

Technical specifications

H1 Pumps General Specification

Axial piston closed circuit variable displacement pump of cradle swash-plate design with clockwise or counterclockwise direction of rotation.

Pipe connections

- Main pressure ports H1P 045/053: SAE straight thread O-ring boss
- Main pressure ports H1P 060/068: ISO split flange boss
- Remaining ports: SAE straight thread O-ring boss

Recommended installation position

Pump installation position is discretionary, however the recommended control position is on the top or at the side with the top position preferred. If the pump is installed with the control at the bottom, flushing flow must be provided through port M14 located on the EDC, FNR and NFPE control.

Vertical input shaft installation is acceptable. If input shaft is at the top, 1 bar case pressure must be maintained during operation.

The housing must always be filled with hydraulic fluid.

Recommended mounting for a multiple pump stack is to arrange the highest power flow towards the input source.

Consult Danfoss for nonconformance to these guidelines.

Auxiliary cavity pressure

Auxiliary cavity pressure will be inlet pressure with internal charge pump or case pressure with external charge supply. For reference see [Operating parameters H1 Tandem Pumps](#) on page 5. Please verify mating pump shaft seal capability.

Technical Data for H1 Tandem Pumps

Feature	Unit	Size 045	Size 053	Size 060	Size 068
Displacement	cm ³ [in ³]	45.0 [2.75]	53.8 [3.28]	60.4 [3.69]	68.0 [4.15]
Flow at rated (continuous) speed*	l/min [US gal/min]	153 [40]	183 [48]	210 [55.5]	238 [62.8]
Torque at maximum displacement (theoretical)	N·m/bar [lbf·in/1000 psi]	0.8 [488]	0.9 [549]	0.96 [590]	1.08 [610]
Mass moment of inertia of rotating components	kg·m ² [slug·ft ²]	0.0078 [0.00575]	0.0077 [0.00568]	0.01431 [0.01055]	0.01427 [0.01052]
Mass (weight dry, without charge pump or auxiliary flange)	kg [lb]	65 [143]		96.2 [212]	
Oil volume	l [US gal]	2.3 [0.61]		4.2 [1.1]	
Mounting flange per ISO 3019-1		Flange 101-2 (SAE B), Special bolt diameter		Flange 127-4 (SAE C)	
Input shaft outer diameter, splines per ISO 3019-1		Outer Ø25 mm - 4 (SAE B-B, 15 teeth) Outer Ø32 mm - 4 (SAE-C, 14 teeth) Outer Ø31 mm - 4 (19 teeth)		Outer Ø32 mm - 4 (SAE C, 14 teeth) Outer Ø35 mm - 4 (SAE-C, 21 teeth)	

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Feature	Unit	Size 045	Size 053	Size 060	Size 068
Auxiliary mounting flange with metric fasteners, shaft outer diameter and splines per ISO 3019-1		Flange 82 - 2: outer Ø16 mm - 4 (SAE A, 9 teeth) outer Ø19 mm - 4 (SAE A, 11 teeth) Flange 101 - 2: outer Ø22 mm - 4 (SAE B, 13 teeth) outer Ø25 mm - 4 (SAE B-B, 15 teeth)		Flange 101 - 2: outer Ø22 mm - 4 (SAE B, 13 teeth) outer Ø25 mm - 4 (SAE B-B, 15 teeth)	
Charge inlet port per ISO 11926-1 (SAE O-ring boss)		7/8 -14		1 1/16 -14	
Main port configuration		ISO 11926-1: 1 5/16 -12 (SAE O-ring boss)		ISO 6162: M12 x 1.75 (Split flange)	
Case drain port L3 per ISO 11926-1 - 1 (use for cooling purposes)		1 1/16 -12 (SAE O-ring boss)		1 5/16 -12 (SAE O-ring boss)	
Other ports		SAE O-ring boss			
Customer interface threads		Metric fasteners			

* Applies for each rotating group.

Operating parameters H1 Tandem Pumps

Feature		Size 045	Size 053	Size 060	Size 068
Input speed (at minimum charge/control pressure)	Minimum for external charge supply ¹⁾	500 min ⁻¹ (rpm)			
	Rated	3400 min ⁻¹ (rpm)		3500 min ⁻¹ (rpm)	
	Maximum	3500 min ⁻¹ (rpm)		4000 min ⁻¹ (rpm)	
System pressure	Maximum working pressure	420 bar [6090 psi]	380 bar [5510 psi]	420 bar [6090 psi]	380 bar [5510 psi]
	Maximum pressure	450 bar [6527 psi]	400 bar [5800 psi]	450 bar [6527 psi]	400 bar [5800 psi]
	Maximum low loop	45 bar [650 psi]			
	Minimum low loop pressure	10 bar [145 psi]			
Charge pressure	Minimum without CCO valve	16 bar [232 psi]			
	Minimum with CCO valve	18 bar [265 psi]			
	Maximum	34 bar [435 psi]			
Control pressure	Min. at corner power (EDC, MDC, FNR)	21.5 bar [312 psi]		18.5 bar [268 psi]	
	Maximum	40 bar [580 psi]			
Case pressure	Rated	3 bar [44 psi]			
	Maximum	5 bar [73 psi]			
Lip seal external maximum pressure		0.4 [5.8 psi]			

¹⁾ Full performance (pressure and displacement) possible at minimum charge and control pressure supply.

Technical specifications

Fluid Specifications

Viscosity

Intermittent ¹⁾	Minimum	Recommended range	Maximum
5 mm ² /s [42 SUS]	7 mm ² /s [49 SUS]	12 – 80 mm ² /s [66 – 370 SUS]	1600 mm ² /s [7500 SUS]

¹⁾ Intermittent = Short term t < 1 min per incident and not exceeding 2 % of duty cycle based load-life

Temperature

Minimum (cold start)	Rated	Recommended range*	Maximum Intermittent
-40°C [-40°F]	104°C [220°F]	60 – 85°C [140 – 185°F]	115°C [240°F]

* At the hottest point, normally case drain port

Filtration, Cleanliness level and Efficiency β_x-ratio (Recommended Minimum)

Cleanliness per ISO 4406	22/18/13
Efficiency β_x (charge pressure filtration)	β ₁₅₋₂₀ = 75 (β ₁₀ ≥ 10)
Efficiency β_x (suction and return line filtration)	β ₃₅₋₄₅ = 75 (β ₁₀ ≥ 2)
Recommended inlet screen mesh size	100 – 125 μm

