



**M+S**

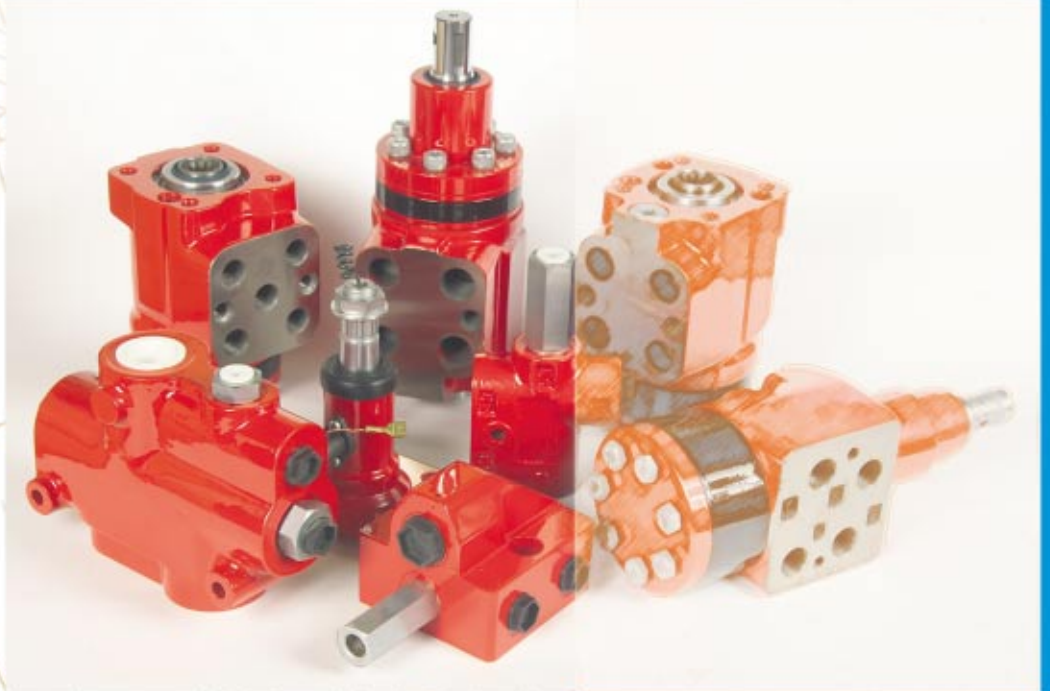
**HYDRAUMIC**

**SAE version**

**HYDRAUMIC**



# HYDROSTATIC STEERING UNITS & ACCESSORIES



**TYPE**

**HKU**

**HKUS**

**UVM**

# HYDROSTATIC STEERING UNITS AND ACCESSORIES

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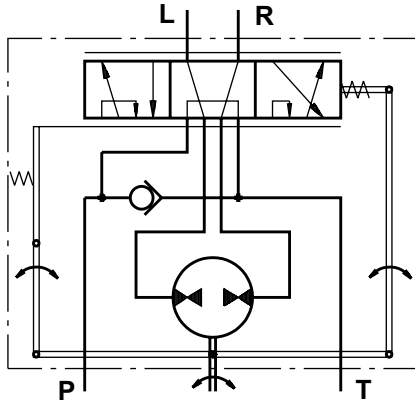
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# HYDROSTATIC STEERING UNITS TYPE HKU.../3, 4

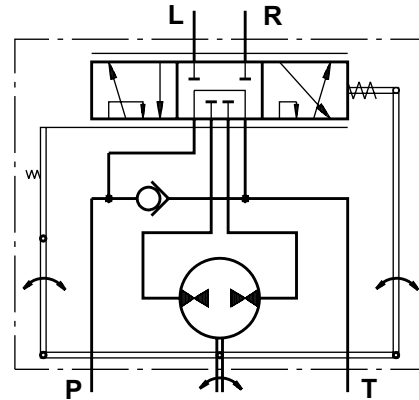


The M+S Hydraulic Hydrostatic Steering units are used in low-speed vehicles which driving speed does not exceed 37 mph [60 km/h] - such as: building machines, fork-lift trucks, harvesting machines, off-highway equipment and others. These hydraulic units amplify the torque to the steering wheels, with no need of hard mechanical connection.

The newly designed HKU steering units, with radial distribution, incorporate two rotary tracing valves in the housing which turn on the metering pump.



"Open Center - Load Reaction"  
Version 3 - HKU.../3



"Open Center - Non Load Reaction"  
Version 4 - HKU.../4

## SPECIFICATION DATA

Parameters	Type																
	HKU 40/3	HKU 50/3	HKU 63/3	HKU 80/3	HKU 100/3	HKU 125/3	HKU 160/3	HKU 200/3	HKU 250/3	HKU 320/3	HKU 400/3						
	HKU 40/4	HKU 50/4	HKU 63/4	HKU 80/4	HKU 100/4	HKU 125/4	HKU 160/4	HKU 200/4	HKU 250/4	HKU 320/4	HKU 400/4	HKU 500/4	HKU 630/4	HKU 800/4	HKU 1000/4		
Displacement	in. <sup>3</sup> /rev. [cm. <sup>3</sup> /rev.]	2.42 [39,6]	3.0 [49,5]	4.0 [65,6]	4.83 [79,2]	6.04 [99,0]	7.56 [123,8]	9.67 [158,4]	12.08 [198]	15.1 [247,5]	19.3 [316,8]	24.17 [396]	30.2 [495]	38.05 [623,6]	48.4 [793]	60.4 [990]	
Rated Flow*	GPM [lpm]	1.1 [4]	1.3 [5]	1.6 [6]	2.1 [8]	2.6 [10]	3.4 [13]	4.2 [16]	5.3 [20]	6.6 [25]	8.4 [32]	10.6 [40]	13.2 [50]	16.6 [63]	21.1 [80]		
Rated Pressure	PSI [bar]	2320 [160]											2030 [140]		1450 [100]		
Max. Cont. Pressure in Line T - P <sub>T</sub>	PSI [bar]	363 [25]															
Max. Torque at Servoamplifying in - lb [Nm]		53 ( by P <sub>T</sub> max ) [6]															
Max. Torque w/o Servoamplifying in - lb [Nm]		1065 [120]															
Weight	lb [kg]	11.7 [5,3]	11.9 [5,4]	12.2 [5,5]	12.4 [5,6]	12.6 [5,7]	12.8 [5,8]	13.2 [6,0]	13.9 [6,3]	14.3 [6,5]	15.4 [7,0]	16.3 [7,4]	17.6 [8,0]	19.2 [8,7]	21.2 [9,6]	23.4 [10,6]	
Dimension A	in. [mm]	5.15 [130,8]	5.20 [132,2]	5.27 [133,9]	5.36 [136,2]	5.47 [138,8]	5.60 [142,2]	5.78 [146,8]	5.99 [152,2]	6.25 [158,8]	6.62 [168,2]	7.04 [178,8]	7.56 [192]	8.24 [209,3]	9.14 [232,2]	10.18 [258,6]	

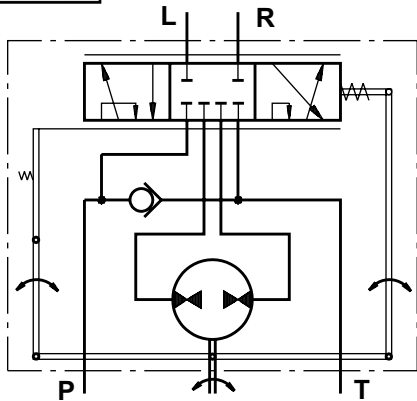
\* Rated Flow at 100 RPM.

# HYDROSTATIC STEERING UNIT TYPE HKU.../7



The HKU.../7 is a "Closed Center - Non Load Reaction" hydrostatic steering unit, designed for integration into systems with built-in hydroaccumulator, achieving minimal energy losses.

When connecting to a differential cylinder the L and R ports of the steering unit must be connected as follows: L to the greater piston area, and R - to the smaller one.



"Closed Center - Non Load Reaction"  
Version 7 - HKU.../7

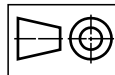
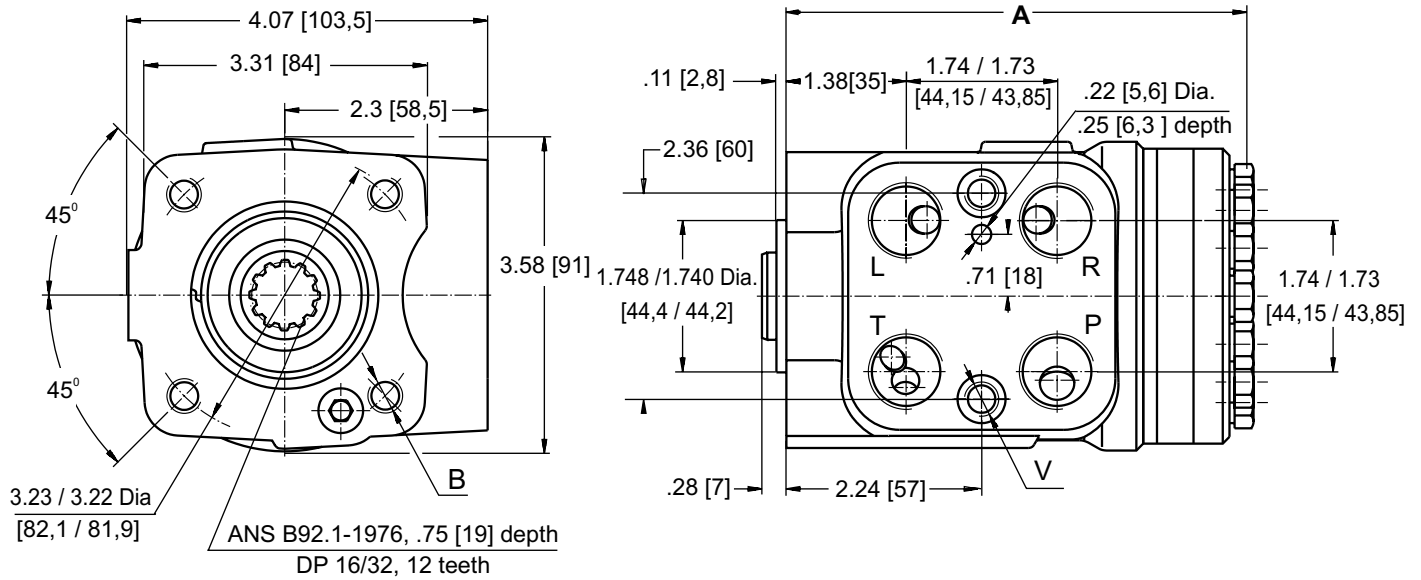
For the "Closed Center - Non Load Reaction" and "Closed Center - Non Reaction and Load Sensing" steering units is possible to observe Thermal Shock - condition caused when the hydraulic system has operated for some time without turning the steering wheel, causing the fluid in the reservoir and the system to heat up while the steering unit is relatively cool (i.e. there is more than 50°F [10°C] difference in the temperature). If, under the condition of Thermal Shock, the steering wheel is turned very quickly, it is possible to experience temporary seizure and have the internal parts of the steering unit damaged. The temporary seizure may be followed by a total free wheeling.

## SPECIFICATION DATA

Parameters	Type														
	HKU 40/7	HKU 50/7	HKU 63/7	HKU 80/7	HKU 100/7	HKU 125/7	HKU 160/7	HKU 200/7	HKU 250/7	HKU 320/7	HKU 400/7	HKU 500/7	HKU 630/7	HKU 800/7	
Displacement	in. <sup>3</sup> /rev.	2.42	3.0	4.0	4.83	6.04	7.56	9.67	12.08	15.1	19.3	24.17	30.2	38.05	48.4
	[cm. <sup>3</sup> /rev.]	[39,6]	[49,5]	[65,6]	[79,2]	[99,0]	[123,8]	[158,4]	[198]	[247,5]	[316,8]	[396]	[495]	[623,6]	[793]
Rated Flow*	GPM	1.1	1.3	1.6	2.1	2.6	3.4	4.2	5.3	6.6	8.4	10.6	13.2	16.6	21.1
	[lpm]	[4]	[5]	[6]	[8]	[10]	[13]	[16]	[20]	[25]	[32]	[40]	[50]	[63]	[80]
Rated Pressure	PSI	2540													
	[bar]	[175]													
Max. Cont. Pressure in Line T - P <sub>T</sub>	PSI	363													
	[bar]	[25]													
Max. Torque at Servoamplifying in - lb [Nm]		53 ( by P <sub>T</sub> max )													
		[6]													
Max. Torque w/o Servoamplifying in - lb [Nm]		1065													
		[120]													
Weight	lb	11.7	11.9	12.2	12.4	12.6	12.8	13.2	13.9	14.3	15.4	16.3	17.6	19.2	21.2
	[kg]	[5,3]	[5,4]	[5,5]	[5,6]	[5,7]	[5,8]	[6,0]	[6,3]	[6,5]	[7,0]	[7,4]	[8,0]	[8,7]	[9,6]
Dimension A	in.	5.15	5.20	5.27	5.36	5.47	5.60	5.78	5.99	6.25	6.62	7.04	7.56	8.24	9.14
	[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]	[232,2]

\* Rated Flow at 100 RPM.

**DIMENSIONS AND MOUNTING DATA - HKU.../3, 4, 7**



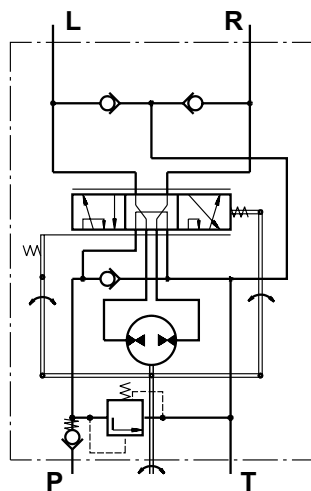
Code	Ports - P, T, R, L Thread	Column Mounting Thread - B	Valve Mounting Thread - V
A	3/4 - 16 UNF O-ring .67 [17] depth	4 x 3/8 - 16 UNC .62 [15,7] depth	2 x 3/8 - 24 UNF .56 [14,2] depth
BA*	9/16 - 18 UNF O-ring .67 [17] depth	4 x 3/8 - 16 UNC .62 [15,7] depth	2 x 3/8 - 24 UNF .56 [14,2] depth
-	G1/2 .67 [17] depth	4 x M10 .71 [18] depth	2 x M10x1 .63 [16] depth
M	M22x1,5 .67 [17] depth	4 x M10 .71 [18] depth	2 x M10x1 .63 [16] depth

\* These threads are for displacements from HKU40 to HKU160 only.

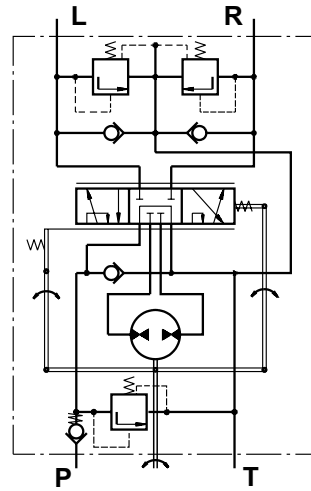
# HYDROSTATIC STEERING UNITS TYPE HKUS.../3, 4, 8



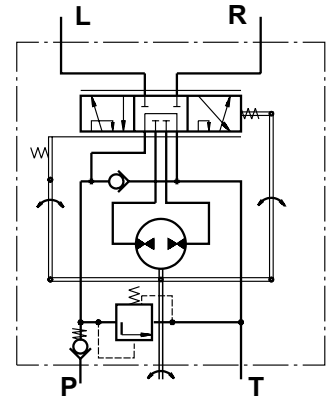
The HKUS Hydrostatic Steering unit is based on the HKU unit but has built-in relief and check valves. Thus M+S Hydraulic achieves one very compact steering unit which reduces the need for additional hydraulic components in the system.



