CASAPPA®
FLUID POWER DESIGN



HYDRAULIC GEAR PUMPS

FORMULA®

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Replaces: 01/08.2005

FEATURES

FORMULA designates a CASAPPA gear pump range specifically designed for applications requiring high pressure levels also at low speed; applications such as truck-mounted cranes, tripper trucks and lift-trucks etc. Special design features and an exclusive CASAPPA patent have perfected a sophisticated mechanism which makes FORMULA a highly reliable unit, proven by years of service in the specific field of use. The versatility offered by the range of Italian (triangular) European (ISO) and American (SAE) mounting flanges allows to the FORMULA pumps to be used in several applications.

DISPLACEMENTS

From 0.50 in^3/rev (8,26 cm^3/rev)
To 9.20 in^3/rev (150,79 cm^3/rev)

PRESSURE

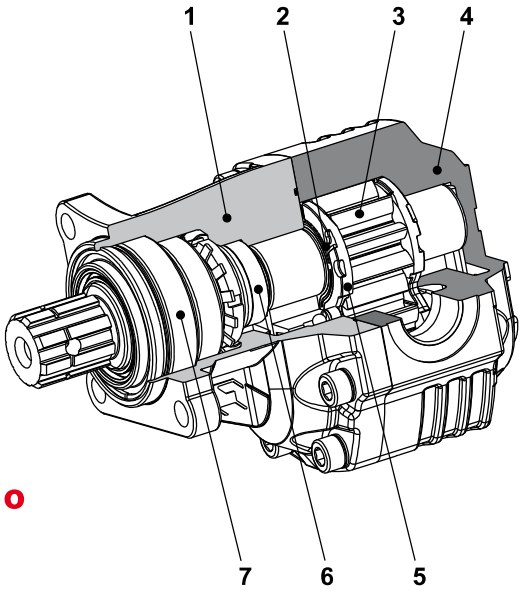
Max. continuous 4205 psi (290 bar)
Max. intermittent 4568 psi (315 bar)
Max. di peak 4713 psi (325 bar)

MAX. SPEED

Max. 3000 min^{-1}

- Two piece cast iron housing
- High performance at very low speed
- Ideal for truck applications

1	Mounting flange
2	Seals
3	Gear
4	Body
5	Thrust plates
6	Shaft
7	Outboard bearing



o 03/05.2013

o **Modification from former edition.**

FEATURES

WARNING !

Failure or improper use of the product can cause damage at the same product or system.

Make sure that this is the last issue.

Replaces: 02/07.2008

Construction	External gear type pumps
Mounting	ISO (ZF), ITALIAN (triangular) and SAE flanges
Line connections	Screw
Direction of rotation (looking at the drive shaft)	Anti-clock (S) - clockwise (D) - reversible (R or B)
Inlet pressure range for pumps	10 ÷ 44 psi - [0,7 ÷ +3 bar (abs.)]
Fluid temperature range	See table (1)
Fluid	Mineral oil based hydraulic fluids to ISO/DIN and fire resistant fluids [see table (1)]. For other fluids please consult our technical sales department.
Viscosity range	From 60 to 456 SSU [12 to 100 mm²/s (cSt)] recommended Up to 3410 SSU [750 mm2/s (cSt)] permitted
Filtering requirement	See table (2)
Antioxidant protection	Red paint IC105

Tab. 1

Type	Fluid composition	Max pressure psi - (bar)	Max speed min⁻¹	Temperature °F - (°C)			Seals (◆)
				Min	Max continuous	Max peak	
ISO/DIN	Mineral oil based hydraulic fluid to ISO/DIN	See page 5 - 6 - 7	See page 5 - 6 - 7	-13 (-25)	176 (80)	212 (100)	N
				-13 (-25)	230 (110)	257 (125)	V
HFA	Oil emulsion in water 5 ÷ 15% of oil	725 (50)	1500	36 (2)	131 (55)	_	N
HFB	Water emulsion in oil 40 % of water	1740 (120)	1500	36 (2)	140 (60)	_	N
HFC	Water - glycol	1450 (100)	1500	-4 (-20)	140 (60)	_	N Bz
HFD	Phosphate ester (●)	2175 (150)	1500	14 (-10)	176 (80)	_	V Bz

(◆) **N** = Buna N (standard) - **V**= Viton - **N Bz**= Buna N and Bronze thrust plates - **V Bz**=Viton and Bronze thrust plates.
(●) For skydrol phosphate esters please consult our technical sales department.

O 03/05.2013

Tab. 2 O

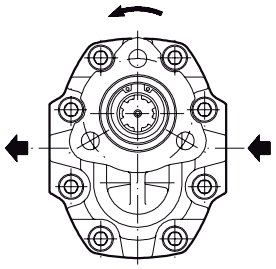
Working pressure psi (bar)	Δp<2030 (140)	2030<Δp<3045 (140) (210)	Δp>3045 (210)
Contamination class NAS 1638	10	9	8
Contamination class ISO 4406:1999	21/19/16	20/18/15	19/17/14
Achieved with filter $\beta_{10\,(c)} \geq 200$ according to ISO 16889	_	10 µm	10 µm
Achieved with filter $\beta_{25\,(c)} \geq 200$ according to ISO 16889	25 µm	_	_

Casappa recommends to use its own production filters:

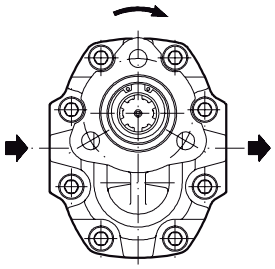
IKRON® Fluid Filtration

FEATURES

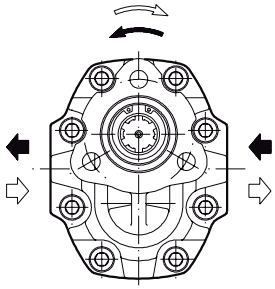
DEFINITION OF ROTATION DIRECTION LOOKING AT THE DRIVE SHAFT



ANT-CLOCK ROTATION

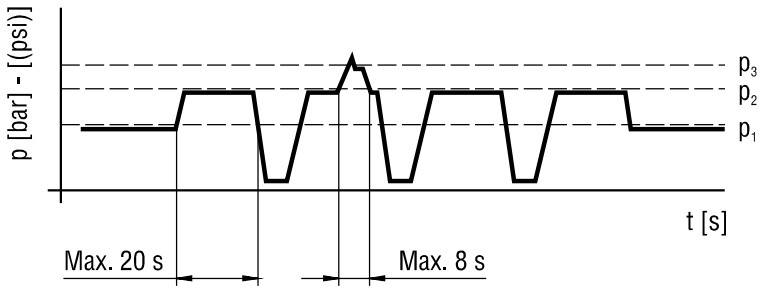


CLOCKWISE ROTATION



REVERSIBLE ROTATION

PRESSURE DEFINITION



p_1 Max. continuous pressure
p_2 Max. intermittent pressure
p_3 Max. peak pressure

GENERAL NOTES

01/08.2005

Available with different inlet and outlet ports. Standard pumps are equipped with BUNA N (N) seals, for particular operating conditions (V) VITON seals and BUNA or VITON seals with bronze thrust plates (N Bz), (V Bz) are available. If you use fire resistant fluids specify the type of them at the order.
For more information please consult our technical sales department.

FORMULA 40 GENERAL DATA PUMPS

FP 40

Pump type	Displacement	Max. pressure			Intermittent max. speed		Min. speed
		p_1	p_2	p_3	At p_2 press.	Without load	At p_2 press.
	in^3/rev (cm^3/rev)		psi (bar)			min^{-1}	
FP 40•63	3.75 (61,43)	4205 (290)	4568 (315)	4713 (325)	2700	4200	300
FP 40•73	4.43 (72,60)	4060 (280)	4350 (300)	4568 (315)	2700	4200	300
FP 40•87	5.28 (86,56)	3770 (260)	4060 (280)	4205 (290)	2700	4000	300
FP 40•109	6.64 (108,90)	3480 (240)	3770 (260)	4060 (280)	2700	4000	300
FP 40•133	8.18 (134,03)	3190 (220)	3625 (250)	3770 (260)	2500	4000	300
FP 40•151	9.20 (150,79)	2610 (180)	3045 (210)	3190 (220)	2500	4000	300

p_1= Max. continuous pressure p_2= Max. intermittent pressure p_3= Max. peak pressure

The values in the table refer to unidirectional pumps.
Reversible pump max pressures are 15% lower than those shown in table.
For different working conditions please consult our sales department.

T2 type double shaft flange allow the pumps to work in clockwise or anticlockwise rotation obtaining the reversible advantages and maintaining the general data of unidirectional pumps.

01/08.2005

DESIGN CALCULATIONS FOR PUMPS

Q	US gpm (l/min)		Flow
M	lbf in(Nm)		Torque
P	HP (kW)		Power
V	in^3/rev (cm^3/rev)		Displacement
n	min^{-1}		Speed
Δp	psi (bar)		Pressure
$\eta_v = \eta_v$ (V, Δp, n)		(≈ 0,98)	Volumetric efficiency
$\eta_{hm} = \eta_{hm}$ (V, Δp, n)		(≈ 0,90)	Mechanical efficiency
$\eta_t = \eta_v \bullet \eta_{hm}$		(≈ 0,88)	Overall efficiency

$$Q = Q_{theor.} \bullet \eta_v$$

$$Q_{theor.} = \frac{V\ (cm^3/rev) \bullet n\ (min^{-1})}{1000} \quad [l/min]$$

$$M = \frac{M_{teor.}}{\eta_{hm}}$$

$$M_{theor.} = \frac{\Delta p\ (bar) \bullet V\ (cm^3/rev)}{62{,}83} \quad [Nm]$$

$$P_{IN} = \frac{P_{OUT}}{\eta_t}$$

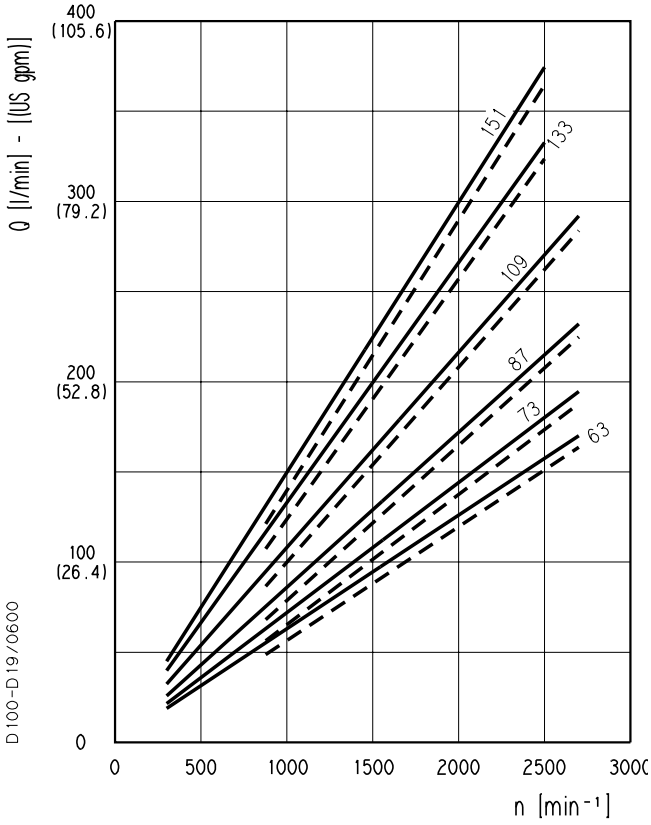
$$P_{OUT} = \frac{\Delta p\ (bar) \bullet Q\ (l/min)}{600} \quad [kW]$$

Note: Diagrams providing approximate selection data will be found on subsequent pages.

Replaces: 01/08.2005
03/05.2013

FORMULA 40 GEAR PUMPS PERFORMANCE CURVES FP 40

FP 40

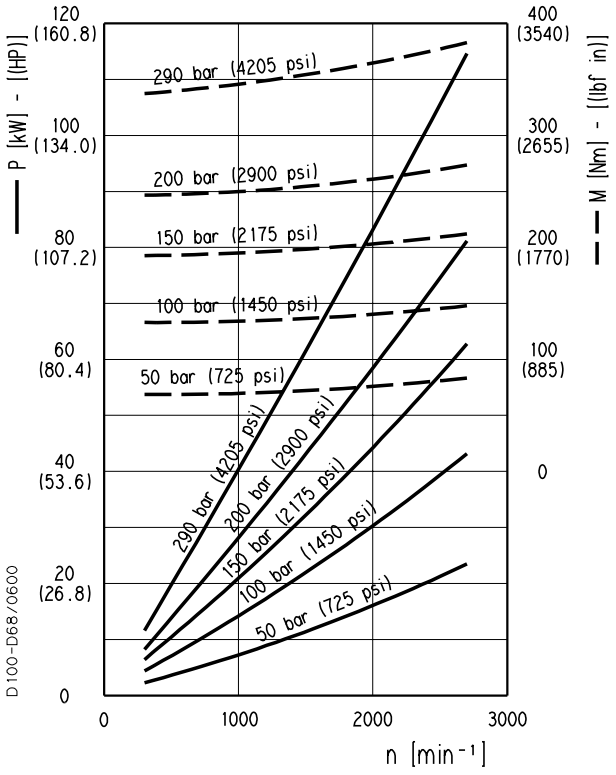


Each curve has been obtained at 122 °F (50°C), using oil with viscosity 168 SSU (36 cSt) at 104 °F (40°C) and at these pressures:

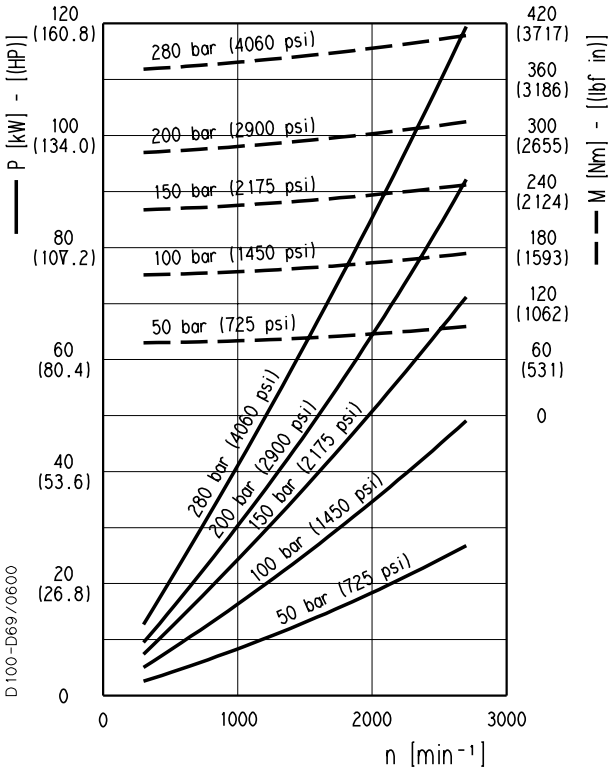
FP 40•63	290 psi (20 bar)
	4205 psi (290 bar)
FP 40•73	290 psi (20 bar)
	4060 psi (280 bar)
FP 40•87	290 psi (20 bar)
	3770 psi (260 bar)
FP 40•109	290 psi (20 bar)
	3480 psi (240 bar)
FP 40•133	290 psi (20 bar)
	3190 psi (220 bar)
FP 40•151	290 psi (20 bar)
	2610 psi (180 bar)

