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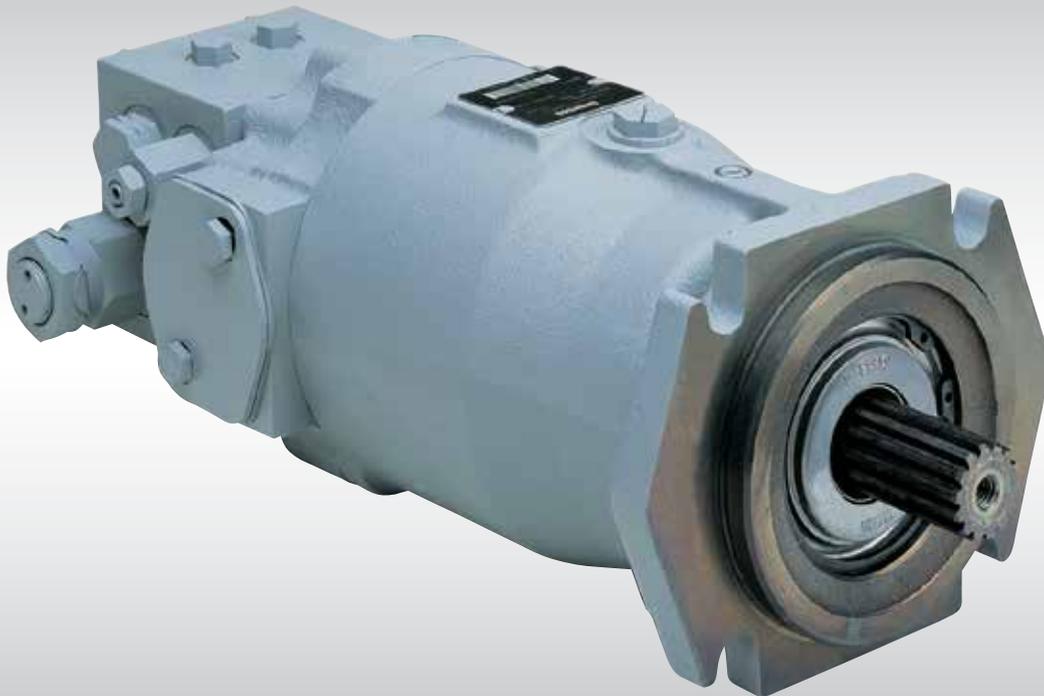
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Technical Information

Axial Piston Motors
Series 20

General Information

Introduction

Danfoss a world leader in hydraulic power systems has developed a family of axial piston motors.

Description

Danfoss axial pistons fixed displacement motors are of swash plate design with preset displacement suitable for hydrostatic transmissions with closed loop circuit.
The output speed is proportional to the motor's input flow.
The output torque is proportional to the differential pressure applied to the main pressure ports.
The direction of motor (output) shaft rotation depends on flow input to the main pressure ports.

Danfoss axial piston fixed displacement motors are well engineered and easy to handle.
The full-length shaft with a highly efficient tapered roller bearing arrangement offers a high loading capacity for external radial forces.
High case pressures can be achieved without leakage even at the lowest temperatures by using suitable shaft seals.
Danfoss axial piston units are designed for easy servicing. Complete dismantling and reassembly can be carried out with standard hand tools, and all components or sub-assemblies are replaceable.
Axial piston fixed displacement motors of the Danfoss pattern are made by licensed producers worldwide, providing consistent service and fully inter-changeable parts.

