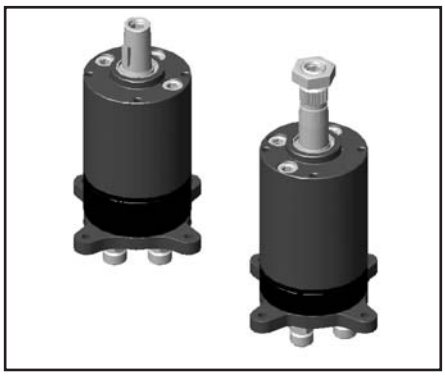
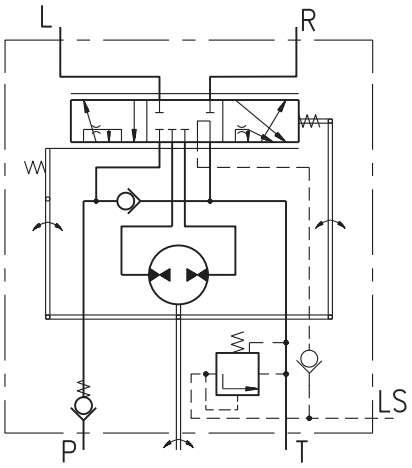
HYDROSTATIC STEERING UNITS TYPE HKUM.../5DT



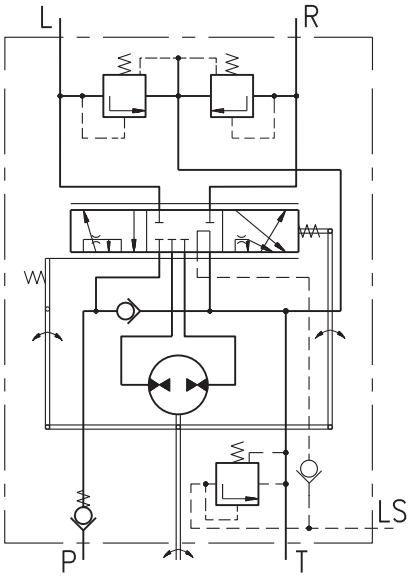
HKUM…/5DT is a steering unit with load sensing dynamic signal and integrated valve functions.

HKUM…/5DT works in a system with a dynamic priority valve and it is appropriate for machines with increased energy saving requirements.

The flow to LS-line allows easy and smooth control when starting steering.



