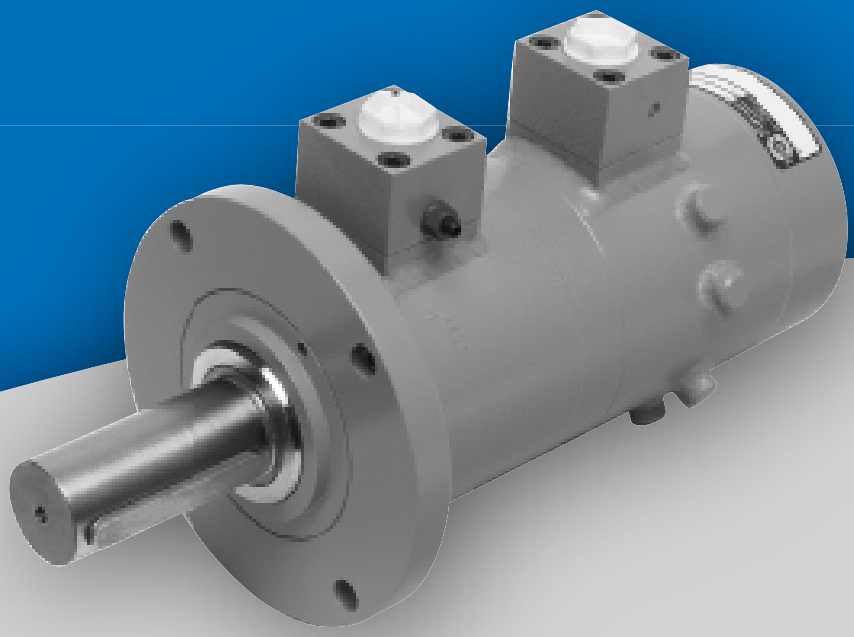
ECKART
HYDRAULIK
PNEUMATIK



Rotary actuator SM1

Hydraulic / 100 bar

GATEWAY
to new technologies.

Advantages through innovative technology...

highly perfected end cushioning

for absorption of kinetic energy

- negating the need for expensive proportional or servo controls with virtually identical characteristics

from 15 bar economically applicable

- through precise combined helical gears and low friction seals, is the SM1 already from 15 bar economically applicable
- from 3 to 6 bar functionally

one-piece steel housing

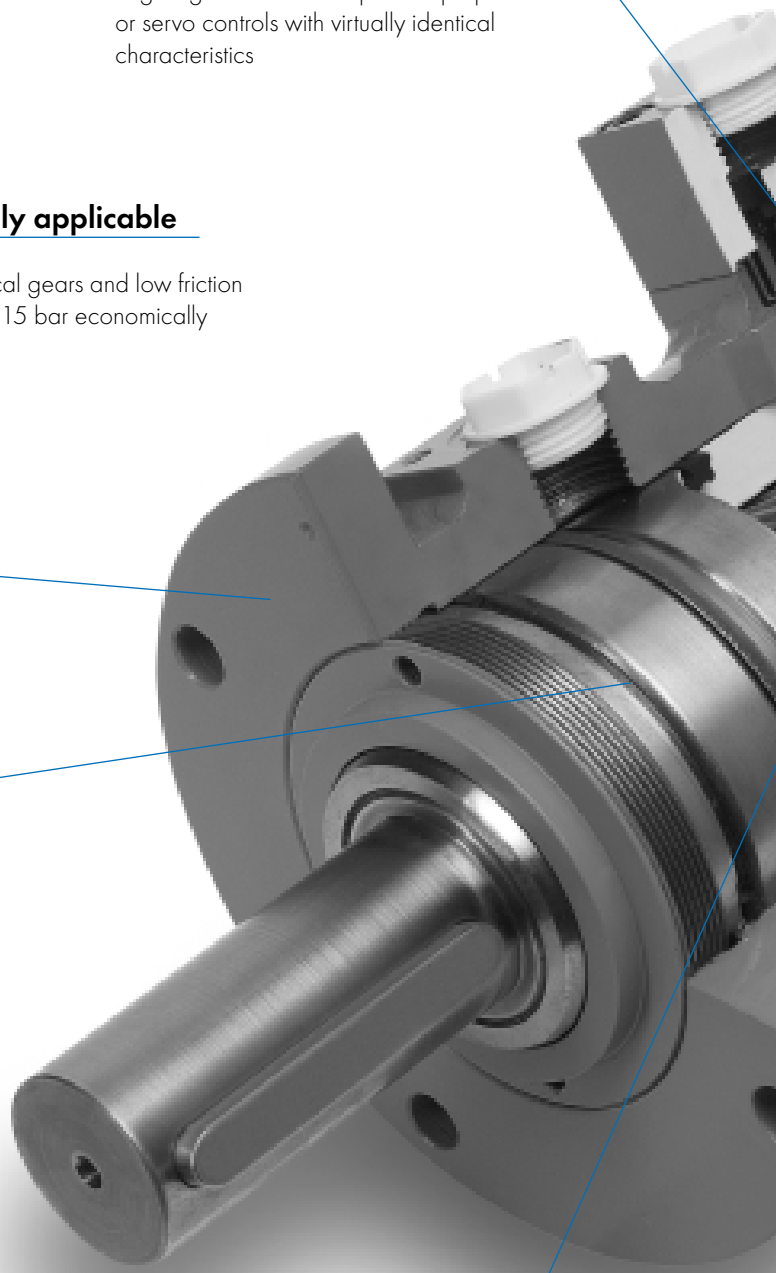
- by a double flange you can transmit especially bending moments, but also torques, about the housing

sealing technology

- extended service life of seals
- increased safety, also with regard to the environment
- suitable for most fluids
- no internal leakages through solid seals enabling the load to be held in any intermediate position
- all sliding surfaces in contact with seals are honed or ground and polished

short building measurements – low weight

- the measurements are reduced at the shortest possible measure, and therefore we reached also a low weight

