B1, E2B1, E7B1



Options:

Solenoid off = max. displacement

Solenoid on = min. displacement

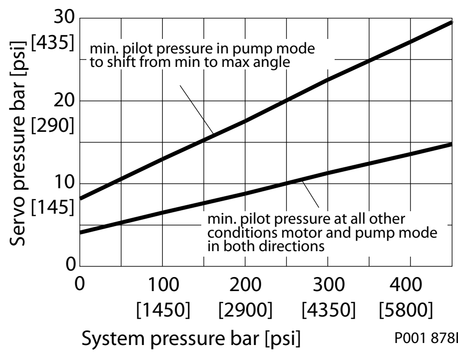
Pilot pressure for solenoid:

internal = low pressure

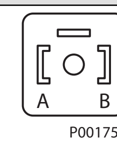
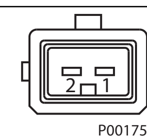
The graph shows the necessary servo pressure (= low pressure), which is needed to stroke the motor, depending on high system pressure and the pump or motor mode.

Controls circuit diagram – nomenclature – description

*Control E*B1 necessary low system pressure*



E1B1, E2B1, E7B1 solenoid connectors

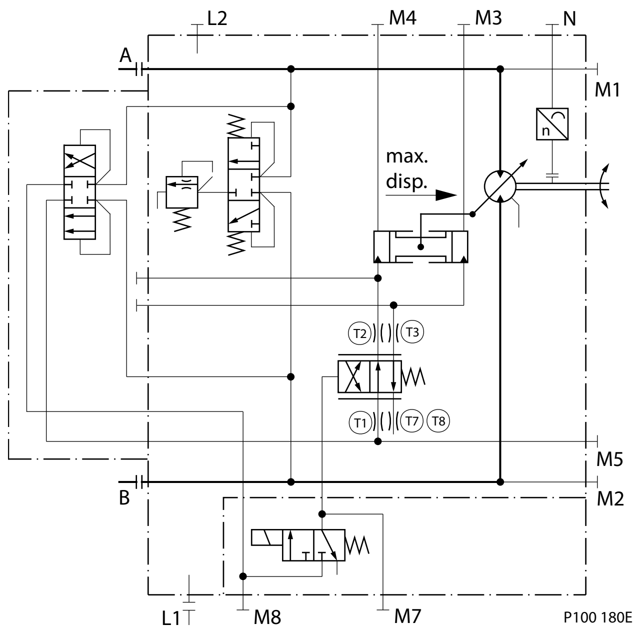
Configuration	Voltage / Electric power	Connector (supplied)	
E1B1	12 V_{DC} / 34 W	Solenoid plug face for DIN 46350 Mating connector No.: K09129 Id. No.: **514117**	
E2B1	24 V_{DC} / 34 W		
E7B1	12 V_{DC} / 34 W	AMP Junior Timer two-pin Mating connector No.: K19815 Id. No.: **508388**	

Not all control options are shown in this Technical Information.
Contact your Danfoss representative for special control functions.

Controls circuit diagram – nomenclature – description

Options E1A5, E2A5 – electrohydraulic two-position control for 51 (frame size 160, 250)

Circuit diagram – motor with control options: E1A5, E2A5

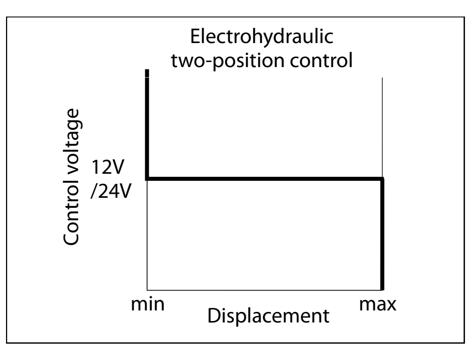


Ports:

A, B = Main pressure lines
L1, L2 = Drain lines
M1, M2 = Gauge port for A and B
M3, M4 = Gauge port servo pressure
M5 = Gauge port servo supply pressure, internal
M7, M8 = Gauge port control pressure, internal
T1, T2, T3, T7, T8 = Optional orifices
N = Speed sensor

Displacement can be changed electrohydraulically under load from maximum displacement to minimum displacement and vice versa, by using a built-in solenoid valve.

Control operation E1A5, E2A5



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Options:

Solenoid off = max. displacement

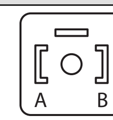
Solenoid on = min. displacement

Pilot pressure for solenoid:

Controls circuit diagram – nomenclature – description

internal = low pressure

E1A5, E2A5 solenoid connectors

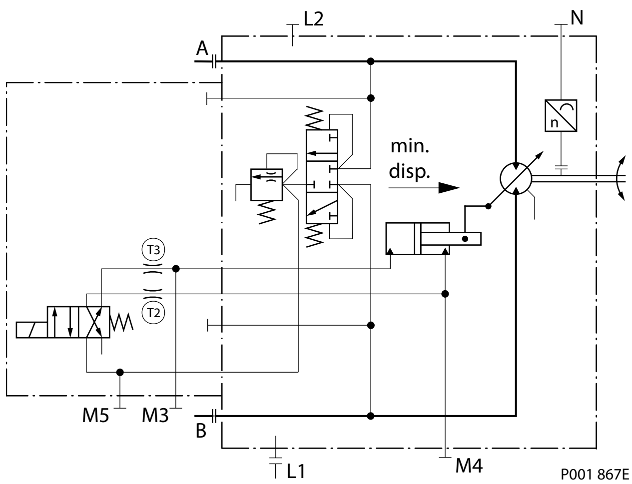
Configuration	Voltage / Electric power	Connector (Supplied)	
E1A5	12 V_{DC} / 14.7 W	Solenoid plug face for DIN 46350 Mating connector No.: K09129 Id. No.: **514117**	 P001752
E2A5	24 V_{DC} / 14.7 W		

Not all control options are shown in this Technical Information.
Contact your Danfoss representative for special control functions.

Controls circuit diagram – nomenclature – description

Options F1B1, F2B1 – electrohydraulic two-position control for 51-1 (frame size 060, 080, 110)

Circuit diagram – motor with control options: F1B1, F2B1

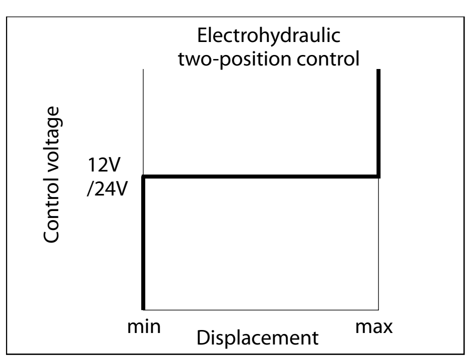


Ports:

A, B = Main pressure lines
L1, L2 = Drain lines
M3, M4 = Servo pressure
M5 = Gauge port servo supply pressure internal
T2, T3 = Optional orifices
N = Speed sensor

Displacement can be changed electrohydraulically under load from maximum displacement to minimum displacement and vice versa, by using a built-in solenoid valve.

Control operation F1B1, F2B1



Options:

Solenoid off = min. displacement
Solenoid on = max. displacement

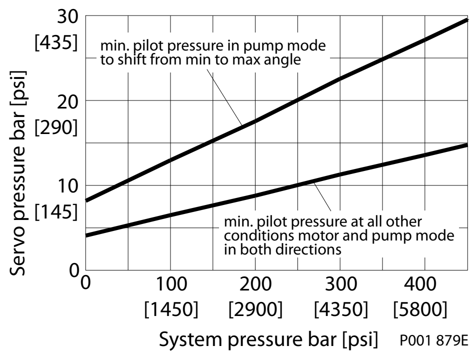
Pilot pressure for solenoid:

internal = low pressure

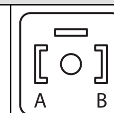
The graph shows the necessary servo pressure (= low pressure), which is needed to stroke the motor, depending on high system pressure and the pump or motor mode.

Controls circuit diagram – nomenclature – description

Control F1B1, F2B1 necessary low system pressure



F1B1, F2B1 solenoid connectors

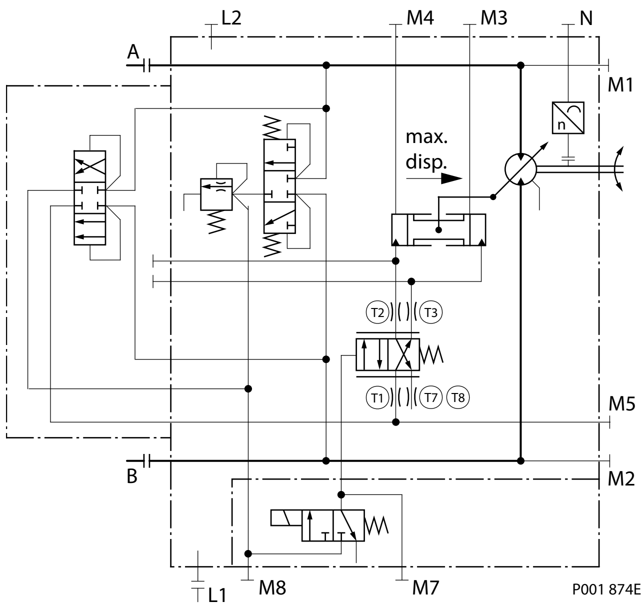
Configuration	Voltage / Electric power	Connector (Supplied)	
F1B1	12 V_{DC} / 14.7 W	Solenoid plug face for DIN 46350 Mating connector No.: K09129 Id. No.: **514117**	 P001752
F2B1	24 V_{DC} / 14.7 W		

Not all control options are shown in this Technical Information.
Contact your Danfoss representative for special control functions.

Controls circuit diagram – nomenclature – description

Options F1A5, F2A5 – electrohydraulic two-position control for 51 (frame size 160, 250)

Circuit diagram – motor with control options: F1A5, F2A5

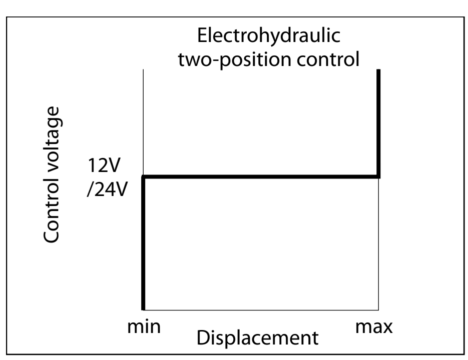


Ports:

A, B = Main pressure lines
L1, L2 = Drain lines
M1, M2 = Gauge port for A and B
M3, M4 = Gauge port servo pressure
M5 = Gauge port servo supply pressure, internal
M7, M8 = Gauge port control pressure, internal
T1, T2, T3, T7, T8 = Optional orifices
N = Speed sensor

Displacement can be changed electrohydraulically under load from maximum displacement to minimum displacement and vice versa, by using a built-in solenoid valve.

Control operation F1A5, F2A5



Options:

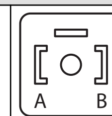
Solenoid off = min. displacement
Solenoid on = max. displacement

Pilot pressure for solenoid:

Controls circuit diagram – nomenclature – description

internal = low pressure

F1A5, F2A5 solenoid connectors

Configuration	Voltage / Electric power	Connector (Supplied)	
F1A5	12 V_{DC} / 14.7 W	Solenoid plug face for DIN 46350 Mating connector No.: K09129 Id. No.: **514117**	 P001752
F2A5	24 V_{DC} / 14.7 W		

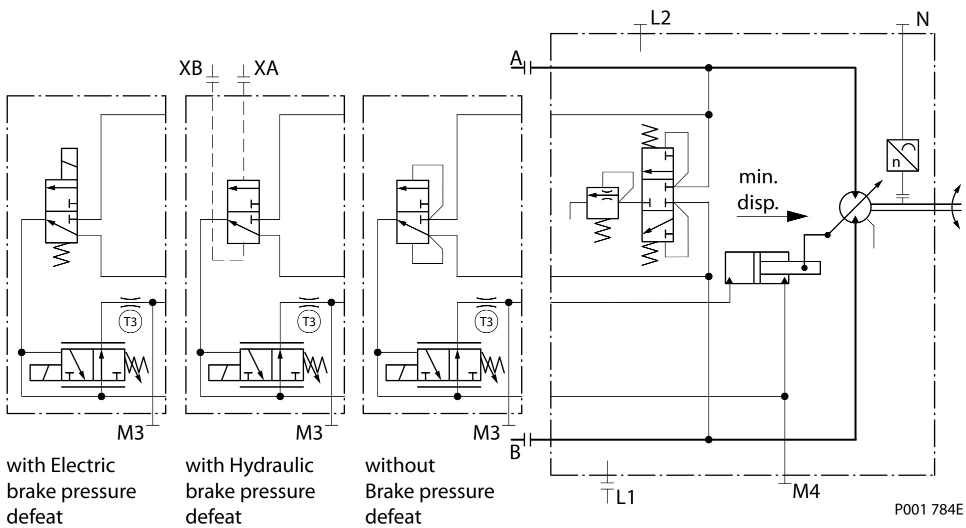
Not all control options are shown in this Technical Information.

Contact your Danfoss representative for special control functions.

Controls circuit diagram – nomenclature – description

Options T1**, T2**, T7** – electrohydraulic two-position control for 51-1 (frame size 060, 080, 110)

*Circuit diagram – motor with electrohydraulic two-position control T1**, T2**, T7***



Ports:

- **A, B** = Main pressure lines
- **L1, L2** = Drain lines
- **M3, M4** = Gauge port servo pressure
- **XA, XB** = Control pressure ports, brake pressure defeat
- **T3** = Optional orifices
- **N** = Speed sensor

Displacement can be changed electrohydraulically under load from minimum displacement to maximum displacement and vice versa, by using a solenoid. When the solenoid is energized the motor has maximum displacement and the pressure compensator does not function.

Solenoid not energized = minimum displacement

Solenoid energized = maximum displacement

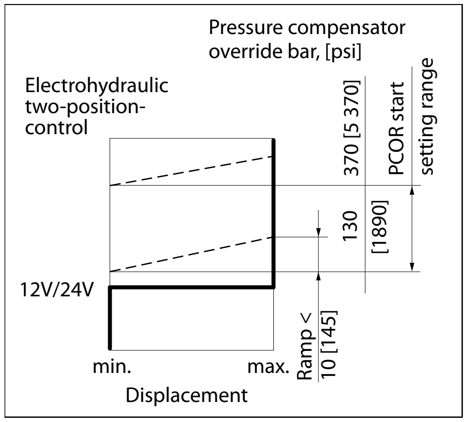
Pressure Compensator Override (PCOR)

The control can be overridden by PCOR using high loop pressure. When the PCOR activates, the motor displacement increases toward maximum. Pressure ramp from PCOR start pressure (with motor at minimum displacement) until maximum displacement is reached is less than 10 bar [145 psi]. This ensures optimal power utilization throughout the entire displacement range of the motor.

PCOR start pressure is adjustable from 130 to 370 bar [1890 to 5370 psi].

Controls circuit diagram – nomenclature – description

*Control operation T1**, T2**, T7***



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Option T*CA: pressure compensator configuration with hydraulic Brake Pressure Defeat

A shuttle valve ahead of the pressure compensator prevents operation in the deceleration direction (when motor is running in pump mode). This is designed to prevent rapid or uncontrolled deceleration while the vehicle/machine is slowing down.

Pressure compensator override with brake pressure defeat is mainly used in systems with pumps having electric or hydraulic proportional controls or automotive controls.

The shuttle valve must be controlled by a 2-line external signal, based on direction of motor rotation, see the following table:

Motor rotation	High pressure port	Control pressure on port*	PCOR function
CW	A	XA	yes
CW	A	XB	no
CCW	B	XA	no
CCW	B	XB	yes

* Differencial control pressure between port XA/XB:
Δp_{min} = 0.5 bar [7 psi]
Δp_{max} = 50 bar [725 psi]

Options T*D1, T*D2, T* D7: pressure compensator configuration with electric BPD

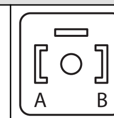
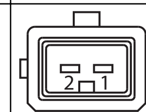
A solenoid-switched valve ahead of the pressure compensator prevents operation in the deceleration direction (when motor is running in pump mode). This is designed to prevent rapid or uncontrolled deceleration while the vehicle/machine is slowing down.

The solenoid valve must be controlled by an external electric signal, based on direction of motor rotation, see the following table:

Motor rotation	High pressure port	Solenoid	PCOR function
CW	A	energized	yes
CW	A	non energized	no
CCW	B	energized	no
CCW	B	non energized	yes

Controls circuit diagram – nomenclature – description

T1D1, T2D2, T7D7 solenoid connectors

Configuration	Voltage / Electric power	Connector (Supplied)	
T1D1	12 V_{DC} / 34 W	Solenoid plug face for DIN 46350 Mating connector No.: K09129 Id. No.: **514117**	 P001752
T2D2	24 V_{DC} / 34 W		
T7D7	12 V_{DC} / 34 W	AMP Junior Timer two-pin Mating connector No.: K19815 Id. No.: **508388**	 P001751

Option T*C2: pressure compensator configuration without Brake Pressure Defeat

Pressure compensator functions when the motor is running in motor mode as well as in pump (deceleration) mode.

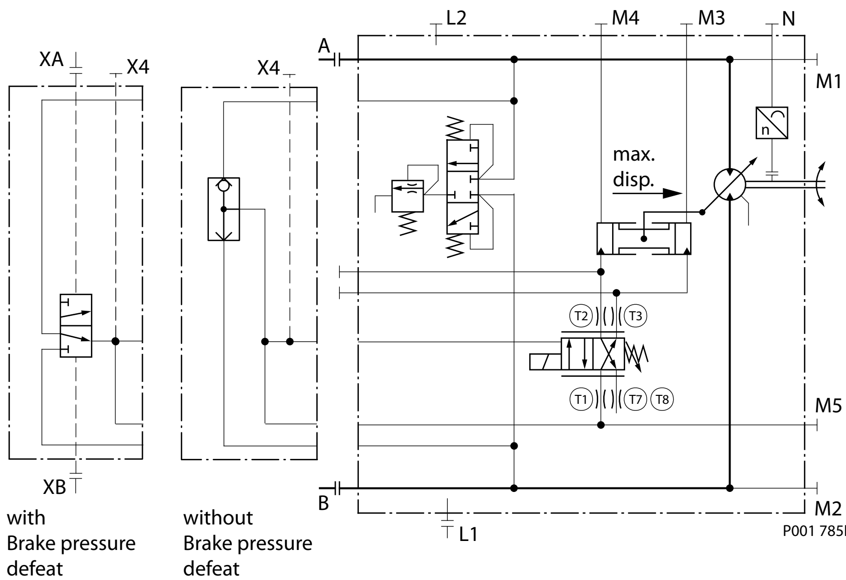
Configuration option	High pressure port	PCOR function
T*C2	A and B	yes

Not all control options are shown in this Technical Information.
Contact your Danfoss representative for special control functions.

Controls circuit diagram – nomenclature – description

Options T1**, T2** – electrohydraulic two-position control for 51 (frame size 160, 250)

*Circuit diagram – motor with electrohydraulic two-position control T1**, T2***



Ports:

A, B = Main pressure lines
L1, L2 = Drain lines
M1, M2 = Gauge port for A and B
M3, M4 = Gauge port servo pressure
M5 = Gauge port servo supply
XA, XB = Control pressure ports, brake pressure defeat
T1, T2, T3, T7, T8 = Optional orifices
N = Speed sensor

Displacement can be changed electrohydraulically under load from minimum displacement to maximum displacement and vice versa, by using a solenoid. When the solenoid is energized the motor has maximum displacement and the pressure compensator does not function.

Solenoid not energized = minimum displacement

Solenoid energized = maximum displacement

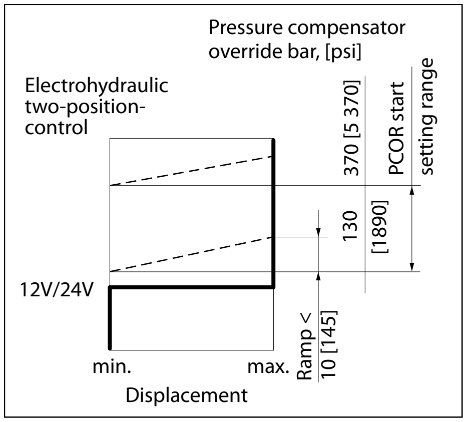
Pressure Compensator OverRide (PCOR)

The control can be overridden by PCOR using high loop pressure. When the PCOR activates, the motor displacement increases toward maximum. Pressure ramp from PCOR start pressure (with motor at minimum displacement) until maximum displacement is reached is less than 10 bar [145 psi]. This ensures optimal power utilization throughout the entire displacement range of the motor.

PCOR start pressure is adjustable from 130 to 370 bar [1890 to 5370 psi].

Controls circuit diagram – nomenclature – description

*Control operation T1**, T2***



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Option T*C0: pressure compensator configuration with hydraulic Brake Pressure Defeat

A shuttle valve ahead of the pressure compensator prevents operation in the deceleration direction (when motor is running in pump mode). This is designed to prevent rapid or uncontrolled deceleration while the vehicle/machine is slowing down. Pressure compensator override with brake pressure defeat is mainly used in systems with pumps having electric or hydraulic proportional controls or automotive controls.

The shuttle valve must be controlled by a 2-line external signal, based on direction of motor rotation, see the following table:

Motor rotation	High pressure port	Control pressure on port*	PCOR function
CW	A	XA	no
CW	A	XB	yes
CCW	B	XA	yes
CCW	B	XB	no

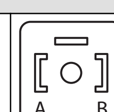
* Differencial control pressure between port XA/XB:
Δp_{min} = 0.5 bar [7 psi]
Δp_{max} = 50 bar [725 psi]

Option T*C2: pressure compensator configuration without Brake Pressure Defeat

Pressure compensator functions when the motor is running in motor mode as well as in pump (deceleration) mode.

Configuration option	High pressure port	PCOR function
T*C2	A and B	yes

T1C2, T2C2 solenoid connectors

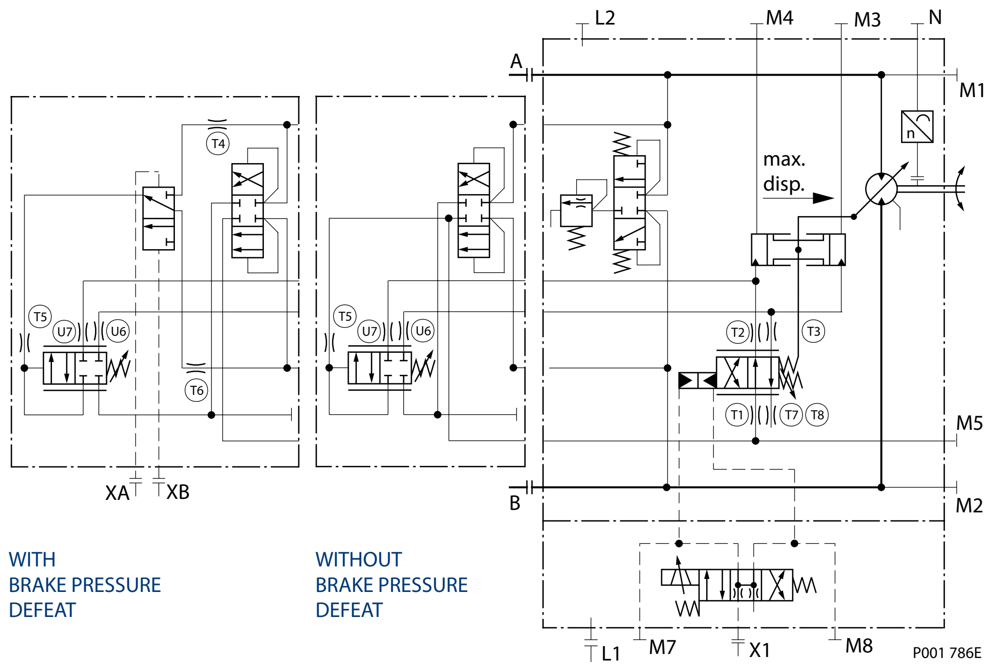
Configuration	Voltage / Electric power	Connector (Supplied)	
T1C2	12 V_{DC} / 14.7 W	Solenoid plug face for DIN 46350 Mating connector No.: K09129 Id. No.: **514117**	 P001752
T2C2	24 V_{DC} / 14.7 W		

Not all control options are shown in this Technical Information.
Contact your Danfoss representative for special control functions.

Controls circuit diagram – nomenclature – description

Options EP**, EQ** – electrohydraulic proportional control for 51 (all frame sizes)

*Circuit diagram – motor with electrohydraulic proportional control EP**, EQ***



Ports:

- **A, B** = Main pressure lines
- **L1, L2** = Drain lines
- **M1, M2** = Gauge port for A and B
- **M3, M4** = Gauge port servo pressure
- **M5** = Gauge port servo supply pressure internal
- **M7, M8** = Gauge port control pressure internal
- **X1** = Port for control supply pressure external
- **XA, XB** = Control pressure ports, BPD
- **T1, T2, T3,T4, T5, T6,T7, T8, U6, U7** = Optional orifices
- **N** = Speed sensor

Displacement can be changed under load in response to an electrical signal between maximum displacement and minimum displacement and vice versa.

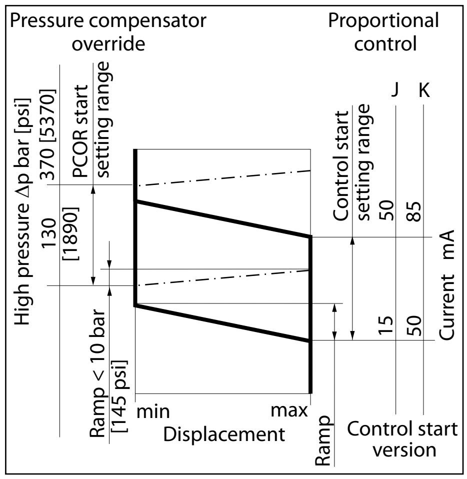
Control start = maximum displacement
Control end = minimum displacement

Control supply pressure (port X1)

p_{min} = 20 bar [290 psi]
$p_{max\ allowable}$ = 70 bar [1015 psi]

Controls circuit diagram – nomenclature – description

*Control operation EP**, EQ***



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Control setting options

Type	Start current (adjustable)*	Standard setting: control start	Ramp**	Coil wiring
JY	15 to 50 mA	**30** = 30 mA	70 mA	Single Coil resistance = 26 Ω
JW			95 mA	
KY	50 to 85 mA	**70** = 70 mA	70 mA	
KW			95 mA	

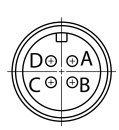
* Max. current = 250 mA

** from max. to min. displacement; full stroke current.

Connectors

MS Connector
MS3102C-14S-2P
(Supplied Connector)

Mating Connector
No.: K08106
Id.-No.: 615062



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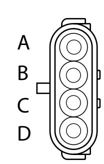
Packard Weather-Pack
4 pin
(Supplied Connector)

Mating Connector
No.: K03384
Id.-No.: 712208



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Wiring (maximum to minimum displacement)

Coil wiring	Positive voltage on pin	Ground on pin
Single coil	B	A
Single coil (alt.)	D	C

Pressure Compensator Override (PCOR)

The control can be overridden by PCOR using high loop pressure.

When the PCOR activates, the motor displacement increases to maximum.

Pressure ramp from PCOR start pressure (with motor at minimum displacement) until maximum displacement is reached is less than 10 bar [145 psi] . This ensures optimal power utilization throughout the entire displacement range of the motor.

PCOR start pressure is adjustable from 130 to 370 bar [1890 to 5370 psi].

Controls circuit diagram – nomenclature – description

Configuration option	PCOR at port	BPD function
EPA1/EQA1	A and B	with
EPA2/EQA2	A and B	without

Options EPA1, EQA1: pressure compensator configuration with Brake Pressure Defeat

A shuttle valve ahead of the pressure compensator prevents operation in the deceleration direction (when motor is running in pump mode). This is designed to prevent rapid or uncontrolled deceleration while the vehicle/machine is slowing down.

Pressure compensator override with brake pressure defeat is mainly used in systems with pumps having electric or hydraulic proportional controls or automotive controls.

The shuttle valve must be controlled by a 2-line external signal, based on direction of motor rotation, see the following table:

Pressure compensator operation

Motor rotation	High pressure port	Control pressure on port*	PCOR function
CW	A	XA	no
CW	A	XB	yes
CCW	B	XA	yes
CCW	B	XB	no

* Differencial control pressure between port XA/XB:
Δp_{min} = 0.5 bar [7 psi]
Δp_{max} = 50 bar [725 psi]

Options EPA2, EQA2: pressure compensator configuration without Brake Pressure Defeat

The pressure compensator override functions when the motor is running in motor mode as well as in pump (deceleration) mode.

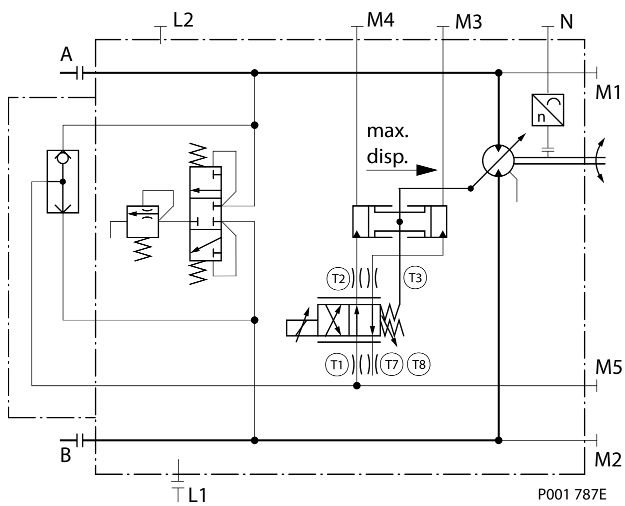
Not all control options are shown in this Technical Information.

Contact your Danfoss representative for special control functions.

Controls circuit diagram – nomenclature – description

Options L1B1, L2B1, L7B1 – electrohydraulic proportional control for 51 (all frame sizes)

Circuit diagram – motor with electrohydraulic propor. control L1B1, L2B1, L7B1



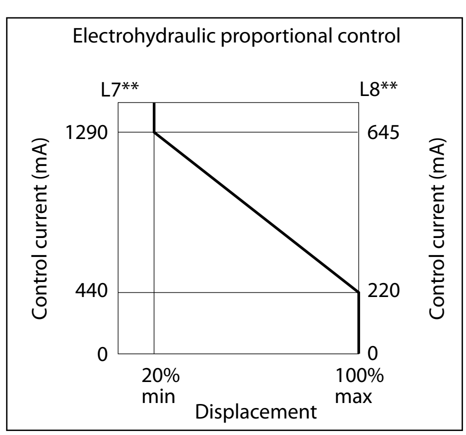
Ports:

- **A, B** = Main pressure lines
- **L1, L2** = Drain lines
- **M1, M2** = Gauge port for A and B
- **M3, M4** = Gauge port servo pressure
- **M5** = Gauge port servo supply pressure internal
- **T1, T2, T3,T7, T8** = Optional orifices
- **N** = Speed sensor

Displacement can be changed electrohydraulically under load in response to an electrical signal from minimum displacement to maximum displacement and vice versa. The displacement changes proportional to the electrical signal. The electrical signal must be a pulse-width modulated (PWM) signal, (f = 100...200 Hz).