"Closed Center - Non Reaction"
HKUMR.../5DT



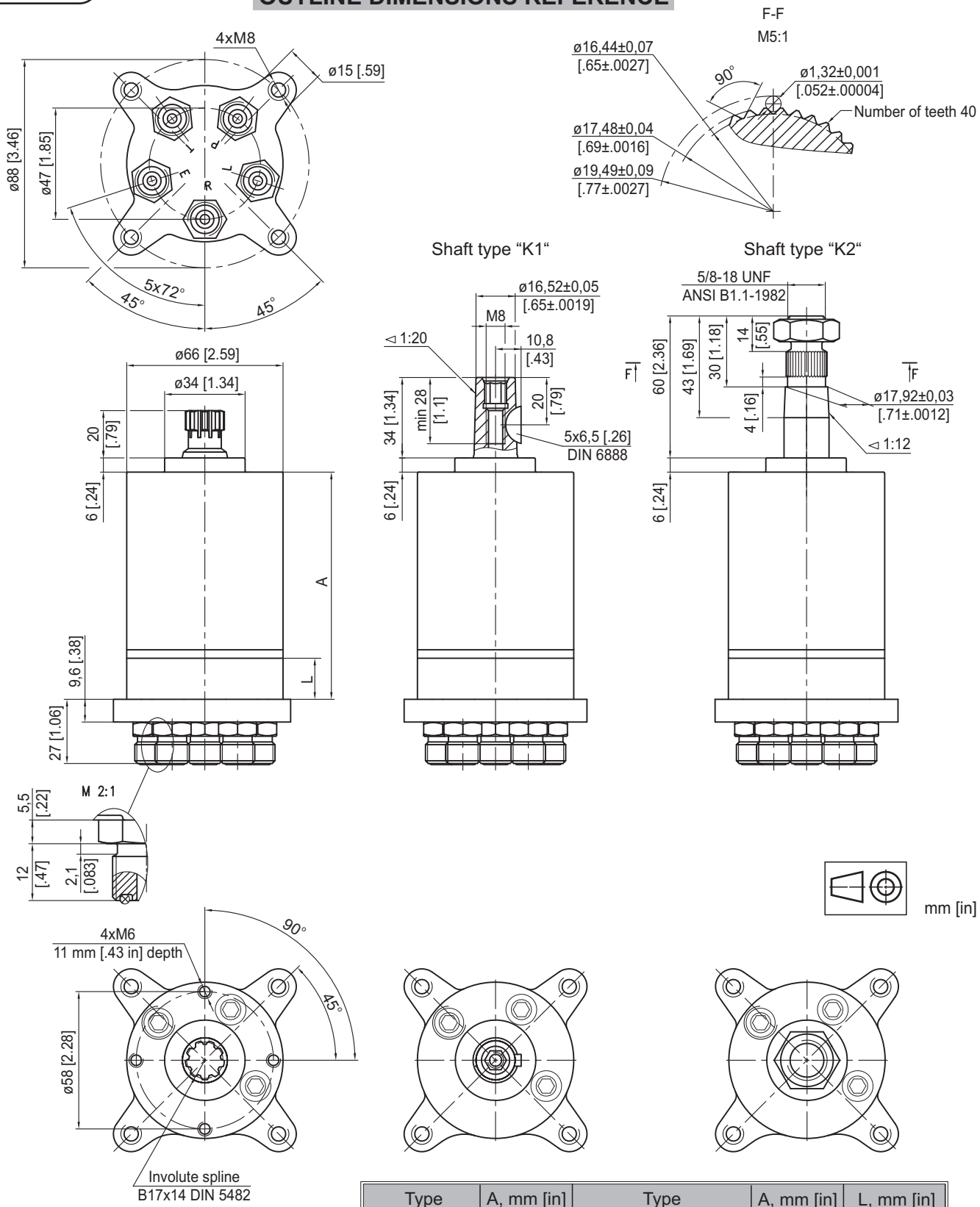
"Closed Center - Non Reaction"
HKUMS.../5DT

SPECIFICATION DATA

Parameters	Type						
	HKUM... 32/5DT	HKUM... 40/5DT	HKUM... 50/5DT	HKUM... 63/5DT	HKUM... 70/5DT	HKUM... 80/5DT	HKUM... 100/5DT
Displacement cm^3/rev [in^3/rev]	31,8 [1.94]	40 [2.44]	50 [3.05]	63 [3.84]	70 [4.27]	80 [4.88]	100 [6.10]
Rated Flow* lpm [GPM]	3,2 [.85]	4,0 [1.06]	5,0 [1.32]	6,0 [1.59]	7,0 [1.85]	8,0 [2.11]	10,0 [2.64]
Rated Pressure bar [PSI]	125 [1810]						
LS-Valve Pressure** Settings bar [PSI]	60 [870]	70 [1015]	80 [1160]	90 [1305]	100 [1450]	110 [1595]	125 [1810]
Shock Valves Pressure*** Settings bar [PSI]	120 [1740]	130 [1885]	140 [2030]	150 [2175]	160 [2320]	170 [2465]	185 [2683]
Max. Cont. Pressure in Line T bar [PSI]	20 [290]						
Max. Torque at Servoamplifing Nm [lb-in]	2,0 [17.7]						
Max. Torque w/o Servoamplifing Nm [lb-in]	80 [708]						
Weight kg [lb]	2,6 [5.7]	2,7 [5.95]	2,8 [6.2]	2,9 [6.39]	2,95 [6.5]	3 [6.6]	3,2 [7.05]

* Rated Flow at 100 RPM.
** The pilot pressure relief valve is set at an oil flow to the priority valve of 12 l/min [3.17GPM]
*** Pressure Settings are at flow rate of 1 l/min [.26 GPM] and viscosity 21 mm^2/s [105 SUS] at 50°C [120°F].

