

HYDROSTATIC STEERING UNITS TYPE HKU(S).../5(T)(E)(TE)



The HKU(S).../5(T)(E)(TE) range expands the steering units family of M+S Hydraulic with the "Closed Center - Non Reaction and Load Sensing Outlet" version (static hydraulic connection to the priority valve).

This range is manufactured in two versions; for modularly and pipe mounting and therefore were developed the two versions of priority (tracing) valves: PRD... and PRT...

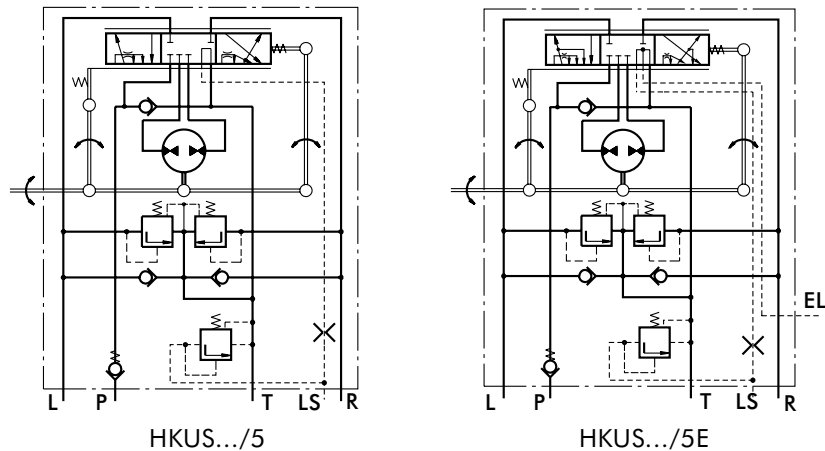
HKU.../5 is designed to be connected with priority valves with built-in relief valves for rated flow up to 160 l/min.

The control hydraulic circuits of the HKU(S).../5(T)(E)(TE) steering units were designed to ensure minimal energy consumption (energy losses) in various hydraulic systems such as those of: fork-lift trucks, agricultural and construction machines and others.

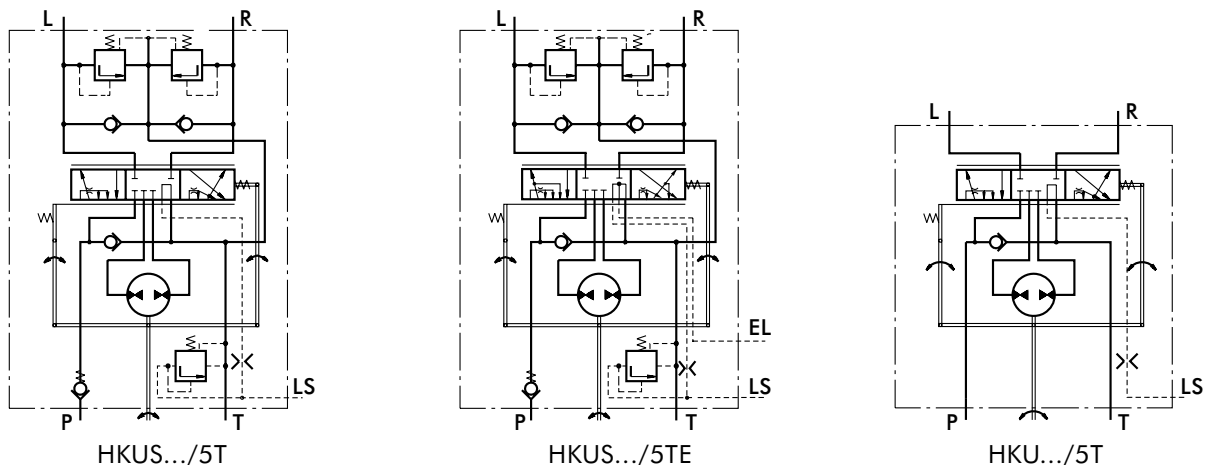
The HKUS.../5E and HKUS.../5TE are equipped with an electrohydraulic relay, mounted in the EL port, which supplies signal to the electric - control system. The relay can be pre-set to normally - open (N.O) or normally - closed (N.C) contacts, with control range from 0,1 to 50 bars. Upon customer's request the relay could be supplied with another type of fixing thread.