Replaces: 01/08.2005

FP 40•63



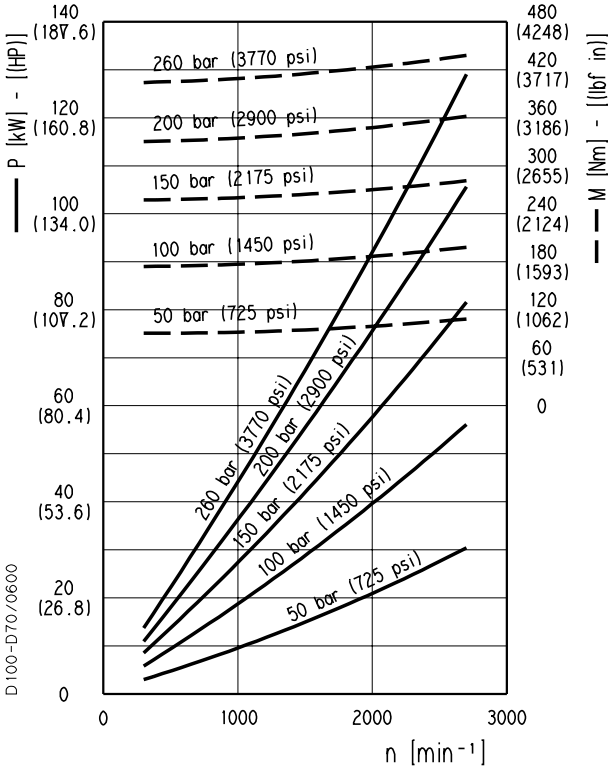
FP 40•73



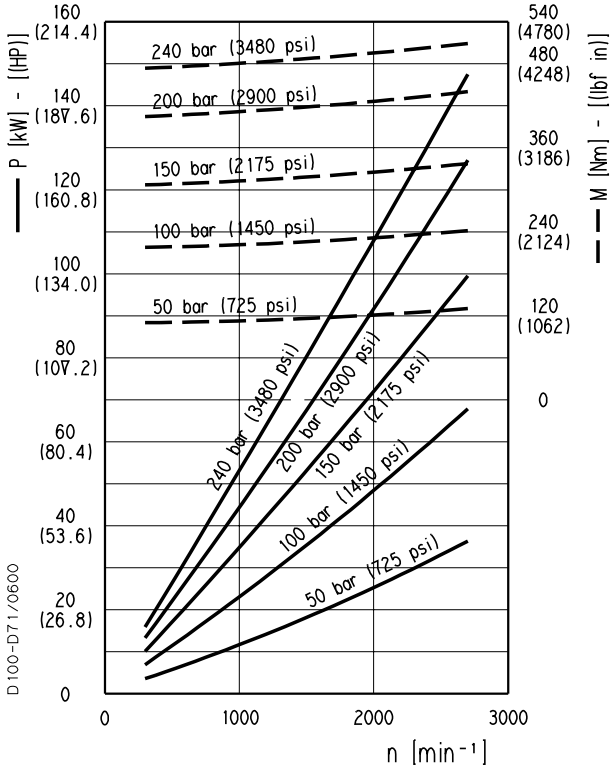
03/05.2013

FORMULA 40 GEAR PUMPS PERFORMANCE CURVES FP 40

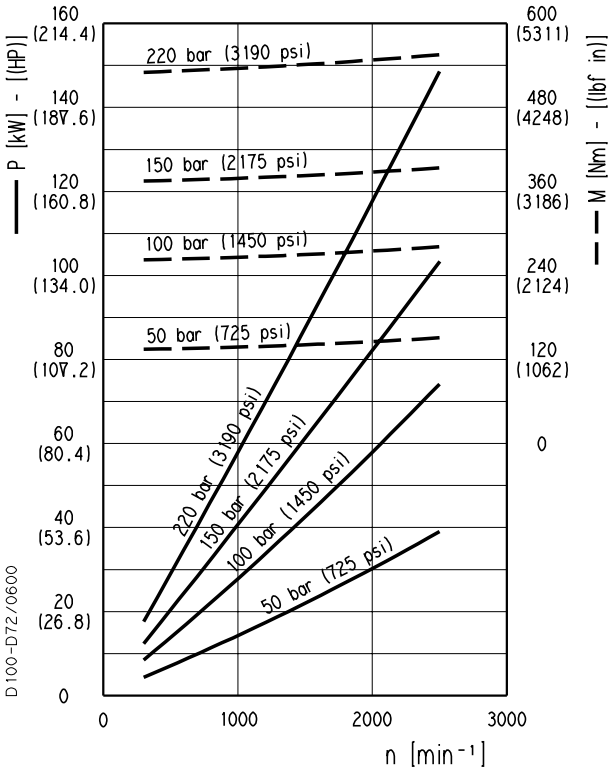
FP 40•87



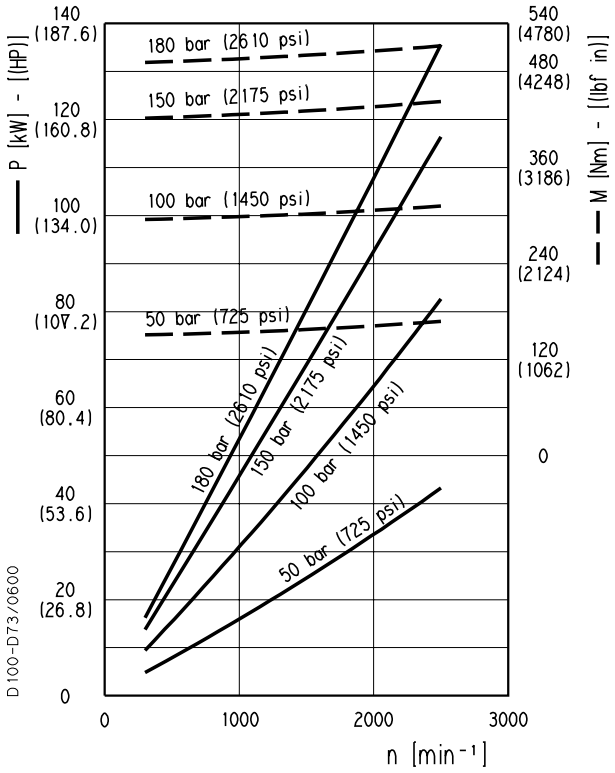
FP 40•109



FP 40•133



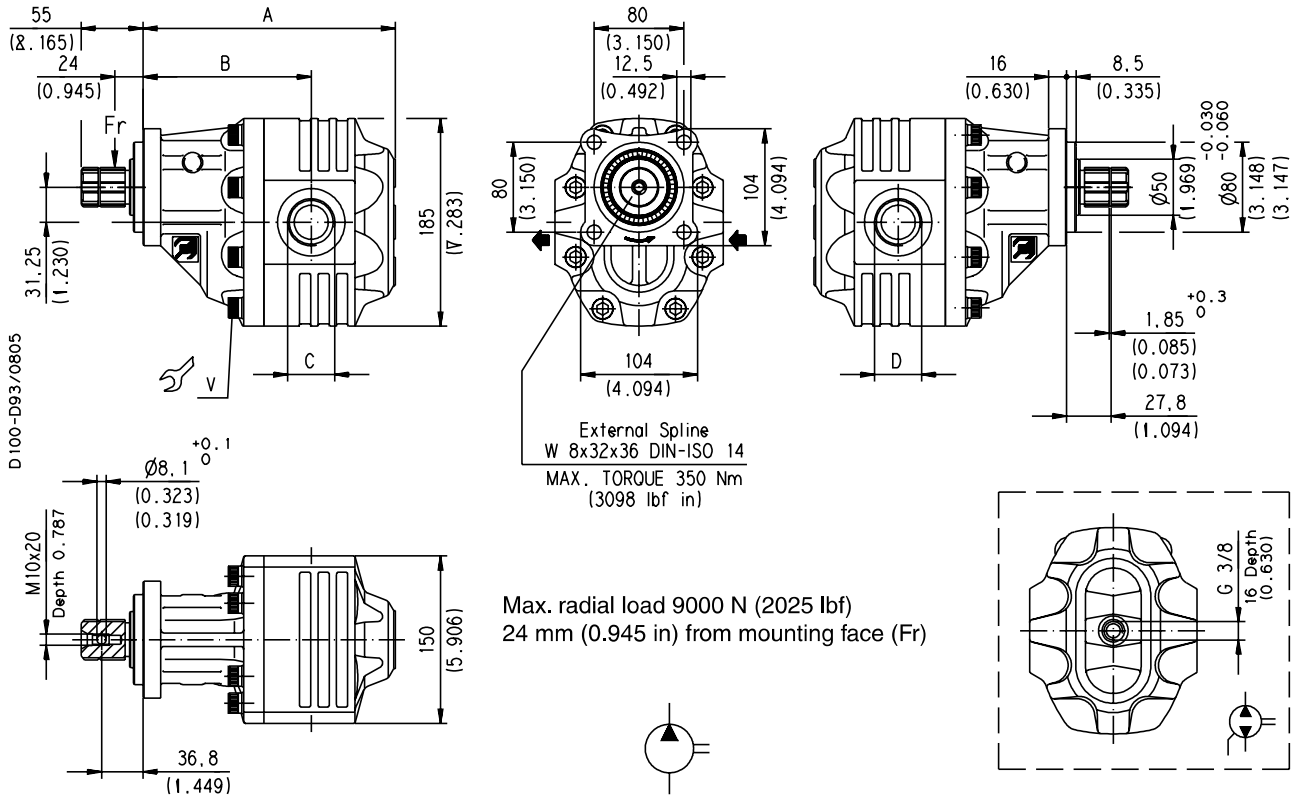
FP 40•151



01/08.2005

FORMULA 40 HYDRAULIC GEAR PUMPS ISO STANDARD 16 Z0

GAS STRAIGHT THREAD PORTS
British standard pipe parallel (55°) conforms to UNI - ISO 228



Max. radial load 9000 N (2025 lbf)
24 mm (0.945 in) from mounting face (Fr)

Screw tightening torque Nm (lbf in)
V
100 ±10 (797 ÷ 974)

Pump type				A	B	C	D	Mass
				mm (in)	mm (in)	IN	OUT	kg (lbs)
FP 40•63	S D R B	0-16 Z0	L GF/GE-N	199 (7.835)	131 (5.157)	G 1	G 3/4	18,65 (41.12)
FP 40•73				203 (7.992)	135 (5.315)			19,30 (42.56)
FP 40•87			L GG/GF-N	208 (8.189)	140 (5.512)	G 1 1/4	G1	19,75 (43.55)
FP 40•109				216 (8.504)	141 (5.551)			21 (46.31)
FP 40•133			L GH/GF-N	225 (8.858)	150 (5.906)	G 1 1/2		22,10 (48.73)
FP 40•151				231 (9.094)	156 (6.142)			22,90 (50.49)

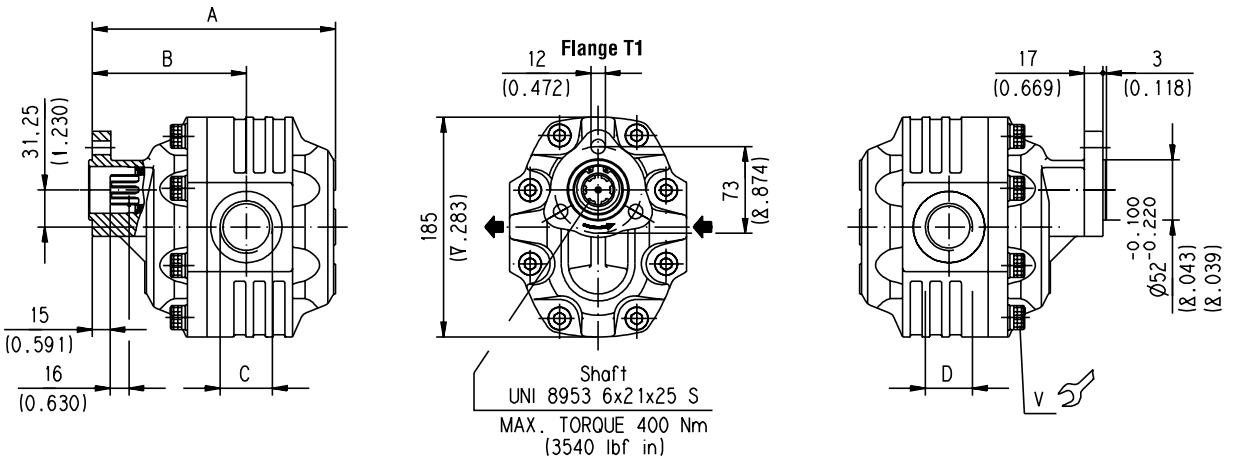
Rotation: S=left - D=right - R=reversible - B=reversible internal drain
How to order:

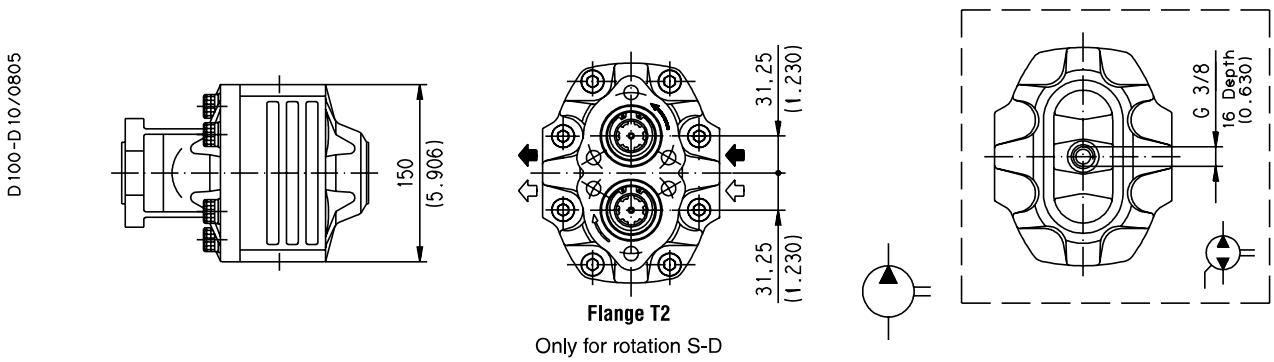
FP 40•63S0-16Z0-L GF/GE-N

01/08.2005

FORMULA 40 HYDRAULIC GEAR PUMPS ITALIAN STANDARD 19 T

GAS STRAIGHT THREAD PORTS
British standard pipe parallel (55°) conforms to UNI - ISO 228