External radial shaft loads H1 Tandem

External radial shaft loads

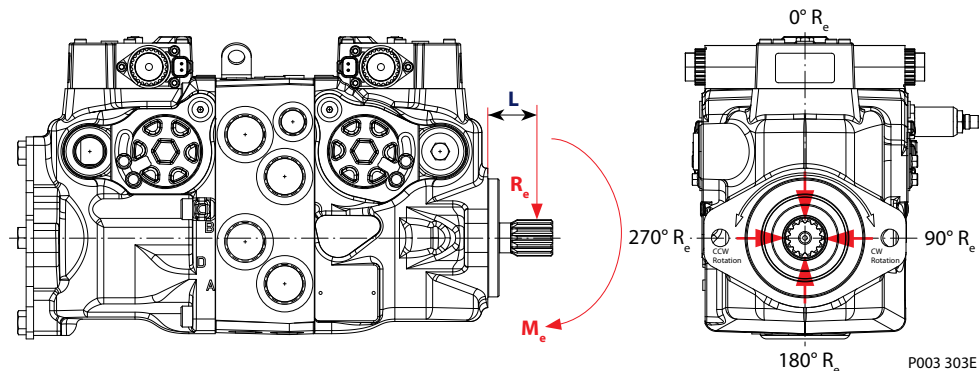
H1 pumps are designed with bearings that can accept some external radial loads. The external radial shaft load limits are a function of the load position and orientation, and the operating conditions of the unit. External radial shaft loads impact lifetime. For lifetime calculations please contact Danfoss representative.

The **maximum allowable radial load (R_e)** is based on the maximum external moment (M_e) and the distance (L) from the mounting flange to the load.

$$R_e = \frac{M_e}{L}$$

It may be determined using the following formula:

Radial load position (045/053 shown)



- M_e** = shaft moment
- L** = flange distance
- R_e** = external force to the shaft

Thrust loads should be avoided. Contact factory in the event thrust loads are anticipated.

Technical specifications

Bearing Life

Maximum external shaft load based on shaft deflection

External radial moment	Unit	Size 045 / 053	Size 060 / 068
M_e	N·m [lbf·in]	104 [920]	104 [920]

All external shaft loads affect bearing life. In applications with external shaft loads, minimize the impact by positioning the load at 0° or 180° as shown in the figure.

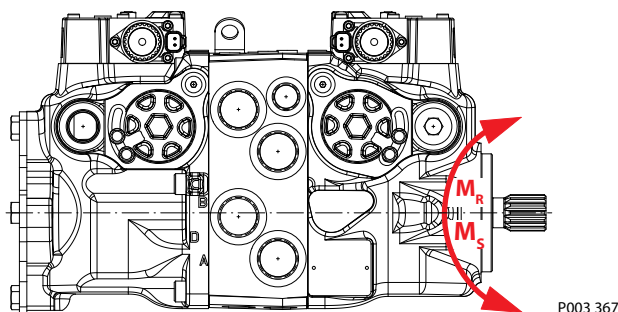
Danfoss recommends clamp-type couplings for applications with radial shaft loads.

Contact your Danfoss representative for an evaluation of unit bearing life if you have continuously applied external loads exceeding 25 % of the maximum allowable radial load (R_e) or the pump swashplate is positioned on one side of center all or most of the time.

Mounting flange loads H1T 045/053

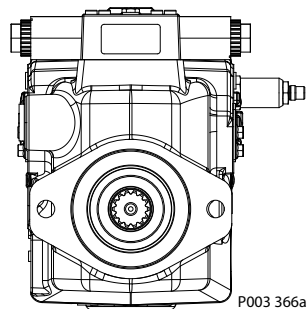
H1 tandem pump front flange load

Mounting flange loads H1T 045/053, Controls on top



The moments shown below apply for the control orientation on top or side.

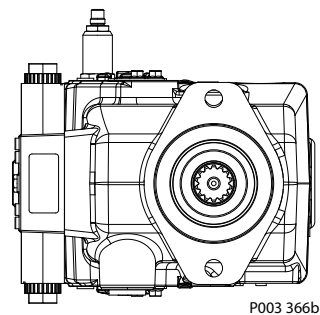
Mounting flange loads, Control on top



Rated moment:
 $M_R = 2020 \text{ N}\cdot\text{m} [17\ 880 \text{ lbf}\cdot\text{in}]$

Shock load moment:
 $M_S = 4110 \text{ N}\cdot\text{m} [36\ 380 \text{ lbf}\cdot\text{in}]$

Mounting flange loads, Control on side



Rated moment:
 $M_R = 1300 \text{ N}\cdot\text{m} [11\ 510 \text{ lbf}\cdot\text{in}]$

Shock load moment:
 $M_S = 2930 \text{ N}\cdot\text{m} [25\ 935 \text{ lbf}\cdot\text{in}]$

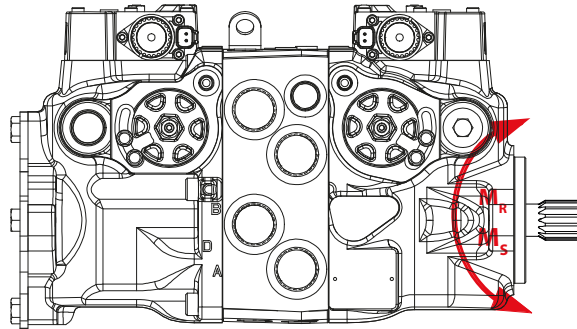
For more information, see *H1 Axial Piston Pumps, Basic Information, BC0000057*, the section "Mounting flange loads".

Technical specifications

Mounting flange loads H1T 060/068

H1 tandem pump front flange load

Mounting flange loads H1T 060/068, Controls on top



Rated moment:

$M_R = 2190 \text{ N}\cdot\text{m}$ [19 380 lbf·in]

Shock load moment:

$M_S = 6560 \text{ N}\cdot\text{m}$ [58 060 lbf·in]

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The moments shown apply for the control orientation on top or side.

For more information, see *H1 Axial Piston Pumps, Basic Information*, **BC0000057**, the section “Mounting flange loads”.

Case drain

The tandem housings are connected through the center section via a drilled hole. The charge relief valve discharges oil into the front housing. In order to provide positive flow through both housings, use of the rear housing case drain is required. The front housing case pressure ports should only be used if the pump is used as a common drain manifold for the vehicle where external drain flow is brought into the rear housing and discharged out the front.