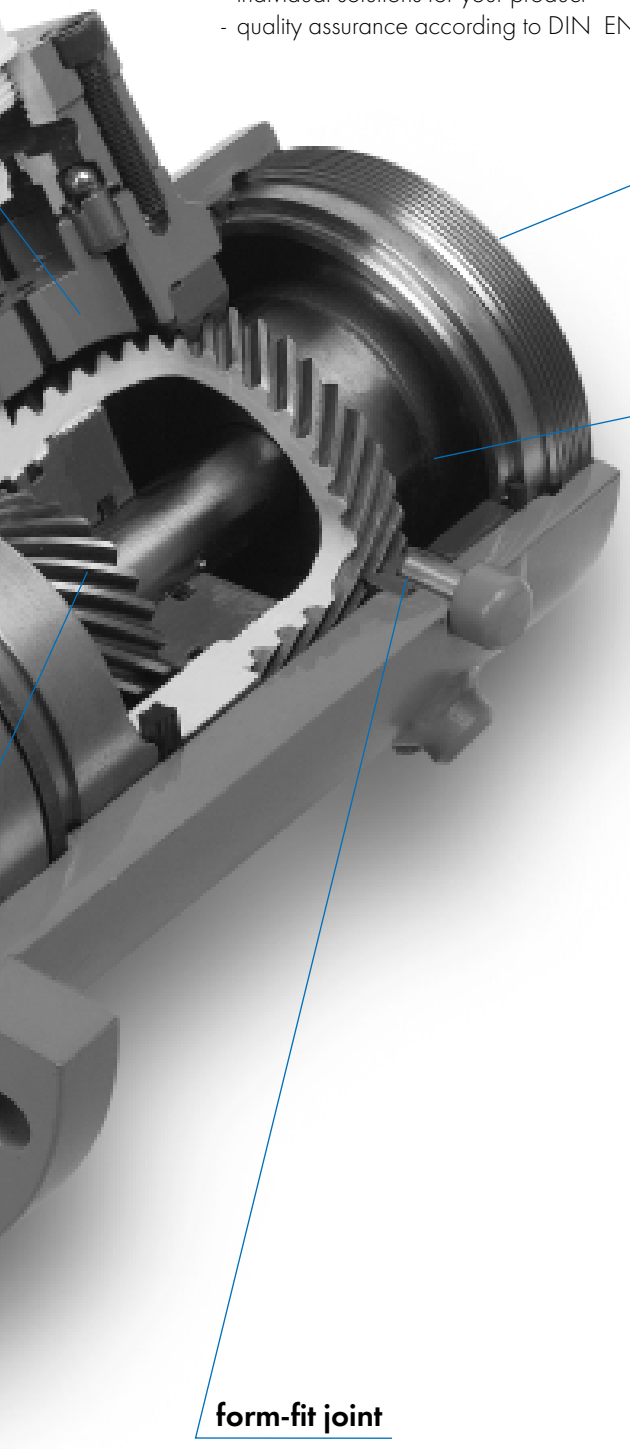


wear-resistant moving parts

- long service life of the rotary actuator through extended-period nitriding
- excellent sliding characteristics of the gears

... over time

- short delivery times through flexible storage
- individual solutions for your product
- quality assurance according to DIN EN ISO 9001



through shaft

- the axial force required for mounting the shaft on the hub can be exerted at the end of the shaft, preventing destruction of the four-point bearing

externally adjustable end stop (standard)

