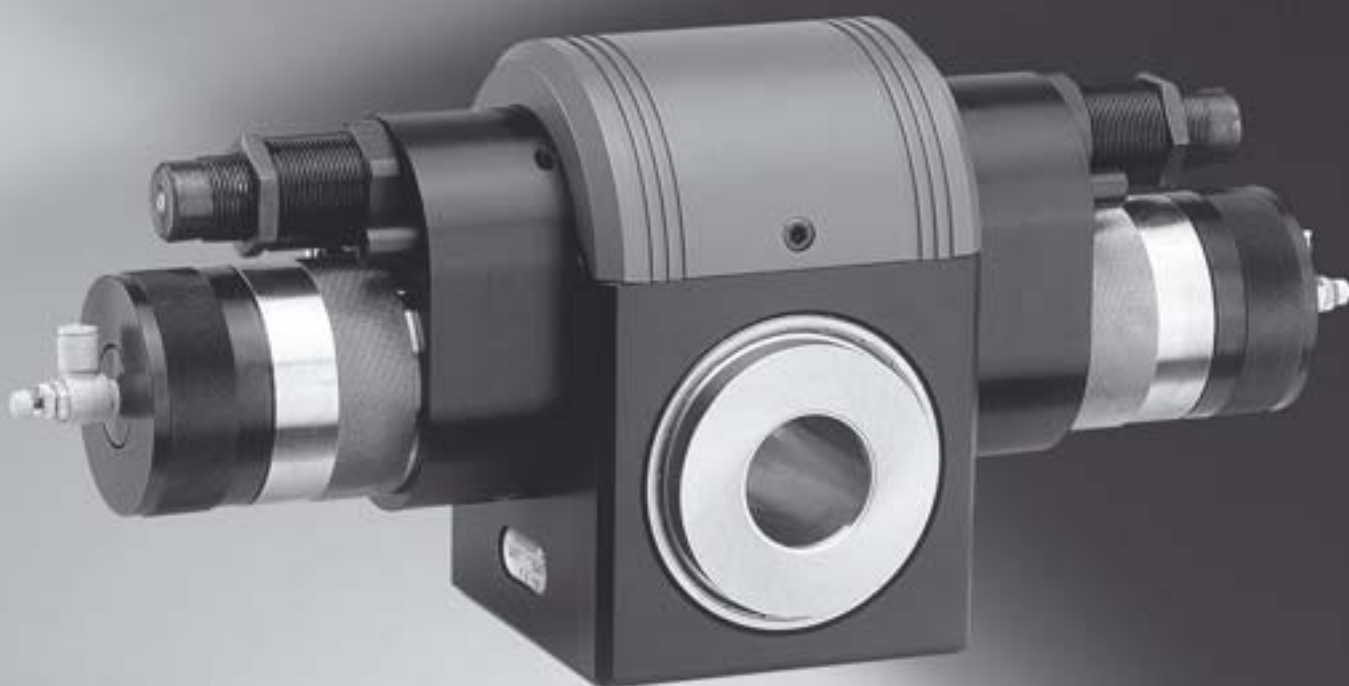


ROTARY DRIVES



ROTARY DRIVES DAP CONTENTS

PRODUCT DESCRIPTION

44-45



APPLICATIONS

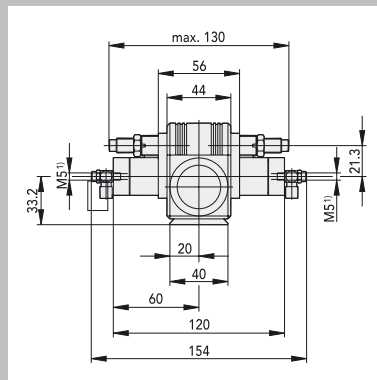
46-48



ROTARY DRIVES

49



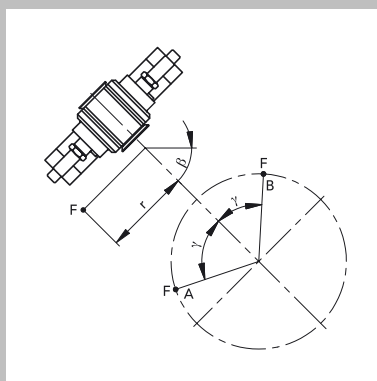


TECHNICAL DATA/ DIMENSION

50-65



SPECIAL ACCESSORIES 66-70



CALCULATION EXAMPLES

71-73

ROTARY DRIVES DAP PRODUCT DESCRIPTION



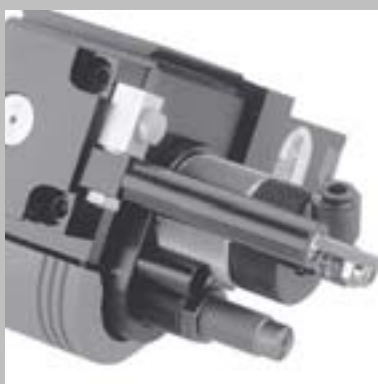
DAP with DZA.



DAP with two DZA.

The **Rotary Drives DAP** are distinguished by exceptionally **high performance data** and an extremely **efficient operation**. The low own weight results in **high dynamic performance** and **short cycle times**.

The **angle of rotation** is fully adjustable with stops ranging **from 0 to 180°**. The absorption characteristic of the hydraulic shock-absorbers integrated in the stops can be adjusted to the application. With the **attachable DZA** intermediate stop an additional position can be added, which is fully adjustable over half the angle of rotation. Up to two intermediate stops can be used and therefore up to two intermediate positions reached.



DAPI with integral air flow.

Pushbutton

The two interlaced toothed racks permit the rotary pinion to be set automatically at the end and intermediate positions to an **exact, backlash-free position**.

The Rotary Drives DAP and DZA intermediate stops operate with extremely **low wear**, which ensures an unusually long service life.

In the DAPI version, the air is supplied to the end effector through the rotary shaft (internal air supply). All moving hoses are eliminated.

Size 2 can be supplied with special shock-absorbers if required (**DAP(I)-2 reinforced**).

The end positions can be detected by using the **pushbutton** (see page 68) instead of proximity switches.

All Rotary Drives are fitted with Quick-Set® **dovetail holders** to simplify installation and adjustment (see chapter Quick-Set® from page 338).

APPLICATIONS



Rotary Drive, size 1;
Rotary Drive DAPI for low,
central loads and rapid rota-
tion.



Rotary Drive, size 2;
Rotary Drive DAPI for moder-
ate, non-central loads for rapid
rota-tion. Example with internal
air supply.



Rotary Drive, size 3;
 Rotary Drive DAP for heavy, projecting loads. When short rotation times are required despite heavy loads. The clamping element SLR-24-80-40 and adapter plate ADP-40 were used as connecting element. (See special accessories from page 66.)



Robust transfer module;
 Precision Parallel Gripper GPP, perpendicular to axis of rotation, with angle adapter WA mounted on Rotary Drive DAPI-2; internal air flow permitted. Elimination of moving hoses.



Rotary Drive with internal air flow; Precision Parallel Gripper GPP fitted, supplied internally with compressed air by Rotary Drive DAPI-1; all moving hoses are eliminated.

ROTARY DRIVES DAP / INTERMEDIATE STOP DZA



Three construction sizes available in a total of six versions.



DAP; with dovetail for fast mounting/adjusting.



DAPI; with internal air supply.



DZA; intermediate stop adapted to Rotary Drives.

SCOPE OF DELIVERY

Rotary Drives with two shock-absorbers, two exhaust-air throttles, two holders for proximity switches and comprehensive operating instructions.