The allowable case pressures must be met accordingly.

Master model code H1 Tandem

H1T045RANA2C3ND1F G5NN42421818NP20P

H1T Master Model Code

Displacement (Front pump, second pump see "C")

045	45 cm ³ [2.75 in ³]
053	53.8 cm ³ [3.28 in ³]
060	60 cm ³ [3.66 in ³]
068	68 cm ³ [4.15 in ³]

A – Rotation

L	Left hand (counter clockwise)
R	Right hand (clockwise)

B – Product version

A	Revision code
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Z – Port configuration

A	Inch, Customer O-ring port sealing according to ISO 11926-1
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C – Second pump size

N	Frame size of rear stage equal front stage (default)
A	Rear stage kit 45cc/rev (only use with 53cc/rev front stage)
B	Rear stage kit 60cc/rev (only use with 68cc/rev front stage)

D – Controls

Code	Control type	Voltage	Miscellaneous options	Connector
A2	EDC	12 V	—	DEUTSCH
A3	EDC	24 V	—	DEUTSCH
A4	EDC	12 V	MOR	DEUTSCH
A5	EDC	24 V	MOR	DEUTSCH
A9	FNR	12 V	MOR	DEUTSCH
H3	EDC	24 V	Angle sensor	DEUTSCH
H4	MDC front unit	—	Gain 0.52 with NSS	—
	FNR rear unit	12 V	Gain 0.52 with MOR	DEUTSCH
H6	EDC	12 V	Angle sensor + MOR	DEUTSCH
H7	EDC	24 V	Angle sensor + MOR	DEUTSCH
B1	FNR	24 V	MOR	DEUTSCH
B6	FNR front unit	12 V	—	DEUTSCH
	EDC rear unit	12 V	Gain 0.52	DEUTSCH
D7	EDC front unit	12 V	MOR	DEUTSCH
	FNR rear unit	12 V	MOR	DEUTSCH

Master model code H1 Tandem
D – Controls (continued)

Code	Control type	Voltage	Miscellaneous options	Connector
D9	MDC front unit	—	Gain 0.52 with NSS	—
	MDC rear unit	—	Gain 0.52	DEUTSCH
N1	NFPE ¹⁾	12 V	MOR	DEUTSCH
N2	NFPE ¹⁾	24 V	MOR	DEUTSCH
N5	NFPE ¹⁾	12 V	Angle sensor + MOR	DEUTSCH
N6	NFPE ¹⁾	24 V	Angle sensor + MOR	DEUTSCH
M1	MDC	—	—	—
M2	MDC	—	NSS	—

¹⁾ Align with options: **E**: Displacement limiters and **W**: Special hardware.

F – Orifices (mm)

Code	Tank (A+B)	P	A / B	Note
C3	No orifice			Not to be used for FDC controls and mobile applications.
C1	—	—	0.8	Not to be used for FDC controls.
C6	1	—	—	To be used for MDC controls <u>only</u> .
C7	1.3	—	—	
C8	0.6	0.8	—	
C9	0.6	1	—	
D1	0.8	1	—	
D2	0.8	1.3	—	
D3	1	1.3	—	
D4	1	1.3	1.3	
D5	0.6	0.6	0.8	

E – Displacement limiter

N	None
C	No limiters, with nested springs, required for NFPE
B	Adjustable externally
D	Adjustable externally with nested springs, required for NFPE

G – Endcap options

Code	Description	045/053	060/068
E7	Tandem same-sided SAE O-ring boss ports, (HPRV only) standard	●	—
D1	Tandem same-sided SAE O-ring boss ports with Control Cut Off (HPRV only), 12 V	●	—
F7	Tandem same-sided SAE O-ring boss ports with Control Cut Off (HPRV only), 24 V	●	—
H3	Tandem Opp. Port Code 62, 12V CCO & Brake	—	●
H4	Tandem Opp. Port Code 62, 24V CCO & Brake	—	●
H5	Tandem Opp. Port Code 62, 12V CCO	—	●
H6	Tandem Opp. Port Code 62, 24V CCO	—	●

Master model code H1 Tandem
G – Endcap options (continued)

Code	Description	045/053	060/068
H7	Tandem Opp. Port Code 62	—	●
H8	Tandem Opp Port Code 62, Opposite Charge Inlet	—	●

H – Mounting

F	ISO 3019-1, flange 101-2 SAE B (045/053)
H	ISO 3019-1, flange 127-4 SAE C (060/068)
J	ISO 3019-1, flange 101-2 SAE B and speed sensor (045/053)

J – Input shaft

Code	Description	045/053	060/068
G1	ISO 3019-1, outer Ø32 mm - 4 (SAE C, 14 teeth splined shaft 12/24 pitch)	●	●
G5	ISO 3019-1, outer Ø25 mm - 4 (SAE B-B, 15 teeth splined shaft 16/32 pitch)	●	—
G6	ISO 3019-1, outer Ø31 mm - 4 (19 teeth splined shaft 16/32 pitch) (45/53 only)	●	—
F1	ISO 3019-1 outer diameter 35mm -4 (SAE C, 21 teeth splined shaft 16/32 pitch) (60/68 only)	—	●

K – Auxiliary mounting pad ISO 3019-1 without charge pump, with shipping cover

Code	Description	045/053	060/068
NN	No auxiliary mounting pad, No shipping cover	●	—
H2	Flange 82 - 2, outer Ø16 mm - 4 (SAE A, 9 teeth 16/32 coupling) (45/53)	●	●
H1	Flange 82 - 2, outer Ø19 mm - 4 (SAE A, 11 teeth 16/32 coupling) (45/53)	●	●
H3	Flange 101 - 2, outer Ø22 mm - 4 (SAE B, 13 teeth 16/32 coupling)	●	●
H5	Flange 101 - 2, outer Ø25 mm - 4 (SAE B-B, 15 teeth 16/32 coupling)	●	●

Align with options: **S** – Charge pump and **Y** – Special settings.