- the end angle can be re-adjusted at any time by ± 5°

form-fit joint

- assuring positive power/torque transmission even at peak load conditions

Contents

SM1

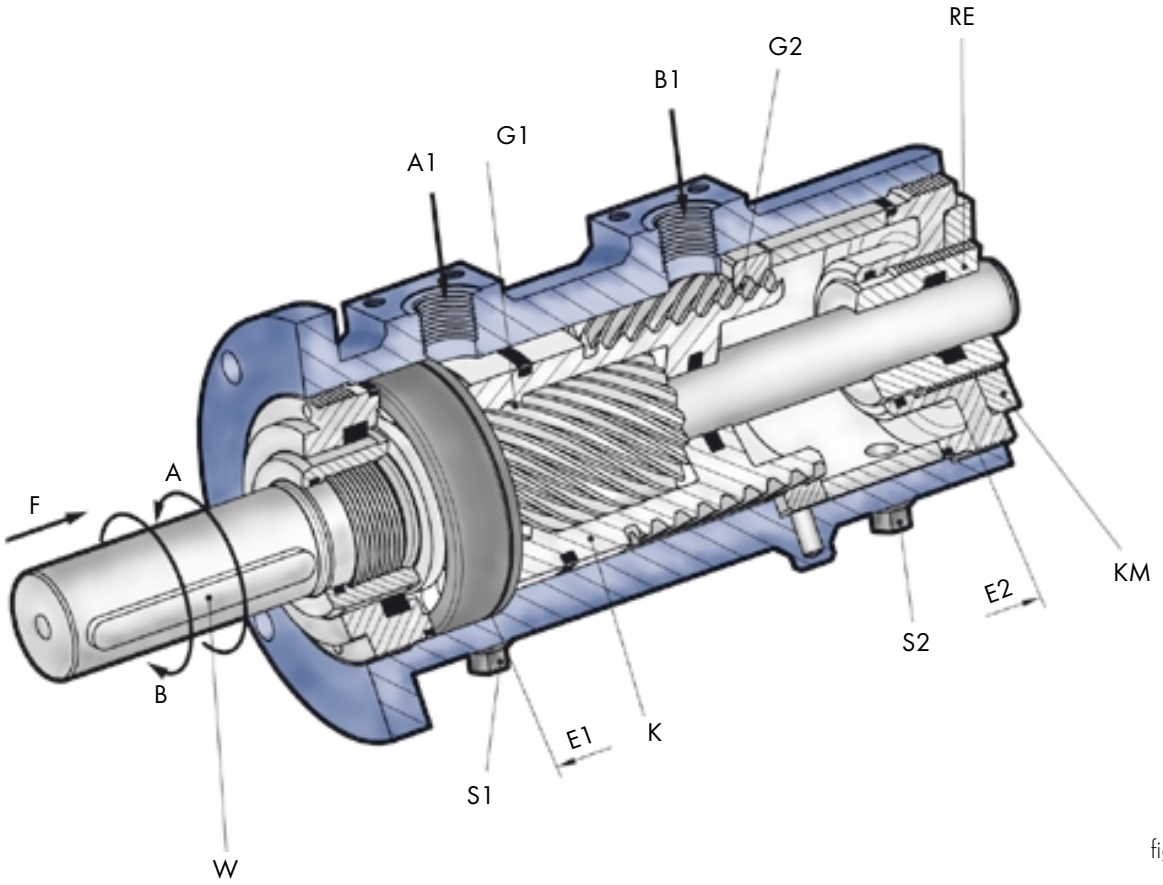


figure-2

[Operation]

The rotary actuator SM1 is used for rotating or turning useful loads.

As in a hydraulic cylinder the piston K (fig.-2) is moved in a linear motion between the two mechanical end positions E1 and E2 by means of hydraulic power.

Through the multiple helical gears the linear motion is mechanically transformed into a turning motion and transferred to the drive shaft W.

The opposed direction of the helical gears G1 and G2 causes a simple stroke of the piston to produce a doubling of the angular movement.

The pairs of helical gears are not self-inhibiting. Positive lubrication and nitriding of the surfaces of the helical gears ensures a long service life of the rotary actuator.

[Operating pressure]

The maximum operating pressure of the rotary actuator is 100 bar. Low friction seals allow the rotary actuator to operate from as low as 3 to 6 bar operating pressure and so can be economically set at approximately 15 bar.

For especially slow rotation stick-slip seals can be supplied as a special specification.

[Drive shaft datum]

The drive shaft datum is adjusted at the factory as shown in fig.- 2, with the piston K resting against the stop E1 (also see pages 10 and 11).
A different drive shaft datum is available on request.

[Torque output]

The stated torque figures are effective torques, with the pressure versus the torque curve being virtually linear. For multi-shift, heavy duty or high frequency applications a safety factor between 1.2 and 1.5 is recommended. Torque output is equal in both directions.

[Shaft rotation]

From view F, the drive shaft W will rotate anti-clockwise (arrow A) when pressure is applied to port A1. A different direction of rotation is available as a special feature.

[Rotation]

Standard rotations are 90°, 180°, 270° and 360°. Other rotations can be supplied on request by using the model with the next standard rotation up and limiting the stroke of the piston in accordance. Also available are special models with rotations in excess of 360°.

[Backlash]

In order to function, the set of helical gears require a certain backlash of approx. 20 angular minutes. On special request, the rotary actuator can also be supplied with a reduced backlash of as little as 5 angular minutes.

[Externally adjustable end stop]

This standard feature allows re-adjustment of the angle of rotation as supplied within ±5°. Adjustment is only possible in the unpressurised state and at the end position E2 (see page 12).

[Fluids]

We recommend mineral oil based hydraulic fluids of the group HLP as per DIN 51524 / Part 2 and VDMA recommendation 24318. Fluids without emulsifying agents reduce the service life of the rotary actuator. For heavily flammable fluids, please consult factory. The recommended viscosity range is 16 cSt to 68 cSt at 40° to 60° C.

[Operating temperature]

The operating temperature can range from -25° C to +70° C, providing suitable fluids with the correct viscosity rating are used. Please contact us for any applications outside these limits.

[Oil change]

The oil change depends on the size of the system and should be carried out at regular intervals.

[Filtration]

The hydraulic fluid used in the rotary actuator does not exceed the pollution classification 19/15 in accordance with ISO 4406. Therefore, a filter setting of < 25 µm should be installed in the pressure line. With hermetically sealed containers a return filter should suffice. With open containers a pressure filter must be installed in the compressed air line. The maintenance intervals described above should be adhered to in line with manufacturer specifications.

[Leakage]

The use of solid seals reduces leakage to the absolute minimum, therefore allowing the load to be held in any intermediate position.

[End of stroke]

The piston K (fig. 2) can be moved under load against the end stops E1 and E2 and be loaded in this position.

The end stops are designed to withstand the force created by the maximum allowable operating pressure relating to the maximum premissable torque output.

If higher forces can be expected, we recommend installation of external stops or other methods of control such as end cushioning (see page 6 and 12) or control valves.

[Installation, maintenance and running in]

An operating instruction for the installation, maintenance and running in are provided with every delivery.
Spare-part-list as well as dismantling and assembly instruction are available by request.

[Non-standard options]

In addition to the options listed in this catalogue, special features can also be supplied, such as splined shafts, special seals, several cams for sequential operation of switches, etc.

DO YOU THOUGHT AT ALL?
Please use our fax form at page 13.

End cushioning

[Z1- End cushioning]

End cushioning is aimed at dissipating and/or decelerating the rotary movement before the final end stop.

Eckart end cushioning is designed to meet the toughest requirements in modern hydraulics. On the basis of continuous research and development as well as close co-operation with our customers, we can offer you state-of-the-art end cushioning.