OUTLINE DIMENSIONS REFERENCE



code	Ports - P, T, R, L, E Thread
A	9/16-18 UNF (ORFS)

Type	A, mm [in]	Type	A, mm [in]	L, mm [in]
HKUM 32/4	90 [3.54]	HKUM 32/4PB(5DT)	103 [4.06]	11,0 [.43]
HKUM 40/4	93 [3.66]	HKUM 40/4PB(5DT)	106 [4.17]	13,7 [.54]
HKUM 50/4	96 [3.78]	HKUM 50/4PB(5DT)	109 [4.29]	17,1 [.67]
HKUM 63/4	100 [3.94]	HKUM 63/4PB(5DT)	113 [4.45]	21,6 [.85]
HKUM 70/4	103 [4.06]	HKUM 70/4PB(5DT)	116 [4.57]	24,0 [.94]
HKUM 80/4	106 [4.17]	HKUM 80/4PB(5DT)	119 [4.69]	27,4 [1.08]
HKUM 100/4	113 [4.45]	HKUM 100/4PB(5DT)	126 [4.96]	34,2 [1.35]

ORDER CODE for HKUM.../4(PB)...

	1	2		3		4		5		6	7	8
HKUM			/		-		-		-			

Pos.1 - Option

	Relief Valve	Check Valve in P-port	Shock Valve
omit	no build-in valves		
R	•		
S	•	•	•

Pos.2 - Displacement code

32	- 31,8 cm^3/rev [1.94 in^3/rev]
40	- 40,0 cm^3/rev [2.44 in^3/rev]
50	- 50,0 cm^3/rev [3.05 in^3/rev]
63	- 63,0 cm^3/rev [3.84 in^3/rev]
70	- 70,0 cm^3/rev [4.27 in^3/rev]
80	- 80,0 cm^3/rev [4.88 in^3/rev]
100	- 100,0 cm^3/rev [6.10 in^3/rev]

Pos.3 - Versions

4	- *"Open Center - Non Load Reaction"*
4PB	- *"Open Center - Non Load Reaction" with 5 ports (Power Beyond)*

Pos.4 - Relief Valve Pressure Settings* [bar]

60	**70**	**80**	**90**	**100**	**110**	**125**

Pos.5 - Shaft Versions

omit	- Splined B17x14 DIN 5482
K1	- Tapered 1:20, key 5x6,5 DIN 6888
K2	- Tapered 1:12, with 11/16 in-40 serrations

Pos.6 - Ports

A	- ORFS main ports - ISO 8434-3

Pos.7 - Option (Paint)**

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

Pos.8 - Design Series

omit - Factory specified

Notes: * For HKUMR... and HKUMS... only.
** Colour at customer's request.
The steering units are mangano-phosphatized as standard.

ORDER CODE for HKUM.../5DT

	1	2		3	4		5		6		7	8	9
HKUM			/	5D	T	-		-		-			

Pos.1 - Option

	Relief Valve	Check Valve in P-port	Shock Valve
R	•		
S	•	•	•

Pos.2 - Displacement code

32	- 31,8 cm^3/rev [1.94 in^3/rev]
40	- 40,0 cm^3/rev [2.44 in^3/rev]
50	- 50,0 cm^3/rev [3.05 in^3/rev]
63	- 63,0 cm^3/rev [3.84 in^3/rev]
70	- 70,0 cm^3/rev [4.27 in^3/rev]
80	- 80,0 cm^3/rev [4.88 in^3/rev]
100	- 100,0 cm^3/rev [6.10 in^3/rev]

Pos.3 - Versions

5D	- Version 5 "Close Center - Non Load Reaction and Dynamic Load Signal"

Pos.4 - Priority Valve Connection

T	- Pipe Mounting

Pos.5 - Relief Valve Pressure Settings [bar]

60	**70**	**80**	**90**	**100**	**110**	**125**

Pos.6 - Shaft Versions

omit	- Splined B17x14 DIN 5482
K1	- Tapered 1:20, key 5x6,5 DIN 6888
K2	- Tapered 1:12, with 11/16 in-40 serrations

Pos.7 - Ports

A	- ORFS main ports - ISO 8434-3

Pos.8 - Option (Paint)*

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

Pos.9 - Design Series

omit - Factory specified

Notes: * Colour at customer's request.
The steering units are mangano-phosphatized as standard.