"Open Center - Load Reaction"  
With Built-in Valves  
Version 3 - HKUS.../3



"Open Center - Non Load Reaction"  
With Built-in Valves  
Version 4 - HKUS.../4



"Open Center - Non Load Reaction"  
With Built-in Valve  
Version 8 - HKUS.../8

## SPECIFICATION DATA

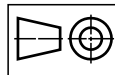
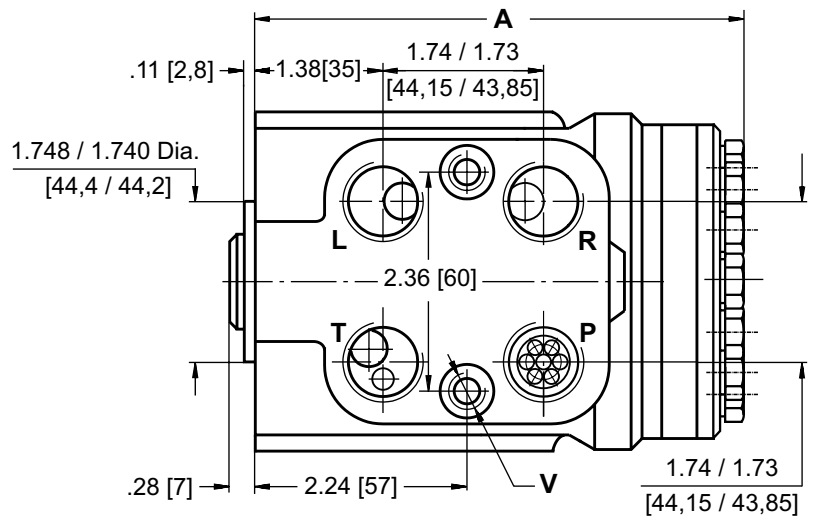
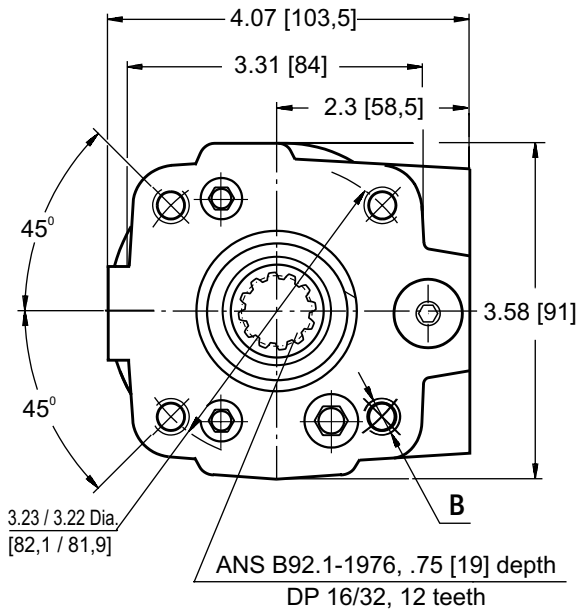
Parameters	Type											
	HKUS 40/3,4,8	HKUS 50/3,4,8	HKUS 63/3,4,8	HKUS 80/3,4,8	HKUS 100/3,4,8	HKUS 125/3,4,8	HKUS 160/3,4,8	HKUS 200/3,4,8	HKUS 250/3,4,8	HKUS 320/3,4,8	HKUS 400/3,4,8	
Displacement	in. <sup>3</sup> /rev.	2.42	3.0	4.0	4.83	6.04	7.56	9.67	12.08	15.1	19.3	24.17
	[cm. <sup>3</sup> /rev.]	[39,6]	[49,5]	[65,6]	[79,2]	[99,0]	[123,8]	[158,4]	[198]	[247,5]	[316,8]	[396]
Rated Flow*	GPM	1.1	1.3	1.6	2.1	2.6	3.4	4.2	5.3	6.6	8.4	10.6
	[lpm]	[4]	[5]	[6]	[8]	[10]	[13]	[16]	[20]	[25]	[32]	[40]
Rated Pressure	PSI	2320										
	[bar]	[160]										
Relief Valve Pressure Settings**	PSI [bar]	1160    1450    1810    2175 [80]    [100]    [125]    [150]										
	Shock Valves Pressure Settings***	2030    2320    2610    2900 [140]    [160]    [180]    [200]										
Max. Cont. Pressure in Line T - P <sub>T</sub>	PSI [bar]	363 (725 by HKUS.../8) [25 (50 )]										
	Max. Torque at Servoamplifying	53 ( by P <sub>T</sub> max ) [6]										
Max. Torque w/o Servoamplifying	in - lb [Nm]	1065 [120]										
	Weight	lb	11.7	11.9	12.2	12.4	12.6	12.8	13.2	13.9	14.3	15.4
	[kg]	[5,3]	[5,4]	[5,5]	[5,6]	[5,7]	[5,8]	[6,0]	[6,3]	[6,5]	[7,0]	[7,4]
Dimension A	in.	5.15	5.20	5.27	5.36	5.47	5.60	5.78	5.99	6.25	6.62	7.04
	[mm]	[130,8]	[132,2]	[133,9]	[136,2]	[138,8]	[142,2]	[146,8]	[152,2]	[158,8]	[168,2]	[178,8]

\* Rated Flow at 100 RPM.

\*\* Pressure Settings are at Rated Flow (as in the table ) and viscosity 105 SUS [21 mm<sup>2</sup>/s] at 122°F [50° C].

\*\*\*Pressure Settings are at flow rate of .53 GPM [ 2 lpm] and viscosity 105 SUS [21 mm<sup>2</sup>/s] at 122°F [50° C].

**DIMENSIONS AND MOUNTING DATA - HKUS.../3, 4, 8**



Code	Ports - *P, T, R, L Thread	Column Mounting Thread - B	Valve Mounting Thread - V
<b>A</b>	3/4 - 16 UNF O-ring .67 [17] depth	4 x 3/8 - 16 UNC .62 [15,7] depth	2 x 3/8 - 24 UNF .56 [14,2] depth
-	G1/2 .67 [17] depth	4 x M10 .71 [18] depth	2 x M10x1 .63 [16] depth
<b>M</b>	M22x1,5 .67 [17] depth	4 x M10 .71 [18] depth	2 x M10x1 .63 [16] depth

\*Threaded Ports P min .63 [16] depth for pipe mounting.

**ORDER CODE**

	1	2	3	4	5
<b>H K U</b>		/	-		

**Pos.1 - Displacement code** (see Specification Data)

<b>40</b>	- 2.42 [39,6] in. <sup>3</sup> /rev. [cm <sup>3</sup> /rev]
<b>50</b>	- 3.00 [49,5] in. <sup>3</sup> /rev. [cm <sup>3</sup> /rev]
<b>63</b>	- 4.00 [65,6] in. <sup>3</sup> /rev. [cm <sup>3</sup> /rev]
<b>80</b>	- 4.83 [79,2] in. <sup>3</sup> /rev. [cm <sup>3</sup> /rev]
<b>100</b>	- 6.04 [99,0] in. <sup>3</sup> /rev. [cm <sup>3</sup> /rev]
<b>125</b>	- 7.56 [123,8] in. <sup>3</sup> /rev. [cm <sup>3</sup> /rev]
<b>160</b>	- 9.67 [158,4] in. <sup>3</sup> /rev. [cm <sup>3</sup> /rev]
<b>200</b>	- 12.08 [198,0] in. <sup>3</sup> /rev. [cm <sup>3</sup> /rev]
<b>250</b>	- 15.10 [247,5] in. <sup>3</sup> /rev. [cm <sup>3</sup> /rev]
<b>320</b>	- 19.30 [316,8] in. <sup>3</sup> /rev. [cm <sup>3</sup> /rev]
<b>400</b>	- 24.17 [396,0] in. <sup>3</sup> /rev. [cm <sup>3</sup> /rev]
<b>500</b>	- 30.20 [495,0] in. <sup>3</sup> /rev. [cm <sup>3</sup> /rev]
<b>630</b>	- 38.05 [623,6] in. <sup>3</sup> /rev. [cm <sup>3</sup> /rev]
<b>800</b>	- 48.40 [793,0] in. <sup>3</sup> /rev. [cm <sup>3</sup> /rev]
<b>1000</b>	- 60.40 [990,0] in. <sup>3</sup> /rev. [cm <sup>3</sup> /rev]

**Pos.2 - Versions**

<b>3</b>	- Version 3 "Open Center - Load Reaction"
<b>4</b>	- Version 4 "Open Center - Non Load Reaction"
<b>7</b>	- Version 7 "Closed Center - Non Load Reaction"

**Pos.3 - Ports**

omit	- BSPP (ISO 228)
<b>A</b>	- SAE (ANSI B 1.1 - 1982)
<b>BA</b>	- SAE (ANSI B 1.1 - 1982)(for HKU 40÷160 only)
<b>M</b>	- Metric (ISO 262)

**Pos.4 - Option (Paint)\***

omit	- No Paint
<b>P</b>	- Painted Low Gloss Color
<b>PC</b>	- Corrosion Protected Paint

**Pos.5 - Design Series**

omit	- Factory specified
------	---------------------

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

**ORDER CODE**

	1	2	3	4	5	6
<b>H K U S</b>		/	-	-		

**Pos.1 - Displacement code** (see Specification Data)

<b>40</b>	- 2.42 [39,6] in. <sup>3</sup> /rev. [cm <sup>3</sup> /rev]
<b>50</b>	- 3.00 [49,5] in. <sup>3</sup> /rev. [cm <sup>3</sup> /rev]
<b>63</b>	- 4.00 [65,6] in. <sup>3</sup> /rev. [cm <sup>3</sup> /rev]
<b>80</b>	- 4.83 [79,2] in. <sup>3</sup> /rev. [cm <sup>3</sup> /rev]
<b>100</b>	- 6.04 [99,0] in. <sup>3</sup> /rev. [cm <sup>3</sup> /rev]
<b>125</b>	- 7.56 [123,8] in. <sup>3</sup> /rev. [cm <sup>3</sup> /rev]
<b>160</b>	- 9.67 [158,4] in. <sup>3</sup> /rev. [cm <sup>3</sup> /rev]
<b>200</b>	- 12.08 [198,0] in. <sup>3</sup> /rev. [cm <sup>3</sup> /rev]
<b>250</b>	- 15.10 [247,5] in. <sup>3</sup> /rev. [cm <sup>3</sup> /rev]
<b>320</b>	- 19.30 [316,8] in. <sup>3</sup> /rev. [cm <sup>3</sup> /rev]
<b>400</b>	- 24.17 [396,0] in. <sup>3</sup> /rev. [cm <sup>3</sup> /rev]

**Pos.2 - Versions**

<b>3</b>	- Version 3 "Open Center - Load Reaction"
<b>4</b>	- Version 4 "Open Center - Non Load Reaction"
<b>8</b>	- Version 8 "Open Center - Non Load Reaction"

**Pos.3 - Relief Valve Pressure Settings, bar**

80, 100, 125, 150

**Pos.4 - Ports**

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

**Pos.5 - Option (Paint)\***

omit	- No Paint
<b>P</b>	- Painted Low Gloss Color
<b>PC</b>	- Corrosion Protected Paint

**Pos.6 - Design Series**

omit	- Factory specified
------	---------------------

Version	Manual Steering Check Valve	Relief Valve	Inlet Check Valve	Cylinder Relief Valve	Anti-Cavitation Valve
3	•	•	•		•
4	•	•	•	•	•
8	•	•	•		

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

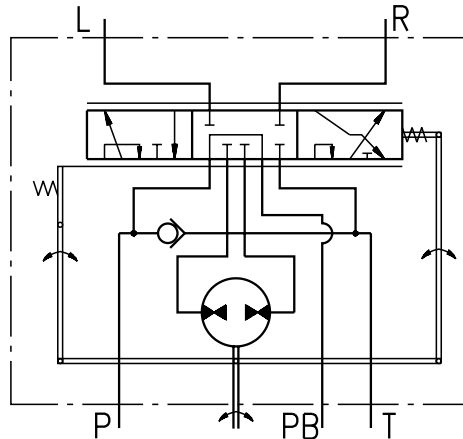
# HYDROSTATIC STEERING UNIT TYPE HKU.../4PB



The hydrostatic steering unit is available for steering medium and large sized transport vehicles as building and agricultural machines.

HKU.../4PB works as standard steering unit with auxiliary port destined for flow providing additional vehicles functions. When the steering wheel is not turned, the flow will be delivered to port PB. After steering wheel has been turned a part of flow will be deviated to the steering unit and the flow trough port PB will be inconstant.

It is not recommended to use this unit in systems with auxiliary functions during the vehicle steering.

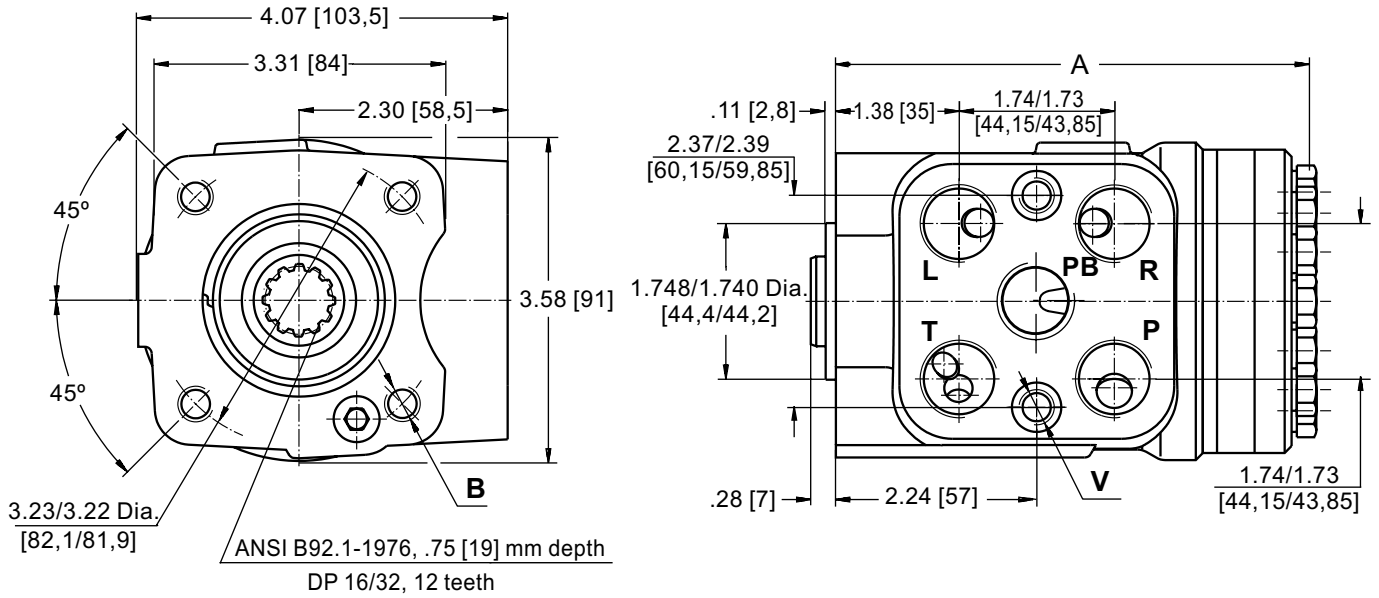


"Open Center - Non Load Reaction"  
HKU.../4PB - Power Beyond

## SPECIFICATION DATA

Parameters	Type						
	HKU 40/4PB	HKU 50/4PB	HKU 63/4PB	HKU 80/4PB	HKU 100/4PB	HKU 125/4PB	
Displacement	in. <sup>3</sup> /rev. [cm. <sup>3</sup> /rev.]	2.42 [39,6]	3.0 [49,5]	4.0 [65,6]	4.83 [79,2]	6.04 [99,0]	7.56 [123,8]
Rated Flow-5 Port (Power Beyond)	GPM [lpm]	3.96 [15]					
Rated Pressure	PSI [bar]	1813 [125]					
Max. Pressure in line PB,	PSI [bar]	1813 [125]					
Max. Cont. Pressure in Line T - P <sub>T</sub>	PSI [bar]	145 [10]					
Max. Torque at Servoamplifying	in - lb [Nm]	24.78 ( by PT max ) [2,8]					
Max. Torque w/o Servoamplifying	in - lb [Nm]	1195 [135]					
Weight	lb [kg]	11.7 [5,3]	11.9 [5,4]	12.2 [5,5]	12.4 [5,6]	12.6 [5,7]	12.8 [5,8]
Dimension A	in. [mm]	5.15 [130,8]	5.20 [132,2]	5.27 [133,9]	5.36 [136,2]	5.47 [138,8]	5.60 [142,2]

**DIMENSIONS AND MOUNTING DATA**



code	Ports - P, T, R, L, PB Thread	Column Mounting Thread - B	Valve Mounting Thread - V
A	9/16 - 18 UNF O-ring .67 17 mm depth	4x 3/8 - 16 UNC .62 [15,7] mm depth	2 x 3/8 - 24 UNF .56 [14,2] mm depth
-	G3/8 .67 [17] mm depth	4 x M10 .71 [18] mm depth	2 x M10x1 .63 [16] mm depth

**ORDER CODE for HKU.../4PB**

	1	2	3	4	5
<b>HKU</b>		<b>/ 4PB</b>	<b>-</b>		

**Pos.1 - Displacement code** (see Specification Data)

<b>40</b>	- 2.42 [39,6] in. <sup>3</sup> /rev. [cm <sup>3</sup> /rev]
<b>50</b>	- 3.00 [49,5] in. <sup>3</sup> /rev. [cm <sup>3</sup> /rev]
<b>63</b>	- 4.00 [65,6] in. <sup>3</sup> /rev. [cm <sup>3</sup> /rev]
<b>80</b>	- 4.83 [79,2] in. <sup>3</sup> /rev. [cm <sup>3</sup> /rev]
<b>100</b>	- 6.04 [99,0] in. <sup>3</sup> /rev. [cm <sup>3</sup> /rev]
<b>125</b>	- 7.56 [123,8] in. <sup>3</sup> /rev. [cm <sup>3</sup> /rev]

**Pos.2 - Versions**

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

**Pos.3 - Ports**

omit - BSPP (ISO 228)  
**A** - SAE (ANSI B 1.1 - 1982)

**Pos.4 - Option (Paint)\***

omit - No Paint  
**P** - Painted Low Gloss Color  
**PC** - Corrosion Protected Paint

**Pos.5 - Design Series**

omit - Factory specified

NOTES: \* Colour at customer's request.

