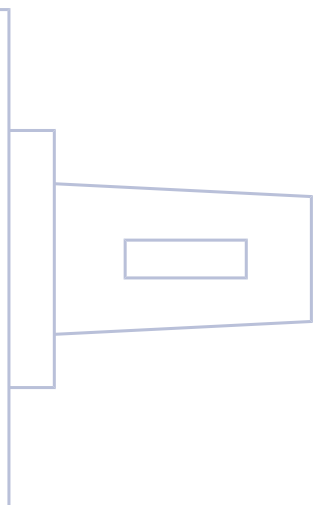
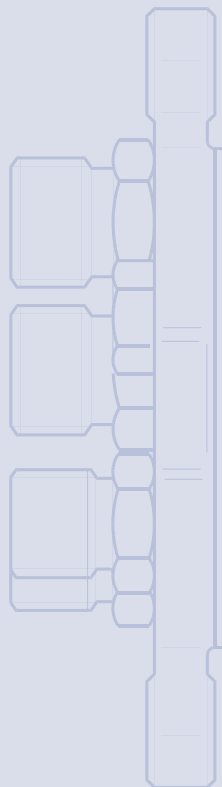




OSPM
Mini-steering unit
OTPM
Steering Column

Technical
Information



INTRODUCTION

Sauer-Danfoss has marketed mini-steering unit OSPM and the matching steering column OTPM ever since 1995. Positive feedback from the market has now motivated the implementation of the following upratings in the program of OSPM mini-steering units:

- Max pressure loads increased. Now up to a 125 bar [1813 psi] steering pressure
- Additional variants introduced. E.g. new 63 cm³ and 100 cm³ [3.84 in³ and 6.10 in³] displacements plus supplementary valve functions.
- Introduction of tilt able steering column OTPM-T for OSPM
- Production capacity considerably expanded through establishment of a European parallel to the original US-production. Steering units from the two factories are provided with their own separate code numbers. OSPM-customers on the American continent will be provided with mini-steering units from the OSPM-factory in the USA, whilst OSPM for all other customers will be delivered from the steering unit factory in Europe.

APPLICATION

Examples:

- Minitractors
- Mowing machines
- Universal tractors
- Forklift trucks
- Municipal vehicles

ADVANTAGES

- Small dimensions and low weight
- End ports with integrated fittings
- Easy installation
- Possibility of integrated steering column
- Low pressure drop
- Low input torque
- Low system price

FUNCTION

OSPM is a hydrostatic steering unit which can be used with an add-on steering column, OTPM/OTPM-T or with the steering column integrated with the unit.

The steering unit consists of a rotary valve and a rotary meter.

Via a steering column the steering unit is connected to the steering wheel of the vehicle. When the steering wheel is turned, oil is directed from the steering system pump via the rotary valve and rotary meter to the cylinder ports L or R, depending on the direction of turn. The rotary meter meters the oil flow to the steering cylinder in proportion to the angular rotation of the steering wheel.

If the oil supply from the steering system pump fails or is too small, the steering unit is able to work as a manual steering pump.

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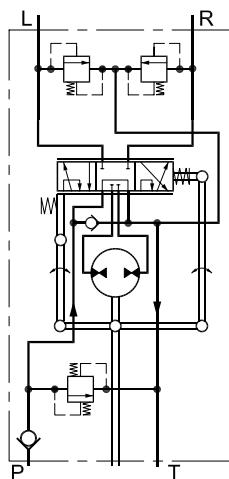
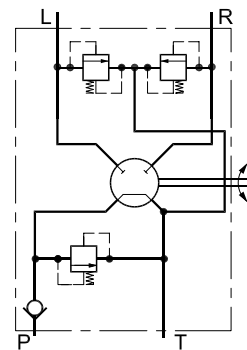
FUNCTION

The mini-steering unit is available in two versions:

- Open-Center Non-Reaction (ON) version, and
- Power Beyond (PB) version where surplus oil can be led to the working hydraulics.

OSPM-ON

Open centre steering units have open connection between pump and tank in the neutral position.