SUITABLE ACCESSORIES

Special accessories
Accessories
Quick-Set®

from page 66
from page 302
from page 338

ROTARY DRIVE DAP-1

SIZE 1

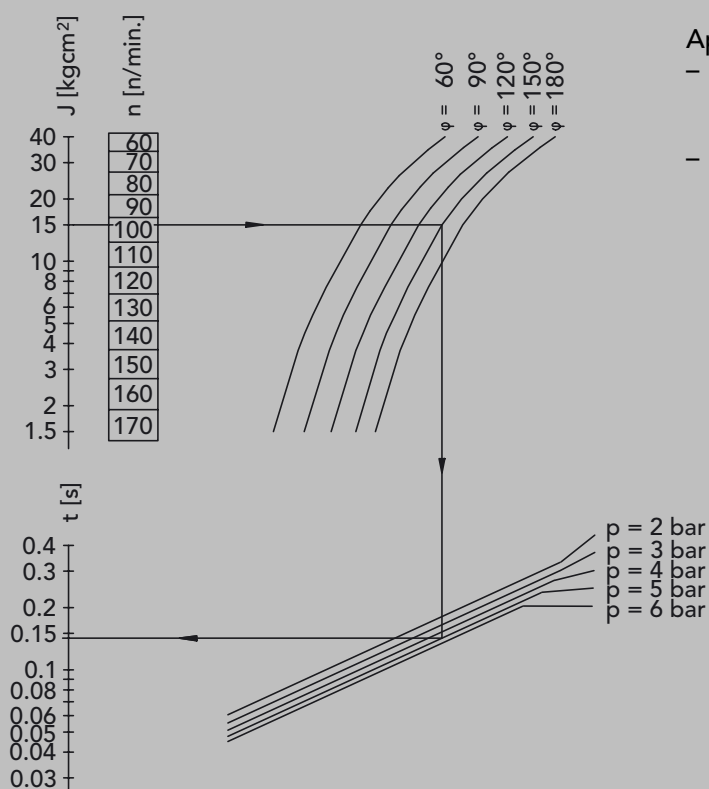
Angle of rotation	[°]	0–180
Piston diameter	[mm]	20
Permissible moment of inertia	[kgcm ²]	40
Permissible shaft load	1) [Nm]	5
Perm. axial load tension/compression	[N]	90/120
Weight	[kg]	0.54
Operating pressure	[bar]	2–6
Driving medium		air, oiled or unoled, filtered to 5 µm, dew point < 6°C
End stop absorption		hydraulic shock-absorbers
Repeatability	2) [°]	≤ 0.01
Check of end positions	3)	inductive proximity switches
Pneumatic connection		hose-Ø 4 mm
Speed regulation		adjustable exhaust throttles
Ambient: Temperature	[°C]	10–50
Rel. humidity		< 95% (without condensation)
Air purity		normal workshop atmosphere
Guaranty period		2 years from the date of delivery
Maintenance		none required
Mounting position		any
Material		aluminum, steel, bronze, plastics

1) Load torque acting about the longitudinal axis of the shaft

2) Scatter of end positions of 100 successive strokes under constant conditions

3) See accessories page 302

PERFORMANCE DIAGRAM DAP/DAP1-1



Application:

- Centre of gravity of the rotating mass located in the axis of rotation which may be in any position
- Centre of gravity of the rotating mass outside the axis of rotation with the axis vertical.

Example:

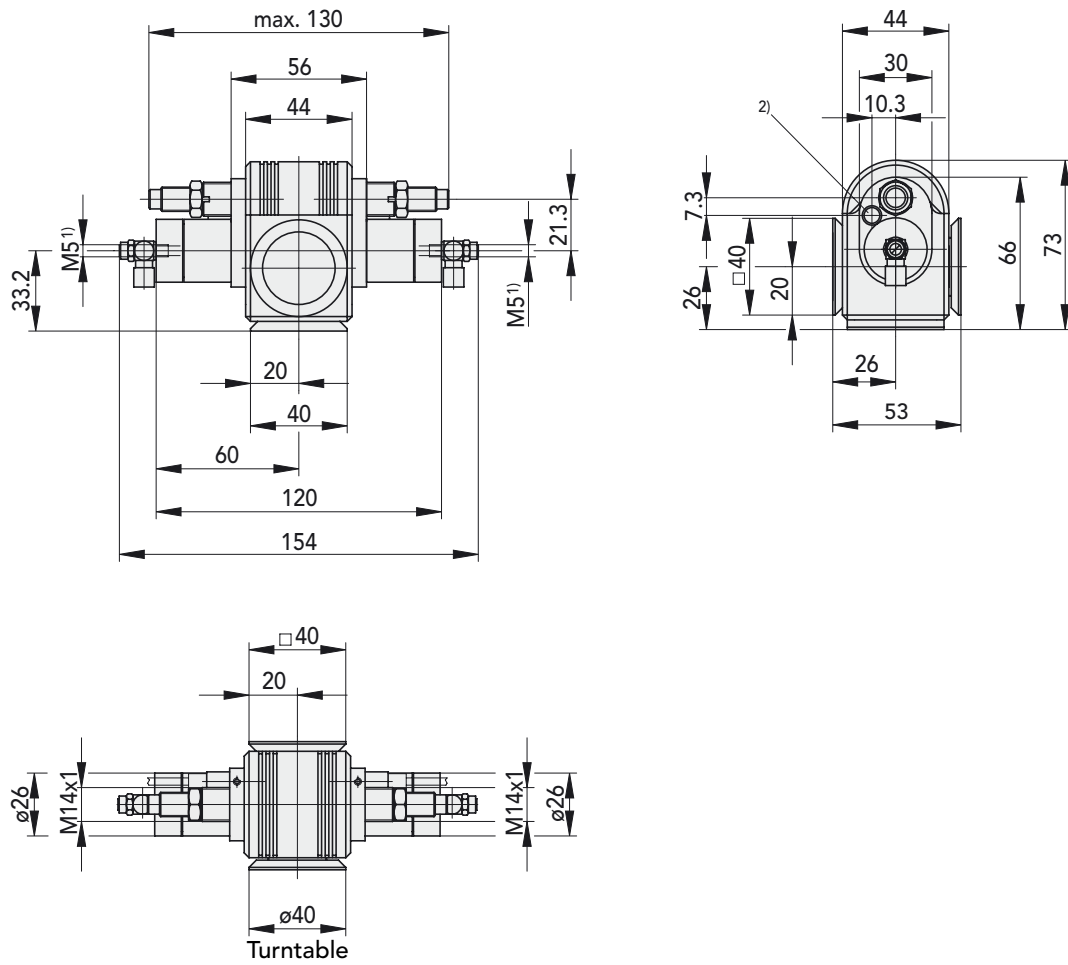
$J = 15$ kgcm²
 $\varphi = 150^\circ$
 $p = 5$ bar

Results:

$n_{\max} = 100$ double strokes
per minute
 $t = 0.14$ s

J = Mass moment of inertia
 n = Max. number of double strokes
 p = Pneumatic op. pressure
 t = Travel time per stroke
 φ = Angle of rotation

European projection



- 1) Input of compressed air to the rotary unit
- 2) Holders for inductive proximity switches $\varnothing 6.5$

