

HYDRAULIC DISC BRAKES LB, LBS, LBV- Wet



- APPLICATION**
- » Heavy Duty machinery
 - » Wheel drives
 - » Material handling
 - » Mining
 - » Agricultural machines
 - » Conveyors
 - » Door openers and swing drives etc.



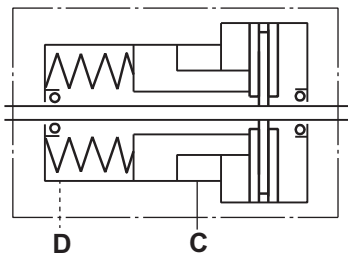
GENERAL

Fluid type	Mineral based- HLP(DIN 51524) or HM(ISO 6743/4)
Temperature range, °C [°F]	-40÷140 [-40÷284]
Viscosity range, mm ² /s	20÷75 [98÷347]
Filtration	ISO code 20/16 (nominal filtration of 25 microns)
Maintenance	Changed after the first 50-100 h, then after every 500-1500 h.

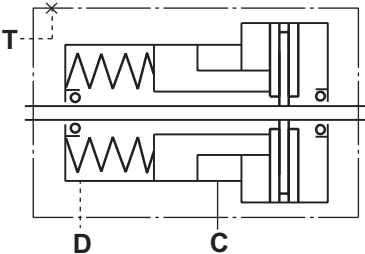
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LB, LBS

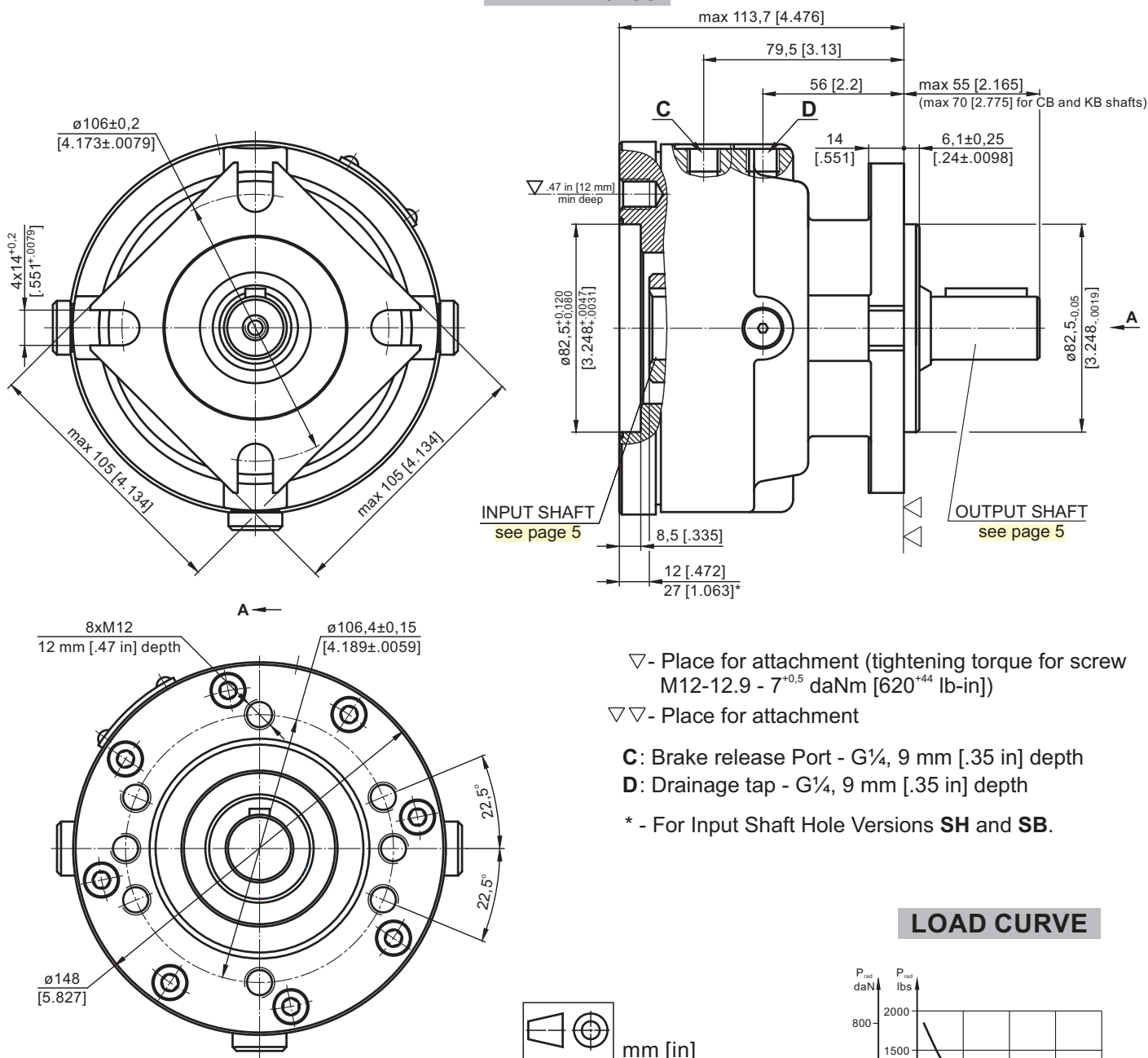


LBV

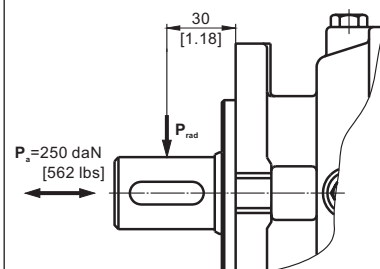
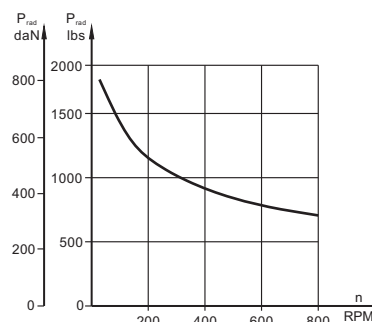


HYDRAULIC DISC BRAKE for FLANGE ATTACHMENT to MP, MR and MS HYDRAULIC MOTORS

TYPE LB/288



LOAD CURVE



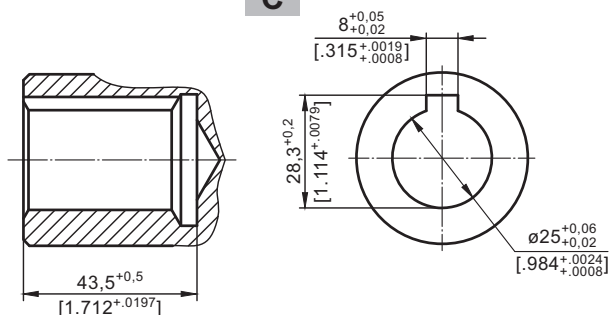
SPECIFICATION DATA

Description LB/288...	7	14	21	32	43	63
*Min. Static Torque, daNm [lb-in]	6-8 [531-708]	13-15 [1150-1327]	20-22 [1770-1947]	31-34 [2743-3009]	41-45 [3628-3982]	61-64 [5399-5665]
Opening Pressure, min bar [PSI]	4-5 [58-73]	8-9 [116-130]	12-13 [174-188]	18-20 [260-290]	24-26 [348-377]	38-39 [550-565]
max	300 [4350]					
Min. oil quantity for brake releasing, cm ³ [in ³]	7 - 8 [.427 - .488]					
Oil volume, cm ³ [in ³]	50 - 120 [3.5 - 7.35]					
Max. Pressure in drain space, bar [PSI]	0,5 [7.25]					
Weight, kg [lb]	9 [19.8]					

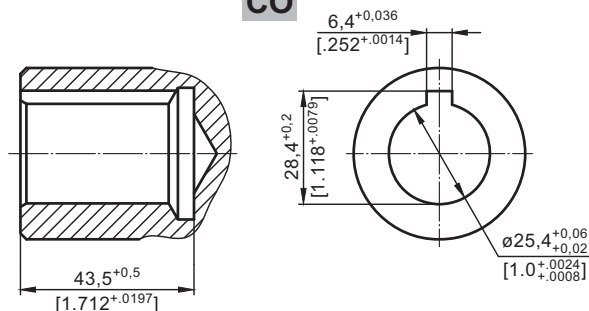
*Static torque is obtained at working pressure - 0 bar [0 PSI].

INPUT SHAFT HOLES

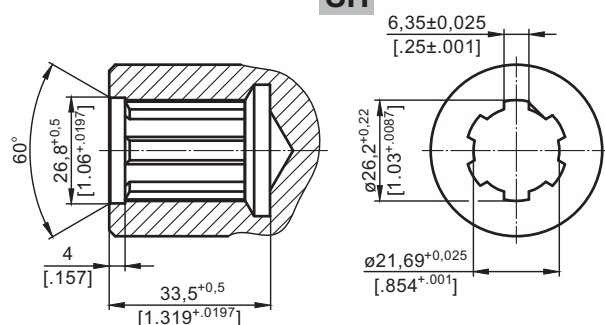
C



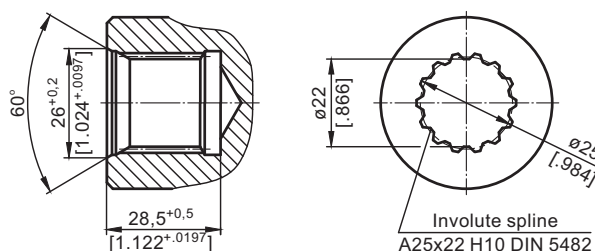
CO



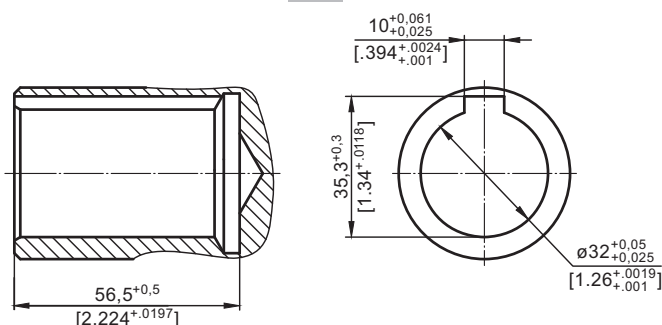
SH



SB

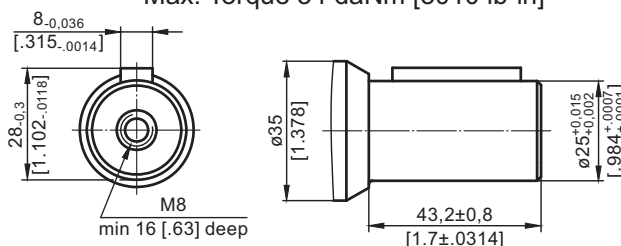


CB

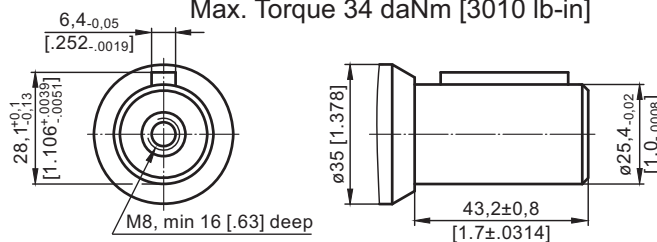


OUTPUT SHAFT EXTENSIONS

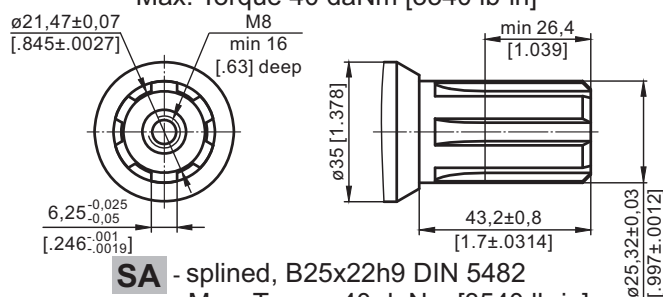
C - $\varnothing 25$ straight, Parallel key A8x7x30 DIN 6885
Max. Torque 34 daNm [3010 lb-in]