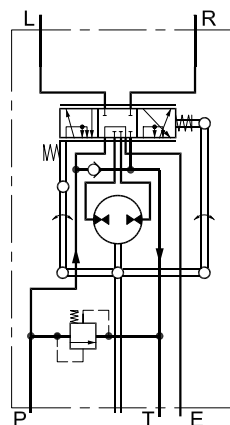
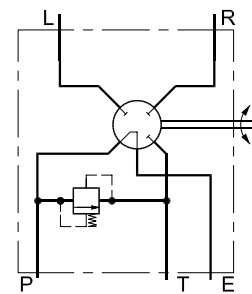
150-539.10

OSPM-PB

In Power Beyond steering units the oil from the pump is routed in the neutral position through the steering unit to the E-port.

The steering function always has priority, with any excess oil flow passing through the E port.

If the steering wheel is held at full lock, all flow is led to tank across the pressure relief valve, and flow from the E port will stop.



150-540.10

CODE NUMBERS

The mini-steering unit is available with displacements of 32, 50, 63, 80 and 100 cm³/rev. [1.95, 3.05, 3.84, 4.88 and 6.10 in³/rev.] The check valve for emergency steering is standard in all versions, but optionally, the OSPM can also be fitted with an integrated relief valve and/or a shock valve and a check valve in the P-port.

The OSPM is also available with an integrated steering column or alternatively in a version prepared for a flange-on steering column (see page 12).

The connections are integrated endport fittings of the ORFS-type (O-ring face seal). See page 8.

**OSPM
 OPEN CENTER NON-
 REACTION STEERING
 UNITS**

Steering unit	Code No. OSPM from USA	Code No. OSPM from Europe	Relief valve bar [psi]	Shock valves bar [psi]	Check valve in P-port	Steering wheel connection	Weight kg [lb]
OSPM 32 ON	150L0101		None	None	None	Flanged-on	2.3 [5.1]
OSPM 32 ON	150L0102	150L2102	None	None	None	Integrated type A	2.3 [5.1]
OSPM 32 ON	150L0103	150L2103	75-80 [1087-1160]	None	None	Flanged-on	2,3 [5.1]
OSPM 32 ON	150L0104	150L2104	75-80 [1087-1160]	None	None	Integrated type A	2.3 [5.1]
OSPM 50 ON	150L0111		None	None	None	Flanged-on	2.5 [5.5]
OSPM 50 ON	150L0112		None	None	None	Integrated type A	2.5 [5.5]
OSPM 50 ON	150L0133		None	None	None	Integrated type B	2.5 [5.5]
OSPM 50 ON	150L0113	150L2113	75-80 [1087-1160]	None	None	Flanged-on	2.5 [5.5]
OSPM 50 ON	150L0114	150L2114	75-80 [1087-1160]	None	None	Integrated type A	2.5 [5.5]
OSPM 50 ON	150L0150	150L2150	90-95 [1305-1378]	150-170 [2175-2465]	Yes	Integrated type A	2.5 [5.5]
OSPM 50 ON	150L0132	150L2132	75-80 [1087-1160]	None	None	Integrated type B	2.5 [5.5]
OSPM 63 ON	150L0142		75-80 [1087-1160]	None	None	Flanged-on	2.6 [5.7]
OSPM 63 ON	150L0143		75-80 [1087-1160]	None	None	Integrated type A	2.6 [5.7]
OSPM 63 ON	150L0144		75-80 [1087-1160]	None	None	Integrated type B	2.6 [5.7]
OSPM 80 ON	150L0121		None	None	None	Flanged-on	2.7 [5.9]
OSPM 80 ON	150L0122		None	None	None	Integrated type A	2.7 [5.9]
OSPM 80 ON	150L0137		None	None	None	Integrated type B	2.7 [5.9]
OSPM 80 ON	150L0123	150L2123	75-80 bar [1087-1160]	None	None	Flanged-on	2.7 [5.9]
OSPM 80 ON	150L0124	150L2124	75-80 bar [1087-1160]	None	None	Integrated type A	2.7 [5.9]
OSPM 80 ON	150L0136	150L2136	75-80 bar [1087-1160]	None	None	Integrated type B	2.7 [5.9]
OSPM 100 ON	150L0154		75-80 [1087-1160]	None	None	Flanged-on	2.9 [6.4]
OSPM 100 ON	150L0155		75-80 [1087-1160]	None	None	Integrated type A	2.9 [6.4]
OSPM 100 ON	150L0156		75-80 bar [1087-1160]	None	None	Integrated type B	2.9 [6.4]