Ref. No.
DAP-1

44821

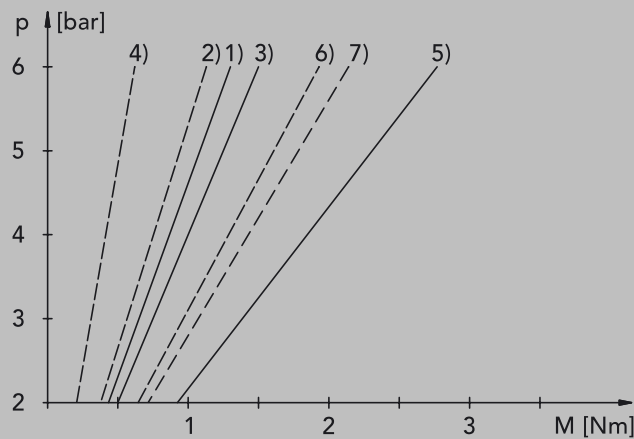
ROTARY DRIVE DAPI-1

SIZE 1

Angle of rotation	[°]	0–180
Piston diameter	[mm]	20
Permissible moment of inertia	[kgcm ²]	40
Permissible shaft load	1) [Nm]	5
Perm. axial load tension/compression	[N]	90/120
Weight	[kg]	0.64
Operating pressure	[bar]	2–6
Driving medium		air, oiled or unoled, filtered to 5 µm, dew point < 6°C
End stop absorption		hydraulic shock-absorbers
Repeatability	2) [°]	≤ 0.01
Check of end positions	3)	inductive proximity switches
Pneumatic connection		hose-Ø 4 mm
Speed regulation		adjustable exhaust throttles
Ambient: Temperature	[°C]	10–50
Rel. humidity		< 95% (without condensation)
Air purity		normal workshop atmosphere
Guaranty period		2 years from the date of delivery
Maintenance		none required
Mounting position		any
Material		aluminum, steel, bronze, plastics

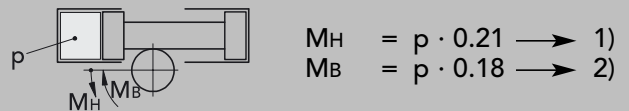
- 1) Load torque acting about the longitudinal axis of the shaft
- 2) Scatter of end positions of 100 successive strokes under constant conditions
- 3) See accessories page 302

PRESSURE-TORQUE DIAGRAM DAP/DAPI/DZA-1

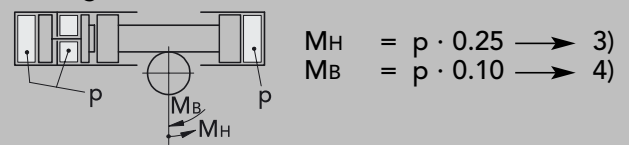


p = Pneumatic operating pressure
 M_H = Holding torque, corresponding to that which can be exerted externally on the stationary pinion shaft without moving it.
 M_B = Moving torque, corresponding to that made available by the pneumatic drive on the moving pinion shaft.

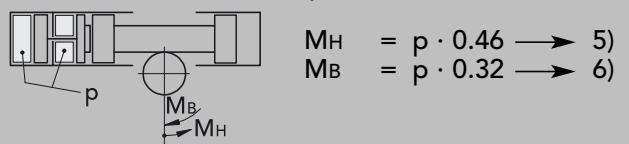
DAP left-hand/right-hand end position



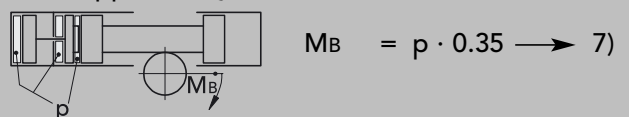
DAP against moved out DZA



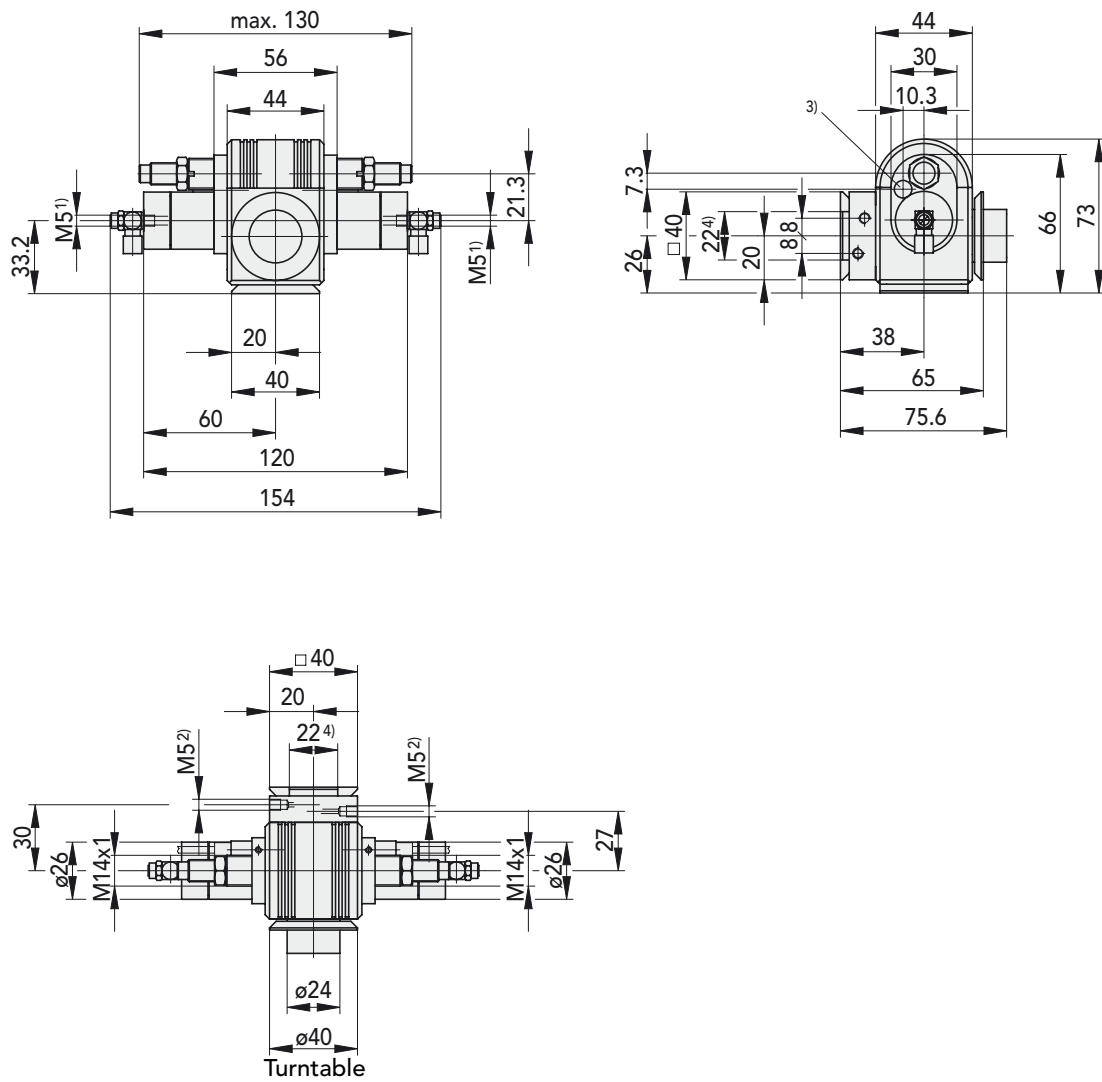
DZA moved out, DAP depressurized



DAP supported by DZA



European projection



- 1) Input of compressed air to the rotary unit
- 2) Input of compressed air to the intermediate stop
- 3) Holders for inductive proximity switches $\varnothing 6.5$
- 4) Clamping length of dovetail