Control start = maximum displacement
Control end = minimum displacement

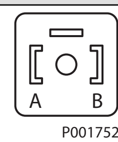
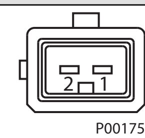
*Control operation L1**, L2**, L7***



P001 777E

Controls circuit diagram – nomenclature – description

L1B1, L2B1, L7B1 solenoid connectors

Solenoid plug face DIN 46350 (Supplied)	AMP Junior Timer two-pin (Supplied)
 Mating connector No.: K09129 Id. No.: **514117**	 Mating connector No.: K19815 Id. No.: **508388**

Solenoid data

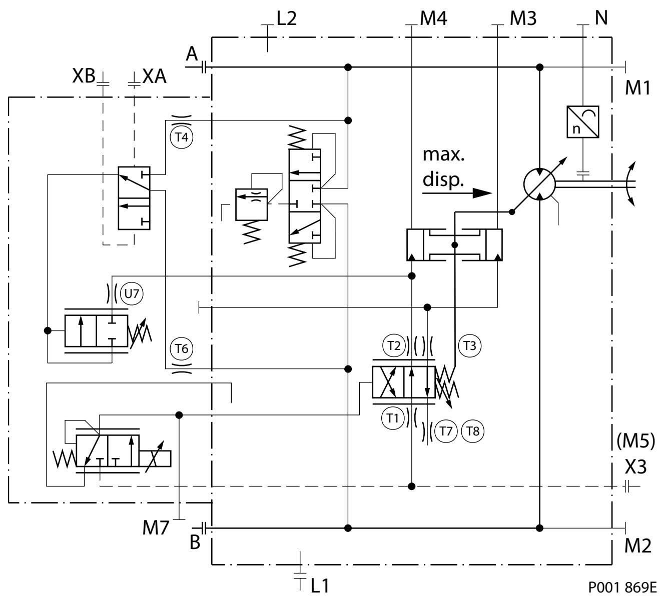
Configuration	Voltage	Nominal resistance 20 °C	Control current			Connector
			Start	End	Max.	
L1B1	12 V_{DC}	5.7 Ω	440 mA	1290 mA	1500 mA	DIN 46350
L7B1						AMP Junior Timer
L2B1	24 V_{DC}	21.3 Ω	220 mA	645 mA	750 mA	DIN 46350

Not all control options are shown in this Technical Information.
Contact your Danfoss representative for special control functions.

Controls circuit diagram – nomenclature – description

Options D7M1, D8M1 – electrohydraulic proportional control with PCOR and hydraulic BPD for 51 (all frame sizes)

Circuit diagram – motor with EH prop. control D7M1, D8M1



Ports:

A, B = Main pressure lines
L1, L2 = Drain lines
M1, M2 = Gauge port for A and B
M3, M4 = Gauge port servo pressure
X3 (M5) = Servo pressure supply
M7 = Gauge port control pressure
XA, XB = Control pressure ports, hydraulic BPD
T1, T2, T3,T4, T6,T7, T8, U7 = Optional orifices
N = Speed sensor

Displacement can be changed electrohydraulically under load in response to an electrical signal from minimum displacement to maximum displacement and vice versa. The displacement changes proportional to the electrical signal. The electrical signal must be a pulse-width modulated (PWM) signal, (f = 100...200 Hz).

Solenoid not energized = maximum displacement

Solenoid energized = minimum displacement

Servo pressure supply = external pressure at port **X3**

Min. pressure = 25 bar [360 psi]
Max. pressure = 50 bar [725 psi]

Pressure Compensator Override (PCOR)

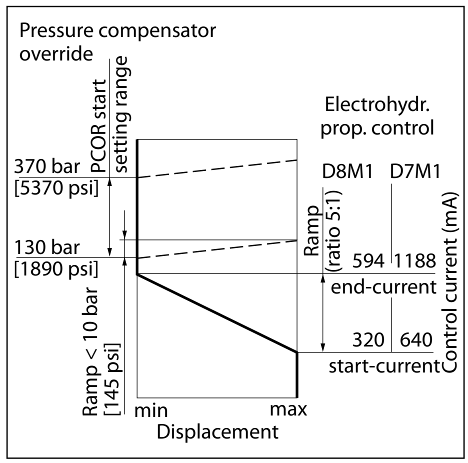
The control can be overridden by PCOR using high loop pressure.

When the PCOR activates, the motor displacement increases to maximum. Pressure ramp from PCOR start pressure (with motor at minimum displacement) until maximum displacement is reached is less than 10 bar [145 psi]. This ensures optimal power utilization throughout the entire displacement range of the motor.

PCOR start pressure is adjustable from 130 to 370 bar [1890 to 5370 psi].

Controls circuit diagram – nomenclature – description

Control operation D7M1, D8M1



P001 873E

Options D7M1, D8M1: pressure compensator configuration with hydraulic Brake Pressure Defeat

A shuttle valve ahead of the pressure compensator prevents operation in the deceleration direction (when motor is running in pump mode). This is designed to prevent rapid or uncontrolled deceleration while the vehicle/machine is slowing down.

Pressure compensator override with brake pressure defeat is mainly used in systems with pumps having electric or hydraulic proportional controls or automotive controls.

The shuttle valve must be controlled by a 2-line external signal, based on direction of motor rotation, see the following table:

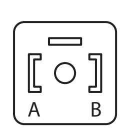
Motor rotation	High pressure port	Control pressure on port*	PCOR function
CW	A	XA	no
CW	A	XB	yes
CCW	B	XA	yes
CCW	B	XB	no

* Differencial control pressure between port XA/XB:
Δp_{min} = 0.5 bar [7 psi]
Δp_{max} = 50 bar [725 psi]

D7M1, D8M1 solenoid connector

Solenoid connector

Plug face DIN 46350 (Supplied)
Mating connector No.: K09129
Id. No.: **514117**



P001752

Configuration	Voltage	Nominal resistance 20 °C	Control current			Connector
			Start	End	Max.	
D7M1	12 V_{DC}	5.7 Ω	640 mA	1188 mA	1500 mA	AMP Junior Timer two-pin
D8M1	24 V_{DC}	21.2 Ω	320 mA	594 mA	750 mA	

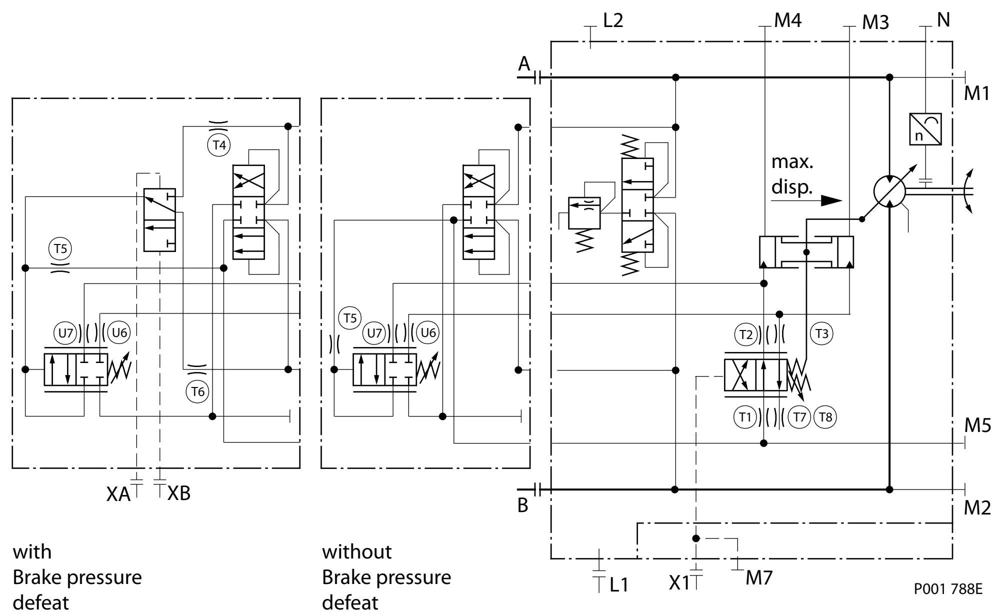
Not all control options are shown in this Technical Information.

Contact your Danfoss representative for special control functions.

Controls circuit diagram – nomenclature – description

Options HS** – hydraulic proportional control for 51 (all frame sizes)

*Circuit diagram – motor with hydraulic proportional control HS***



A, B = Main pressure lines

L1, L2 = Drain lines

M1, M2 = Gauge port for A and B

M3, M4 = Gauge port servo pressure

M5 = Gauge port servo supply pressure

M7 = Gauge port control pressure

X1 = Port for control supply pressure external

XA, XB = Control pressure ports, BPD

T1, T2, T3,T4, T5, T6,T7, T8, U6, U7 = Optional orifices

N = Speed sensor

Displacement can be changed in response to a hydraulic signal under load between maximum displacement and minimum displacement and vice versa.

Control start = maximum displacement
Control end = minimum displacement

Control pressure (Port X1)

External = absolute pressure

Control start setting range (pressure above case pressure)	
p_{start}	3 to 5 bar [44 to 73 psi]
	5 to 12 bar [73 to 175 psi]
	12 to 30 bar [175 to 435 psi]
$P_{max\ allowable}$	control start pressure + 50 bar [725 psi]

Control ramp	
From 100% to 20% displacement	7 bar [102 psi]
From 100% to 20% displacement	14 bar [203 psi]

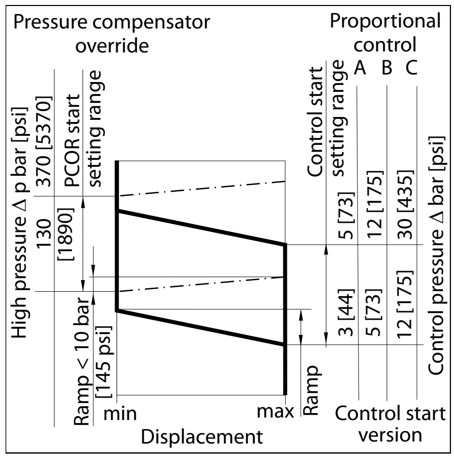
Pressure Compensator OverRide (PCOR)

The control can be overridden by PCOR using high loop pressure. When the PCOR activates, the motor displacement increases to maximum. Pressure ramp from PCOR start pressure (with motor at minimum displacement) until maximum displacement is reached is less than 10 bar [145 psi] . This ensures optimal

Controls circuit diagram – nomenclature – description

power utilization throughout the entire displacement range of the motor. PCOR start pressure is adjustable from 130 to 370 bar [1890 to 5370 psi].

*Control Operation HS***



P001 171E

Configuration	PCOR at port	BPD function
HSA1	A and B	with
HSA2	A and B	without

Option HSA1: pressure compensator configuration with Brake Pressure Defeat

A shuttle valve ahead of the pressure compensator prevents operation in the deceleration direction (when motor is running in pump mode). This is designed to prevent rapid or uncontrolled deceleration while the vehicle/machine is slowing down. Pressure compensator override with brake pressure defeat is mainly used in systems with pumps having electric or hydraulic proportional controls or automotive controls.

The shuttle valve must be controlled by a 2-line external signal, based on direction of motor rotation, see the following table:

Motor rotation	High pressure port	Control pressure on port*	PCOR function
CW	A	XA	no
CW	A	XB	yes
CCW	B	XA	yes
CCW	B	XB	no

* Differencial control pressure between port XA/XB:
Δp_{min} = 0.5 bar [7 psi]
Δp_{max} = 50 bar [725 psi]

Option HSA2: pressure compensator configuration without Brake Pressure Defeat

The pressure compensator override functions when the motor is running in motor mode as well as in pump (deceleration) mode.

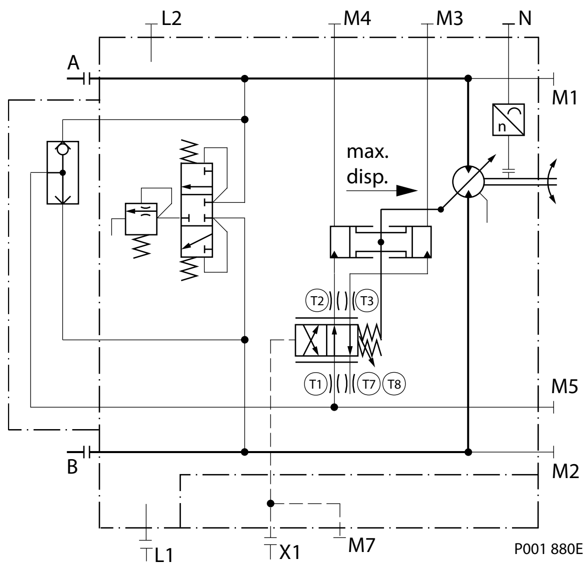
Not all control options are shown in this Technical Information.

Contact your Danfoss representative for special control functions.

Controls circuit diagram – nomenclature – description

Option HZB1 – hydraulic proportional control for 51 (all frame sizes)

Circuit diagram – motor with hydraulic propor. control HZB1



A, B = Main pressure lines
L1, L2 = Drain lines
M1, M2 = Gauge port for A and B
M3, M4 = Gauge port servo pressure
M5 = Gauge port servo supply pressure internal
M7 = Gauge port control pressure
X1 = Control pressure port
T1, T2, T3, T7, T8 = Optional orifices
N = Speed sensor

Displacement can be changed in response to a hydraulic signal under load between maximum displacement and minimum displacement and vice versa.

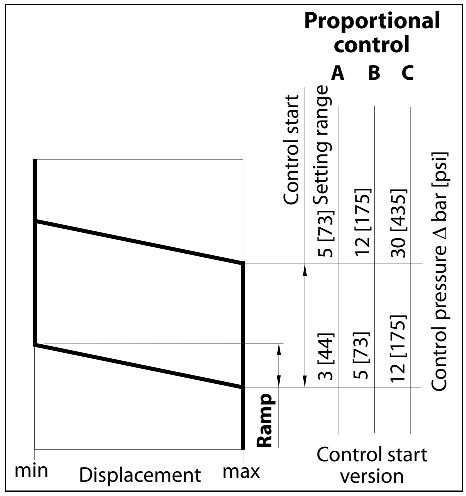
Control start = maximum displacement
Control end = minimum displacement

Control pressure on port X1

External = absolute pressure

Controls circuit diagram – nomenclature – description

Control Operation HZB1



Control start setting range (pressure above case pressure)	
p_{start}	3 to 5 bar [44 to 73 psi]
	5 to 12 bar [73 to 175 psi]
	12 to 30 bar [175 to 435 psi]
$P_{max\ allowable}$	control start pressure + 50 bar [725 psi]

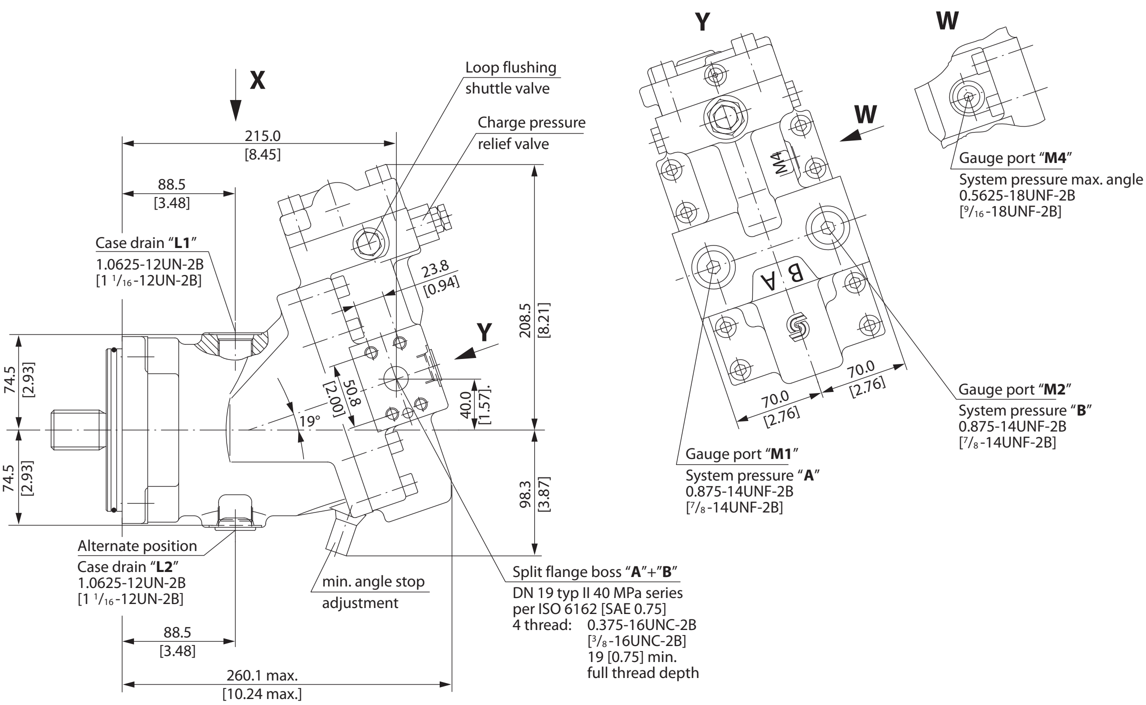
Control ramp	
From 100% to 20% displacement	7 bar [102 psi]
From 100% to 20% displacement	14 bar [203 psi]

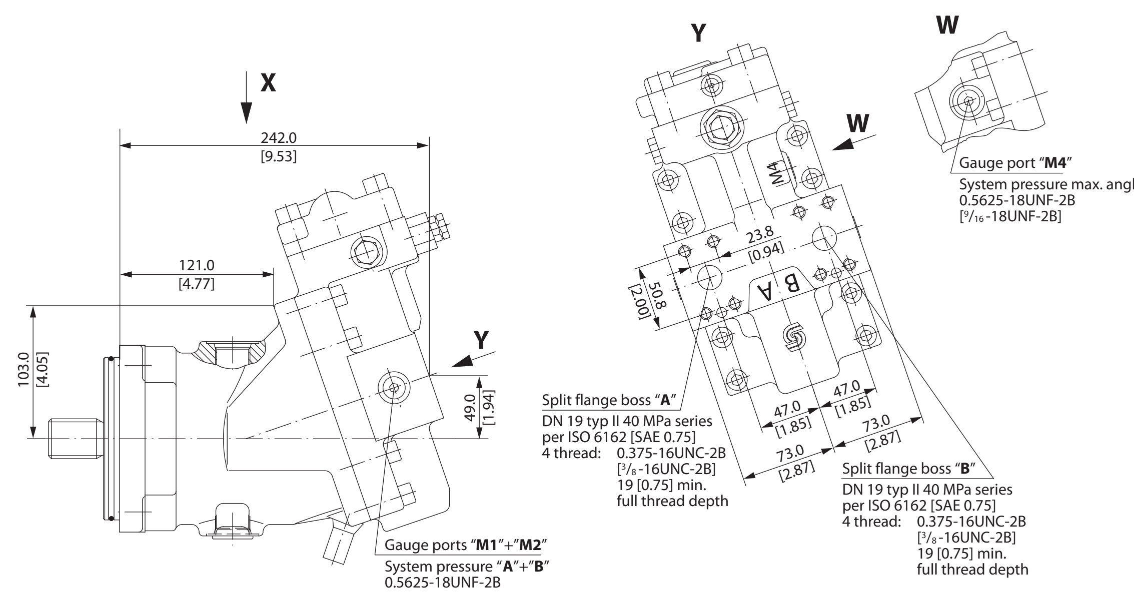
Not all control options are shown in this Technical Information.
Contact your Danfoss representative for special control functions.

General dimensions – frame size 060

SAE flange design per ISO 3019/1

51V060-1 Two Position Control, N1NN (Side port on top, Axial port below)

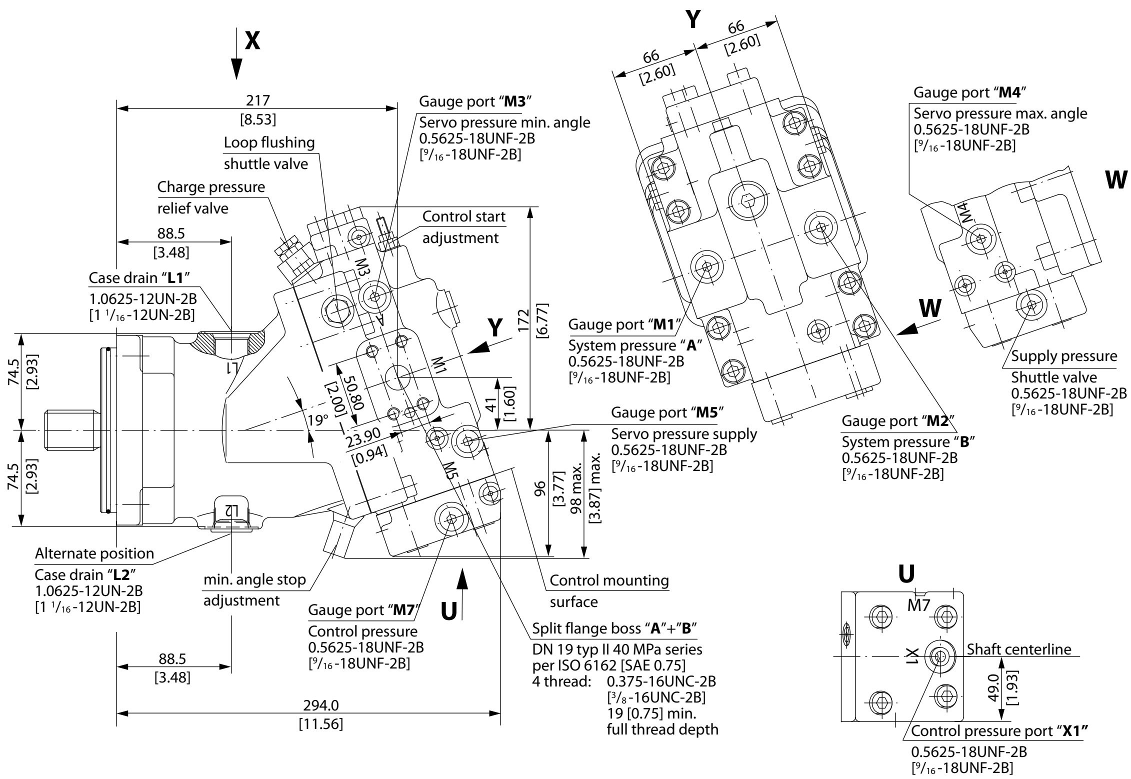


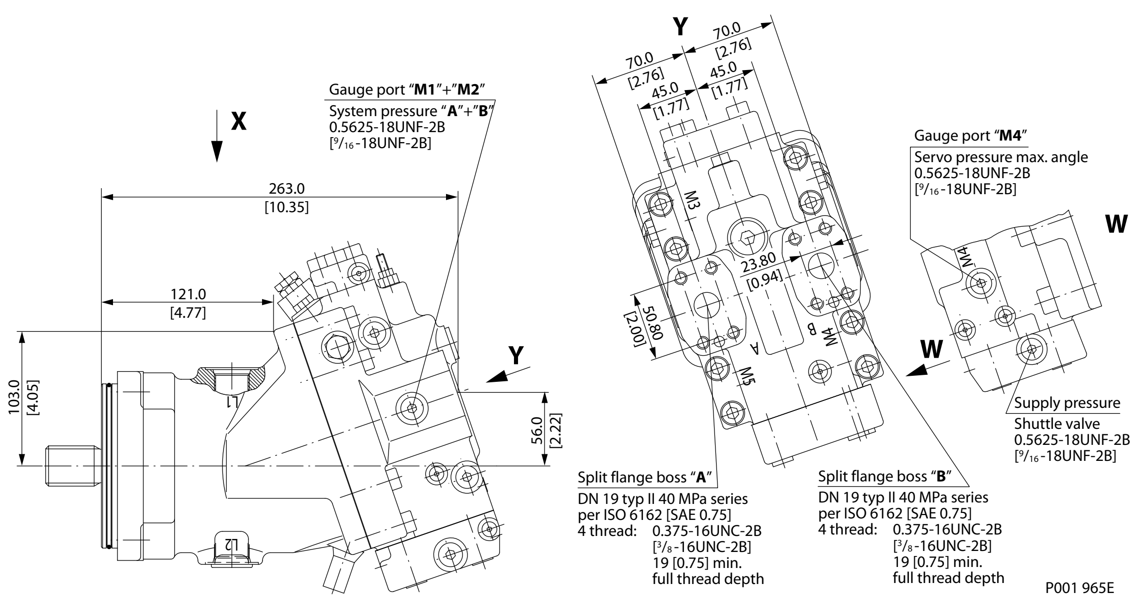


P001 790E

General dimensions – frame size 060

51V060 Proportional and Two Position Control, HZB1 (Side port on top, Axial port below)

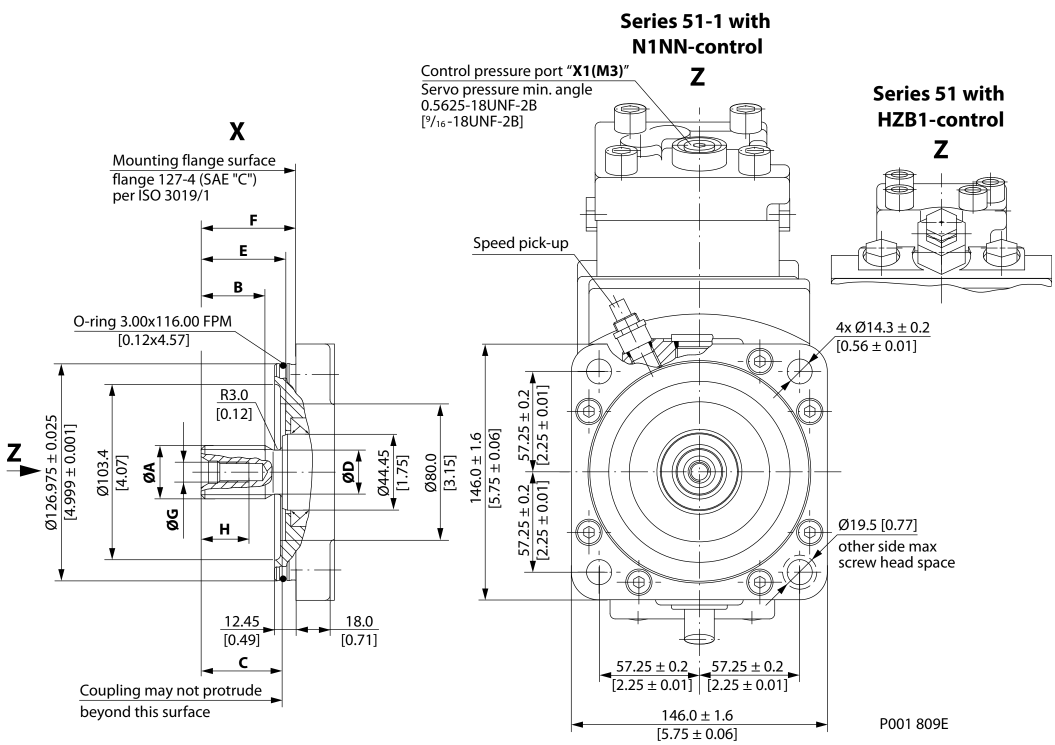




P001 965E

General dimensions – frame size 060

Shaft options – 51V060-1 and 51V060



Shaft spline data - mm [in]

Shaft option	**S1**	**C6**
Number of teeth	14	21
Pitch	12/24	16/32
Pitch Ø	29.633 [1.167]	33.337 [1.312]
Ø A	31.15 [1.23]	34.43 [1.36]
Ø D	25.8 [1.02]	30.0 [1.18]
Pressure angle	30°	
B	37.5 [1.476]	
C	47.5±0.5 [1.87]	
E	50.3±1.2 [1.98]	
F	55.5±0.7 [2.19]	
H	28.0 [1.1]	
Spline	ANSI B92.1-1970, class 5, flat root side fit	
Ø G	0.4375-14UNC-2B [7/16-14UNC-2B]; allowed torque in thread max. 91 N•m [805 lbf•in]	

Flow into port **A** results in **CW** rotation of output shaft.

Flow into port **B** results in **CCW** rotation of output shaft.

Shaft rotation is determined by viewing from shaft end. Ports with O-ring seal and inch threads shall be in accordance with ISO 11926/1.

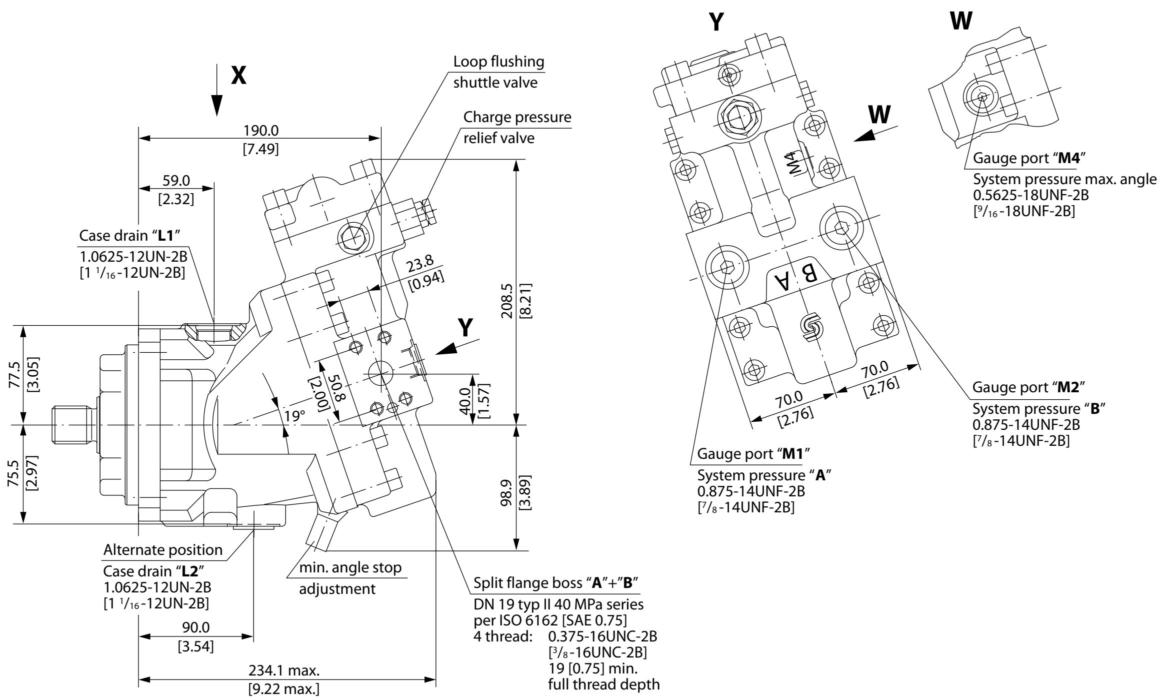
Splite flange boss A and B per ISO 6162 is identical with high pressure series SAEJ518 code 62 (6000 psi).