CODE NUMBERS

**OSPM
 POWER BEYOND
 STEERING UNITS**

Steering unit	Code No. OSPM from USA	Code No. OSPM from Europe	Relief valve bar [psi]	Shock valves bar [psi]	Check valve in P-port	Steering wheel connection	Weight kg [lb]
OSPM 32 PB	150L0105		None	None	None	Flanged-on	2.6 [5.7]
OSPM 32 PB	150L0106	150L2106	None	None	None	Integrated type A	2.6 [5.7]
OSPM 32 PB	150L0107		75-80 [1087-1160]	None	None	Flanged-on	2.6 [5.7]
OSPM 32 PB	150L0108	150L2108	75-80 [1087-1160]	None	None	Integrated type A	2.6 [5.7]
OSPM 50 PB	150L0115		None	None	None	Flanged-on	2.8 [6.2]
OSPM 50 PB	150L0116		None	None	None	Integrated type A	2.8 [6.2]
OSPM 50 PB	150L0135		None	None	None	Integrated type B	2.8 [6.2]
OSPM 50 PB	150L0117	150L2117	75-80 [1087-1160]	None	None	Flanged-on	2.8 [6.2]
OSPM 50 PB	150L0118		75-80 [1087-1160]	None	None	Integrated type A	2.8 [6.2]
OSPM 50 PB	150L0134		75-80 [1087-1160]	None	None	Integrated type B	2.8 [6.2]
OSPM 63 PB	150L0163		75-80 bar [1087-1160]	None	None	Flanged-on	2.9 [6.4]
OSPM 63 PB	150L0164		75-80 bar [1087-1160]	None	None	Integrated type A	2.9 [6.4]
OSPM 63 PB	150L0165		75-80 bar [1087-1160]	None	None	Integrated type B	2.9 [6.4]
OSPM 80 PB	150L0125		None	None	None	Flanged-on	3.0 [6.6]
OSPM 80 PB	150L0126		None	None	None	Integrated type A	3.0 [6.6]
OSPM 80 PB	150L0139		None	None	None	Integrated type B	3.0 [6.6]
OSPM 80 PB	150L0127		75-80 bar [1087-1160]	None	None	Flanged-on	3.0 [6.6]
OSPM 80 PB	150L0128	150L2128	75-80 bar [1087-1160]	None	None	Integrated type A	3.0 [6.6]
OSPM 80 PB	150L0138		75-80 bar [1087-1160]	None	None	Integrated type B	3.0 [6.6]
OSPM 100 PB	150L0160		75-80 bar [1087-1160]	None	None	Flanged-on	3.2 [7.1]
OSPM 100 PB	150L0161		75-80 bar [1087-1160]	None	None	Integrated type A	3.2 [7.1]
OSPM 100 PB	150L0162		75-80 bar [1087-1160]	None	None	Integrated type B	3.2 [7.1]

If you wish information on other valve combinations, valve functions, valve settings or displacement 40 cm³ [2.44 in³], please contact the Sauer-Danfoss sales organisation. New code numbers for the units manufactured in Europe will be established as required.

TECHNICAL DATA OSPM

Max. input flow		20 l/min	[5.28 US gal/min]
Ambient temperature	min.	-30°C	[-22°F]
	max.	+60°C	[140°F]
Surface treatment	Permissible temperature assuming non-activated steering unit	120°C [248°F] for 20 minutes	
Oil temperature ¹⁾	min.	-30°C	[-22°F]
	max.	+90°C	[194°F]
Oil viscosity ²⁾	min.	4 mm ² /s	[40 SUS]
	max.	1000 mm ² /s	[4629 SUS]
Filtration	Max. degree of contamination	ON	22 / 20 / 17
	ISO 4406	PB	22 / 20 / 17
Steering torque	Normal steering	0.8-1.5 Nm	[7.08-13.3 lbf-in]
	Manual steering ³⁾	Max. 80 Nm	[708 lbf-in]
	Momentary load	Max. 160 Nm	[1416 lbf-in]

¹⁾ Recommended oil temperature: 30-60°C [86-140°F]

²⁾ Recommended viscosity: 20-300 mm²/s [100-1400 SUS]