Typical markets

- Industrial
- Mining
- Transit Mixer
- Utility Vehicles

Contents

General Description

Axial piston fixed displacement motor

Sectional View
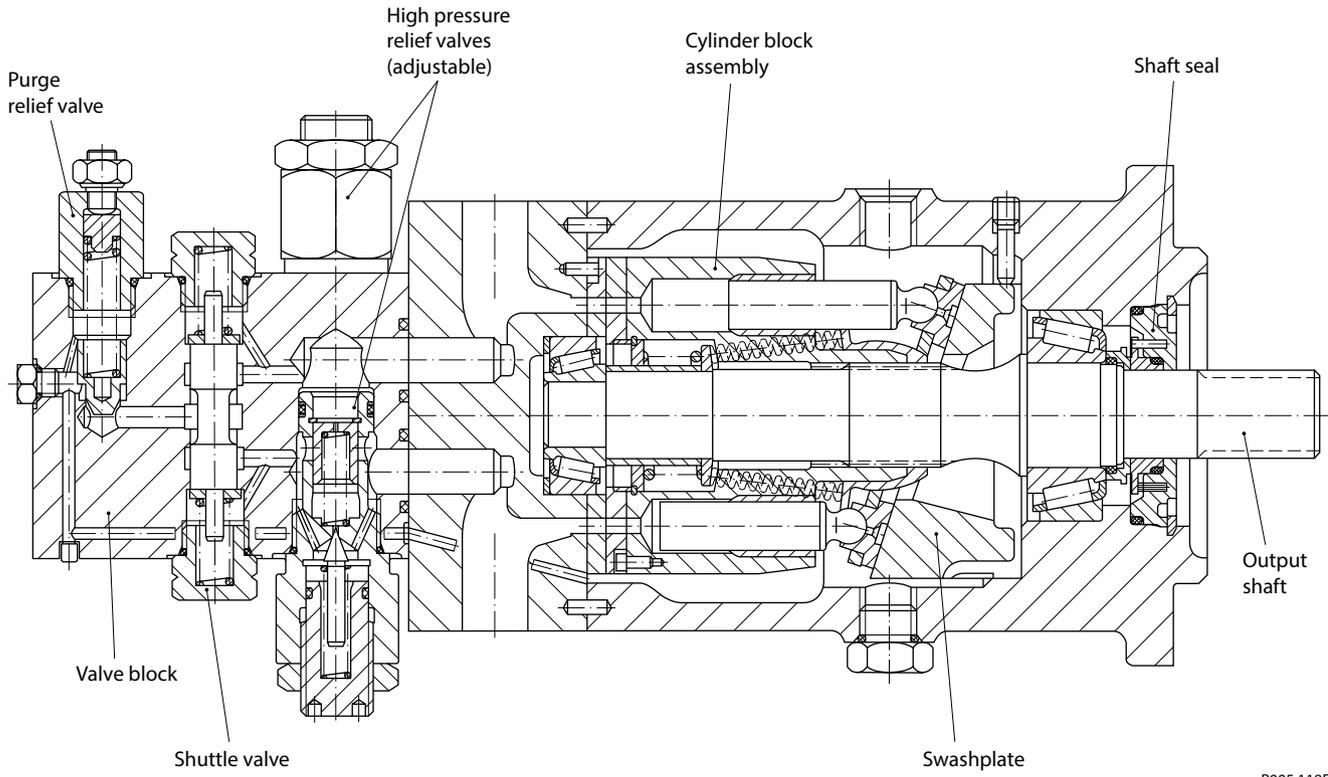
P005 118E

General Description

Pump and motor circuit description

HEAT EXCHANGER BYPASS VALVE

RESERVOIR

CONTROL HANDLE

VACUUM GAUGE

HEAT EXCHANGER

SERVO CONTROL CYLINDER

REVERSIBLE VARIABLE DISPLACEMENT PUMP

PUMP SWASHPLATE

SERVO PRESSURE RELIEF VALVES

PURGE RELIEF VALVE

FIXED DISPLACEMENT MOTOR

CHARGE PRESSURE RELIEF VALVE

INPUT SHAFT

LOOP FLUSHING VALVE

OUTPUT SHAFT

SERVO CONTROL CYLINDER

MOTOR SWASHPLATE

| ■ WORKING LOOP (HIGH PRESSURE) | ■ WORKING LOOP (LOW PRESSURE) | ■ CONTROL FLUID | □ SUCTION LINE | ■ CASE DRAIN FLUID |

P000 027E

Above figure shows schematically the function of a hydrostatic transmission using an axial piston variable displacement pump and a fixed displacement motor.

Motor circuit schematic
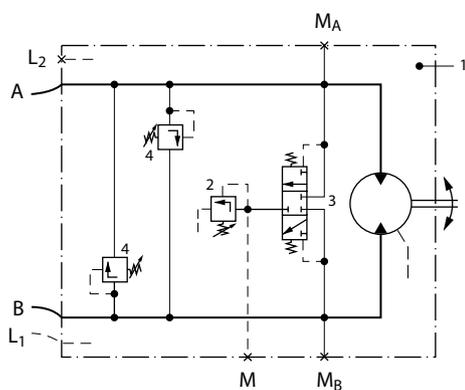
P000 034

Designation:
1 = Fixed displacement motor
2 = Purge relief valve
3 = Shuttle valve
4 = High pressure relief valve

Ports:
A, B = Main pressure ports (working loop)
L_1, L_2 = Drain ports
MA = Gauge port for port A
MB = Gauge port for port B
M = Gauge port - charge pressure

Technical Specification

Technical parameters

Design
Axial piston motor with fixed displacement and swash plate design.

Type of mounting
SAE four bolt flanges.

Pipe connections
Main pressure ports: SAE split flange
Remaining ports: SAE O-ring boss

Direction of rotation and flow
Clockwise or counterclockwise (viewing from the output shaft).
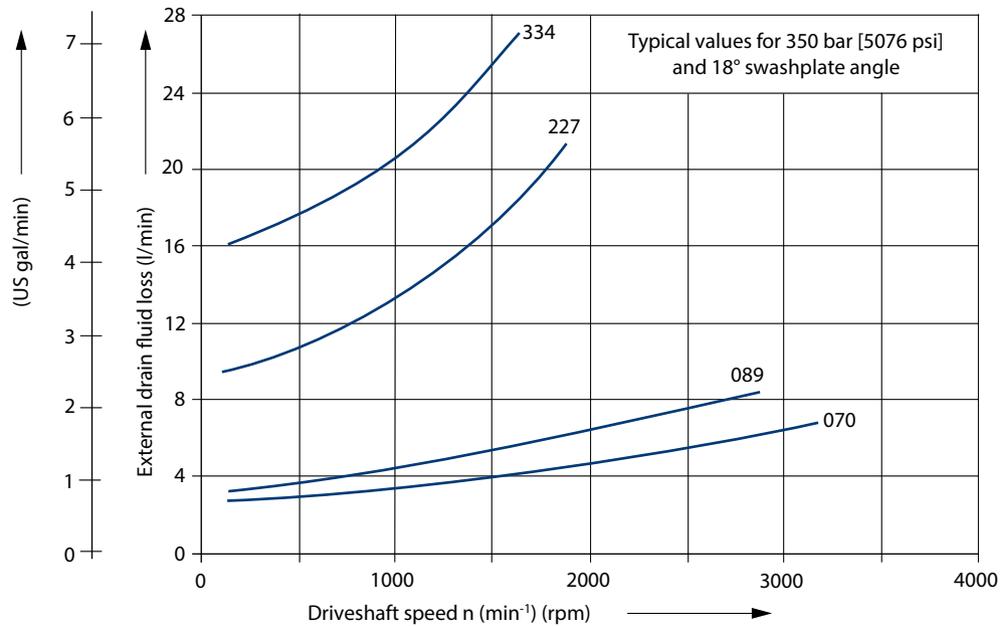
Direction of rotation	Port A	Port B
Clockwise (R)	Output	Input
Counterclockwise (L)	Input	Output

Installation position
Optional; motor housing must be always filled with hydraulic fluid.