*For operation in condition of Thermal Shock see the notes on page 6.

Modularity Mounting



Pipe Mounting

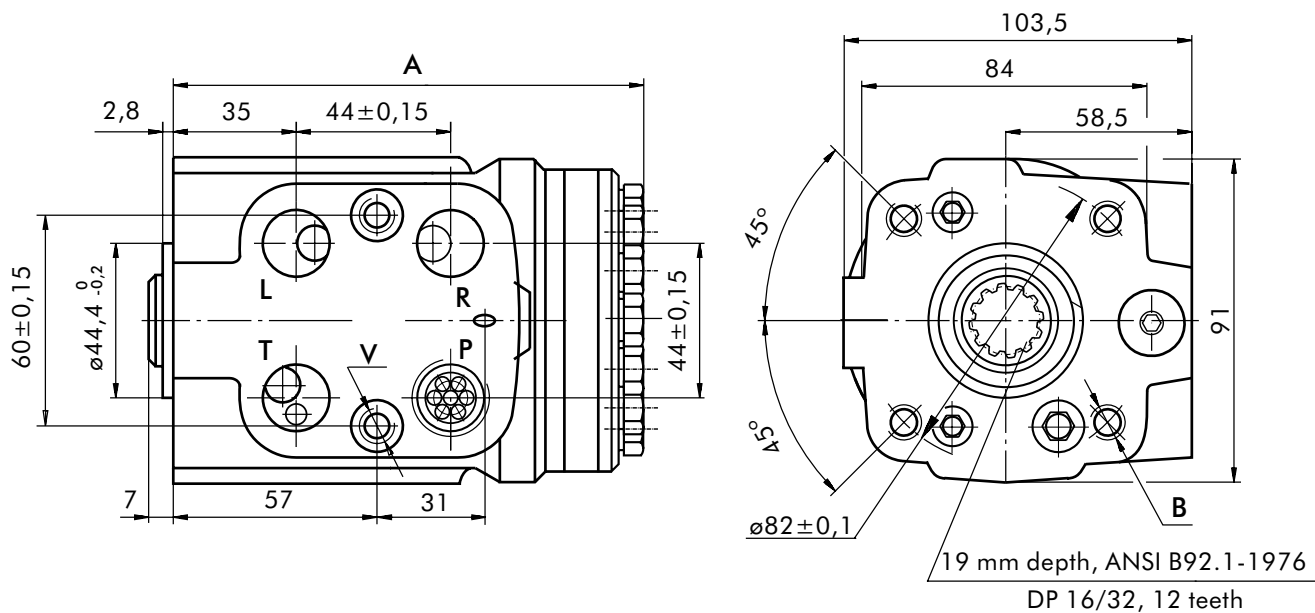


SPECIFICATION DATA

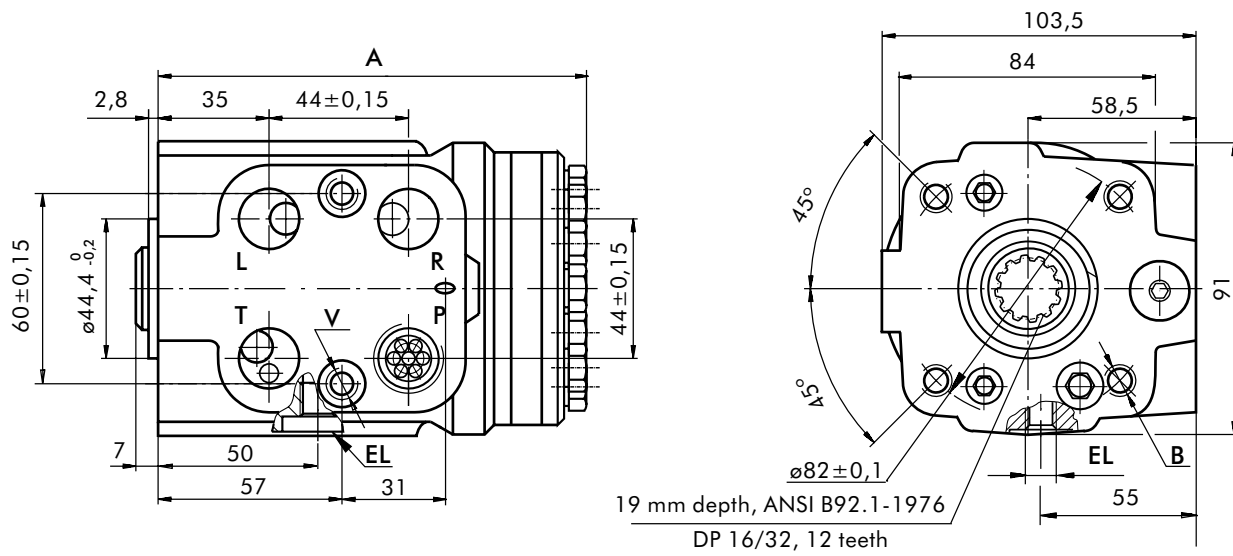
Parameters	Type													
	HKU 40/5T	HKU 50/5T	HKU 63/5T	HKU 80/5T	HKU 100/5T	HKU 125/5T	HKU 160/5T	HKU 200/5T	HKU 250/5T	HKU 320/5T	HKU 400/5T	HKU 500/5T	HKU 630/5T	
	HKUS 40/5...	HKUS 50/5...	HKUS 63/5...	HKUS 80/5...	HKUS 100/5...	HKUS 125/5...	HKUS 160/5...	HKUS 200/5...	HKUS 250/5...	HKUS 320/5...	HKUS 400/5...			
Displacement [cm ³ /rev]	39,6	49,5	65,6	79,2	99,0	123,8	158,4	198	247,5	316,8	396	495	618,7	
Rated Flow* [l/min]	4	5	6	8	10	13	16	20	25	32	40	50	63	
Rated Pressure [bar]	125	150	175											
LS - Valve Pressure Settings** [bar]				80	100	125	150	175						
Shock Valves Pressure Settings*** [bar]				140	160	180	200	240						
Max.Cont. Pressure in Line T - P _T [bar]								20						
Max.Torque at Servoamplifying [Nm]								6	(by P _T max)					
Max.Torque w/o Servoamplifying [Nm]								120						
Weight, avg. [kg]	5,4	5,5	5,6	5,7	5,8	5,9	6,2	6,5	6,6	7,2	7,8	8	8,7	
Dimension A [mm]	130,8	132,2	133,9	136,2	138,8	142,2	146,8	152,2	158,8	168,2	178,8	192	209,3	

* Rated Flow at 100 RPM.
 ** Pressure Settings are at flow rate of 6 l/min and viscosity 21 mm²/s (50° C).
 ***Pressure Settings are at flow rate of 2 l/min and viscosity 21 mm²/s (50° C).