³⁾ OSPM must not be used for continuous manual steering

Steering unit	Displacement cm ³ /rev [in ³ /rev]	Recommended* oil flow l/min [US gal/min]	Max. pressure on connections			
			P bar [psi]	T bar [psi]	L, R bar [psi]	E bar [psi]
OSPM 32 ON	32 [1.95]	3-9 [0.8-2.4]	125 [1813]	20 [290]	180 [2610]	-
OSPM 50 ON	50 [3.05]	5-15 [1.3-4.0]	125 [1813]	20 [290]	180 [2610]	-
OSPM 63 ON	63 [3.84]	6-18 [1.6-4.8]	125 [1813]	20 [290]	180 [2610]	-
OSPM 80 ON	80 [4.88]	7-20 [1.9-5.3]	125 [1813]	20 [290]	180 [2610]	-
OSPM 100 ON	100 [6.10]	7-20 [1.9-5.3]	125 [1813]	20 [290]	180 [2610]	-
OSPM 32 PB	32 [1.95]	3-20 [0.8-5.3]	125 [1813]	20 [290]	180 [2610]	125 [1813]
OSPM 50 PB	50 [3.05]	5-20 [1.3-5.3]	125 [1813]	20 [290]	180 [2610]	125 [1813]
OSPM 63 PB	63 [3.84]	6-20 [1.6-5.3]	125 [1813]	20 [290]	180 [2610]	125 [1813]
OSPM 80 PB	80 [4.88]	7-20 [1.9-5.3]	125 [1813]	20 [290]	180 [2610]	125 [1813]
OSPM 100 PB	100 [6.10]	7-20 [1.9-5.3]	125 [1813]	20 [290]	180 [2610]	125 [1813]

* Criteria for determining the recommended oil flow:

- Must minimum be the oil flow it takes to ensure sufficient steering speed at idle motor speed
- Must ensure the least possible pressure loss at full speed

The steering unit can cope with an oil flow that is up to 50% higher than the maximum recommended value.

MANUAL STEERING PRESSURE

Under normal operating where the steering pumps supplies an adequate oil flow at the required pressure, the maximum torque on the steering wheel will not exceed 2 Nm [17.7 lbf-in]. If the oil flow from the steering system pump fails or is too small, the steering unit functions automatically as a manual steering pump.

Manual steering can only be used for a limited control of the vehicle if a sudden drop of pump pressure occurs.

The table below shows the manual steering pressure (P_m) for all sizes of Sauer-Danfoss steering units type OSPM at a steering wheel torque of 80 Nm [708 lbf-in].

The values apply only if the suction conditions on the steering unit T port are adequate.

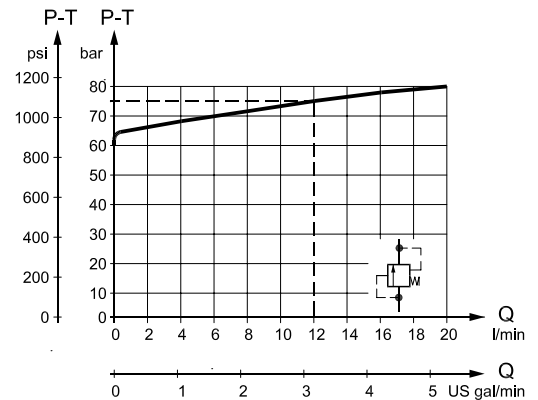
OSPM		32	50	63	80	100
P_m	bar	100	80	60	50	40
	[psi]	[1450]	[1160]	[870]	[725]	[580]

PRESSURE RELIEF VALVE

The pressure relief valve protects the pump and steering unit against excess pressure and limits the system pressure while steering.

The pressure relief valve in the steering unit will limit the maximum pressure drop from P to T.

The pressure relief valve is set at 12 l/min [3.17 US gal/min] flow.



150-507.10

SHOCK VALVES

The shock valves protect the steering unit against shocks from external forces on the steering cylinder. The shock valves in the steering unit limit the max pressure drop from L to T and from R to T. The shock valves are set at 1 l/min [0.27 US gal/min].

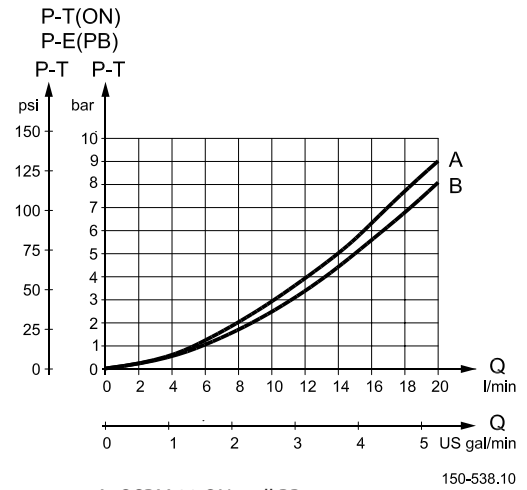
They are of the direct type and therefore have a very quick reaction. The setting tolerance is +20 bar [+290 psi].