Ref. No.
DAPI-1

44905

INTERMEDIATE STOP DZA-1

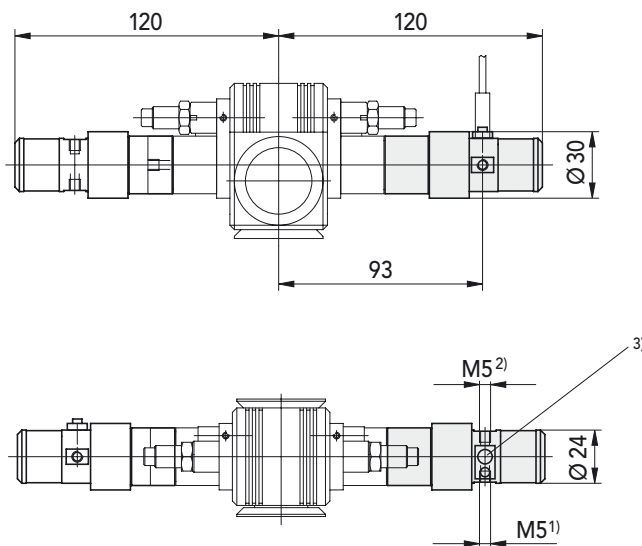
SIZE 1

Angle of rotation	[°]	0–90
Piston diameter	[mm]	20
Weight	[kg]	0.08
Operating pressure	[bar]	2–6
Driving medium		air, oiled or unoiled, filtered to 5 µm, dew point < 6°C
End stop absorption		resilient column of air
Repeatability	1) [°]	≤ 0.03
Check of end positions	2)	inductive proximity switches
Pneumatic connection		hose-Ø 4 mm
Speed regulation		adjustable exhaust throttles
Ambient: Temperature	[°C]	10–50
Rel. humidity		< 95% (without condensation)
Air purity		normal workshop atmosphere
Guaranty period		2 years from the date of delivery
Maintenance		none required
Mounting position		any
Material		aluminum, steel, bronze, plastics

1) Scatter of end positions of 100 successive strokes under constant conditions

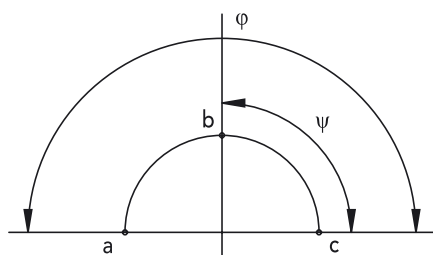
2) See accessories page 302

European projection



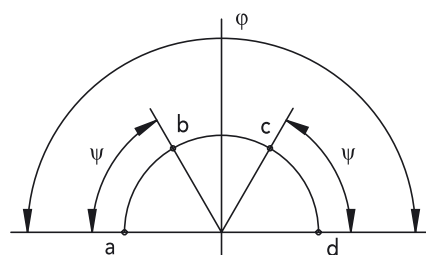
- 1) Input of compressed air to the rotary unit
- 2) Input of compressed air to the intermediate stop
- 3) Holders for inductive proximity switches $\varnothing 6.5$

3 positions attain with one DZA-1



- a DAP left
- b DZA right
- c DAP right

4 positions attain with two DZA-1



- a DAP left
- b DZA left
- c DZA right
- d DAP right

φ = angle of rotation DAP: 0–180° infinitely adjustable
 ψ = angle of rotation DZA: 0–90° infinitely adjustable

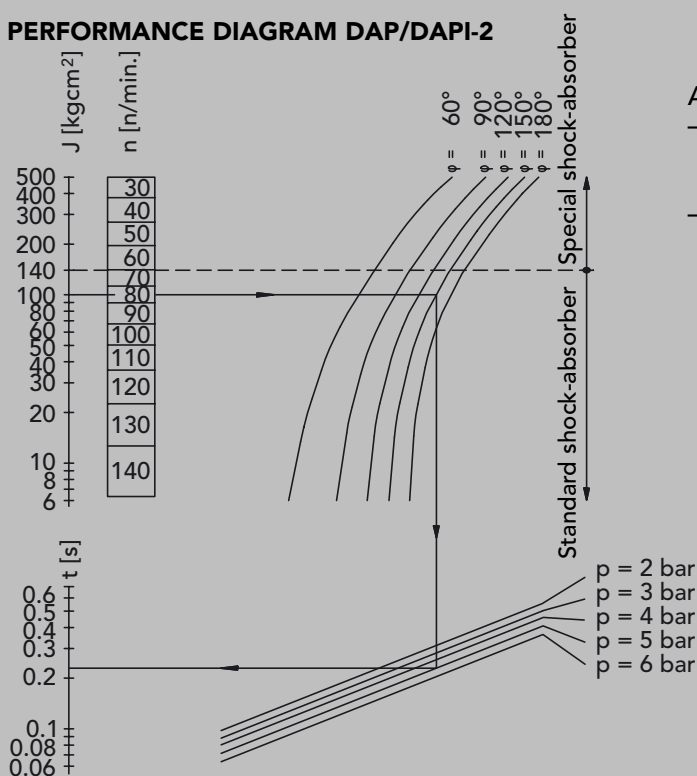
ROTARY DRIVE DAP-2

SIZE 2

Angle of rotation	[°]	0–180
Piston diameter	[mm]	32
Permissible moment of inertia		
with standard shock-absorber	[kgcm ²]	140
with special shock-absorber	[kgcm ²]	500
Permissible shaft load	1) [Nm]	15
Perm. axial load tension/compression	[N]	240/460
Weight	[kg]	1.4
Operating pressure	[bar]	2–6
Driving medium		air, oiled or unoled, filtered to 5 µm, dew point < 6°C
End stop absorption		hydraulic shock-absorbers
Repeatability	2) [°]	≤ 0.02
Check of end positions	3)	inductive proximity switches
Pneumatic connection		hose-Ø 4 mm
Speed regulation		adjustable exhaust throttles
Ambient: Temperature	[°C]	10–50
Rel. humidity		< 95% (without condensation)
Air purity		normal workshop atmosphere
Guaranty period		2 years from the date of delivery
Maintenance		oiling of lubricating felts
Mounting position		any
Material		aluminum, steel, bronze, plastics

- 1) Load torque acting about the longitudinal axis of the shaft
- 2) Scatter of end positions of 100 successive strokes under constant conditions
- 3) See accessories page 302

PERFORMANCE DIAGRAM DAP/DAP-2



Application:

- Centre of gravity of the rotating mass located in the axis of rotation which may be in any position
- Centre of gravity of the rotating mass outside the axis of rotation with the axis vertical.

Example:

$$J = 100 \text{ kgcm}^2$$

$$\varphi = 150^\circ$$

$$p = 5 \text{ bar}$$

Results:

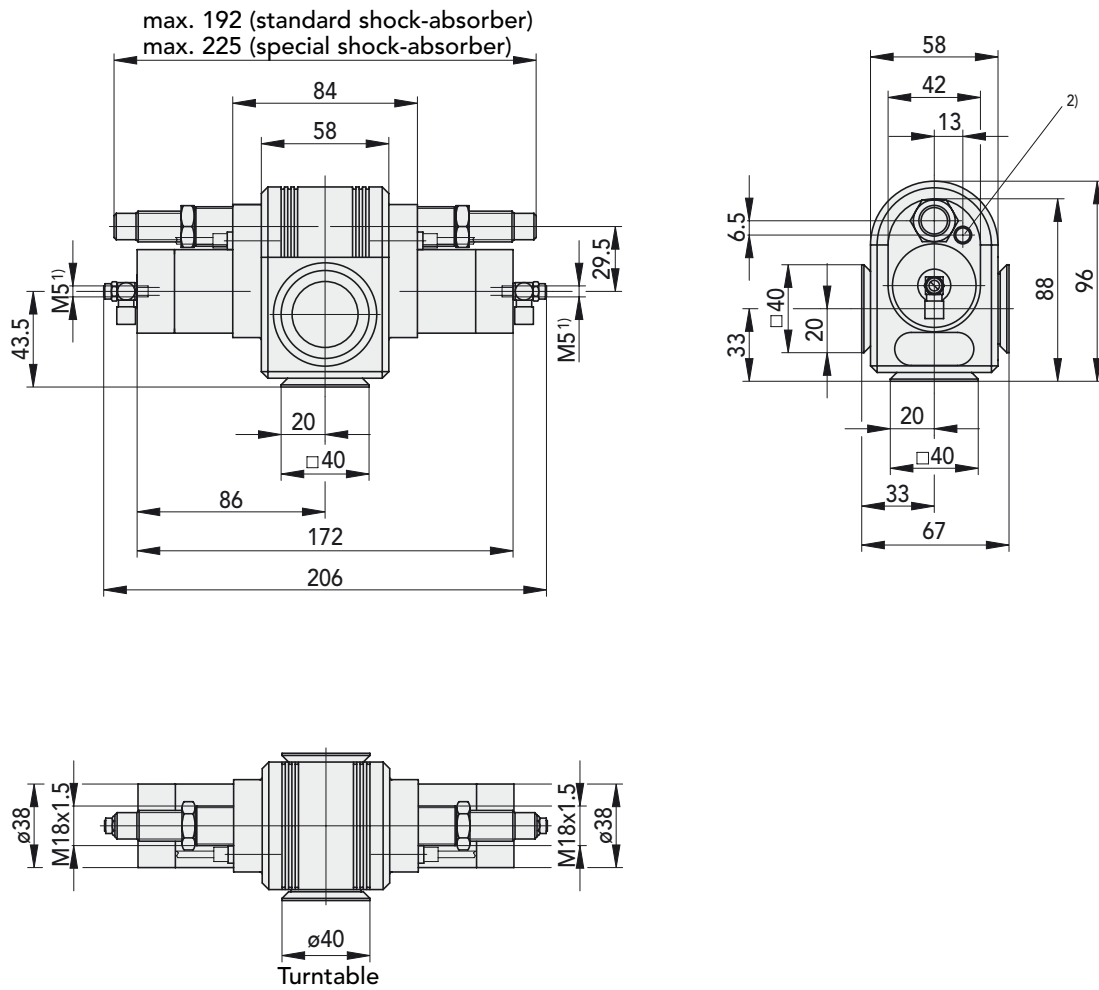
$$n_{\max} = 80 \text{ double strokes per minute}$$