Screw tightening torque Nm (lbf in)
V
100 ±10 (797 ÷ 974)

Pump type					A	B	C	D	Mass
					mm (in)	mm (in)	IN	OUT	kg (lbs)
FP 40•63	S D R B	0-19	T1 T2	L GF/GE-N	187,5 (7.382)	119,5 (4.705)	G 1	G 3/4	16,1 (35.50)
FP 40•73					191,5 (7.539)	123,5 (4.862)			16,5 (36.38)
FP 40•87				L GG/GF-N	196,5 (7.736)	128,5 (5.059)	G 1 1/4	G 1	17 (37.49)
FP 40•109					204,5 (8.051)	129,5 (5.098)			18 (39.69)
FP 40•133				L GH/GF-N	213,5 (8.406)	138,5 (5.453)	G 1 1/2		19,5 (43.00)
FP 40•151					219,5 (8.642)	144,5 (5.689)			20 (44.10)

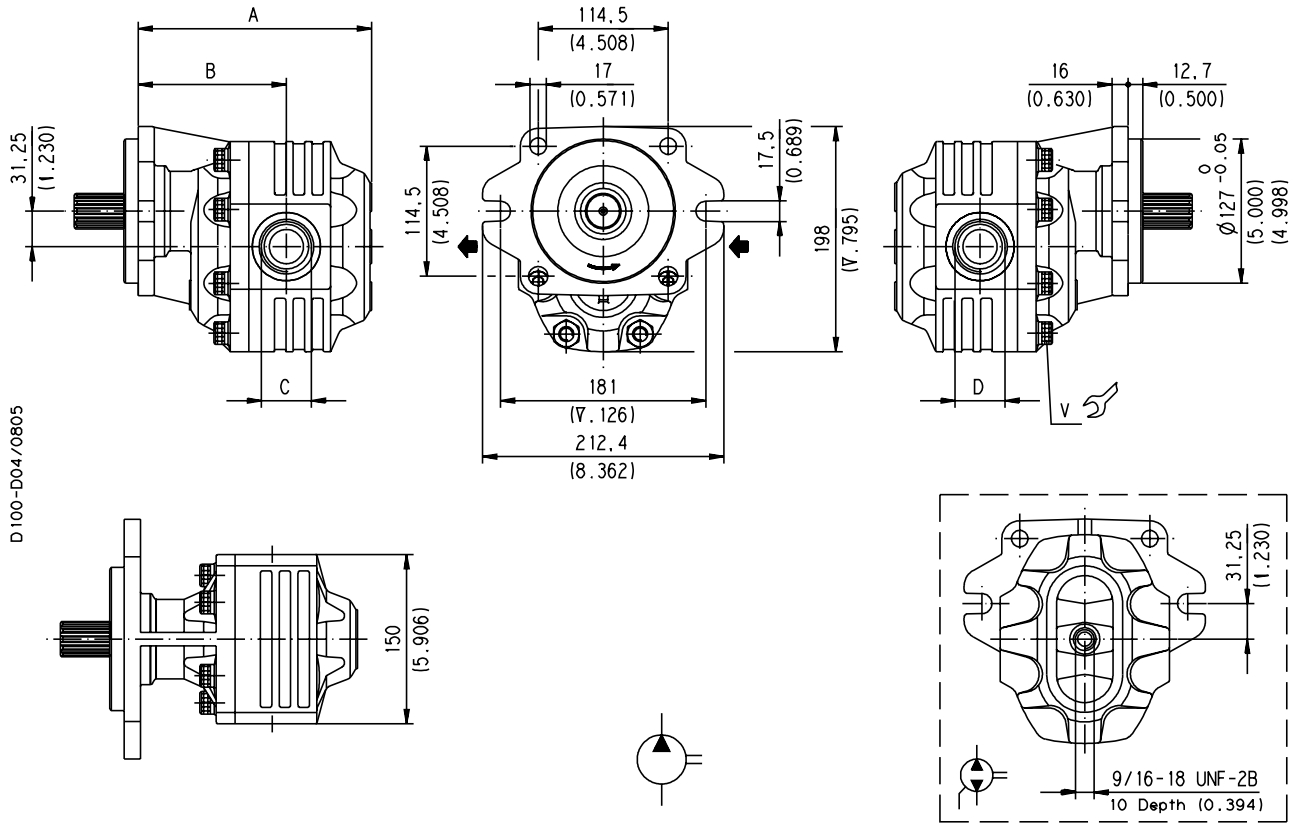
Rotation: S=left - D=right - R=reversible - B=reversible internal drain
How to order:

FP 40•63S0-19T1-L GF/GE-N

01/08.2005

FORMULA 40 HYDRAULIC GEAR PUMPS SAE STANDARD SAE

SAE STRAIGHT THREAD PORTS J514
American straight thread UNC-UNF 60° conforms to ANSI B 1.1.



Screw tightening torque Nm (lbf in)
V
100 ±10 (797 ÷ 974)

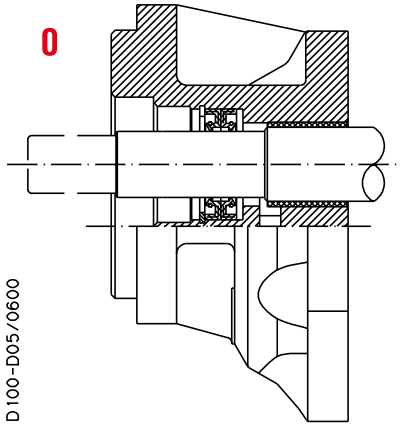
To order see page 34 - 37

01/08.2005

Pump type	A	B	C	D	Ports code		Mass
	mm (in)	mm (in)	IN	OUT	IN	OUT	kg (lbs)
FP 40•63	188,5 (7.421)	120,5 (4.744)	1-5/16-12 UN-2B	1-1/16-12 UN-2B	OF	OD	19,5 (43.00)
FP 40•73	192,5 (7.579)	124,5 (4.902)					20 (44.10)
FP 40•87	197,5 (7.776)	129,5 (5.098)	1-5/8-12 UN-2B	1-5/16-12 UN-2B	OG	OF	20,5 (45.20)
FP 40•109	205,5 (8.091)	130,5 (5.138)					21 (46.31)
FP 40•133	214,5 (8.445)	139,5 (5.492)	1-7/8-12 UN-2B		OH		23 (50.72)
FP 40•151	220,5 (8.681)	145,5 (5.728)					25 (55.13)

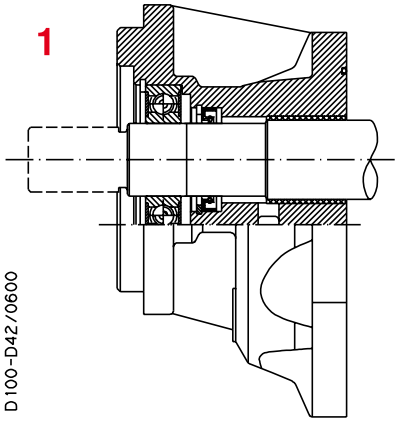
FORMULA 40 SAE VERSION SAE

0



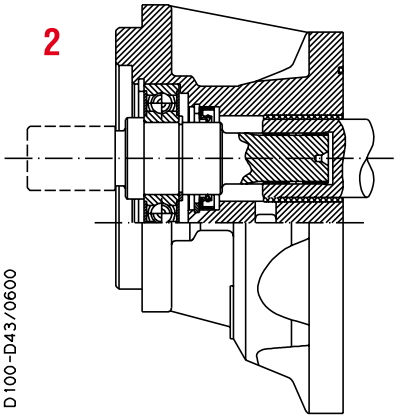
Version for applications without radial and axial load on the drive shaft.

1



Version for applications with low radial load and without axial load on the drive shaft.

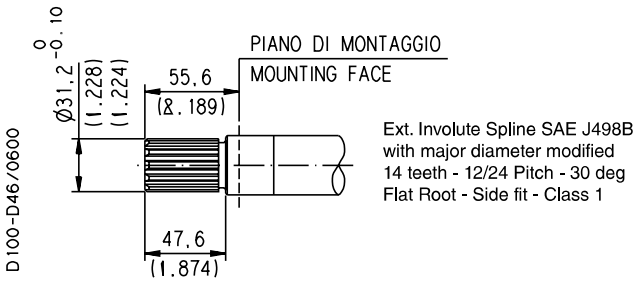
2



Special version with independent shaft for applications with low radial load and without axial load on the drive shaft.

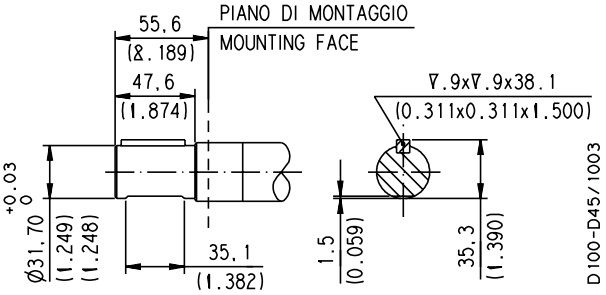
FORMULA 40 SAE END DRIVE SHAFTS SAE

SAE "C" SPLINE 06



MAX 900 Nm (7966 lbf in) ◆

SAE "C" STRAIGHT 34



MAX 600 Nm (5311 lbf in) ◆

◆For "2" version whichever and shaft, the max. torque applicable is M= 600 Nm (5311 lbf in)

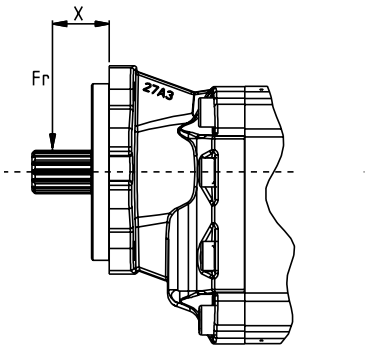
PUMP - VERSION - SHAFT AVAILABILITY TABLE SAE

Pump type	VERSION			
	0	1	2	
FP 40 • 63	06	06	06 - 34	SHAFT
FP 40 • 73	06 - 34	06 - 34	06 - 34	
FP 40 • 87	06 - 34	06 - 34	06 - 34	
FP 40 • 109	06	06	06 - 34	
FP 40 • 133	06 - 34	06 - 34	06 - 34	
FP 40 • 151	06 - 34	06 - 34	06 - 34	

01/08.2005

FORMULA 40 PERMISSIBLE RADIAL LOADING

SAE



X= Distance of the radial load result from the mounting flange.

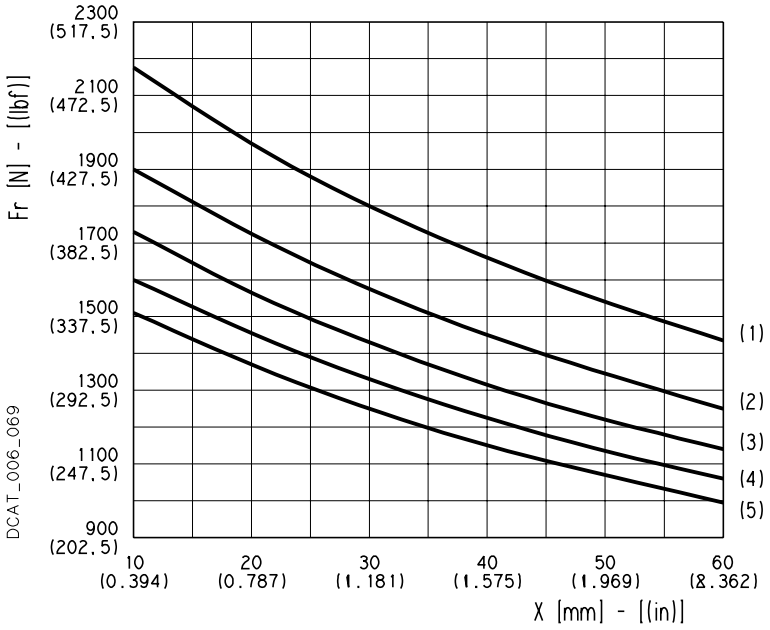
Fatigue life (hours) L_h= **1000 [h]**

Each curve has been obtained at

(1) 1000 min^{-1}
(2) 1500 min^{-1}
(3) 2000 min^{-1}
(4) 2500 min^{-1}
(5) 3000 min^{-1}

VERSION

1- 2



01/08.2005

HOW TO ORDER SINGLE PUMPS

1	2	3		4	5		6	7		8
FP40•63	S	0	-	06	S8	-	L	OF/OD	-	N

1 Pump type	Code
3.75 (61,43) in³/rev (cm³/rev)	FP 40·63
4.43 (72,60) in³/rev (cm³/rev)	FP 40·73
5.28 (86,56) in³/rev (cm³/rev)	FP 40·87
6.64 (108,90) in³/rev (cm³/rev)	FP 40·109
8.18 (134,03) in³/rev (cm³/rev)	FP 40·133
9.20 (150,79) in³/rev (cm³/rev)	FP 40·151

2 Rotation	Code
Left	S
Ringht	D
Reversible	R
Reversible with internal drain	B

3 Version	Code
Without outboard bearing	0
With outboard bearing	1
With outboard bearing and indep. shaft	2

4 Drive shaft	Code
SAE “C” spline (14 teeth)	06
SAE “C” straight	34

5 Mounting flange	Code
SAE “C” 2-4 holes	S8

Code	6 Ports position
L	Side

Code	7 PORTS IN/OUT
Side	Pump type
OF/OD	FP 40•63
OF/OD	FP 40•73
OG/OF	FP 40•87
OG/OF	FP 40•109
OH/OF	FP 40•133
OH/OF	FP 40•151

Code	8 Seals (a)
N	Buna N (standard)
V	Viton
N Bz	Buna N and Bronze thrust plates
V Bz	Viton and Bronze thrust plates

(a) Choose the seals according to the temperature shown on page 3

ORDER EXAMPLE

Standard pump **FP40.63S0-06S8-LOF/OD-N**

Special version pump **FP40.63S2-34S8-LOF/OD-V Bz**

01/08.2005

MULTIPLE PUMPS

FORMULA series pumps can be coupled together in combination. Where imput power requirement of each element varies, that with the greater requirement must be at the drive shaft end, and progressively smaller to the rear.

Features and performances are the same as the corresponding single pumps, but pressures must be limited by the transmissible torque of the drive and connecting shafts. To have appropriate data, use the formula below.

The maximum rotational speed is that of the lowest rated speed of the single units incorporated.