CHECK VALVE

The check valve protects the driver against kickbacks in the steering wheel. It prevents the oil from flowing back into the pump line during steering under high pressure on the cylinder side. The check valve is mounted in the P-connection of the steering unit.

PRESSURE DROP IN NEUTRAL

The pressure drop is measured with the steering unit in neutral position.
 On the OSPM ON the pressure drop is measured from P to T.
 On the OSPM PB the pressure drop is measured from P to E.
 The values are valid at an oil temperature of 50°C [122°F] and a viscosity of 21 cSt [100 SUS].



A: OSPM 32 ON + all PB
 B: OSPM 50-100 ON

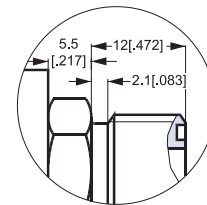
PORT CONNECTIONS

The connections of all OSPM-steering units in the catalogue are 9/16-18 UNF of the O-ring face seal type (ORFS).

The integrated end port fittings are specially developed for OSPM and therefore easily interchangeable.

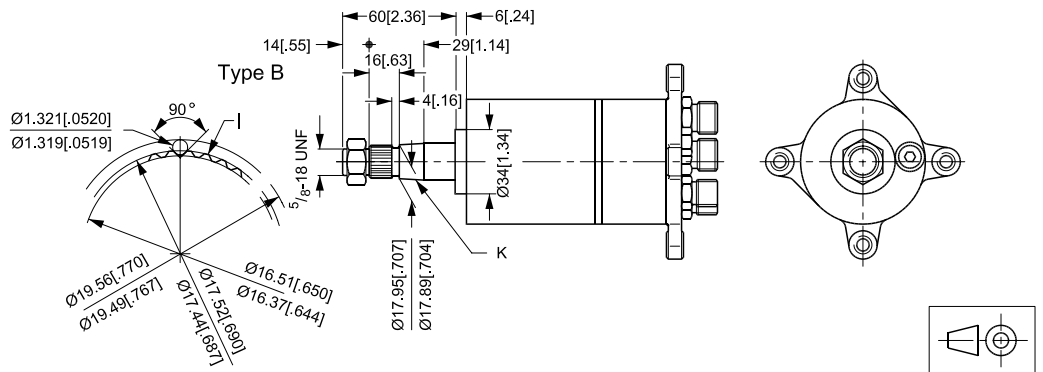
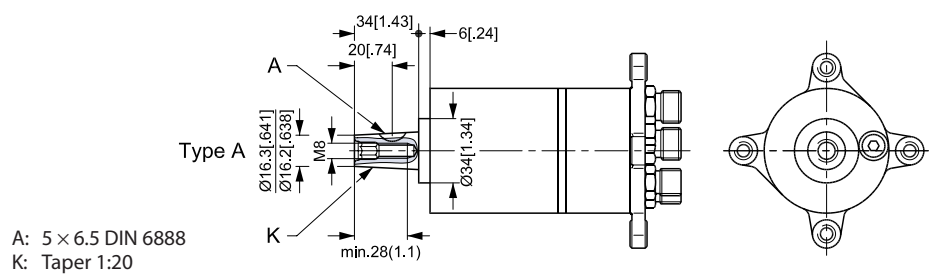
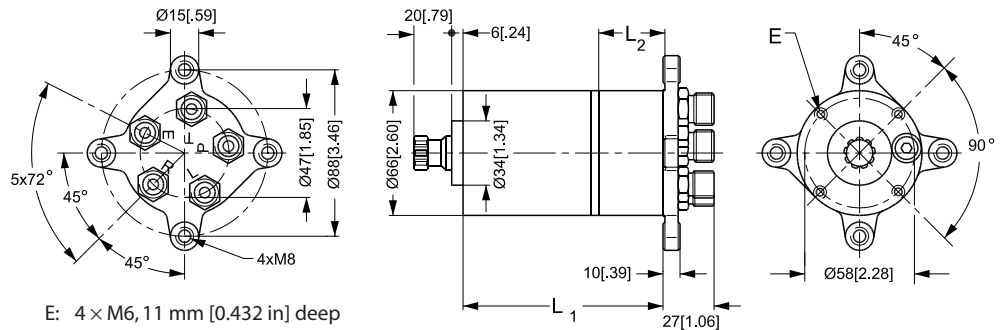
Dimensions of O-rings for ORFS ports:
 7.65 × 1.78 mm [3.02 × 0.702 in]
 (SAE J515 seal size no. 011).