$$t = 0.23 \text{ s}$$

Standard shock-absorber

J = Mass moment of inertia
 n = Max. number of double strokes
 p = Pneumatic op. pressure
 t = Travel time per stroke
 φ = Angle of rotation

European projection



- 1) Input of compressed air to the rotary unit
2) Holders for inductive proximity switches $\phi 6.5$

Ref. No.
DAP-2
DAP-2 reinforced

44280
44280V

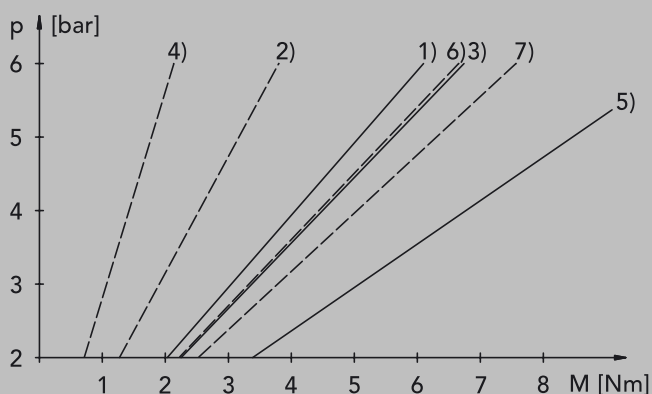
ROTARY DRIVE DAPI-2

SIZE 2

Angle of rotation	[°]	0–180
Piston diameter	[mm]	32
Permissible moment of inertia		
with standard shock-absorber	[kgcm ²]	140
with special shock-absorber	[kgcm ²]	500
Permissible shaft load	1) [Nm]	15
Perm. axial load tension/compression	[N]	240/460
Weight	[kg]	1.6
Operating pressure	[bar]	2–6
Driving medium		air, oiled or unoled, filtered to 5 µm, dew point < 6°C
End stop absorption		hydraulic shock-absorbers
Repeatability	2) [°]	≤ 0.02
Check of end positions	3)	inductive proximity switches
Pneumatic connection		hose-Ø 4 mm
Speed regulation		adjustable exhaust throttles
Ambient: Temperature	[°C]	10–50
Rel. humidity		< 95% (without condensation)
Air purity		normal workshop atmosphere
Guaranty period		2 years from the date of delivery
Maintenance		oiling of lubricating felts
Mounting position		any
Material		aluminum, steel, bronze, plastics

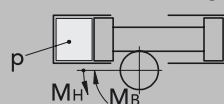
- 1) Load torque acting about the longitudinal axis of the shaft
 2) Scatter of end positions of 100 successive strokes under constant conditions
 3) See accessories page 302

PRESSURE-TORQUE DIAGRAM DAP/DAPI/DZA-2



- p = Pneumatic operating pressure
 M_H = Holding torque, corresponding to that which can be exerted externally on the stationary pinion shaft without moving it.
 M_B = Moving torque, corresponding to that made available by the pneumatic drive on the moving pinion shaft.

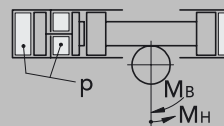
DAP left-hand/right-hand end position



$$M_H = p \cdot 1.01 \rightarrow 1)$$

$$M_B = p \cdot 0.63 \rightarrow 2)$$

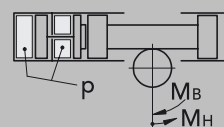
DAP against moved out DZA



$$M_H = p \cdot 1.12 \rightarrow 3)$$

$$M_B = p \cdot 0.35 \rightarrow 4)$$

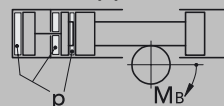
DZA moved out, DAP depressurized



$$M_H = p \cdot 1.69 \rightarrow 5)$$

$$M_B = p \cdot 1.10 \rightarrow 6)$$

DAP supported by DZA



$$M_B = p \cdot 1.26 \rightarrow 7)$$

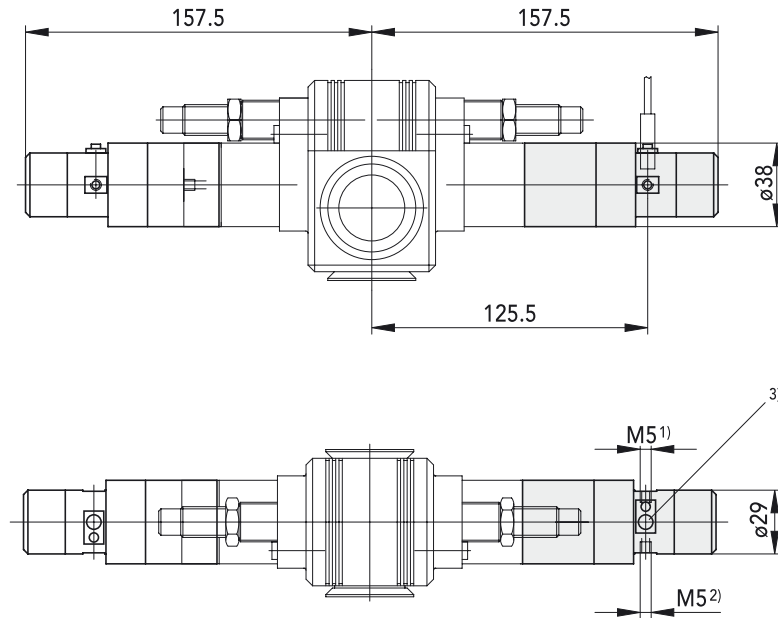
INTERMEDIATE STOP DZA-2

SIZE 2

Angle of rotation	[°]	0–90
Piston diameter	[mm]	32
Weight	[kg]	0.25
Operating pressure	[bar]	2–6
Driving medium		air, oiled or unoled, filtered to 5 µm, dew point < 6°C
End stop absorption		resilient column of air
Repeatability	1) [°]	≤ 0.05
Check of end positions	2)	inductive proximity switches
Pneumatic connection		hose-Ø 4 mm
Speed regulation		adjustable exhaust throttles
Ambient: Temperature	[°C]	10–50
Rel. humidity		< 95% (without condensation)
Air purity		normal workshop atmosphere
Guaranty period		2 years from the date of delivery
Maintenance		none required
Mounting position		any
Material		aluminum, steel, bronze, plastics