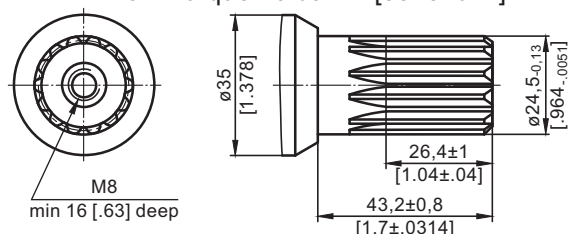
CO - $\varnothing 1$ " straight, Parallel key $\frac{1}{4}$ "x $\frac{1}{4}$ "x $\frac{1}{4}$ " BS46
Max. Torque 34 daNm [3010 lb-in]



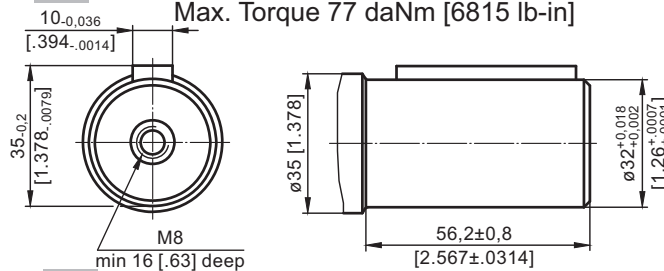
SH - splined, BS 2059 (SAE 6B)
Max. Torque 40 daNm [3540 lb-in]



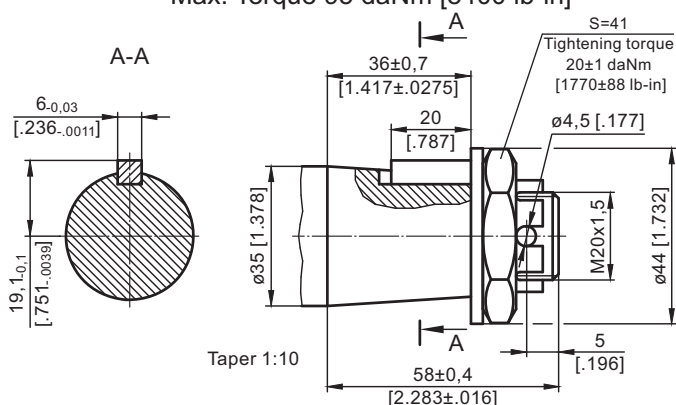
SA - splined, B25x22h9 DIN 5482
Max. Torque 40 daNm [3540 lb-in]



CB - $\varnothing 32$ straight, Parallel key A10x8x45 DIN 6885
Max. Torque 77 daNm [6815 lb-in]

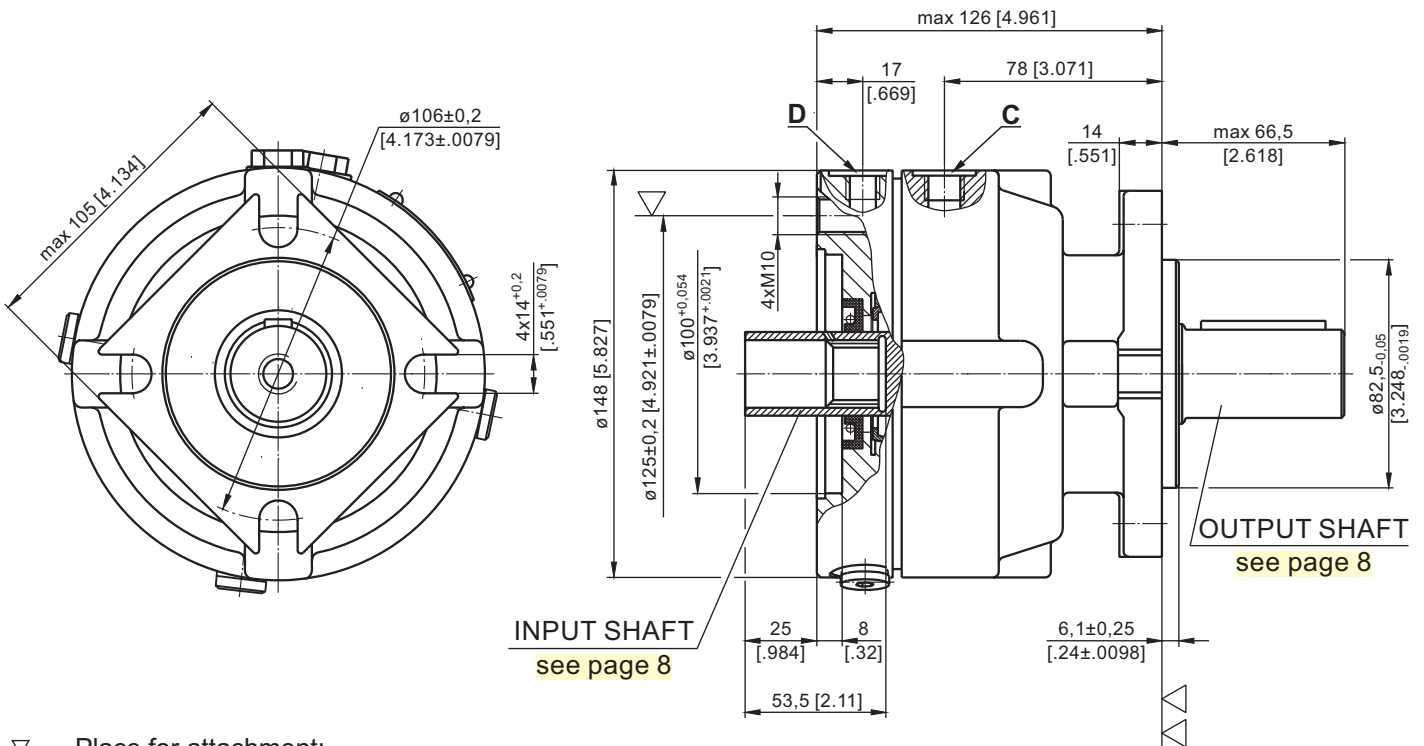


KB - tapered, Parallel key B6x6x20 DIN 6885
Max. Torque 95 daNm [8400 lb-in]



HYDRAULIC DISC BRAKE for FLANGE ATTACHMENT to MSS and MSV HYDRAULIC MOTORS

TYPE LBS/289



▽ - Place for attachment:

LBS - tightening torque for screw M10x35 - 12.9 DIN 912 - $6,5^{+0.5}_{-0}$ daNm [575^{+44}_{-0} lb-in]

LBV - tightening torque for screw M10xL - 12.9 DIN 931 - $6,5^{+0.5}_{-0}$ daNm [575^{+44}_{-0} lb-in]

▽▽ - Place for attachment



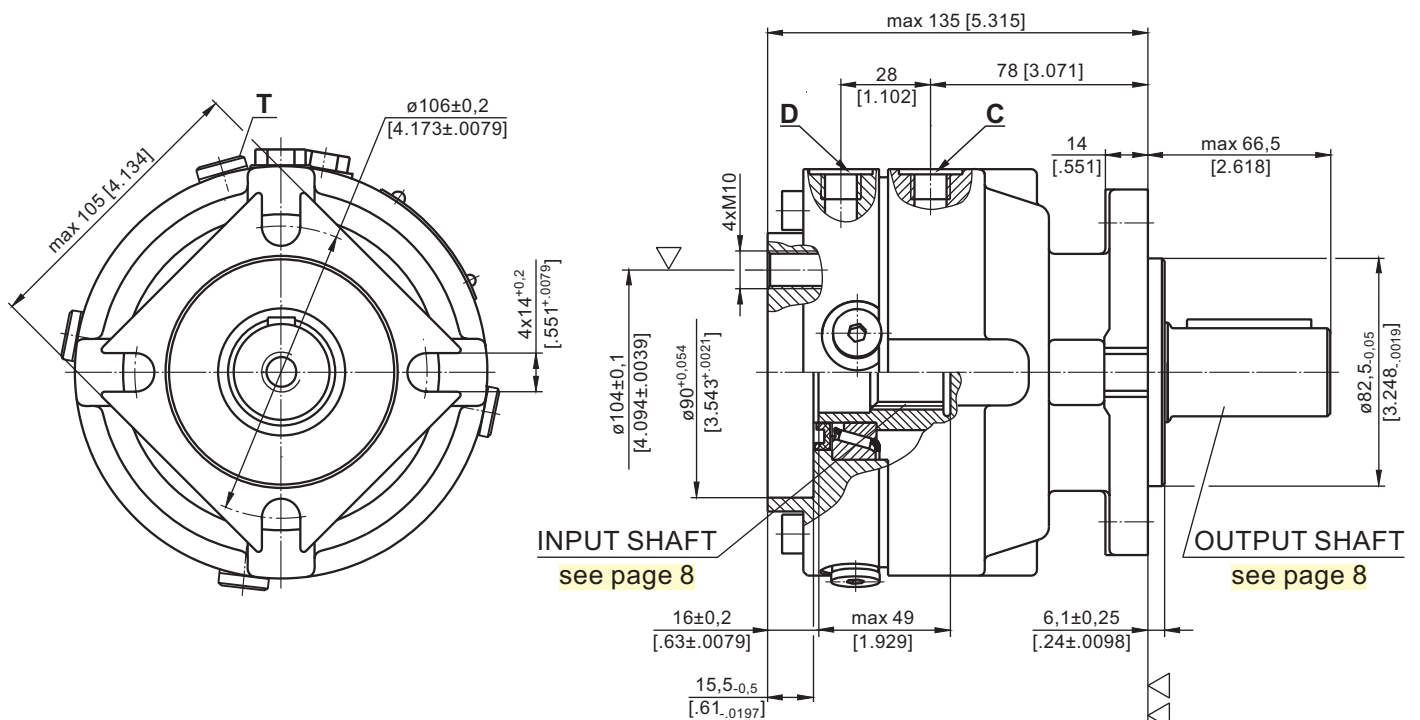
mm [in]