Set of seals Sauer-Danfoss code no. 150L4042 contains 5 pcs. of these O-rings.



150-480.10

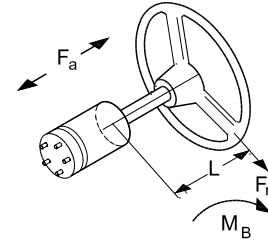
DIMENSIONS



Mini steering unit	L ₁ mm	[in]	L ₂ mm	[in]
OSPM 32 ON	90	[3.54]	11.0	[0.43]
OSPM 50 ON	96	[3.78]	17.1	[0.67]
OSPM 63 ON	100	[3.94]	21.6	[0.85]
OSPM 80 ON	106	[4.17]	27.4	[1.08]
OSPM 100 ON	113	[4.45]	34.2	[1.35]
OSPM 32 PB	103	[4.06]	11.0	[0.43]
OSPM 50 PB	109	[4.29]	17.1	[0.67]
OSPM 63 PB	113	[4.45]	21.6	[0.85]
OSPM 80 PB	119	[4.69]	27.4	[1.08]
OSPM 100 PB	126	[4.96]	34.2	[1.35]

LOAD ON INTEGRATED STEERING COLUMN

Symbols:
 L (m/in): Axial length between OSPM housing and steering wheel
 F_r (N/lb): Radial force on steering wheel
 F_a (N/lb): Axial force on steering wheel
 M_B (Nm/lbf-in): Bending moment on steering column $M_B = F_r \times L$



150-477.10

The following max. permissible values must not be exceeded:

M_B max.: 50 Nm [438 lbf-in]
 F_r max: 500 N [112 lb]
 F_a max: 600 N [135 lb]

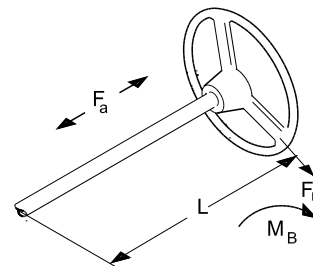
With a given length L the max. force F_r on the steering wheel can be calculated:

$$F_r = \frac{M_B \text{ max}}{L + 0.015} \quad \text{N; L in m}$$

$$F_r = \frac{M_B \text{ max}}{L + 0.590} \quad \text{lb; L in inch}$$

LOAD ON THE STEERING UNIT COLUMN

The construction of the steering column must ensure that no axial or radial forces are transferred to the steering unit. Such forces may prevent the steering unit from returning to neutral position automatically after a steering action has been completed.



150-271.10

The steering column must be supported. The following max. permissible values for Sauer-Danfoss steering columns OTPM and OTPM-T must not be exceeded:

M_B max.: 200 Nm [1752 lbf-in]
 F_a max: 1000N [224 lb]

**SPLINED TUBE SECTION
 FOR STEERING COLUMNS**

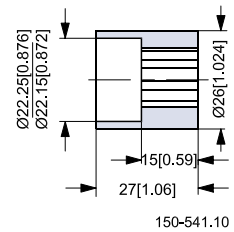
Customers who wish to construct their own steering column can purchase splined tube sections from Sauer-Danfoss.
 Code no. 150L0387.

When constructing your own steering column, please observe the following points:

1. Make sure, that the distance from mounting surface of the steering column to end of splined tube section and other dimensions of steering column are correct, so that engagement with the Sauer-Danfoss steering unit is as it should be (see page 13).
2. There must be only one bearing in the steering column (at the top).
3. The welded splined tube section must be coaxial with the steering column.
4. The steering column must be coaxial with the spigot hole $\varnothing 35$ [1.38 in] (see page 13)

Splined tube section material:
 Structural steel (St. 52-3, W.no. 1.0570).

We recommend CO₂ welding.



STEERING COLUMNS

OTPM and OTPM-T steering columns are suitable for OSPM steering units made for flanged-on steering columns.