- 1) Scatter of end positions of 100 successive strokes under constant conditions
 2) See accessories page 302

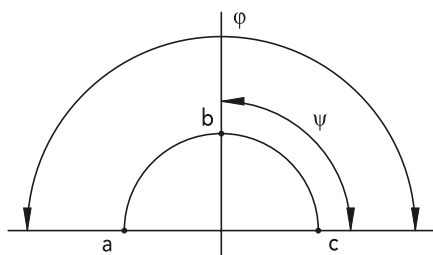
European projection



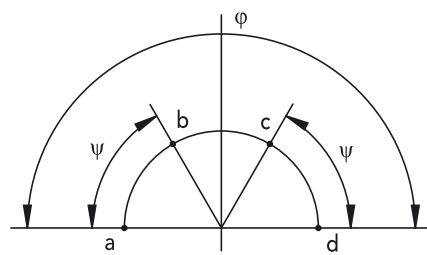
- 1) Input of compressed air to the rotary unit
- 2) Input of compressed air to the intermediate stop
- 3) Holders for inductive proximity switches \varnothing 6.5

3 positions attain with one DZA-2

4 positions attain with two DZA-2



- a DAP left
- b DZA right
- c DAP right



- a DAP left
- b DZA left
- c DZA right
- d DAP right

φ = angle of rotation DAP: 0–180° infinitely adjustable
 ψ = angle of rotation DZA: 0–90° infinitely adjustable

ROTARY DRIVE DAP-3

SIZE 3

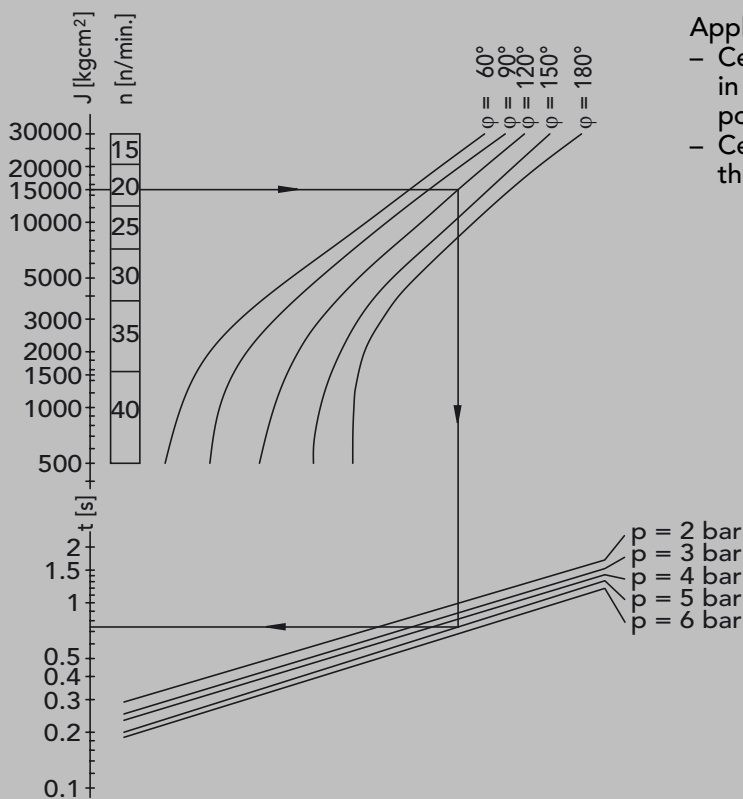
Angle of rotation	[°]	60–180
Piston diameter	[mm]	60
Permissible moment of inertia	[kgcm ²]	30 000
Permissible shaft load	1) [Nm]	100
Perm. axial load tension/compression	[N]	3000/5000
Weight	[kg]	11
Operating pressure	[bar]	2–6
Driving medium		air, oiled or unoled, filtered to 5 µm, dew point < 6°C
End stop absorption		hydraulic shock-absorbers
Repeatability	2) [°]	≤ 0.02
Check of end positions	3)	inductive proximity switches M8 x 1 spec.
Pneumatic connection		hose-Ø 6 mm
Speed regulation		adjustable exhaust throttles
Ambient: Temperature	[°C]	10–50
Rel. humidity		< 95% (without condensation)
Air purity		normal workshop atmosphere
Guaranty period		2 years from the date of delivery
Maintenance		oiling of lubricating felts
Mounting position		any
Material		aluminum, steel, bronze, plastics

1) Load torque acting about the longitudinal axis of the shaft

2) Scatter of end positions of 100 successive strokes under constant conditions

3) See accessories page 302

PERFORMANCE DIAGRAM DAP-3



Application:

- Centre of gravity of the rotating mass located in the axis of rotation which may be in any position
- Centre of gravity of the rotating mass outside the axis of rotation with the axis vertical.

Example:

$$J = 100 \text{ kgcm}^2$$

$$\varphi = 150^\circ$$

$$p = 5 \text{ bar}$$

Results:

$$n_{\max} = 20 \text{ double strokes per minute}$$

$$t = 0.23 \text{ s}$$

Standard shock-absorber

J = Mass moment of inertia

n = Max. number of double strokes

p = Pneumatic op. pressure

t = Travel time per stroke

 φ = Angle of rotation

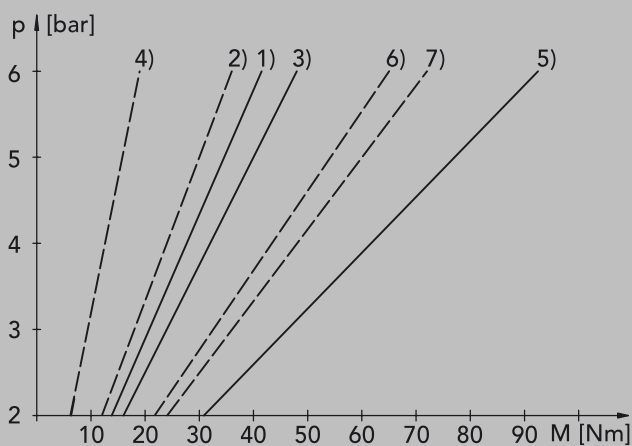
INTERMEDIATE STOP DZA-3

SIZE 3

Angle of rotation	[°]	0–90
Piston diameter	[mm]	60
Weight	[kg]	1.4
Operating pressure	[bar]	2–6
Driving medium		air, oiled or unoled, filtered to 5 µm, dew point < 6°C
End stop absorption		resilient column of air
Repeatability	1) [°]	≤ 0.05
Check of end positions	2)	inductive proximity switches
Pneumatic connection		hose-Ø 6 mm
Speed regulation		adjustable exhaust throttles
Ambient: Temperature	[°C]	10–50
Rel. humidity		< 95% (without condensation)
Air purity		normal workshop atmosphere
Guaranty period		2 years from the date of delivery
Maintenance		none required
Mounting position		any
Material		aluminum, steel, bronze, plastics

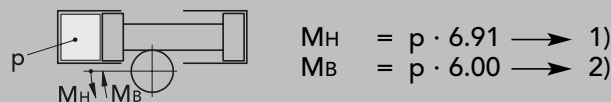
- 1) Scatter of end positions of 100 successive strokes under constant conditions
- 2) See accessories page 302

PRESSURE-TORQUE DIAGRAM DAP/DZA-3

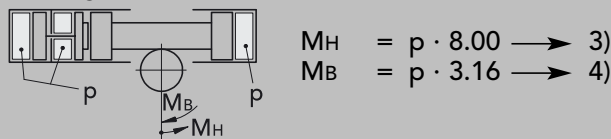


p = Pneumatic operating pressure
 M_H = Holding torque, corresponding to that which can be exerted externally on the stationary pinion shaft without moving it.
 M_B = Moving torque, corresponding to that made available by the pneumatic drive on the moving pinion shaft.