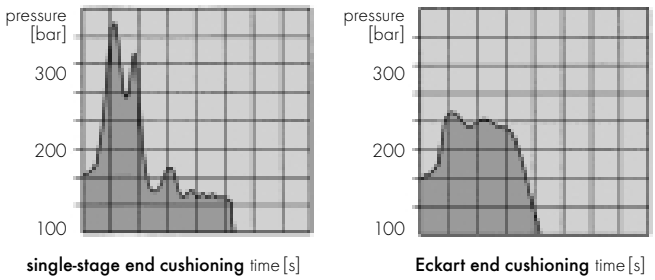


figure-3

The diagram shows one of the advantages of Eckart end cushioning over conventional cushioning with single-stage control

- You do not need to include any expensive proportional or servo controls in order to dissipate kinetic energy, because Eckart end cushioning will perform this function almost identically.
- Eckart end cushioning largely prevents pressure peaks, which often destroy rotary actuators with conventional single-stage cushioning or throttle regulation (see diagram in fig. 3).
- The standard effective cushioning range in the end position is from 12° to 20° (see too page 12). Other cushioning can be supplied on request.
- It is possible for the customer to adjust the cushioning effect individually by screwing in nozzles.
- End cushioning Z1 can also be delivered for each special angle of rotation (see too page 12).

[Operation]

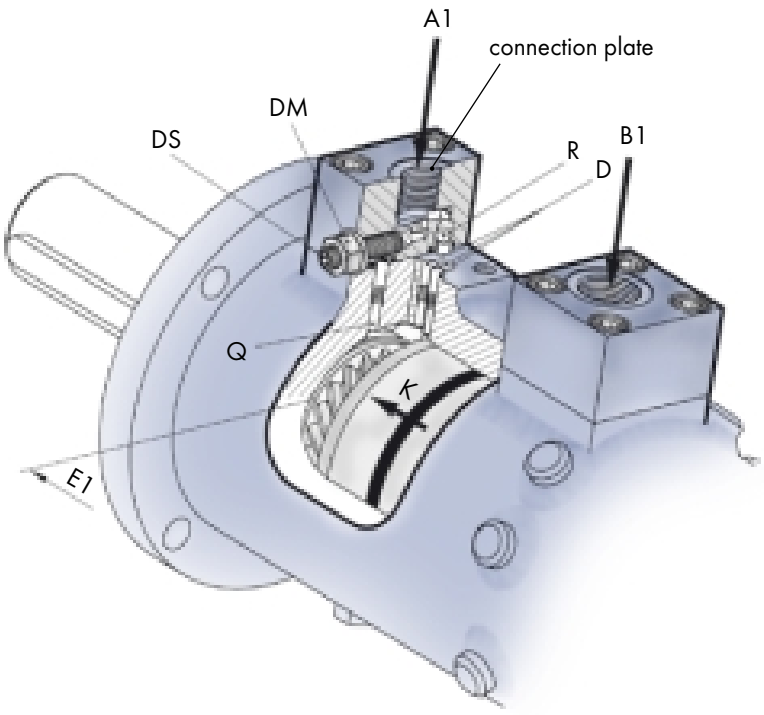


figure-4

A. Starting position

- piston K is in end position E2 (see page 4)
- port A1 is pressurised
- port B1 is unpressurised

B. Reversing the directional control valve

- port B1 is pressurised
- ball check valve R in port B1 opens
- hydraulic fluid flows freely into the cylinder space
- piston K moves in the direction end position E1 (direction arrow piston K)
- ball check valve R is closed in port A1
- pressure medium flows off freely through the bores D

C. Cushioning process

- piston K now approaches the end position E1 and seals the bores D one after the other
- piston speed is progessively reduced
- piston K now completely covers the bores D
- pressure medium can now only escape through the bore Q with the adjusting screw DS to the port A1
- the cushioning effect can therefore be adjusted again by the adjusting screw DS
- this cushioning phase runs linear

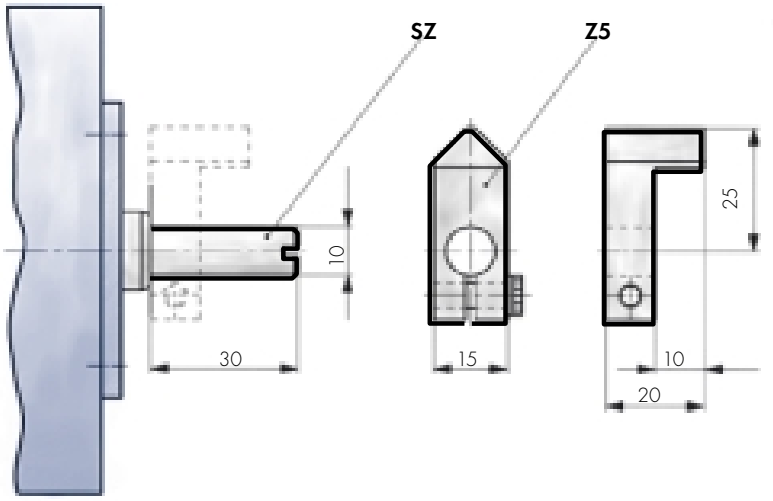


figure-5

[SZ - Locating pin]

The locating pin SZ (fig. 5) is intended for the fitting of cams Z5 or other control equipment. It simply screws or is glued into the tapping provided at the back end of the shaft. It can be supplied at a later stage without reconstruction of the rotary actuator. The locating pin should not be used for torque transmission or for limiting the angle of rotation.

[Z5 - Cam]

The cam Z5 (fig. 5) is clamped onto the locating pin SZ and is used to operate the control switches. If two cams are fitted, the second one is reversed and fitted upside down, while both cams remain individually adjustable.

DO YOU THOUGHT AT ALL?
Please use our fax form at page 13.