C: Brake release Port - G $\frac{1}{4}$, 9 mm [.35 in] depth

D: Drain plug for the Brake - G $\frac{1}{4}$, 9 mm [.35 in] depth

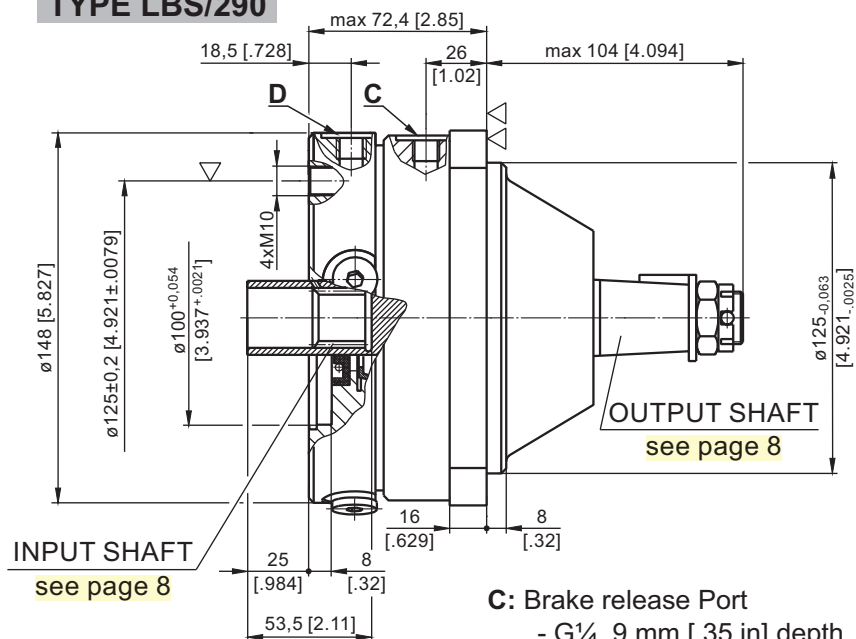
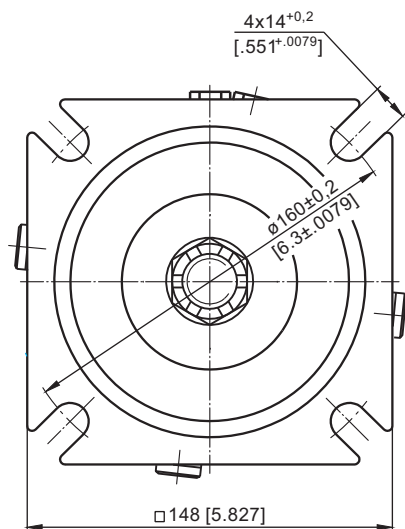
T: Drain plug for the Motor - G $\frac{1}{4}$, 9 mm [.35 in] depth

TYPE LBV/289



HYDRAULIC DISC BRAKE for FLANGE ATTACHMENT to MSS and MSV HYDRAULIC MOTORS

TYPE LBS/290



▽ - Place for attachment

LBS - tightening torque for screw M10x35 - 12.9 DIN 912 - 6,5⁺⁵ daNm [575⁺⁴⁴ lb-in]

LBV - tightening torque for screw M10xL - 12.9 DIN 931 - 6,5⁺⁵ daNm [575⁺⁴⁴ lb-in]

▽▽ - Place for attachment

C: Brake release Port

- G $\frac{1}{4}$, 9 mm [.35 in] depth

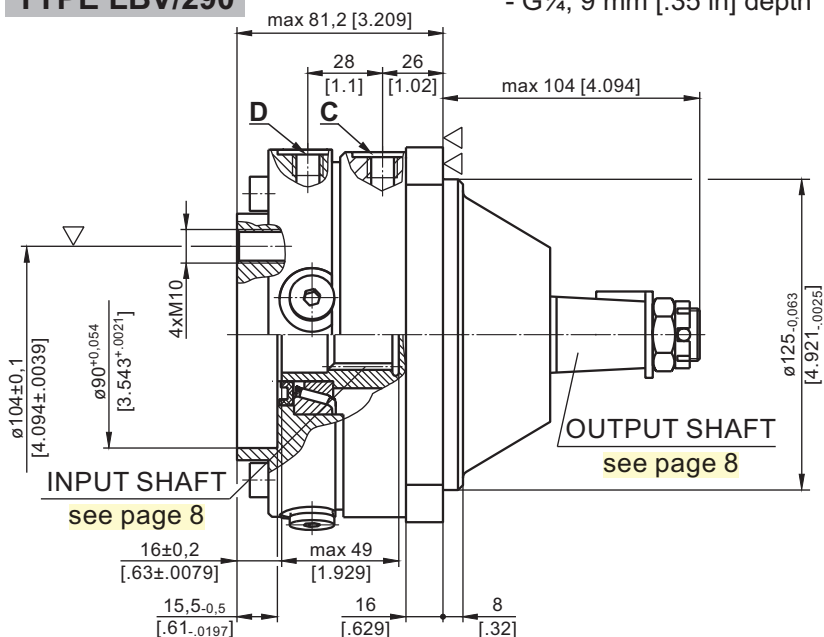
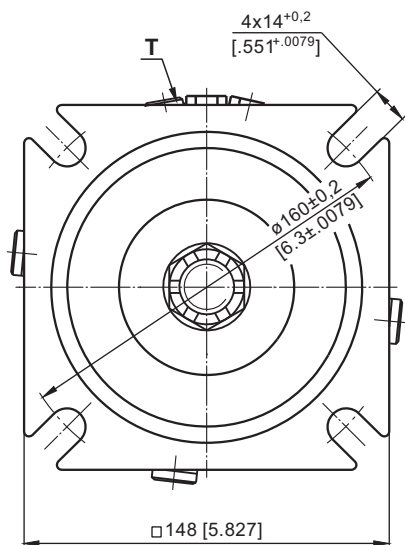
D: Drain plug for the Brake

- G $\frac{1}{4}$, 9 mm [.35 in] depth

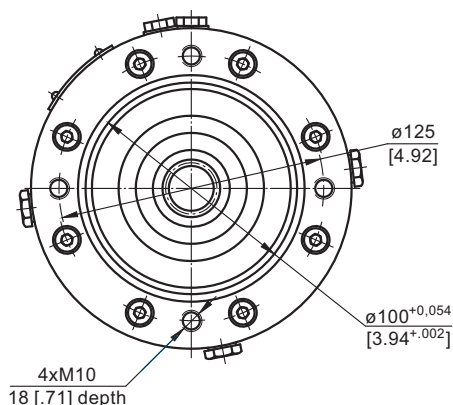
T: Drain plug for the Motor

- G $\frac{1}{4}$, 9 mm [.35 in] depth

TYPE LBV/290



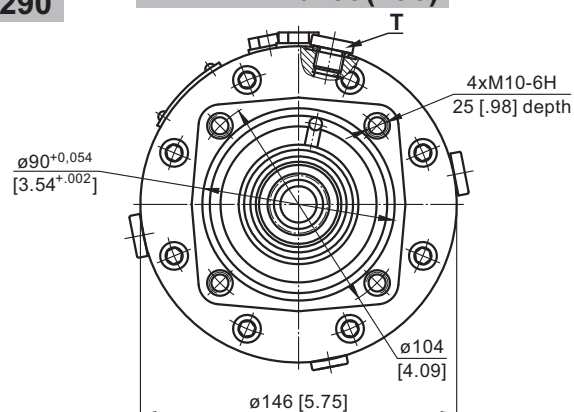
TYPE LBS/289(290)



INPUT FACE For Versions 289 and 290



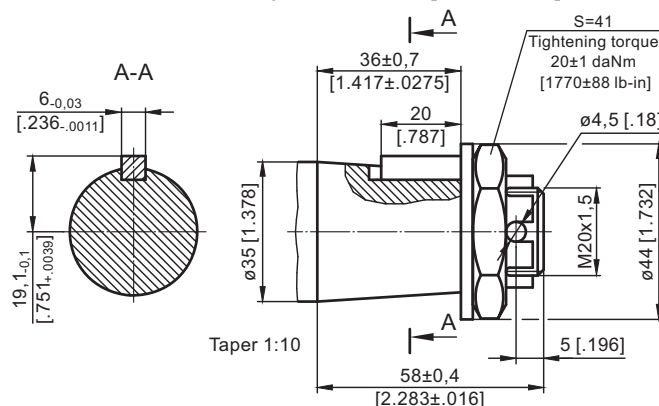
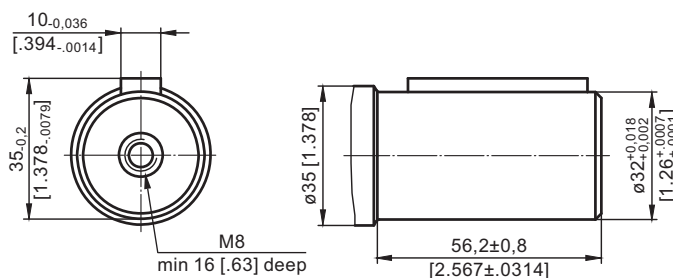
TYPE LBV/289(290)



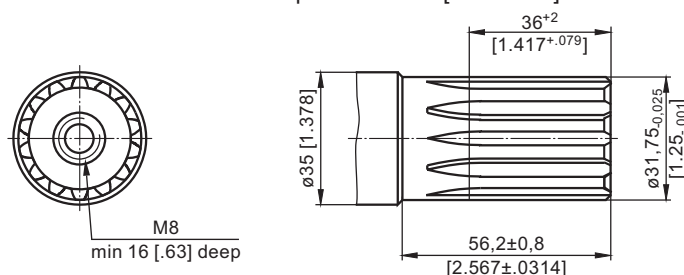
OUTPUT SHAFT EXTENSIONS

CB - $\phi 32$ straight, Parallel key A10x8x45 DIN 6885
Max. Torque 77 daNm [6815 lb-in]

KB - tapered 1:10, Parallel key B6x6x20 DIN 6885
Max. Torque 95 daNm [8400 lb-in]



SH - $\phi 1\frac{1}{4}$ " splined 14T, DP12/24 ANS B92.1-1970
Max. Torque 95 daNm [8400 lb-in]



SPECIFICATION DATA

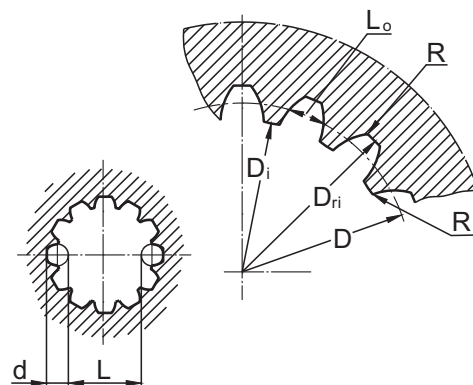
Description LBS/289(290) LBV/289(290)	21	32	43	63	L43	L63
*Min. Static Torque, daNm [lb-in]	20-22 [1770-1947]	31-34 [2743-3009]	41-45 [3628-3982]	61-64 [5399-5665]	41-45 [3628-3982]	61-64 [5399-5665]
Opening Pressure, min bar [PSI]	12-13 [174-188]	18-20 [260-290]	24-26 [348-377]	37-39 [540-565]	20-22 [290-320]	21-23 [305-333]
max	300 [4350]					
Min. oil quantity for brake releasing cm ³ [in ³]	7 - 8 [.427 - .488]					
Oil volume cm ³ [in ³]	50 - 120 [3.05 - 7.35]					
Max. Pressure in drain space bar [PSI]	5 [72]					
Weight kg [lb]	9 [19.8]					

* Static torque is obtained at working pressure - 0 bar [0 PSI].