The steering units are mangano-phosphatized as standard.

# HYDROSTATIC STEERING UNIT TYPE HKUQ.../4



HKUQ.../4 is a new series of hydrostatic steering units with an additionally increased flow. The hydrostatic steering unit type HKUQ.../4 is available for steering medium and large sized vehicles, allowing easy control either in servo-amplified mode or in emergency operation.

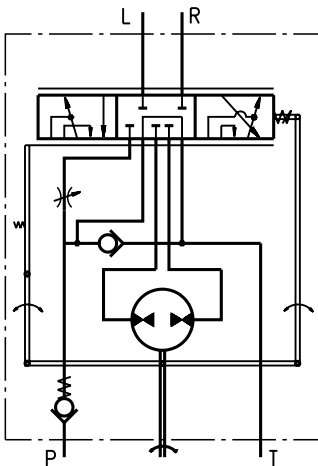
HKUQ.../4 is an "Open Center-Non Load Reaction" hydrostatic steering in which restrictor for amplifying factor from 1,3 to 2,5 is built-in.

In accordance with the size of the gear wheel set and amplifying factor, HKUQ.../4 has the following working volume:

- from 80 cm<sup>3</sup> to 200 cm<sup>3</sup> for emergency operation mode (manual steering without servo-amplifying);

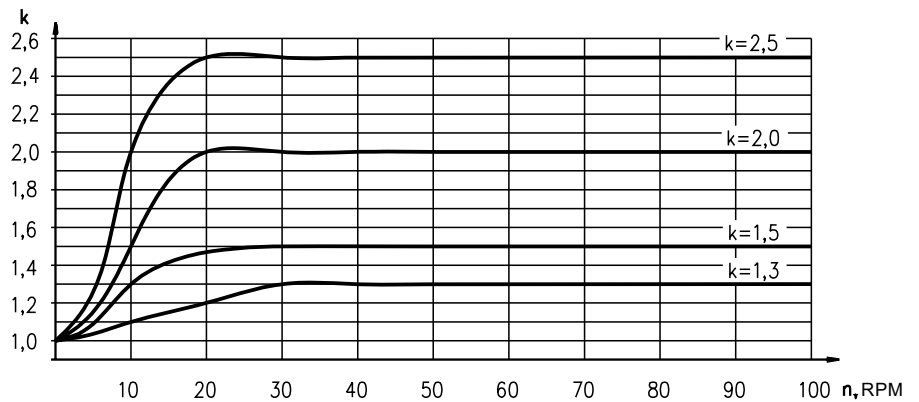
- from 100 cm<sup>3</sup> to 500 cm<sup>3</sup> for normal operation mode (with total flow amplifying).

There is no servo-amplifying of flow if low steering speed till 10 RPM is applied. In steering speed increase over 20 RPM there is total servo-amplifying of flow. In this mode gear wheel set flow and restrictor flow are added.



"Open Center - Non Load Reaction"  
HKUQ.../4

## VARIABLE AMPLIFYING FACTOR

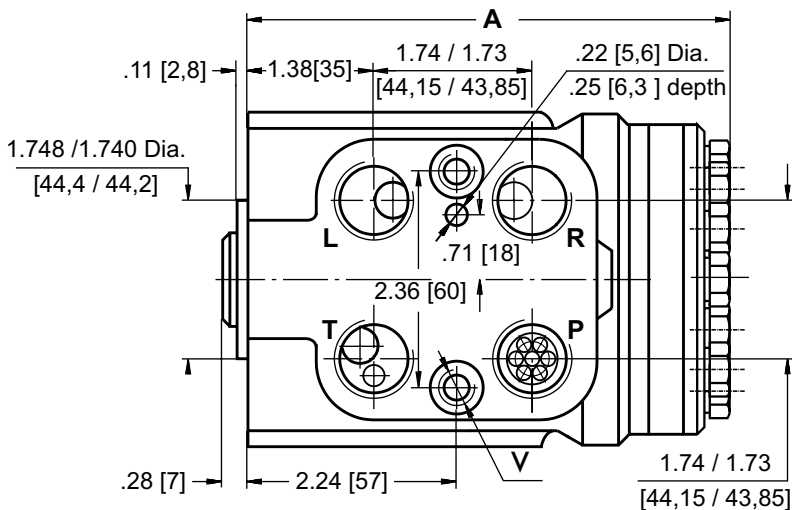
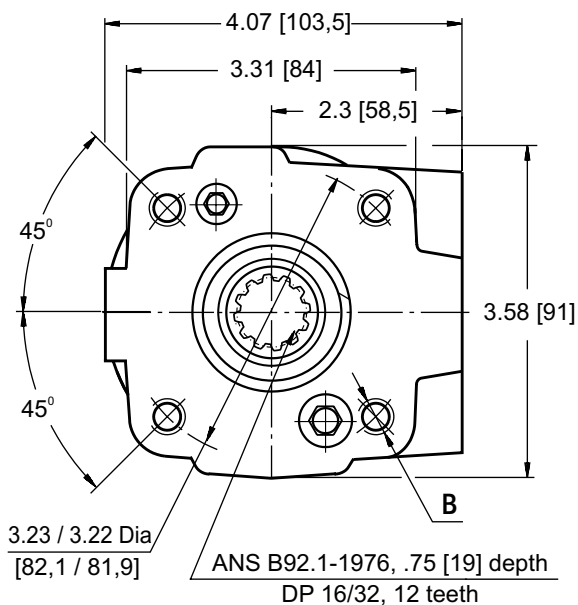


## SPECIFICATION DATA

Parameters	Type																			
	HKUQ 80/.../4				HKUQ 100/.../4				HKUQ 125/.../4				HKUQ 160/.../4				HKUQ 200/.../4			
Displacement - without servo-amplifying (in emergency mode) in <sup>3</sup>	4.83 [79,2]				6.04 [99,0]				7.56 [123,8]				9.67 [158,4]				12.08 [198]			
- with servo-amplifying [cm <sup>3</sup> /rev]	6.10 [100]	7.62 [125]	9.76 [160]	12.20 [200]	7.62 [125]	9.76 [160]	12.20 [200]	15.25 [250]	9.76 [160]	12.20 [200]	15.25 [250]	19.52 [320]	12.20 [200]	15.25 [250]	19.52 [320]	24.4 [400]	15.25 [250]	19.52 [320]	24.4 [400]	30.5 [500]
Rated Flow* GPM	2.64 [10]	3.30 [12,5]	4.22 [16]	5.28 [20]	3.30 [12,5]	4.22 [16]	5.28 [20]	6.60 [25]	4.22 [16]	5.28 [20]	6.60 [25]	8.45 [32]	5.28 [20]	6.60 [25]	8.45 [32]	10.57 [40]	6.60 [25]	8.45 [32]	10.57 [40]	13.21 [50]
Amplifying Factor (at shaft revolution over 20 min <sup>-1</sup> )	1,3	1,5	2,0	2,5	1,3	1,5	2,0	2,5	1,3	1,5	2,0	2,5	1,3	1,5	2,0	2,5	1,3	1,5	2,0	2,5
Rated Pressure PSI [bar]	2320 [160]																			
Max. Cont. Pressure in Line T - P <sub>T</sub> PSI [bar]	363 [25]																			
Max. Torque at Servoamplifying in-lb [Nm]	53 (by P <sub>T</sub> max) [6]																			
Max. Torque w/o Servoamplifying in-lb [Nm]	1065 [120]																			
Weight, avg. lb [kg]	12.4 [5,6]				12.6 [5,7]				12.8 [5,8]				13.2 [6,0]				13.9 [6,3]			
Dimension A in. [mm]	5.36 [136,2]				5.47 [138,8]				5.60 [142,2]				5.78 [146,8]				5.99 [152,2]			

\* Rated Flow at 100 RPM.

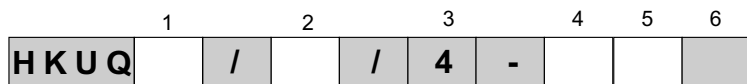
**DIMENSIONS AND MOUNTING DATA**



code	Ports - P*, T, R, L Thread	Column Mounting Thread - B	Valve Mounting Thread - V
A	3/4 - 16 UNF O-ring .67 [17] depth	4x 3/8 - 16 UNC .62 [15,7] depth	2 x 3/8 - 24 UNF .56 [14,2] depth
-	G1/2 .67 [17] depth	4 x M10 .71 [18] depth	2 x M10x1 .63 [16] depth
M	M22x1,5 .67 [17] depth	4 x M10 .71 [18] depth	2 x M10x1 .63 [16] depth

\*Threaded Port **P** min .63 [16] depth.

**ORDER CODE for HKUQ...**



**Pos.1 - Displacement code**

<b>80</b>	4.83 [79,2] in. <sup>3</sup> /rev. [cm <sup>3</sup> /rev]
<b>100</b>	6.04 [99,0] in. <sup>3</sup> /rev. [cm <sup>3</sup> /rev]
<b>125</b>	7.56 [123,8] in. <sup>3</sup> /rev. [cm <sup>3</sup> /rev]
<b>160</b>	9.67 [158,4] in. <sup>3</sup> /rev. [cm <sup>3</sup> /rev]
<b>200</b>	12.08 [198,0] in. <sup>3</sup> /rev. [cm <sup>3</sup> /rev]

**Pos.2 - Displacement with amplifying factor 1,3; 1,5; 2,0 or 2,5**

	80	100	125	160	200
<b>100</b>	■				
<b>125</b>	■	■			
<b>160</b>	■	■	■		
<b>200</b>	■	■	■	■	
<b>250</b>	■	■	■	■	■ k=1,3
<b>320</b>	■	■	■	■	■ k=1,5
<b>400</b>	■	■	■	■	■ k=2,0
<b>500</b>	■	■	■	■	■ k=2,5

**Pos.3 - Versions**

**4** - Version 4 "Open Center - Non Load Reaction"

**Pos.4 - Ports**

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

**Pos.5 - Option (Paint)\*\***

- omit - No Paint
- P** - Painted Low Gloss Color
- PC** - Corrosion Protected Paint

**Pos.6 - Design Series**

omit - Factory specified

**NOTES:**

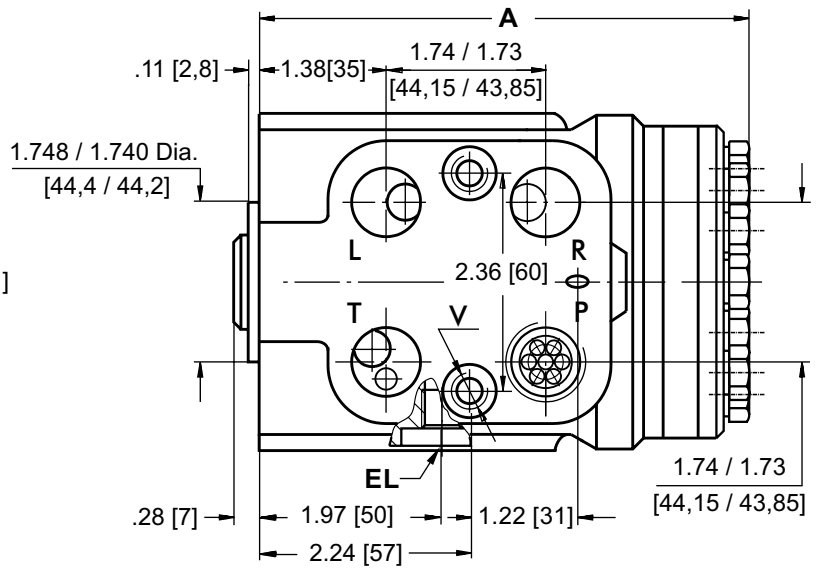
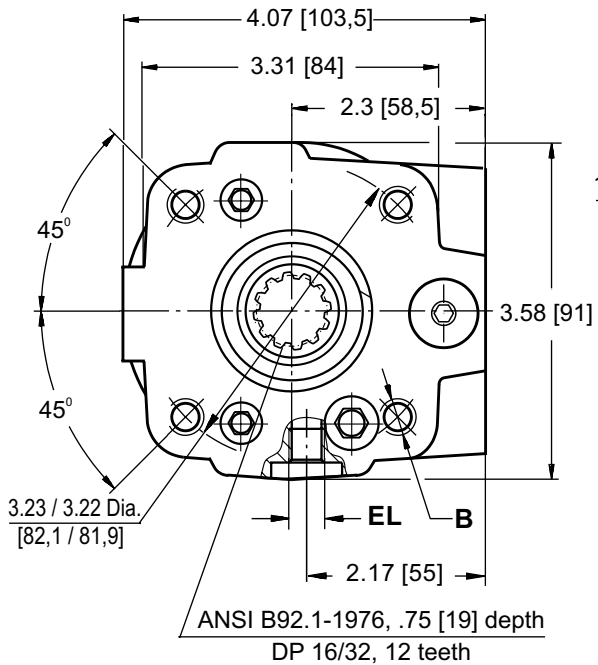
- \* Exemplary designation of steering unit with displacement 200 cm<sup>3</sup> and amplifying factor 2,5: HKUQ 200/500/4
- \*\* Colour at customer's request.

The steering units are mangano-phosphatized as standard.