[Z3 - Longe-range adjustable end stop]

not available in conjunction with option SZ/HWSZ

Micrometer-style adjustment allowing exact pre-setting of the desired angle of rotation with 100 % repeatability. Available over the total or only part of the rotation, for example: total rotation 270°, adjustable between 180° and 270°. Mat chrome surface finish. Dimension „L" and the total length of the rotary actuator is extended by this option, depending on the range of adjustment (see page 10).

[Z4 - Longe-range adjustable end stop]

simplified version of Z3

The angle of rotation can be adjusted individually with this option (fig. 4), both over its total range of rotation and over a partial range (e.g. total angle 270°, desired partial adjustment from 180° to 270°). To this end, the adjusting insert RE is simply screwed inwards or outwards to give the desired angle of rotation. The shaft goes all the way through, allowing control equipment to be fitted. Adjustment is only possible in the unpressurised state. Dimension „L" and the total length of the rotary actuator is extended by this option, depending on the range of adjustment (see page 10).

[Z6.1 - Control switch assembly]

This option allows the respective end positions to be mechanically confirmed and the intermediate angles to be recalled. The locating pin SZ and the cam Z5 are included in this option.

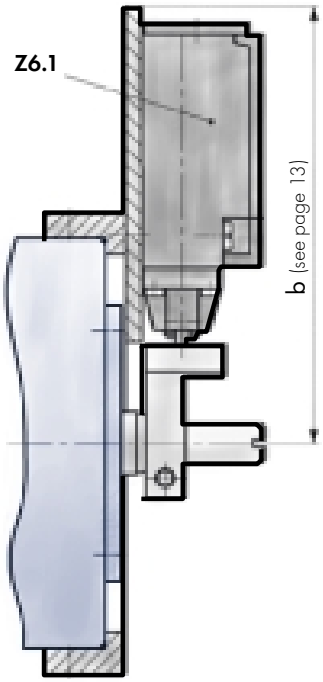


figure-6

Technical data Z6.1 - mechanical (figure-6):

control element:	according to DIN EN 50047
insulation:	according to VDE 0110 Group C
nominal insulation voltage:	500 V ~ 25-60 Hz
permanent current:	10 A
nominal operating current:	4 A (220~); 2,5 A (380~); 1 A (500~)
permissible temperature:	-30°...+80°
system of protection:	IP 67 according to DIN 40050 p. 1

[Z6.2 - Control switch assembly]

This option allows the respective end positions to be touchless and electronically confirmed and the intermediate angles to be recalled. The locating pin SZ and the cam Z5 are included in this option. The respective assembly dimensions are given on page 13.

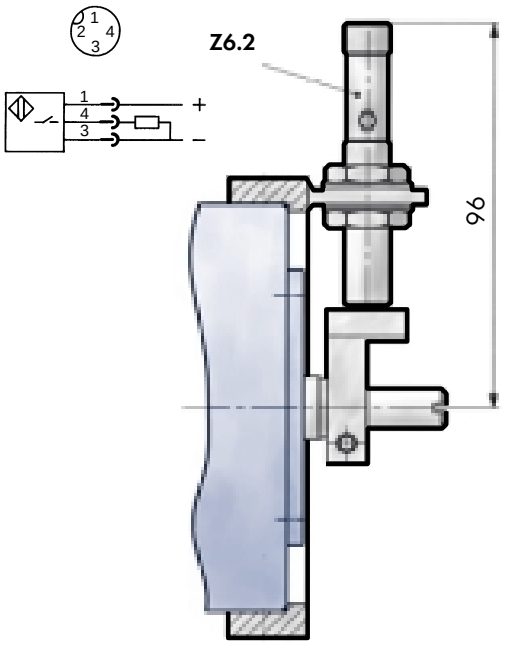


figure-7

Technical data Z6.2 - inductive (figure-7):

control element:	PNP Schließer M12x1
nominal control interval:	2 mm
operating voltage:	10 . . . 30 V DC
current carrying capacity:	200 mA
connection type:	plug
permissible temperature:	-25°...+70°
system of protection:	IP 67

Plugs are not delivered as standard!
Concerning this we ask for your inquiry.

[Technical data]

Size (piston-Ø)			40	50	63	80	100	125	160	200
max. torque at 100 bar		[Nm]	74	162	304	588	1275	2450	5200	10295
spec. torque		[Nm/bar]	0,74	1,62	3,04	5,88	12,75	24,5	52,0	102,95
angle of rotation			standard 90°/180°/270°/360° and any intermediate angle, even above 360°							
medium			recommended: mineral oil of group HLP/DIN 51524, page 2 and VDMA page 24318; others on request							
min. operating pressure required			3 to 6 bar							
max. allowable operating pressure			100 bar / higher on request							
installation position			as required, provided that adequate air bleeding is provided							
temperature range			- 25°C to +70°C / higher or lower on request							
absorption volume		[cm³/1°]	0,17	0,38	0,7	1,43	2,98	5,86	12,14	23,36
max. admissible rotation time per 90°		[s]	0,13	0,18	0,24	0,26	0,43	0,55	0,73	1,24
weight „N" [kg] ca.	angle	90°	3,2	5	8	13,5	21	41	80	129
		180°	3,5	5,5	9	15,5	24,5	48	95	151,5
		270°	3,8	6	10	17,5	28	55	110	174
		360°	4,1	6,5	11	19,5	31,5	62	125	195,5
weight „HW" [kg] ca.	angle	90°	-	-	7,4	12,5	18,5	36,7	69	108
		180°	-	-	8,4	14,5	22	42,7	84	130,5
		270°	-	-	9,4	16,5	25,5	48,7	99	153
		360°	-	-	10,4	18,5	29	54,7	114	175,5
max. radial load F_R		[KN]	0,589	1,864	3,434	7,358	8,829	11,772	15,696	19,620
max. axial load F_{AE}		[KN]	1,472	2,453	4,905	8,829	11,772	17,658	29,430	39,240
max. axial load F_{AA}		[KN]	0,245	0,392	0,589	0,758	1,177	1,472	1,766	2,060

[Important technical information]

- Adherence to the data provided here is a precondition for trouble-free operation.
- The regulations of the Technical Supervision, Social Insurance Against Occupational Hazards and the respective environmental regulations etc. must be observed.
- Plant driven by a rotary actuator must be laid out in such a manner that in case of technical or human failure there is no danger of injury or death.
- We reserve the right to alter or improve design specifications without prior notice.