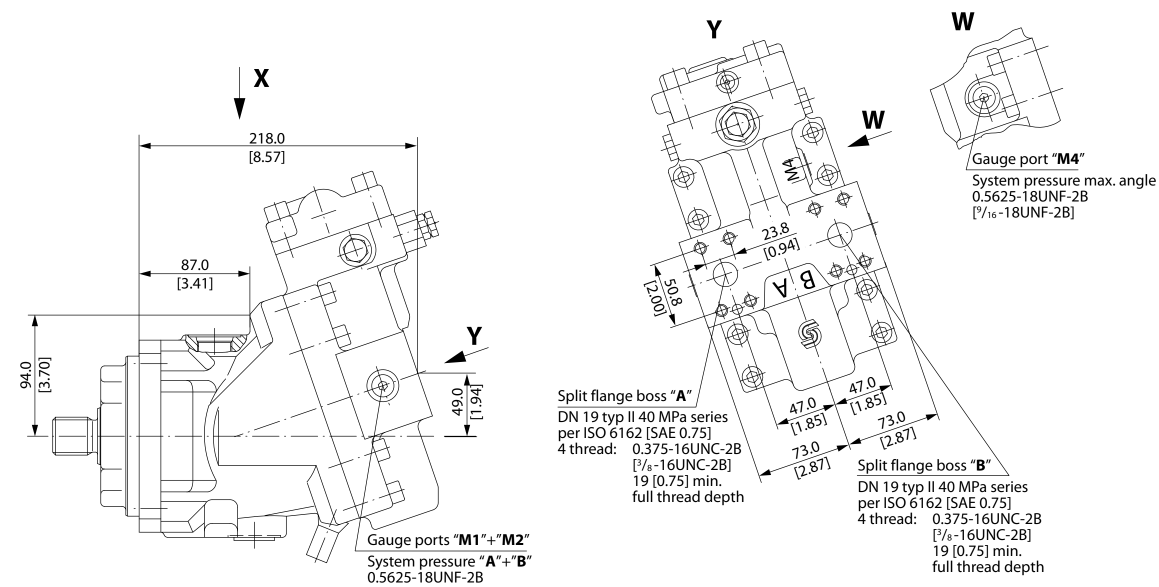
Contact your Danfoss representative for specific installation drawings.

General dimensions – frame size 060

DIN flange design per ISO 3019/2

51D060-1 two position control, N1NN (Side port on top, Axial port below)

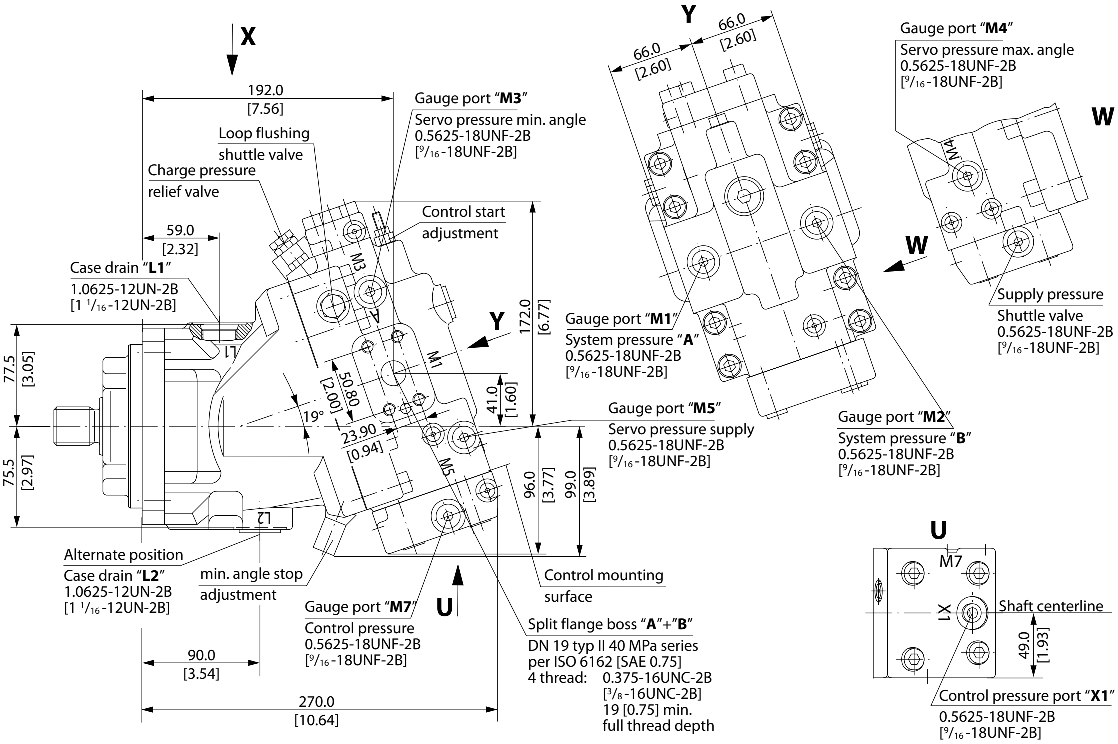


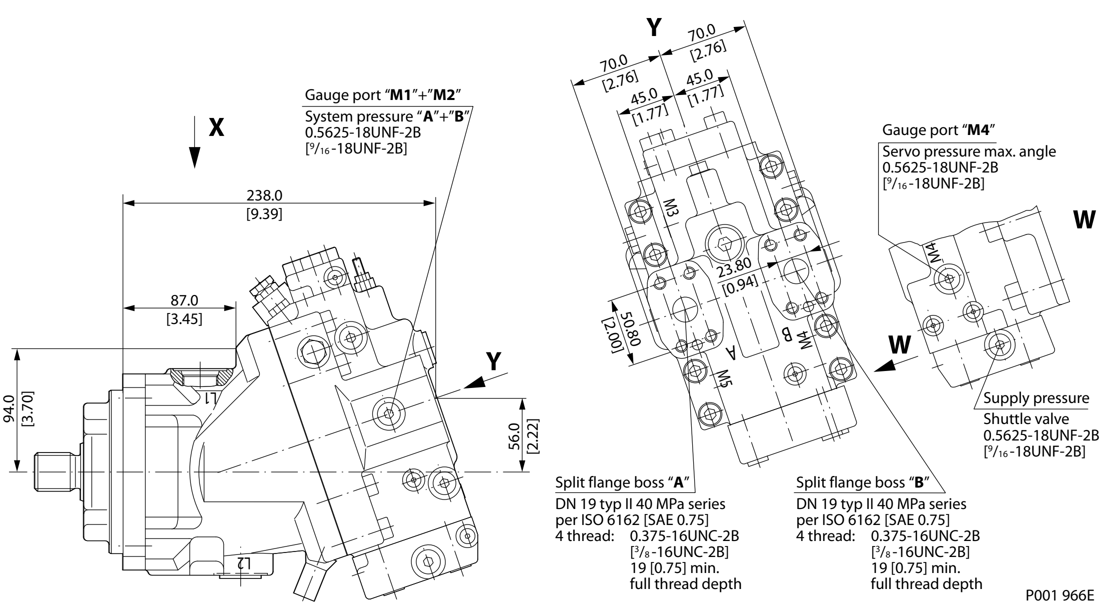


P001 791E

General dimensions – frame size 060

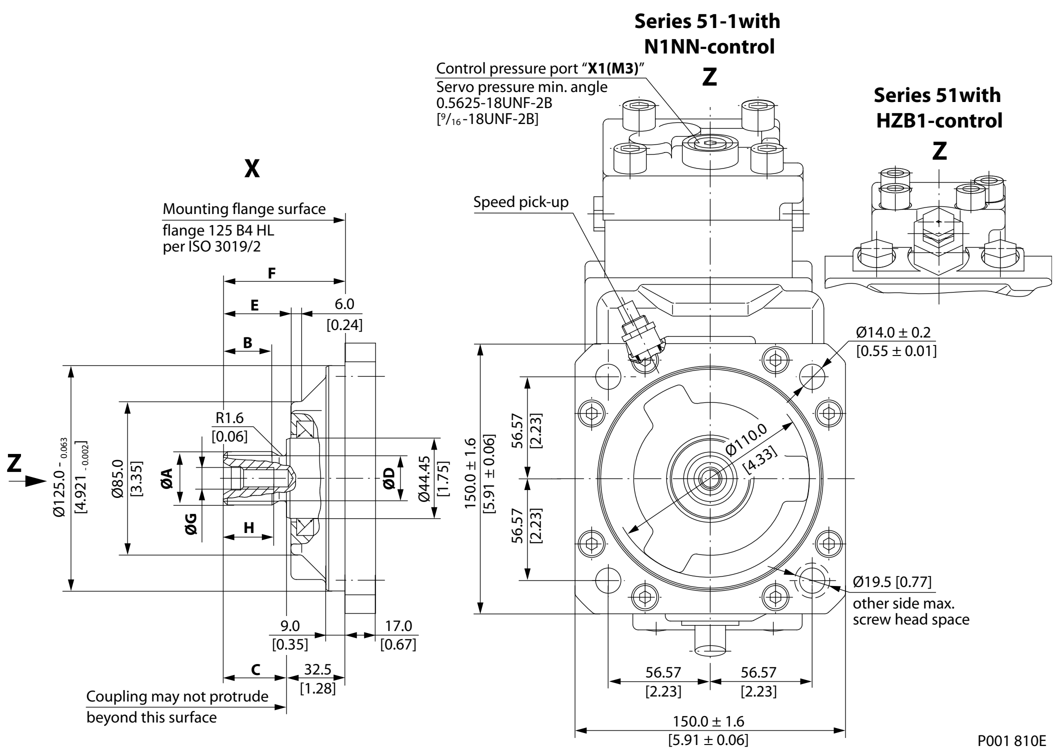
51D060 proportional and two position control, HZB1 (Side port on top, Axial port below)





General dimensions – frame size 060

Shaft options – 51D060-1 and 51D060



Shaft spline data - mm [in]

Shaft option	D1	D2
Number of teeth	14	16
Spline	W30x2x30x14x9g, side fit DIN 5480	W35x2x30x16x9g side fit DIN 5480
Pitch Ø	28.0 [1.102]	32.0 [1.260]
Ø A	29.6 [1.17]	34.6 [1.36]
B	27.0 [1.06]	32.0 [1.260]
C	35.0±0.5 [1.38]	40.0±0.5 [1.58]
Ø D	25.0 [0.98]	30.0 [1.18]
E	37.5±1.1 [1.48]	42.5±1.1 [1.67]
F	67.5±0.6 [2.66]	72.5±0.6 [2.85]
H	25.0 [0.98]	25.0 [0.98]
Ø G	M10x1.5 allowed torque in thread max. 67 N•m [593 lbf•in]	

Flow into port **A** results in **CW** rotation of output shaft.

Flow into port **B** results in **CCW** rotation of output shaft.

Shaft rotation is determined by viewing from shaft end. Ports with O-ring seal and inch threads shall be in accordance with ISO 11926/1.

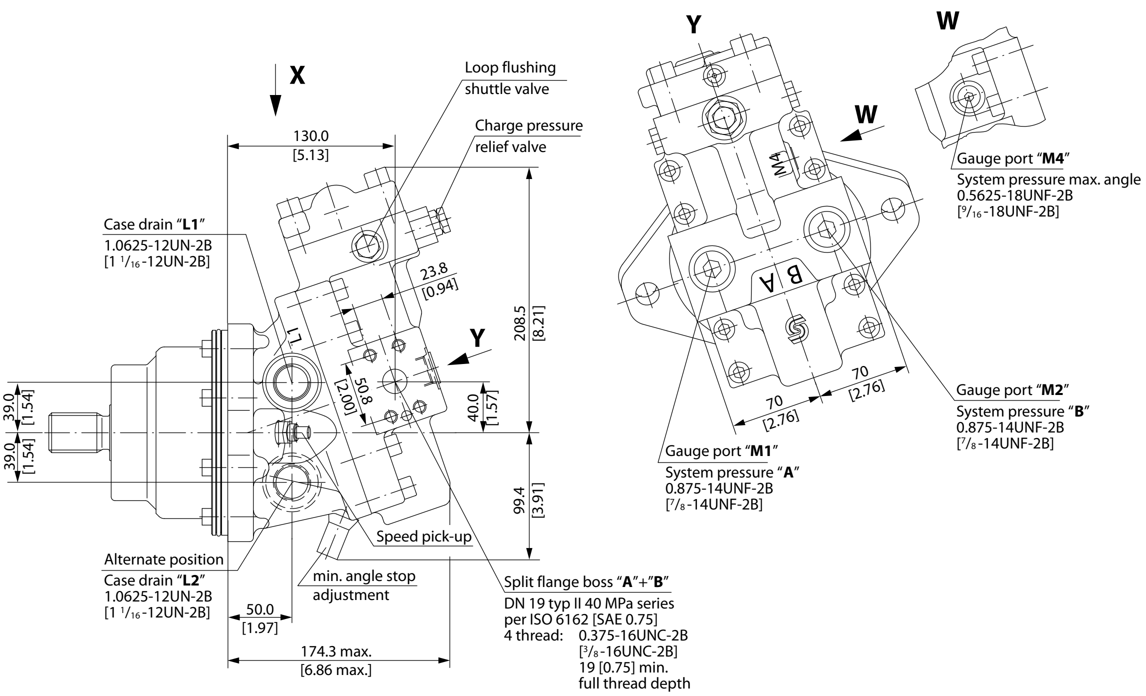
Splite flange boss A and B per ISO 6162 is identical with high pressure series SAEJ518 code 62 (6000 psi).

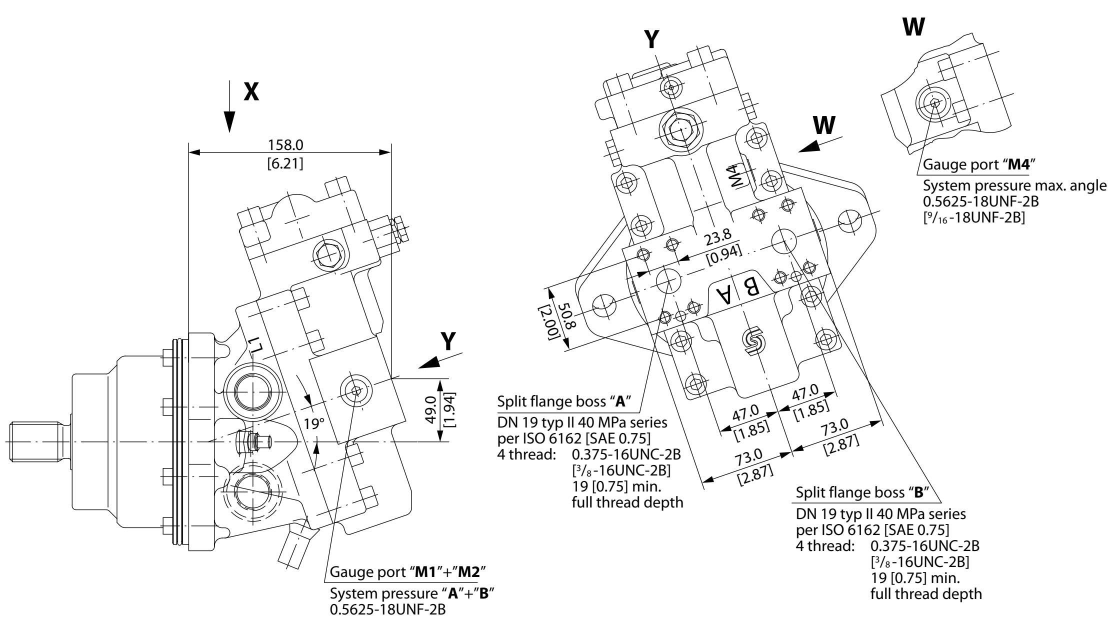
Contact your Danfoss representative for specific installation drawings.

General dimensions – frame size 060

Cartridge flange

51C060-1 two-position control, N1NN (Side port on top, Axial port below)

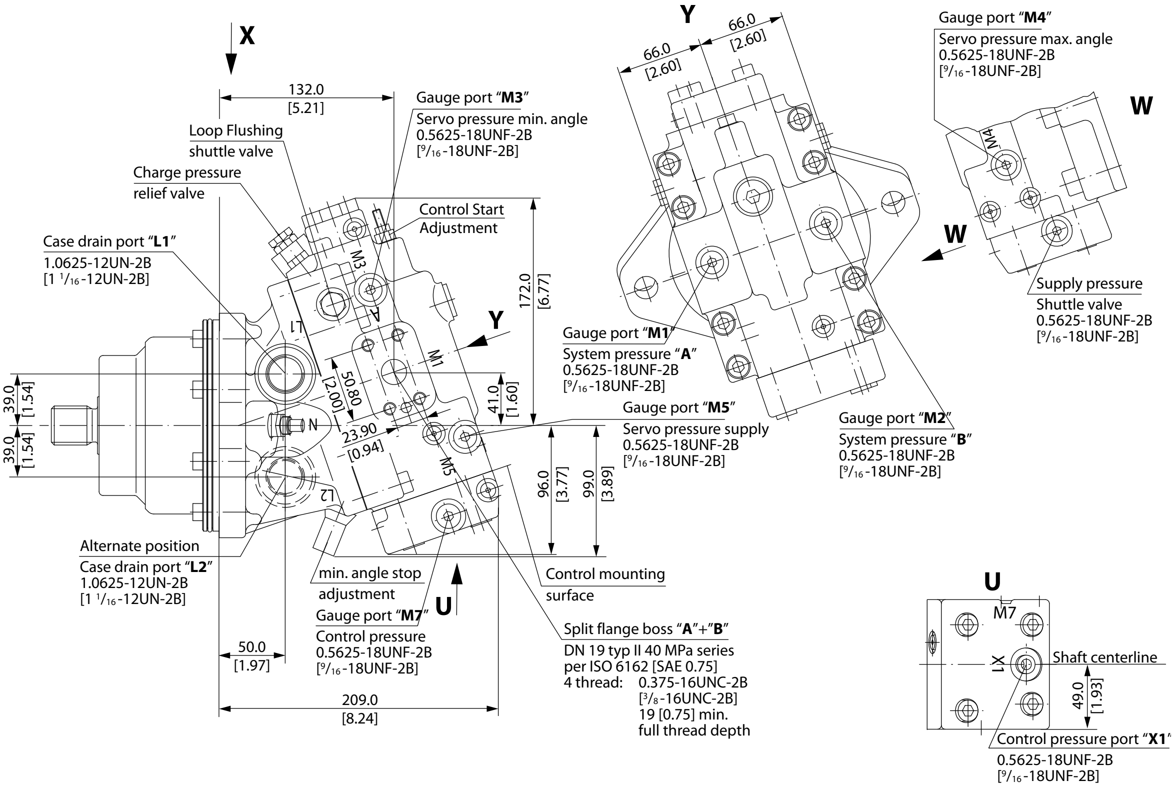


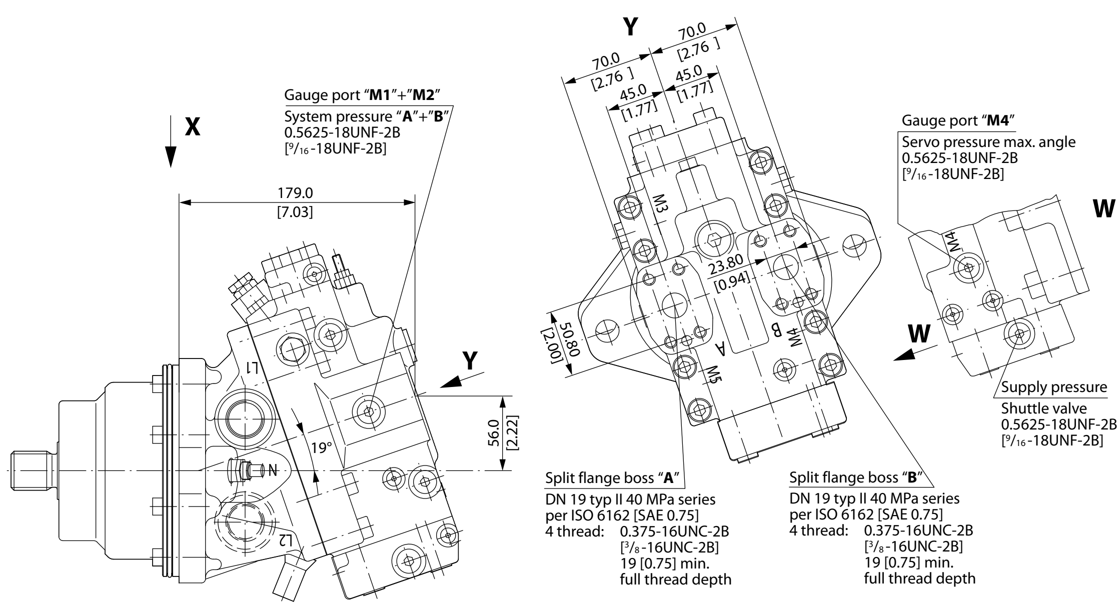


P001 792E

General dimensions – frame size 060

51C060 proportional and two-position control, HZB1 (Side port on top, Axial port below)

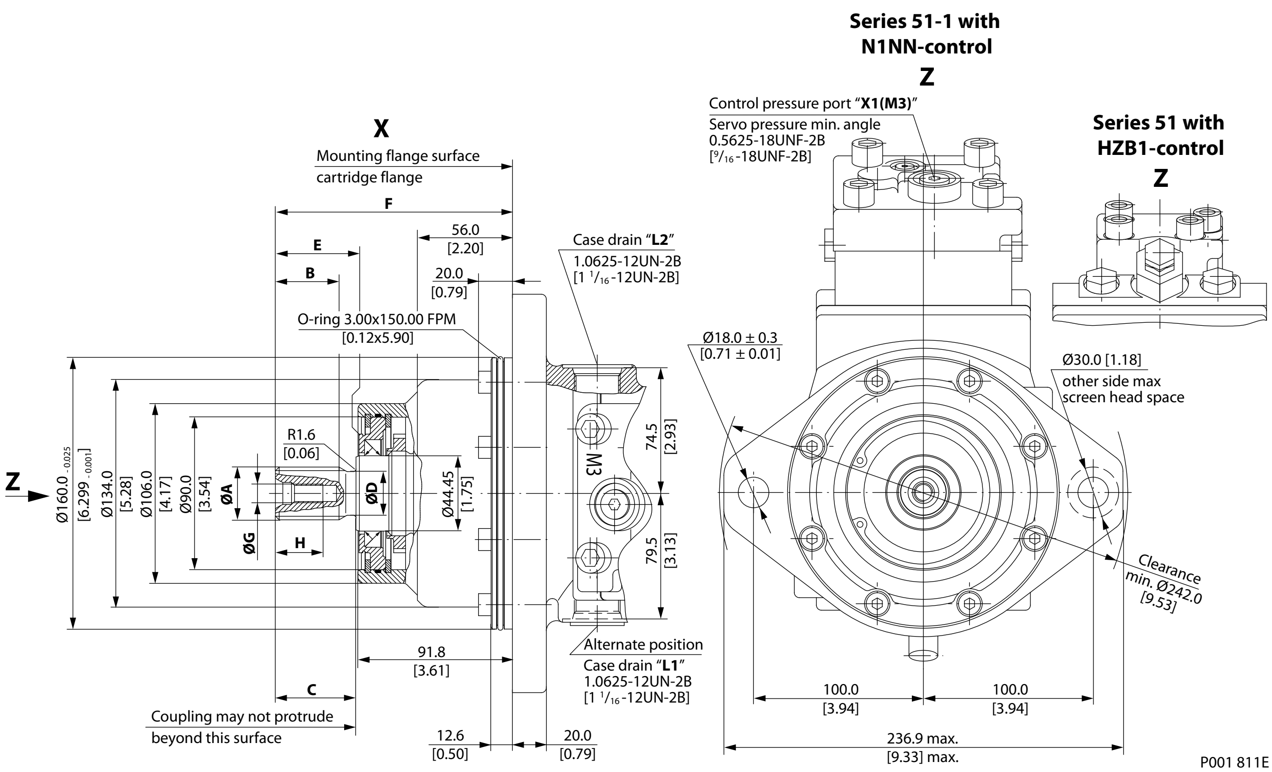




P001 967E

General dimensions – frame size 060

Shaft options – 51C060-1 and 51C060



Shaft spline data - mm [in]

Shaft option	D1	D2
Number of teeth	14	16
Spline	W30x2x30x14x9g, side fit DIN 5480	W35x2x30x16x9g side fit DIN 5480
Pitch Ø	28.0 [1.102]	32.0 [1.26]
Ø A	29.6 [1.17]	34.6 [1.36]
B	27.0 [1.06]	32.0 [1.26]
C	35.0±0.5 [1.38]	40.0±0.5 [1.58]
Ø D	25.0 [0.98]	30.0 [1.18]
E	36.8±1.4 [1.45]	41.8±1.4 [1.65]
F	127.2±0.6 [5.0]	132.2±0.6 [5.21]
H	25.0 [0.98]	25.0 [0.98]
Ø G	M10x1.5 allowed torque in thread max. 67 N•m [593 lbf•in]	

Flow into port **A** results in **CW** rotation of output shaft.

Flow into port **B** results in **CCW** rotation of output shaft.

Shaft rotation is determined by viewing from shaft end. Ports with O-ring seal and inch threads shall be in accordance with ISO 11926/1.

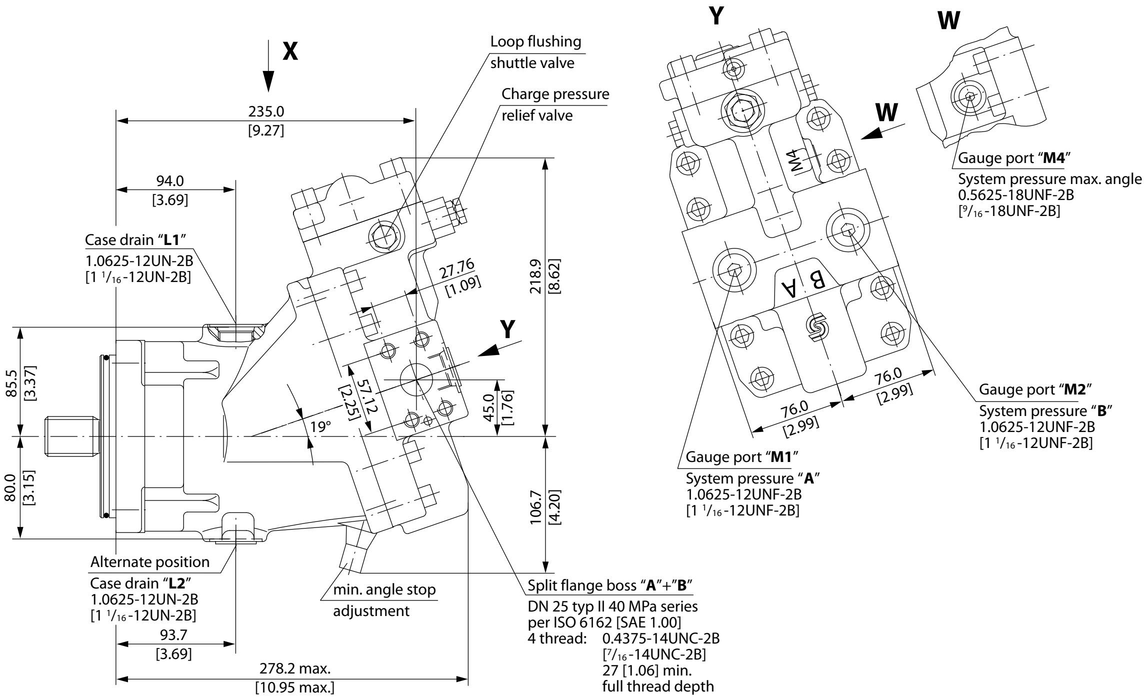
Splite flange boss A and B per ISO 6162 is identical with high pressure series SAEJ518 code 62 (6000 psi).

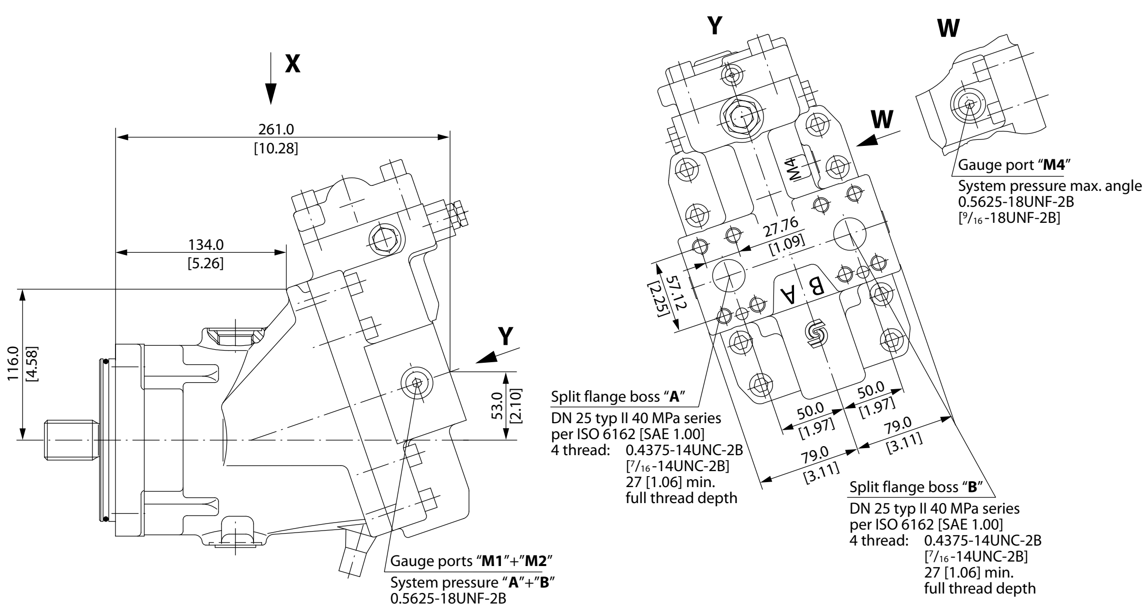
Contact your Danfoss representative for specific installation drawings.