OTPM steering columns are supplied in three different versions (M1, M2 and M3). Two with serrations and one with woodruff key. The steering columns are available in two standard lengths.



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OTPM-T steering columns are supplied in one version (M3).
 OTPM-T can be adjusted in steps of 5°, totally 40° from -25° against the driver, +15° away from the driver.
 By spring release the upper part tilts away from the driver.



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Type		Code number		
		OTPM 163	OTPM 350	OTPM-T 131
C-dim. (See page 13)	mm [in]	163 [6.42]	350 [13.78]	–
B-dim. (See page 14)	mm [in]	–	–	84 [3.31]
E-dim. (See page 14)	mm [in]	–	–	47 [1.85]
Weight	kg [lb]	1.3 [2.9]	1.8 [4.0]	2.7 [5.95]
M1*)	With woodruff key 5 × 6,5 d _{min} = 16,52 mm [0.65 in] Taper 1:20	150L1024	150L1025	–
M2*)	With serrations 7/8 in - 36, d _{min} = 21,55 mm [0.85 in] Taper 1:19,26	150L1026	150L1027	–
M3*)	With serrations 1 1/16 in - 40, d _{min} = 17,92 mm [0.71 in] Taper 1:12	150L1028	150L1029	150L1100

*) The numbers refer to the dimensioned sketch on page 13.

The steering column must be supported.

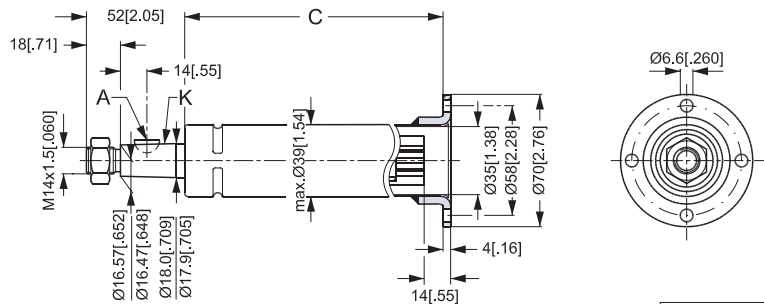
For information on other versions of OTPM and OTPM-T steering columns, please contact the Sauer-Danfoss Sales Organisation.

DIMENSIONS

**OTPM
 STEERING COLUMNS,
 TYPES M1, M2, M3**

Type M1

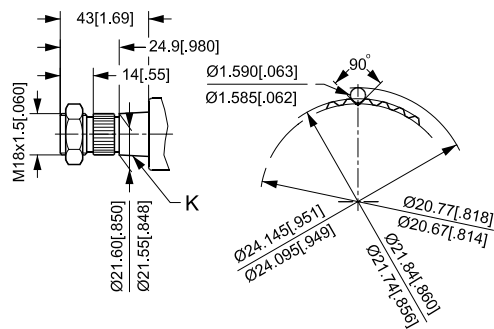
A: 5 × 6.5 DIN 6888
 $d_{\min} = 16.52 \text{ mm [0.65 in]}$
 K: Taper 1:20



150-506.10

Type M2

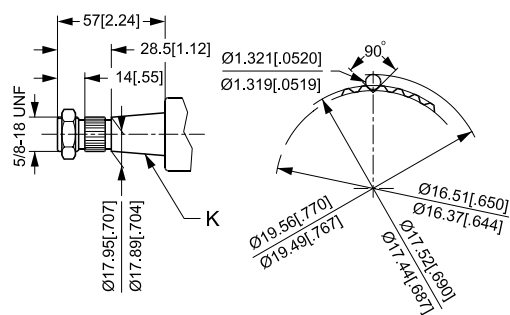
With $\frac{7}{8}$ in-36 serrations
 $d_{\min} = 21.55 \text{ mm [0.85 in]}$
 K: Taper 1:19.26



150-483.10

Type M3

With $\frac{11}{16}$ in-40 serrations
 $d_{\min} = 17.92 \text{ mm [0.71 in]}$
 K: Taper 1:12