External drain fluid loss

P005 105E

Technical Specification

Hydraulic parameters

System pressure range, input p_1
Pressure on port A or B:

Max. operating pressure	Δp = 420 bar [6092 psi]
Max. high pressure setting	Δp = 460 bar[1] [6672 psi]

[1] only with POR-valve

System pressure range, output p_2
Normal setting for configuration MS and MR: 11.0 - 12.5 bar [160 - 181 psi] above case pressure.

Minimum: 8 bar, intermittent only

Case pressure
Max. rated pressure	=	2.5 bar [36.3 psi]
Intermittent	=	5.0 bar [72.5 psi]

Hydraulic fluid
RRefer to Danfoss publications *Hydraulic Fluids and Lubricants,* **520L0463** and *Experience with Biodegradable Hydraulic Fluids,* **520L0465**.

Hydraulic fluid temperature range
ϑ_{min} = -40 °C [- 40 °F]
ϑ_{max} = 95 °C [203 °F]

Viscosity range
ν_{min} = 7 mm^2/s [49 SUS*]
ν_{max} = 1000 mm^2/s [4630 SUS*] (intermittent cold start)
Recommended viscosity range: 12 - 60 mm^2/s [66 - 278 SUS*]

*SUS (Saybolt Universal Second)

Filtration
Required cleanliness level: ISO 4406-1999 Code 22/18/13 or better.
Refer to Danfoss publications *Hydraulic Fluids and Lubricants,* **520L0463** and *Design Guideline for Hydraulic Fluid Cleanliness,* **520L0467**.

Shaft load
The pump will accept radial and axial loads on its shaft, the maximum capacity being determined by direction and point of application of the load.
Please contact your Danfoss representative.

Technical Specification

Hydraulic parameters (continued)

Technical data

		Frame size			
		070	**089**	**227**	**334**
Max. displacement	cm^3 [in^3]	69.8 [4.26]	89.0 [5.43]	227.3 [13.87]	333.7 [20.36]
Rated speed 1	min^{-1} (rpm)	3200	2900	2100	1900
Theoretical torque	Nm/bar [in lb/1000 psi]	1.11 [677]	1.42 [867]	3.62 [2209]	5.31 [3240]
Mass moment of inertia of rotating group	kg m$^2 \cdot 10^{-3}$ [lbf•ft$^2 \cdot 10^{-3}$]	12.34 [292.8]	17.77 [421.7]	86.80 [2059.8]	161.40 [3830.0]

[1] for higher speeds contact your Danfoss representative

Determination of nominal motor size

Unit:	Metric System:		Inch System	
Input flow	$Q_e = \dfrac{V_g \cdot n}{1000 \cdot \eta_v}$	l/min	$Q_e = \dfrac{V_g \cdot n}{231 \cdot \eta_v}$	[gpm]
Output torque	$M_e = \dfrac{V_g \cdot \Delta p \cdot \eta_m}{20 \cdot \pi}$	Nm	$M_e = \dfrac{V_g \cdot \Delta p \cdot \eta_m}{2 \cdot \pi}$	[lbf•in]
Output power	$P_e = \dfrac{Q_e \cdot \Delta p \cdot \eta_t}{600}$	kW	$P_e = \dfrac{V_g \cdot n \cdot \Delta p \cdot \eta_t}{396\,000}$	[hp]
Speed	$n = \dfrac{Q_e \cdot 1000 \cdot \eta_v}{V_g}$	min^{-1}	$n = \dfrac{Q_e \cdot 231 \cdot \eta_v}{V_g}$	(rpm)

Efficiency characteristic curves available on request.

V_g = Moror displacement per revolution   cm^3 [in^3]
n = Motor speed   min^{-1} (rpm)
Δp = Hydraulic pressure differential   bar   [psid]
      $\Delta p = p_{HD} - p_{ND}$
η_v = Moror volumetric efficiency
η_m = Moror mechanical efficiency
η_t = Moror total efficiency
p_{HD} = High pressure   bar   [psid]
p_{ND} = Low pressure   bar   [psid]