[Ordering code]

N . SM1 . 63 – 180° / Z1 / ... / SO / U

shaft style: N, SZ, HW, HWSZ

100 bar series

size (piston Ø)

rotation (standard) – other rotations available on request: 90°, 180°, 270°, 360°

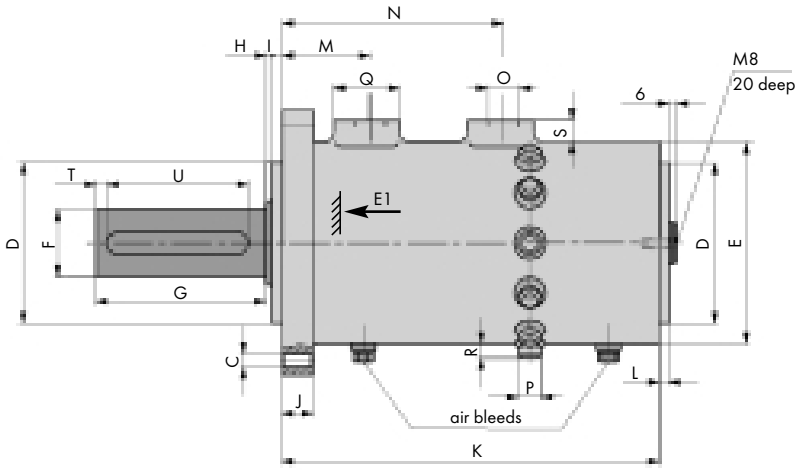
options – omit for standard
- Z1 - end cushioning
- Z3 - long-range adjustable end stop
- Z4 - long-range adjustable end stop
- Z5 - cam
- SZ - locating pin
- Z6._ - control switch (1-mech./2-ind.)

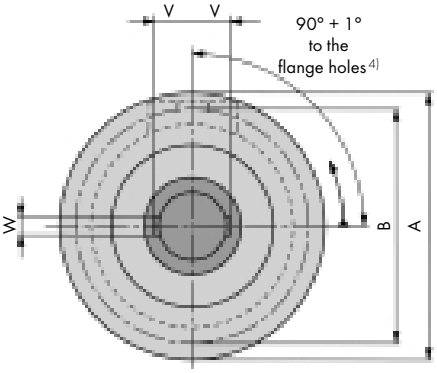
non-standard options (consult factory) omit for standard

internal referenz (must be specified when ordering)

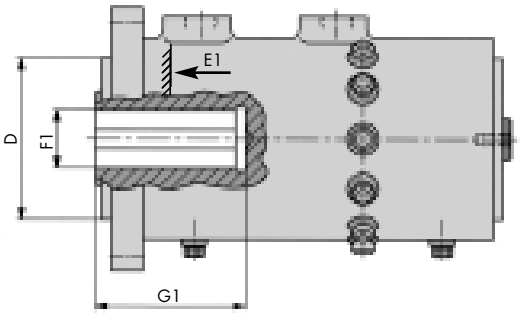
Dimensions

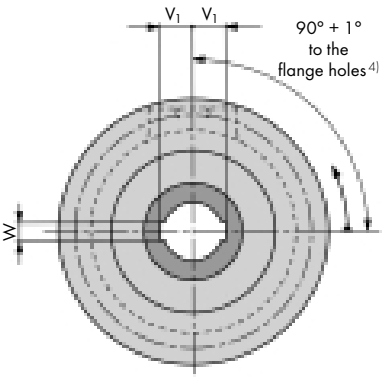
[Standard-model - type N]





[Model with hollow shaft - HW]





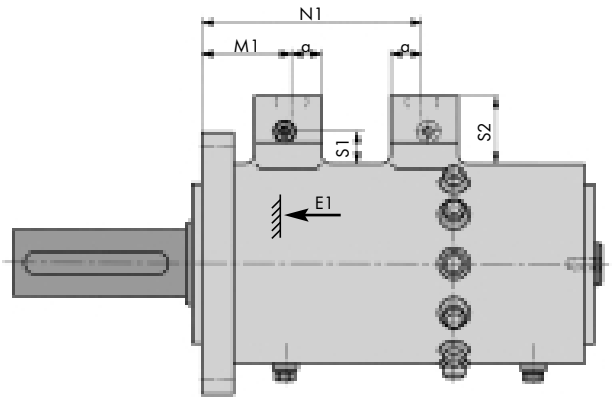
[Comments]

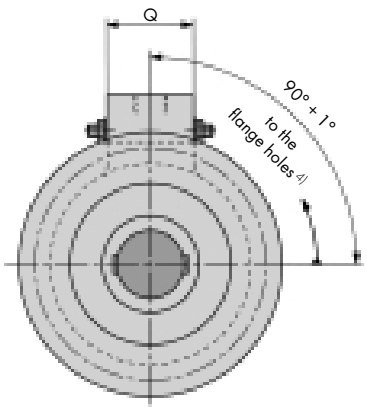
[1] Depth as per DIN 6885, page 3 (all other depths as per DIN 6885, page 1)
[2] The figures stated are maximum diameters; in order to transmit the torque without torsional damage to the shaft, we recommend hardening of the shaft or reducing the pressure (torque).
[3] Dimension varies for models including option Z3/Z4 = adjustment of angle of rotation. Please consult factory.
[4] Drive shaft datum