General dimensions – frame size 080

SAE flange design per ISO 3019/1

51V080-1 Two Position Control, N1NN (Side port on top, Axial port below)

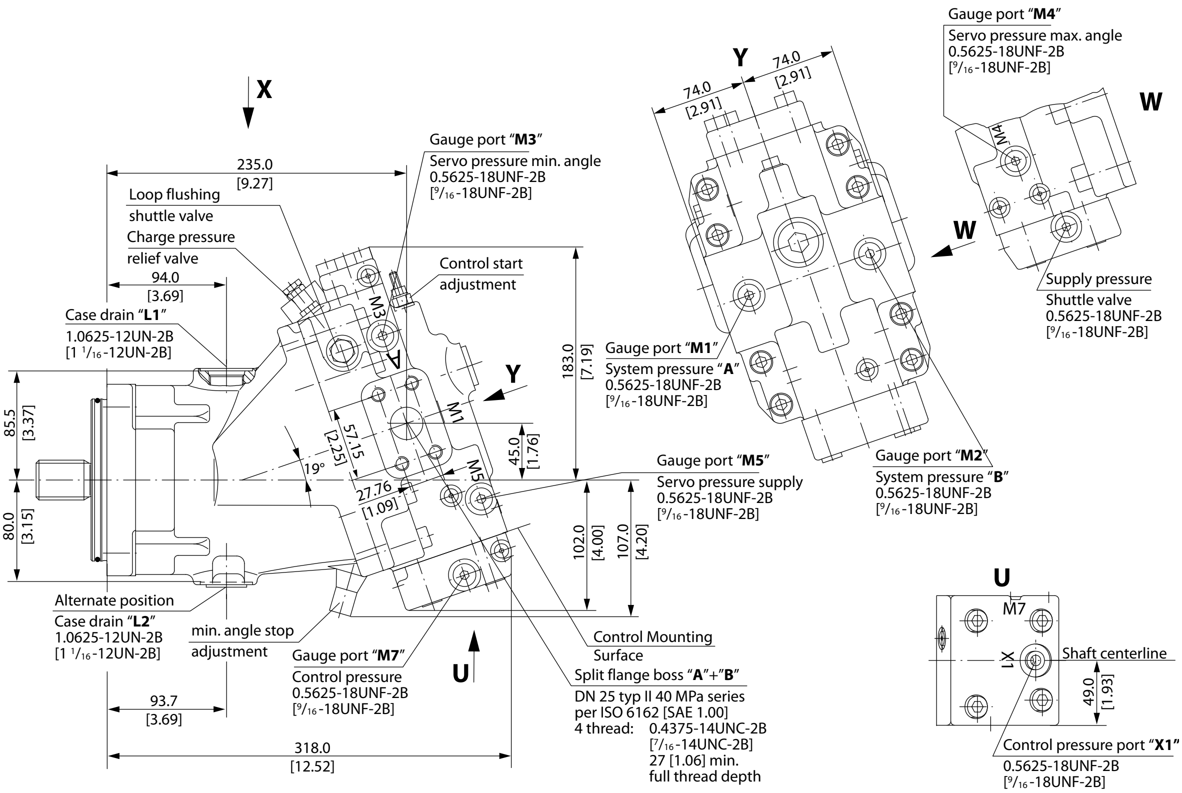


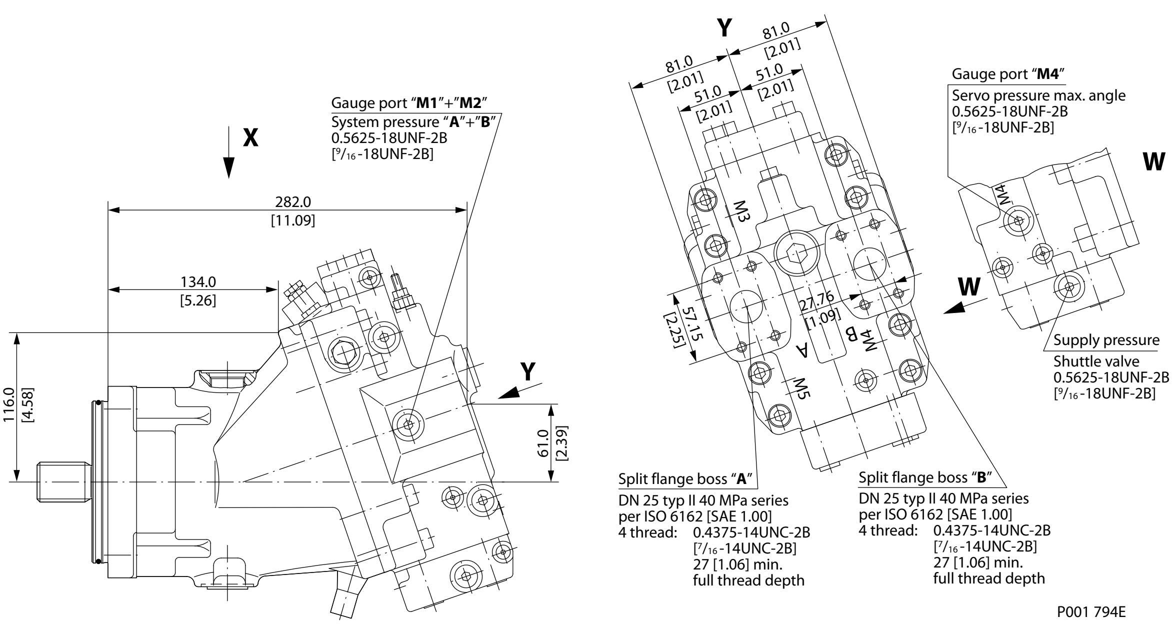


P001 793E

General dimensions – frame size 080

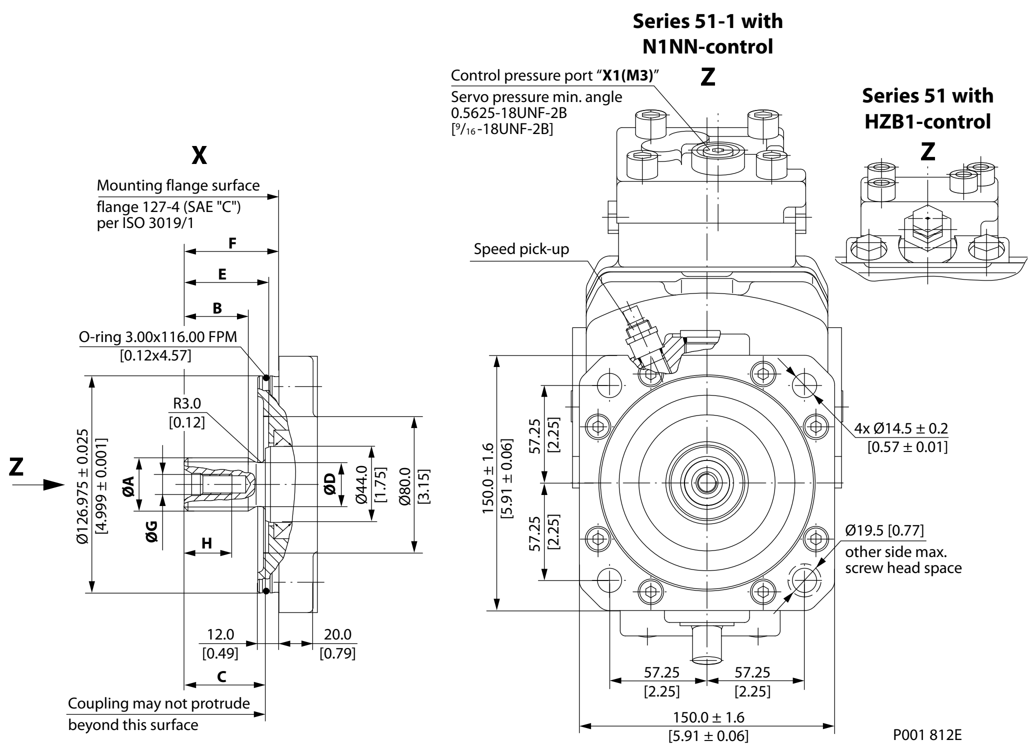
51V080 Proportional and Two-Position Control, HZB1 (Side port on top, Axial port below)





General dimensions – frame size 080

Shaft Options – 51V080-1 and 51V080



Shaft spline data - mm [in]

Shaft option	**S1**	**C7**
Number of teeth	14	23
Pitch	12/24	16/32
Pitch Ø	29.633 [1.167]	36.513 [1.438]
Ø A	31.15 [1.23]	37.61 [1.481]
Ø D	25.8 [1.02]	32.0 [1.26]
Pressure angle	30°	
B	37.5 [1.476]	
C	47.5±0.5 [1.87]	
E	49.5±1.1 [1.95]	
F	55.5±0.7 [2.19]	
H	28.0 [1.1]	
Spline	ANSI B92.1-1970, class 5, flat root side fit	
Ø G	0.4375-14UNC-2B [7/16-14UNC-2B]; allowed torque in thread max. 91 N•m [805 lbf•in]	

Flow into port **A** results in **CW** rotation of output shaft.

Flow into port **B** results in **CCW** rotation of output shaft.

Shaft rotation is determined by viewing from shaft end. Ports with O-ring seal and inch threads shall be in accordance with ISO 11926/1.

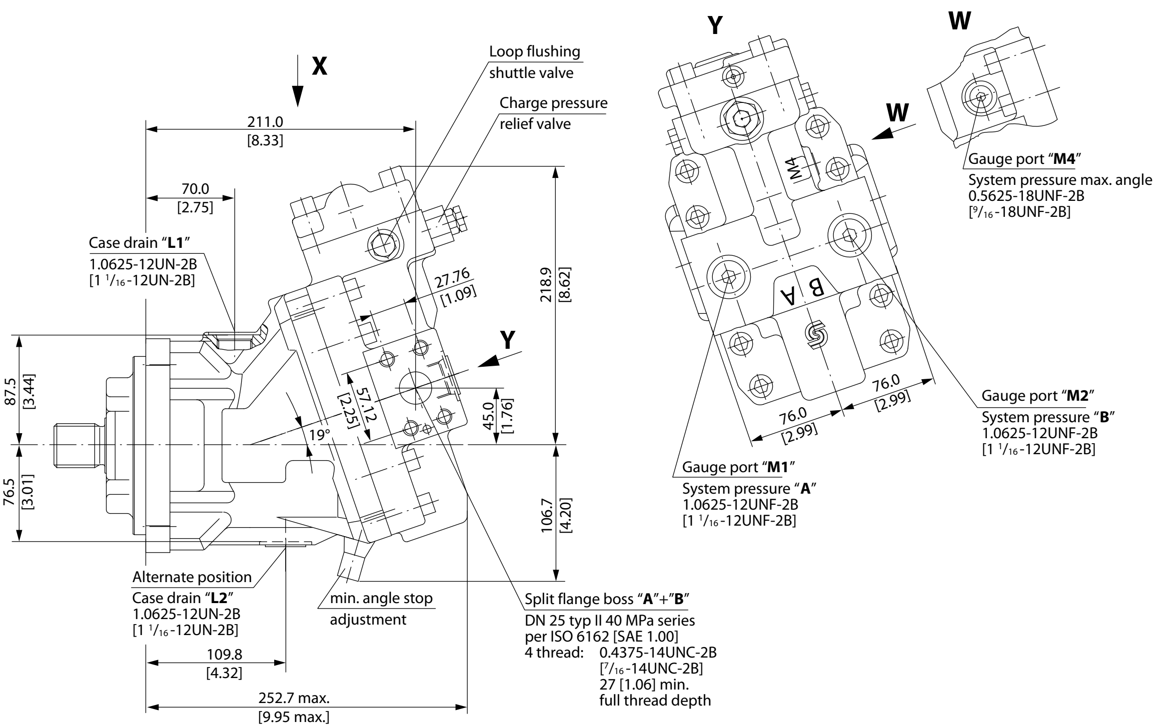
Splite flange boss A and B per ISO 6162 is identical with high pressure series SAEJ518 code 62 (6000 psi).

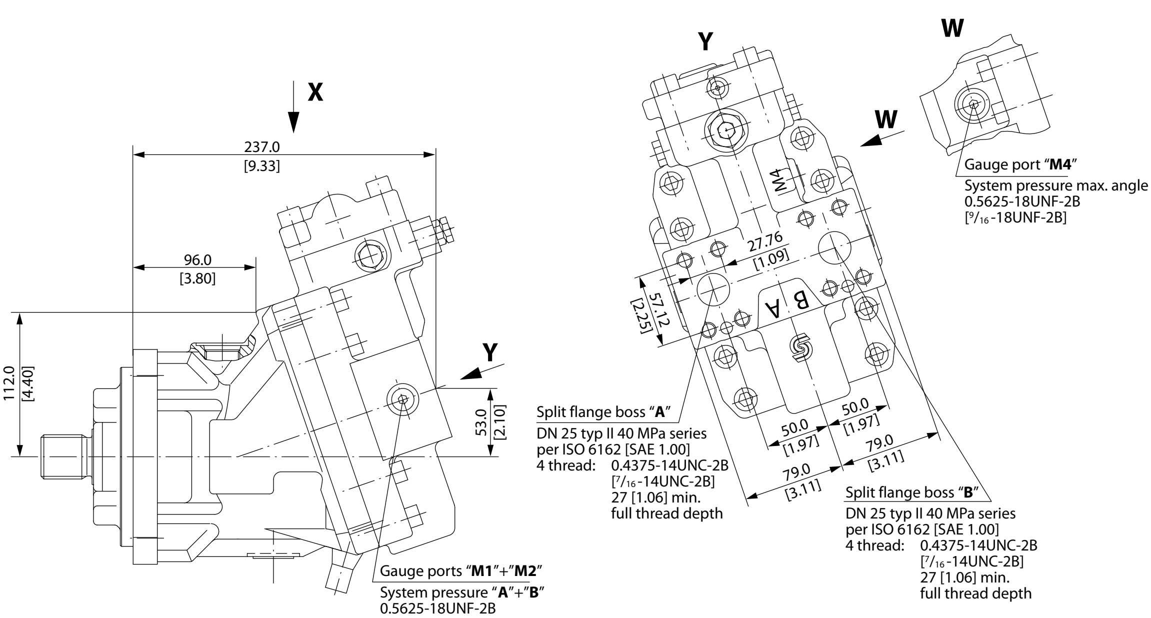
Contact your Danfoss representative for specific installation drawings.

General dimensions – frame size 080

DIN flange design per ISO 3019/2

51D080-1 two position control, N1NN (Side port on top, Axial port below)

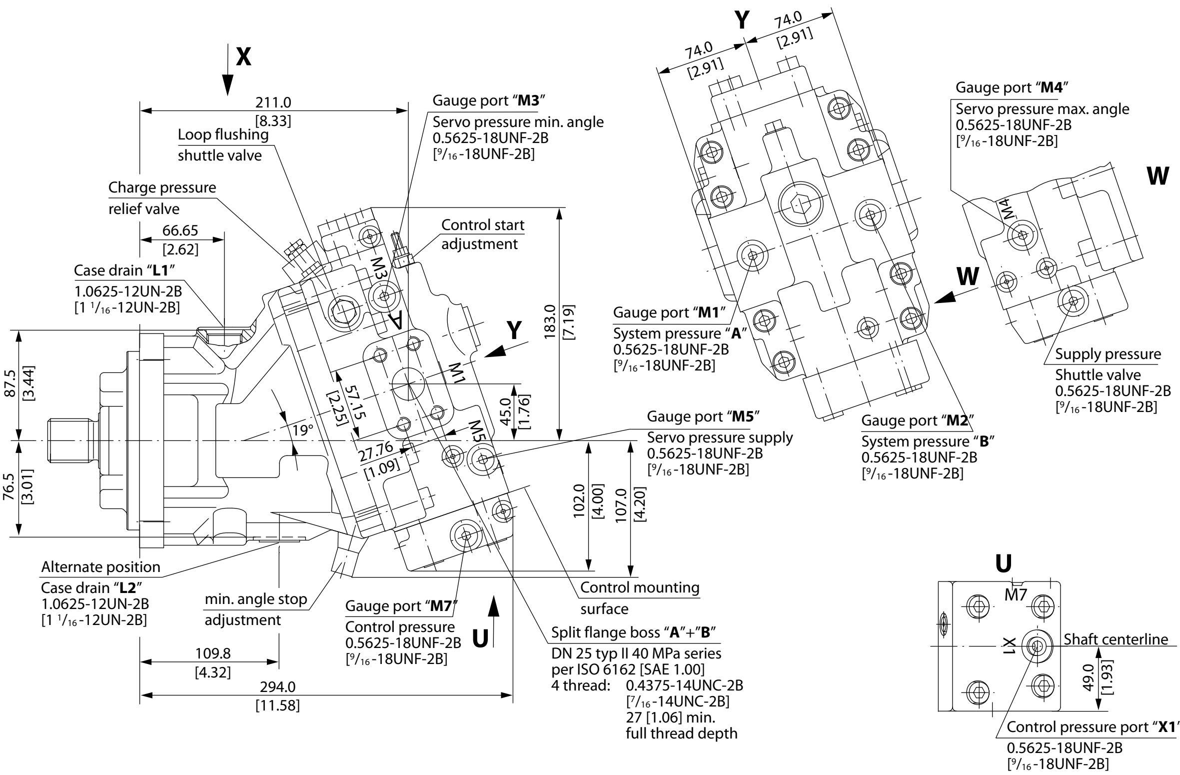


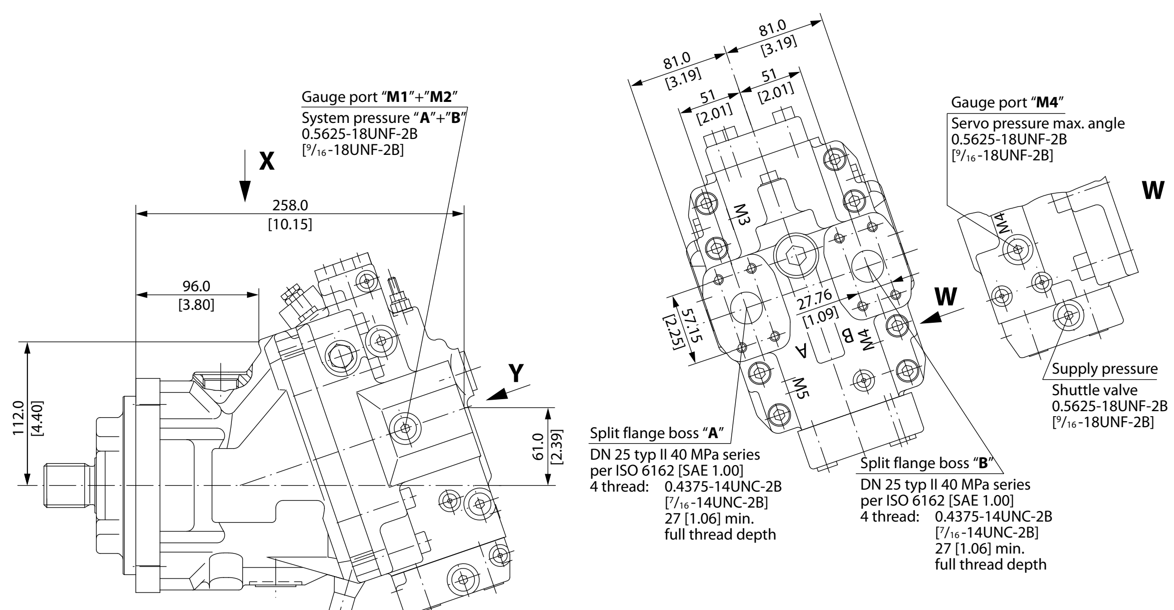


P001 795E

General dimensions – frame size 080

51D080 Proportional and two position control, HZB1 (Side port on top, Axial port below)

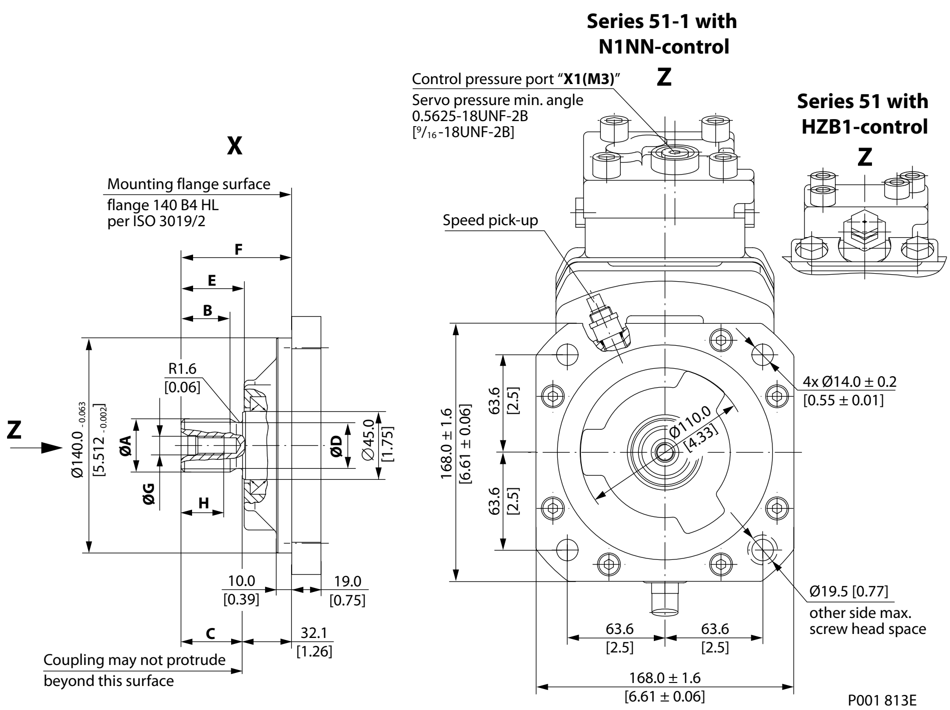




P001 796E

General dimensions – frame size 080

Shaft Options – 51D080-1 and 51D080



Shaft spline data - mm [in]

Shaft option	D2	D3
Number of teeth	16	18
Spline	W35x2x30x16x9g side fit DIN 5480	W40x2x30x18x9g side fit DIN 5480
Pitch Ø	32.0 [1.260]	36.0 [1.417]
Ø A	34.6 [1.36]	39.6 [1.56]
B	32.0 [1.26]	37.0 [1.46]
C	40.0±0.5 [1.58]	45.0±0.5 [1.77]
Ø D	30.0 [1.18]	35.0 [1.38]
E	42.5±1.1 [1.67]	47.3±1.1 [1.86]
F	72.5±0.6 [2.85]	85.3±0.6 [3.36]
H	25.0 [0.98]	25.0 [0.98]
Ø G	M10x1.5 allowed torque in thread max. 67 N•m [593 lbf•in]	

Flow into port **A** results in **CW** rotation of output shaft.

Flow into port **B** results in **CCW** rotation of output shaft.

Shaft rotation is determined by viewing from shaft end. Ports with O-ring seal and inch threads shall be in accordance with ISO 11926/1.

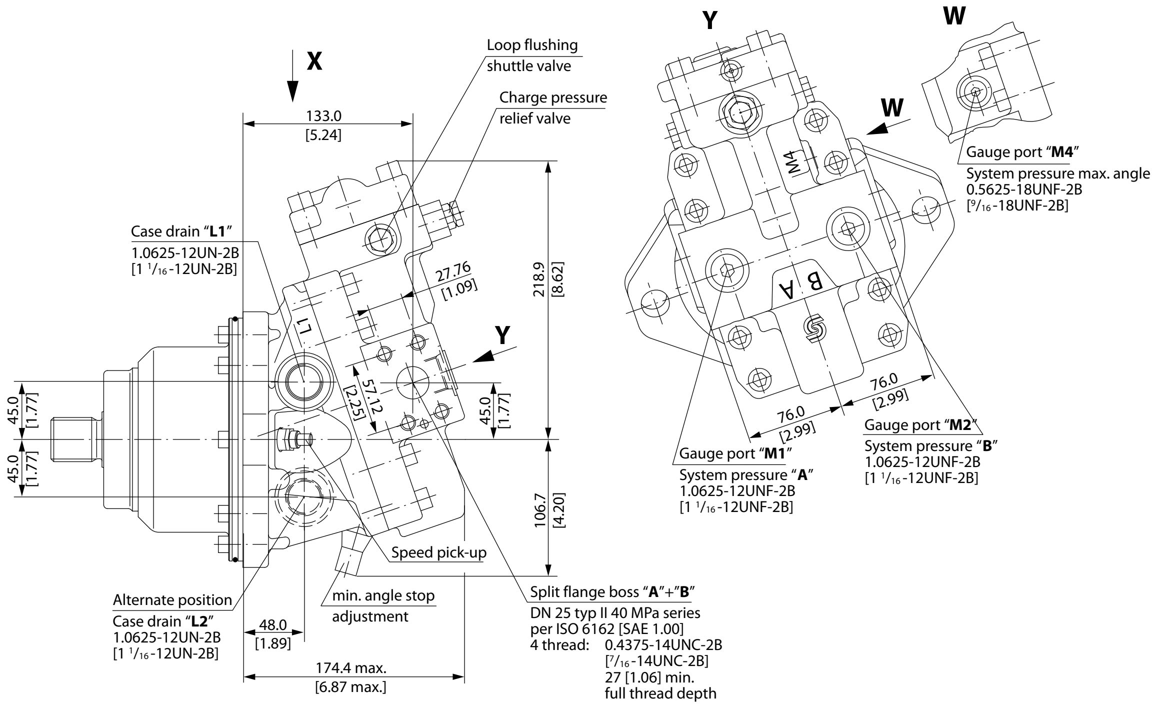
Splite flange boss A and B per ISO 6162 is identical with high pressure series SAEJ518 code 62 (6000 psi).

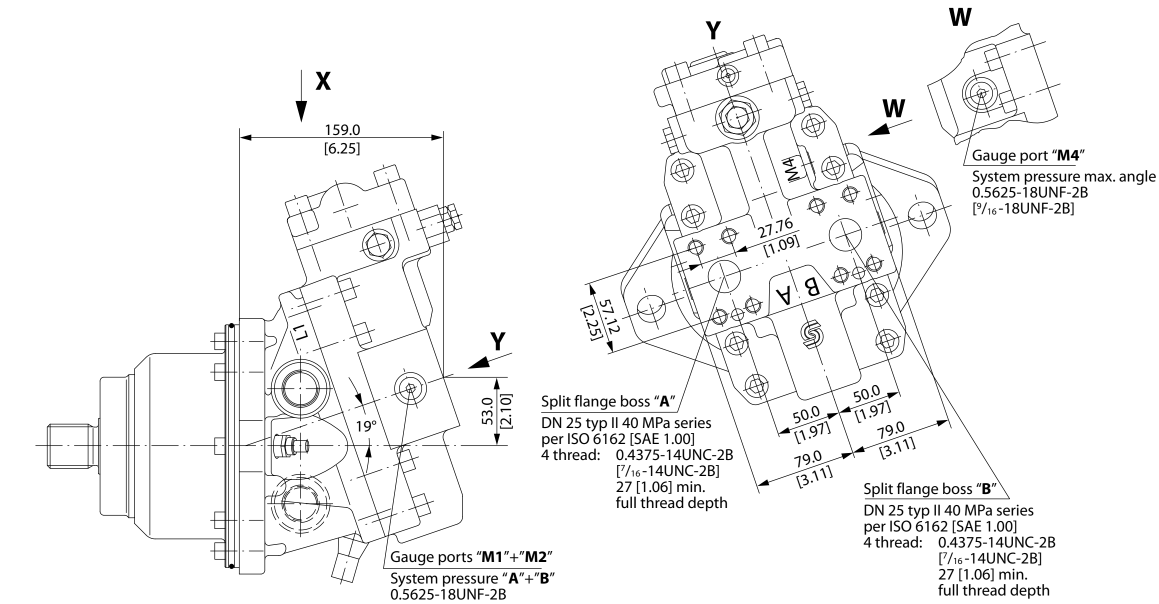
Contact your Danfoss representative for specific installation drawings.

General dimensions – frame size 080

Cartridge flange

51C080-1 two-position control, N1NN (Side port on top, Axial port below)

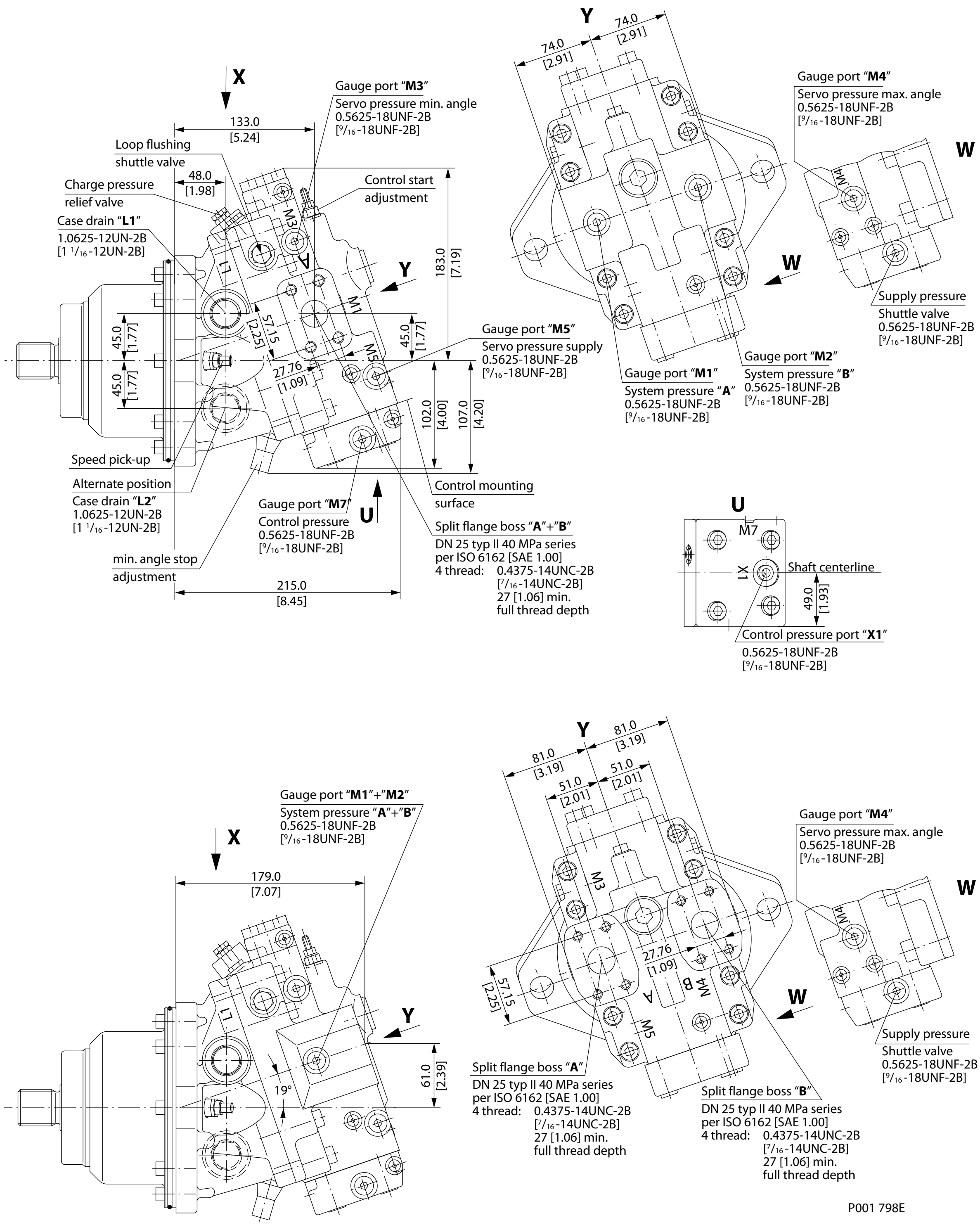




P001 797E

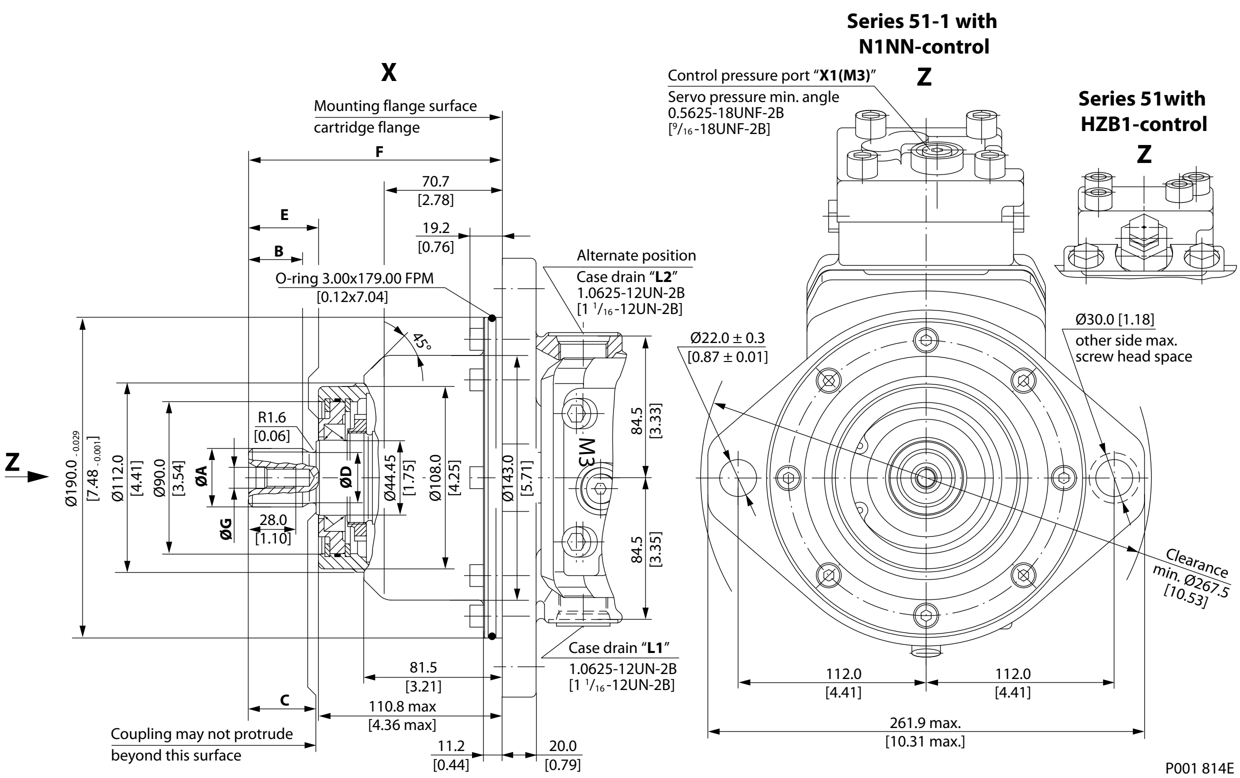
General dimensions – frame size 080

51C080 proportional and two-position control, HZB1 (Side port on top, Axial port below)



General dimensions – frame size 080

Shaft options – 51C080-1 and 51C080



Shaft spline data - mm [in]

Shaft option	D2	D3
Number of teeth	16	18
Spline	W35x2x30x16x9g side fit DIN 5480	W40x2x30x18x9g side fit DIN 5480
Pitch Ø	32.0 [1.260]	36.0 [1.417]
Ø A	34.6 [1.36]	39.6 [1.56]
B	32.0 [1.26]	37.0 [1.46]
C	40.0±0.5 [1.58]	45.0±0.5 [1.77]
Ø D	30.0 [1.18]	35.0 [1.38]
E	41.55±1.4 [1.64]	46.55±1.4 [1.83]
F	150.4±0.6 [5.92]	155.4±0.6 [6.12]
H	25.0 [0.98]	25.0 [0.98]
Ø G	M10x1.5 allowed torque in thread max. 67 N•m [593 lbf•in]	

Flow into port **A** results in **CW** rotation of output shaft.