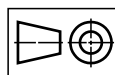
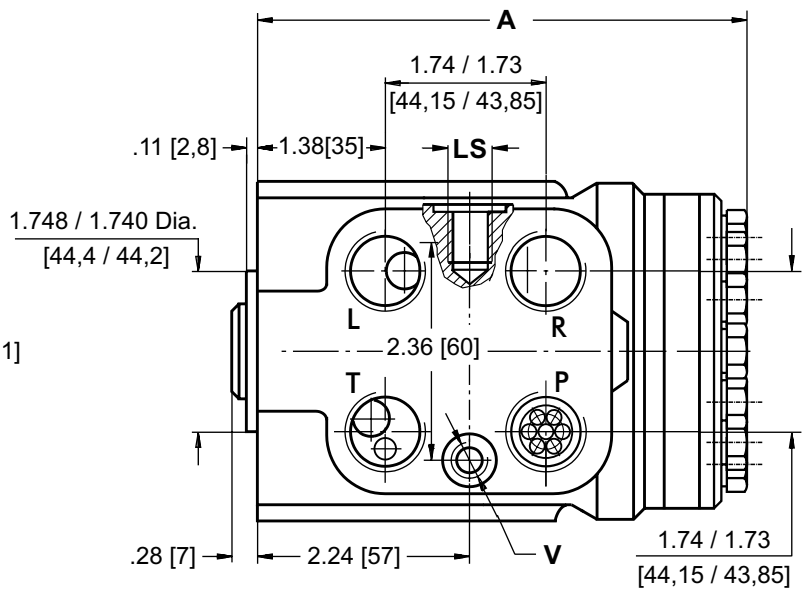
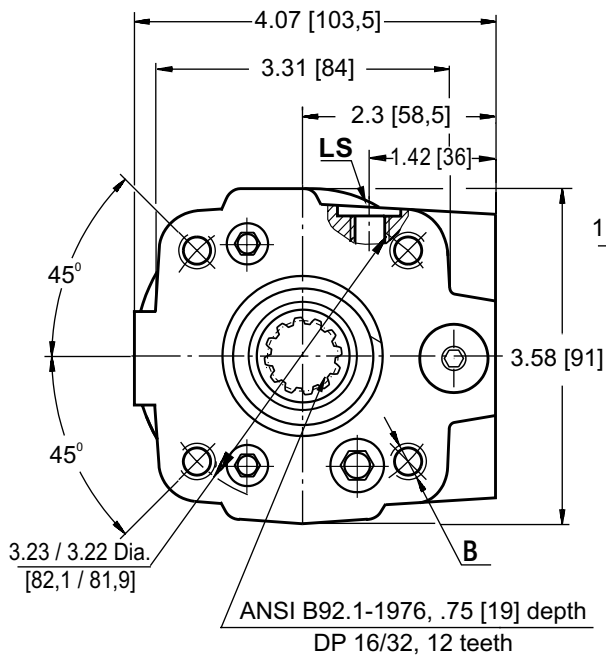




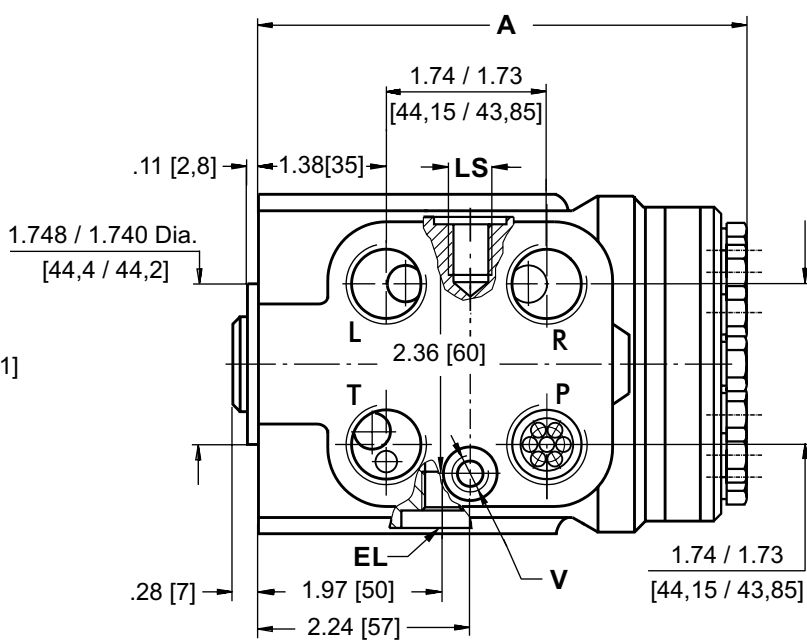
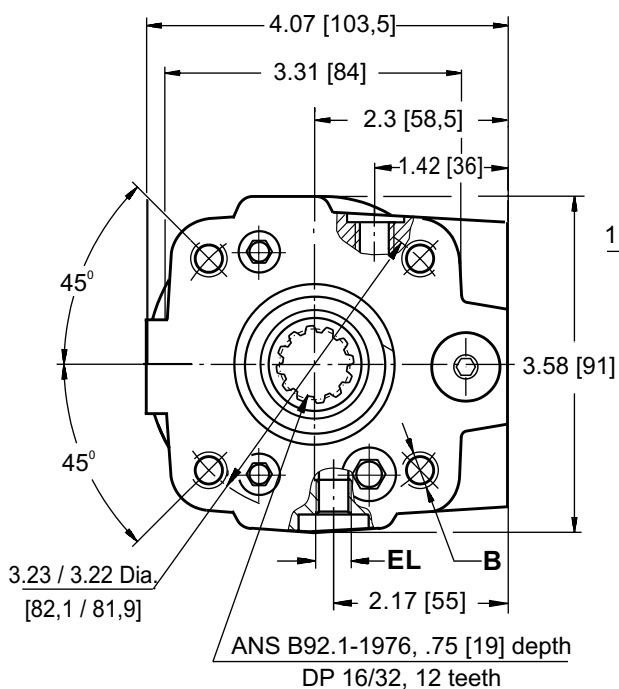
**DIMENSIONS AND MOUNTING DATA - HKUS.../5E**



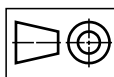
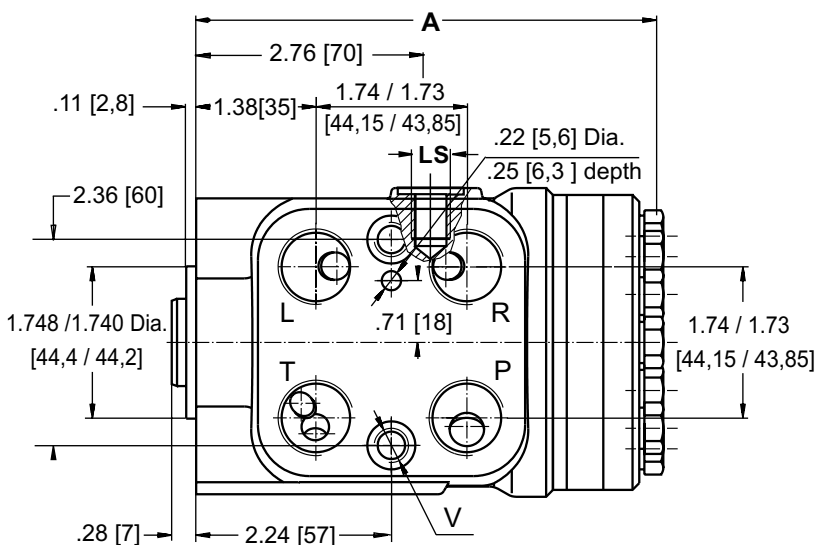
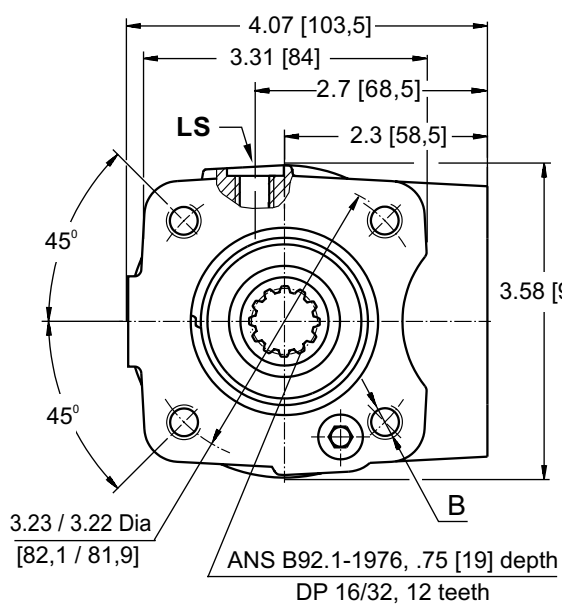
**DIMENSIONS AND MOUNTING DATA - HKUS.../5T**



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



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



Code	Ports - P*, T, R, L Thread	Column Mounting Thread - B	Valve Mounting Thread - V	LS - Port	EL - Port
A	3/4 - 16 UNF O-ring .67 [17] depth	4 x 3/8 - 16 UNC .62 [15,7] depth	2 x 3/8 - 24 UNF .56 [14,2] depth	7/16 - 20 UNF O-ring .50 [12,7] depth	7/16 - 20 UNF O-ring .50 [12,7] depth
-	G1/2 .67 [17] depth	4 x M10 .71 [18] depth	2 x M10x1 .63 [16] depth	G1/4 .55 [14] depth	M10x1 .39 [10] depth
M	M22x1,5 .67 [17] depth	4 x M10 .71 [18] depth	2 x M10x1 .63 [16] depth	G1/4 .55 [14] depth	M10x1 .39 [10] depth

\*Threaded Ports P min.63 [16] depth for pipe mounting.

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

	1		2	3	4		5		6	7	8
<b>HKUS</b>		/	<b>5</b>			-		-			

**Pos.1 - Displacement code** (see Specification Data)

<b>40</b>	-	2.42	[39,6]	in. <sup>3</sup> /rev.	[cm <sup>3</sup> /rev.]
<b>50</b>	-	3.00	[49,5]	in. <sup>3</sup> /rev.	[cm <sup>3</sup> /rev.]
<b>63</b>	-	4.00	[65,6]	in. <sup>3</sup> /rev.	[cm <sup>3</sup> /rev.]
<b>80</b>	-	4.83	[79,2]	in. <sup>3</sup> /rev.	[cm <sup>3</sup> /rev.]
<b>100</b>	-	6.04	[99,0]	in. <sup>3</sup> /rev.	[cm <sup>3</sup> /rev.]
<b>125</b>	-	7.56	[123,8]	in. <sup>3</sup> /rev.	[cm <sup>3</sup> /rev.]
<b>160</b>	-	9.67	[158,4]	in. <sup>3</sup> /rev.	[cm <sup>3</sup> /rev.]
<b>200</b>	-	12.08	[198,0]	in. <sup>3</sup> /rev.	[cm <sup>3</sup> /rev.]
<b>250</b>	-	15.10	[247,5]	in. <sup>3</sup> /rev.	[cm <sup>3</sup> /rev.]
<b>320</b>	-	19.30	[316,8]	in. <sup>3</sup> /rev.	[cm <sup>3</sup> /rev.]
<b>400</b>	-	24.17	[396,0]	in. <sup>3</sup> /rev.	[cm <sup>3</sup> /rev.]

**Pos.2 - Versions**

<b>5</b>	-	Version 5 "Closed Center - Non Reaction and Load Sensing Outlet"
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**Pos.3 - Priority Valve Connection**

omit	-	Modularity Mounting
<b>T</b>	-	Pipe Mounting

**Pos.4 - Electric Signal Connection**

omit	-	without electric signal connection
<b>E</b>	-	with electric signal connection

**Pos.5 - LS - Valve Pressure Settings, bar**

<b>80</b>	<b>100</b>	<b>125</b>	<b>150</b>	<b>175</b>
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**Pos.6 - Ports**

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

**Pos.7 - Option (Paint)\***

omit	-	No Paint
<b>P</b>	-	Painted Low Gloss Color
<b>PC</b>	-	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
<b>HKU</b>		/	<b>5</b>	<b>T</b>	-		

**Pos.1 - Displacement code** (see Specification Data)

<b>40</b>	-	2.42	[39,6]	in. <sup>3</sup> /rev.	[cm <sup>3</sup> /rev.]
<b>50</b>	-	3.00	[49,5]	in. <sup>3</sup> /rev.	[cm <sup>3</sup> /rev.]
<b>63</b>	-	4.00	[65,6]	in. <sup>3</sup> /rev.	[cm <sup>3</sup> /rev.]
<b>80</b>	-	4.83	[79,2]	in. <sup>3</sup> /rev.	[cm <sup>3</sup> /rev.]
<b>100</b>	-	6.04	[99,0]	in. <sup>3</sup> /rev.	[cm <sup>3</sup> /rev.]
<b>125</b>	-	7.56	[123,8]	in. <sup>3</sup> /rev.	[cm <sup>3</sup> /rev.]
<b>160</b>	-	9.67	[158,4]	in. <sup>3</sup> /rev.	[cm <sup>3</sup> /rev.]
<b>200</b>	-	12.08	[198,0]	in. <sup>3</sup> /rev.	[cm <sup>3</sup> /rev.]
<b>250</b>	-	15.10	[247,5]	in. <sup>3</sup> /rev.	[cm <sup>3</sup> /rev.]
<b>320</b>	-	19.30	[316,8]	in. <sup>3</sup> /rev.	[cm <sup>3</sup> /rev.]
<b>400</b>	-	24.17	[396,0]	in. <sup>3</sup> /rev.	[cm <sup>3</sup> /rev.]
<b>500</b>	-	30.20	[495,0]	in. <sup>3</sup> /rev.	[cm <sup>3</sup> /rev.]
<b>630</b>	-	38.05	[623,6]	in. <sup>3</sup> /rev.	[cm <sup>3</sup> /rev.]

**Pos.2 - Versions**

<b>5</b>	-	Version 5 "Closed Center - Non Reaction and Load Sensing Outlet"
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**Pos.3 - Priority Valve Connection**

<b>T</b>	-	Pipe Mounting (only)
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**Pos.4 - Ports**

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

**Pos.5 - Option (Paint)\***

omit	-	No Paint
<b>P</b>	-	Painted Low Gloss Color
<b>PC</b>	-	Corrosion Protected Paint

**Pos.6 - Design Series**

omit	-	Factory specified
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Notes: \* Colour at customer's request.

The steering units are mangano-phosphatized as standard.

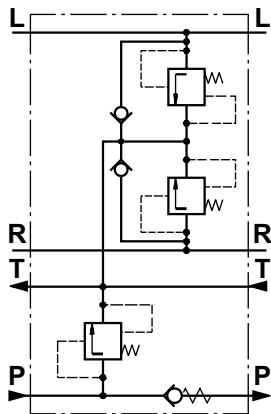
# VALVE BLOCKS FOR HKU TYPE BKH...



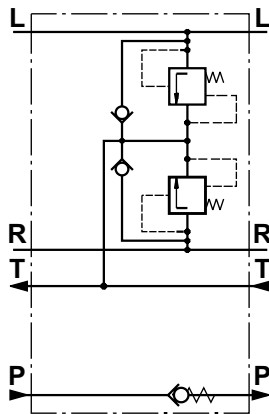
The M+S Hydraulic BKH valves are developed to protect the components of the hydraulic circuit: pumps, steering units and cylinders - from overloads, impacts and cavitation. Some of their advantages are: easy integration into any hydraulic circuit, easy mounting to the steering unit, and quick and easy hose connections.



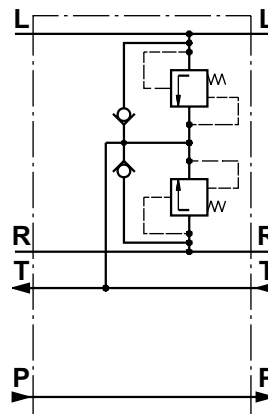
Depending on the design and the built in valves the BKH valves can be divided into 5 types: BKH1 ... BKH4 and BKHR. The maximum flow rate is in compliance with the whole range of HKU steering units but no more than 21 GPM [80 lpm]. The pressure settings for the entry relief valves and the shock valves are given in the table.