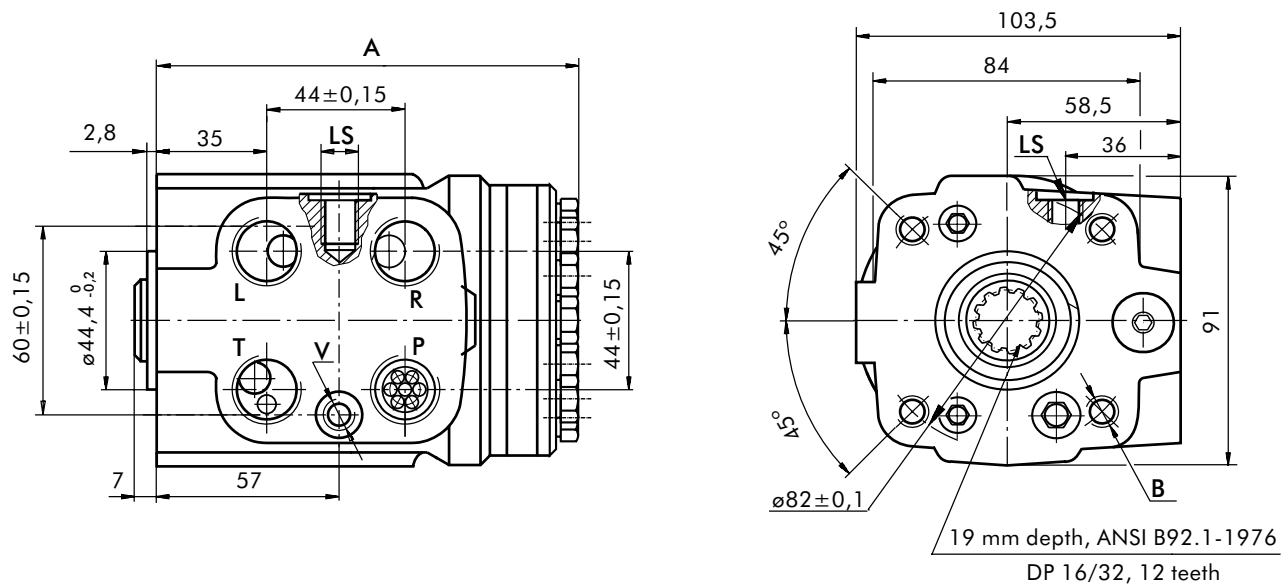
DIMENSIONS AND MOUNTING DATA - HKUS.../5