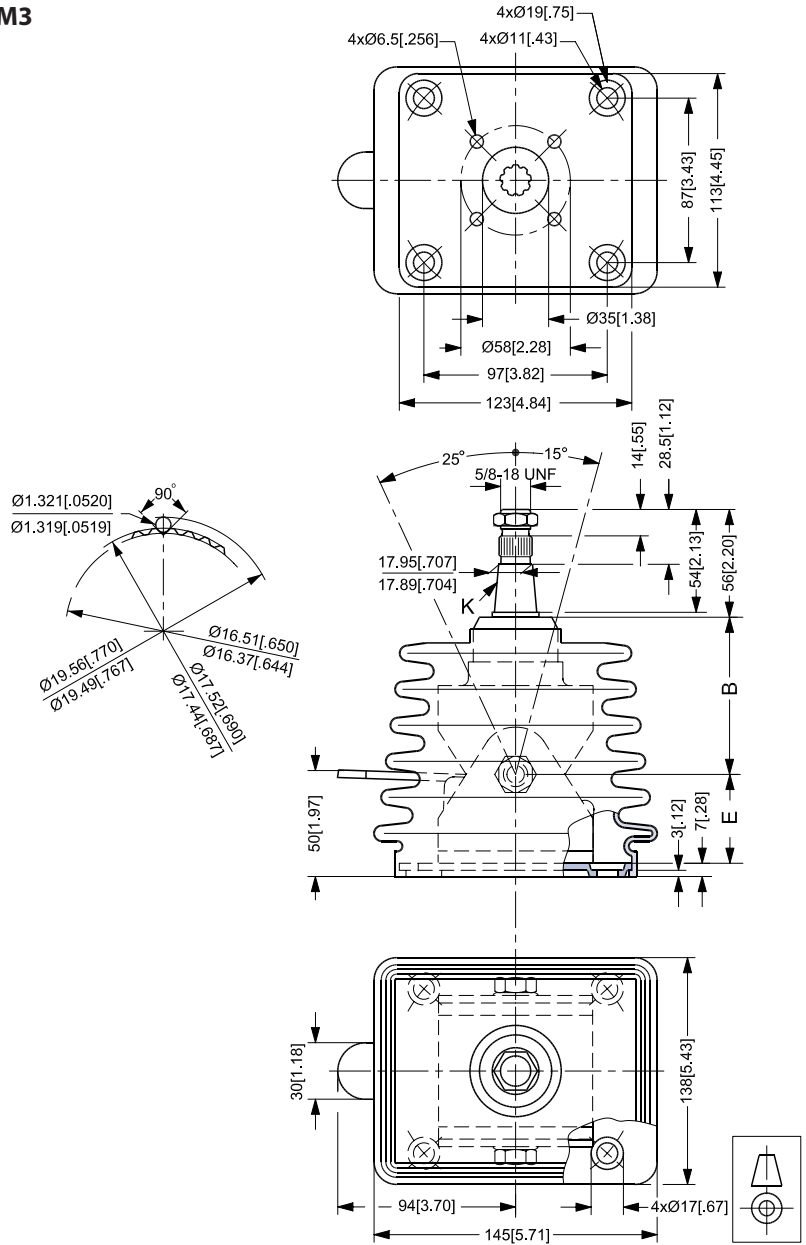


150-484.10

DIMENSIONS

**OTPM-T
 STEERING COLUMNS**

Type M3



150-537.10

With $1^{1}/16$ in-40 serrations
 $d_{\min} = 17.92$ mm [0.71 in]
 K: Taper 1:12



OSPM mini-steering unit, OTPM steering column
Technical Information
Notes

Notes



OUR PRODUCTS

Hydrostatic transmissions
Hydraulic power steering
Electric power steering
Closed and open circuit axial piston pumps and motors
Gear pumps and motors
Bent axis motors
Radial piston motors
Orbital motors
Transit mixer drives
Planetary compact gears
Proportional valves
Directional spool valves
Cartridge valves
Hydraulic integrated circuits
Hydrostatic transaxles
Integrated systems
Fan drive systems
Electrohydraulic controls
Digital electronics and software
Battery powered inverter
Sensors

Sauer-Danfoss Hydraulic Power Systems – Market Leaders Worldwide

Sauer-Danfoss is a comprehensive supplier providing complete systems to the global mobile market.

Sauer-Danfoss serves markets such as agriculture, construction, road building, material handling, municipal, forestry, turf care, and many others.

We offer our customers optimum solutions for their needs and develop new products and systems in close cooperation and partnership with them.

Sauer-Danfoss specializes in integrating a full range of system components to provide vehicle designers with the most advanced total system design.

Sauer-Danfoss provides comprehensive worldwide service for its products through an extensive network of Authorized Service Centers strategically located in all parts of the world.

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