**Dimensions
– Frame Size 070 and 089 cm³**
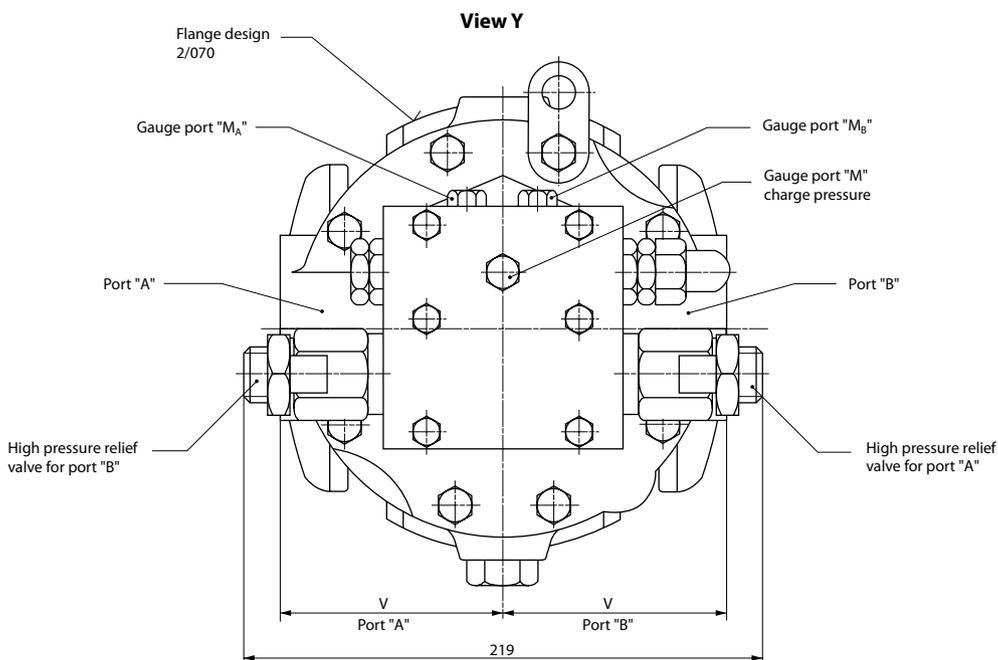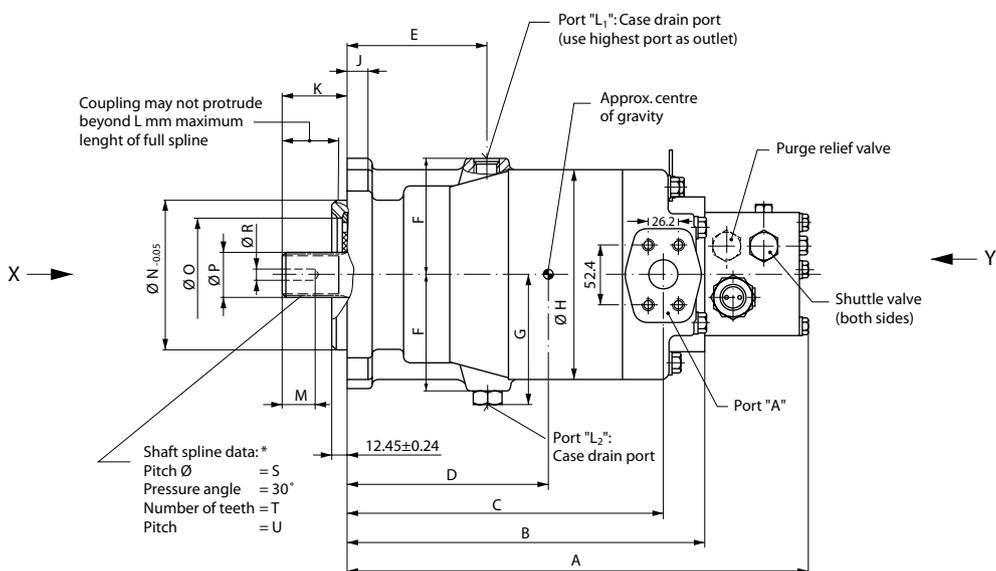
**Outline drawing,
configuration MS**

Port "L₁": Case drain port (use highest port as outlet)

Approx. centre of gravity

Coupling may not protrude beyond L mm maximum lenght of full spline

Purge relief valve

Shuttle valve (both sides)

Port "A"

Port "L₂": Case drain port

12.45±0.24

Shaft spline data: *
Pitch Ø   = S
Pressure angle   = 30°
Number of teeth = T
Pitch   = U

View Y

Flange design 2/070

Gauge port "M_A"

Gauge port "M_B"

Gauge port "M" charge pressure

Port "A"

Port "B"

High pressure relief valve for port "B"

High pressure relief valve for port "A"

Port "A"   Port "B"

219

* Shaft spline data: spline shaft with involute spline, according to SAE handbook, 1963, class 1, fillet root side fit.

Frame size	Port A and B	Port L₁ and L₂	Port M_A and M_B	Port M
070	SAE flange, size 1 SAE split flange boss 5000 psi 4 threads	7/8-14 UNF-2B SAE straight thread O-ring boss	7/16-20 UNF-2B SAE straight thread O-ring boss	
089	3/8-16 UNC-2B 18 deep			

**Dimensions
– Frame Size 070 and 089 cm³**

**Outline drawing,
configuration MS
(continued)**

View X (for SMF 2/070 only)

Rotation
L   R
45°
142.8
168
Ø193.5
W
Ø162
Approx. centre
of gravity
Ø15 $^{+0.8}_{-0.3}$
168
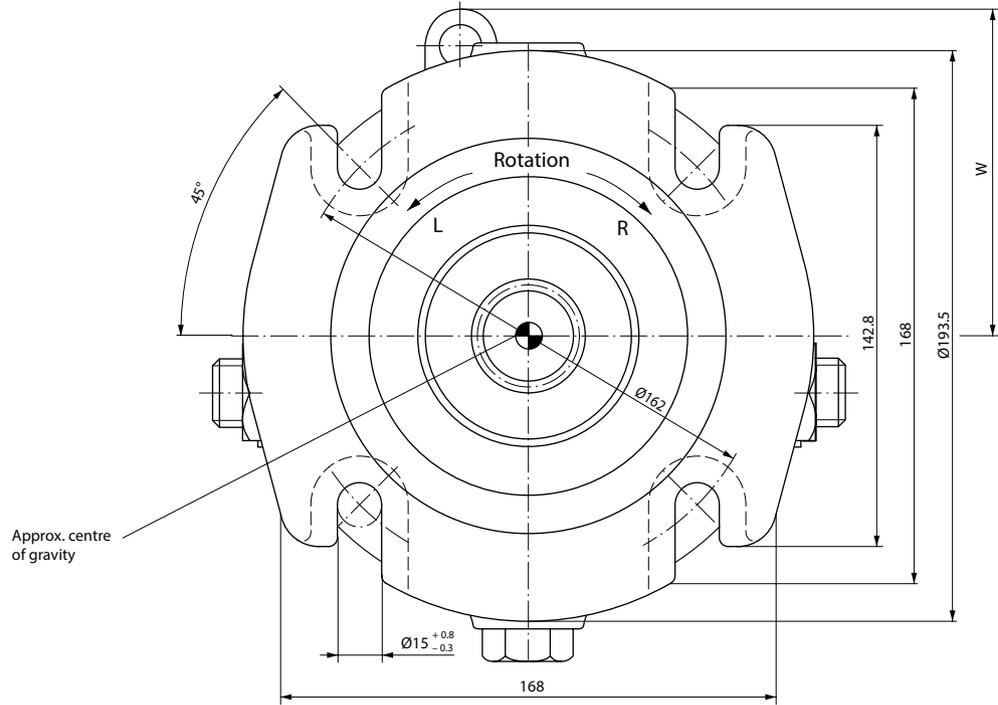
P005 119E