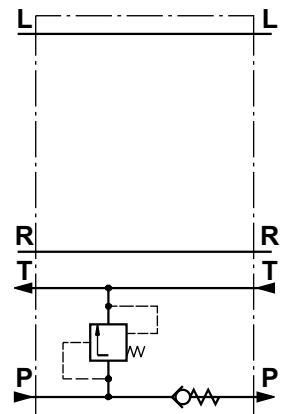
BKH1, BKHR



BKH2



BKH3



BKH4

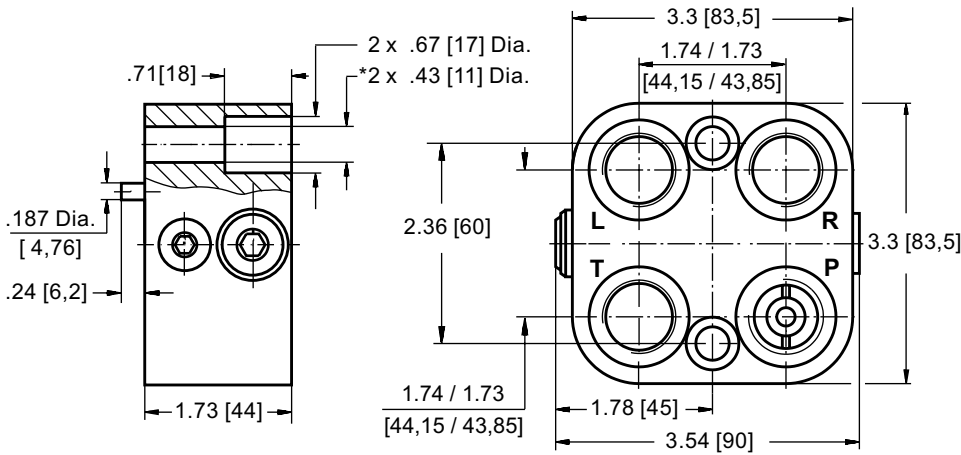
## SPECIFICATION DATA

Parameters		Type									
		BKH1, BKHR				BKH2	BKH3	BKH4			
Rated Flow	GPM [lpm]	21.1 [80]									
Rated Pressure	PSI [bar]	2320 [160]									
Relief Valve Pressure Settings*	PSI [bar]	1160 [80]	1450 [100]	1810 [125]	2175 [150]	-	-	1160 [80]	1450 [100]	1810 [125]	2175 [150]
Shock Valves Pressure Settings**	PSI [bar]	2030 [140]	2320 [160]	2610 [180]	2900 [200]	2900 [200]	3480 [240]	-	-	-	-
Weight	lb [kg]	4.0 , 5.1 [1,8] , [2,3]				4.0 [1,8]		4.0 [1,8]			

\* Pressure Settings are at flow rate of 7.92 GPM [30 lpm] and viscosity 105 SUS [21 mm<sup>2</sup>/s] at 122°F [50° C].

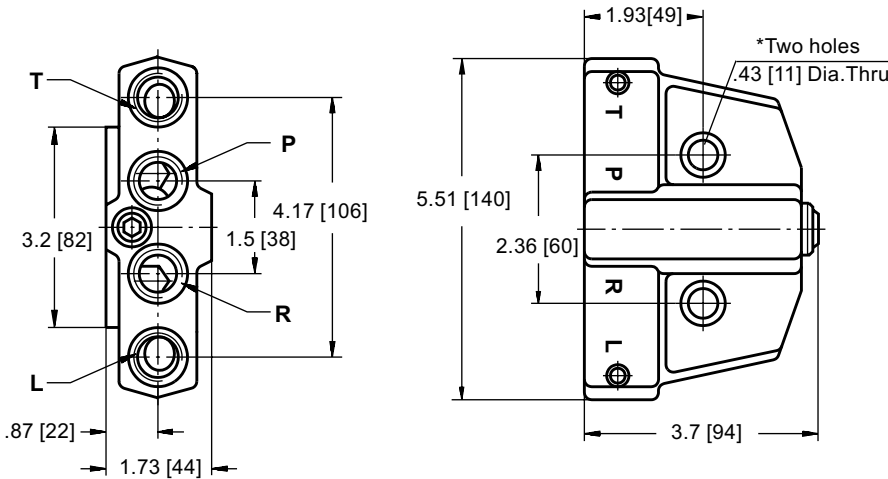
\*\* Pressure Settings are at flow rate of .53 GPM [ 2 lpm] and viscosity 105 SUS [21 mm<sup>2</sup>/s] at 122°F [50° C].

**DIMENSIONS AND MOUNTING DATA - BKH1, 2, 3, 4**

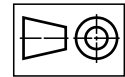


Code	Ports - P, T, R, L Thread
A	3/4 - 16 UNF O-ring .80 [20] depth
-	G1/2 .80 [20] depth
M	M22x1,5 .80 [20] depth

**DIMENSIONS AND MOUNTING DATA - BKHR**



Code	Ports - P, T, R, L Thread
A	3/4 - 16 UNF O-ring .87 [22] depth
M	M18x1,5 .87 [22] depth



**ORDER CODE**

	1	2	3	4	5
<b>BKH</b>		-	-		

**Pos.1 - Versions\***

R	1	2	3	4	
•	•			•	- Input relief valve on line "P"
•	•	•		•	- Input check (non-return) valve on line "P"
•	•	•	•		- Shock valves on lines "R" and "L"
•	•	•	•	•	- Anti-cavitation valves on lines "R" and "L"

**Pos.2 - Relief Valve Pressure Settings, bar\*\***

<b>80</b>	<b>100</b>	<b>125</b>	<b>150</b>
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**Pos.3 - Ports**

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

**Pos.4 - Option (Paint)\*\*\***

- omit - No Paint
- P** - Painted Low Gloss Color
- PC** - Corrosion Protected Paint

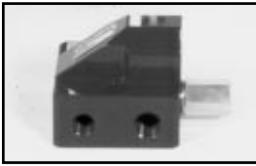
**Pos.5 - Design Series**

- omit - Factory specified

Notis: \* Connection to the HKU is done with 2 screws 3/8-24 UNF ANSI B18.3-76, long 1.5" or with 2 screws M10x1-8.8 DIN 912 long 1.58" [40mm]. Tightening torque: 177±265 in - lb [2,5±0,5 daNm].  
 \*\* That does not concern version 2 and 3.  
 \*\*\* Colour at customer's request.

The valve blocks are mangano-phosphatized as standard.

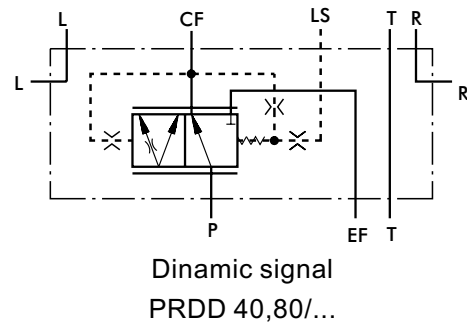
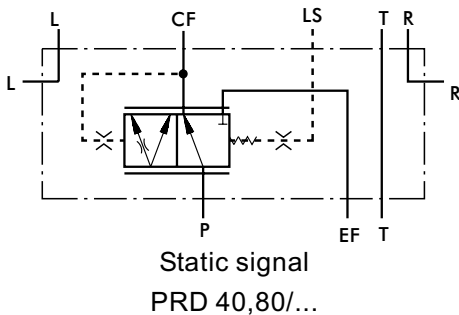
# PRIORITY VALVES FOR HKUS.../5... TYPE PR...



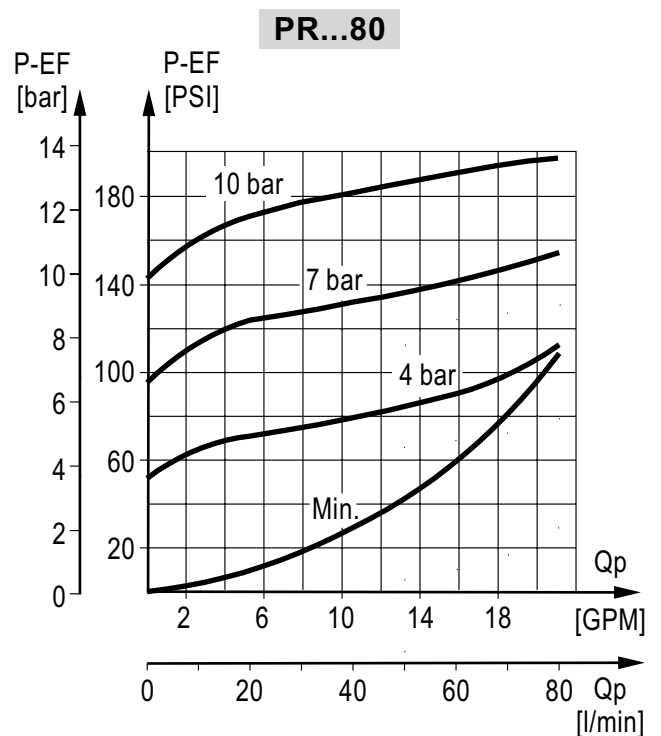
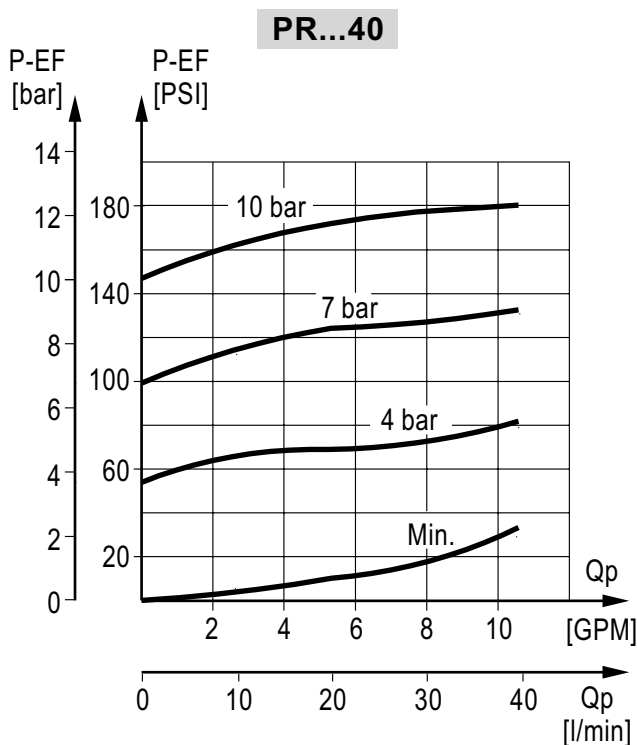
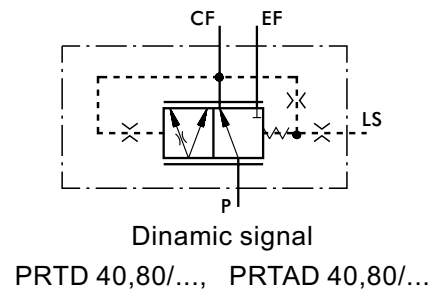
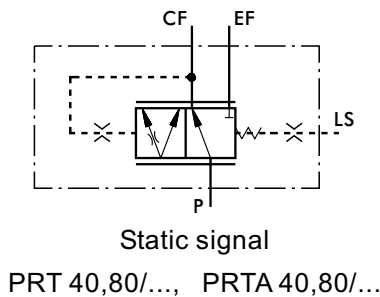
The Priority Valves distribute and trace the hydraulic flow from the supply pump of the hydraulic system to the hydraulic components which control and run the vehicle. The Priority Valves are used only with the HKUS.../5(E)(T)(TE) hydrostatic steering units. When connected, the steering unit and the priority valve represent sophisticated hydraulic tracing system that controls the flow in both main pipelines of the hydraulic system (the working and control one) at any time of its operation.

As a static signal, the "LS" signal must be used in systems with circuit stability. The connection between the PRT, PRTA priority valves and the HKUS.../5(T)E steering units has to be as short as possible, but should not exceed 4.92 ft [1,5 m] (for iron pipe with .157 in. [4 mm] internal diameter). When a rubber hose is used this length have to be even shorter.

## Modulary Mounting



## Pipe Mounting



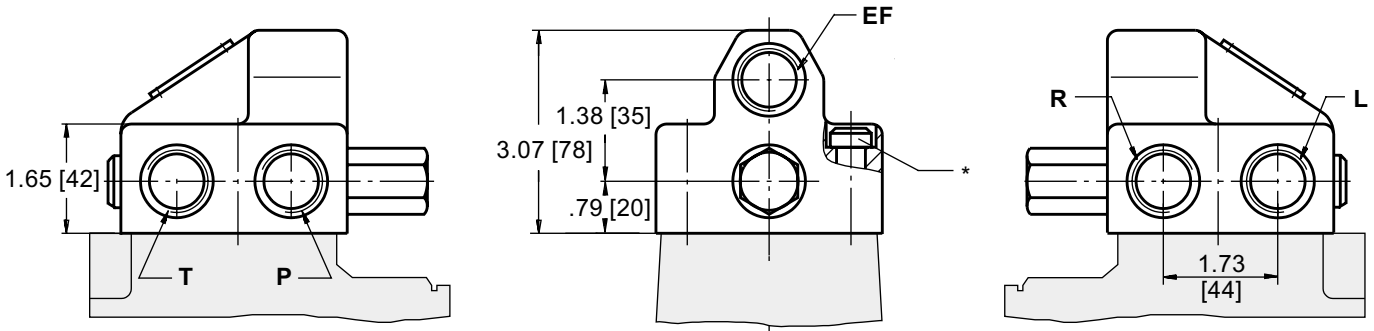
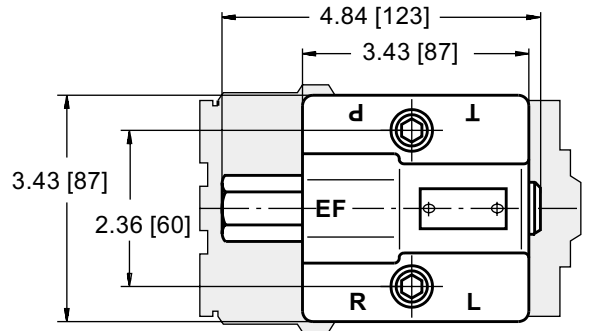
**SPECIFICATION DATA**

Parameters		Type					
		PRD(D), PRT(D)			PRTA(D)		
Rated Flow	GPM [lpm]	10.6 [40]			21.1 [80]		
Control Spring Pressure	PSI [bar]	58 [4]	101.5 [7]	145 [10]	58 [4]	101.5 [7]	145 [10]
Max. Pressures in Oil Ports:	P, EF, R, L	3625 [250]					
	CF	2540 [175]					
	T	220 [15]					
Weight	lb [kg]	5.95 [2,7]			2.65 [1,2]		

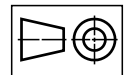
**P** - pump, **EF** - excess flow, **CF** - control flow (first priority oil flow),  
**L** - left, **R** - right, **LS** - load sensing, **T** - tank (for PRD, PRDD only)

**DIMENSIONS AND MOUNTING DATA - PRD(D) 40, 80/...**

Code	Ports - P, EF Thread	Ports - T, R, L Thread
<b>A</b>	7/8 - 14 UNF O-ring .71 [18] depth	3/4 - 16 UNF O-ring .71 [18] depth
<b>-</b>	G1/2 .71 [18] depth	G3/8 .71 [18] depth
<b>M</b>	M22x1,5 .71 [18] depth	M18x1,5 .71 [18] depth

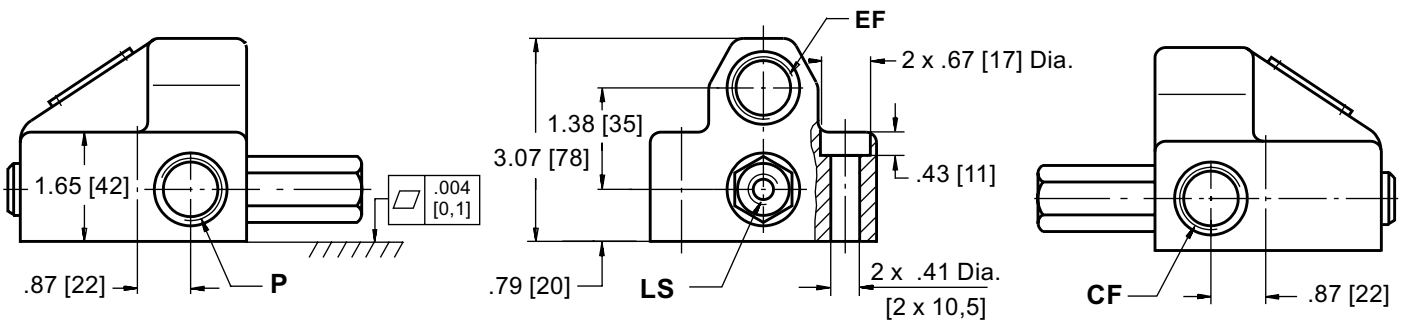
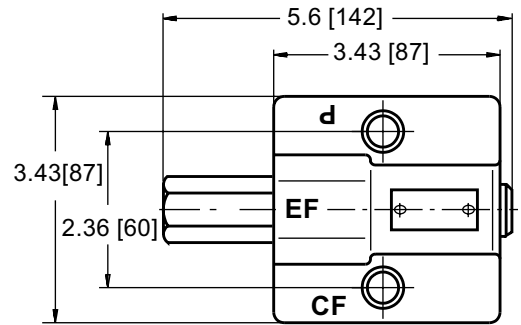


\* Connection to the HKUS.../5... is done with 2 screws 3/8-24 UNF ANSI B18.3-76, 1.75" long or with 2 screws M10x1 -10.9 DIN 912 long 1.77" [45 mm].  
 Tightening torque: 360 ÷ 440 in - lb [ 4,5±0,5 daNm].