Replaces: 01/08.2005

M	lbf in [Nm]	Torque
V	in^3/rev [cm^3/rev]	Displacement
Δp	psi [bar]	Pressure
$\eta_{hm} = \eta_m (V, \Delta p, n)$	(≈ 0,90)	Hydro-mechanical efficiency

$$M = \frac{M_{theor.}}{\eta_{hm}} \quad [Nm]$$

$$M_{theor.} = \frac{\Delta p\ (bar) \bullet V\ (cm^3/rev)}{62,83}$$

DRIVE SHAFT SELECTION

The torque absorbed from the shaft of the first pump results from the sum of the torques due to all single stages. The achieved value must not exceed the maximum torque limit given for the shaft of the first pump. Diagrams providing approximate selection data will be found on page 38.

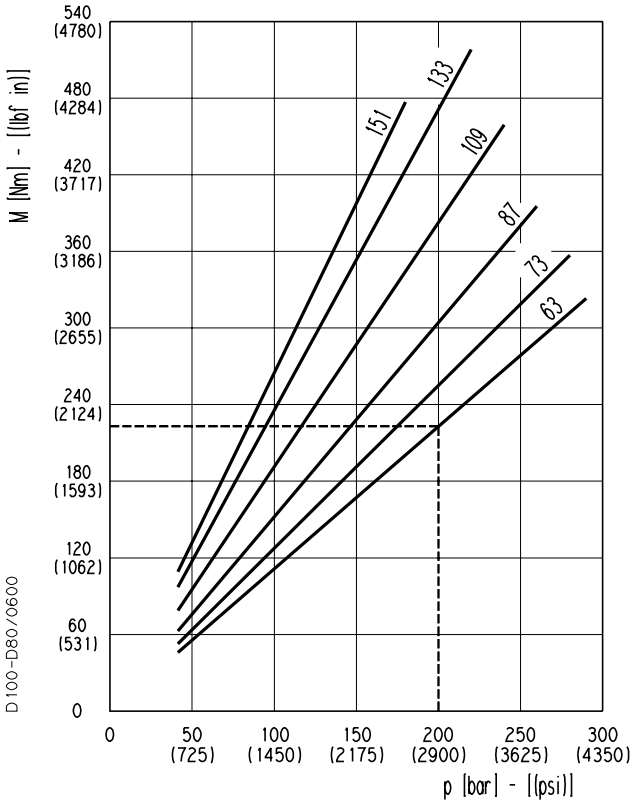
O 03/05.2013

Example

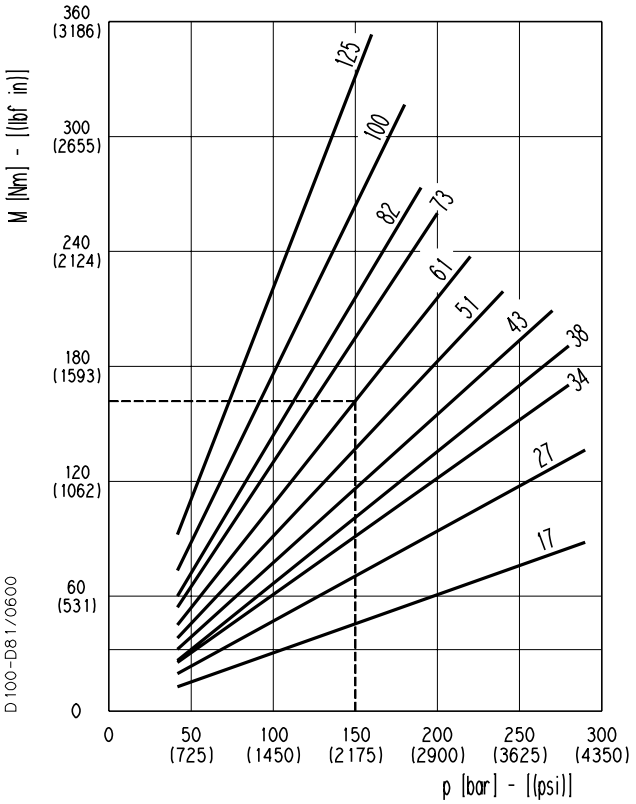
Let us consider a double pump FP40•63+ FP30•61. If we suppose that we have to work with the first pump at a pressure of 2900 psi (200 bar) and the second pump at a pressure of 2175 psi (150 bar), the grafh 1 shows that the torque absorbed by FP40•63 is 1974 lbf in (223 Nm) and the grafh 2 shows that the torque absorbed by FP30•61 is 1416 lbf in (160 Nm) [acceptable value because it don't exceed the maximum drive shaft torque that is 2478 lbf in (280 Nm), see page 42]. The torque to be transmitted by the first drive shaft will thus be 1974+1416=3390 lbf in (223+160= 383 Nm), this value must not exceed the shaft's maximum rated value.

ABSORBED TORQUE

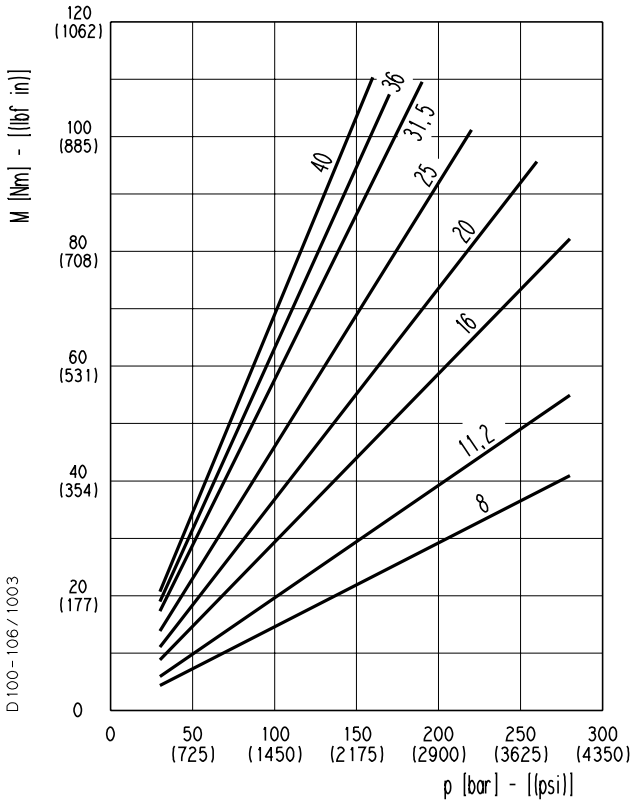
FP 40 (1)



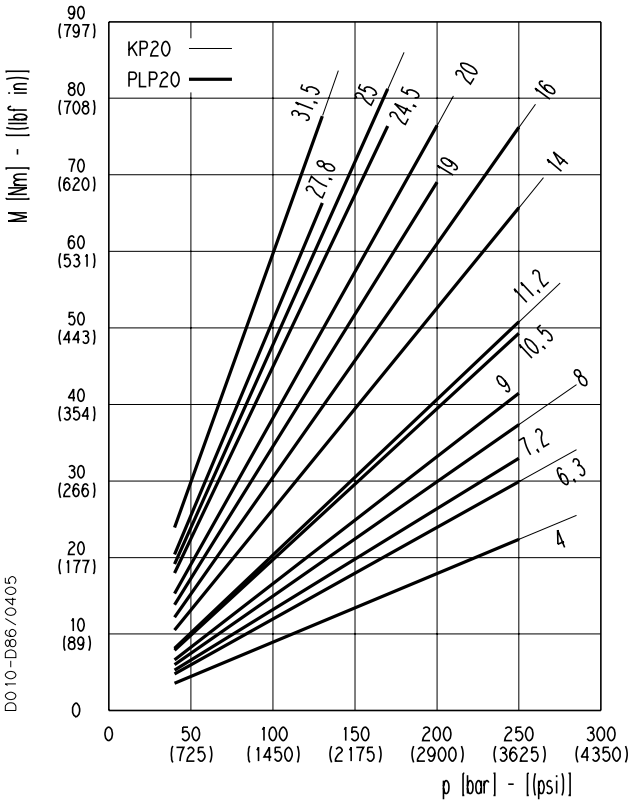
FP 30 (2)



FP 20 (3)



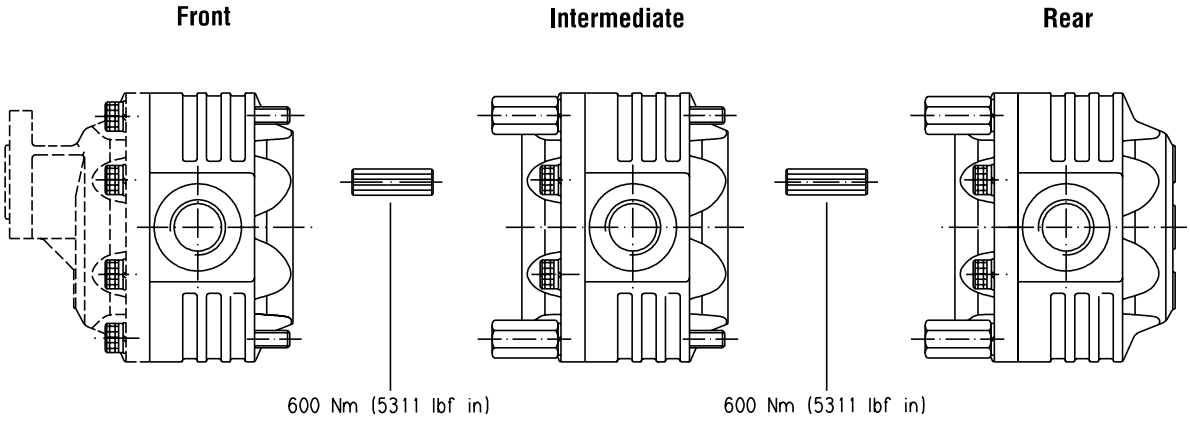
KP 20-PLP 20 (4)



01/08.2005

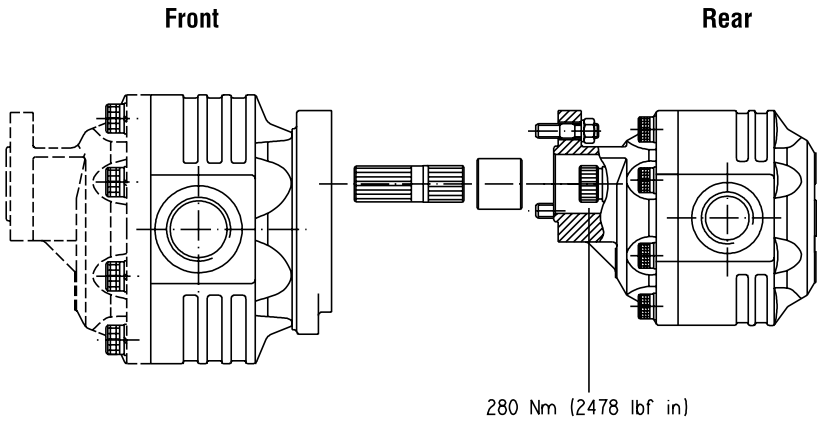
FORMULA 40 MULTIPLE PUMPS COMBINATION

FORMULA 40 + FORMULA 40 STANDARD VERSION



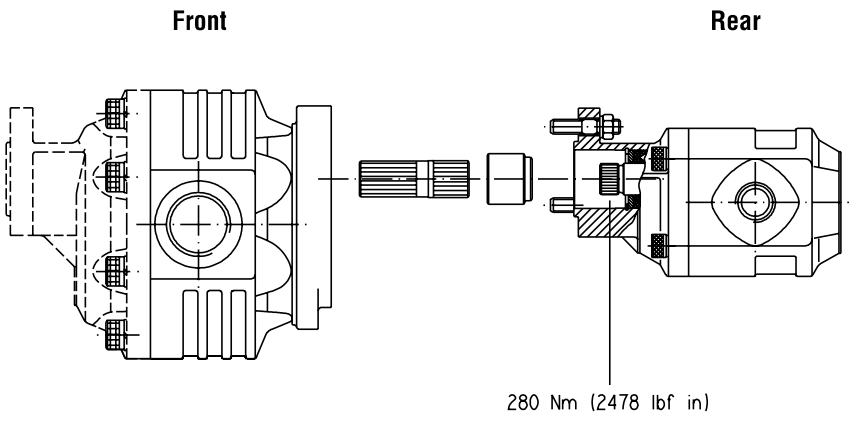
D003-D27/0493

FORMULA 40 + FORMULA 30 STANDARD VERSION



D100-D75/0600

FORMULA 40 + FORMULA 20 STANDARD VERSION



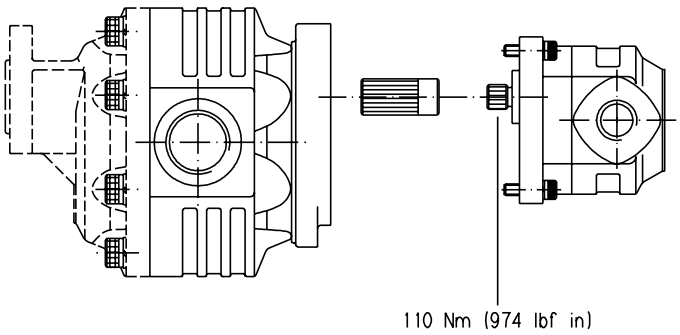
D100-103/1003

01/08.2005

FORMULA 40 MULTIPLE PUMPS COMBINATION

FORMULA 40 + KAPPA20 STANDARD VERSION

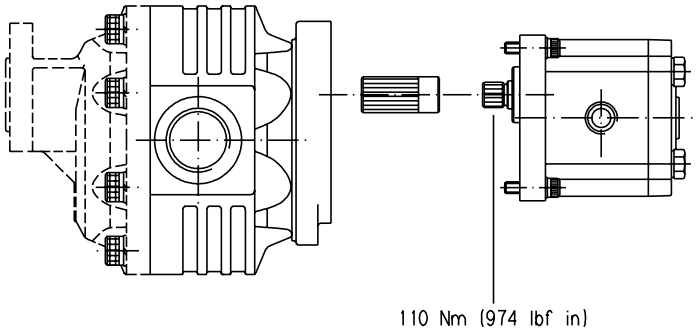
Front Rear



D100-D76/0600

FORMULA 40 + POLARIS20 STANDARD VERSION

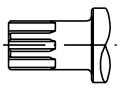
Front Rear



D100-D77/0600

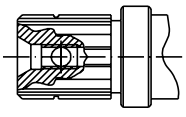
FORMULA 40 END DRIVE SHAFT

ITALIAN STANDARD **19**



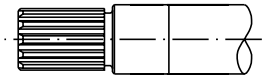
MAX 400 Nm (3540 lbf in)

ISO STANDARD **16**



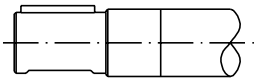
MAX 350 Nm (3098 lbf in)

SPLINE SAE STANDARD **06**



MAX 900 Nm (7965 lbf in)

STRAIGHT SAE STANDARD **34**



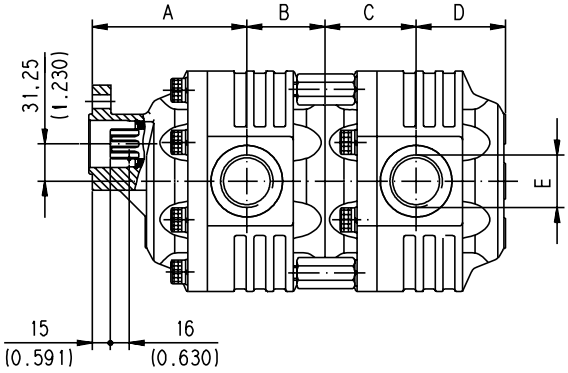
MAX 600 Nm (5310 lbf in)

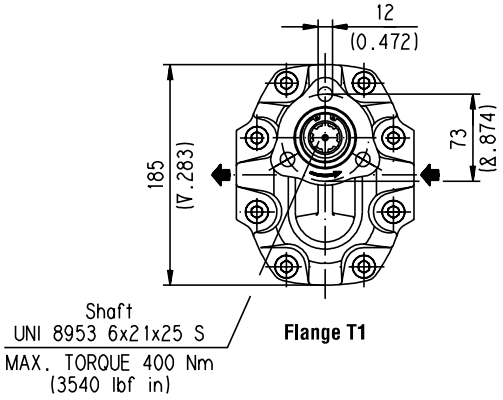
01/08.2005

FORMULA 40 HYDRAULIC GEAR PUMPS ITALIAN STANDARD 19 T

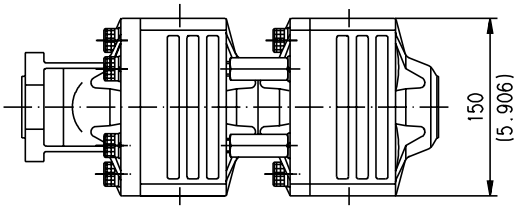
ISO (Z0) version available (◆).
SAE (S8) version at page 62.