View X (for SMF 2/089 only)

Rotation
L   R
45°
156
168
W
Ø162
Approx. centre
of gravity
Ø15 $^{+0,8}_{-0,3}$
168
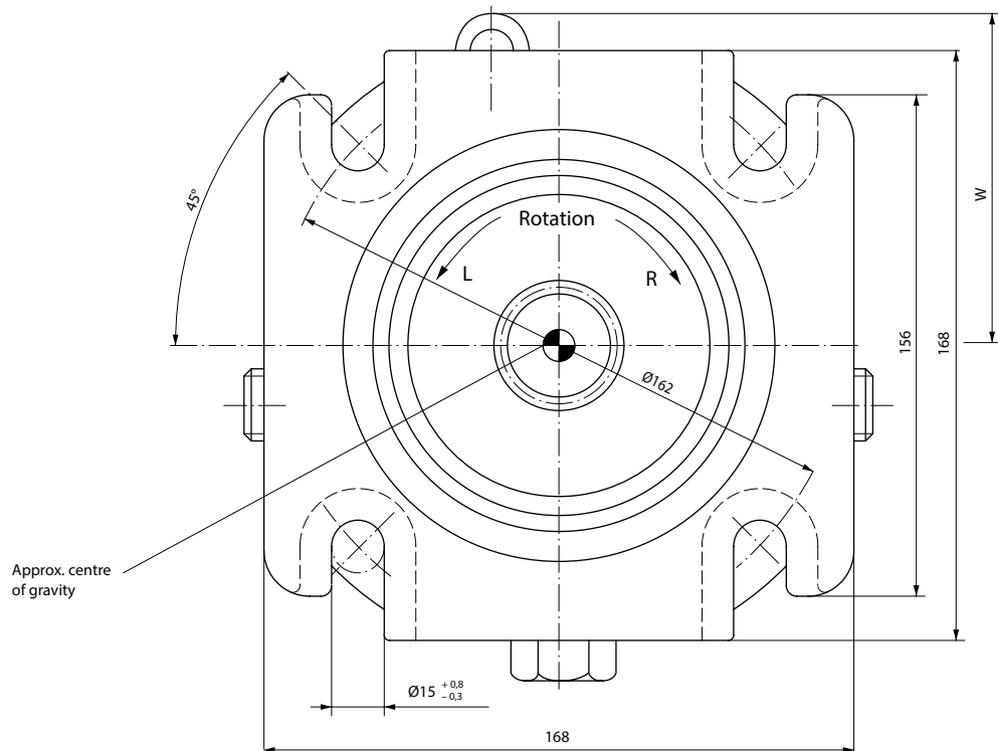
P005 120

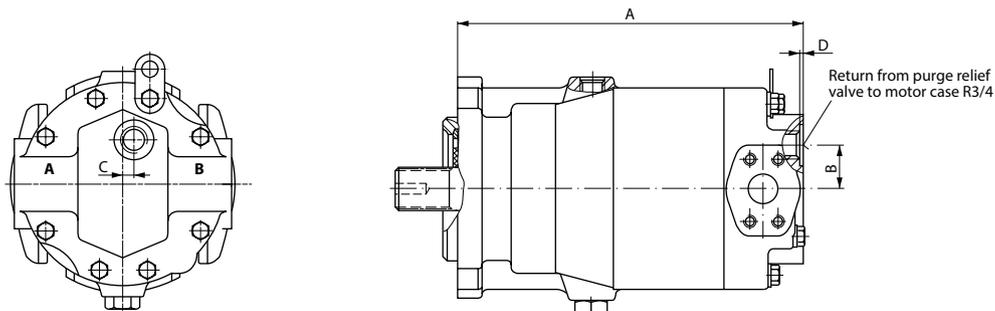**Dimensions**
– Frame Size 070 and 089 cm³

Outline drawing,
configuration MS
(continued)

Dimensions

Frame size	A mm [in]	B mm [in]	C mm [in]	D mm [in]	E mm [in]	F mm [in]	G mm [in]	Ø H mm [in]	J mm [in]	K mm [in]	L mm [in]	M mm [in]
070	378 [14.882]	290 [11.417]	255 [10.039]	165 [6.496]	108 [4.252]	86.5 [3.406]	98 [3.858]	161 [6.339]	16 [0.630]	56 [2.205]	48 [1.890]	28.4 [1.118]
089	395 [15.551]	307 [12.087]	273 [10.748]	170 [6.693]	118 [4.646]	96.0 [3.780]	107 [4.213]	181 [7.126]	18 [0.709]	56 [2.205]	48 [1.890]	28.4 [1.118]

Frame size	Ø N mm [in]	Ø O mm [in]	Ø P mm [in]	Ø R mm [in]	Ø S mm [in]	T mm [in]	U mm [in]	V mm [in]	W mm [in]	Diameter for shaft coupling mm [in]	Weight kg [lb]
070	127 [5.000]	84 [3.307]	$34.50^{-0.17}_{-0.0067}$ [1.358]	8.5 [0.335]	33.338 [1.313]	21 [0.827]	16/32	85.8 [3.378]	101 [3.976]	$31.75^{+0.062}_{+0.0024}$ [1.250]	40 [88]
089	127 [5.000]	98 [3.858]	$37.68^{-0.17}_{-0.0067}$ [1.483]	8.5 [0.335]	36.513 [1.438]	23 [0.906]	16/32	95.2 [3.748]	114 [4.488]	$34.95^{+0.062}_{+0.0024}$ [1.376]	47 [104]