DIMENSIONS AND MOUNTING DATA - HKUS.../5E

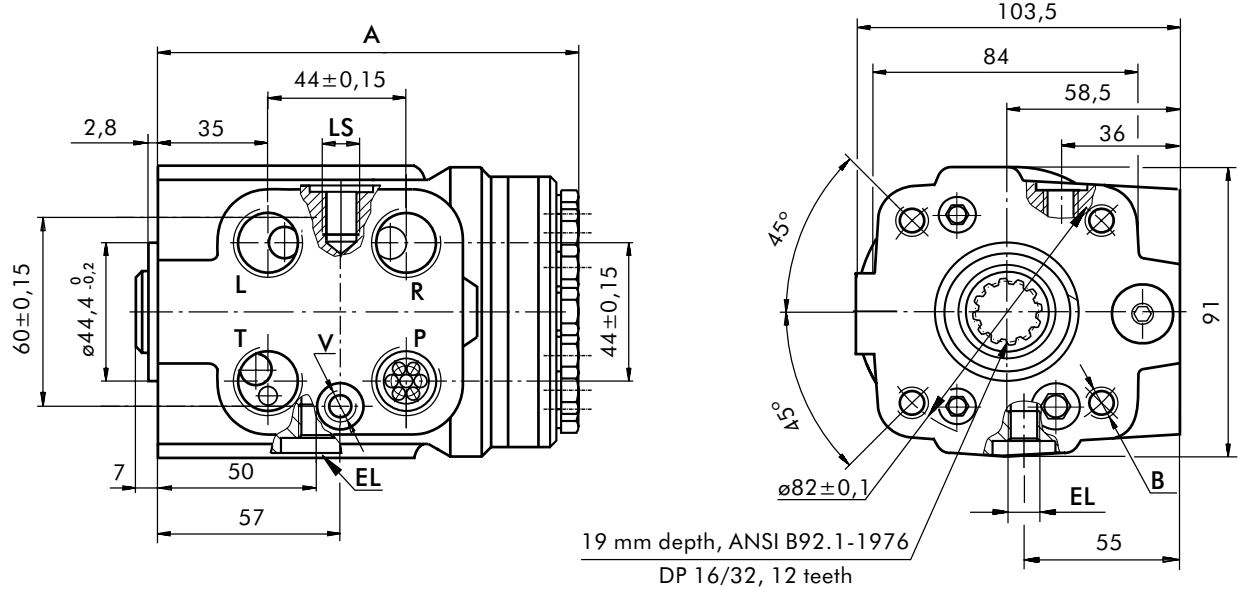


DIMENSIONS AND MOUNTING DATA - HKUS.../5T

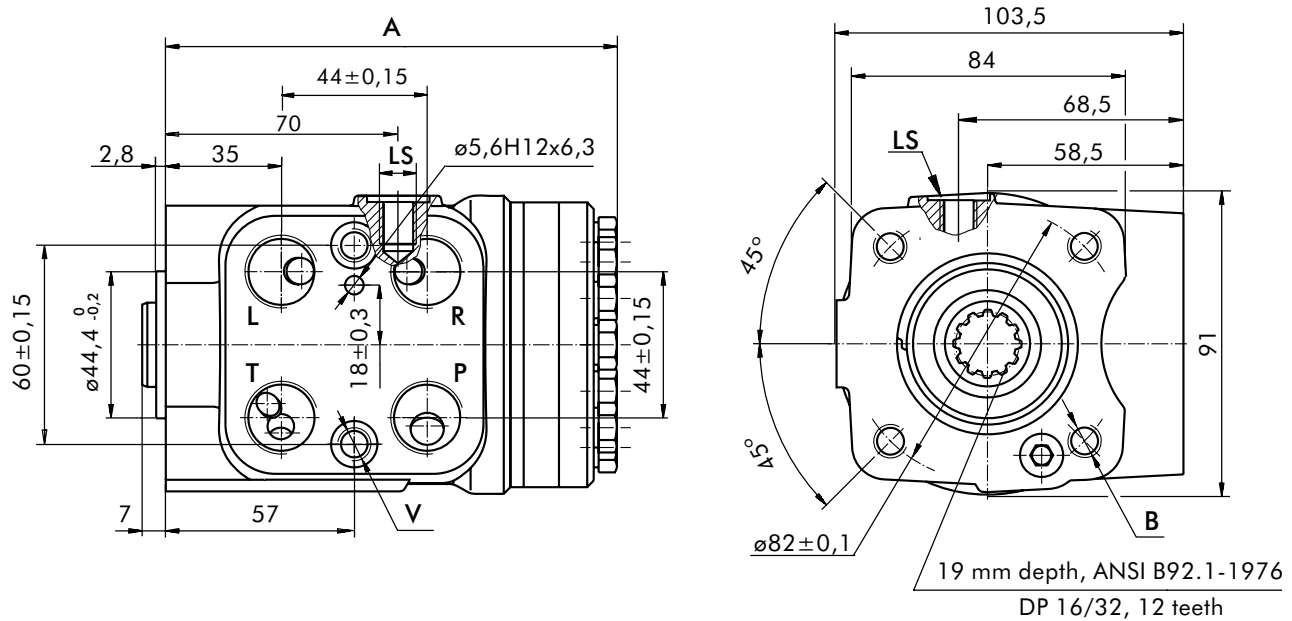


* The ports are shown in the Table of page 18.