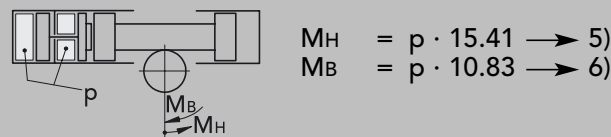
DAP left-hand/right-hand end position



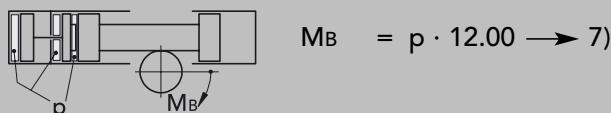
DAP against moved out DZA



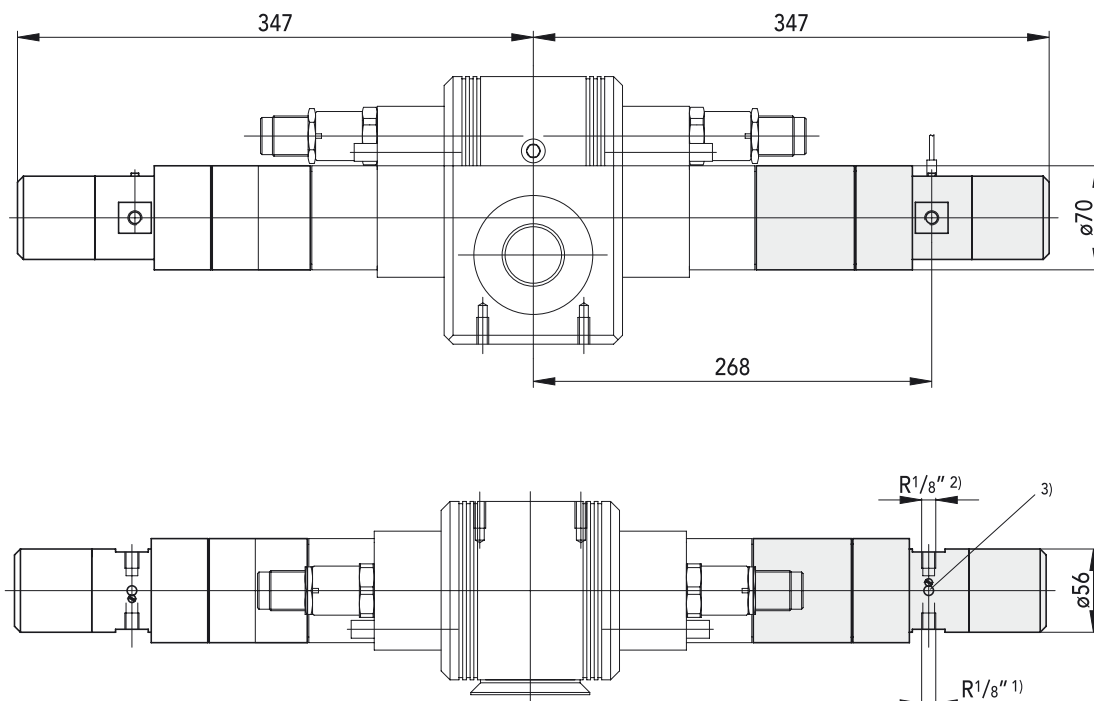
DZA moved out, DAP depressurized



DAP supported by DZA

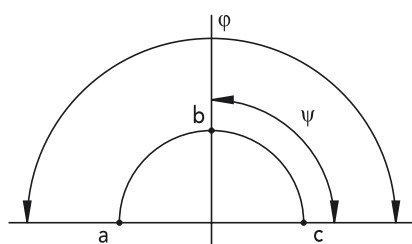


European projection



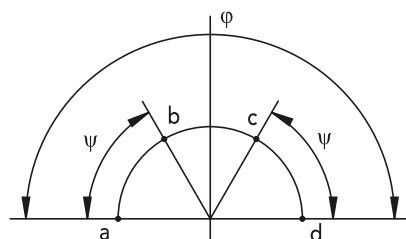
- 1) Input of compressed air to the rotary unit
- 2) Input of compressed air to the intermediate stop
- 3) Holders for inductive proximity switches $\varnothing 6.5$

3 positions attain with one DZA-3



- | | | |
|---|-----|-------|
| a | DAP | left |
| b | DZA | right |
| c | DAP | right |

4 positions attain with two DZA-3



- | | | |
|---|-----|-------|
| a | DAP | left |
| b | DZA | left |
| c | DZA | right |
| d | DAP | right |

φ = angle of rotation DAP: 0–180° infinitely adjustable
 ψ = angle of rotation DZA: 0–90° infinitely adjustable

Ref. No.
DZA-3

45071

SPECIAL ACCESSORIES

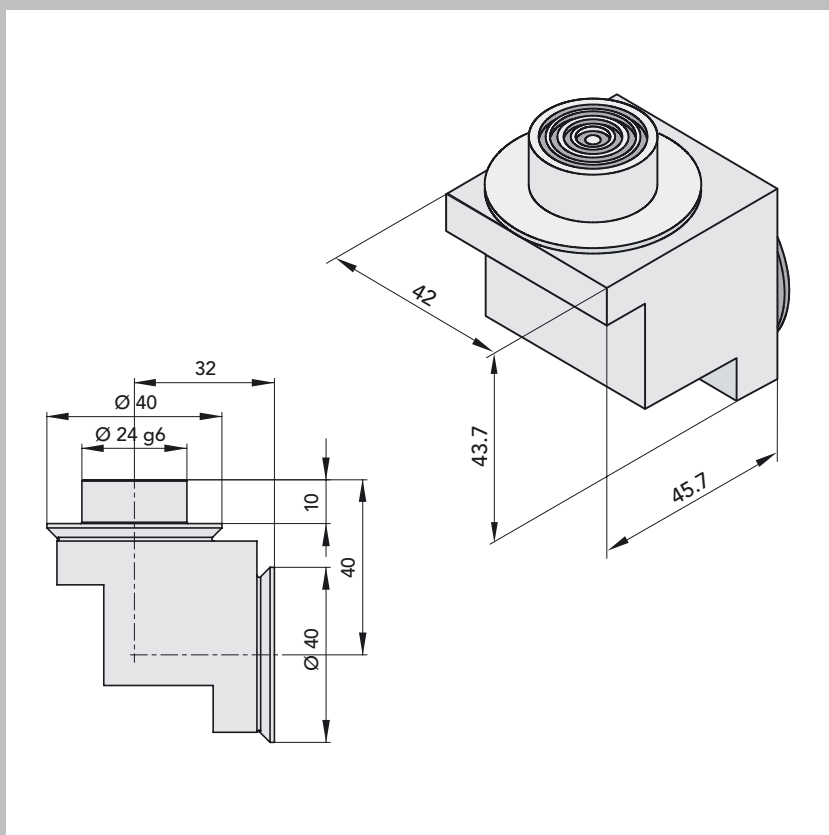
**CONVERSION SET, DAP/DAPI-2 reinforced**

For retroactive conversion of standard versions size 2 with more powerful hydraulic shock-absorbers for higher power range.
(Technical data see pages 56 or 58, dimension see pages 57 or 59).

DAP/DAPI-2 reinforced

44862**ANGLE ADAPTER WA**

for Rotary Drives DAPI-1/DAPI-2



For mounting grippers with internal air supply right-angled to the axis of rotation of Rotary Drives. The delivery is made with a suitable set of seals.