Flow into port **B** results in **CCW** rotation of output shaft.

Shaft rotation is determined by viewing from shaft end. Ports with O-ring seal and inch threads shall be in accordance with ISO 11926/1.

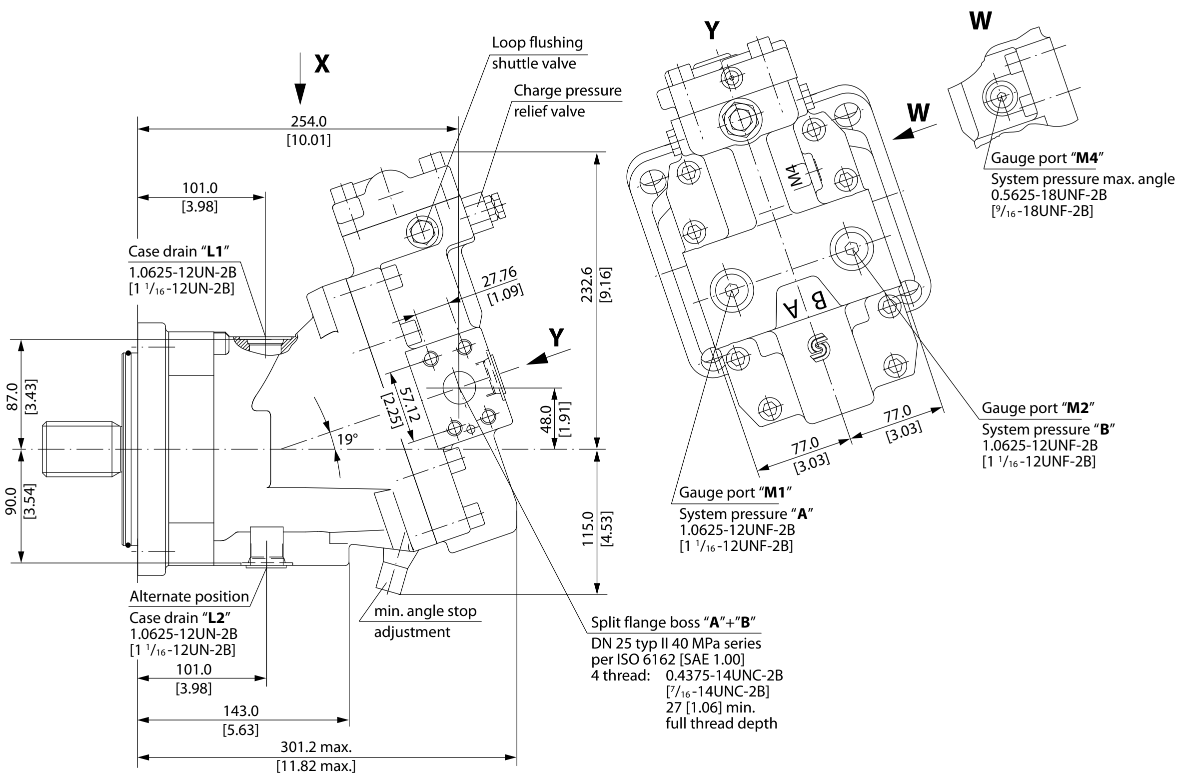
Splite flange boss A and B per ISO 6162 is identical with high pressure series SAEJ518 code 62 (6000 psi).

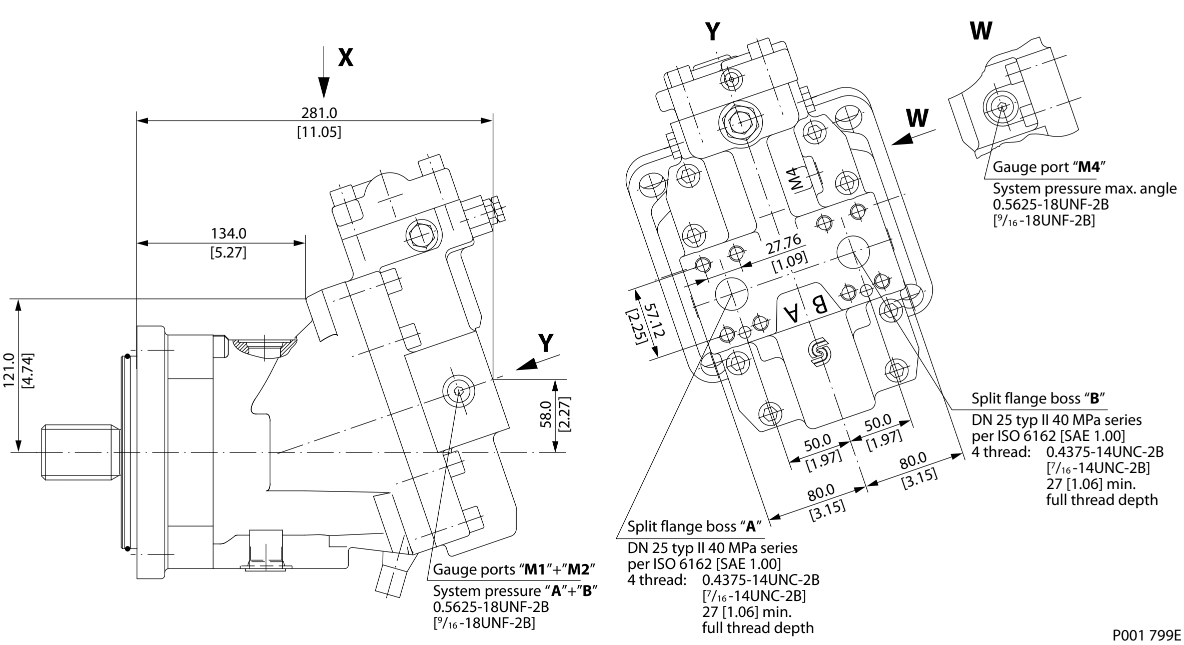
Contact your Danfoss representative for specific installation drawings.

General dimensions – frame size 110

SAE flange design per ISO 3019/1

51V110-1 Two Position Control, N1NN (Side port on top, Axial port below)

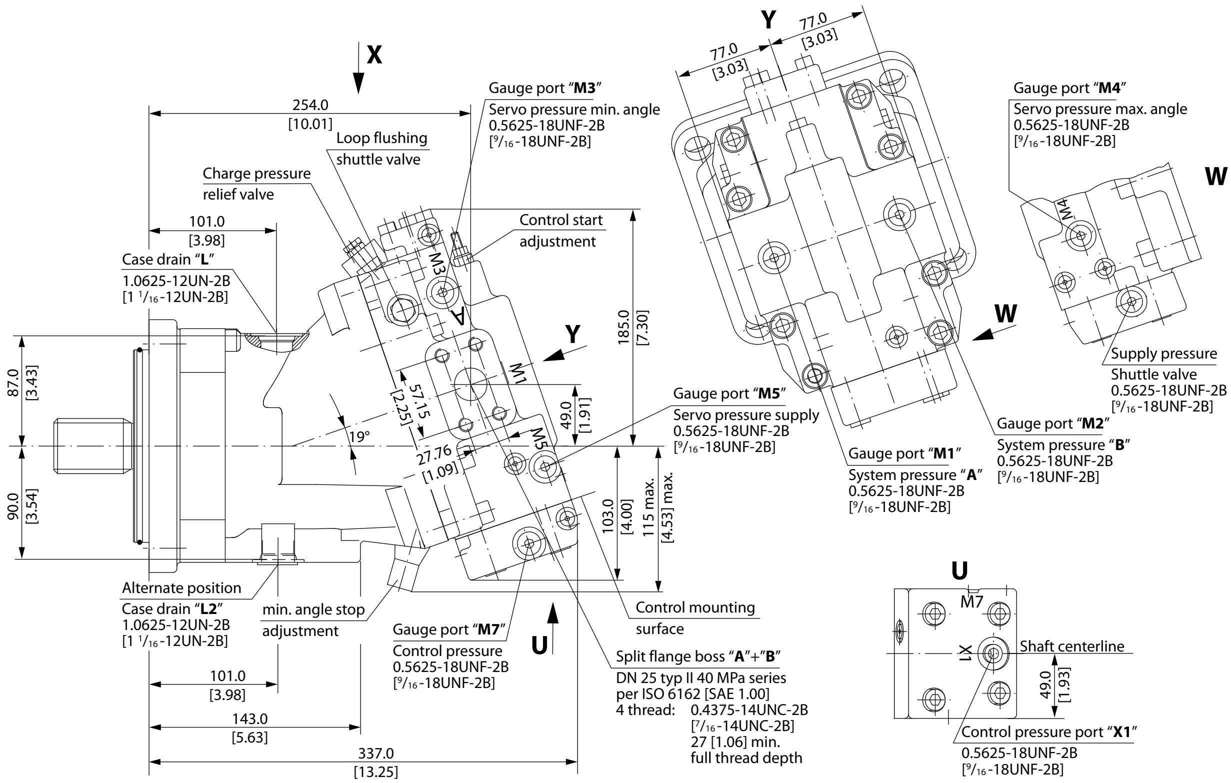


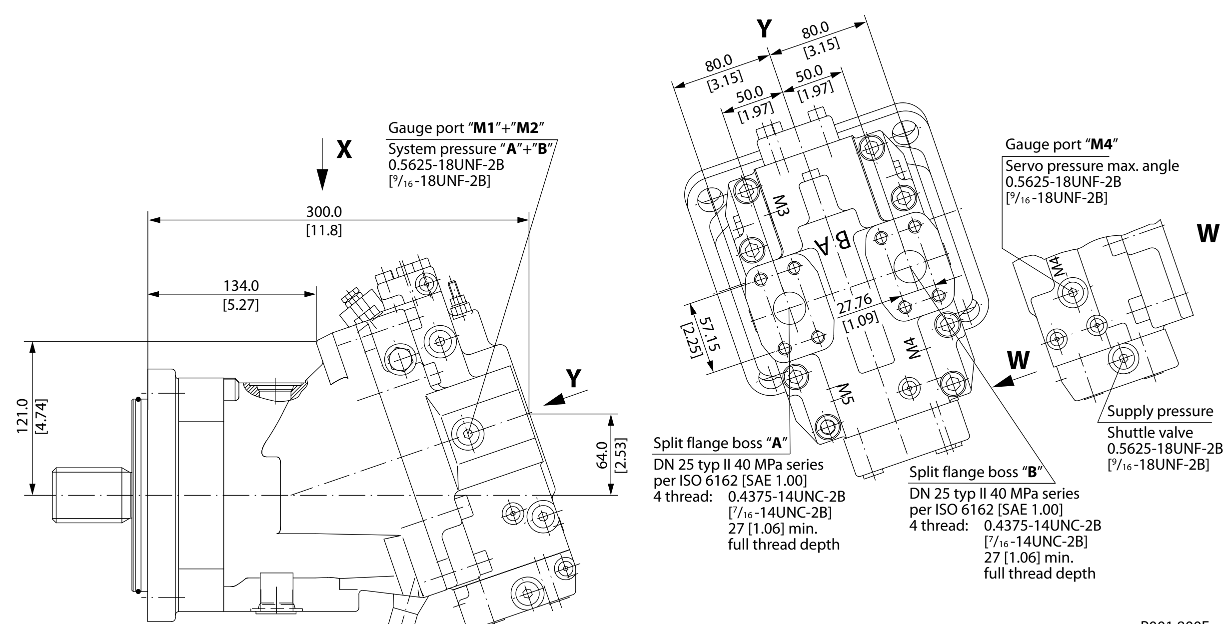


P001 799E

General dimensions – frame size 110

51V110 Proportional and Two-Position Control, HZB1 (Side port on top, Axial port below)

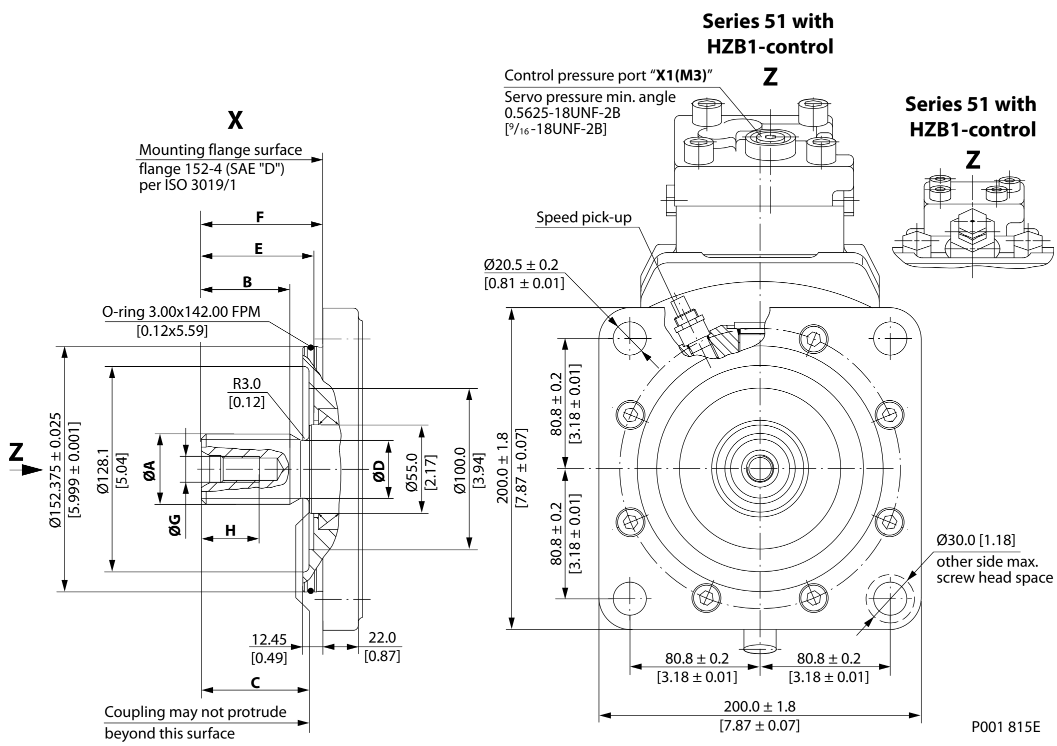




P001 800E

General dimensions – frame size 110

Shaft Options – 51V110-1 and 51V110



Shaft spline data - mm [in]

Shaft option	**F1**	**C8**
Number of teeth	13	27
Pitch	8/16	16/32
Pitch Ø	41.275 [1.625]	42.862 [1.688]
Ø A	43.64 [1.72]	43.96 [1.73]
Ø D	36.0 [1.42]	39.60 [1.56]
Pressure angle	30°	
B	55.0 [2.17]	
C	67.0±0.5 [2.64]	
E	69.8±1.1 [2.75]	
F	75.40±0.7 [2.97]	
H	28.0 [1.1]	
Spline	ANSI B92.1-1970, class 5, flat root side fit	
Ø G	0.625-11UNC-2B [5/8-11UNC-2B]; allowed torque in thread max. 200 N•m [1770 lbf•in]	

Flow into port **A** results in **CW** rotation of output shaft.

Flow into port **B** results in **CCW** rotation of output shaft.

Shaft rotation is determined by viewing from shaft end. Ports with O-ring seal and inch threads shall be in accordance with ISO 11926/1.

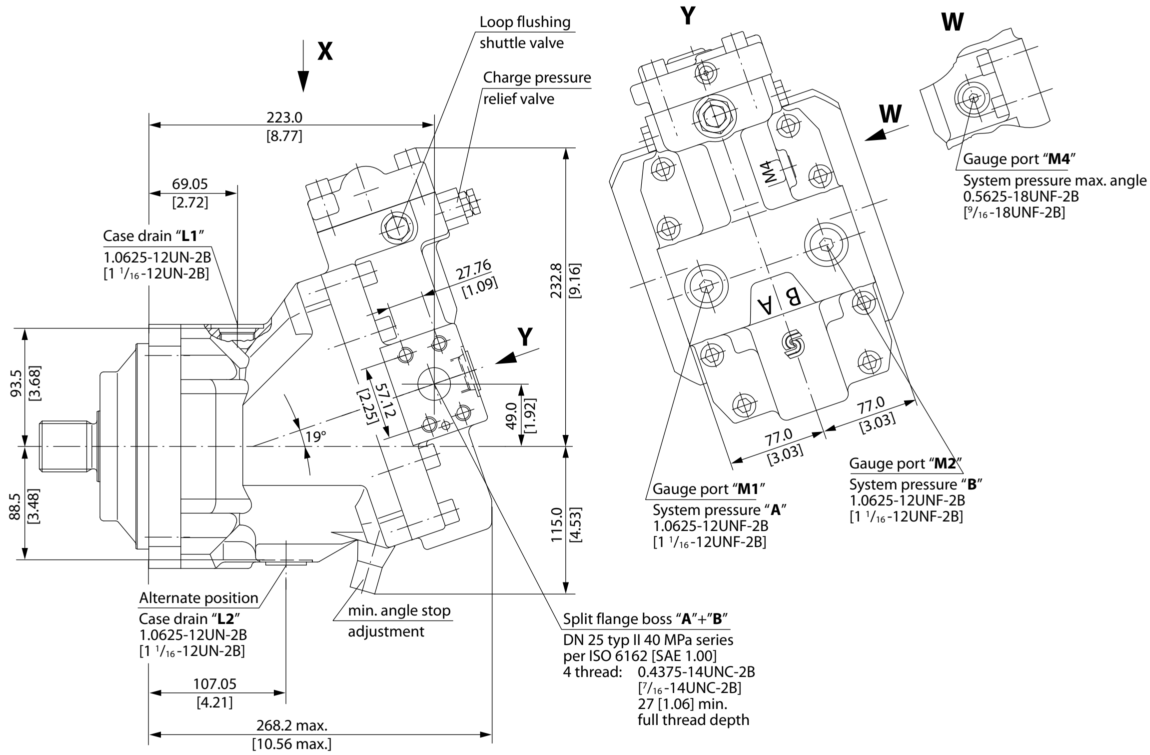
Splite flange boss A and B per ISO 6162 is identical with high pressure series SAEJ518 code 62 (6000 psi).

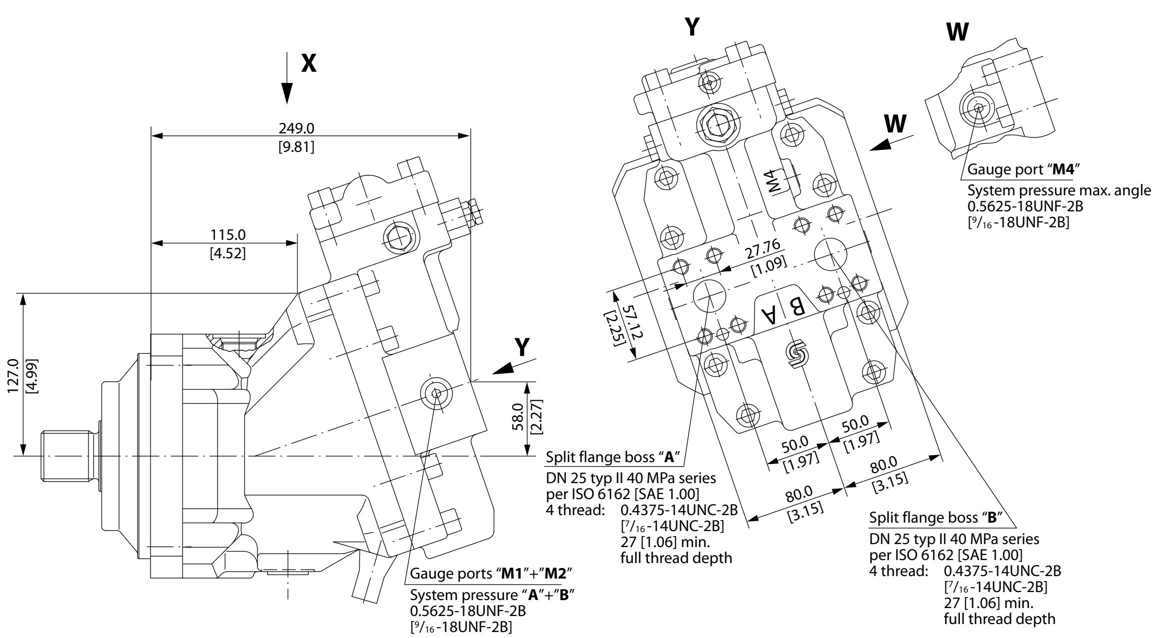
Contact your Danfoss representative for specific installation drawings.

General dimensions – frame size 110

DIN flange design per ISO 3019/2

51D110-1 two position control, N1NN (Side port on top, Axial port below)

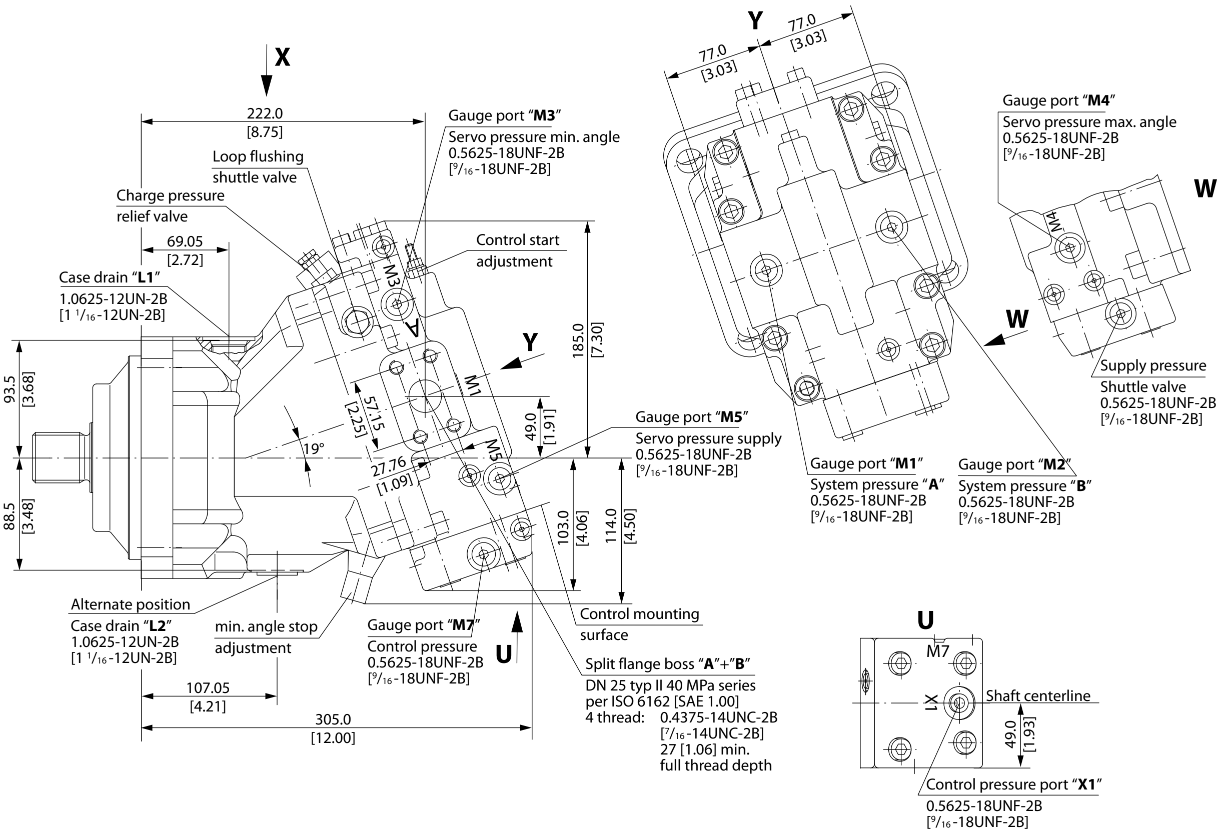


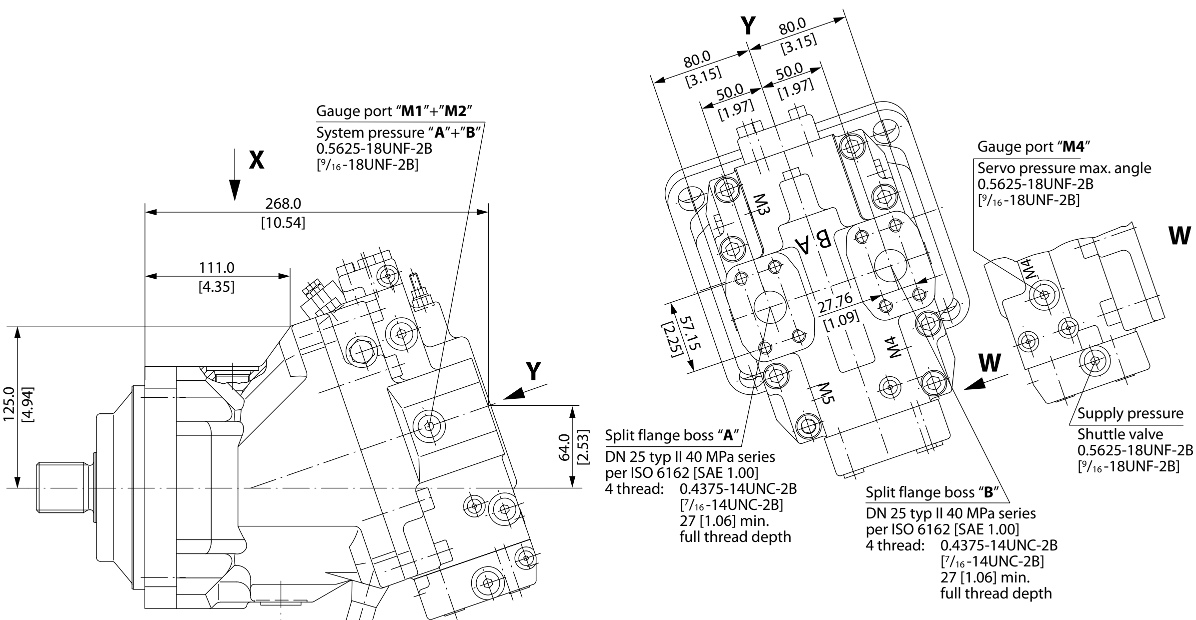


P001 801E

General dimensions – frame size 110

51D110 proportional and two position control, HZB1 (Side port on top, Axial port below)

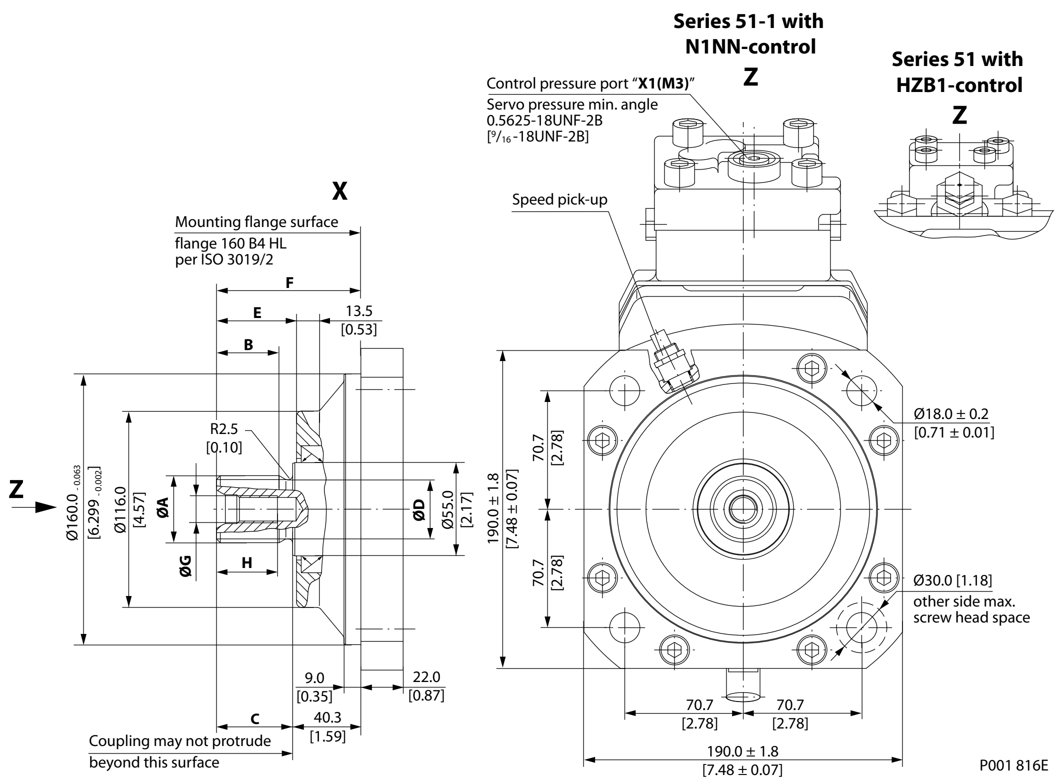




P001 802E

General dimensions – frame size 110

Shaft options – 51D110-1 and 51D110



Shaft spline data - mm [in]

Shaft option	D3	D4
Number of teeth	18	21
Spline	W40x2x30x18x9g side fit DIN 5480	W45x2x30x21x9g side fit DIN 5480
Pitch Ø	36.0 [1.417]	42.0 [1.654]
Ø A	39.6 [1.56]	44.6 [1.76]
B	37.0 [1.46]	42.0 [1.65]
C	45.0±0.5 [1.77]	50.0±0.5 [1.97]
Ø D	35.0 [1.38]	40.0 [1.57]
E	47.3±1.1 [1.86]	52.3±1.1 [2.06]
F	85.3±0.6 [3.36]	90.3±0.6 [3.56]
H	30.0 [1.18]	30.0 [1.18]
Ø G	M12x1.75 allowed torque in thread max. 115 N•m [1018 lbf•in]	

Flow into port **A** results in **CW** rotation of output shaft.