DIMENSIONS AND MOUNTING DATA - HKUS.../5TE



DIMENSIONS AND MOUNTING DATA - HKU.../5T



THREADED PORTS

code	Ports - *P, T, R, L Thread	Column Mounting Thread - B	Valve Mounting Thread- V	LS - Port	EL - Port
-	G1/2 17 mm depth	4 x M10 18 mm depth	2 x M10x1 16 mm depth	G1/4 14 mm depth	M10x1 10 mm depth
A	3/4 - 16 UNF O-ring 17 mm depth	4 x 3/8 - 16 UNC 15,7 mm depth	2 x 3/8 - 24 UNF 14,2 mm depth	7/16 - 20 UNF O-ring 12,7 mm depth	7/16 - 20 UNF O-ring 12,7 mm depth
M	M22x1,5 17 mm depth	4 x M10 18 mm depth	2 x M10x1 16 mm depth	G1/4 14 mm depth	M10x1 10 mm depth

*Threaded Port P min 16 mm.

ORDER CODE for HKUS.../5...

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

Pos.1 - Displacement code (see Specification Data)

40	- 39,6 [cm ³ /rev]
50	- 49,5 [cm ³ /rev]
63	- 65,6 [cm ³ /rev]
80	- 79,2 [cm ³ /rev]
100	- 99,0 [cm ³ /rev]
125	- 123,8 [cm ³ /rev]
160	- 158,4 [cm ³ /rev]
200	- 198,0 [cm ³ /rev]
250	- 247,5 [cm ³ /rev]
320	- 316,8 [cm ³ /rev]
400	- 396,0 [cm ³ /rev]

Pos.2 - Versions

5	- Version 5 "Closed Center - Non Reaction and Load Sensing Outlet"
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Pos.3 - Priority Valve Connection

omit	- Modulary Mounting
T	- Pipe Mounting

Pos.4 - Electric Signal Connection

omit	- without electric signal connection
E	- with electric signal connection

Pos.5 - LS - Valve Pressure Settings, bar

80	100	125	150	175
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Pos.6 - Ports

omit	- BSPP (ISO 228)
A	- SAE (ANSI B 1.1 - 1982)
M	- Metric (ISO 262)

Pos.7 - Option (Paint)*

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

Pos.8 - Design Series

omit	- Factory specified
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NOTES:

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

ORDER CODE for HKU.../5T...

	1		2		3		4		5		6
HKU		/	5	T							

Pos.1 - Displacement code (see Specification Data)

40	- 39,6 [cm ³ /rev]
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63	- 65,6 [cm ³ /rev]
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100	- 99,0 [cm ³ /rev]
125	- 123,8 [cm ³ /rev]
160	- 158,4 [cm ³ /rev]
200	- 198,0 [cm ³ /rev]
250	- 247,5 [cm ³ /rev]
320	- 316,8 [cm ³ /rev]
400	- 396,0 [cm ³ /rev]
500	- 495,0 [cm ³ /rev]
630	- 618,7 [cm ³ /rev]

Pos.2 - Versions

5	- Version 5 "Closed Center - Non Reaction and Load Sensing Outlet"
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Pos.3 - Priority Valve Connection

T	- Pipe Mounting
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HYDROSTATIC STEERING UNITS

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].

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

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

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

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

Chart No 1

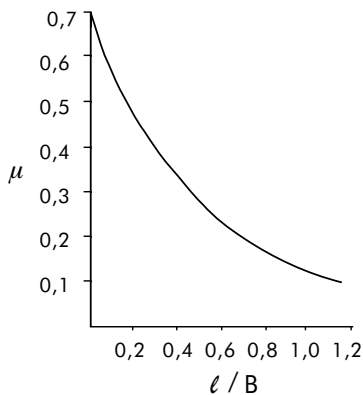


Diagram No 1

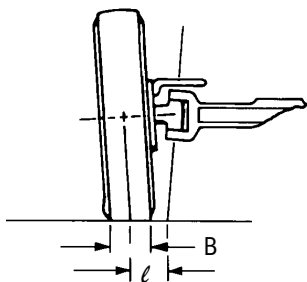
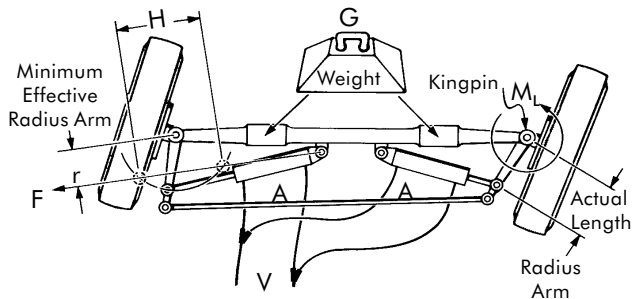


Diagram No 2



STEP TWO:

Calculate approximate cylinder; force-area-stroke-volume.