INTERNAL SPLINE DATA for the ATTACHED COMPONENT

Fillet Root Side Fit		LBS(V)/289 LBS(V)/290		LBS(V)/314 LBS(V)/315	
		mm	inch	mm	inch
Number of Teeth	z	12	12	16	16
Diametral Pitch	DP	12/24	12/24	12/24	12/24
Pressure Angle		30°	30°	30°	30°
Pitch Dia.	D	25,4	1	33,8656	1.3333
Major Dia.	D _{ri}	28,0 _{-0,1}	1.1 ± 1.098	38,4 ^{+0,4}	1.5118 ± 1.5275
Minor Dia.	D _i	23,0 ^{+0,033}	.907 ± .905	32,15 ^{+0,06}	1.2657 ± 1.2673
Space Width [Circular]	L _o	4,308±0,020	.1704 ± .1688	4,516±0,037	.1763 ± .1791
Fillet Radius	R	0,2	.008	0,5	.02
Max. Measurement between Pins	L	17,62 ^{+0,15}	.699 ± .694	26,9 ^{+0,10}	1.063 ± 1.059
Pin Dia.	d	4,835±0,001	.19039 ± .190314	4,835±0,001	.19026 ± .19034
Corrected	x.m	+0,8	+0.031	+1,0	+0.039

Standard ANS B92.1-1970, class 5
[m=2.1166]

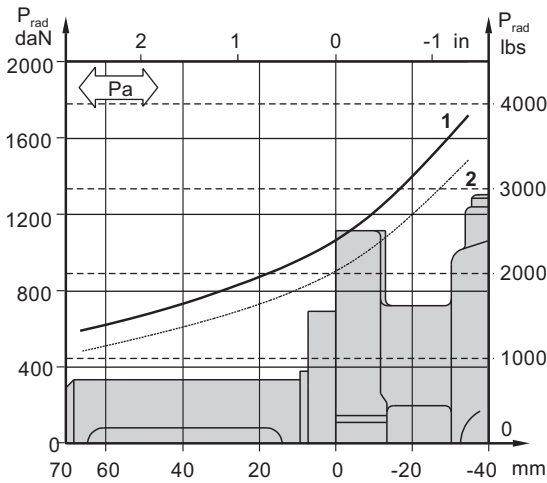


LOAD CURVE

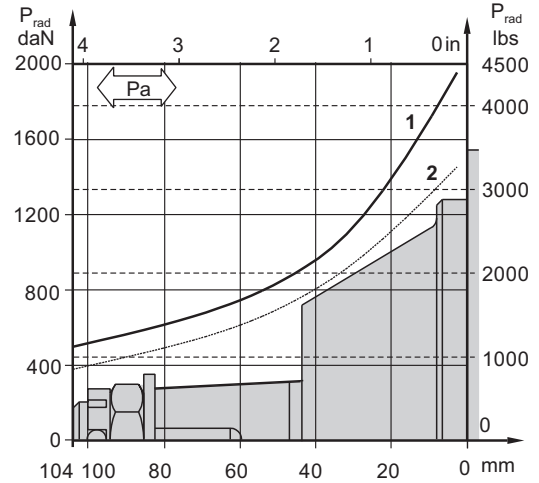
The curve applies to a B10 bearing life of 3000 hours at 200 RPM

- 1: $P_a < 350 \text{ daN}$ [787 lbs]
 2: $P_a = 500 \text{ daN}$ [1125 lbs]

LBS(V)/289



LBS(V)/290



ORDER CODE - LB/288

1	2	3	4	5
LB/288	-			

Pos.1 - Input Shaft Hole

C, CO, SH, CB, SB

Pos.2 - Static Torque code (See Specification data)

7, 14, 21, 32, 43, 63

Pos.3 - Output Shaft Extensions**

- C** - $\varnothing 25$ straight, Parallel key A8x7x32 DIN6885
CO - $\varnothing 1$ " straight, Parallel key $\frac{1}{4} \times \frac{1}{4} \times \frac{1}{4}$ " BS46
SH - $\varnothing 25,32$ splined BS 2059 (SAE 6B)
SA - $\varnothing 24,5$ splined B25x22 DIN 5482

CB - $\varnothing 32$ straight, Parallel key A10x8x45 DIN6885

KB - $\varnothing 35$ tapered 1:10, Parallel key B6x6x20 DIN6885

Pos.4 - Option (Paint)***

omit - no Paint

P - Painted

PC - Corrosion Protected Paint

Pos.5 - Design Series

omit - Factory specified

ORDER CODE - LBS, LBV

1	2	3	4	5	6
LB	/	-			

Pos.1 - Type

- S** - Disc Brake for short motor S - MSS
V - Disc Brake for very short motor V - MSV

Pos.2 - Design code

- 289** - for MSS and MSV motors
290 - for MSS and MSV motors (Wheel Mount)

Pos.3 - Static Torque code (See Specification data)

21, 32, 43, 63, L43, L63

Pos.4 - Output Shaft Extensions*

- CB** - $\varnothing 32$ straight, Parallel key A10x8x45 DIN6885
KB - $\varnothing 35$ tapered 1:10, Parallel key A6x6x20 DIN6885
SH - $\varnothing 1\frac{1}{4}$ " splined 14T ANS B92.1-1970

Pos.5 - Option (Paint)**

omit - no Paint

P - Painted

PC - Corrosion Protected Paint

Pos.6 - Design Series

omit - Factory specified

NOTES:

- * The permissible output torque for shafts must not be exceeded!
 For Max. Torque values see data on pages 5 and 8.
 ** The color is by customer's request.

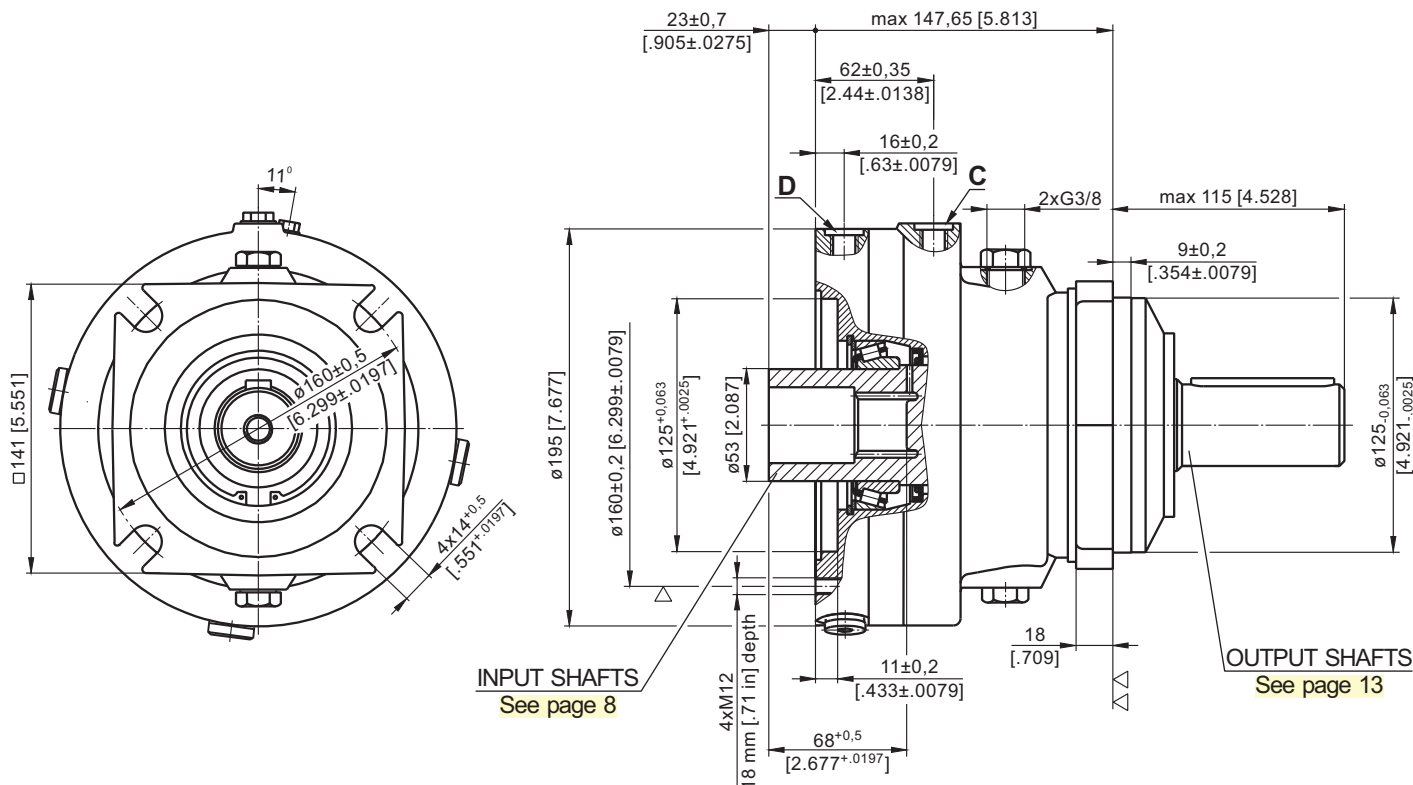
The Disc Brakes are mangano-phosphatized as standard.

ATTENTION:

- Hydraulic brake is delivered without oil (it is lubricated only).
- Hydraulic brake is filled through the drain port **D**. Space is filled with $50 \div 120 \text{ cm}^3$ [$3.05 \div 7.32 \text{ in}^3$] mineral oil HLP (DIN 51524) or HM (ISO 6743/4). For LB/288 fill oil after hydraulic motor assembly.
- In all brakes, friction discs and separators should be lubricated.

HYDRAULIC DISC BRAKES for FLANGE ATTACHMENT to MTS and MTV HYDRAULIC MOTORS

TYPE LBS/314

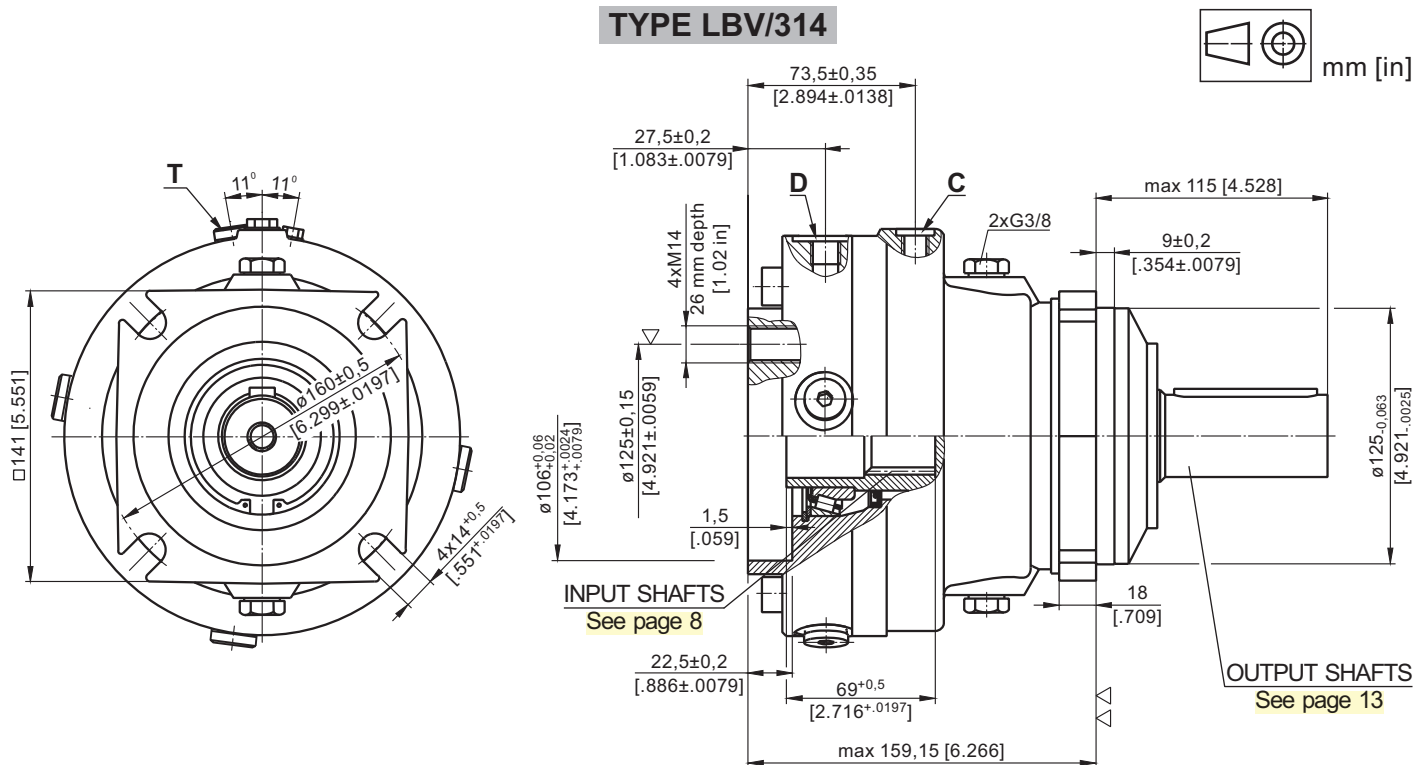


▽ - Place for attachment
(tightening torque for screw M12x30 - 12.9 DIN 912,
10^{+0.5} daNm [885⁺⁴⁴ lb-in])