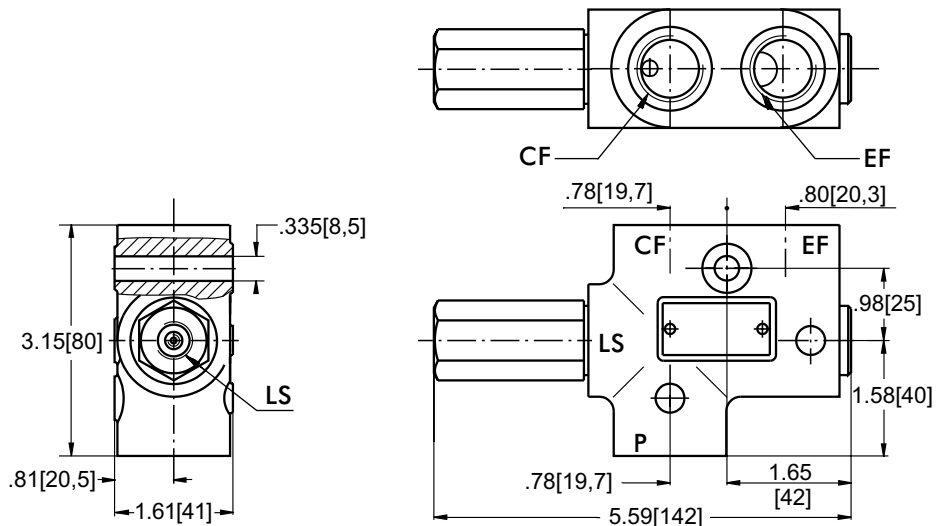


**DIMENSIONS AND MOUNTING DATA - PRT(D) 40, 80/...**

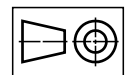
Code	Ports - P, EF Thread	Port - CF Thread	LS - Port
<b>A</b>	7/8 - 14 UNF O-ring .71 [18] depth	3/4 - 16 UNF O-ring .71 [18] depth	7/16 - 20 UNF O-ring .50 [12,7] depth
-	G1/2 .71 [18] depth	G1/2 .71 [18] depth	G1/4 .55 [14] depth
<b>M</b>	M22x1,5 .71 [18] depth	M22x1,5 .71 [18] depth	G1/4 .55 [14] depth



**DIMENSIONS AND MOUNTING DATA - PRTA(D) 40, 80/...**



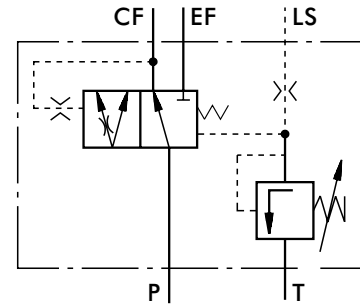
Code	Ports - P, EF Thread	Port - CF Thread	LS - Port
<b>A</b>	7/8 - 14 UNF O-ring .71 [18] depth	3/4 - 16 UNF O-ring .71 [18] depth	7/16 - 20 UNF O-ring .50 [12,7] depth
-	G1/2 .71 [18] depth	G1/2 .71 [18] depth	G1/4 .55 [14] depth
<b>M</b>	M22x1,5 .71 [18] depth	M22x1,5 .71 [18] depth	G1/4 .55 [14] depth



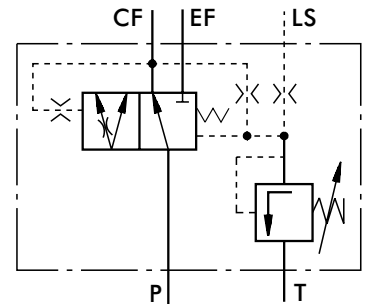
# PRIORITY VALVES FOR HKUS.../5T... TYPE PRT...160/...



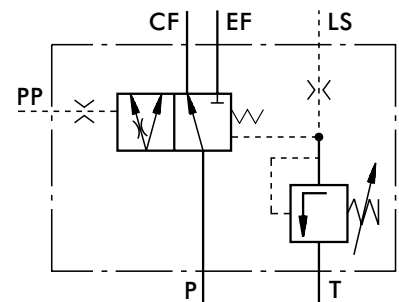
The Priority Valves PRT...160 have built-in a pilot pressure relief valve, who protects the steering unit against excess pressure. The pilot pressure relief valve operates with the Shuttle of the Priority valve to limit the maximum steering pressure P-T measured across the steering units ports.



Static signal  
PRT 160/...



Dynamic signal  
PRTD 160/...



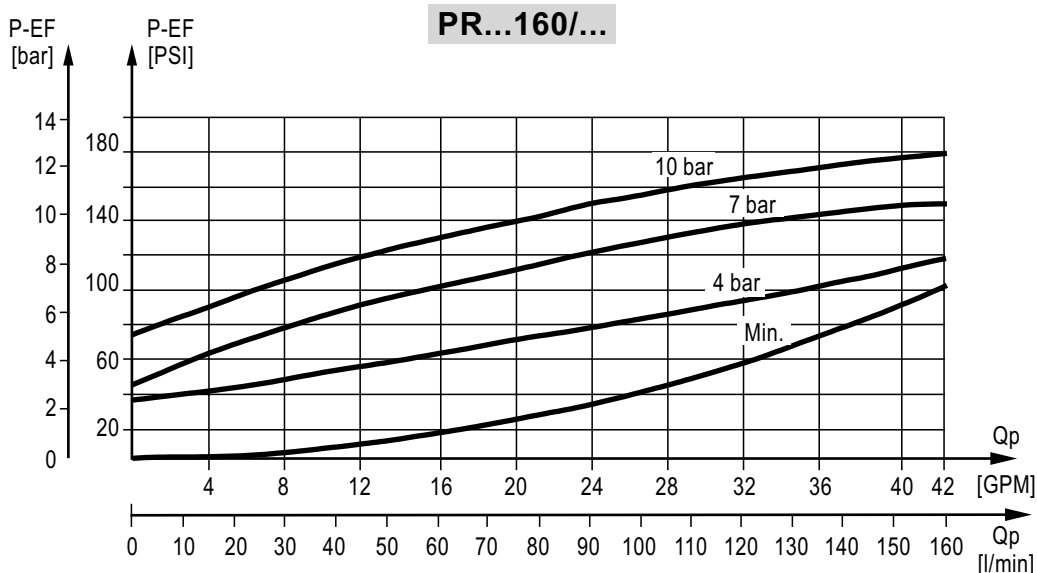
Static signal with External Pilot  
PRTE 160/...

## SPECIFICATION DATA

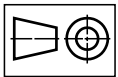
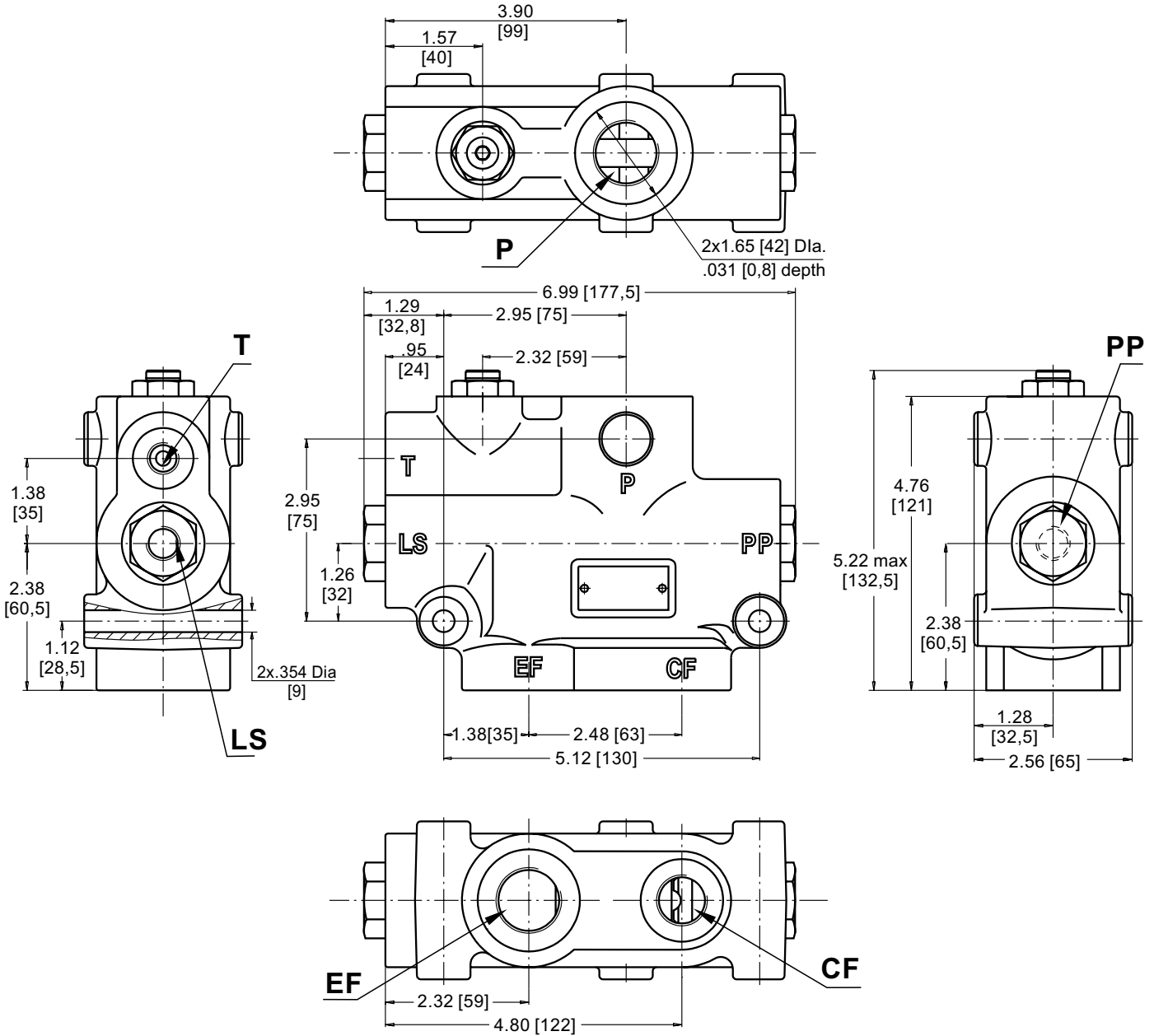
Parameters		Type		
		PRT(D), PRTE		
Rated Flow	GPM [lpm]	42.3 [160]		
Control Spring Pressure	PSI [bar]	58 [4]	101.5 [7]	145 [10]
Max. Pressures in Oil Ports:	PSI [bar]	P, EF	3625 [250]	
		CF	3045 [210]	
		T	220 [15]	
		PP	3045 [210]	
Standart Relief Valve Pressure Settings		2540 [175]		
Weight	lb	9.70		
	[kg]	[4,4]		

\* - Adjusted valve pressure from 1160 [80] till 3045 [210] PSI [bar] upon customer request.

**P** - pump, **EF** - excess flow, **CF** - control flow (first priority oil flow), **LS** - load sensing, **T** - tank, **PP** - pilot pressure



**DIMENSIONS AND MOUNTING DATA - PRT(D)(E)160/...**



Code	Ports - P, EF Thread	Port - CF Thread	LS, PP, T - Ports
<b>A</b>	1 1/16 - 12 UN O-ring .81 [20,5] depth	3/4 - 16 UNF O-ring .73 [18,5] depth	7/16 - 20 UNF O-ring .49 [12,5] depth
-	G3/4 .81 [20,5] depth	G1/2 .73 [18,5] depth	G1/4 .49 [12,5] depth
<b>M</b>	M27x2 .81 [20,5] depth	M18x1,5 .73 [18,5] depth	M12x1,5 .49 [12,5] depth

**ORDER CODE**

	1	2	3	4	5	6	7
<b>PR</b>			<b>/</b>		<b>-</b>		

**Pos.1 - Mounting**

- D** - Modularly Mounting
- T** - Pipe Mounting (Model 1)
- TA** - Pipe Mounting (Model 2)

**Pos.2 - Signal Type**

- omit - with Static signal
- D** - with Dinamic signal
- E\*** - with Static signal w/ External Pilot

**Pos.3 - Rated Flow, l/min**

<b>40</b>	<b>80</b>	<b>160**</b>
-----------	-----------	--------------

**Pos.4 - Control Spring Pressure , bar**

<b>4</b>	<b>7</b>	<b>10</b>
----------	----------	-----------

**Pos.5 - Ports [see pages 21, 22]**

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

**Pos.6 - Option [Paint]\*\*\***

- omit - No Paint
- P** - Painted Low Gloss Color
- PC** - Corrosion Protected Paint

**Pos.7 - Design Series**

- omit - Factory specified

Notes: \* For PRT 160/... only  
 \*\* For PRT only  
 \*\*\* Colour at customer's request.

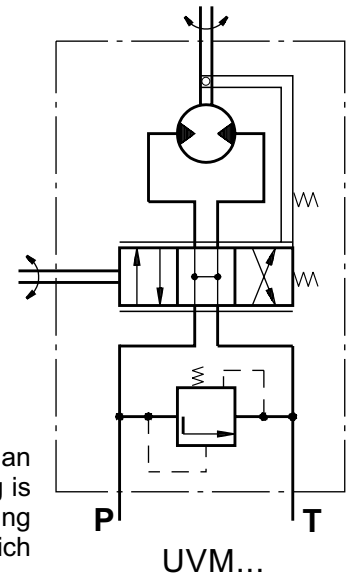
The priority valves are mangano-phosphatized as standard.

# TORQUE AMPLIFIERS TYPE UVM...



The M+S Hydraulic UVM Torque Amplifiers amplify the applied torque to the control shaft and thus ease the running. The M+S Hydraulic UVM Torque Amplifiers amplify the applied torque to the control shaft and thus ease the running of various transport vehicles such as:

- agricultural and wood working machines;
- road rollers and road cleaning machines;
- fork-lift trucks and construction machinery;



The totally transferred power in terms of output torque is up to 1.47 HP [1,1 kW].

The UVM torque amplifiers with their simple design, consisted of a pump and an amplifier, ensure 40 times higher output torque than the applied one. The amplifying is achieved as follows; by rotating the input shaft to the left or right the spool and the bushing are displaced, and the hydraulic flow enters the system turning the gerotor set, which transfers the already amplified torque to the output shaft.

One advantage of the UVM torque amplifier is that it allows manual steering in cases of engine (pump) failure.