M – High pressure relief valve setting, NO bypass, side “A” (front pump)

N – High pressure relief valve setting, NO bypass side “B” (front pump)

P – High pressure relief valve setting, NO bypass, side “C” (rear pump)

R – High pressure relief valve setting, NO bypass, side “D” (rear pump)

Code	Pressure setting (Use the selection for ports A, B, C and D)	045	053	60	68
13	130 bar [1885 psi]	●	●	—	—
15	150 bar [2175 psi]	●	●	—	—
18	180 bar [2610 psi]	●	●	●	●
20	200 bar [2900 psi]	●	●	●	●
23	230 bar [3336 psi]	●	●	●	●
25	250 bar [3630 psi]	●	●	●	●
28	280 bar [4061 psi]	●	●	●	●
30	300 bar [4350 psi]	●	●	●	●
33	330 bar [4786 psi]	●	●	●	●

Master model code H1 Tandem

M – High pressure relief valve setting, NO bypass, side “A” (front pump)

N – High pressure relief valve setting, NO bypass side “B” (front pump)

P – High pressure relief valve setting, NO bypass, side “C” (rear pump)

R – High pressure relief valve setting, NO bypass, side “D” (rear pump) (continued)

Code	Pressure setting (Use the selection for ports A, B, C and D)	045	053	60	68
35	350 bar [5080 psi]	●	●	●	●
38	380 bar [5510 psi]	●	●	●	●
40	400 bar [5800 psi]	●	—	●	—
41	410 bar [5946 psi]	●	—	—	—
42	420 bar [6090 psi]	●	—	●	—

● = available option,
 — = not available option

Pressure limiter 060/068

Code	Pressure setting (Use the selection for ports A, B, C and D)	060	068
AE	150 bar PL / 200 bar HPRV	●	●
AH	180 bar PL / 250 bar HPRV	●	●
BK	200 bar PL / 250 bar HPRV	●	●
BC	230 bar PL / 280 bar HPRV	●	●
BE	250 bar PL / 300 bar HPRV	●	●
BH	280 bar PL / 330 bar HPRV	●	●
CK	300 bar PL / 350 bar HPRV	●	●
CC	330 bar PL / 380 bar HPRV	●	●
CE	350 bar PL / 400 bar HPRV	●	●
CH	380 bar PL / 430 bar HPRV	●	●
DK	400 bar PL / 450 bar HPRV	●	-
DA	410 bar PL / 450 bar HPRV	●	-
DB	420 bar PL / 450 bar HPRV	●	-

S – Charge pump

N	No charge pump, external charge supply (Align with options: T – Filtration)
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T – Filtration

P	Remote full charge flow filtration (045/053 only)
E	External charge filtration (060/068 only)

V – Charge pressure relief setting

18	18 bar [261 psi]	Not to be used for NFPE controls.
20	20 bar [290 psi]	
22	22 bar [319 psi]	
24	24 bar [348 psi]	

Master model code H1 Tandem

V – Charge pressure relief setting (continued)

26	26 bar [377 psi]
28	28 bar [406 psi]
30	30 bar [435 psi]
32	32 bar [464 psi]
34	34 bar [493 psi]

W – Special hardware features

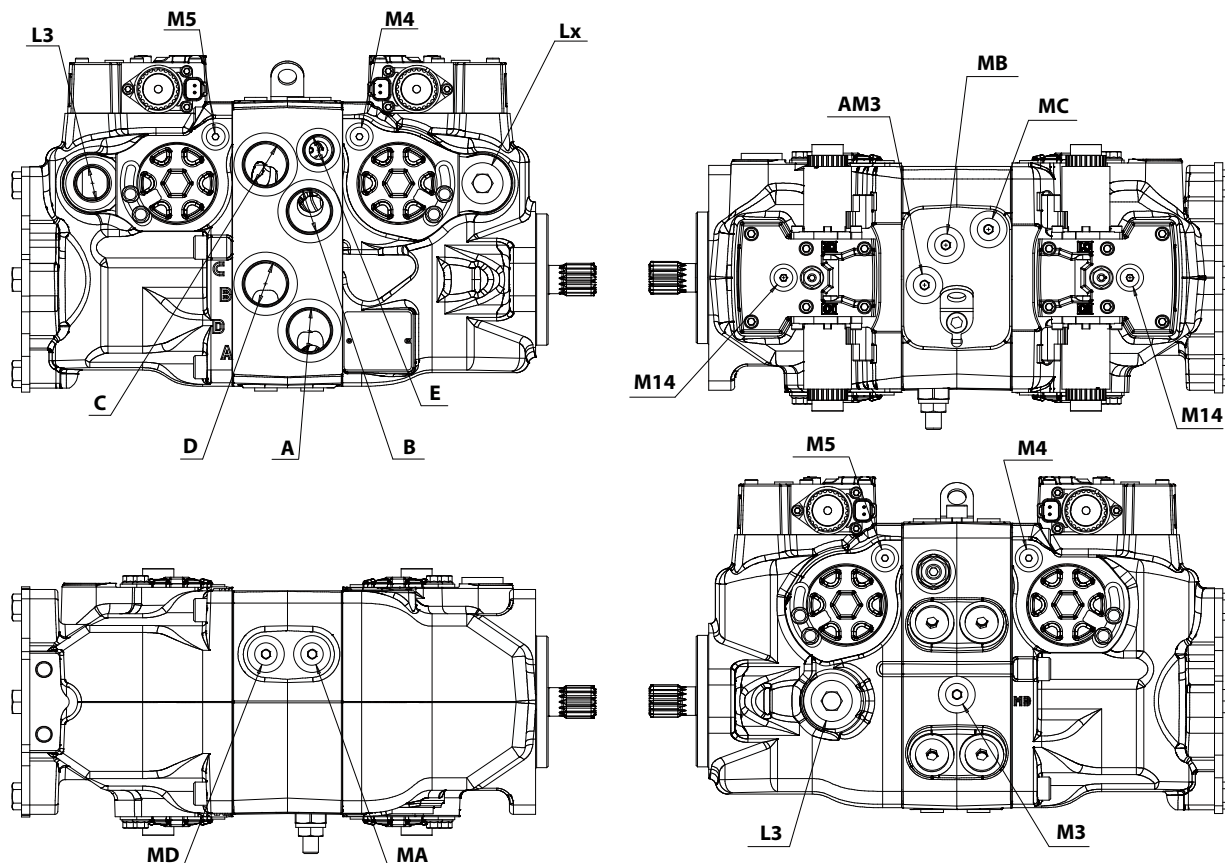
PN	EDC/FNR/MDC valve plate (without a handle)
P1	NFPE valve plate (<i>Align with options: D – Control selection and E – Displacement limiters</i>)
P4	EDC/FNR/MDC Valve Plate and Speed Ring (045/053 only)
H1	EDC/FNR/MDC Valve Plate, included MDC Handle (All frames)
H2	EDC/FNR/MDC Valve Plate, MDC Handle Front, System Loop Bypass (045/053 only)