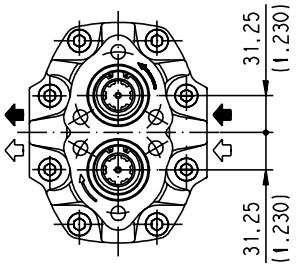
GAS STRAIGHT THREAD PORTS
British standard pipe parallel (55°) conforms to UNI - ISO 228



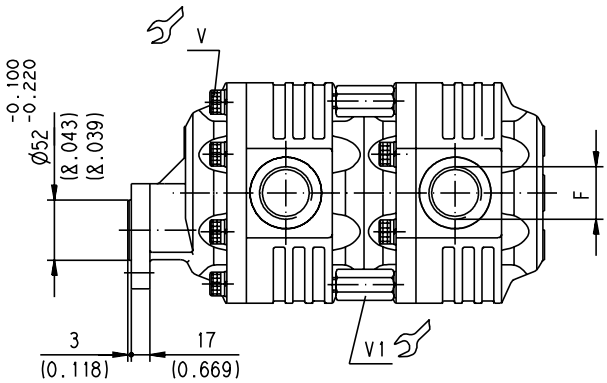


Flange T1



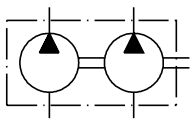


Flange T2



D100-D11/0805

01/08.2005



Screw tightening torque Nm (lbf in)

V	V1
100 ±10 (797 ÷ 974)	100 ±10 (797 ÷ 974)

FORMULA 40 HYDRAULIC GEAR PUMPS ITALIAN STANDARD 19 T

	(◆) Dimension "A" ISO version
	mm (in)
A (Z0)	A (19 T) + 11,5 (0.453)

Pump type	A (19 T)	B	C	D	E	F	Ports code	
	mm (in)	mm (in)	mm (in)	mm (in)	IN	OUT	IN	OUT
FP 40•63	119,5 (4.705)	57,5 (2.264)	65,5 (2.579)	68 (2.677)	G 1	G 3/4	GF	GE
FP 40•73	123,5 (4.862)	57,5 (2.264)	69,5 (2.736)	68 (2.677)				
FP 40•87	128,5 (5.059)	57,5 (2.264)	74,5 (2.933)	68 (2.677)	G 1 1/4	G 1	GG	GF
FP 40•109	129,5 (5.098)	64,5 (2.539)	75,5 (2.972)	75 (2.953)				
FP 40•133	138,5 (5.453)	64,5 (2.539)	84,5 (3.327)	75 (2.953)	G 1 1/2		GH	
FP 40•151	144,5 (5.689)	64,5 (2.539)	90,5 (3.563)	75 (2.953)				

The lenght of a triple pump is obtained with the sum of the following dimensions: **A+B+C+B+C+D.**

How to order a triple pump

(for double pump omit the intermediate pump)

Front pump	/	Intermediate pump	/	Rear pump	(1) Rotation	-	(2) Seals
FP40•63	/	40•63	/	40•63	S	-	

(1) S= Left - D= Right

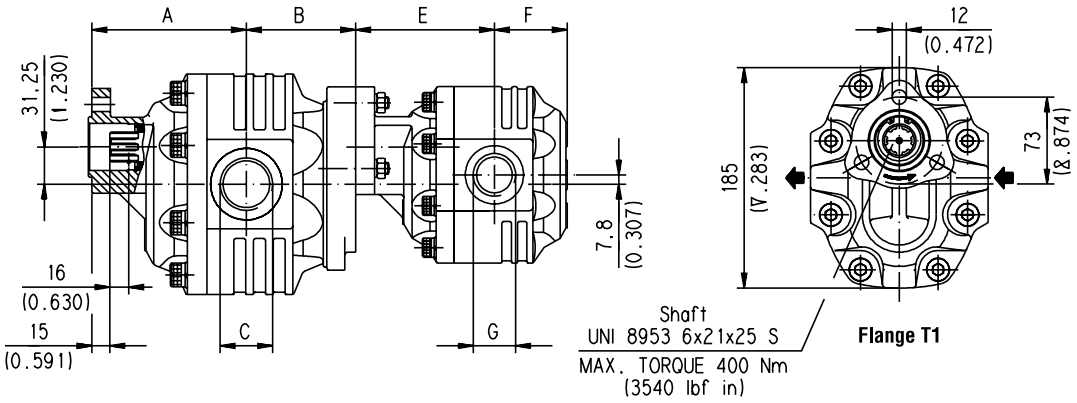
(2) See page 3 (for Buna N seals no code)

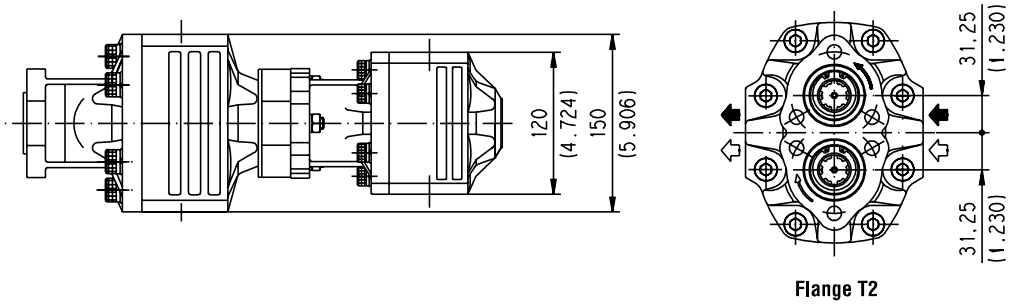
01/08.2005

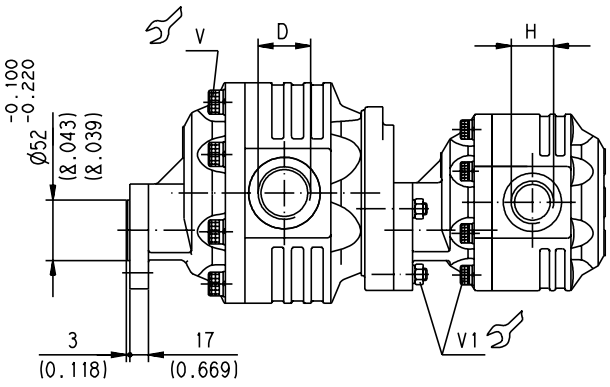
FORMULA 40 HYDRAULIC GEAR PUMPS ITALIAN STANDARD 19 T+FP30

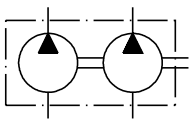
ISO (Z0) and SAE (S8) version available (◆)

GAS STRAIGHT THREAD PORTS
British standard pipe parallel (55°) conforms to UNI - ISO 228









D100-D30/0805

01/08.2005

Screw tightening torque Nm (lbf in)

V	V1
100 ±10 (797 ÷ 974)	70 ±7 (558 ÷ 682)

FORMULA 40 HYDRAULIC GEAR PUMPS ITALIAN STANDARD 19 T+FP30

	(◆) Dimension "A" ISO and SAE version
	mm (in)
A (Z0)	A (19 T) + 11,5 (0.453)
A (S8)	A (19 T) + 1 (0.039)

Pump type	A (19 T)	B	C	D	Ports code	
	mm (in)	mm (in)	IN	OUT	IN	OUT
FP 40•63	119,5 (4.705)	84,5 (3.327)	G 1	G 3/4	GF	GE
FP 40•73	123,5 (4.862)	84,5 (3.327)				
FP 40•87	128,5 (5.059)	84,5 (3.327)	G 1 1/4	G 1	GG	GF
FP 40•109	129,5 (5.098)	91,5 (3.602)				
FP 40•133	138,5 (5.453)	91,5 (3.602)	G 1 1/2		GH	
FP 40•151	144,5 (5.689)	91,5 (3.602)				

Pump type	E	F	G	H
	mm (in)	mm (in)	IN	IN
FP 30•17	100,5 (5.925)	50 (1.969)	G 1/2	G 1/2
FP 30•27	106,5 (4.193)	50 (1.969)	G 3/4	G 3/4
FP 30•34	106,5 (4.193)	55 (2.165)		
FP 30•38	109,5 (4.311)	55 (2.165)		
FP 30•43	112,5 (4.429)	55 (2.165)		
FP 30•51	110,5 (4.350)	62 (2.441)	G 1	G 1
FP 30•61	116,5 (4.587)	62 (2.441)		
FP 30•73	117,5 (4.623)	69 (2.717)		
FP 30•82	122,5 (4.823)	69 (2.717)	G 1 1/4	

01/08.2005

How to order

Front pump			/	Rear pump	(1) Rotation	-	(2) Seals
FP40•63	-	53	/	FP30•17	S	-	

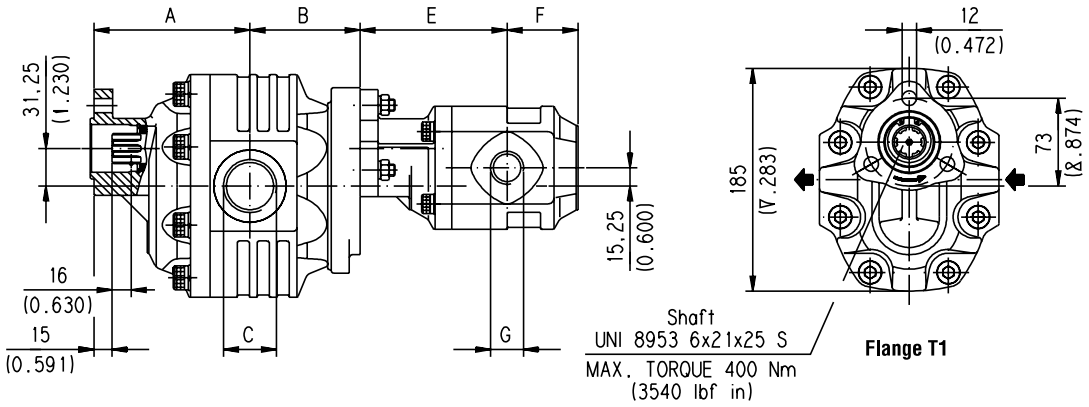
(1) S= Left - D= Right

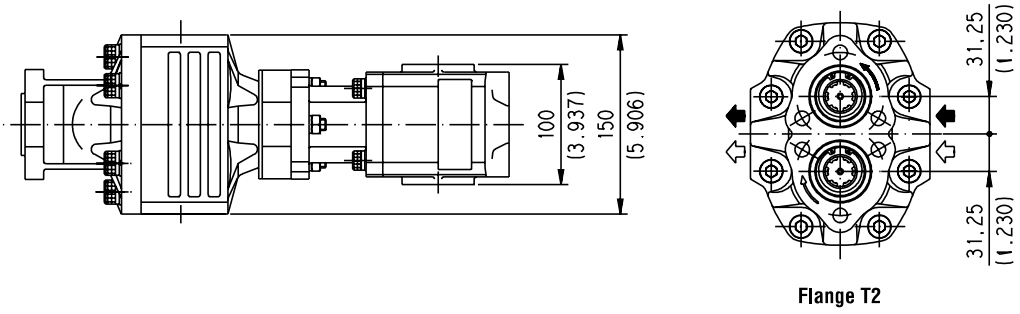
(2) See page 3 (for Buna N seals no code)

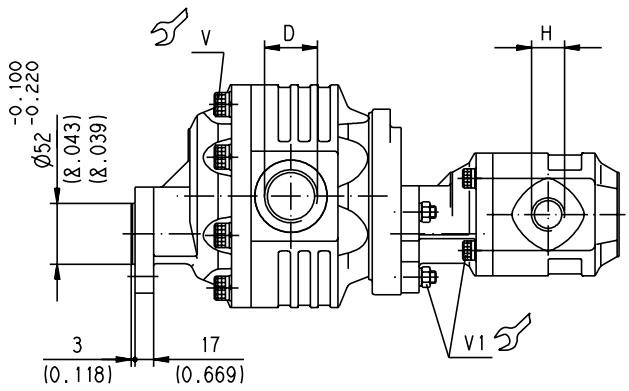
FORMULA 40 HYDRAULIC GEAR PUMPS ITALIAN STANDARD 19 T+FP20

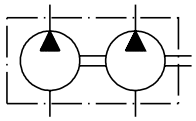
ISO (Z0) and SAE (S8) version available (◆)

GAS STRAIGHT THREAD PORTS
British standard pipe parallel (55°) conforms to UNI - ISO 228









D100-D96/0805

01/08.2005

Screw tightening torque Nm (lbf in)

V	V1
100 ±10 (797 ÷ 974)	70 ±7 (558 ÷ 682)