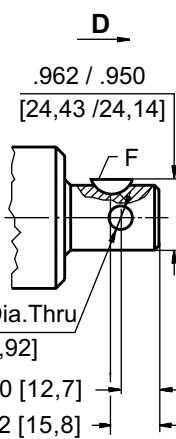
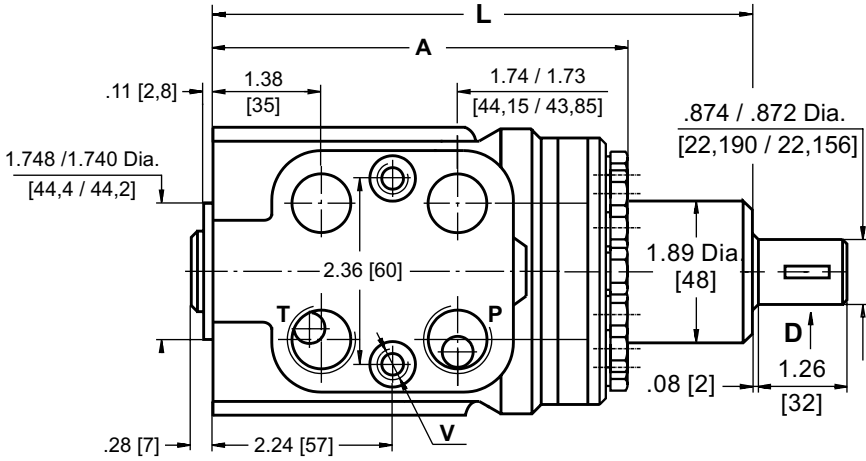
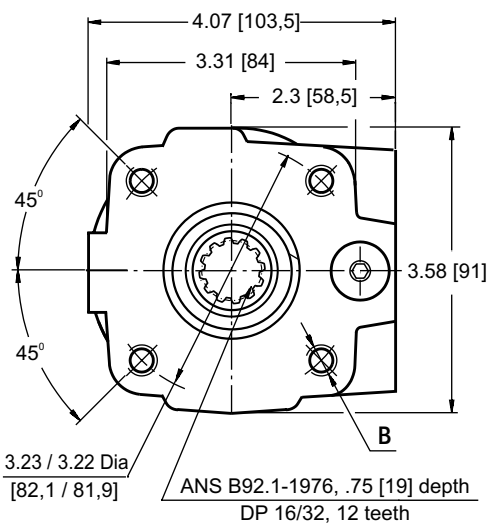
## SPECIFICATION DATA

Parameters		Type	
		UVM 100	UVM 160
Displacement	in. <sup>3</sup> /rev.	6.04	9.67
	[cm. <sup>3</sup> /rev.]	[99,0]	[158,4]
Rated Flow*	GPM	2.6	4.2
	[lpm]	[10]	[16]
Rated Pressure**	PSI	1015	1015
	[bar]	[70]	[70]
Input Torque	in - lb	31...44	31...44
	[daNm]	[0,35...0,5]	[0,35...0,5]
Max. Input Torque	in - lb	178	178
	[Nm]	[20]	[20]
Torque Output at 1015 PSI [70 bar]	in - lb	708	1062
	[Nm]	[80]	[120]
Pressure Drop between P and T at Rated Flow	PSI	14.5...29	23.2...36.3
	[bar]	[1... 2]	[1,6...2,5]
Max. Speed of Rotation at Rated Flow and Pressure	RPM	100	100
Max. Continuous Pressure in Line T	PSI	290	290
	[bar]	[20]	[20]
Weight	lb	12.8	13.7
	[kg]	[5,8]	[6,2]

\* Rated Flow at 100 RPM

\*\* Pressure Settings are at Rated Flow (as in the table ) and viscosity 105 SUS [21 mm<sup>2</sup>/s] at 122°F [50° C].

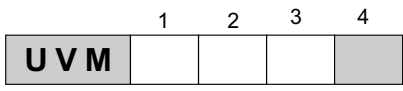
**DIMENSIONS AND MOUNTING DATA**



Dimensions	Type	
	UVM 100	UVM 160
A in. [mm]	5.64 [143,3]	5.96 [151,3]
L in. [mm]	7.13 [181,2]	7.45 [189,2]

Code	Ports - P, T Thread	Column Mounting Thread - B	Port Mounting Thread - V
A	3/4 - 16 UNF O-ring .67 [17] depth	4 x 3/8 - 16 UNC .62 [15,7] depth	2 x 3/8 - 24 UNF .56 [14,2] depth
-	G1/2 .67 [17] depth	4 x M10 .71 [18] depth	2 x M10x1 .63 [16] depth
M	M22x1,5 .67 [17] depth	4 x M10 .71 [18] depth	2 x M10x1 .63 [16] depth

**ORDER CODE**



**Pos.1 - Displacement code**

- 100** - 6.04 [99,0] in<sup>3</sup>/rev [cm<sup>3</sup>/rev]
- 160** - 9.67 [158,4] in<sup>3</sup>/rev [cm<sup>3</sup>/rev]

**Pos.2 - Ports**

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

**Pos.3 - Option (Paint)\***

- omit - No Paint
- P** - Painted Low Gloss Color
- PC** - Corrosion Protected Paint

**Pos.4 - Design Series**

- omit - Factory specified

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

# STEERING COLUMNS TYPE KK...



The M+S Hydraulic KK Steering Columns transfer the torque from the steering wheel of the vehicle to the HKU, HKUS or other of the same class steering units. The KK steering columns are consisted of a pipe in which is centred the control shaft.

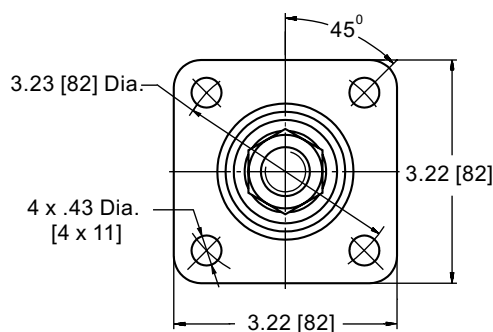
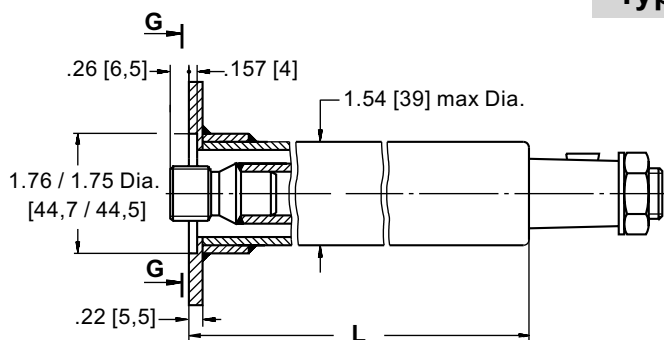
Permissible loads on the steering column are as follows:

Max. torque applied to the steering wheel            2124 in - lb [24 daNm]  
 Max. bending moment    1770 in - lb [20 daNm]  
 Max. axial load            225 lbs [100 daN]

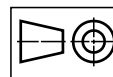
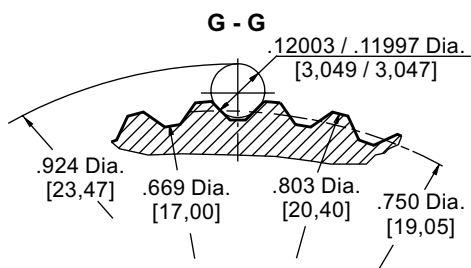
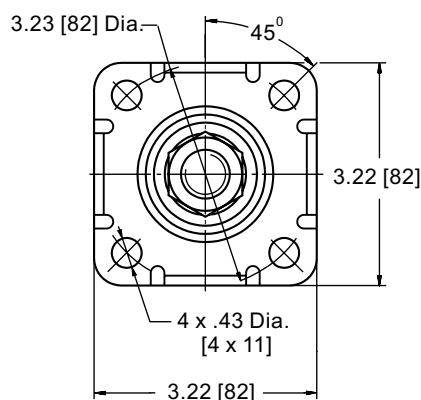
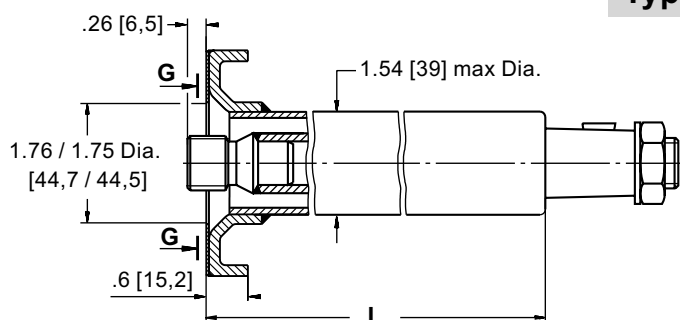
The steering column must be additionally supported when the length L exceeds 5.91 in. [150 mm].

## DIMENSIONS AND MOUNTING DATA

### Type KK



### Type KKF



## SPECIFICATION DATA

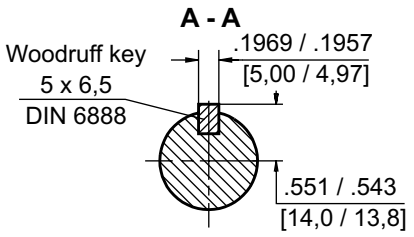
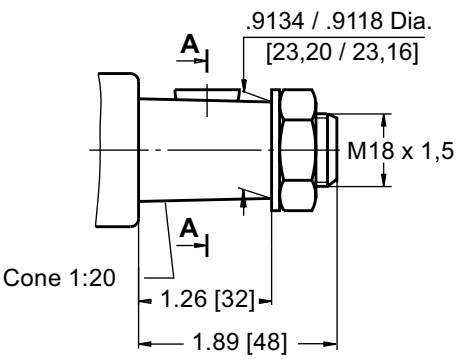
Involute Spline Data		
Number of Teeth	z	12
Pressure Angle	$\alpha$	30°
Diametral Pitch	DP	16/32

Parameters	Type					
	KK 75	KK 150	KK 390	KK 441	KK 750	
L	in. [mm]	3.07 [78]	6.62 [168,2]	15.47 [393]	17.36 [441]	30.62 [777,8]
Weight	lb [kg]	1.65 [0,75]	2.43 [1,1]	4.19 [1,9]	11.13 [5,05]	7.28 [3,3]

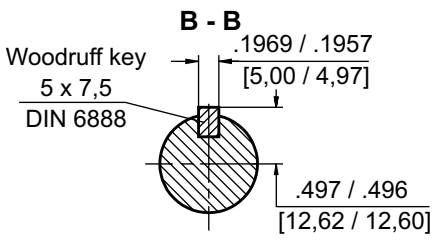
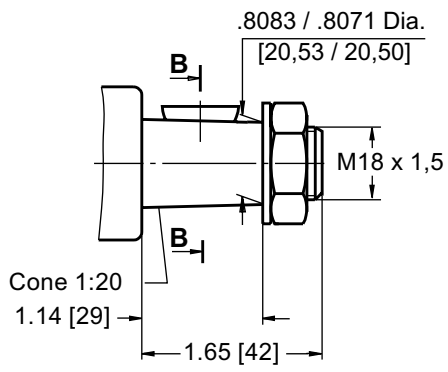
**Note:** The length L depends on the transport vehicle construction. Please, contact factory or your regional manager regarding other lengths.

**SHAFT VERSIONS**

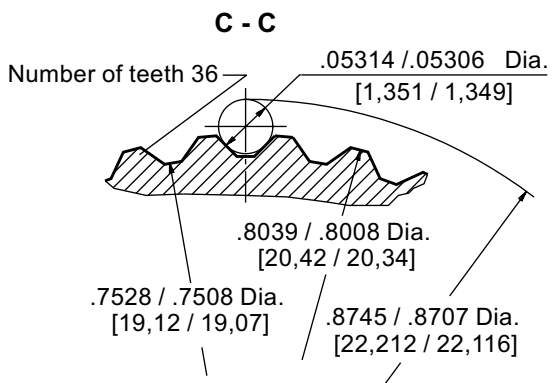
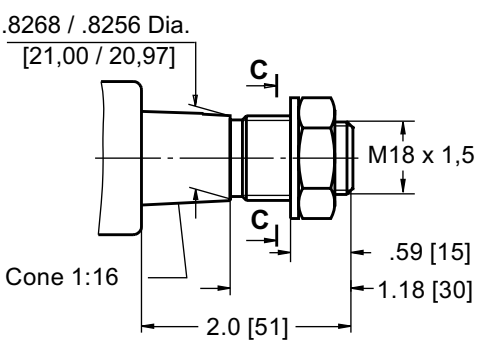
**TYPE I**



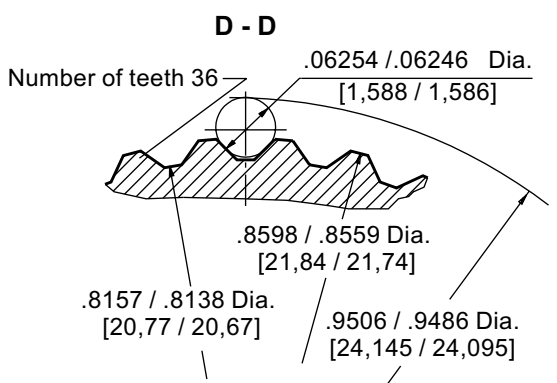
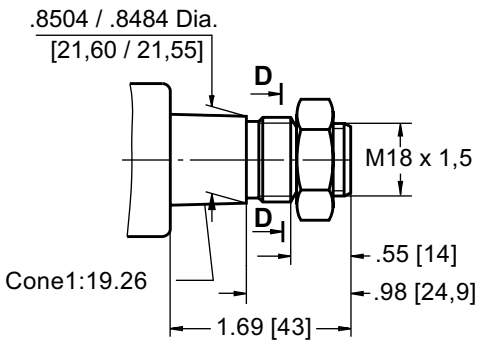
**TYPE II**



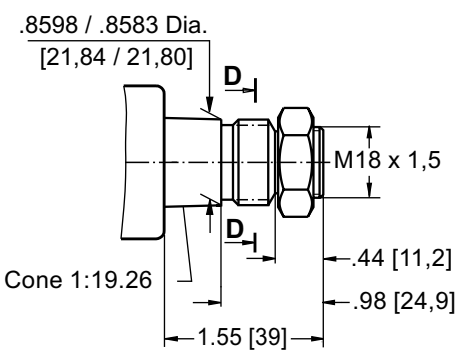
**TYPE III**



**TYPE IV**

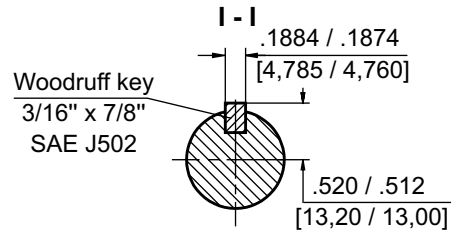
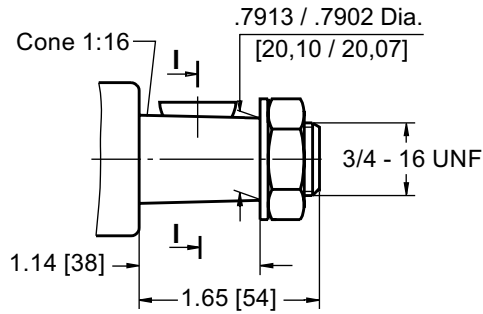


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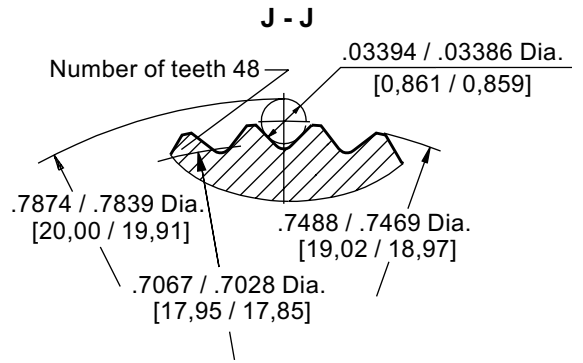
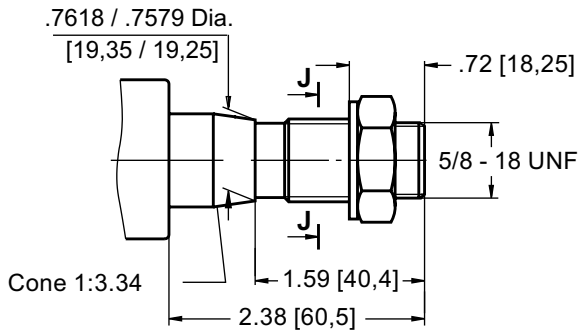


**SHAFT VERSIONS**

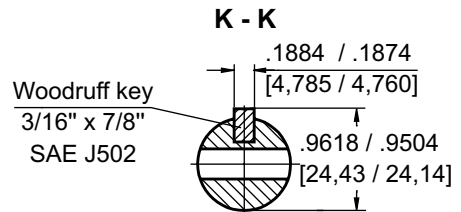
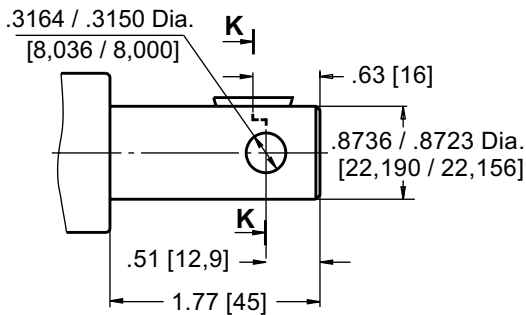
**TYPE VI**