Outline drawing, basic
model

P000 568E

Dimensions

Frame size	A mm [in]	B mm [in]	C mm [in]	D mm [in]	Weight kg [lb]
070	290 [11.417]	30 [1.181]	12 [0.472]	2 [0.079]	34 [75]
089	307 [12.087]	44 [1.732]	6 [0.236]		41 [90]

For further dimensions see previous pages.
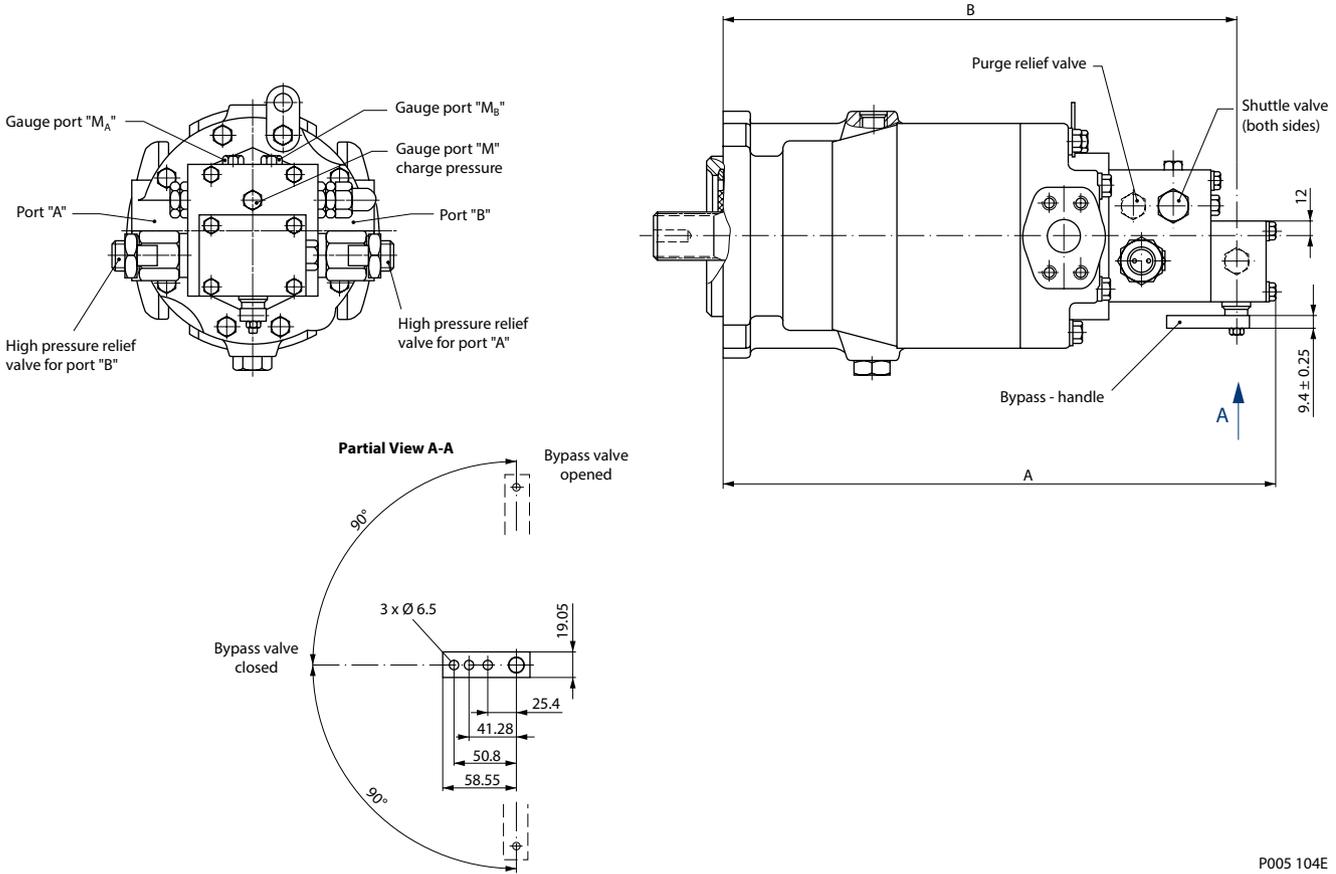
Outline drawing, motor
configuration AM 01000
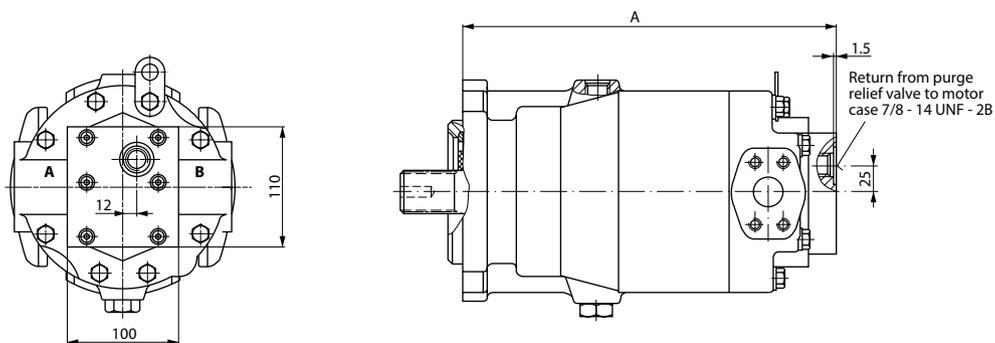
P000 569E

Dimensions

Frame size	A mm [in]	Weight [1] kg [lb]
070	315 [12.402]	36 [79]
089	332 [13.071]	43 [95]

[1] Light weight and short options available on request
For further dimensions see previous pages.