GENERAL APPLICATION AND SPECIFICATION INFORMATION

APPLICATION
(SIZING AND STEERING SYSTEM DESIGN PROCESS)

STEP ONE:
Calculate approximate kingpin torque (M_L).

$$M_L = G \cdot \mu \sqrt{\frac{B^2}{8} + \ell^2}$$

Note: Double M_L if steered wheels are powered.

M_L = Kingpin torque in daNm [*lb-in*].

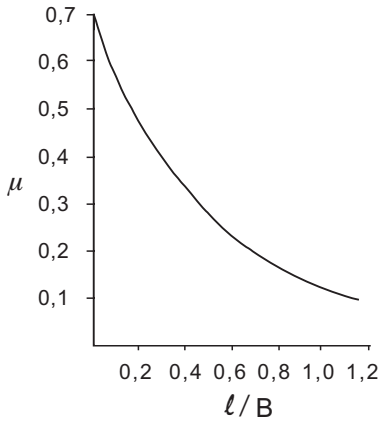
G = Vehicle weight on steered axle daN [*lbs*] (use maximum estimated overload weight).

μ = Coefficient of friction (use Chart № 1, dimensionless) determined by ℓ/B (see Diagram № 1).

B = Nominal width of tyre print, m [*in*] (see Diagram № 1).

ℓ = Kingpin offset. The distance between tyre centerline intersection at ground and kingpins centerline intersection at ground in, m [*in*] (see Diagram№1).

Chart № 1



Rubber tyres on dry concrete.

Diagram № 1

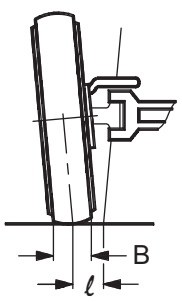
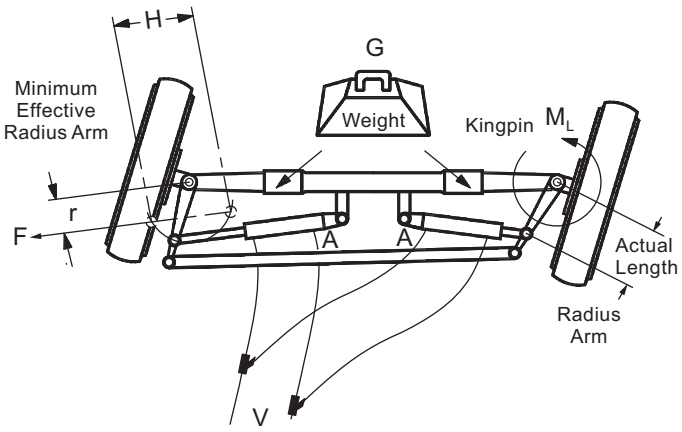


Diagram № 2



STEP TWO:
Calculate approximate cylinder; force-area-stroke-volume.

FORCE $F = \frac{M_L}{r}$

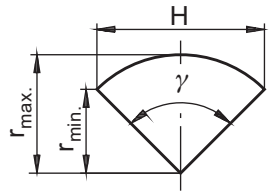
F = Force required daN [*lbs*] to steer axle.

M_L = Kingpin torque in daNm [*lb-in*] from step one. Double M_L if steered wheels are powered.

r = Effective radius Arm mm [*in*] is the minimum distance from the centerline of the cylinders minimum and maximum stroke points parallel to the kingpin center pivot. This is not the physical length of the radius Arm (see Diagram № 2 and Chart № 2).