▽▽ - Place for attachment

C: Brake release Port - G¹/₄, 12 mm [.47 in] depth
D: Drain tap - G¹/₄, 12 mm [.47 in] depth

TYPE LBV/314



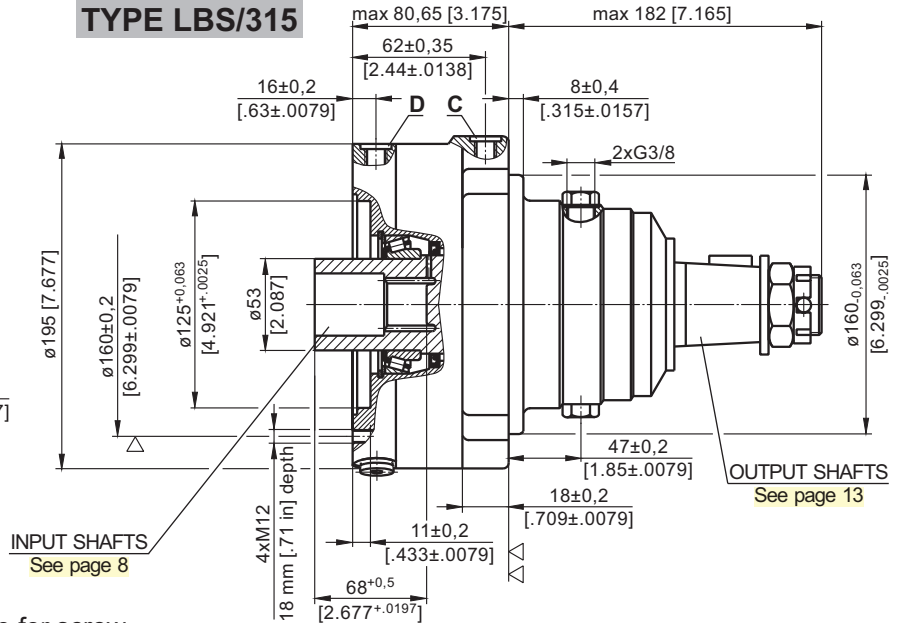
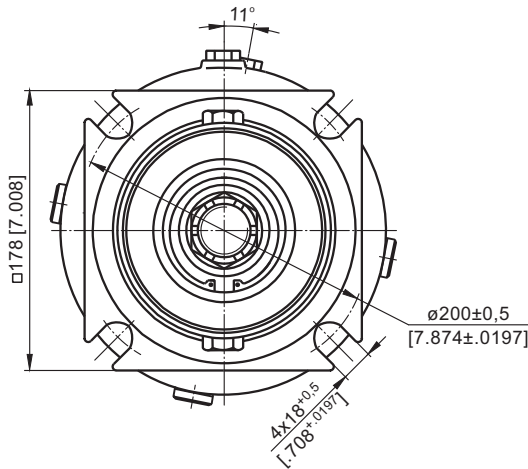
▽ - Place for attachment
(tightening torque for screw M14xL - 12.9 DIN 912,
13^{+0.5} daNm [1150⁺⁴⁴ lb-in])

▽▽ - Place for attachment

C: Brake release Port - G¹/₄, 9 mm [.35 in] depth
D: Drain plug for the Brake - G¹/₄, 9 mm [.35 in] depth
T: Drain plug for the Motor - G¹/₄, 9 mm [.35 in] depth

HYDRAULIC DISC BRAKES for FLANGE ATTACHMENT to MTS and MTV HYDRAULIC MOTORS

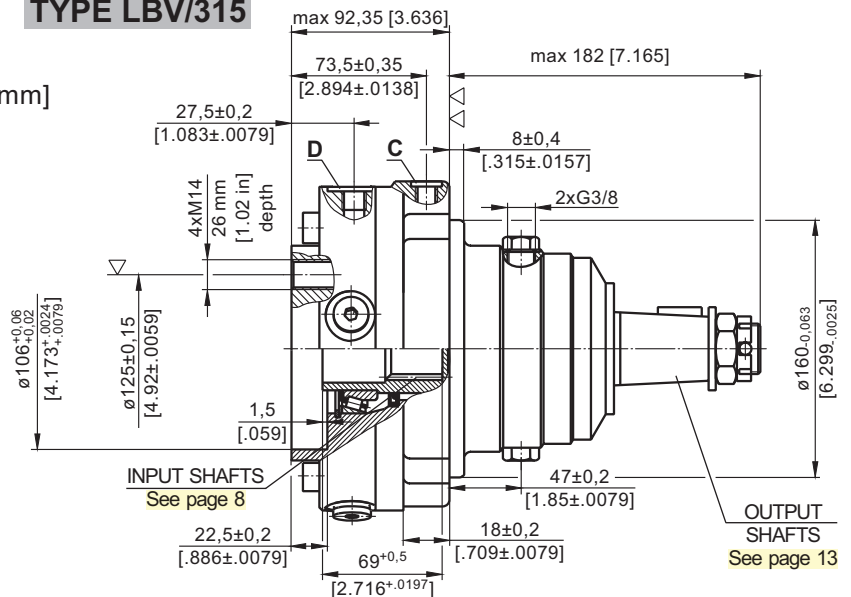
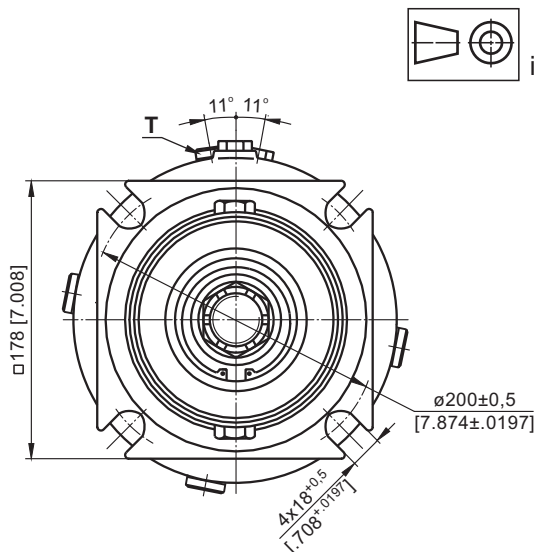
TYPE LBS/315



- ▽ - Place for attachment (tightening torque for screw M12x30 - 12.9 DIN 912, 10^{+0.5} daNm [885⁺⁴⁴ lb-in])
- ▽▽ - Place for attachment

- C: Brake release Port - G¹/₄, 12 mm [0.47 in] depth
- D: Drainage tap - G¹/₄, 12 mm [0.47 in] depth

TYPE LBV/315



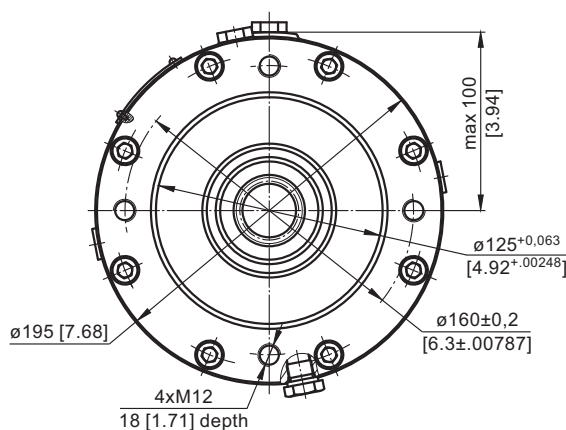
- ▽ - Place for attachment (tightening torque for screw M14xL - 12.9 DIN 912, 13^{+0.5} daNm [1150⁺⁴⁴ lb-in])
- ▽▽ - Place for attachment

- C: Brake release Port - G¹/₄, 9 mm [0.35 in] depth
- D: Drain plug for the Brake - G¹/₄, 9 mm [0.35 in] depth
- T: Drain plug for the Motor - G¹/₄, 9 mm [0.35 in] depth

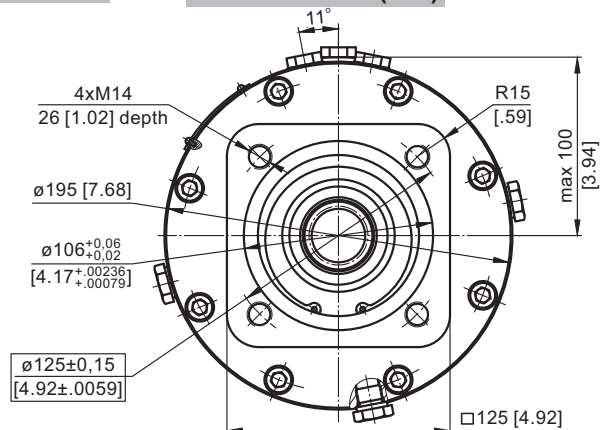
INPUT FACE

For Versions 314 and 315

TYPE LBS/314 (315)



TYPE LBV/314 (315)