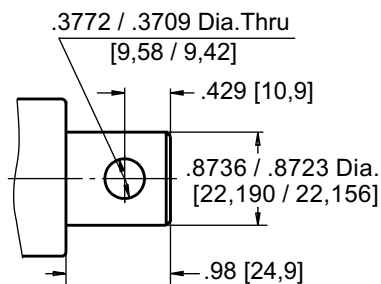
**TYPE VII**



**TYPE VIII**

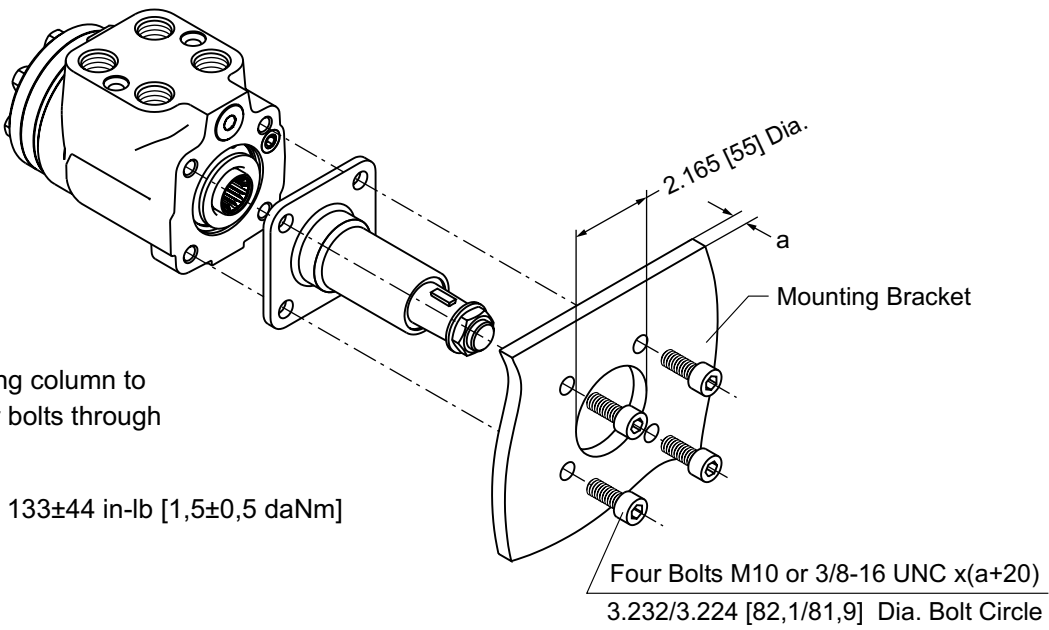


**TYPE IX**



**INSTALLING**

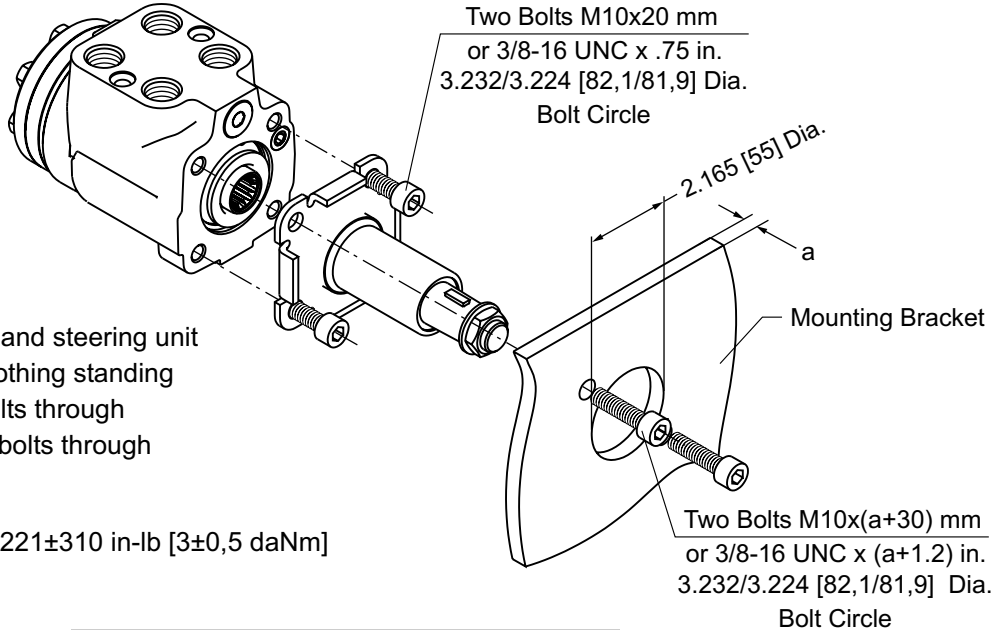
**For column type KK**



For assembling the Steering column to the Steering units use four bolts through mounting bracket.

Tightening torque for bolts 133±44 in-lb [1,5±0,5 daNm]

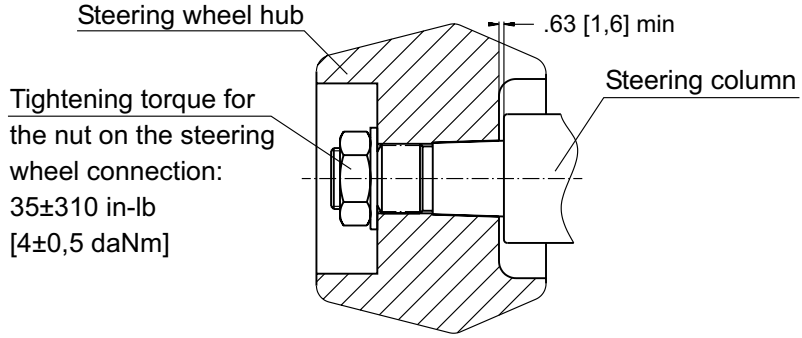
**For column type KKF**



Steering column type KKF and steering unit must be assembled with nothing standing between them. Use two bolts through mounting bracket and two bolts through just the steering column.

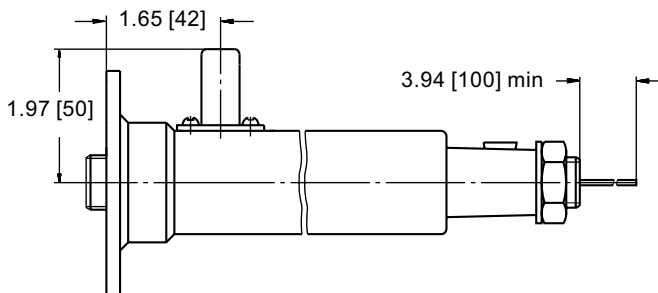
Tightening torque for bolts 221±310 in-lb [3±0,5 daNm]

**Minimum Clearance at Assembly**

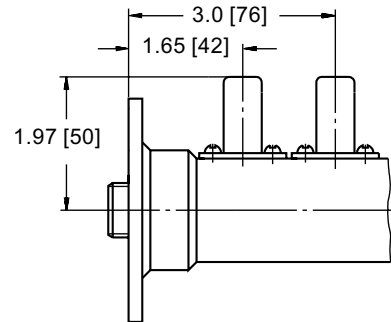


**SOUND SIGNAL CONNECTION**

**E Option**



**EE Option**



**ORDER CODE**

	1	2	3	4	5	6
<b>KK</b>						

**Pos.1 - Mounting Flange**

- omit - Flange without Tabs
- F** - Flange with Tabs

**Pos.2 - Length, mm (acc. to table)**

**Pos.3 - Shaft Extensions**

- I, II, III, IV, V, VI, VII, VIII, IX

**Pos.4 - Signal Connection (Option)**

- omit - without electric signal connection
- E** - with one electric signal connection
- EE\*** - with two electric signal connection

**Pos.5 - Option (Paint)\*\***

- omit - No Paint
- P** - Painted Low Gloss Color
- PC** - Corrosion Protected Paint

**Pos.6 - Design Series**

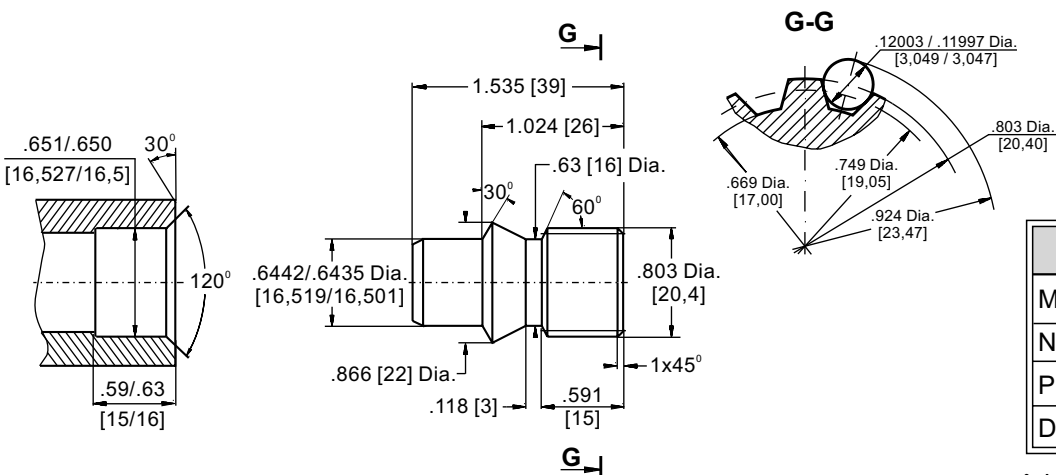
- omit - Factory specified

The steering columns are yellow galvanized as standard.

Notes: \* For steering column's length  $L > 5.9$  in [150 mm] only.  
\*\* Colour at customer's request.

**Shaft End Part**

Order No:46415 001 00



Involute Spline Data		
Modul	m	1.5875
Number of Teeth	z	12
Pressure Angle	$\alpha$	30°
Diametral Pitch	DP	16/32

# 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 *in-lb* [daNm].

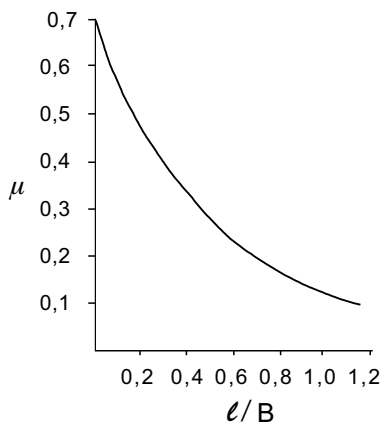
$G$  = Vehicle weight on steered axle *lbs* [daN] (use maximum estimated overload weight).

$\mu$  = Coefficient of friction (use Chart 1, dimensionless) determined by  $\ell/B$  (see Diagram 1).

$B$  = Nominal width of tyre print *in.* [m] (see Diagram 1).

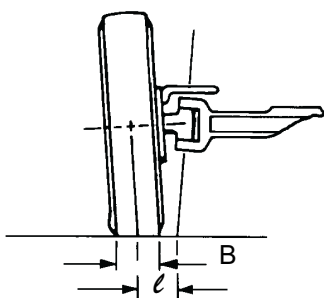
$\ell$  = Kingpin offset. The distance between tyre centerline intersection at ground and kingpins centerline intersection at ground in *in.* [m] (see Diagram 1).

#### Chart 1 1

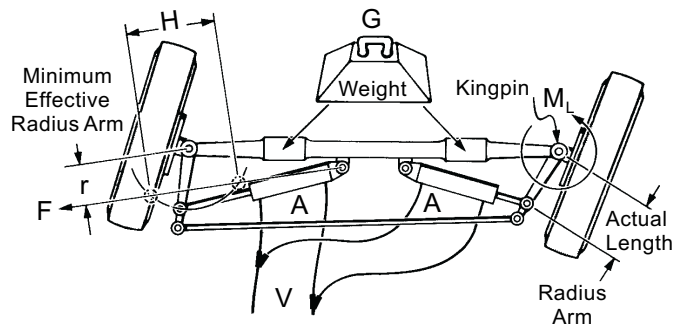


Rubber tyres on dry concrete.

#### Diagram 1 1



#### Diagram 1 2



#### STEP TWO:

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

#### FORCE

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

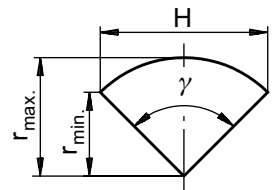
$F$  = Force required *lbs* [daN] to steer axle.

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

$r$  = Effective radius Arm *in.* [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 1 2 and Chart 1 2).

#### Chart 1 2

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



#### STROKE

$H$  = Stroke *in.* [cm].

Calculate stroke of cylinder using Diagram 1 2 and Chart 1 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 *in.*<sup>2</sup> [cm<sup>2</sup>].

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

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

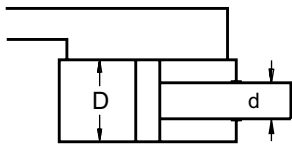
**DIAMETER**

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

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

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

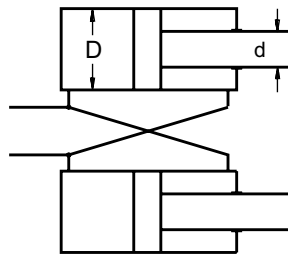
**Differential Cylinder**



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

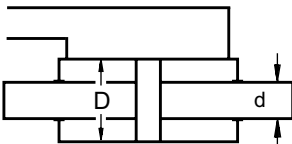
Note:  $\left(\frac{d}{D}\right)^2 \leq 0,15$

**Cross Connected Cylinders**



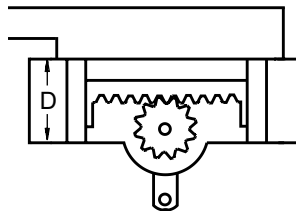
$$D = \sqrt{\frac{2A}{\pi} + \frac{d^2}{2}}$$

**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 in.<sup>3</sup> [cm<sup>3</sup>].  
H = Stroke in. [cm].  
A = Area in.<sup>2</sup> [cm<sup>2</sup>].

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

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

**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 in.<sup>3</sup>/rev. [cm.<sup>3</sup>/rev.]  
V = Volume of oil in.<sup>3</sup> [cm<sup>3</sup>].  
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 in.<sup>3</sup> [cm<sup>3</sup>].  
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 GPM [lpm].  
 $V_D$  = Unit displacement in.<sup>3</sup>/rev. [cm.<sup>3</sup>/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 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. 100 SUS [20 mm<sup>2</sup>/s]. Viscosity range 60 - 1500 SUS [10 - 300 mm<sup>2</sup>/s].

**Temperature**

Normal operating temperature range from +85°F [+30°C] to 140°F [+60°C].

Minimum operating temperature -40°F [-40°C].

Maximum operating temperature +176°F [+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  $\mu\text{m}$  nominal (40 - 50  $\mu\text{m}$  absolute) or finer is recommended.

In extremely dusty conditions filtration of 10  $\mu\text{m}$  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  $\mu\text{m}$  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.

**CONVERSIONS**

**to convert inches and millimeters:**

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

**to convert gallons per minutes and liters per minutes:**

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

**TORQUE TIGHTENING VALUES**

**Fluid connections**

Fluid connection	Max. tightening torque in - lb [daNm]			
	metal edge	copper washer	aluminum washer	O - ring
7/16 - 20 UNF				180[2]
9/16 - 18 UNF				440[5]
3/4 - 16 UNF				530[6]
7/8 - 14 UNF				620[7]
G 1/4	350[4]	180[2]	270[3]	
G 3/8	530[6]	180[2]	440[5]	
G 1/2	885[10]	270[3]	710[8]	
G 3/4	1400[16]	440[5]	1150[13]	
M 10 x 1	350[4]	180[2]	270[3]	
M 18 x 1,5	620[7]	180[2]	440[5]	
M 22 x 1,5	885[10]	270[3]	710[8]	

**Mounting bolts**

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