Chart № 2

$$r_{min.} = r_{max.} \cdot \cos\frac{\gamma}{2}$$



STROKE
H = Stroke, cm [*in*].
Calculate stroke of cylinder using Diagram № 2 and Chart № 2 as shaft.

$$H = 2\, r_{max.} \cdot \sin\frac{\gamma}{2}$$

AREA $A = \frac{F}{\Delta P}$

A = Cylinder area for axle cylinder set, cm^2 [in^2].

F = Force required from step two force formula, daN [*lbs*].

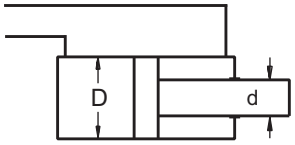
ΔP = Hydraulic pressure bar [*PSI*] use following percentage of relief valve setting by amount of load on steered axle. Severe load 25% - medium load 55% - no load 75% .

DIAMETER
After the cylinder set area is determined, the cylinder diameter can be calculated.

D = Inside diameter of cylinder, cm [*in*].
d = Road diameter of cylinder, cm [*in*].

Choose type of cylinder arrangement and formula shown for that type.

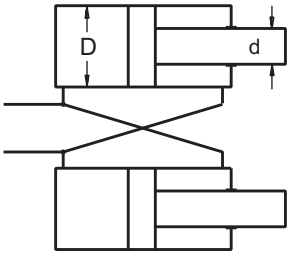
Differential Cylinder



$$D = \sqrt{\frac{4A}{\pi} + d^2}$$

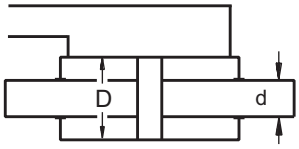
Note: $\left(\frac{d}{D}\right)^2 \leq 0{,}15$

Cross Connected Cylinders



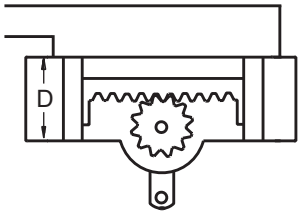
$$D = \sqrt{\frac{2A}{\pi} + \frac{d^2}{2}}$$

Balanced Cylinder



$$D = \sqrt{\frac{4A}{\pi} + d^2}$$

Opposed Cylinder



$$D = \sqrt{\frac{4A}{\pi}}$$

VOLUME $V = H \cdot A$

V = Volume. The total amount of oil required to move the cylinder rod(s) through the entire stroke, cm^3 [in^3].
H = Stroke, cm [*in*].
A = Area, cm^2 [in^2].
Note: For differential cylinders it is important to calculate average cylinder volume for step three using below formula.

$$V_{avg.} = H \cdot \frac{\pi}{4}(2.D^2 - d^2)$$

STEP THREE:

Selecting displacement of hydrostatic steering unit.

At this point determine number of steering wheel revolutions desired for your application to steer the wheels from one side to the other (lock to lock). Depending on the type of vehicle and its use, this will vary from 3 to 5 turns.

DISPLACEMENT $V_D = \frac{V}{n}$

V_D = Displacement, cm^3/rev [in^3/*rev*].
V = Volume of oil, cm^3 [in^3].
n = Steering wheel turns lock to lock.

After completing the above displacement calculation, choose the closest standard hydrostatic steering unit in displacement size that incorporates circuity you require.
Recalculate the number of steering wheel turns using the displacement of selected standard hydrostatic steering unit outlined above. Use the formula shown below.

$$n = \frac{V}{V_D}$$

V = Volume of oil, cm^3 [in^3].
n = Steering wheel turns lock to lock.
Note: For differential cylinders applications the cylinder volume will be different for left and right turns - this means the value *n* (steering wheel turns lock to lock) will vary when turning to the left or right.

STEP FOUR:

Calculate approximate minimum and maximum steering circuit flow requirements.

$$Q = \frac{V_D \cdot N}{\text{Unit Conversion for Imperial or [1000] Metric}}$$

Q = Steering circuit flow, lpm [*GPM*].
V_D = Unit displacement, cm^3/rev [in^3/*rev*]
N = Steering wheel input speed, RPM.
Recommended steering speed is 50 to 100 *RPM*.