FORMULA 40 HYDRAULIC GEAR PUMPS ITALIAN STANDARD 19 T+FP20

	(◆) Dimension "A" ISO and SAE version
	mm (in)
A (Z0)	A (19 T) + 11,5 (0.453)
A (S8)	A (19 T) + 1 (0.039)

Pump type	A (19 T)	B	C	D	Ports code	
	mm (in)	mm (in)	IN	OUT	IN	OUT
FP 40•63	119,5 (4.705)	84,5 (3.327)	G 1	G 3/4	GF	GE
FP 40•73	123,5 (4.862)	84,5 (3.327)				
FP 40•87	128,5 (5.059)	84,5 (3.327)	G 1 1/4	G 1	GG	GF
FP 40•109	129,5 (5.098)	91,5 (3.602)				
FP 40•133	138,5 (5.453)	91,5 (3.602)	G 1 1/2		GH	
FP 40•151	144,5 (5.689)	91,5 (3.602)				

Pump type	E	F	G	H
	mm (in)	mm (in)	IN	IN
FP 20•8	105 (4.134)	27,5 (1.083)	G 1/2	G 1/2
FP 20•11,2	108,5 (4.272)	27,5 (1.083)		
FP 20•16	112,5 (4.429)	33 (1.299)		
FP 20•20	119 (4.685)	33 (1.299)		
FP 20•25	112 (4.409)	48 (1.890)	G 3/4	G 3/4
FP 20•31,5	122 (4.803)	48 (1.890)		
FP 20•36	116,5 (4.587)	59 (2.323)		
FP 20•40	122 (4.803)	59 (2.323)		

01/08.2005

How to order

Front pump			/	Rear pump	(1) Rotation	-	(2) Seals
FP40•63	-	54	/	FP20•11,2	S	-	

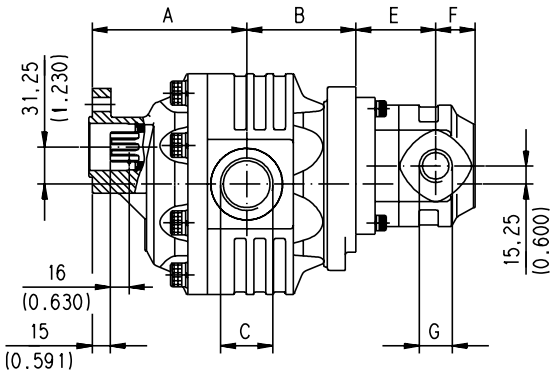
(1) S= Left - D= Right

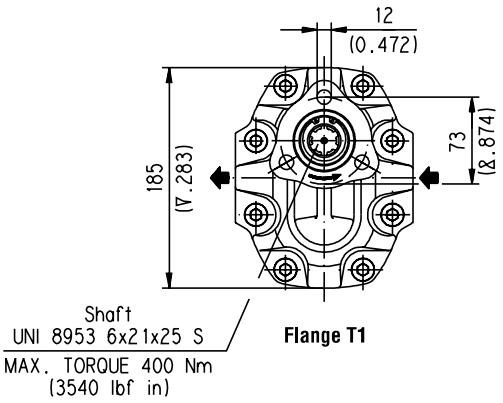
(2) See page 3 (for Buna N seals no code)

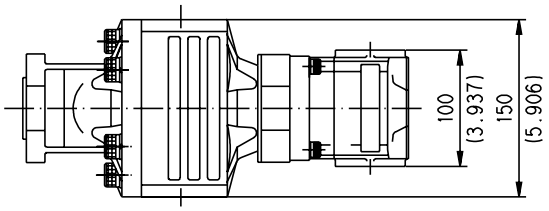
FORMULA 40 HYDRAULIC GEAR PUMPS ITALIAN STANDARD 19 T+KP20

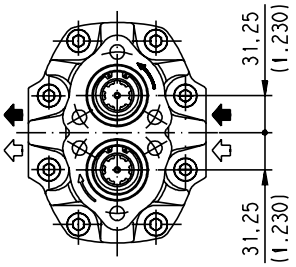
ISO (Z0) and SAE (S8) version available (◆)

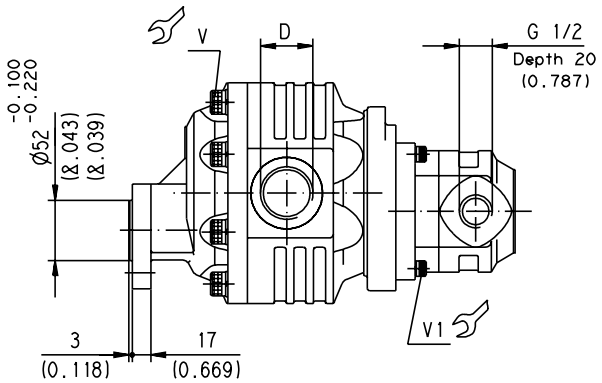
GAS STRAIGHT THREAD PORTS
British standard pipe parallel (55°) conforms to UNI - ISO 228





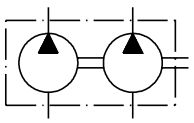






D100-D340805

01/08.2005



Screw tightening torque Nm (lbf in)

V	V1
100 ±10 (797 ÷ 974)	70 ±7 (558 ÷ 682)

FORMULA 40 HYDRAULIC GEAR PUMPS ITALIAN STANDARD 19 T+KP20

	(◆) Dimension "A" ISO and SAE version
	mm (in)
A (Z0)	A (19 T) + 11,5 (0.453)
A (S8)	A (19 T) + 1 (0.039)

Pump type	A (19 T)	B	C	D	Ports code	
	mm (in)	mm (in)	IN	OUT	IN	OUT
FP 40•63	119,5 (4.705)	84,5 (3.327)	G 1	G 3/4	GF	GE
FP 40•73	123,5 (4.862)	84,5 (3.327)				
FP 40•87	128,5 (5.059)	84,5 (3.327)	G 1 1/4	G 1	GG	GF
FP 40•109	129,5 (5.098)	91,5 (3.602)				
FP 40•133	138,5 (5.453)	91,5 (3.602)	G 1 1/2		GH	
FP 40•151	144,5 (5.689)	91,5 (3.602)				

Pump type	F	G	H	Ports code	
	mm (in)	mm (in)	IN	IN	OUT
KP 20•4	60 (2.362)	27,5 (1.083)	G 1/2 Depth 20 (0.787)	GD	GD
KP 20•6,3	62,5 (2.460)	27,5 (1.083)			
KP 20•8	65 (2.559)	27,5 (1.083)			
KP 20•11,2	68,5 (2.697)	27,5 (1.083)			
KP 20•14	67 (2.638)	33 (1.299)	G 3/4 Depth 22 (0.866)	GE	
KP 20•16	72,5 (2.854)	33 (1.299)			
KP 20•20	79 (3.110)	33 (1.299)			
KP 20•25	72 (2.835)	48 (1.890)			
KP 20•31,5	82 (3.228)	48 (1.890)			

01/08.2005

How to order

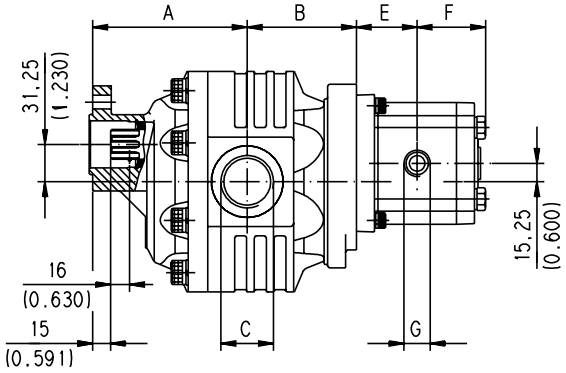
Front pump			/	Rear pump	-	Ports position	Ports IN/OUT	(1) Rotation	-	(2) Seals
FP40•63	-	52	/	KP20•4	-	L	GD/GD	S	-	

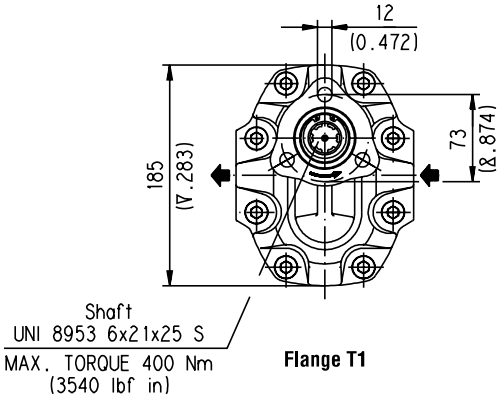
(1) S= Left - D= Right (2) See page 3 (for Buna N seals no code)

FORMULA 40 HYDRAULIC GEAR PUMPS ITALIAN STANDARD 19 T+PL20

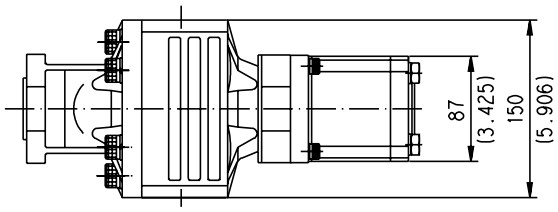
ISO (Z0) and SAE (S8) version available (◆)

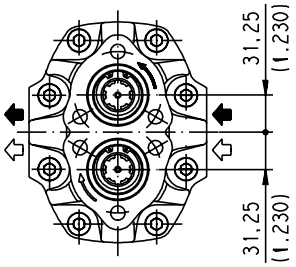
GAS STRAIGHT THREAD PORTS
British standard pipe parallel (55°) conforms to UNI - ISO 228



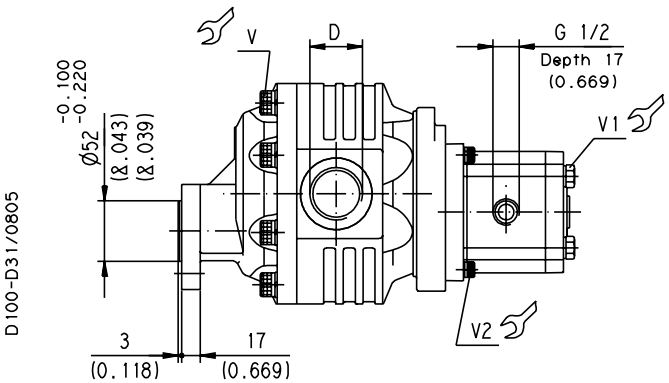


Flange T1



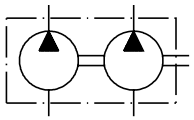


Flange T2



D100-D31/0805

01/08.2005



Screw tightening torque Nm (lbf in)

V	V1 (●)	V2
100 ±10 (797 ÷ 974)	70 ±7 (558 ÷ 682)	70 ±7 (558 ÷ 682)

(●) With cast iron front cover.

FORMULA 40 POMPE A INGRANAGGI UNIFICAZIONE ITALIANA 19 T+PL20

	(◆) Dimension "A" ISO and SAE version
	mm (in)
A (Z0)	A (19 T) + 11,5 (0.453)
A (S8)	A (19 T) + 1 (0.039)

Pump type	A (19 T)	B	C	D	Ports code	
	mm (in)	mm (in)	IN	OUT	IN	OUT
FP 40•63	119,5 (4.705)	84,5 (3.327)	G 1	G 3/4	GF	GE
FP 40•73	123,5 (4.862)	84,5 (3.327)				
FP 40•87	128,5 (5.059)	84,5 (3.327)	G 1 1/4	G 1	GG	GF
FP 40•109	129,5 (5.098)	91,5 (3.602)				
FP 40•133	138,5 (5.453)	91,5 (3.602)	G 1 1/2		GH	
FP 40•151	144,5 (5.689)	91,5 (3.602)				

Pump type	E	F	G	Ports code	
	mm (in)	mm (in)	mm (in)	IN	OUT
PLP 20•4	43,8 (1.722)	49,3 (1.941)	G 1/2 Depth 17 (0.669)	GD	GD
PLP 20•6,3	45 (1.772)	50,5 (1.988)			
PLP 20•7,2	45,5 (1.791)	51 (2.008)			
PLP 20•8	46,3 (1.821)	51,8 (2.039)			
PLP 20•9	46,9 (1.846)	52,4 (2.063)			
PLP 20•10,5	48,3 (1.900)	53,8 (2.118)			
PLP 20•11,2	48,5 (1.909)	54 (2.126)			
PLP 20•14	51 (2.008)	56,5 (2.224)	G 3/4 Depth 18 (0.709)	GE	
PLP 20•16	52,8 (2.077)	58,3 (2.295)			
PLP 20•19	54,5 (2.146)	60 (2.553)			
PLP 20•20	56 (2.205)	61,5 (2.421)			
PLP 20•24,5	58,8 (2.315)	64,3 (2.531)			
PLP 20•25	60 (2.362)	65,5 (2.579)			
PLP 20•27,5	61,4 (2.417)	66,9 (2.634)			
PLP 20•31,5	65 (2.559)	70,5 (2.776)			