Flow into port **B** results in **CCW** rotation of output shaft.

Shaft rotation is determined by viewing from shaft end. Ports with O-ring seal and inch threads shall be in accordance with ISO 11926/1.

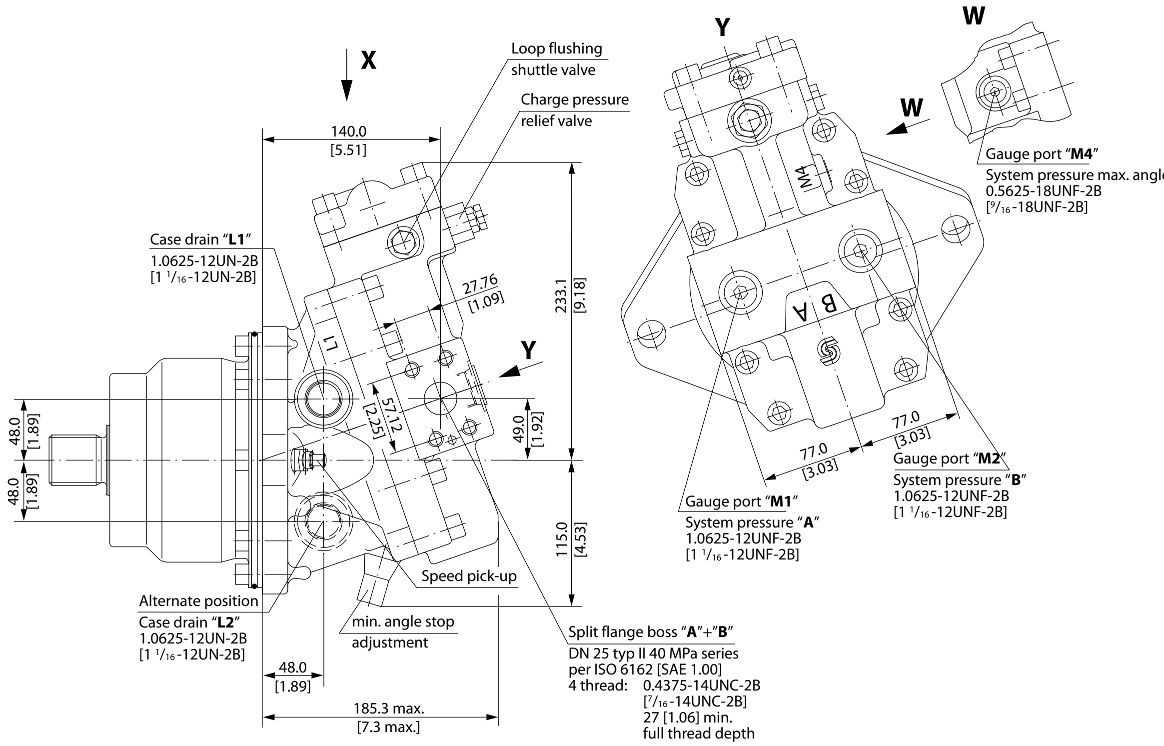
Splite flange boss A and B per ISO 6162 is identical with high pressure series SAEJ518 code 62 (6000 psi).

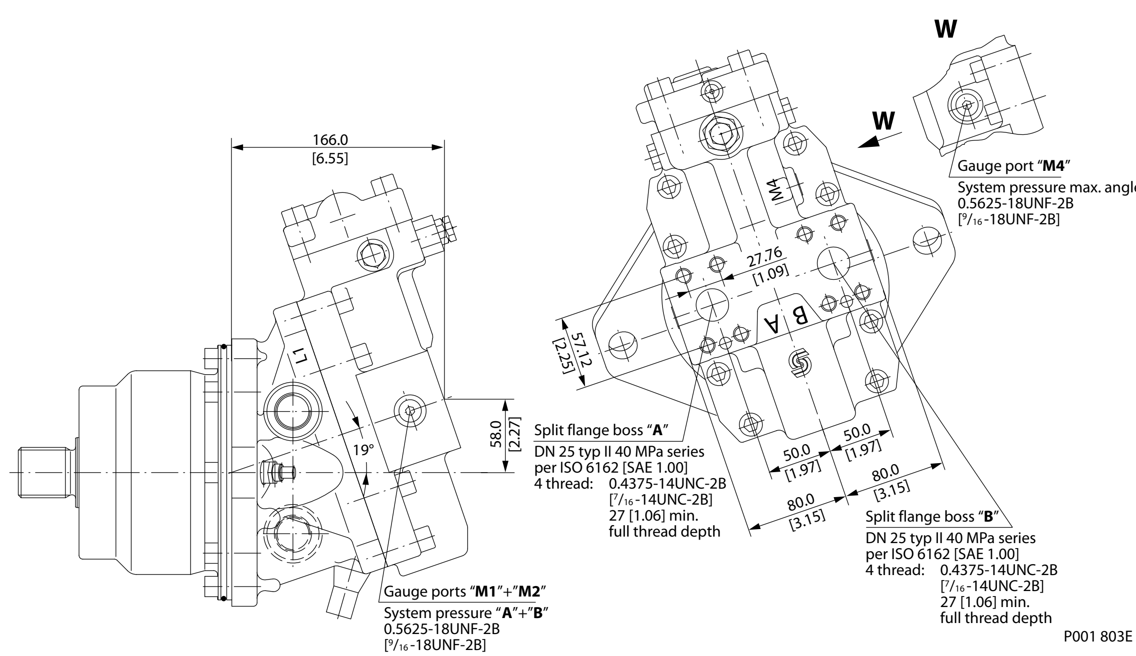
Contact your Danfoss representative for specific installation drawings.

General dimensions – frame size 110

Cartridge flange

51C110-1 two-position control, N1NN (Side port on top, Axial port below)

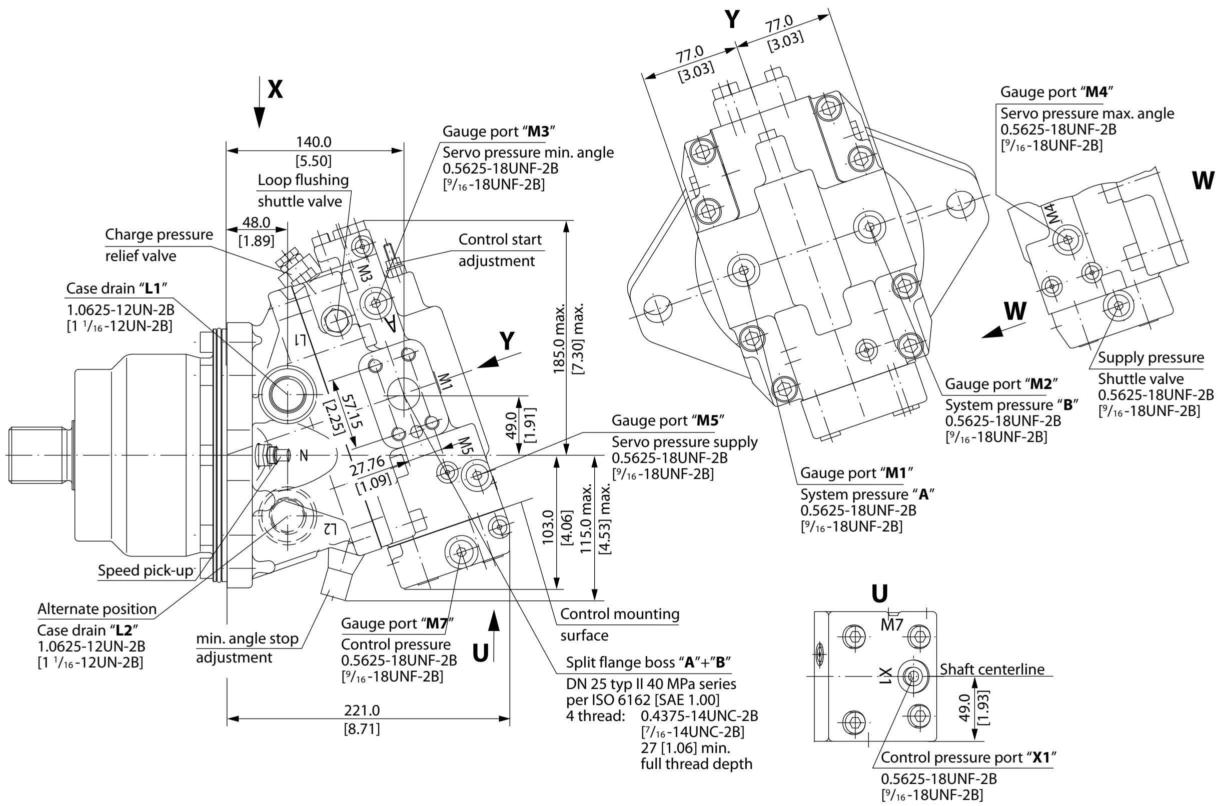


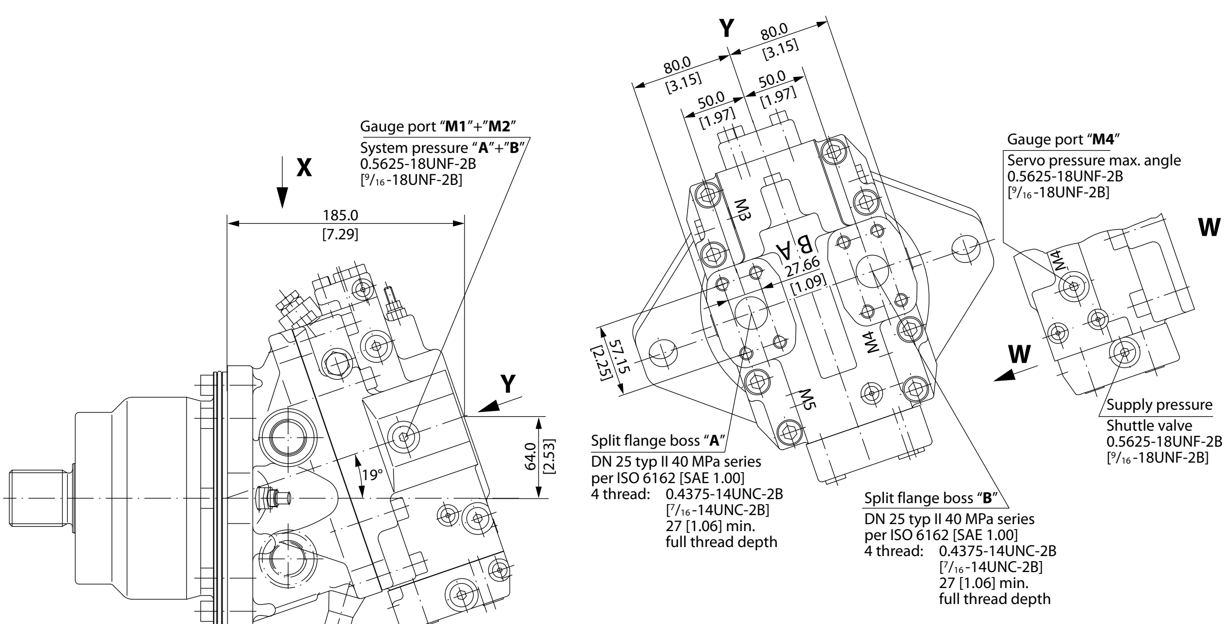


P001 803E

General dimensions – frame size 110

51C110 proportional and two-position control, HZB1 (Side port on top, Axial port below)

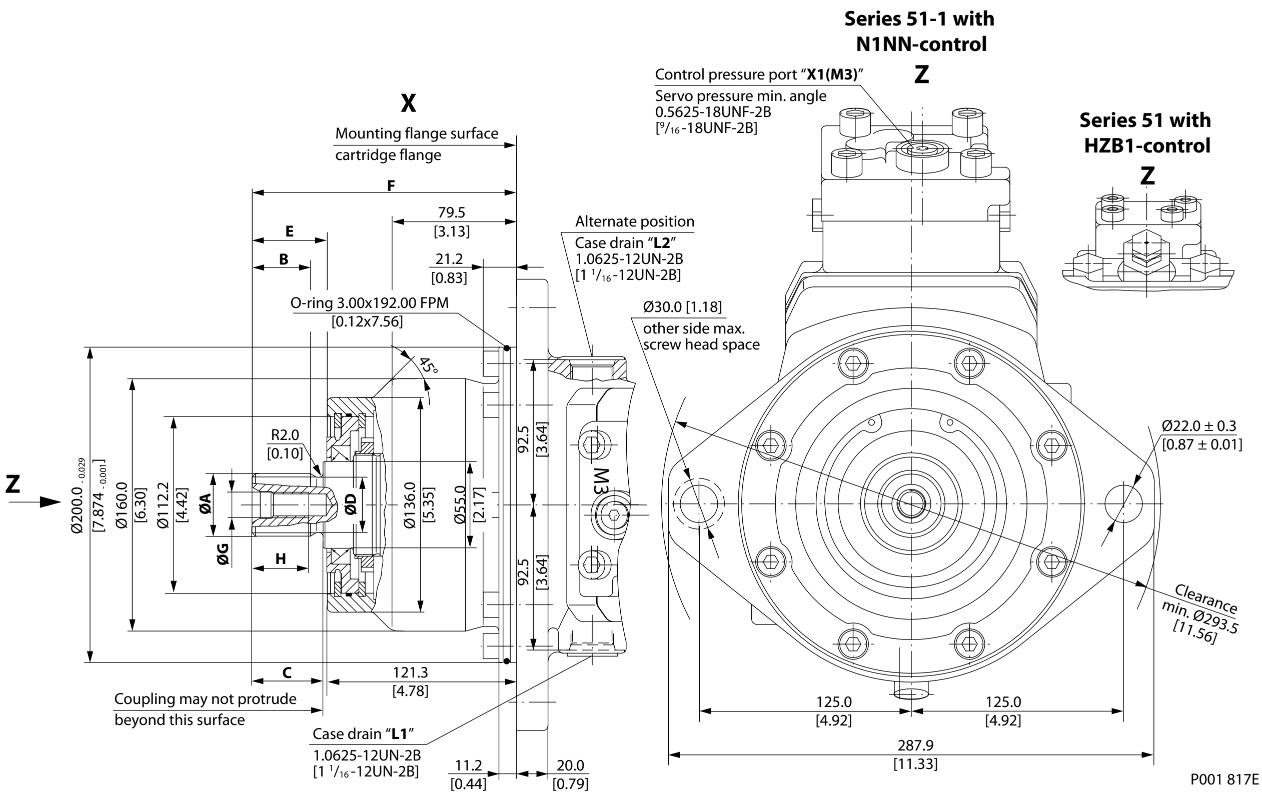




P001 804E

General dimensions – frame size 110

Shaft options – 51C110-1 and 51C110



Shaft spline data - mm [in]

Shaft option	**D3**	**D4**
Number of teeth	18	21
Spline	W40x2x30x18x9g side fit DIN 5480	W45x2x30x21x9g side fit DIN 5480
Pitch Ø	36.0 [1.417]	42.0 [1.654]
Ø A	39.6 [1.56]	44.6 [1.76]
B	37.0 [1.46]	42.0 [1.65]
C	45.0±0.5 [1.77]	50.0±0.5 [1.97]
Ø D	35.0 [1.38]	40.0 [1.57]
E	47.4±1.1 [1.87]	52.4±1.4 [2.06]
F	167.7±0.6 [6.6]	172.7±0.6 [6.8]
H	30.0 [1.18]	30.0 [1.18]
Ø G	M12x1.75 allowed torque in thread max. 115 N•m [1018 lbf•in]	

Flow into port **A** results in **CW** rotation of output shaft.

Flow into port **B** results in **CCW** rotation of output shaft.

Shaft rotation is determined by viewing from shaft end. Ports with O-ring seal and inch threads shall be in accordance with ISO 11926/1.

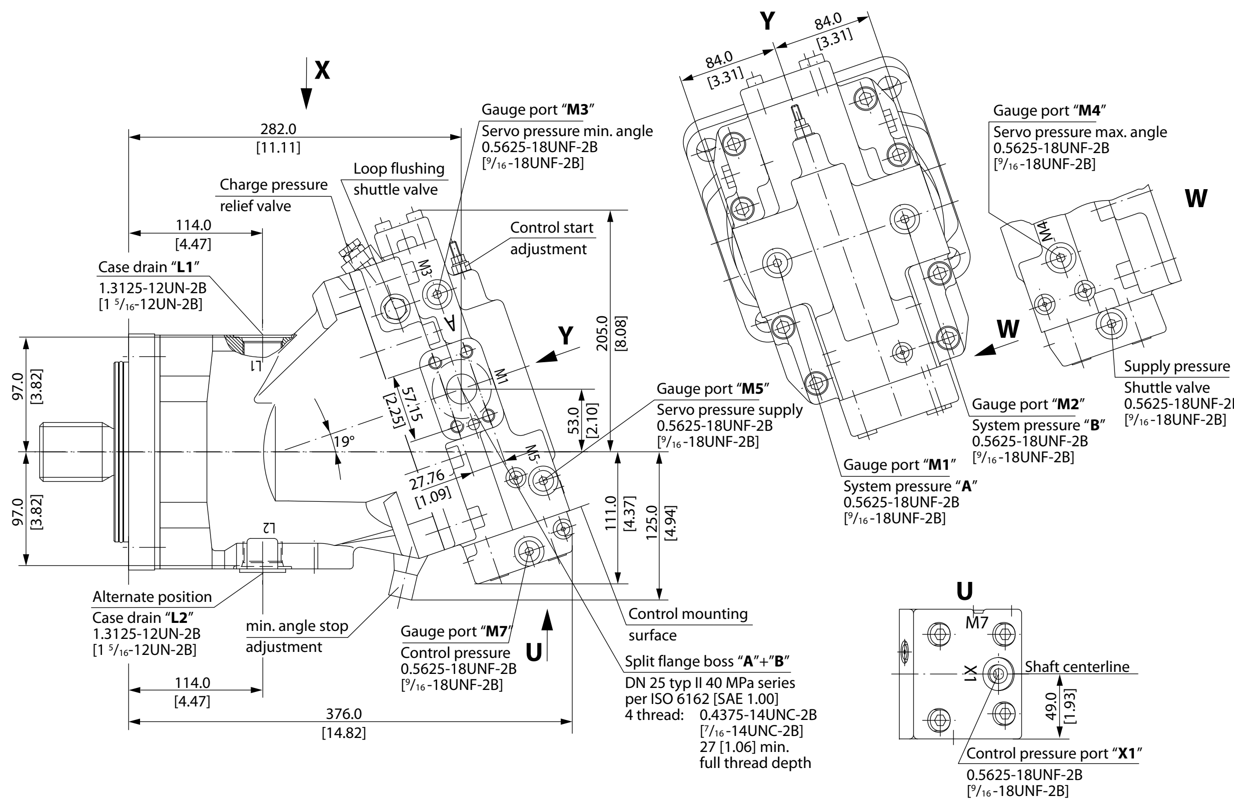
Splite flange boss A and B per ISO 6162 is identical with high pressure series SAEJ518 code 62 (6000 psi).

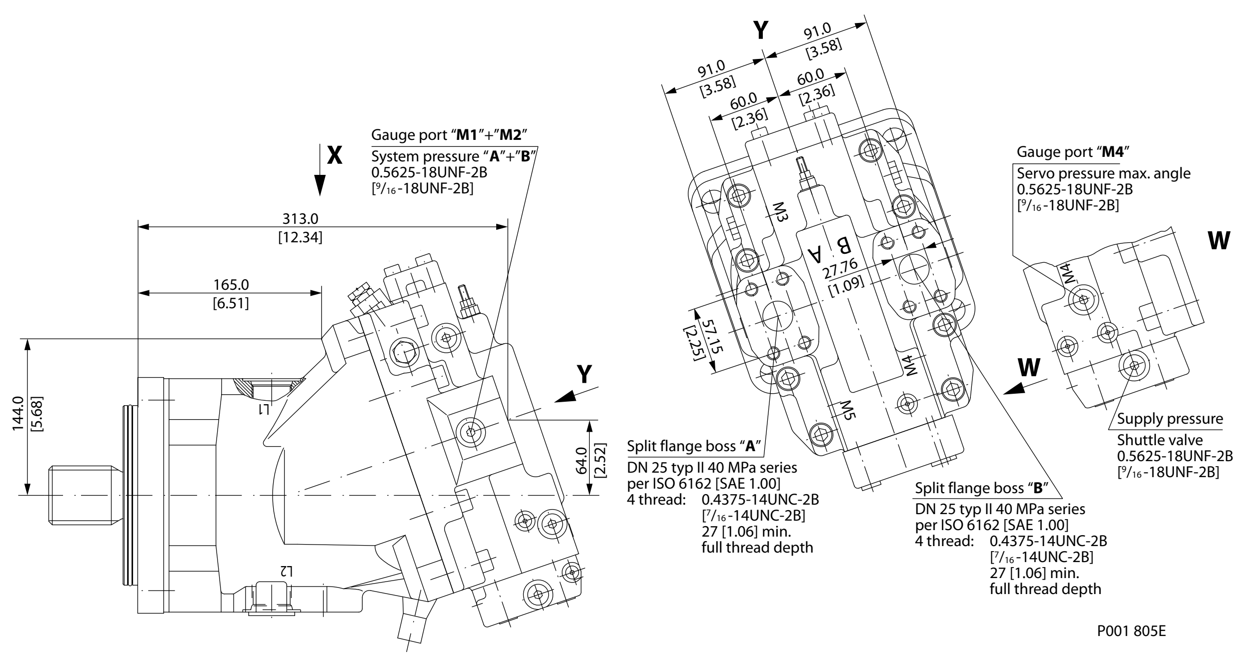
Contact your Danfoss representative for specific installation drawings.

General dimensions – frame size 160

SAE flange design per ISO 3019/1

51V160 proportional and two-position control, HZB1 (Side port on top, Axial port below)

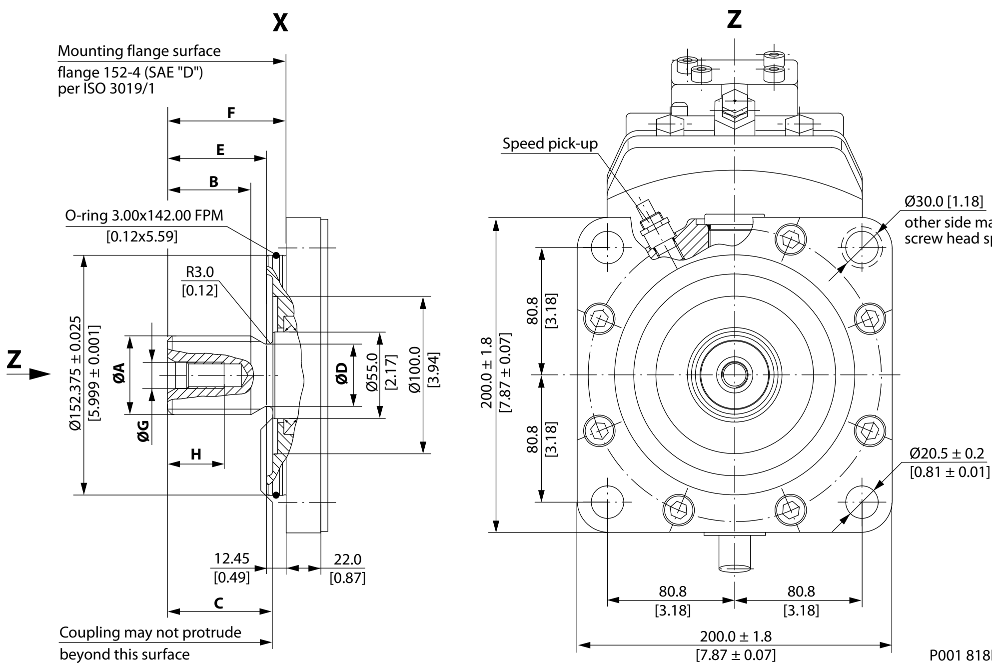




P001 805E

General dimensions – frame size 160

Shaft options – 51V160



Shaft spline data - mm [in]

Shaft option	F1	F2	C8
Number of teeth	13	15	27
Pitch	8/16	8/16	16/32
Pitch Ø	41.275 [1.625]	47.625 [1.875]	42.862 [1.688]
Ø A	43.64 [1.72]	49.99 [1.97]	43.96 [1.73]
B	55.0 [2.17]	53.0 [2.09]	55.0 [2.17]
Ø D	36.0 [1.42]	42.20 [1.66]	39.60 [1.56]
Pressure angle	30°		
C	67.0±0.5 [2.64]		
E	70.0±1.1 [2.76]		
F	75.40±0.7 [2.97]		
H	36.0 [1.42]		
Spline	ANSI B92.1-1970, class 5, flat root side fit		
Ø G	0.625-11UNC-2B [5/8-11UNC-2B]; allowed torque in thread max. 200 N•m [1770 lbf•in]		

Flow into port **A** results in **CW** rotation of output shaft.

Flow into port **B** results in **CCW** rotation of output shaft.

Shaft rotation is determined by viewing from shaft end. Ports with O-ring seal and inch threads shall be in accordance with ISO 11926/1.

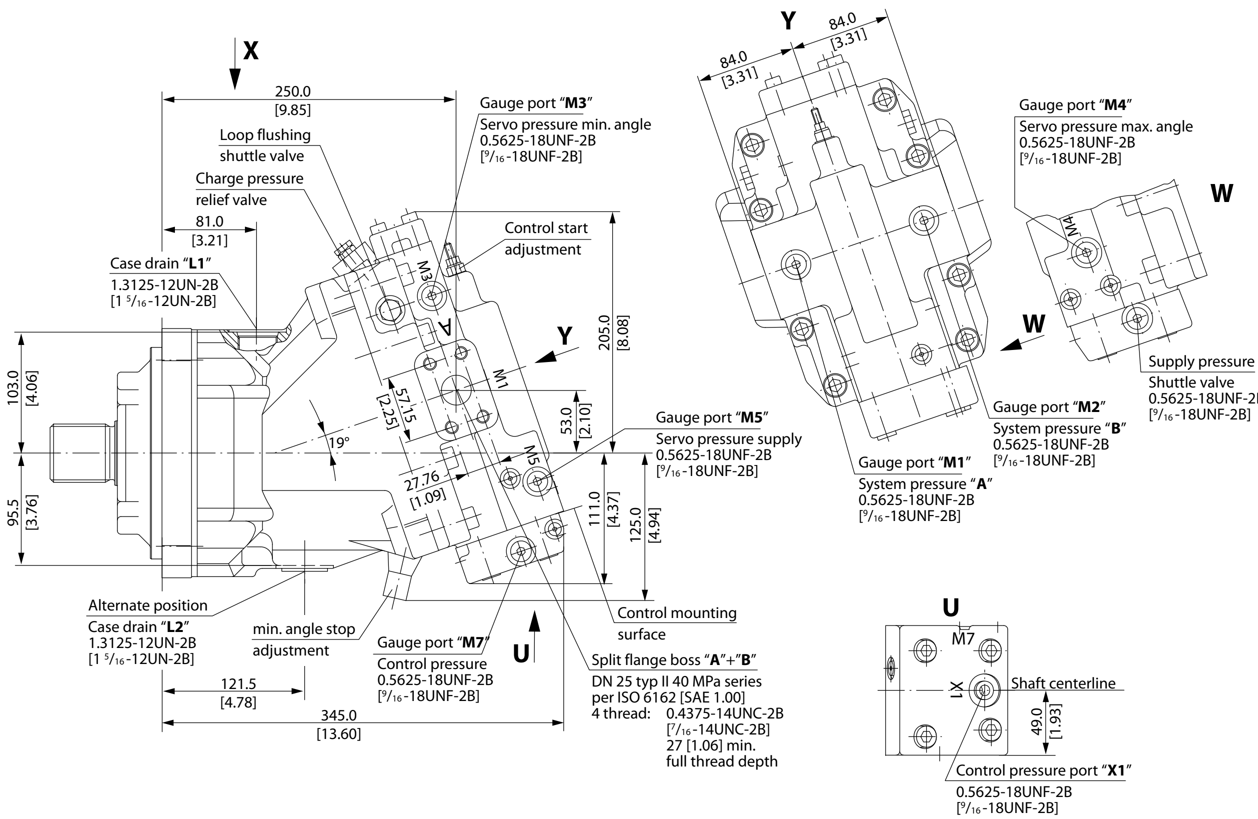
Splite flange boss A and B per ISO 6162 is identical with high pressure series SAEJ518 code 62 (6000 psi).

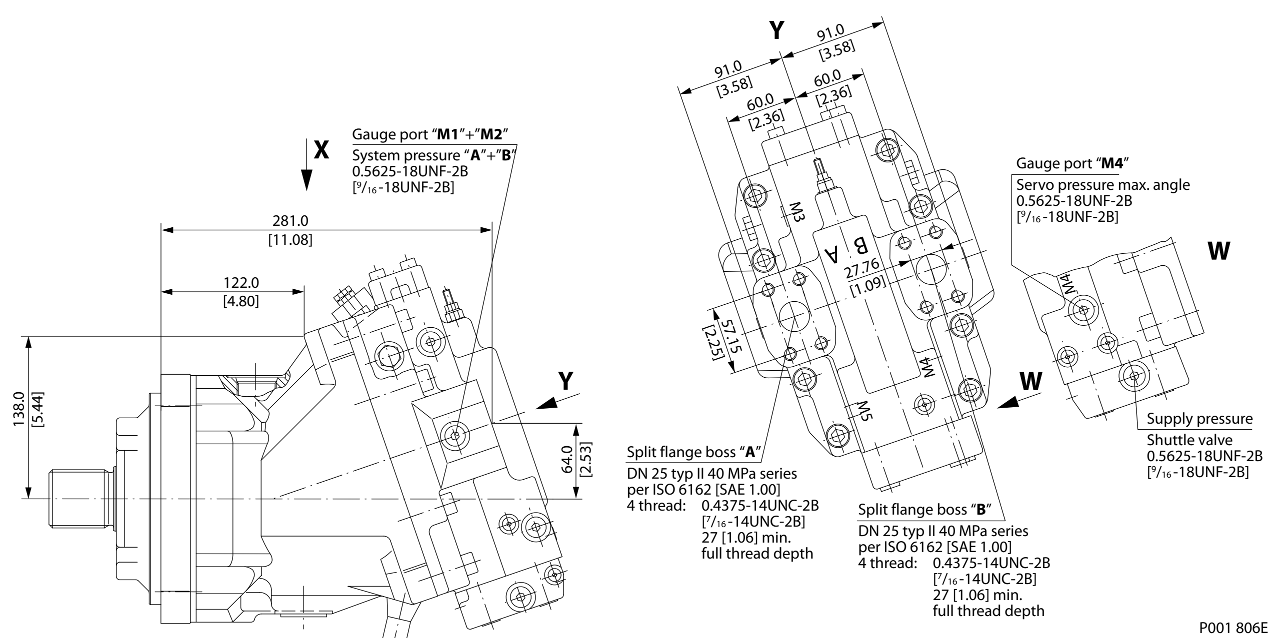
Contact your Danfoss representative for specific installation drawings.