X – Paint and nametag

NNN	Black paint and Danfoss nametag
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Y – Special settings

NNN	None
M00	MDC (handle in standard position)

Port Locations
Port Locations H1P 045/053 Tandem


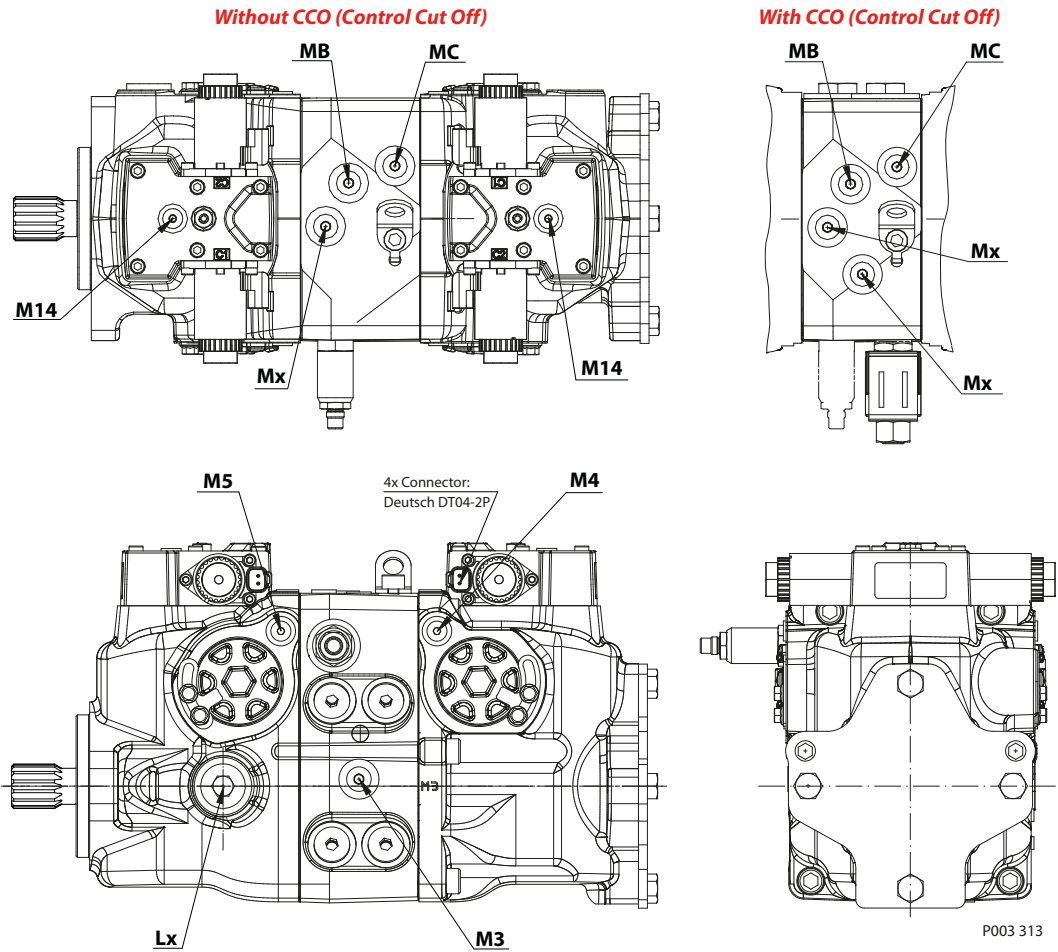
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Mounting flange, shaft and connector surfaces to be paint free.

Ports description, ISO 11926-1

Ports	Description	Sizes
A, B, C, D	System ports: A, B, C and D ; $\varnothing 48.5$ max. clearance for fitting	$1\frac{5}{16} - 12$
MA, MB, MC, MD	System gauge ports A, B, C and D ; $\varnothing 28$ max. clearance for fitting	$\frac{9}{16} - 18$
E	Charge filtration inlet port from filter; $\varnothing 36$ max. clearance for fitting	$\frac{7}{8} - 14$
L3, Lx	Case drain port; $\varnothing 48.5$ max. clearance for fitting	$1\frac{1}{16} - 12$
M3	Charge gauge / constr. port; $\varnothing 28$ max. clearance for fitting	$\frac{9}{16} - 18$
M4, M5	Servo gauge ports; $\varnothing 24.5$ max. clearance for fitting	$\frac{7}{16} - 20$
M14	Case gauge port; $\varnothing 21$ max. clearance for fitting (EDC, MDC, FNR, NFPE)	$\frac{7}{16} - 20$
AM3	Alternate charge pressure port	$\frac{9}{16} - 18$

Port Locations



Mounting flange, shaft and connector surfaces to be paint free.

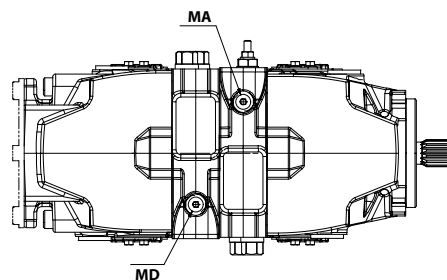
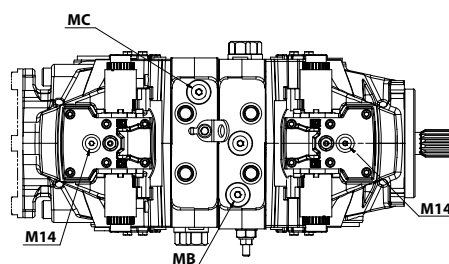
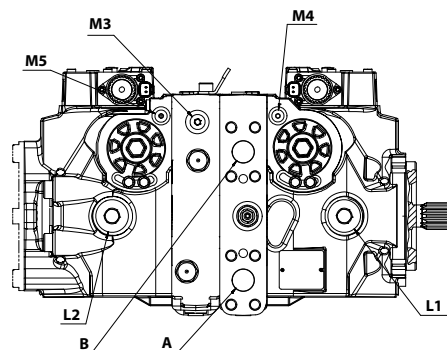
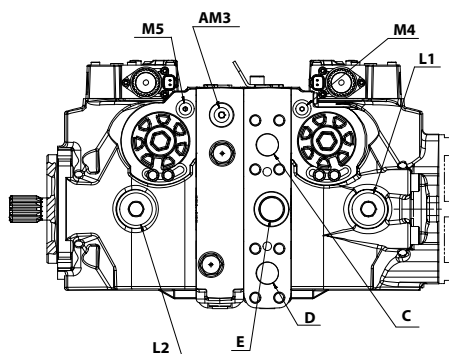
Ports description, ISO 11926-1