SPECIFICATION DATA

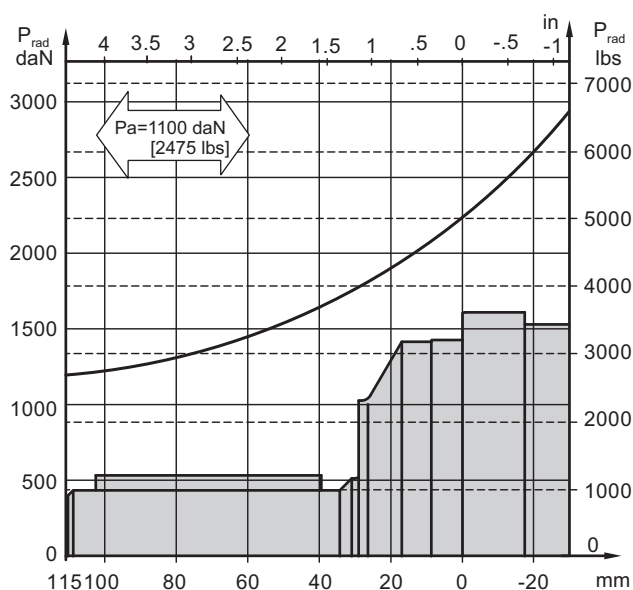
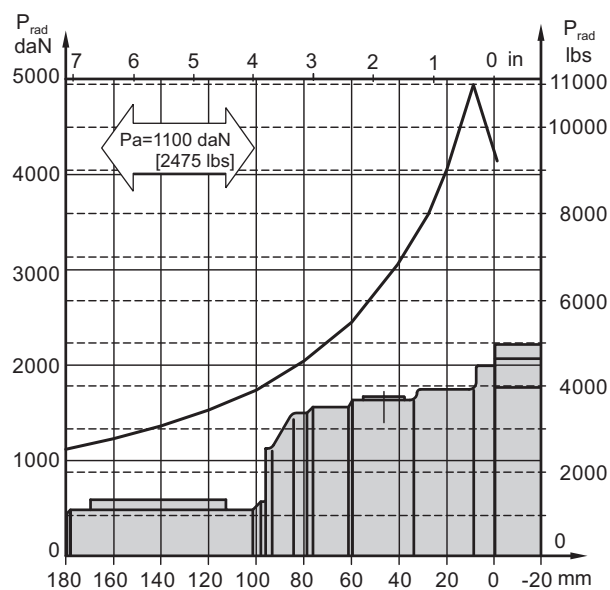
Description LBS/314,315		21	29	43	65	85	110	130
*Min. Static Torque, daNm [lb-in]		18-23 [1593-2036]	28-33 [2478-2921]	42-46 [3717-4071]	61-70 [5399-6196]	83-92 [7346-8143]	108-118 [9559-10444]	126-136 [11152-12037]
Opening Pressure, bar [PSI]	min**	4-5 [58-72]	6-7 [87-101]	9-10 [130-145]	13-15 [188-217]	18-20 [261-290]	23-25 [333-362]	27-29 [391-420]
	max	300 [4350]						
Min. oil quantity for brake releasing, cm ³ [in ³]		8-9 [.488-.549]						
Oil volume, cm ³ [in ³]		250						
Max. Pressure in drain space, bar [PSI]		5 [72]						
Weight for .../314 .../315 kg [lb]		24 [52.9]						
		25 [55.1]						

* Static torque is obtained at working pressure - 0 bar.

** The indicated value is a difference between the inlet pressure for driving of the brake and the drain pressure.
Brakes must always have a drain line.

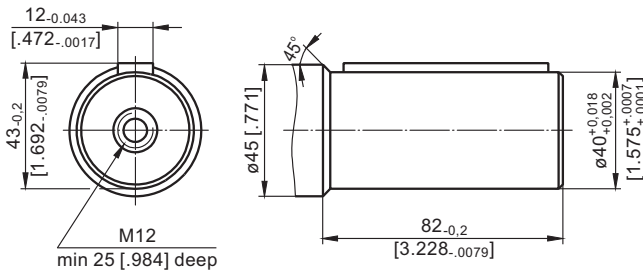
LOAD CURVE

The output shaft runs in tapered bearings that permit high axial and radial forces. The permissible radial load on the shaft is shown for an axial load of 0 N as function of the distance from the mounting flange to the point of load application. The curves apply to a B10 bearing life of 2000 hours at 100 RPM.

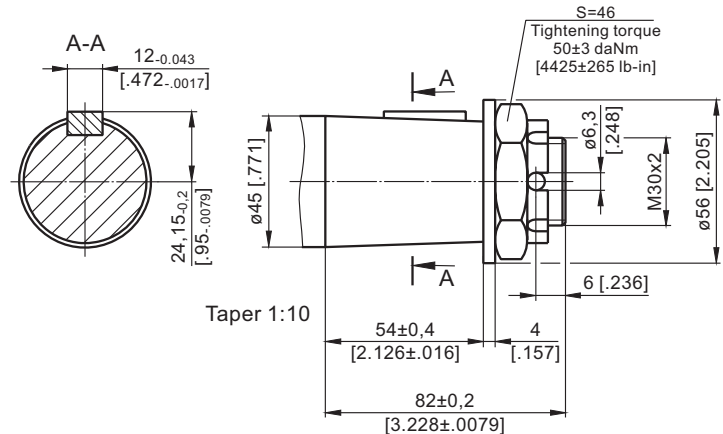
LBS(V) ... /314

LBS(V) ... /315


OUTPUT SHAFT EXTENSIONS

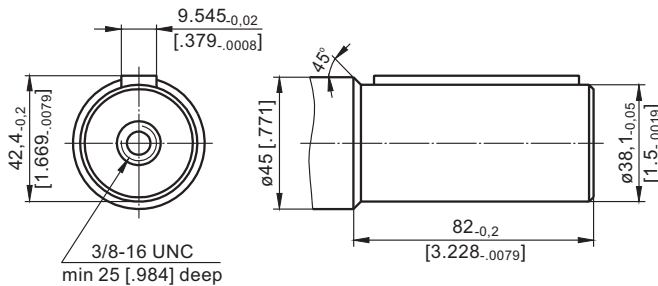
C - $\varnothing 40$ straight, Parallel key A12x8x70 DIN 6885
Max. Torque 132,8 daNm [11755 lb-in]



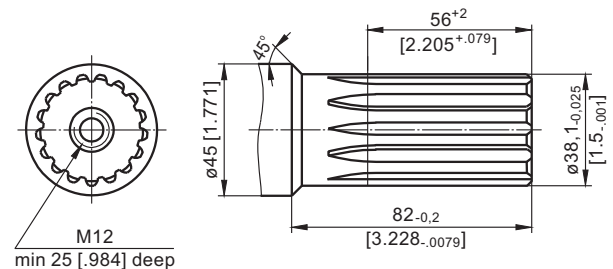
K - tapered 1:10, Parallel key B12x8x28 DIN 6885
Max. Torque 210,7 daNm [18650 lb-in]



CO - $\varnothing 1\frac{1}{2}$ " straight, Parallel key $\frac{3}{8}$ "x $\frac{3}{8}$ "x $2\frac{1}{4}$ " BS46
Max. Torque 132,8 daNm [11755 lb-in]



SH - $\varnothing 1\frac{1}{2}$ " splined 17T, DP 12/24 ANSI B92.1-1976
Max. Torque 132,8 daNm [11755 lb-in]



ORDER CODE

1	2	3	4	5	6
LB	/	-			

Pos.1 - Type

- S** - Disc Brake for short motor **S** - MTS
V - Disc Brake for very short motor **V** - MTV

Pos.2 - Design code

- 314** - for MTS and MTV motors
315 - for MTS and MTV motors (Wheel Mount)

Pos.3 - Static Torque code (see Specification data)

21, 29, 43, 65, 85, 110, 130

Pos.4 - Output Shaft Extensions*

- C** - $\varnothing 40$ straight, Parallel key A12x8x70 DIN6885
CO - $\varnothing 1\frac{1}{2}$ " straight, Parallel key $\frac{3}{8}$ "x $\frac{3}{8}$ "x $2\frac{1}{4}$ " BS46
SH - $\varnothing 1\frac{1}{2}$ " splined 17T, ANSI B 92.1-1976
K - $\varnothing 45$ tapered 1:10, Parallel key B12x8x28 DIN6885

Pos.5 - Option (Paint)**

- omit - no Paint
P - Painted
PC - Corrosion Protected Paint

Pos.6 - Design Series

- omit - Factory specified

NOTES:

- * The permissible output torque for shafts must not be exceeded!
** The color is by customer's request.

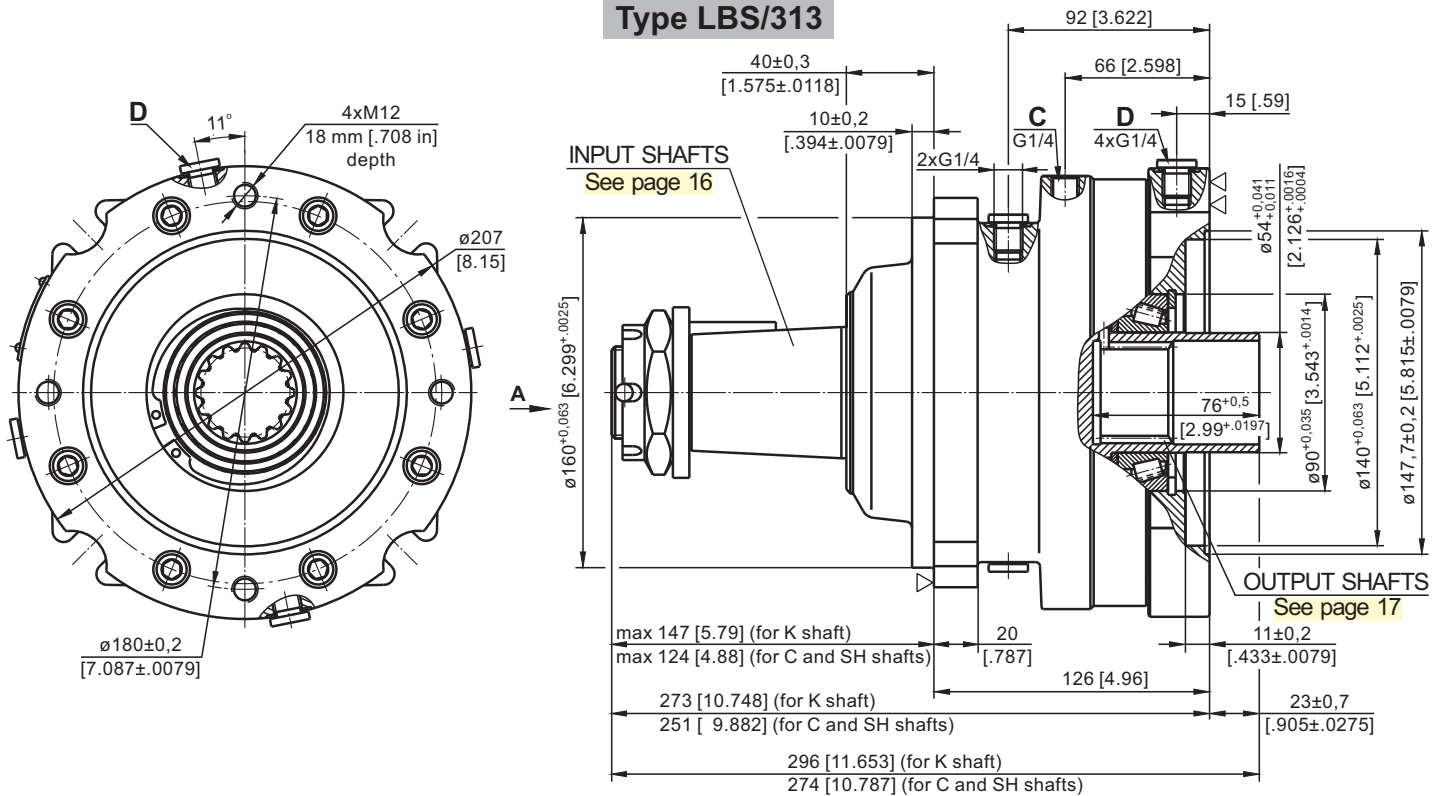
The Disc Brakes are mangano-phosphatized as standard.