Many variables are involved in sizing the pump. We suggest that the manufacturer should test and evaluate for the desired performance.

GENERAL INFORMATION

FLUID DATA:
To insure maximum performance and life of the Hydrostatic steering units, use premium quality hydraulic oils. Fluids with effective quantities of anti-wear agents or additives are highly recommended. If using synthetic fluids consult the factory for alternative seal materials.

- **Viscosity**

Viscosity at normal operating temperature should be approx. 20 mm^2/s [100 SUS]. Viscosity range 10 - 300 mm^2/s [60 - 1500 SUS].

- **Temperature**

Normal operating temperature range from +30°C [+85°F] to +60°C [140°F].
Minimum operating temperature -40°C [-40°F].
Maximum operating temperature +80°C [+176°F].
Note: Extended periods of operation at temperature of 60°C and above will greatly reduce the life of the oil due to oxidation and will shorten the life of the product.

- **Filtration**

The maximum degree of contamination per ISO 4406 or CETOP RP is:
- 20/17 open center units
- 19/16 closed center and load sensing
- 16/12 priority valves

Return line filtration of 25 μm nominal (40 - 50 μm absolute) or finer is recommended.

In extremely dusty conditions filtration of 10 μm absolute should be used.

START UP

All air must be purged from system before operating unit. It is extremely important that any external lines or units with load sensing or priority feature be completely bled. Lines going to and from cylinders as well as lines to and from pump be purged of all air. It is recommended that a 10-15 μm filter be used between pump and steering unit before start up.

MOUNTING UNITS

All hydrostatic steering units should be installed for ease of access. It is recommended that the steering unit be located outside the vehicle cabin.

It is important that no radial axial load be applied to the hydrostatic steering unit input shaft. Some or all radial and axial loads must be absorbed by the steering column or other operating devices supplied by the vehicle manufacturer.

Ports on the steering cylinder(s) should face upward to prevent damage.

During installation of the hydrostatic steering unit, cleanliness is of the utmost importance. Pipe plugs should be left in place during mounting and only removed when hydraulic lines are to be connected.

CONVERSIONS

to convert inches and millimeters:

1 in = 25,4 mm
1 mm = .03973 in

to convert gallons per minute and liters per minute:

1 GPM = 3,785 lpm
1 lpm = .2642 GPM

to convert pounds per square inch and bar:

1 PSI = 0,0689 bar
1 bar =14.51 PSI

to convert pounds-inch and newton-meters:

1 lb-in = 0,113 Nm
1 Nm = 8.85 lb-in

TORQUE TIGHTENING VALUES

Fluid connections

Fluid connection	Max. tightening torque daNm [lb-in]			
	metal edge	copper washer	aluminum washer	O - ring
G 1/4	4,0 [350]	3,5 [309]	3,5 [309]	
G 3/8	7,0 [620]	4,5 [398]	5,0 [442]	
G 1/2	10,0 [885]	5,5 [486]	8,0 [708]	
G 3/4	18,0 [1593]	9,0 [796]	13,0 [1150]	
M 10 x 1	4,0 [350]	2,0 [180]	3,0 [265]	
M 18 x 1,5	8,0 [708]	5,5 [486]	7,0 [620]	
M 22 x 1,5	10,0 [885]	6,5 [575]	8,0 [708]	
7/16 - 20 UNF				2,0 [180]
9/16 - 18 UNF				5,0 [442]
3/4 - 16 UNF				6,0 [531]
7/8 - 14 UNF				9,0 [796]
1 1/16 - 12 UN				12,0 [1062]

Mounting bolts

Mounting bolts	Tightening torque daNm [lb - in]
3/8 - 16 UNC	3,0 ± 0,5 [230 ÷ 310]
M 10 x 1	6,5 ± 0,5 [540 ÷ 620]
M 10	3,0 ± 0,5 [230 ÷ 310]