01/08.2005

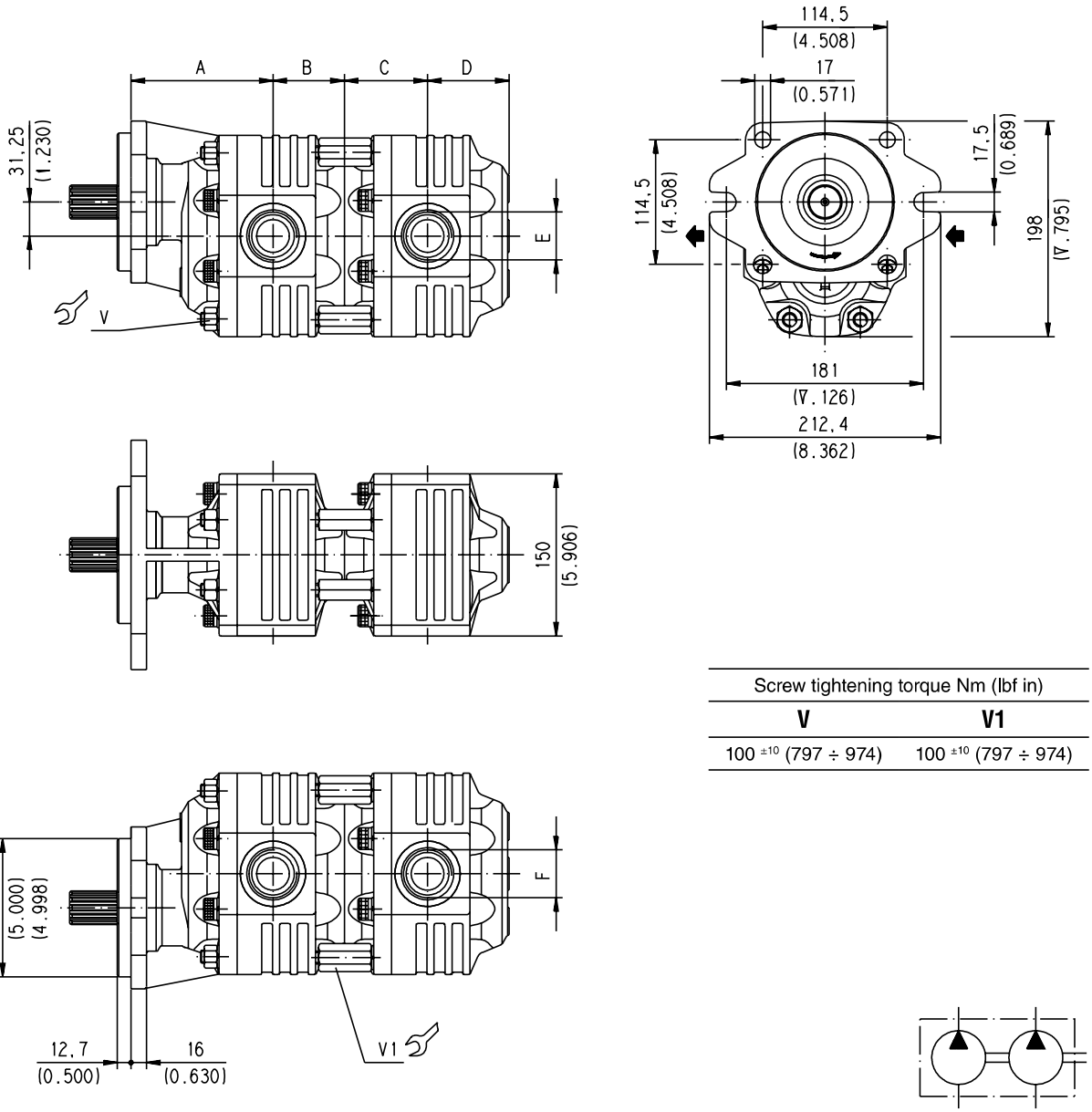
How to order

Front pump/			/	Rear pump	-	Ports position	Ports IN/OUT	(1) Rotation	-	(2) Seals
FP40•63	-	52	/	PLP20•4	-	L	GD/GD	S	-	

(1) S= Left - D= Right (2) See page 3 (for Buna N seals no code)

FORMULA 40 HYDRAULIC GEAR PUMPS SAE STANDARD SAE

SAE STRAIGHT THREAD PORTS J514
American straight thread UNC-UNF 60° conforms to ANSI B 1.1



D 100-D 12/0805

Screw tightening torque Nm (lbf in)	
V	**V1**
100 ±10 (797 ÷ 974)	100 ±10 (797 ÷ 974)

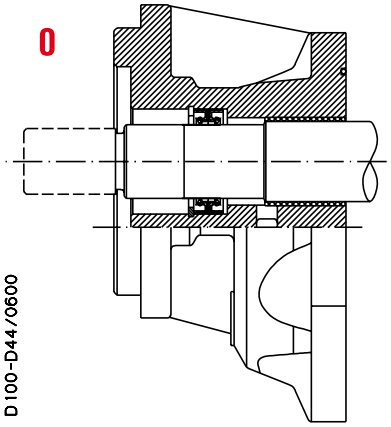
Pump type	A	B	C	D	E	F	Ports code	
	mm (in)	mm (in)	mm (in)	mm (in)	IN	OUT	IN	OUT
FP 40•63	120,5 (4.744)	57,5 (2.264)	65,5 (2.579)	68 (2.677)	1-5/16-12 UN-2B	1-1/16-12 UN-2B	**OF**	**OD**
FP 40•73	124,5 (4.902)	57,5 (2.264)	69,5 (2.736)	68 (2.677)				
FP 40•87	129,5 (5.098)	57,5 (2.264)	74,5 (2.933)	68 (2.677)	1-5/8-12 UN-2B	1-5/16-12 UN-2B	**OG**	**OF**
FP 40•109	130,5 (5.138)	64,5 (2.539)	75,5 (2.972)	75 (2.953)				
FP 40•133	139,5 (5.492)	64,5 (2.539)	84,5 (3.327)	75 (2.953)	1-7/8-12 UN-2B		**OH**	
FP 40•151	145,5 (5.728)	64,5 (2.539)	90,5 (3.563)	75 (2.953)				

The lenght of a triple pump is obtained with the sum of the following dimensions: **A+B+C+B+C+D.**

01/08.2005

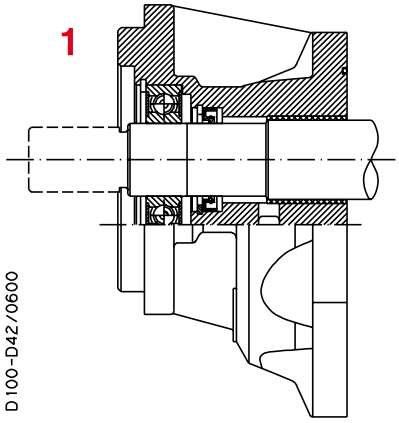
FORMULA 40 SAE VERSION — SAE

0



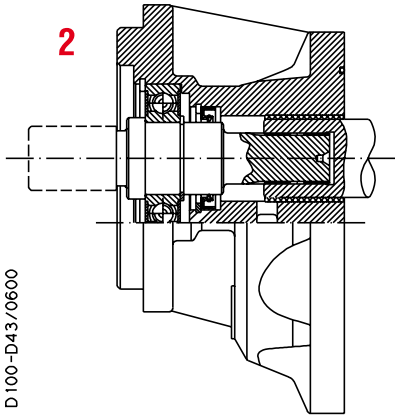
Version for applications without radial and axial load on the drive shaft.

1



Version for applications with low radial load and without axial load on the drive shaft

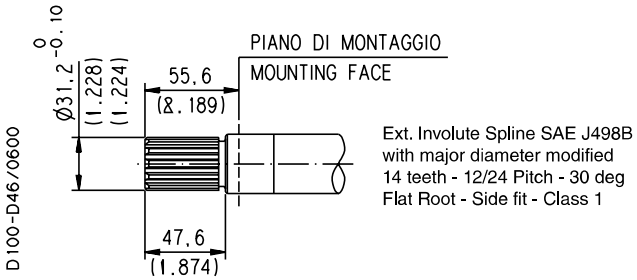
2



Special version with independent shaft for applications with low radial load and without axial load on the drive shaft.

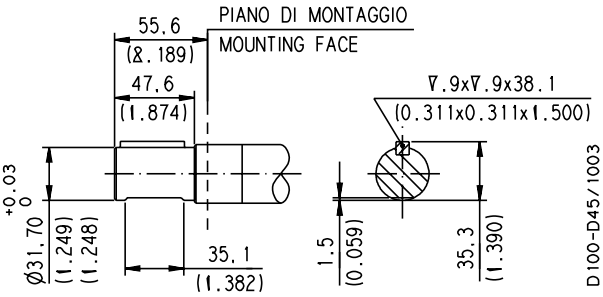
FORMULA 40 SAE END DRIVE SHAFT — SAE

SAE "C" SPLINE — 06



MAX 900 Nm (7966 lbf in) ◆

SAE "C" STRAIGHT — 34



MAX 600 Nm (5311 lbf in) ◆

◆For "2" version whichever and shsft, the max. torque applicable is M= 600 Nm (5311 lbf in)

01/08.2005

PUMP - VERSION - SHAFT AVAILABILITY TABLE — SAE

Pump type	VERSION			
	0	1	2	
FP 40 • 63	06	06	06 - 34	SHAFT
FP 40 • 73	06 - 34	06 - 34	06 - 34	
FP 40 • 87	06 - 34	06 - 34	06 - 34	
FP 40 • 109	06	06	06 - 34	
FP 40 • 133	06 - 34	06 - 34	06 - 34	
FP 40 • 151	06 - 34	06 - 34	06 - 34	

HOW TO ORDER MULTIPLE PUMPS

1	2	3	4	5	6	7	8
FP40•63	- 06	S8	- L	OF/OD	/		
Front pump							
40•63	-		L	OF/OD	/		
Intermediate pump							
40•63	-		L	OF/OD	- S	- 0	N
Rear pump							

1 Pump type	Code
3.75 (61,43) in³/rev (cm³/rev)	FP 40•63
4.43 (72,60) in³/rev (cm³/rev)	FP 40•73
5.28 (86,56) in³/rev (cm³/rev)	FP 40•87
6.64 (108,90) in³/rev (cm³/rev)	FP 40•109
8.18 (134,03) in³/rev (cm³/rev)	FP 40•133
9.20 (150,79) in³/rev (cm³/rev)	FP 40•151

2 Drive shaft	Code
SAE "C" spline (14 teeth)	06
SAE "C" straigh	34

3 mounting flange	Code
SAE "C" 2-4 holes	S8

4 Ports position	Code
Side	L

Code	5 Ports IN/OUT
	SAE STRAIGHT THREAD PORTS (ODT)
Side	Pump type
OF/OD	FP 40•63
OF/OD	FP 40•73
OG/OF	FP 40•87
OG/OF	FP 40•109
OH/OF	FP 40•133
OH/OF	FP 40•151

Code	6 Rotation
S	Left
D	Right

Code	7 Version
0	Without outboard bearing
1	With outboard bearing
2	With outboard bearing and indep. shaft

Code	8 Seals (a)
N	Buna N (standard)
V	Viton
N Bz	Buna N and Bronze thrust plates
V Bz	Viton and Bronze thrust plates

a) Choose the seals according to the temperature shown on page 3

01/08.2005

ORDER EXAMPLE

Triple pump — FP40•63-06S8-LOF/OD/ 40•63-LOF/OD/40•63-LOF/OD S-0-N

PORTS CONNECTORS TIGHTENING TORQUE

Tightening torque for low pressure side port.

Tightening torque for high pressure side port [values obtained at 350 bar (5075 psi)]

For reversible rotation, please consult only the tightening torque for high pressure side port.

Replaces: 01/08.2005

GAS STRAIGHT THREAD PORTS — BSPP

CODE	Nm	(lbf in)	Nm	(lbf in)
GC (◆)	15 +1	133 ÷ 142	_	_
GD	20 +1	177 ÷ 186	50 +2,5	443 ÷ 465
GE	30 +2,5	266 ÷ 288	90 +5	797 ÷ 841
GF	50 +2,5	443 ÷ 465	130 +10	1151 ÷ 1239
GG O	70 +5	620 ÷ 664	170 +15	1505 ÷ 1637
GH	70 +5	620 ÷ 664	_	_

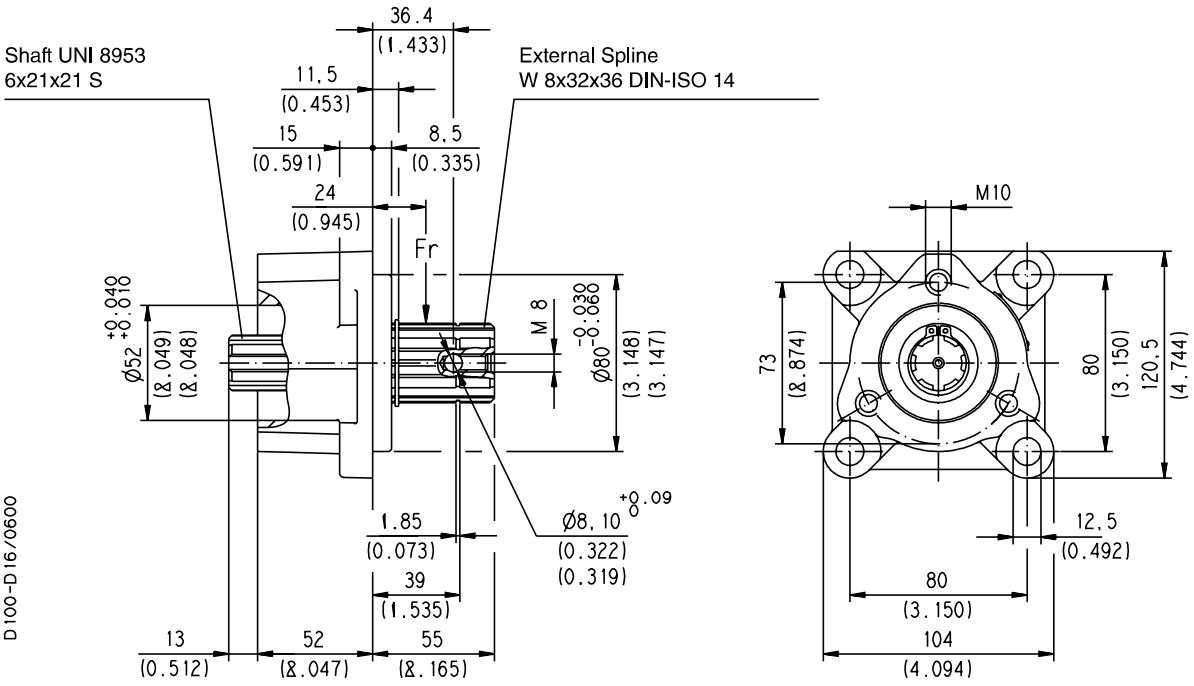
SAE STRAIGHT THREAD PORTS J514 — ODT

CODICE	Nm	(lbf in)	Nm	(lbf in)
OA (◆)	15 +1	133 ÷ 142	_	
OB	20 +1	177 ÷ 186	45 +2,5	398 ÷ 420
OD	40 +2,5	354 ÷ 376	120 +10	1062 ÷ 1151
OE	50 +2,5	443 ÷ 465	145 +10	1283 ÷ 1372
OF	60 +5	531 ÷ 575	170 +10	1505 ÷ 1593
OG	70 +5	620 ÷ 664	_	_
OH	100 +5	885 ÷ 929	_	_

(◆) Drain port: FORMULA 30 and FORMULA 40 rear drain (R).

O 03/05.2013

BEARING SUPPORT FOR COUPLING TO ZF P.T.O.(ISO Standard) SL9 - SR9

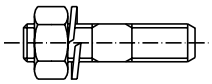
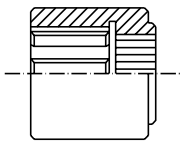


The bearing support allows FORMULA Italian standard pumps to be coupled to P.T.O. of commercial vehicles.