ATTENTION:

- Hydraulic brake is delivered without oil (it is lubricated only).
- Fill the brake through the drain port **D** with 50 ÷ 120 cm³ [3.05 ÷ 7.32 in³] mineral oil HLP (DIN 51524) or HM (ISO 6743/4). LB/288 must be filled after the motor is assembled on the brake.
- In all brakes, friction discs and separators should be lubricated.

HYDRAULIC DISC BRAKES for FLANGE ATTACHMENT to MVS HYDRAULIC MOTORS

Type LBS/313



C: Brake release Port - G $\frac{1}{4}$, 12 mm [.47 in] depth

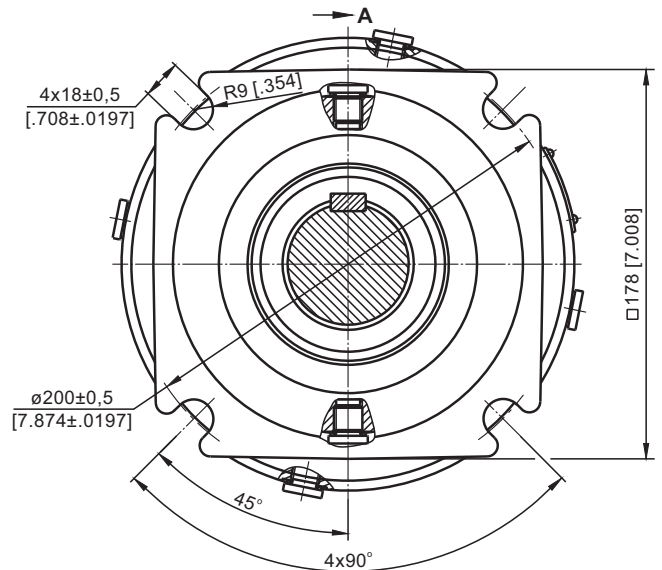
D: Drainage tap - G $\frac{1}{4}$, 12 mm [.47 in] depth

▽ - Place for attachment

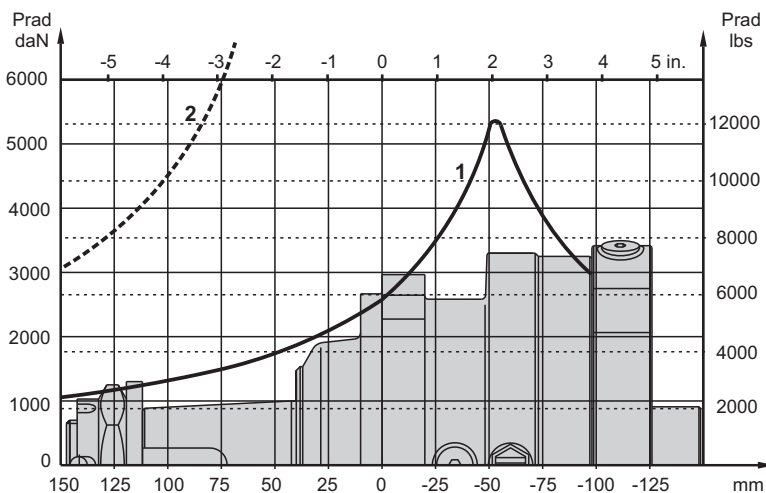
▽▽ - Place for attachment
(tightening torque for screw M12x35 - 12.9 DIN 912,
10^{+0,5} daNm [885⁺⁴⁴ lb-in])



mm [in]



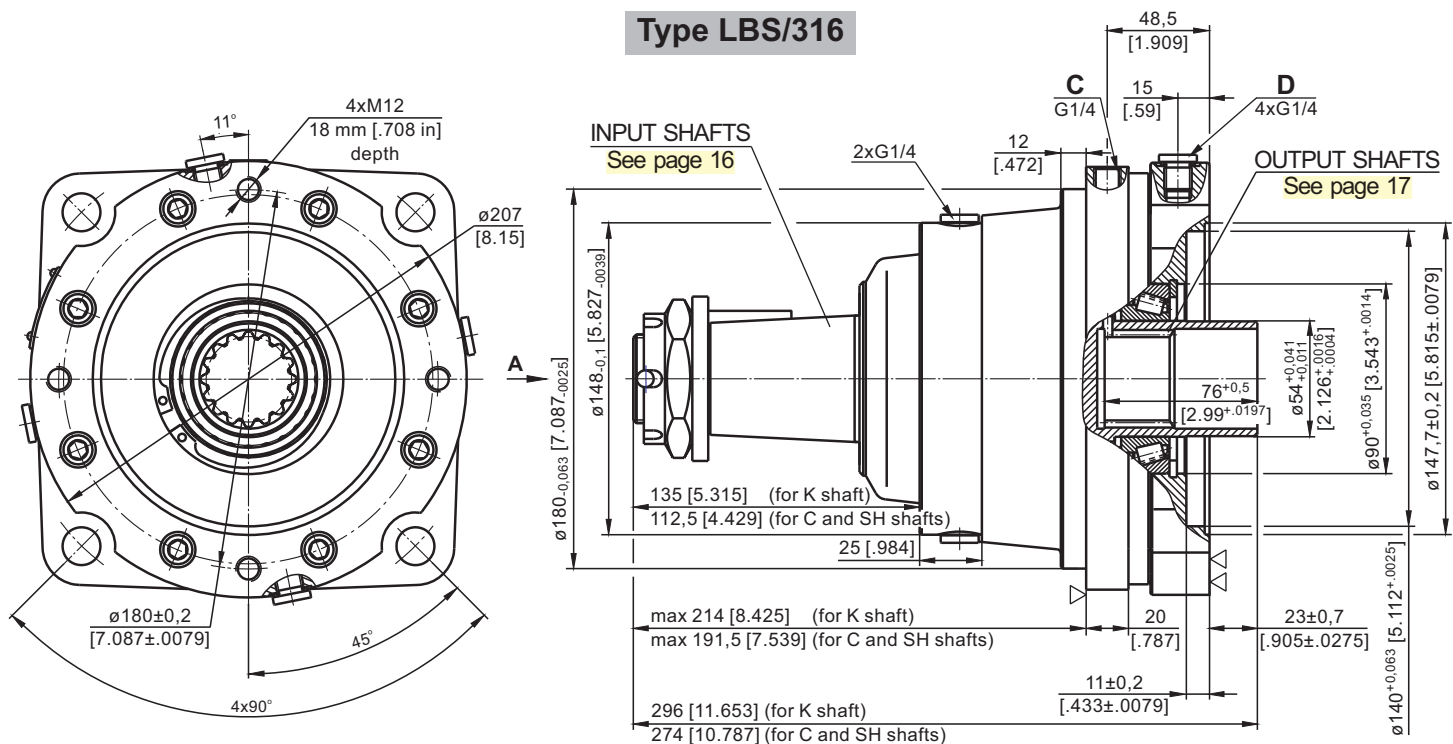
PERMISSIBLE SHAFT LOADS



- 1 - Bearing curve:** The curve applies to a B10 bearing life of 3000 hours at 200 RPM.
- 2 - Shaft curve:** The curve represents Max. permissible radial shaft load with safety factor 3:1.

HYDRAULIC DISC BRAKES for FLANGE ATTACHMENT to MVS HYDRAULIC MOTORS

Type LBS/316

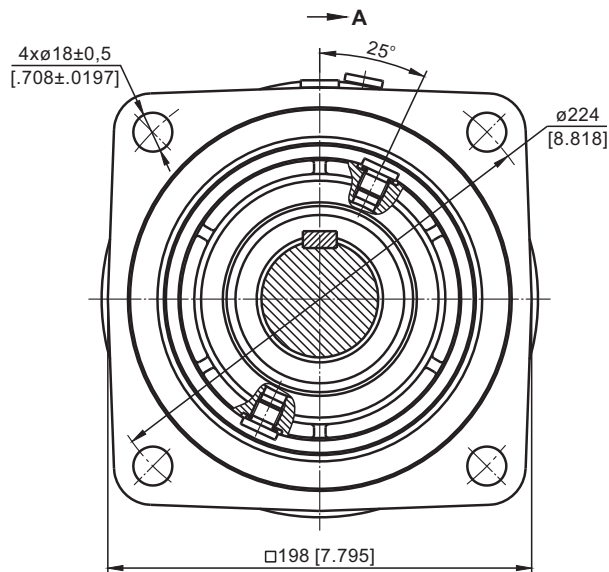


C: Brake release Port - G $\frac{1}{4}$, 12 mm [.47 in] depth

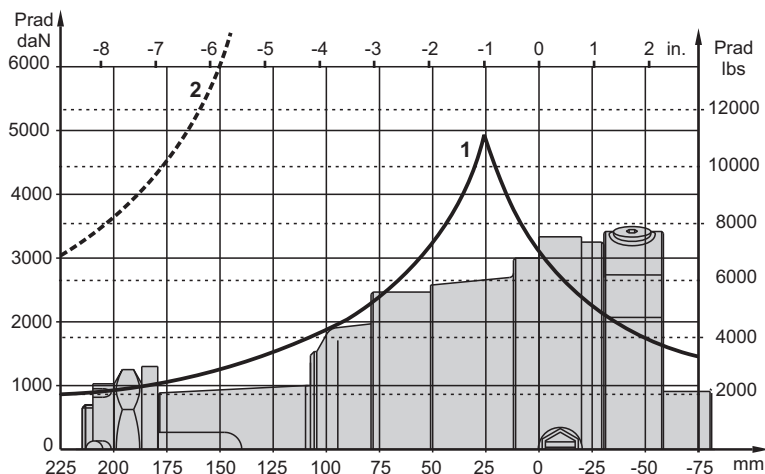
D: Drainage tap - G $\frac{1}{4}$, 12 mm [.47 in] depth

▽ - Place for attachment

▽▽ - Place for attachment
(tightening torque for screw M12x35 - 12.9 DIN 912,
10^{+0.5} daNm [885⁺⁴⁴ lb-in])



PERMISSIBLE SHAFT LOADS



- 1 - Bearing curve: The curve applies to a B10 bearing life of 3000 hours at 200 RPM.
- 2 - Shaft curve: The curve represents Max. permissible radial shaft load with safety factor 3:1.

SPECIFICATION DATA

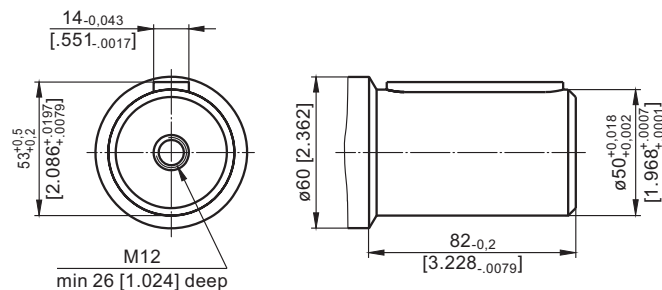
Description LBS/313,316	21	29	43	65	85	110	130
*Min. Static Torque, daNm [lb-in]	18-23 [1593-2036]	28-33 [2478-2921]	42-47 [3717-4160]	61-71 [5399-6285]	83-94 [7346-8320]	108-118 [9559-10444]	127-137 [11240-12125]
Opening Pressure, bar min** [PSI] max	4-5 [58-72]	6-7 [87-101]	9-10 [130-145]	13-15 [188-217]	18-20 [261-290]	23-25 [333-362]	27-29 [391-420]
Min. oil quantity for brake releasing, cm ³ [in ³]	8 ÷ 9 [488 ÷ .549]						
Oil volume, cm ³ [in ³]	250 [15.25]						
Max. Pressure in drain space, bar [PSI]	5 [72]						
Weight for .../313 kg [lb]	25 [55.1]						
.../316	26 [57.3]						

* Static torque is obtained at working pressure - 0 bar.