Order code on page 9

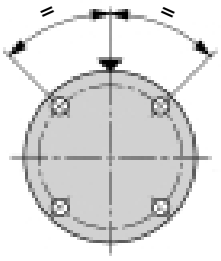
Size (piston-Ø)	Rotary actuator SM1																						
	øA	øB	øC /number	øD h7	øE	øF k6	øF1 [2] H7	G	G1	H	I	J	K 90°	K 180°	K 270°	K 360°	L [3]	M	M1	N 90°	N 180°	N 270°	N 360°
40	85	73	6,5/4	40	62	18	-	50	-	2,5	3	10	123	150	177	204	4	39	42	79,5	93	106,5	120
50	98	86	6,5/4	50	74	25	-	60	-	3	4	10	138	175	212	249	4	40	43	87	105,5	124	142,5
63	116	102	9/4	60	87	30	24	80	65	3	5	12	156	201	246	291	5	46	49	99	121,5	144	166,5
80	150	130	11/4	70	106	35	30	80	85	3	6	16	187	242	297	352	6	52	52,5	119,5	147	174,5	202
100	160	143	11/4	80	125	45	45	110	102	4	6	18	217	291	365	439	6	56	56	132	169	206	243
125	205	182	13/4	100	157	60	55	140	120	5	7	18	256	348	440	532	9	64	67,5	156	202	248	294
160	260	230	17/6	130	200	80	75	170	150	6	8	23	312	428	544	660	8	77	83,5	190	248	306	364
200	310	275	17/6	160	242	100	95	210	173	6	10	28	351	492	633	774	10	85	91	211	281,5	352	422,5

[Model with end cushioning - Z1]

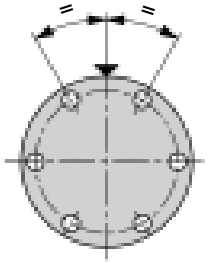




[Arrangement of flange bores] ↓ = ports



sizes: 40, 50, 63, 80, 100, 125



sizes: 160, 200

DO YOU THOUGHT AT ALL?
Please use our **fax form** at **page 13.**

- We reserve the right to alter or improve design specifications without prior notice.
- Non-standard options on request

Rotary actuator SM1																		Z6	Z1		Size (piston-Ø)
N1 90°	N1 180°	N1 270°	N1 360°	O port size	øP	Q	Q1	R	S	S1	S2	T	U DIN 6885	V DIN 6885	V1	W DIN 6885	W1	b	a	cushioning range	
79,5	93	106,5	120	G3/8"	12	37	40	8	6,5	12,5	31,5	1,5	45	11,5	-	6	-	107,8	15	20°	**40**
86	104	122	140	G3/8"	12	37	40	7	6,5	12,5	31,5	3	50	15,5	-	8	-	110,8	15	19°	**50**
97	119	141	163	G3/8"	12	37	40	8	6,5	12,5	31,5	4	70	18	14[1)]	8	8	110,8	15	15°	**63**
120,5	147,5	174,5	201,5	G1/2"	14	42	45	9	8,5	15,5	38,5	4	70	20,5	18,3	10	8	110,8	19	19°	**80**
132	168	204	240	G1/2"	14	42	45	9	9	16	39	4	100	26	26,3	14	14	110,8	19	15°	**100**
153	198	243	288	G3/4"	20	55	55	13	7	14	37	5	125	34	31,8	18	16	110,8	23	18°	**125**
189	245,5	302	358,5	G1"	26	58	60	15	10	17	45	4	160	45	40,2[1)]	22	20	110,8	26	15°	**160**
210	279	348	417	G1"	26	58	60	14	10	17	45	10	180	56	50,4[1)]	28	25	140,3	26	12°	**200**

Important technical information

Because of its torque, angle of rotation, pressure range, positioning accuracy, stability of position, type of attachment and dimensions, the Eckart SM1 rotary actuator can be used in a wide range of applications.

The selection and the size depends above all on the demands and the operating conditions under which the rotary actuator is operating. For the planning of special items, it is also important for us to be aware of all technical details.

In order to provide this we have prepared a catalogue of questions on page 13 which you can fax us if any lack of clarity emerge. Our staff will be glad to work out and submit a proposal to you.

We accept no guarantee claims for disturbances in functioning or complaints which are attributable to lack of information by the customer.

[When planning the rotary actuator, we recommend the following]

- The mechanical stops within the rotary actuator are designed to withstand the force created by the maximum allowable operating pressure relating to the maximum permissible torque output. If they are used to stop the load, the forces acting on them, including forces of inertia, must not exceed the force created by the maximum operating pressure (100 bar).

  If higher forces can be expected, we recommend installation of external stops or other methods of control such as end cushioning, as described below, or control valves.

- On hermetic locking of the rotary actuator (e.g. hydraulically controlled double release valves) and the impact of resetting force on the axle a holding pressure is generated. If the holding pressure reaches the level of the operating pressure there is a torque increase on the axle of 38 %. If resetting forces are expected this should be reflected in selecting the size of the rotary actuator. This also has to be taken into consideration in those cases of operation in which the optional end cushioning Z1 is used.

- In order to guarantee a fresh supply of pressure fluid or medium, the pressure connection lines should be kept as short as possible, and/or the directional control valve should be mounted directly onto the rotary actuator. If this is not possible, we recommend a hydraulically controlled double release valve with additional tank line.

- On hermetic locking of the rotary actuator (e.g. hydraulically controlled blocking valves) and the impact of heat from external sources it should be considered that the hydraulic pressure in the rotary actuator increases by about 6-8 bar per 1°C increase of the temperature. In case of substantial temperature increase the rotary actuator could be destroyed. If operating conditions with substantial temperature increases are expected, appropriate protective measures (e.g. safety valves, cycles of operation) should be provided.