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

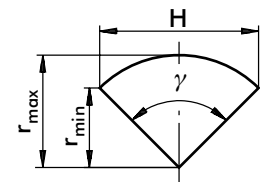
F = Force required [daN] to steer axle.

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

r = Effective radius Arm [mm] 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 No 2 and Chart No 2).

Chart No 2

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



STROKE

H = Stroke [cm].

Calculate stroke of cylinder using Diagram No 2 and Chart No 2 as shavt.

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

AREA

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

A = Cylinder area for axle cylinder set [cm²].

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

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

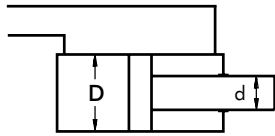
DIAMETER

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

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

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

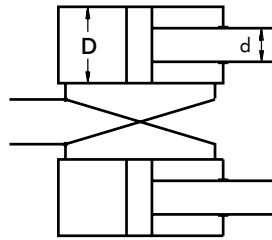
Differential Cylinder



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

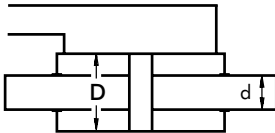
Note: $\left(\frac{d}{D}\right)^2 \leq 0,15$

Cross Connected Cylinders



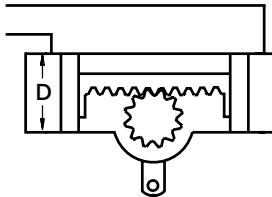
$$D = \sqrt{\frac{2A}{\pi} + \frac{d^2}{2}}$$

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 [cm³].

H = Stroke [cm].

A = Area [cm²].

Note: For differential cylinders it is important to calculate average cylinder volume for step three using below formula.

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

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 [cm³] per rev.

V = Volume of oil [cm³].

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 circuitry 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 [cm³].

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.

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

Q = Steering circuit flow [l/min].

V_D = Unit displacement [cm³] per rev.

N = Steering wheel input speed [rpm] (min⁻¹).

Recommended steering speed is 50 to 100 rpm.

Many variables are involved in sizing the pump. We suggest that the manufacturer test and evaluate for 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 mm²/s. Viscosity range 10 - 300 mm²/s.

Temperature

Normal operating temperature range from +30°C to +60°C.

Minimum operating temperature -40°C.

Maximum operating temperature +80°C.

Note: Extended periods of operation at temperature of 60°C and above will greatly reduce life of oil due to oxidation and shorten life of 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 μ m nominal (40 - 50 μ m absolute) or finer is recommended.

In extremely dusty conditions filtration of 10 μ m 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 mm 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. Any or all radial and axial loads must be absorbed by the steering column or other operating device supplied by the vehicle manufacture.

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.

TORQUE TIGHTENING VALUES

Fluid connections

Fluid connection	Max. tightening torque daNm			
	metal edge	copper washer	aluminum washer	O - ring
7/16 - 20 UNF				2
9/16 - 18 UNF				5
3/4 - 16 UNF				6
7/8 - 14 UNF				7
G 1/4	4	2	3	
G 3/8	6	2	5	
G 1/2	10	3	8	
G 3/4	16	5	13	
M 10 x 1	4	2	3	
M 18 x 1,5	7	2	5	
M 22 x 1,5	10	3	8	

Mounting bolts

Mounting bolts	Tightening torque daNm
3/8 - 16 UNC	3,0 \pm 0,5
M 10 x 1	6,5 \pm 0,5
M 10	3,0 \pm 0,5