General dimensions – frame size 160

DIN flange design per ISO 3019/2

51D160 proportional and two-position control, HZB1 (Side port on top, Axial port below)

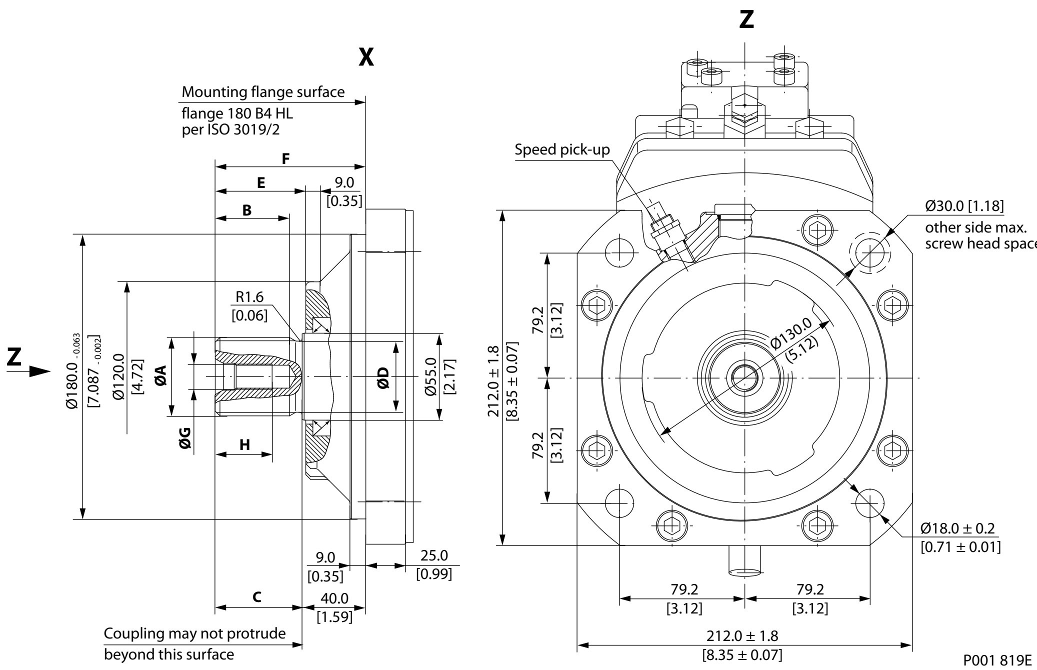




P001 806E

General dimensions – frame size 160

Shaft options – 51D160



Shaft spline data - mm [in]

Shaft option	D4	D5
Number of teeth	21	24
Spline	W45x2x30x21x9g side fit DIN 5480	W50x2x30x24x9g side fit DIN 5480
Pitch Ø	42.0 [1.654]	48.0 [1.890]
Ø A	44.6 [1.76]	49.6 [1.95]
B	42.0 [1.65]	47.0 [1.85]
C	50.0±0.5 [1.97]	55.0±0.5 [2.17]
Ø D	40.0 [1.57]	45.0 [1.77]
E	52.3±1.1 [2.06]	57.3±1.1 [2.26]
F	90.3±0.6 [3.56]	95.3±0.6 [3.75]
H	30.0 [1.18]	30.0 [1.18]
Ø G	M12x1.75 allowed torque in thread max. 115 N•m [1018 lbf•in]	

Flow into port **A** results in **CW** rotation of output shaft.

Flow into port **B** results in **CCW** rotation of output shaft.

Shaft rotation is determined by viewing from shaft end. Ports with O-ring seal and inch threads shall be in accordance with ISO 11926/1.

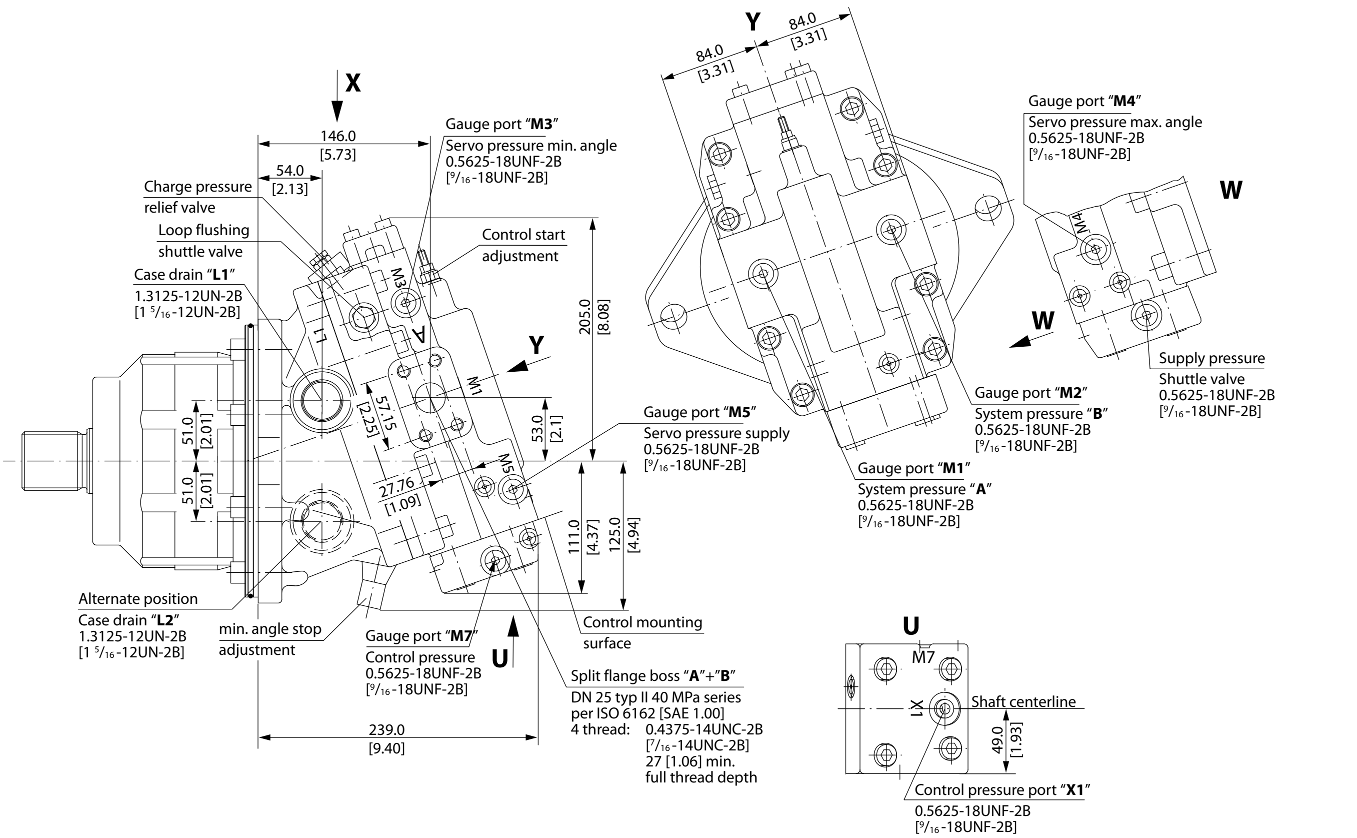
Splite flange boss A and B per ISO 6162 is identical with high pressure series SAEJ518 code 62 (6000 psi).

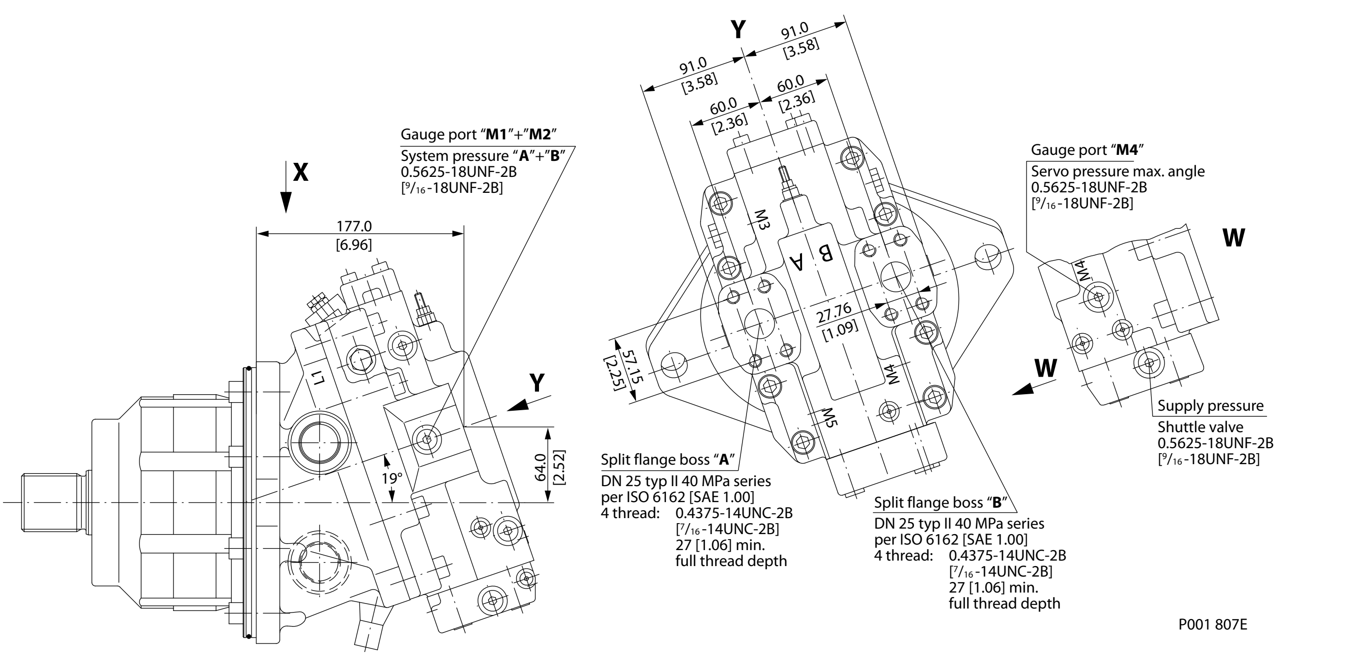
Contact your Danfoss representative for specific installation drawings.

General dimensions – frame size 160

Cartridge flange

51C160 proportional and two-position control, HZB1 (Side port on top, Axial port below)

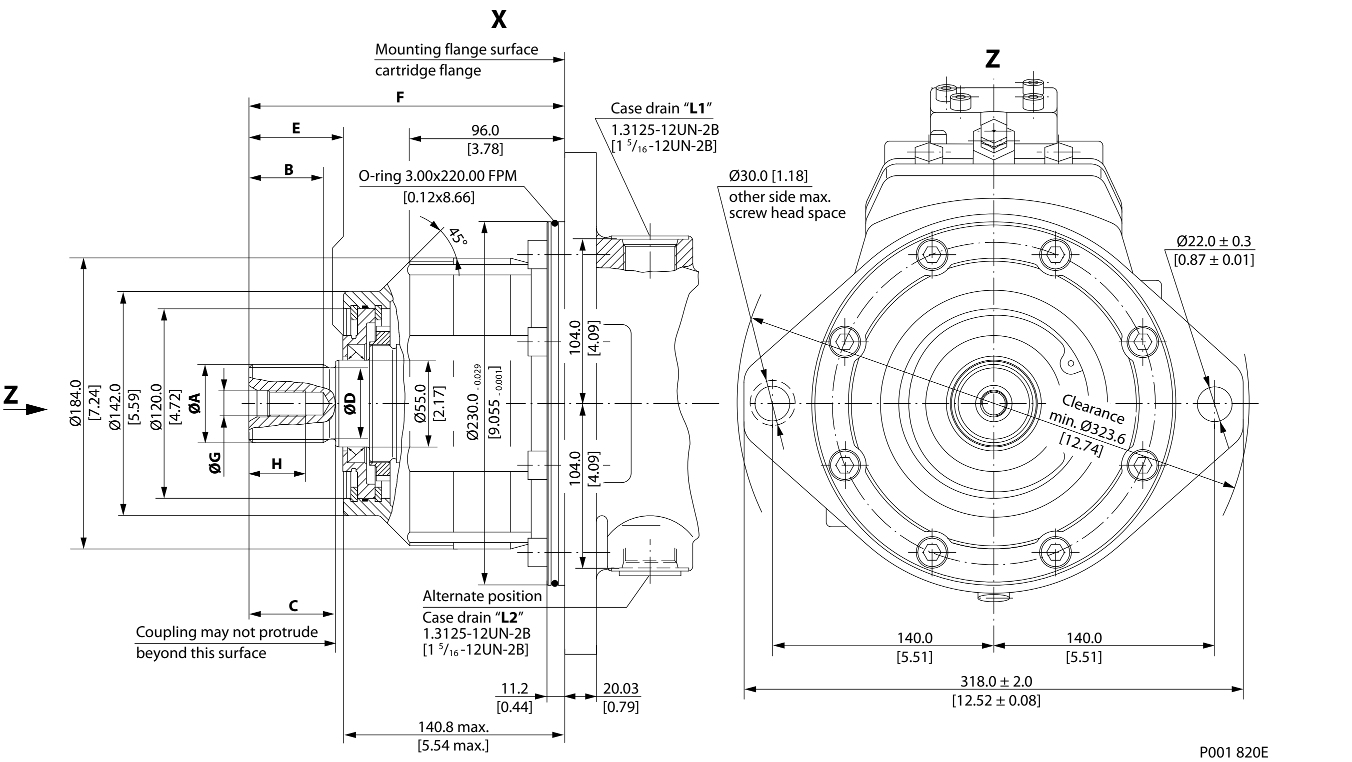




P001 807E

General dimensions – frame size 160

Shaft options – 51C160



Shaft spline data - mm [in]

Shaft option	**D4**	**D5**
Number of teeth	21	24
Spline	W45x2x30x21x9g side fit DIN 5480	W50x2x30x24x9g side fit DIN 5480
Pitch Ø	42.0 [1.654]	48.0 [1.890]
Ø A	44.6 [1.76]	49.6 [1.95]
B	42.0 [1.65]	47.0 [1.85]
C	50.0±0.5 [1.97]	55.0±0.5 [2.17]
Ø D	40.0 [1.57]	45.0 [1.77]
E	54.5±1.4 [2.15]	59.5±1.4 [2.34]
F	194.9±0.6 [7.67]	199.9±0.6 [7.87]
H	30.0 [1.18]	30.0 [1.18]
Ø G	M12x1.75 allowed torque in thread max. 115 N•m [1018 lbf•in]	

Flow into port **A** results in **CW** rotation of output shaft.

Flow into port **B** results in **CCW** rotation of output shaft.

Shaft rotation is determined by viewing from shaft end. Ports with O-ring seal and inch threads shall be in accordance with ISO 11926/1.

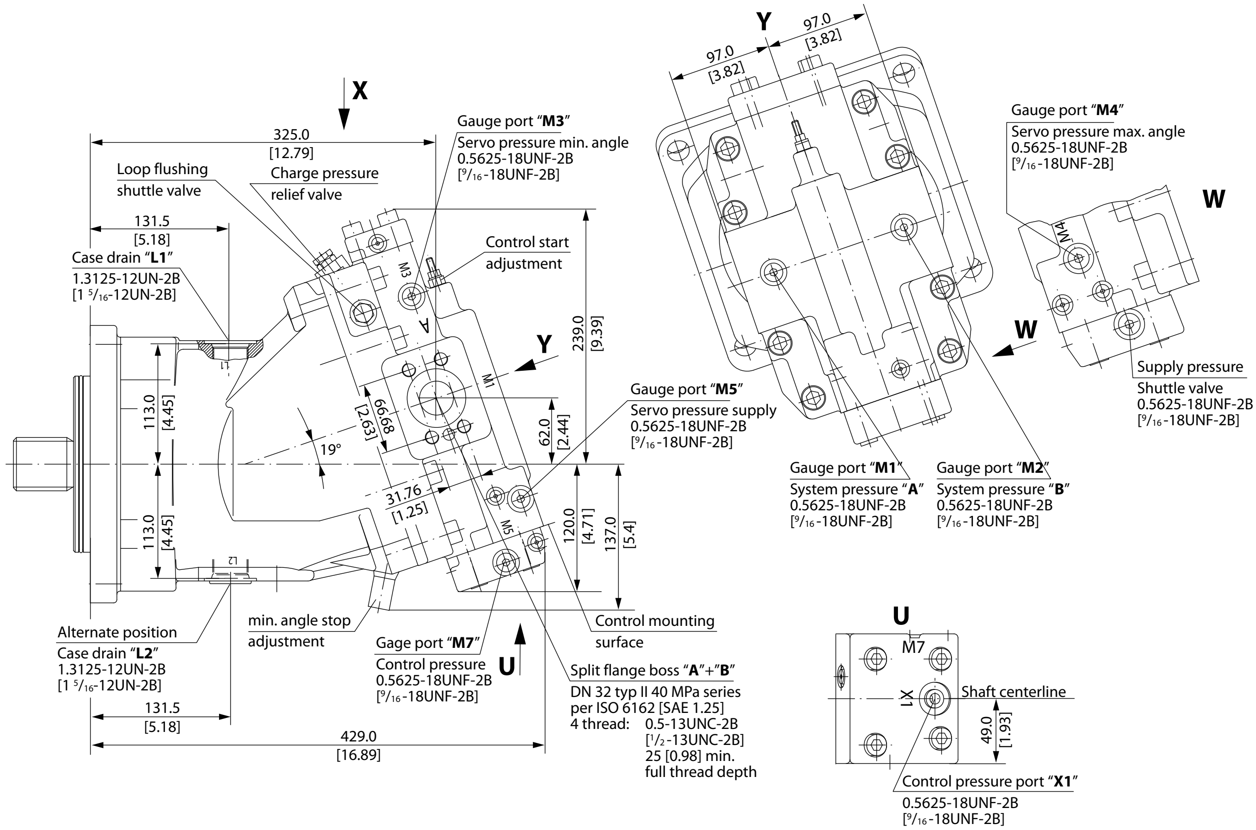
Splite flange boss A and B per ISO 6162 is identical with high pressure series SAEJ518 code 62 (6000 psi).

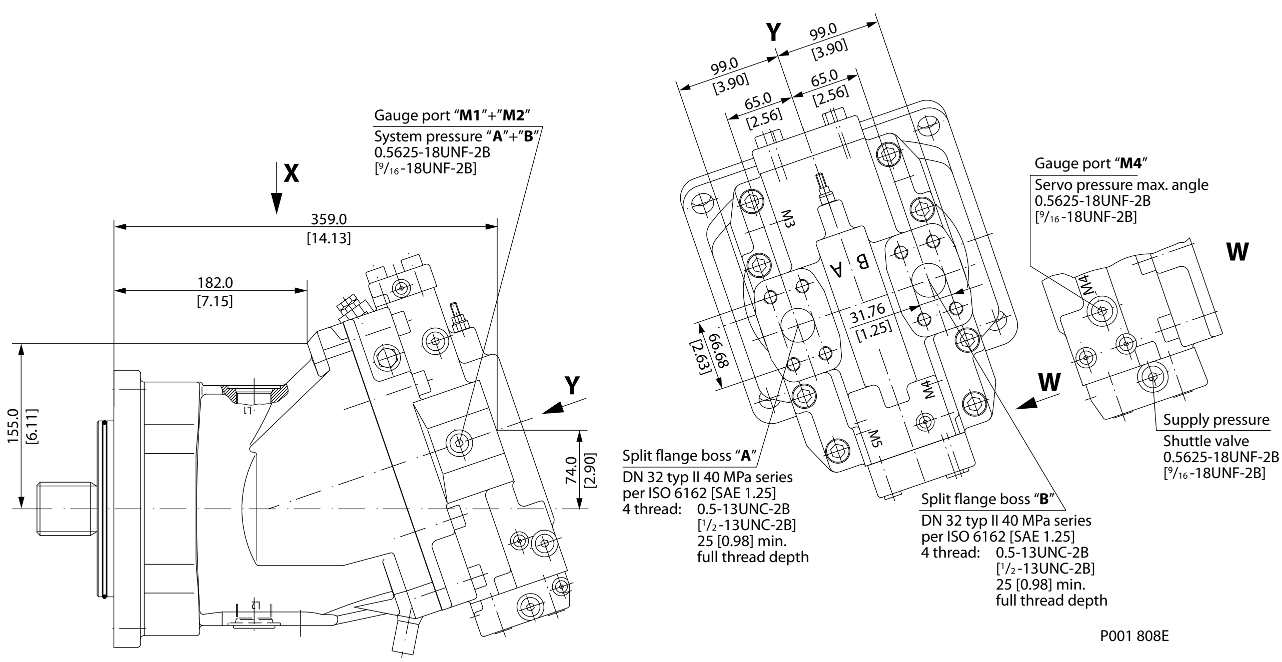
Contact your Danfoss representative for specific installation drawings.

General dimensions – frame size 250

SAE flange design per ISO 3019/1

51V250 Proportional and Two-Position Control, HZB1 (Side port on top, Axial port below)

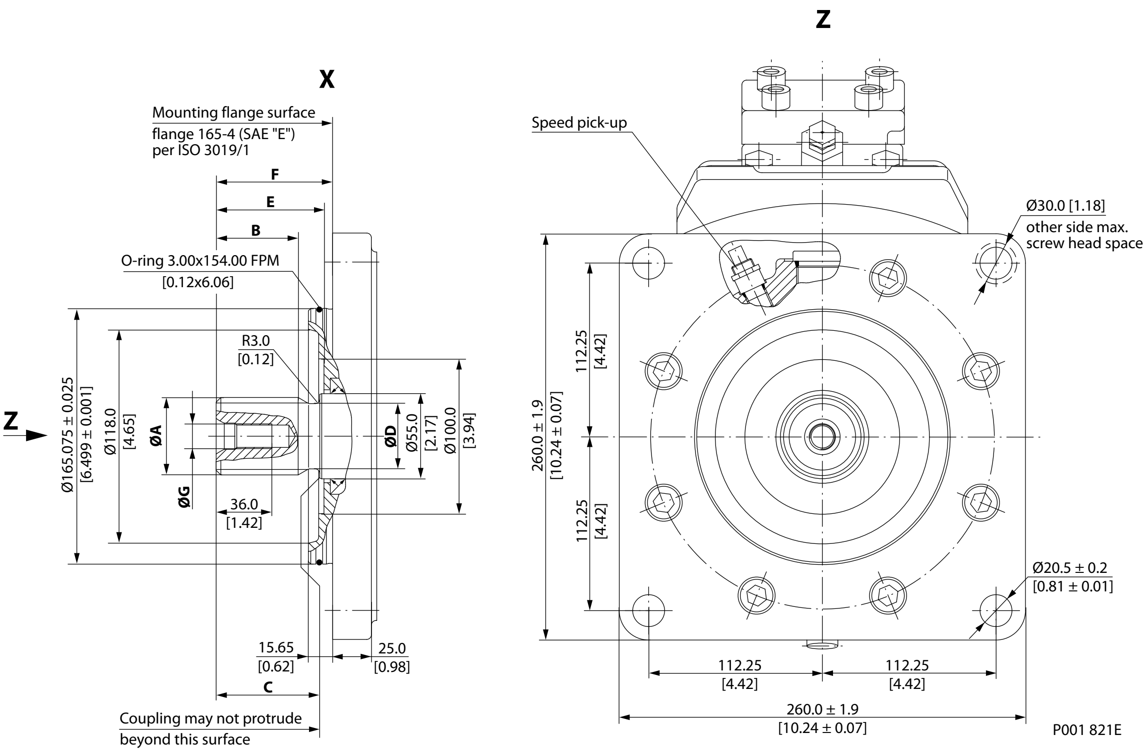




P001 808E

General dimensions – frame size 250

Shaft Options – 51V250



Shaft spline data - mm [in]

Shaft option	F2	C8
Number of teeth	15	27
Pitch	8/16	16/32
Pitch Ø	47.625 [1.875]	42.862 [1.688]
Ø A	49.99 [1.97]	43.96 [1.73]
B	53.0 [2.09]	55.0 [2.17]
Ø D	42.20 [1.66]	39.60 [1.56]
Pressure angle	30°	
C	67.0 ±0.5 [2.64]	
E	70.0 ±1.1 [2.76]	
F	75.4 ±0.7 [2.97]	
H	36.0 [1.42]	
Spline	ANSI B92.1-1970, class 5, flat root side fit	
Ø G	0.625-11UNC-2B [5/8-11UNC-2B]; allowed torque in thread max. 200 N•m [1770 lbf•in]	

Flow into port **A** results in **CW** rotation of output shaft.

Flow into port **B** results in **CCW** rotation of output shaft.

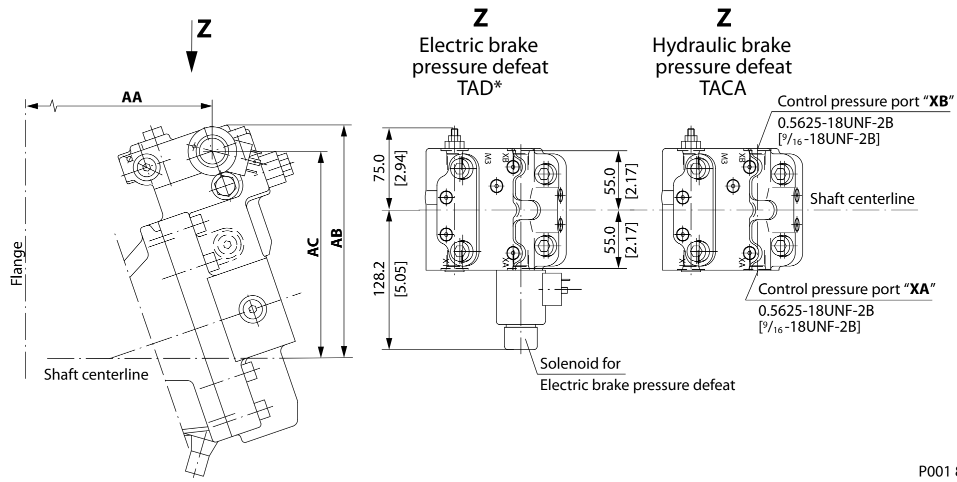
Shaft rotation is determined by viewing from shaft end. Ports with O-ring seal and inch threads shall be in accordance with ISO 11926/1.

Splite flange boss A and B per ISO 6162 is identical with high pressure series SAEJ518 code 62 (6000 psi).

Contact your Danfoss representative for specific installation drawings.

Dimension – Controls

Options TA** for 51-1 – Pressure Compensator Control (Frame Size: 060, 080, 110)



P001 838E

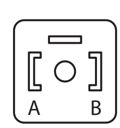
*Control TA** for 51-1 - mm [in]*

Frame	060			080			110		
Design	**V**	**D**	**C**	**V**	**D**	**C**	**V**	**D**	**C**
AA	181.2 [7.13]	156.7 [6.17]	96.9 [3.82]	196.9 [7.75]	172.9 [6.81]	94.5 [3.72]	213.4 [8.40]	181.8 [7.16]	99.0 [3.90]
AB	199.3 [7.85]			209.7 [8.26]			223.5 [8.80]		223.9 [8.82]
AC	176.4 [6.95]			186.8 [7.36]			200.6 [7.90]		201.0 [7.91]

V = SAE-flange
D = DIN-flange
C = Cartridge flange

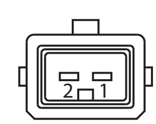
Solenoid connectors

Plug face DIN 46350 (Supplied)
Mating connector No.: K09129
Id. No.: **514117**



P001752

AMP Junior Timer two pin (Supplied)
Mating connector No.: K19815
Id. No.: **508388**

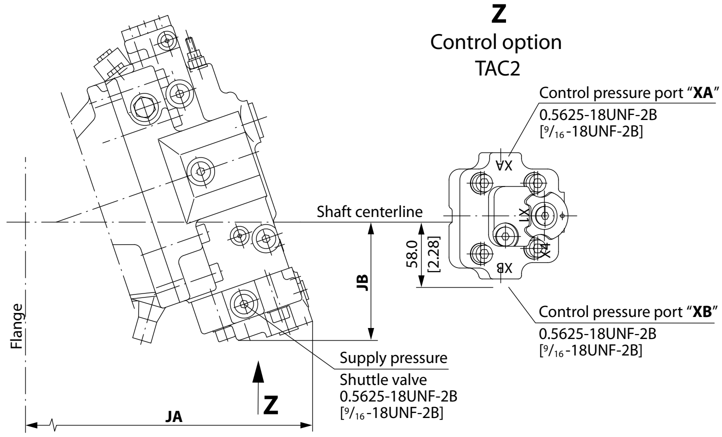


P001751

Shaft rotation is determined by viewing from shaft end. Ports with O-ring seal and inch threads shall be in accordance with ISO 11926/1. Splite flange boss A and B per ISO 6162 is identical with high pressure series SAEJ518 code 62 (6000 psi). Contact your Danfoss representative for specific installation drawings.

Dimension – Controls

Options TA** for 51 – Pressure Compensator Control (Frame Size: 160, 250)



*Control TA** for 51 - mm [in]*

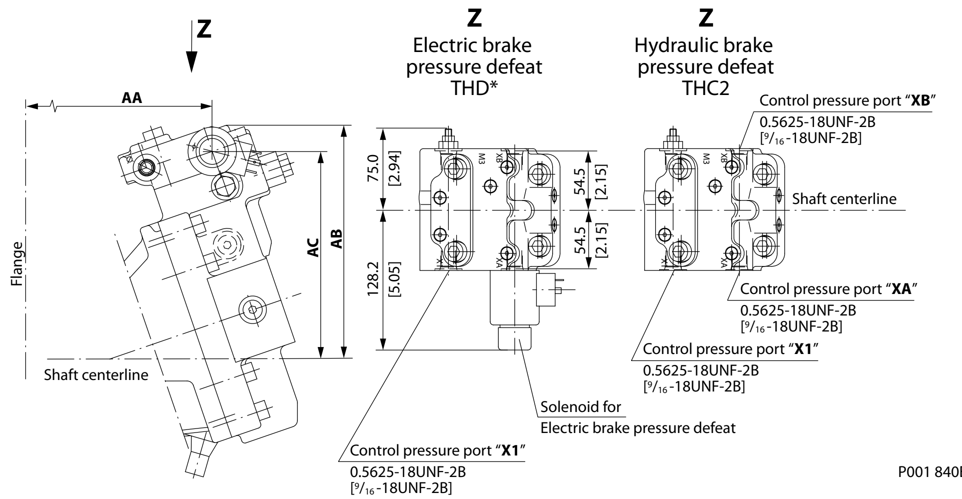
Frame	160			250		
Design	**V**	**D**	**C**	**V**	**D**	**C**
JA	393 [15.48]	361 [14.22]	257 [10.11]	445 [17.51]	–	
JB	114 [4.48]			122 [4.82]	–	

V = SAE-flange
D = DIN-flange
C = Cartridge flange

Shaft rotation is determined by viewing from shaft end. Ports with O-ring seal and inch threads shall be in accordance with ISO 11926/1. Splite flange boss A and B per ISO 6162 is identical with high pressure series SAEJ518 code 62 (6000 psi). Contact your Danfoss representative for specific installation drawings.