- During installation, care should be taken that the drive shaft or hub is perfectly aligned with the counterpart, since otherwise the maximum permissible radial and axial forces can easily be exceeded.

- In the case of option HW - hollow shaft with keyways we recommend a calculation of the torsion and fatigue strength of the shaft. Also see page 8.

- In case of changing the angle of rotation on actuators with the end cushioning option Z1, the cushioning effect on the bottom side should also be changed.

- Ensure that air bleeding S1/S2 is accessible (important in the case of end cushioning Z1).

- The rotary actuator needs to be dismantled when changing replacement parts. It is therefore necessary to allow enough clearance for this to be carried out easily.

- In case of rotary actuators with the end cushioning option Z1, the flowing back of the pressure medium is progressively throttled down which causes the hydraulic pressure to rise on the cushioned side of the piston. In this context it must be ensured that the anticipated cushioning pressure does not exceed the operating pressure maximally admissible.
  As not all factors can be exactly pre-determined, not all requirement profiles can be implemented in configurations which use the end cushioning Z1. For this reason the details of the execution for the end cushioning Z1 must be established under all circumstances during the commissioning of the initial delivery of rotary actuators (we will be glad to assist you concerning this).

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department | name/ref.

street

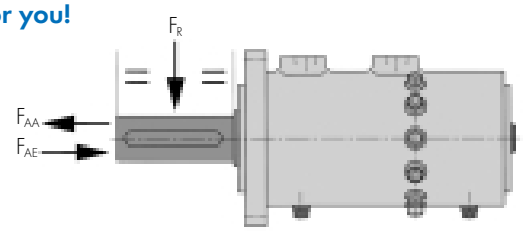
country/postcode/place

phone | fax

e-mail

date	project	no.

We calculate for you!



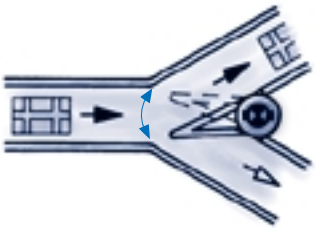
1	fitting position of rotary actuators												
	A		B		C		D		E		F		G
2	options												
	HW	SZ	Z1	Z3	Z4	Z5	Z6.1	Z6.2					

3	angle of rotation, SM1 max.		°	21	pressure medium		
4	angle of rotation, in operate		°	22	temperature of pressure medium		° C
5	rotation time, total	t_g	sec.	23	temperature of environment		° C
6	cushioning time	t_d	sec.	24	volume flow	Q	l/min.
7	cycle frequency	T	sec.	25	stops	☐ internal ☐ external	
8	duration of operation per day		h	26	Z3/Z4 range of adjustment		

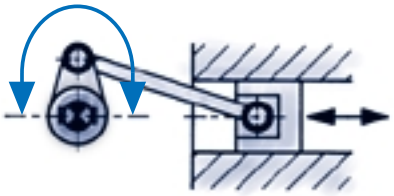
9	torque output	M_d	Nm
10	mass moment of inertia	I	kgm^2
11	lever	r	mm
12	centre of mass	R	mm
13	mass	m	kg
14	reset power, holding power	M_r	Nm
15	radial load	F_R	N
16	axial load	F_{AA}	N
17	axial load	F_{AE}	N
18	required working pressure	P_A	bar
19	maximum operating pressure	P_B	bar
20	pressure peaks	P_S	bar

sketch/special features/
field of application/circuit diagram

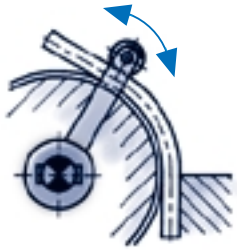
Applications



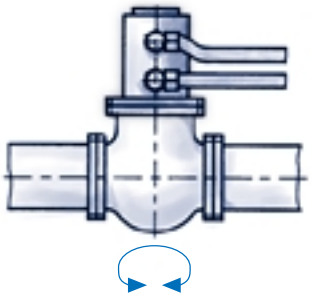
conveyor belts



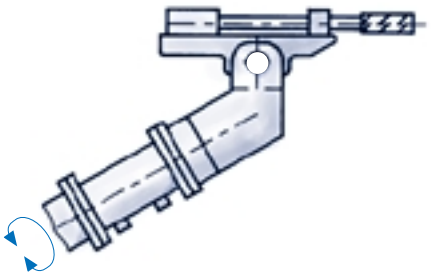
linear actuation



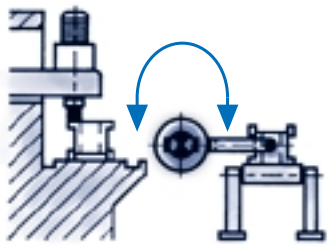
bending machines



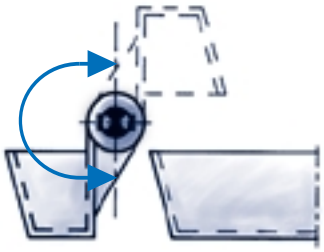
gate valve control



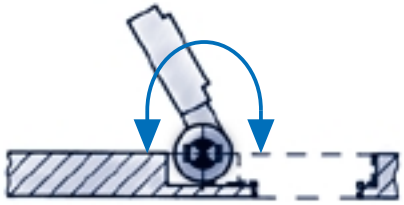
boom rotation



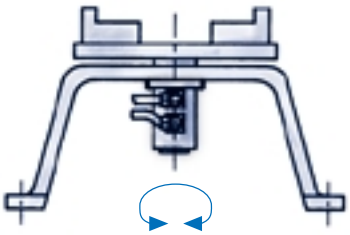
work piece positioning / changing



tipping devices



opening / closing



rotational devices

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