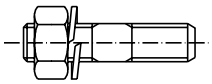
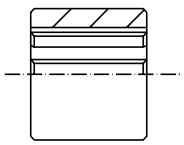
Ordering code	Max. radial load 24 mm (0.945 in) from mounting face (Fr)	Mass
	N	kg (lbs)
SL9	–	2,7 (5.95)
SR9	Low load	

01/08.2005

KIT to assemble FP20 - 13 T1 and FP30 - 13 T pumps with support

Part	Q.ty	Description	Ordering code
	3	Stud M 10x30 UNI 5911 Nut M 10 Washer 10 DIN 7980	
	1	Gasket	KIT 10 - A
	1	Splined coupling MA 6x21x25 UNI 8953 - A 22x19 DIN 5482 L= 31	

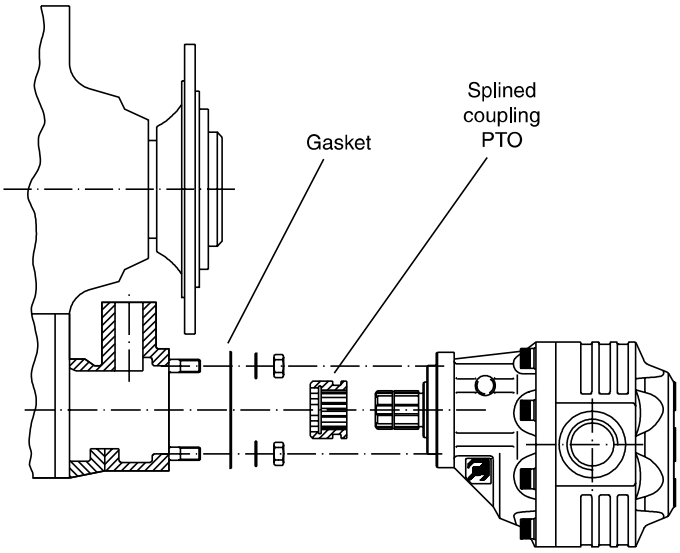
KIT to assemble FP30 - 19 T and FP40 - 19 T pumps with support

Part	Q.ty	Description	Ordering code
	3	Stud M 10x30 UNI 5911 Nut M 10 UNI 7473	
	1	Gasket	KIT 17 - A
	1	Splined coupling MA 6x21x25 UNI 8953 L= 31	

01/08.2005

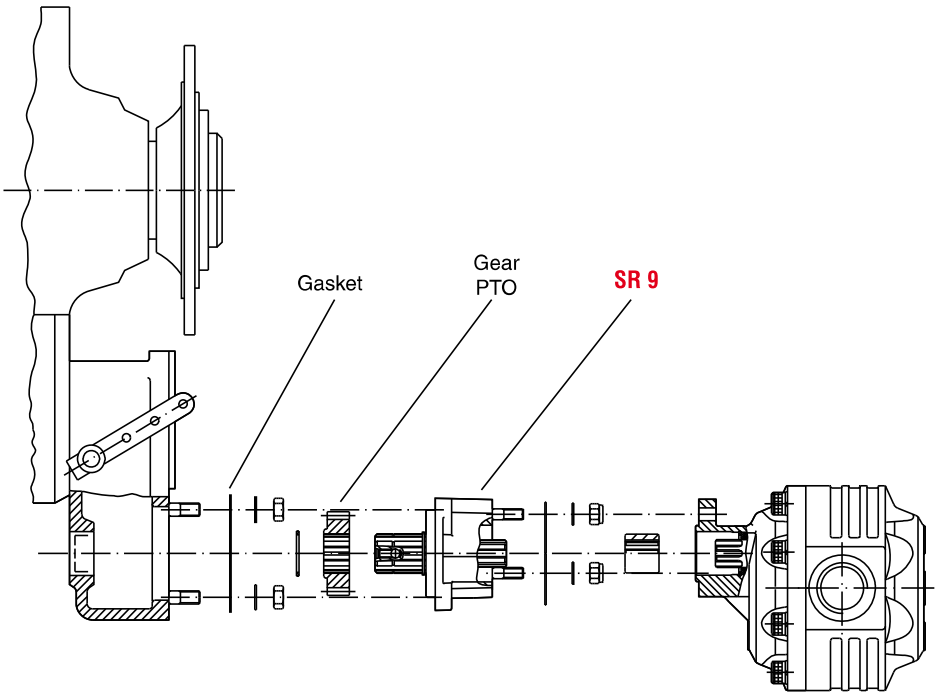
APPLICATIONS FOR FORMULA PUMPS WITH ZF P.T.O.(ISO STANDARD)

D100-108/1003



The FORMULA pumps in the application with radial load can be directly connected to the “ZF” P.T.O.

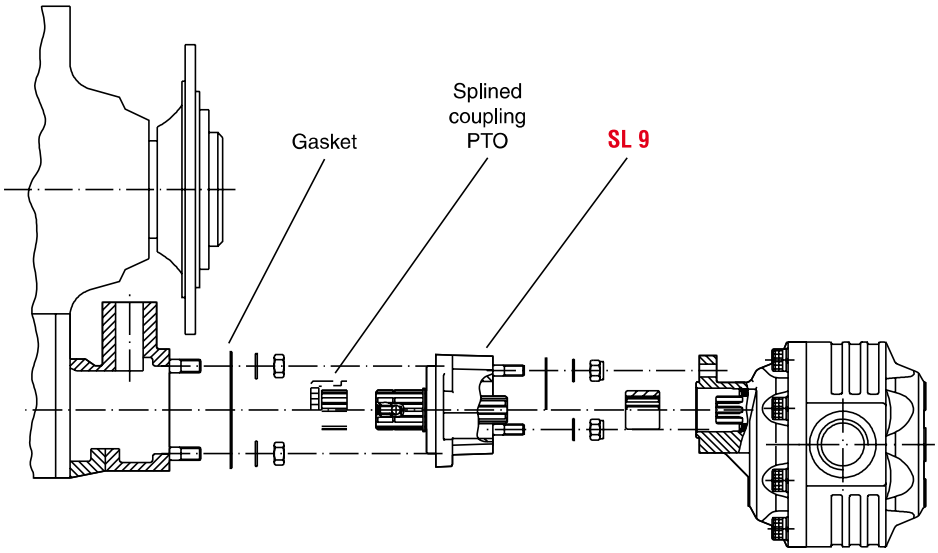
D100-D85/0493



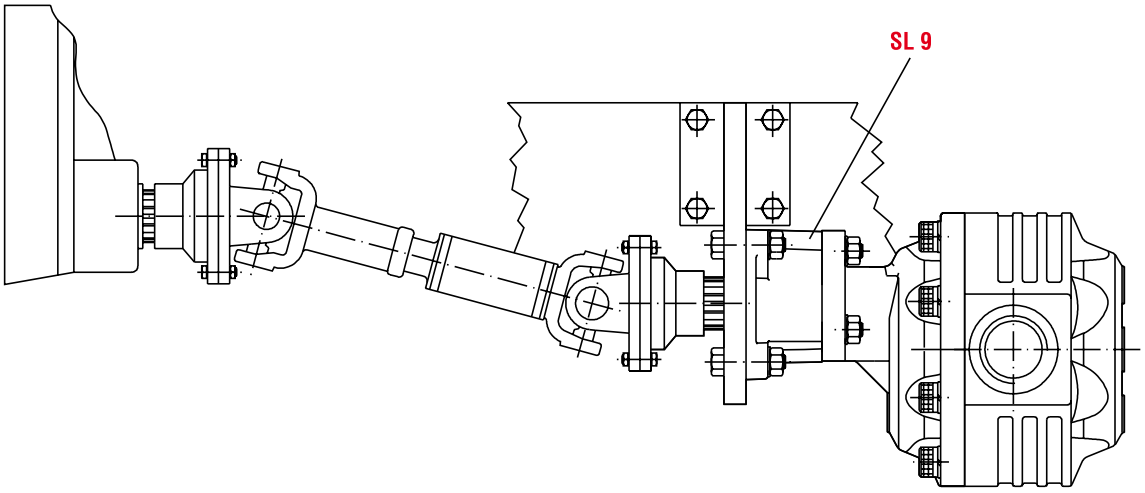
The FORMULA pumps in the application with radial load can be directly connected to the“ZF” P.T.O. with straight teeth gear using the SR9 support.

01/08.2005

APPLICATIONS FOR FORMULA PUMPS WITH ZF P.T.O.(ISO STANDARD)



The FORMULA pumps in the application without radial load can be directly connected to the “ZF” P.T.O. only on self sealed version using the SL9 support.



Use SL9 support to apply the universal joint.

01/08.2005

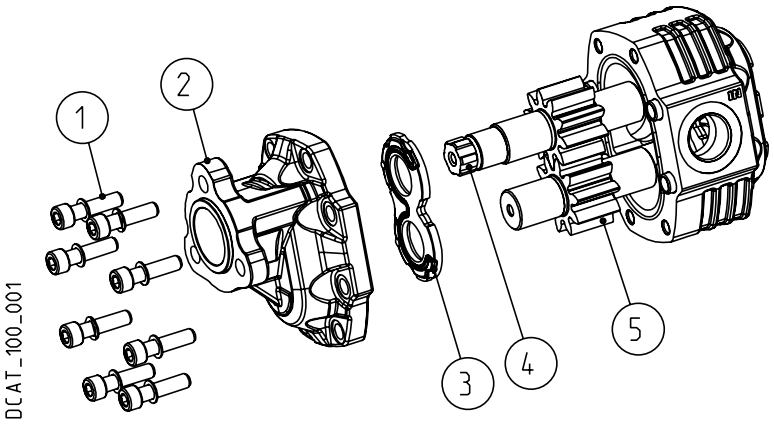
D100-D86/0493

CHANGING ROTATION

Example of changing rotation: from FP30 pump counterclockwise to clockwise

To change rotation of unidirectional pumps is necessary to operate in the following way:

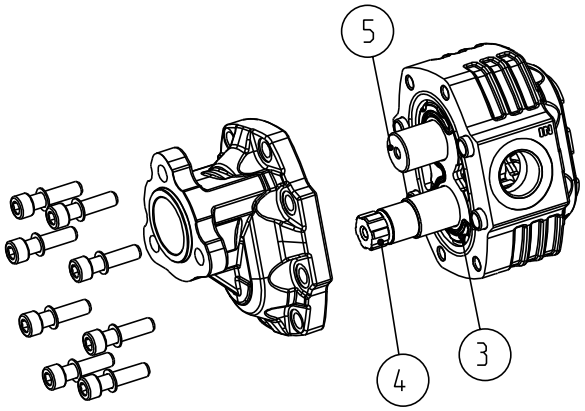
1. Clean the pump externally with care.
2. Loosen, and remove, the clamp bolts (1)
3. Coat the sharp edges of the drive shaft (4) with adhesive tape and smear a layer of clean grease on the shaft end extension to avoid damaging the lip of the shaft seal when removing the mounting flange.
4. Remove the mounting flange (2), taking care to keep the flange as straight as possible during removal. If the flange is stuck, tap around the edge with a fibre or rubber mallet in order to break away from the body. Ensure that while removing the front mounting flange, the drive shaft and other components remain position.



DCAT_100_001

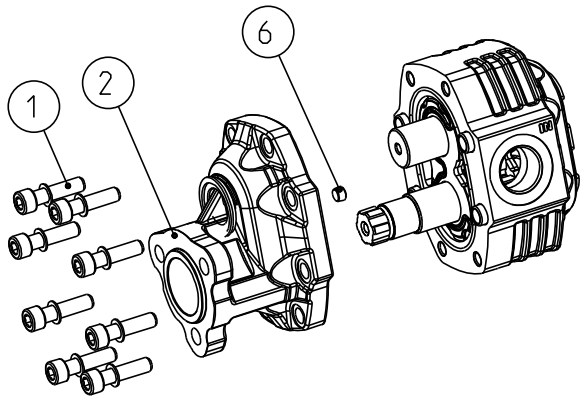
5. Ease the drive gear (4) up to facilitate removal the front plate (3), taking care that the precision ground surfaces do not become damaged, and remove the drive gear.
6. Remove the driven gear (5) without overturning. The rear plate has not to be removed.

7. Re-locate the driven gear (5) in the position previously occupied by the drive gear (4)
8. Re-locate the drive gear (4) in the position previously occupied by the driven gear (5)
9. Replace the front plate (3) in its original position.



DCAT_100_002

10. Remove the grub screw (6) from the mounting flange (2) and re-locate it in the other threaded hole in the same flange.
11. Gently wipe the machined surface of the mounting flange (2) and the body with a flat hand stone.
12. Refit the front mounting flange (2) turned 180° from its original position.
13. Refit the clamp bolts (1) with the washers and tighten in a crisscross pattern to a torque value of 70 ±7 Nm (558 ÷ 682 lbf in).
14. Check that the pump rotates freely when the drive shaft (4) is turned by hand. If not a pressure plate seal may be pinched.
15. The pump is ready for installation with the original rotation reversed.



DCAT_100_003

01/08.2005

INSTRUCTIONS

INSTALLATION

The direction of rotation of single-rotation pumps must be the same as that of the drive shaft. Check that the coupling flange correctly aligns the transmission shaft and the pump shaft, the connection do not generate an axial or radial load on the pump shaft

TANK

Tank capacity must be sufficient for the system's operating conditions (~ 3 times the amount of oil in circulation) to avoid overheating of the fluid. A heat exchanger should be installed if necessary. The intake and return lines in the tank must be spaced apart (by inserting a vertical divider) to prevent the return-line oil from being taken up again immediately.

LINES

The lines must have a major diameter which is at least as large as the diameter of pump ports, and must be perfectly sealed. To reduce loss of power, the lines should be as short as possible, reducing the sources of hydraulic resistance (elbow, throttling, gate valves, etc.) to a minimum. A length of flexible tubing is recommended to reduce the transmission of vibrations. All return lines must end below the minimum oil level, to prevent foaming. Before connecting the lines, remove any plugs and make sure that the lines are perfectly clean

FILTERS

We recommend filtering the entire system flow. Filters on suction and return line must be fitted in according to the contamination class as indicated in the first pages of the catalogue. Casappa recommends to use its own production filters:

IKRON® Fluid Filtration

HYDRAULIC FLUID

Use hydraulic fluid conforming to the table as specified in the first pages of the catalogue. Avoid using mixtures of different oils which could result in decomposition and reduction of the oil's lubricating power.

STARTING UP

Check that all circuit connections are tight and that the entire system is completely clean. Insert the oil in the tank, using a filter. Bleed the circuit to assist in filling. Set the pressure relief valves to the lowest possible setting. Turn on the system for a few moments at minimum speed, then bleed the circuit again and check the level of oil in the tank. Then gradually increase the pressure and speed of rotation until the pre-set operating levels as specified in the catalogue are attained.

PERIODICAL CHECKS - MAINTENANCE

Keep the outside surface clean especially in the area of the drive shaft seal. In fact, abrasive powder can accelerate wear on the seal and cause leakage. Replace filters regularly to keep the fluid clean. The oil level must be checked and oil replaced periodically depending on the system's operating conditions.

01/08.2005

Our policy is one of continuous improvement in product. Specification of items may, therefore, be changed without notice.

F 03 T A Edition: 03/05.2013 Replaces: F 02 T A



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FLUID POWER DESIGN

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