Ports	Description	Sizes
A, B, C, D	System ports: A, B, C and D ; Ø48.5 max. clearance for fitting	1 ⁵ / ₁₆ - 12
MA, MB, MC, MD	System gauge ports A, B, C and D ; Ø28 max. clearance for fitting	9 ¹ / ₁₆ - 18
E	Charge filtration inlet port from filter; Ø36 max. clearance for fitting	7 ⁷ / ₈ - 14
Lx	Case pressure port; Ø48.5 max. clearance for fitting	1 ¹ / ₁₆ - 12
M3 / Mx	Charge gauge / constr. port; Ø28 max. clearance for fitting	9 ¹ / ₁₆ - 18
M4, M5	Servo gauge ports; Ø24.5 max. clearance for fitting	7 ¹ / ₁₆ - 20
M14	Case gauge port; Ø21 max. clearance for fitting (EDC, MDC, FNR, NFPE)	7 ¹ / ₁₆ - 20
X7	Brake gauge port	9 ¹ / ₁₆ - 18

Please contact Danfoss representative for specific installation drawings.

Port Locations

Port Locations H1P 060/068 Tandem



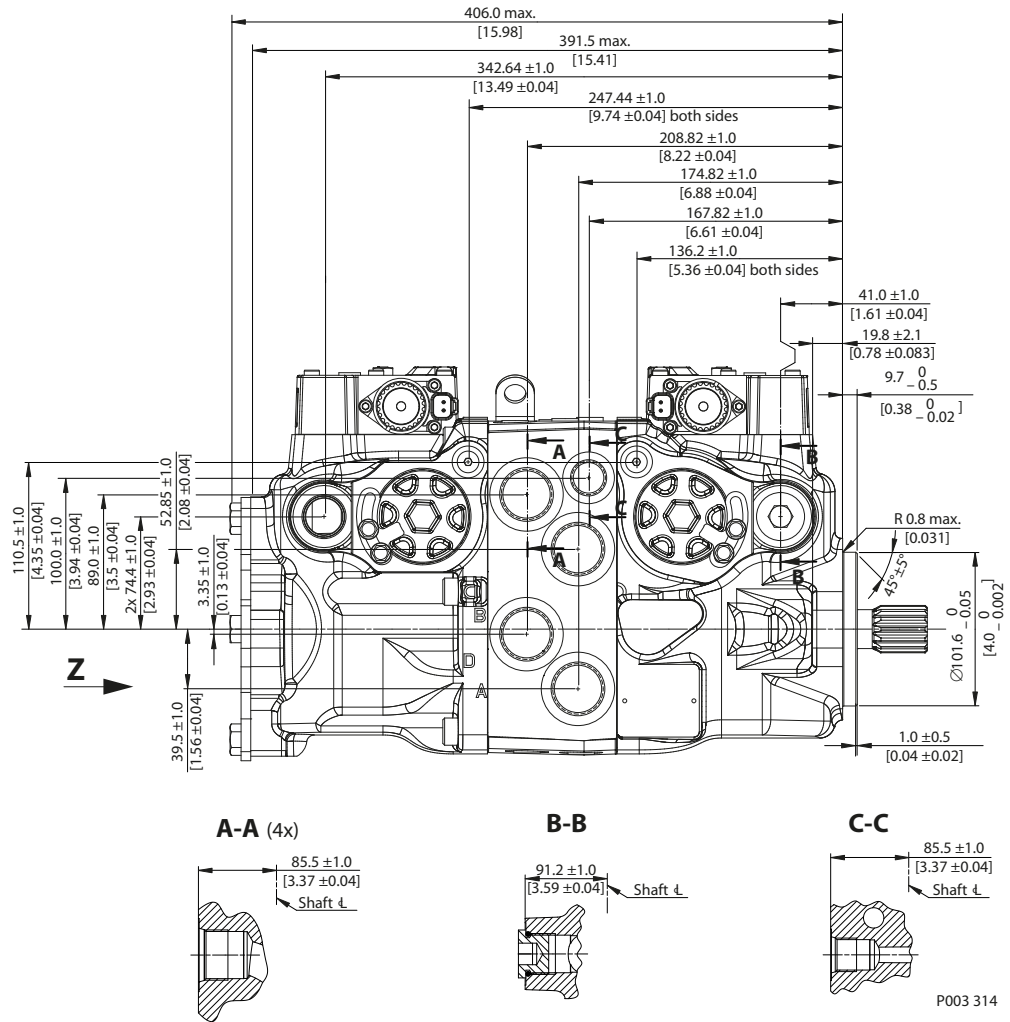
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Ports description, ISO 11926-1

Ports	Description	Size
A, B, C, D	System ports: A, B, C and D	Split flange, M12 x 1.75
MA, MB, MC, MD	System gauge ports A, B, C and D	9/16 - 18
E	Charge filtration inlet port from filter	1 1/16 - 12
L3	Case drain port	1 5/16 - 12
M3 / Mx	Charge gauge / constr. port	9/16 - 18
M4, M5	Servo gauge ports	7/16 - 20
M14	Case gauge port; (EDC, MDC, FNR, NFPE)	7/16 - 20
X7	Brake gauge port	3/4 - 16