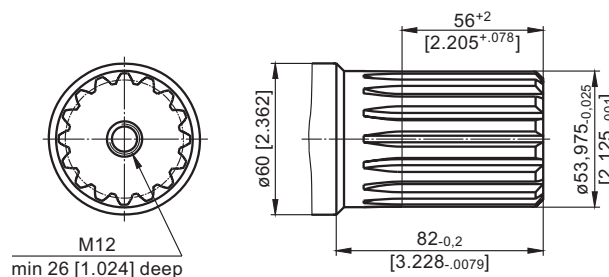
** The indicated value is a difference between the inlet pressure for driving of the brake and the drain pressure. Brakes must always have a drain line.

SHAFT EXTENSIONS

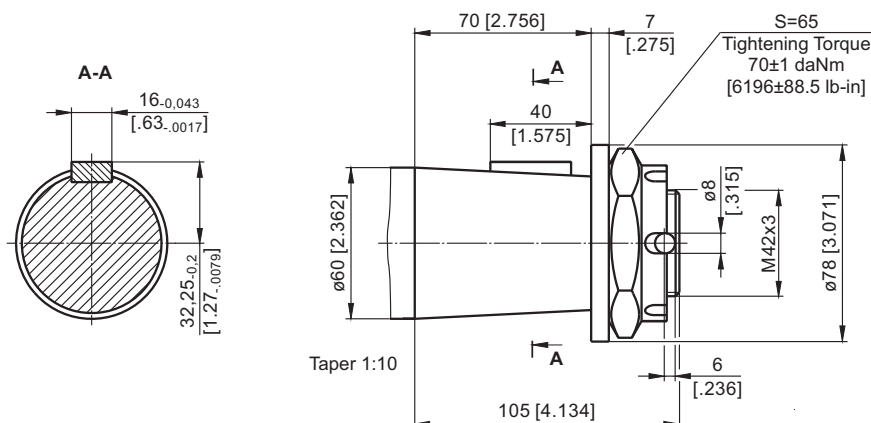
C - ø50 straight, Parallel key A14x9x70 DIN 6885
Max. Torque 271,2 daNm [24000 lb-in]



SH - ø2 1/8" splined, 16 DP 8/16 ANS B92.1-1976
Max. Torque 271,2 daNm [24000 lb-in]



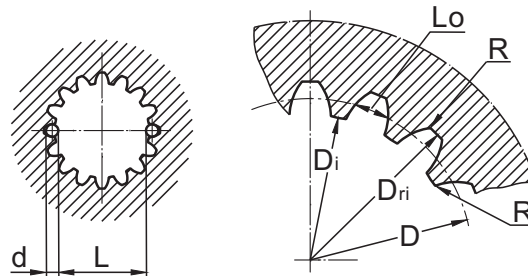
K - tapered 1:10, Parallel key B16x10x32 DIN 6885
Max. Torque 271,2 daNm [24000 lb-in]



INTERNAL SPLINE DATA for the ATTACHED COMPONENT

Standard ANS B92.1-1970, class 5
[$m=2.54$; corrected $x.m=+1,0$]

Fillet Root Side Fit		mm	inch
Number of Teeth	z	16	16
Diametral Pitch	DP	10/20	10/20
Pressure Angle		30°	30°
Pitch Dia.	D	40,640	1.6
Major Dia.	D _{ri}	45,2 ^{+0,4}	1.796 ^{+1.780}
Minor Dia.	D _i	38,5 ^{+0,039}	1.5175 ^{+1.516}
Space Width [Circular]	Lo	5,18 $\pm$ 0,037	.2055 $\div$.2025
Fillet Radius	R	0,4	.015
Max. Measurement between Pins	L	32,47 ^{+0,15}	1.284 ^{+1.278}
Pin Dia.	d	5,6 $\pm$ 0,001	.22051 $\div$.22043



Hardening Specification:
HV=750 $\pm$ 50 on the surface.
HV=560 at 0,7 $\pm$ 0,2 mm [.035 $\pm$.019in] case depth
Material: 20 MoCr4 EN 10084 or better.

ORDER CODE

	1	2	3	4	5
LBS /		-			

Pos.1 - Design code

313 - for MVS motors

316 - for MVS motors (wheel mount)

Pos.2 - Static Torque code (see Specification data)

21, 29, 43, 65, 85, 110, 130

Pos.3 - Output Shaft Extensions*

C - $\varnothing 50$ straight, Parallel key A14x9x70 DIN6885

SH - $\varnothing 2\frac{1}{8}$ " splined, ANSI B 92.1-1976

K - $\varnothing 60$ tapered 1:10, Parallel key B16x10x32 DIN6885

Pos.4 - Option (Paint)**

omit - no Paint

P - Painted

PC - Corrosion Protected Paint

Pos.5 - Design Series

omit - Factory specified

NOTES:

* The permissible output torque for shafts must be not exceeded!

** The color is by customer's request.

The Disc Brakes are mangano-phosphatized as standard.

ATTENTION:

1. Hydraulic brake is delivered without oil (it is lubricated only).
2. In all brakes, friction discs and separators should be lubricated. Space is filled with 150 $\div$ 300 cm³ [9.15 $\div$ 18.3 in³] mineral oil HLP (DIN 51524) or HM (ISO 6743/4).

MOTOR-BRAKE ADDITIONAL OPTIONS

Additional Options Description	Order Code	Motor type						
		B/MR	BD/MR	MT/B	MT/BX	MTM/B	SW	TW
Low Leakage	LL	O	O	-	O	O	-	-
Low Speed Valving	LSV	O	O	-	O	O	-	-
Free Running	FR	-	O	-	-	O		-
Reinforced unit	HD	-	-	O	-	O	-	-
Reverse Rotation	R	O	O	O	O	O	-	-
Paint*	P	O	O	O	O	O	O	O
Corrosion Protected Paint*	PC	O	O	O	O	O	O	O
Special Paint**	PS	O	O	O	O	O	O	O
	PCS							
Check Valves		S	-	S***	S	-	S	S

O	Optional
-	Not applicable
S	Standard

* Colour at customer's request.

** Non painted feeding surfaces, colour at customer's request.

*** Without check valves for "HD" option.

⚠ For more information about HD option please contact with "M+S Hydraulic".

APPLICATION CALCULATION

VEHICLE DRIVE CALCULATIONS

1. Motor speed: n [RPM]

$$n = \frac{2.65 \times V_{km} \times i}{R_m} \quad n = \frac{168 \times V_{mi} \times i}{R_{in}}$$

V_{km} - vehicle speed, km/h;

V_{mi} - vehicle speed, mil/h;

R_m - wheel rolling radius, m;

R_{in} - wheel rolling radius, in;

i - gear ratio between motor and wheels.

If no gearbox, use $i=1$.

2. Rolling resistance: RR , daN [lbs]

The resistance force resulted in wheels contact with different surfaces:

$$RR = G \times \rho$$

G - total weight loaded on vehicle, daN [lbs];

ρ - rolling resistance coefficient (Table 1).

Table 1

Rolling resistance coefficient In case of rubber tire rolling on different surfaces	
Surface	ρ
Concrete- faultless	0.010
Concrete- good	0.015
Concrete- bad	0.020
Asphalt- faultless	0.012
Asphalt- good	0.017
Asphalt- bad	0.022
Macadam- faultless	0.015
Macadam- good	0.022
Macadam- bad	0.037
Snow- 5 cm	0.025
Snow- 10 cm	0.037
Polluted covering- smooth	0.025
Polluted covering- sandy	0.040
Mud	0.037÷0.150
Sand- Gravel	0.060÷0.150
Sand- loose	0.160÷0.300

3. Grade resistance: GR , daN [lbs]

$$GR = G \times (\sin \alpha + \rho \times \cos \alpha)$$

α - gradient negotiation angle (Table 2).

Table 2

Grade %	α Degrees	Grade %	α Degrees
1%	0° 35'	12%	6° 5'
2%	1° 9'	15%	8° 31'
5%	2° 51'	20%	11° 19'
6%	3° 26'	25%	14° 3'
8%	4° 35'	32%	18°
10%	5° 43'	60%	31°

4. Acceleration force: FA , daN [lbs]

Force FA necessary for acceleration from 0 to maximum speed v and time t can be calculated with a formula:

$$FA = \frac{V_{km} \times G}{36 \times t}, [\text{daN}] \quad FA = \frac{V_{mi} \times G}{22 \times t}, [\text{lbs}]$$

FA - acceleration force, daN [lbs];

t - time, [s]

5. Tractive effort: DP , daN [lbs]

Tractive effort DP is the additional force of trailer. This value will be established as follows:

- acc. to constructor's assessment;

- as calculating forces in items 2, 3 and 4 of trailer;

the calculated sum corresponds to the tractive effort requested.

6. Total tractive effort: TE , daN [lbs]

Total tractive effort TE is total effort necessary for vehicle motion; that the sum of forces calculated in items from 2 to 5 and increased with 10% because of air resistance.

$$TE = 1,1 \times (RR + GR + FA + DP)$$

RR - force acquired to overcome the rolling resistance;

GR - force acquired to slope upwards;

FA - force acquired to accelerate (acceleration force);

DP - additional tractive effort (trailer).

7. Motor Torque moment: M , daNm [lb-in]

Necessary torque moment for every hydraulic motor:

$$M = \frac{TE \times R_m [R_{in}]}{N \times i \times \eta_m}$$

N - motor numbers;

η_m - mechanical gear efficiency (if it is available).

8. Cohesion between tire and road covering:

M_w , daNm [lb-in]

Necessary torque moment for every hydraulic motor:

$$M_w = \frac{G_w \times f \times R_m [R_{in}]}{i \times \eta_m}$$

To avoid wheel slipping, the following condition should be observed $M_w > M$

f - frictional factor;

G_w - total weight over the wheels, daN [lbs].

Table 3

Surface	Frictional factor f
Steel on steel	0.15 ÷ 0.20
Rubber tire on polluted surface	0.5 ÷ 0.7
Rubber tire on asphalt	0.8 ÷ 1.0
Rubber tire on concrete	0.8 ÷ 1.0
Rubber tire on grass	0.4

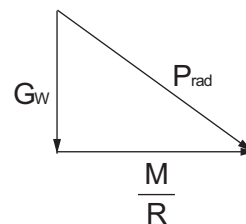
9. Radial motor loading: P_{rad} , daN [lbs]

When motor is used for vehicle motion with wheels mounted directly on motor shaft, the total radial loading of motor shaft P_{rad} is a sum of motion force and weight force acting on one wheel.

G_w - weight held by wheel;

P_{rad} - total radial loading of motor shaft;

M/R - motion force.



$$P_{rad} = \sqrt{G_w^2 + \left(\frac{M}{R}\right)^2}$$

In accordance with calculated loadings the suitable motor from the catalogue is selected.

DRAINAGE SPACE AND DRAINAGE PRESSURE

Advantages in oil drainage from drain space: Cleaning; Cooling and Seal lifetime prolonging.