Dimensions –
Frame Size 070 and 089 cm³

Outline drawing, motor
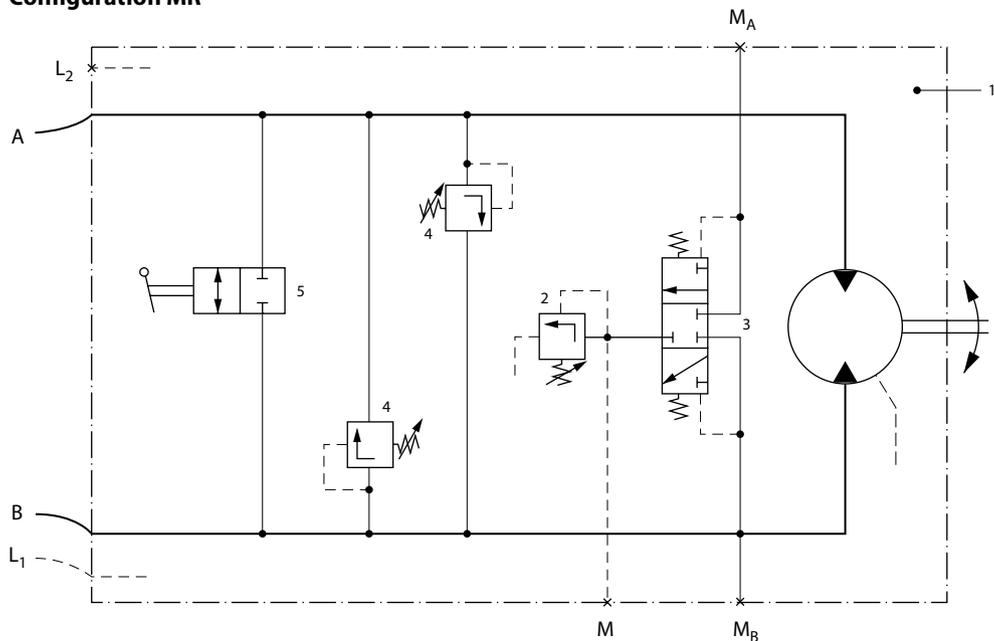**configuration MR**

P005 104E

Dimensions

Frame size	A mm [in]	B mm [in]	Weight kg [lb]	Port M$_A$ and M$_B$	Port M
070	426 [16.772]	391 [15.394]	42 [93]	7/16-20 UNF-2B SAE straight thread O-ring boss	
089	443 [17.441]	408 [16.063]	49 [108]		

For further dimensions see previous pages.

Dimensions
– Frame Size 070 and 089 cm³

Circuit diadrams   **Configuration MR**

P000 035

Basic model and motor configuration AM 01000

Return from purge relief
valve to motor case
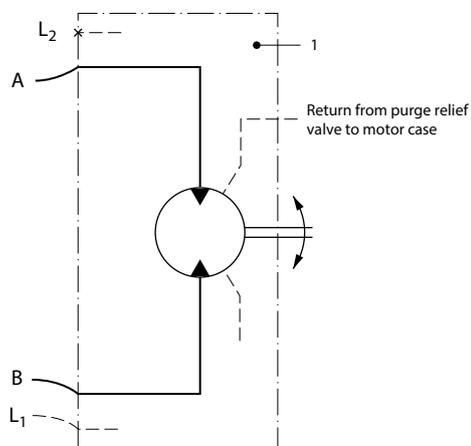
P000 038E

Designation:
1   = Fixed displacement motor
2   = Purge relief valve
3   = Shuttle valve
4   = High pressure relief valve
5   = Bypass valve
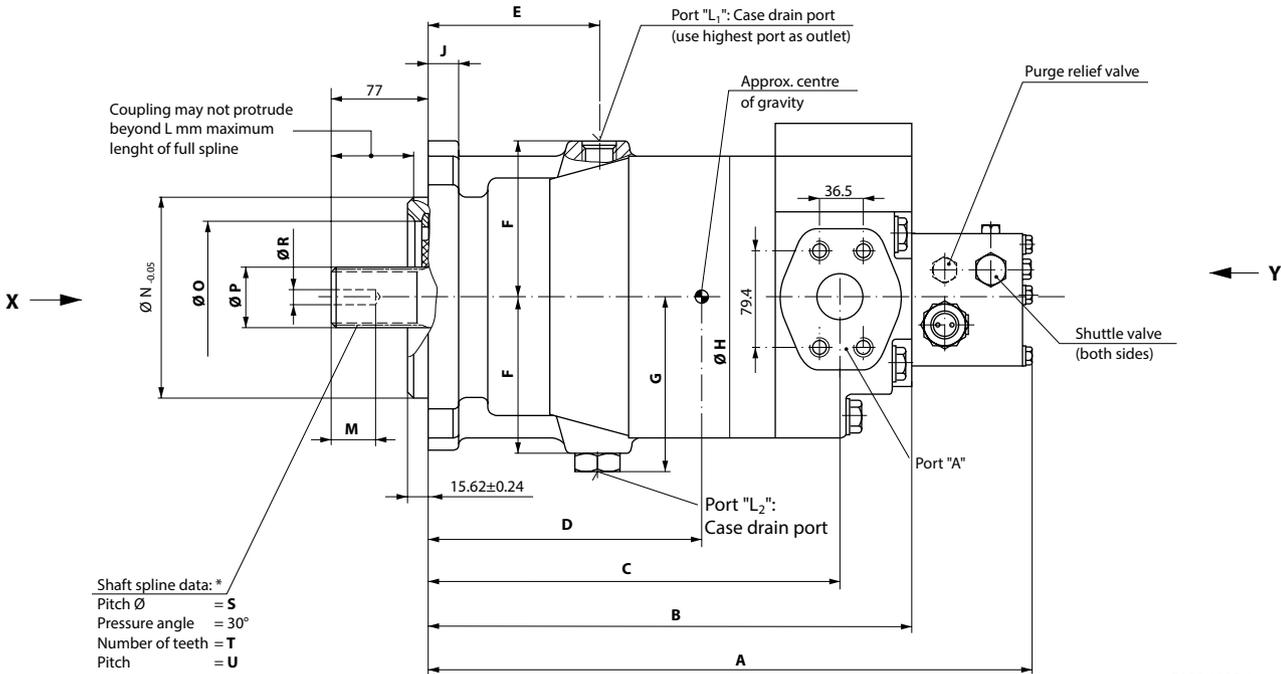
Ports:
A,B = Main pressure ports (working loop)
L_1, L_2 = Drain ports
M_A = Gauge port for port **A**
M_B = Gauge port for port **B**
M   = Gauge port - charge pressure