Dimensions

Dimensions H1T 045/053 Tandem

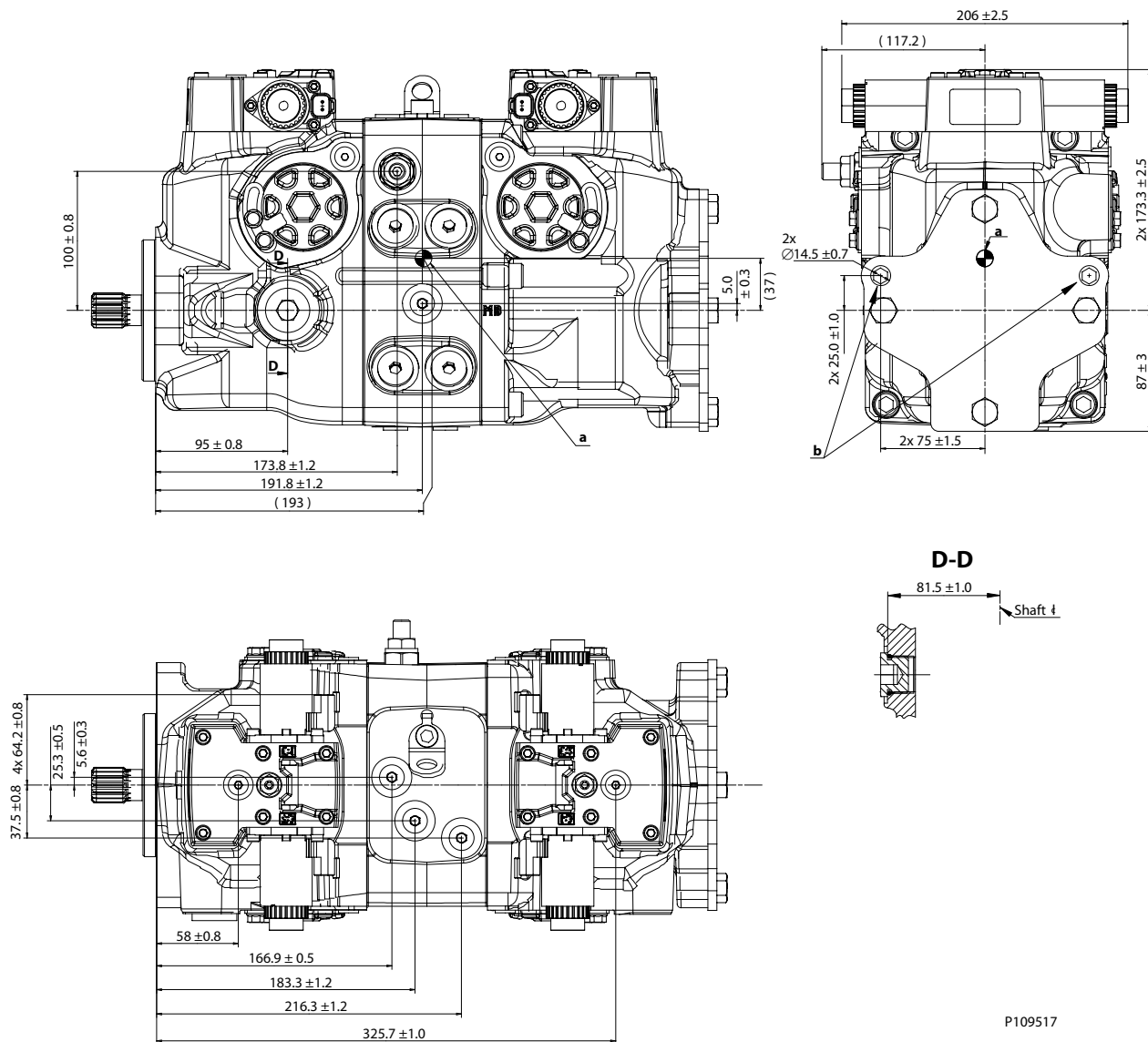


P003 314

L3 case drain port must be used (see the section *Case drain* on page 8 for more details).

Please contact Danfoss representative for specific installation drawings.

Dimensions



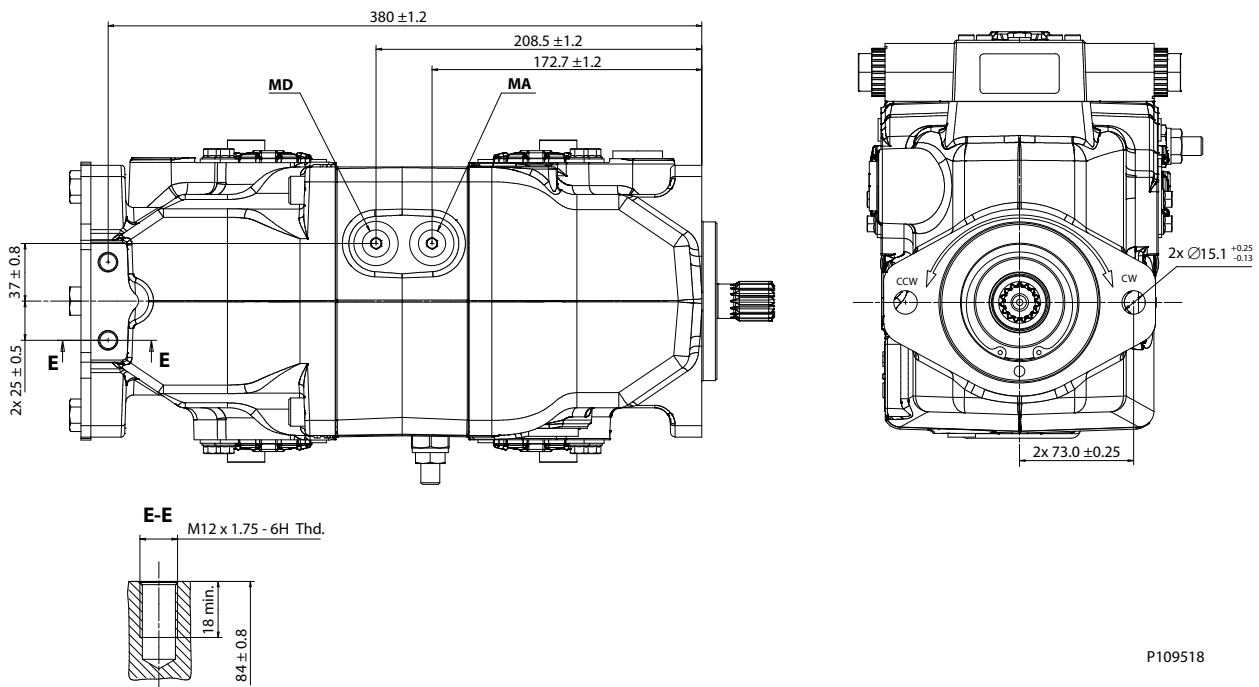
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Notes in the drawing:

- a** – Approximate center of gravity
- b** – Lifting holes weight limit not to exceed 75 kg [165 lb]

Please contact Danfoss representative for specific installation drawings.