Dimension – Controls

Options TH** for 51-1 – Hydraulic Two-Position Control (Frame Size: 060, 080, 110)



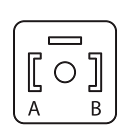
*Control TA** for 51-1 - mm [in]*

Frame	060			080			110		
Design	**V**	**D**	**C**	**V**	**D**	**C**	**V**	**D**	**C**
AA	181.2 [7.13]	156.7 [6.17]	96.9 [3.82]	196.9 [7.75]	172.9 [6.81]	94.5 [3.72]	213.4 [8.40]	181.8 [7.16]	99.0 [3.90]
AB	199.3 [7.85]			209.7 [8.26]			223.5 [8.80]		223.9 [8.82]
AC	176.4 [6.95]			186.8 [7.36]			200.6 [7.90]		201.0 [7.91]

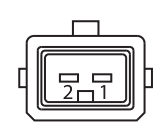
V = SAE-flange
D = DIN-flange
C = Cartridge flange

Solenoid connectors

Plug face DIN 46350 (Supplied)
Mating connector No.: K09129
Id. No.: **514117**



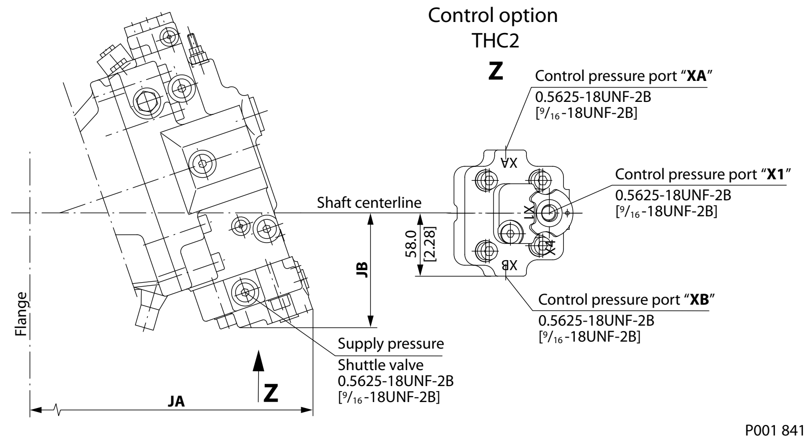
AMP Junior Timer two pin (Supplied)
Mating connector No.: K19815
Id. No.: **508388**



Shaft rotation is determined by viewing from shaft end. Ports with O-ring seal and inch threads shall be in accordance with ISO 11926/1. Splite flange boss A and B per ISO 6162 is identical with high pressure series SAEJ518 code 62 (6000 psi). Contact your Danfoss representative for specific installation drawings.

Dimension – Controls

Options TH** for 51 – Hydraulic Two-Position Control (Frame Size: 160, 250)



*Control TA** for 51 - mm [in]*

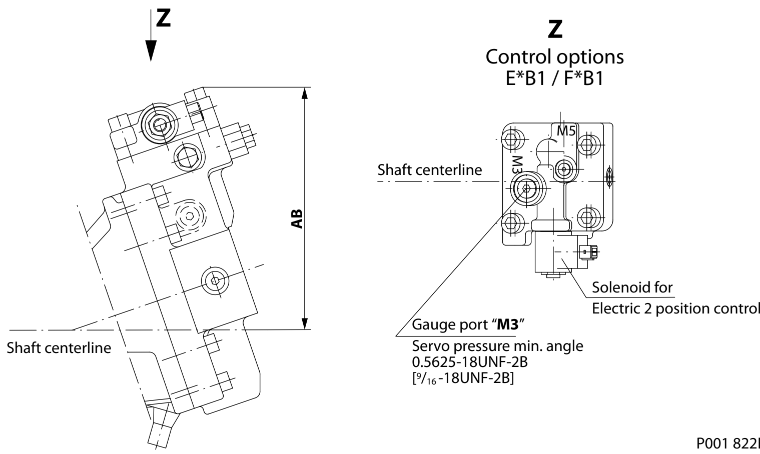
Frame size	160			250		
Design	**V**	**D**	**C**	**V**	**D**	**C**
JA	393 [15.48]	361 [14.22]	257 [10.11]	445 [17.51]	–	
JB	114 [4.48]			122 [4.82]	–	

V = SAE-flange
D = DIN-flange
C = Cartridge flange

Shaft rotation is determined by viewing from shaft end. Ports with O-ring seal and inch threads shall be in accordance with ISO 11926/1. Splite flange boss A and B per ISO 6162 is identical with high pressure series SAEJ518 code 62 (6000 psi). Contact your Danfoss representative for specific installation drawings.

Dimension – Controls

Options E*B1, F*B1 for 51-1 – Electrohydraulic Two-Position Control (Frame Size: 060, 080, 110)



P001 822E

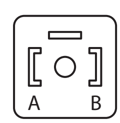
Control E1B1, E2B1, E7B1, F1B1, F2B1 for 51-1 - mm [in]

Frame	060			080			110		
Design	V	D	C	V	D	C	V	D	C
AB	208.5 [8.21]			218.9 [8.62]			232.7 [9.16]		

V = SAE-flange
D = DIN-flange
C = Cartridge flange

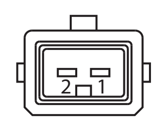
Solenoid connectors

Plug face DIN 46350 (Supplied)
Mating connector No.: K09129
Id. No.: **514117**



P001752

AMP Junior Timer two pin (Supplied)
Mating connector No.: K19815
Id. No.: **508388**

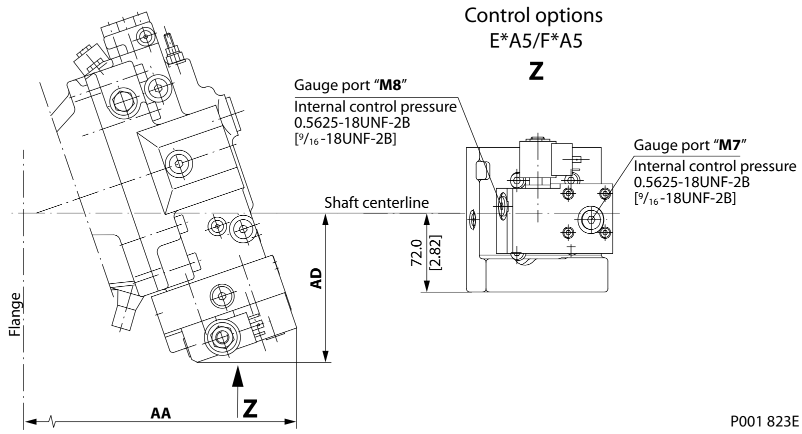


P001751

Shaft rotation is determined by viewing from shaft end. Ports with O-ring seal and inch threads shall be in accordance with ISO 11926/1. Splite flange boss A and B per ISO 6162 is identical with high pressure series SAEJ518 code 62 (6000 psi). Contact your Danfoss representative for specific installation drawings.

Dimension – Controls

Options E*A5, F*A5 for 51 – Electrohydraulic Two-Position Control (Frame Size: 160, 250)



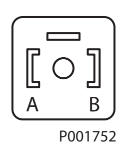
Control E1A5, E2A5, F1A5, F2A5 for 51 - mm [in]

Frame size	160			250		
Design	**V**	**D**	**C**	**V**	**D**	**C**
AA	401 [15.79]	369 [14.53]	265 [10.42]	453 [17.82]	–	
AD	145 [5.72]			154 [6.06]	–	

V = SAE-flange
D = DIN-flange
C = Cartridge flange

Solenoid connector

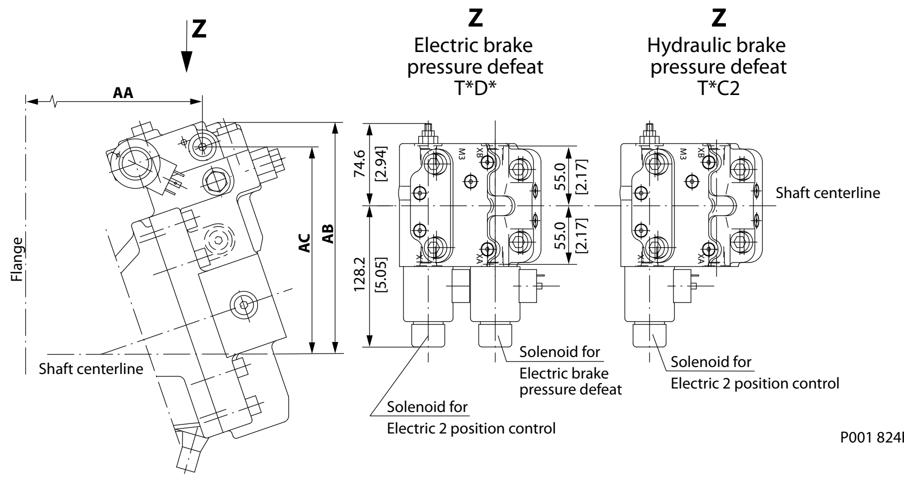
Plug face DIN 46350 (Supplied)
Mating connector No.: K09129
Id. No.: **514117**



Shaft rotation is determined by viewing from shaft end. Ports with O-ring seal and inch threads shall be in accordance with ISO 11926/1. Splite flange boss A and B per ISO 6162 is identical with high pressure series SAEJ518 code 62 (6000 psi). Contact your Danfoss representative for specific installation drawings.

Dimension – Controls

Options T1**, T2**, T7** for 51-1 – Electrohydraulic Two-Position Control (Frame Size: 060, 080, 110)



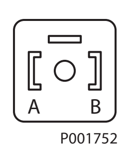
*Control T1**, T2**, T7** for 51-1 - mm [in]*

Frame	060			080			110		
Design	**V**	**D**	**C**	**V**	**D**	**C**	**V**	**D**	**C**
AA	181.2 [7.13]	156.7 [6.17]	96.9 [3.82]	196.9 [7.75]	172.9 [6.81]	94.5 [3.72]	213.4 [8.40]	181.8 [7.16]	99.0 [3.90]
AB	199.3 [7.85]			209.7 [8.26]			223.5 [8.80]		223.9 [8.82]
AC	176.4 [6.95]			186.8 [7.36]			200.6 [7.90]		201.0 [7.91]

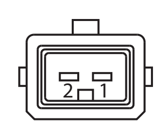
V = SAE-flange
D = DIN-flange
C = Cartridge flange

Solenoid connectors

Plug face DIN 46350 (Supplied)
Mating connector No.: K09129
Id. No.: **514117**



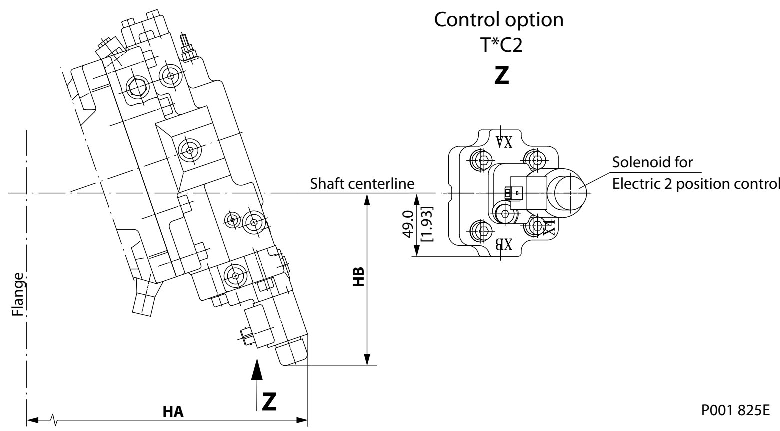
AMP Junior Timer two pin (Supplied)
Mating connector No.: K19815
Id. No.: **508388**



Shaft rotation is determined by viewing from shaft end. Ports with O-ring seal and inch threads shall be in accordance with ISO 11926/1. Splite flange boss A and B per ISO 6162 is identical with high pressure series SAEJ518 code 62 (6000 psi). Contact your Danfoss representative for specific installation drawings.

Dimension – Controls

Options T1C2, T2C2 for 51 – Electrohydraulic Two-Position Control (Frame Size: 060, 080, 110)



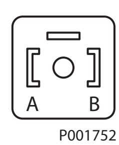
Control T1C2, T2C2 for 51 - mm [in]

Frame size	160			250		
Design	**V**	**D**	**C**	**V**	**D**	**C**
HA	409 [16.10]	377 [14.84]	272 [10.73]	461 [18.13]	–	
HB	178 [7.0]			186 [7.33]	–	

V = SAE-flange
D = DIN-flange
C = Cartridge flange

Solenoid connector

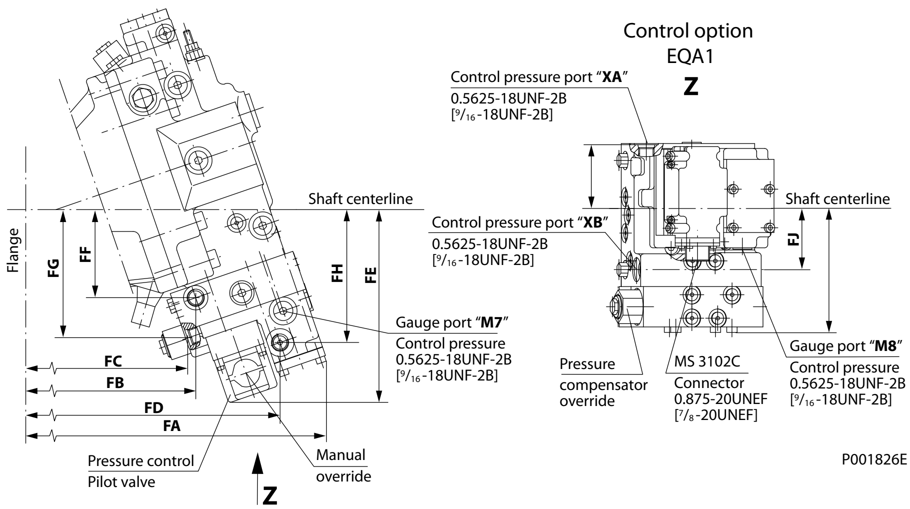
Plug face DIN 46350 (Supplied)
Mating connector No.: K09129
Id. No.: **514117**



Shaft rotation is determined by viewing from shaft end. Ports with O-ring seal and inch threads shall be in accordance with ISO 11926/1. Splite flange boss A and B per ISO 6162 is identical with high pressure series SAEJ518 code 62 (6000 psi). Contact your Danfoss representative for specific installation drawings.

Dimension – Controls

Options EPA1, EQA1 for 51 – Electrohydraulic Two-Position Control (All Frame Sizes)



Control EPA1, EQA1 for 51 - mm [in]

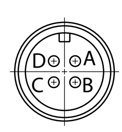
Frame	060			080			110			160			250		
Design	**V**	**D**	**C**	**V**	**D**	**C**	**V**	**D**	**C**	**V**	**D**	**C**	**V**	**D**	**C**
FA	327 [12.89]	303 [11.93]	243 [9.57]	351 [13.81]	327 [12.87]	249 [9.78]	369 [14.54]	337 [13.28]	255 [10.04]	409 [16.11]	377 [14.85]	273 [10.73]	461 [18.31]	–	
FB	210 [8.26]	185 [7.29]	125 [4.94]	233 [9.18]	209 [8.23]	131 [5.15]	252 [9.90]	220 [8.65]	137 [5.40]	283 [11.14]	251 [9.88]	146 [5.76]	334 [13.17]	–	
FC	203 [8.00]	179 [7.04]	119 [4.69]	226 [8.88]	202 [7.94]	123 [4.85]	244 [9.61]	212 [8.35]	130 [5.11]	276 [10.85]	244 [9.59]	139 [5.48]	327 [12.88]	–	
FD	286 [11.25]	261 [10.29]	202 [7.93]	309 [12.17]	285 [11.32]	207 [8.14]	328 [12.90]	296 [11.64]	213 [8.40]	367 [14.47]	335 [13.21]	231 [9.09]	419 [16.50]	–	
FE	168 [6.62]			174 [6.85]			176 [6.91]			183 [7.22]			192 [7.56]	–	
FF	74 [2.91]			80 [3.15]			81 [3.20]			92 [3.63]			101 [3.97]	–	
FG	110 [4.33]			116 [4.58]			118 [4.64]			129 [5.06]			137 [5.41]	–	
FH	114 [4.47]			120 [4.74]			122 [4.80]			130 [5.11]			138 [5.45]	–	
FJ	56 [2.20]			56 [2.20]			56 [2.20]			57 [2.22]			57 [2.22]	–	

V = SAE-flange; D = DIN-flange; C = Cartridge flange
– = not available

Solenoid connectors

MS Connector
MS3102C-14S-2P
(Supplied Connector)

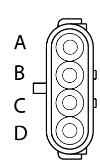
Mating Connector
No.: K08106
Id.-No.: 615062



P001 753E

Packard Weather-Pack
4 pin
(Supplied Connector)

Mating Connector
No.: K03384
Id.-No.: 712208

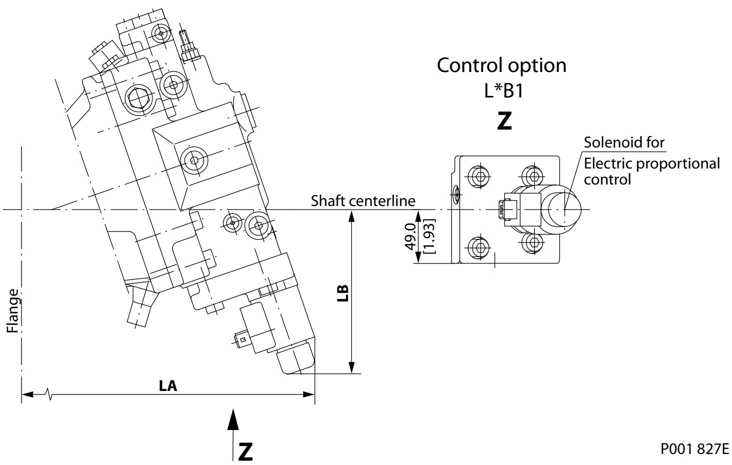


P001 759E

Shaft rotation is determined by viewing from shaft end. Ports with O-ring seal and inch threads shall be in accordance with ISO 11926/1. Splite flange boss A and B per ISO 6162 is identical with high pressure series SAEJ518 code 62 (6000 psi). Contact your Danfoss representative for specific installation drawings.

Dimension – Controls

Options L1B1, L2B1, L7B1 for 51 – Electrohydraulic Two-Position Control (All Frame Sizes)



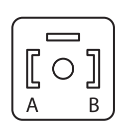
Control L1B1, L2B1, L7B1 for 51 - mm [in]

Frame	060			080			110			160			250		
Design	**V**	**D**	**C**	**V**	**D**	**C**	**V**	**D**	**C**	**V**	**D**	**C**	**V**	**D**	**C**
LA	321 [12.63]	296 [11.66]	236 [9.31]	344 [13.55]	320 [12.60]	242 [9.52]	363 [14.28]	331 [13.02]	248 [9.77]	402 [15.84]	370 [14.58]	266 [10.47]	454 [17.87]	–	
LB	144 [5.66]			150 [5.90]			151 [5.96]			159 [6.27]			168 [6.61]	–	

V = SAE-flange; D = DIN-flange; C = Cartridge flange

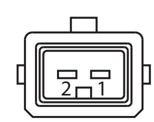
Solenoid connectors

Plug face DIN 46350 (Supplied)
Mating connector No.: K09129
Id. No.: **514117**



P001752

AMP Junior Timer two pin (Supplied)
Mating connector No.: K19815
Id. No.: **508388**

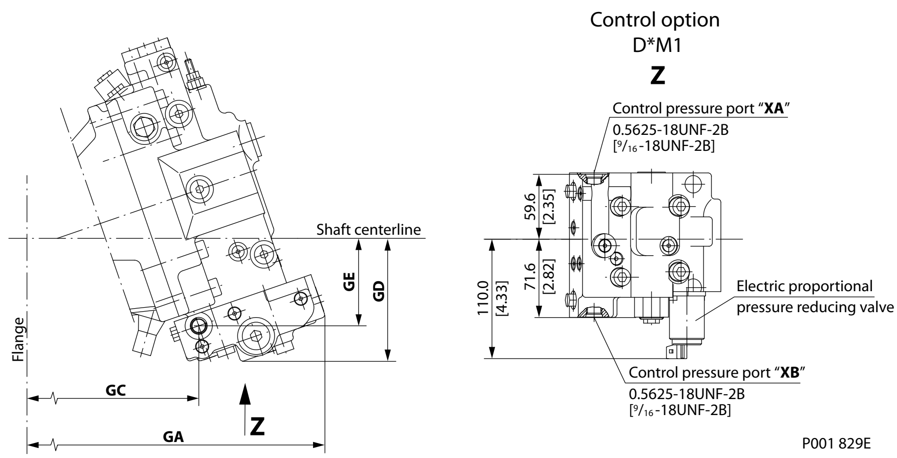


P001751

Shaft rotation is determined by viewing from shaft end. Ports with O-ring seal and inch threads shall be in accordance with ISO 11926/1. Splite flange boss A and B per ISO 6162 is identical with high pressure series SAEJ518 code 62 (6000 psi). Contact your Danfoss representative for specific installation drawings.

Dimension – Controls

Options D7M1, D8M1 for 51 – Electrohydraulic Two-Position Control (Frame Size: 060, 080, 110)



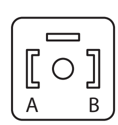
Control D7M1, D8M1 for 51 - mm [in]

Size	060			080			110		
Design	**V**	**D**	**C**	**V**	**D**	**C**	**V**	**D**	**C**
GA	325 [12.80]	301 [11.84]	241 [9.49]	349 [13.73]	325 [12.80]	246 [9.70]	367 [14.64]	335 [13.20]	253 [9.95]
GC	210 [8.26]	185 [7.29]	125 [4.94]	233 [9.18]	209 [8.23]	131 [5.15]	252 [9.91]	220 [8.65]	137 [5.40]
GD	106 [4.19]			112 [4.42]			114 [4.48]		
GE	74 [2.91]			80 [3.15]			81 [3.20]		

V = SAE-flange
D = DIN-flange
C = Cartridge flange

Solenoid connector

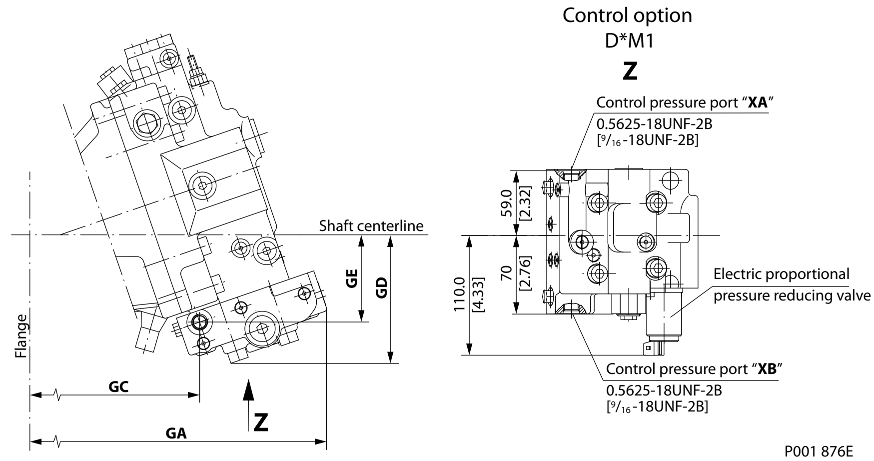
Plug face DIN 46350 (Supplied)
Mating connector No.: K09129
Id. No.: **514117**



Shaft rotation is determined by viewing from shaft end. Ports with O-ring seal and inch threads shall be in accordance with ISO 11926/1. Splite flange boss A and B per ISO 6162 is identical with high pressure series SAEJ518 code 62 (6000 psi). Contact your Danfoss representative for specific installation drawings.

Dimension – Controls

Options D7M1, D8M1 for 51 – Electrohydraulic Two-Position Control (Frame Size: 160, 250)



Control D7M1, D8M1 for 51 - mm [in]

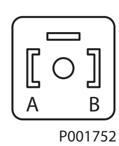
Frame size	**160**			**250**		
Design	**V**	**D**	**C**	**V**	**D**	**C**
GA	407 [16.02]	375 [14.76]	270 [10.65]	459 [18.05]	–	
GC	283 [11.14]	251 [9.88]	146 [5.76]	334 [13.17]	–	
GD	133 [5.22]			141 [5.55]	–	
GE	92 [3.63]			101 [3.97]	–	

V = SAE-flange, D = DIN-flange, C = Cartridge flange

– = not available

Solenoid connector

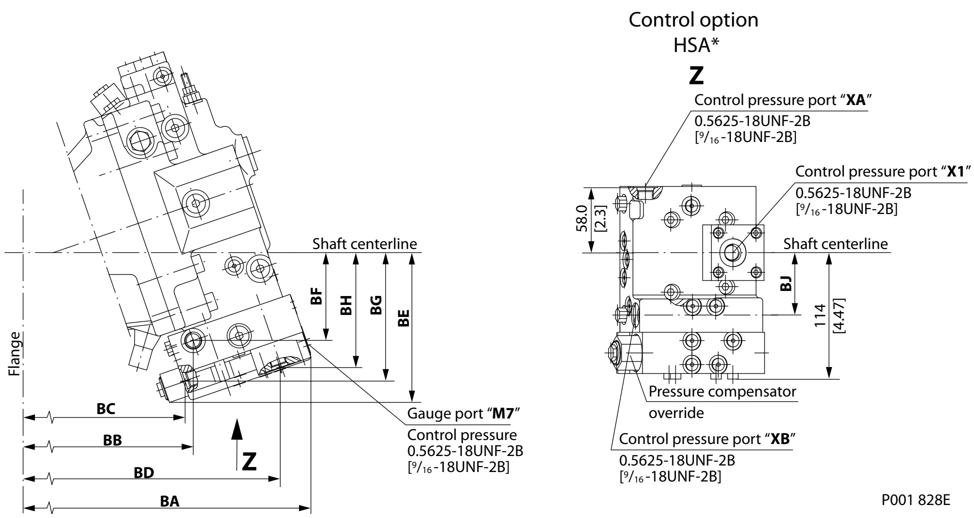
Plug face DIN 46350 (Supplied)
Mating connector No.: K09129
Id. No.: **514117**



Shaft rotation is determined by viewing from shaft end. Ports with O-ring seal and inch threads shall be in accordance with ISO 11926/1. Splite flange boss A and B per ISO 6162 is identical with high pressure series SAEJ518 code 62 (6000 psi). Contact your Danfoss representative for specific installation drawings.

Dimension – Controls

Option HSA* for 51 – Hydraulic Proportional Control (All Frame Sizes)



Control HSA for 51 - mm [in]*

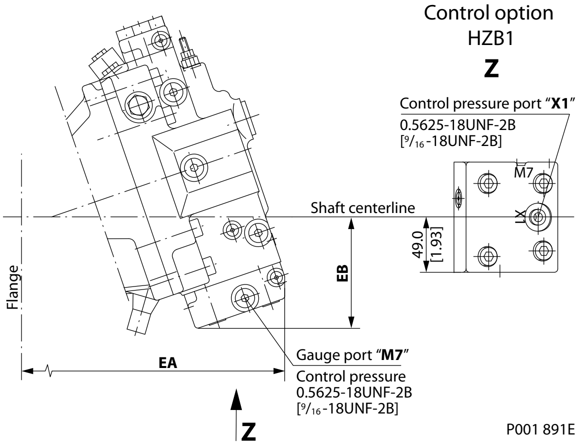
Size	060			080			110			160			250		
Design	**V**	**D**	**C**	**V**	**D**	**C**	**V**	**D**	**C**	**V**	**D**	**C**	**V**	**D**	**C**
BA	316 [12.45]	292 [11.49]	232 [9.13]	340 [13.37]	316 [12.34]	237 [9.34]	358 [14.10]	326 [12.84]	244 [9.60]	398 [15.66]	366 [14.40]	261 [10.29]	449 [17.70]	–	
BB	210 [8.26]	185 [7.29]	125 [4.94]	233 [9.18]	209 [8.23]	131 [5.15]	252 [9.90]	220 [8.65]	137 [5.40]	283 [11.14]	251 [9.88]	146 [5.76]	334 [13.17]	–	
BC	203 [8.00]	179 [7.04]	119 [4.69]	226 [8.88]	202 [7.94]	123 [4.85]	244 [9.61]	212 [8.35]	130 [5.11]	276 [10.85]	244 [9.59]	139 [5.48]	327 [12.88]	–	
BD	288 [11.35]	264 [10.38]	204 [8.03]	312 [12.27]	288 [11.35]	209 [8.24]	330 [12.99]	298 [11.74]	216 [8.49]	370 [14.56]	338 [13.30]	233 [9.18]	421 [16.59]	–	
BE	130 [5.12]			136 [5.35]			137 [5.41]			145 [5.72]			154 [6.06]	–	
BF	74 [2.91]			80 [3.15]			81 [3.20]			92 [3.63]			101 [3.97]	–	
BG	110 [4.33]			116 [4.58]			118 [4.64]			129 [5.06]			137 [5.41]	–	
BH	98 [3.87]			104 [4.10]			106 [4.16]			114 [4.47]			122 [4.81]	–	
BJ	56 [2.20]			56 [2.20]			56 [2.20]			57 [2.22]			57 [2.22]	–	

V = SAE-flange; D = DIN-flange; C = Cartridge flange; – = not available

Shaft rotation is determined by viewing from shaft end. Ports with O-ring seal and inch threads shall be in accordance with ISO 11926/1. Splite flange boss A and B per ISO 6162 is identical with high pressure series SAEJ518 code 62 (6000 psi). Contact your Danfoss representative for specific installation drawings.

Dimension – Controls

Option HZB1 for 51 – Hydraulic Proportional Control (All Frame Sizes)



Control HZB1 for 51 - mm [in]

Size	060			080			110			160			250		
Design	**V**	**D**	**C**	**V**	**D**	**C**	**V**	**D**	**C**	**V**	**D**	**C**	**V**	**D**	**C**
EA	294 [11.56]	270.0 [10.64]	209 [8.24]	318.0 [12.52]	294.0 [11.58]	215 [8.45]	337.0 [13.25]	305.0 [12.00]	221 [8.71]	376.0 [14.82]	345.0 [13.60]	239 [9.40]	429.0 [16.89]	–	
EB	96 [3.77]			102 [4.0]			103 [4.06]			111 [4.37]			120 [4.71]	–	

V = SAE-flange; D = DIN-flange; C = Cartridge flange

– = not available

Shaft rotation is determined by viewing from shaft end. Ports with O-ring seal and inch threads shall be in accordance with ISO 11926/1. Splite flange boss A and B per ISO 6162 is identical with high pressure series SAEJ518 code 62 (6000 psi). Contact your Danfoss representative for specific installation drawings.

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Danfoss Power Solutions is a global manufacturer and supplier of high-quality hydraulic and electronic components. We specialize in providing state-of-the-art technology and solutions that excel in the harsh operating conditions of the mobile off-highway market. Building on our extensive applications expertise, we work closely with our customers to ensure exceptional performance for a broad range of off-highway vehicles.

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