Dimensions
– Frame Size 227 and 334 cm³

Outline drawing,
configuration MS

P005 100E-1

Dimensions

Frame size	A mm [in]	B mm [in]	C mm [in]	D mm [in]	E mm [in]	F mm [in]	G mm [in]	Ø H mm [in]	J mm [in]
227	498 [19.606]	410 [16.142]	346 [13.622]	228.5 [8.996]	139.7 [5.500]	134.9 [5.311]	152 [5.984]	264 [10.394]	27 [1.063]
334	537 [21.142]	449 [17.677]	389 [15.315]	278 [10.945]	154 [6.063]	143. [5.650]	161 [6.339]	292 [11.496]	38 [1.496]

Frame size	M mm [in]	Ø N mm [in]	Ø O mm [in]	Ø P mm [in]	Ø R mm [in]	Ø S mm [in]	T mm [in]	U mm [in]	V mm [in]
227	38.4 [1.512]	165.1 [6.500]	110 [4.331]	44.03 [1.733]	11.80 [0.465]	42.863 [1.688]	27 [1.063]	16/32	143.7 [5.657]
334	46.2 [1.819]	177.8 [7.000]	114 [4.488]	64.66 [2.546]	14.35 [0.565]	63.500 [2.500]	40 [1.575]	16/32	158.7 [6.248]

Frame size	W mm [in]	X mm [in]	Y mm [in]	Z mm [in]	AA mm [in]	BB mm [in]	CC mm [in]	Diameter for shaft coupling mm [in]	Weight kg [lb]
227	156 [6.142]	160 [6.299]	265 [10.433]	265 [10.433]	317.5 [12.500]	20.6 [0.811]	13 [0.512]	41.28 [1.625]	152 [335]
334	176 [6.929]	174 [6.850]	298 [11.732]	298 [11.732]	350 [13.780]	27.0 [1.063]	18 [0.709]	61.93 [2.438]	197 [434]

* Shaft spline data: spline shaft with involute spline, according to SAE handbook, 1963, class 1, fillet root side fit.

Dimensions
– Frame Size 227 and 334 cm³

**Outline drawing,
configuration MS
(continued)**

View Y

Gauge port "M$_A$"

Gauge port "M$_B$"

Gauge port "M"
charge pressure

Port "A"

Port "B"

High pressure relief
valve for port "B"

High pressure relief
valve for port "A"

V
Port "A"

V
Port "B"

Z

View X

CC

Rotation

L   R

45°

X   W

Y

AA

Approx. centre
of gravity

BB
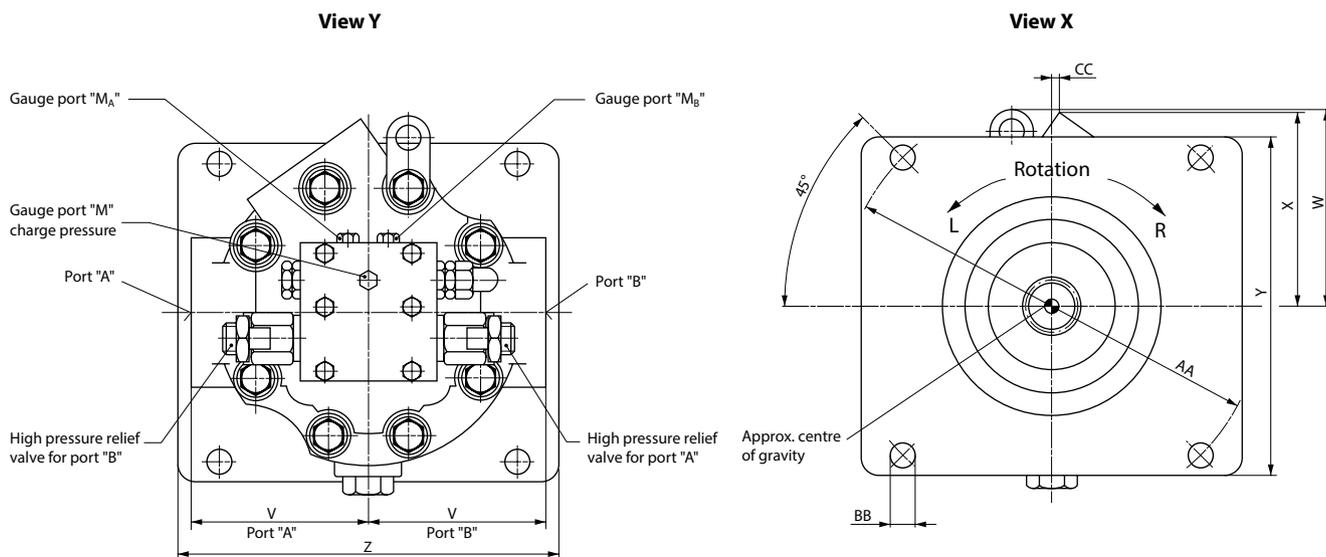
P005 100E-2

Frame size	Port A and B	Port L$_1$ and L$_2$	Port M$_A$ and M$_B$	Port M
227	SAE flange, size 1 1/2 SAE split flange boss 6000 psi 4 threads	1 7/8-12 UNF-2B SAE straight thread O-ring boss	7/16-20 UNF-2B SAE straight thread O-ring boss	
334	5/8-11 UNC-2B 35 mm deep			

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