Dimensions



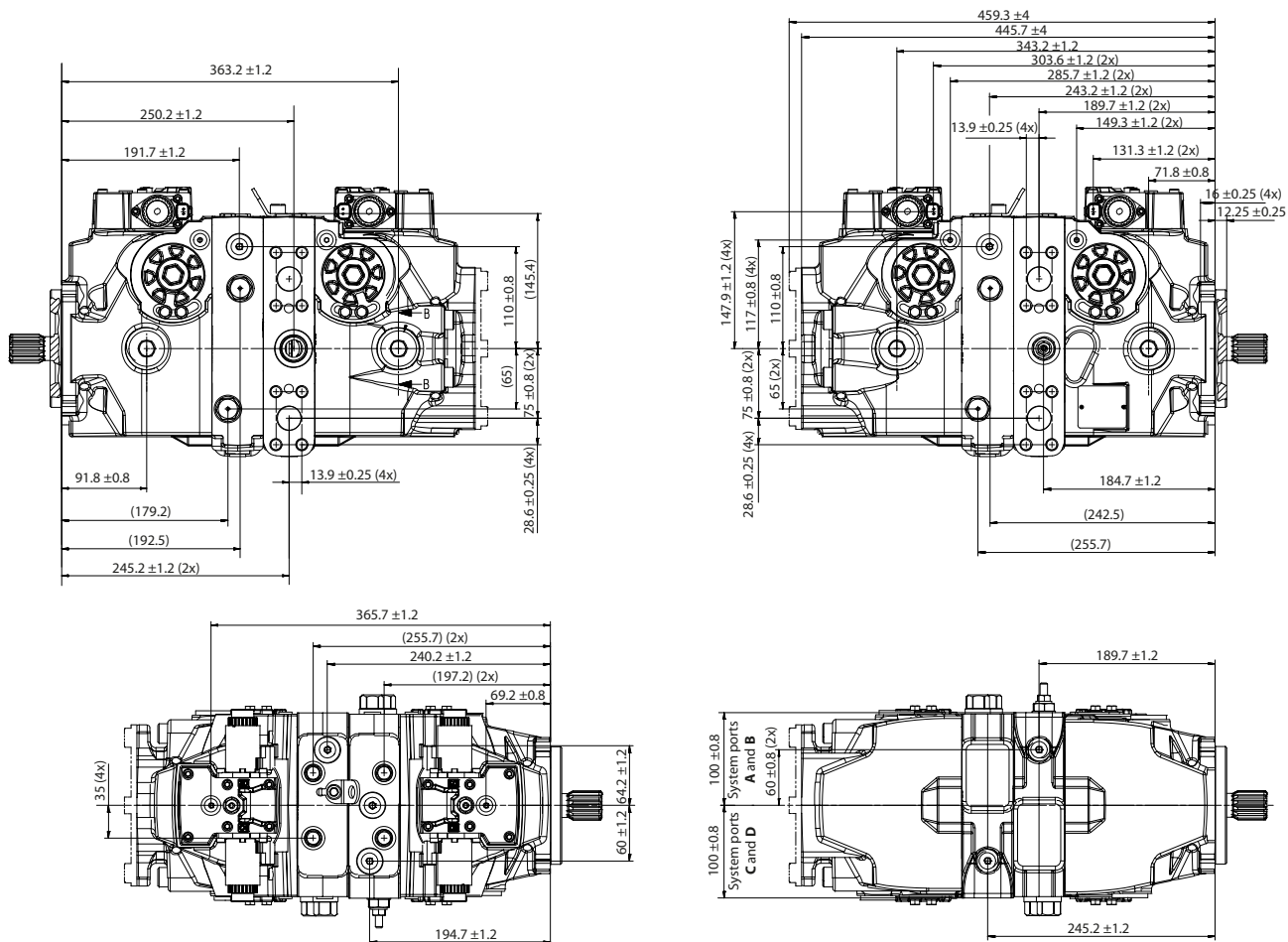
P109518

Mounting bolt holes are sized for 14 mm fasteners. M12 or ½ inch can be used, but require a hardened washer.

[Please contact Danfoss representative for specific installation drawings.](#)

Dimensions

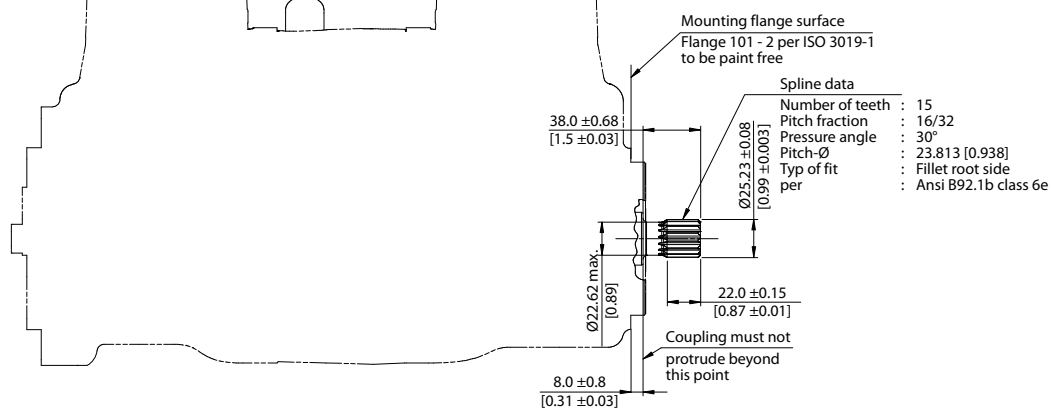
Dimensions H1T 060/068 Tandem



Dimensions

Input shaft, option G5 (SAE B-B, 15 teeth) (045/053 only)

Option G5



Specifications

Option	G5	
Spline	15 teeth, 16/32 pitch	
Min. active spline length¹⁾	22 mm [0.866 in]	
Torque rating²⁾	Rated	277 N•m [2450 lbf•in]
	Maximum	370 N•m [3270 lbf•in]

¹⁾ Minimum active spline length for the specified torque ratings.

²⁾ For definitions of maximum and rated torque values, refer to *Basic Information 11062168*, section Shaft Torque Ratings and Spline Lubrication.