Weight

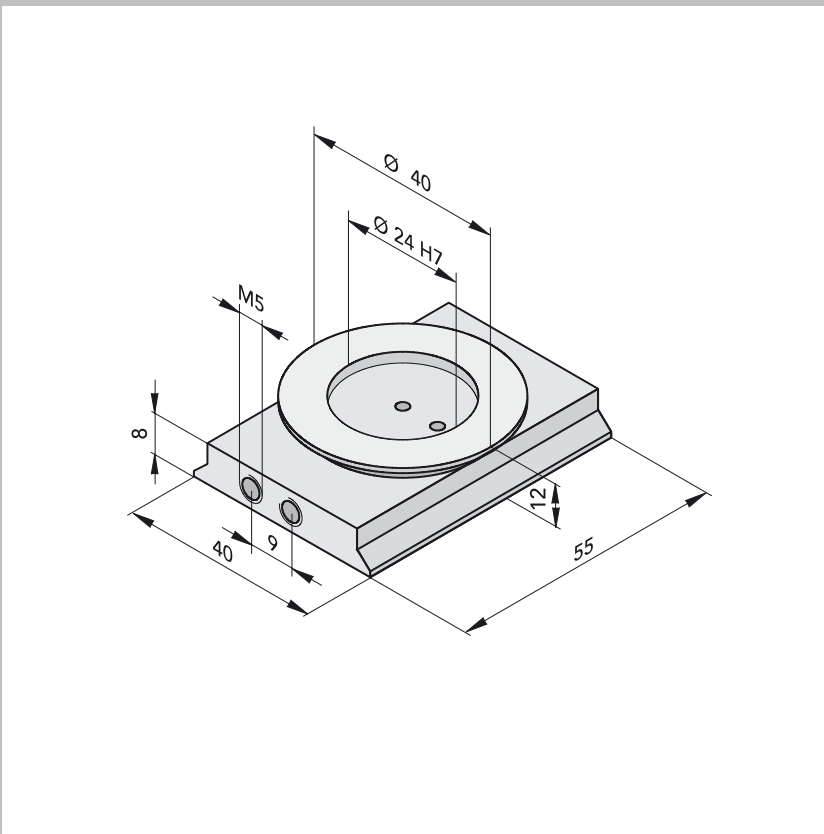
0.350 kg

Ref. No.
WA-40

natural
43711

LINEAR ADAPTER LA

for Rotary Drives DAPI-1/DAPI-2



For feeding internally ported air to accessories.

Weight

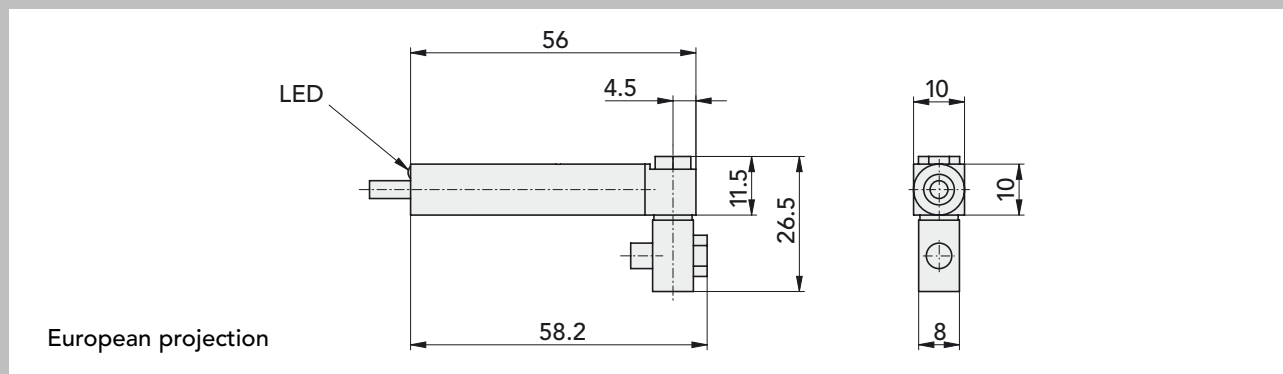
0.050 kg

Ref. No.
LA-40natural
44390

PUSHBUTTON

Operating pressure	[bar]	6
Turn-on pressure	[bar]	3
Turn-off pressure	[bar]	2
Max. switching frequency	[Hz]	100
Turn-on delay	1) [ms]	< 10
Turn-off delay	2) [ms]	< 10
Guaranty period		2 years
Driving medium		oiled or unoled air, filtered to 5 μm , dew point < 6°C
Ambient temperature	[°C]	10–50
Output signal	[VDC]	24
Proximity switch	3)	PNP three-wire
Switching distance	[mm]	2
Cable length	[m]	2

- 1) Measured from the moment when 90% of the pressure (5 bar) has been built up until the positive flank of the output signal
- 2) Measured from the negative flank of the output signal until the pressure at the pneumatic input has dropped to 0.5 bar
- 3) Inductive proximity switch PNP 6.5 mm dia with LED, proof against short circuit and wrong polarity



In an automation system where grippers are attached to a rotating shaft, the problem arises that both the pneumatic hoses and the cables of the proximity switches must also perform the rotary motion. For devices with internal air supply, the movable hoses are eliminated. By installing pushbuttons, it is also possible **to dispense with the moving cables**.

The pushbutton converts a pneumatic signal into an electrical signal. At its output it supplies 24 V DC when there is an input pressure of 3 to 6 bar, or 0 V when $p < 2$ bar. The «on» status ($p \geq 3$ bar) is indicated by an LED.

The use of the pushbutton is particularly advantageous when **changes in pressure are frequent**, because the signal conversion is performed electronically (no moving switch contacts).

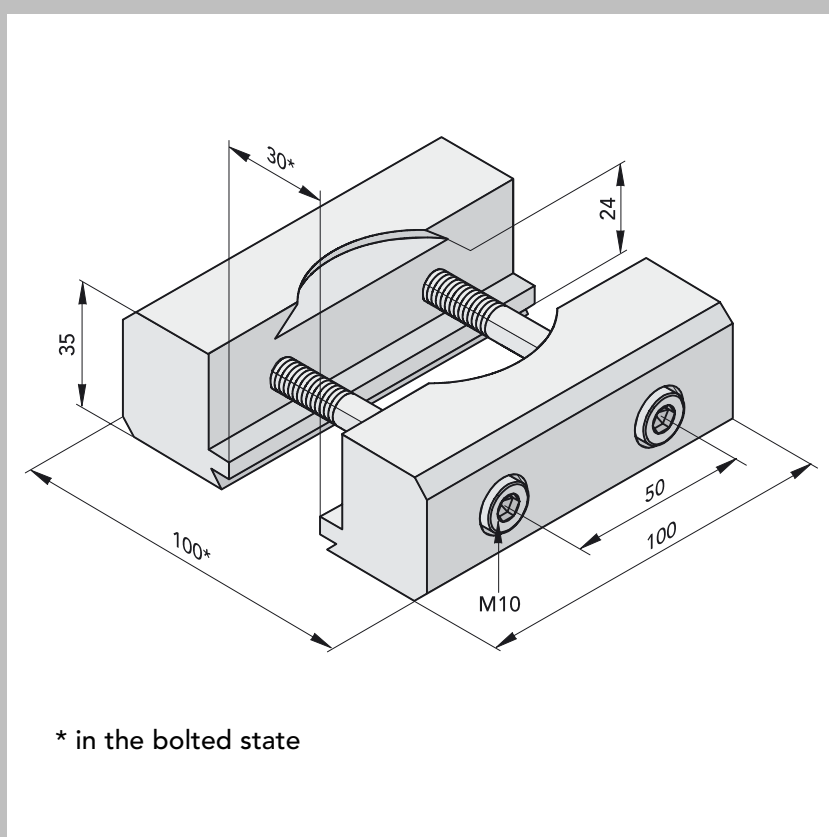


Ref. No.

41886

CLAMPING ELEMENTS, LONGITUDINAL-ROUND SLR-24-80-40

for Rotary Drive DAP-3



Connector between DAP-3 truncated cone and QS-dovetail – aluminum anodized black.

Resistance to displacement	12 000 N
Resistance to torsion	450 Nm
Tightening torque of the screws	42 Nm
Parallelism of the clamped surfaces	± 0.05 mm
Weight	0.62 kg

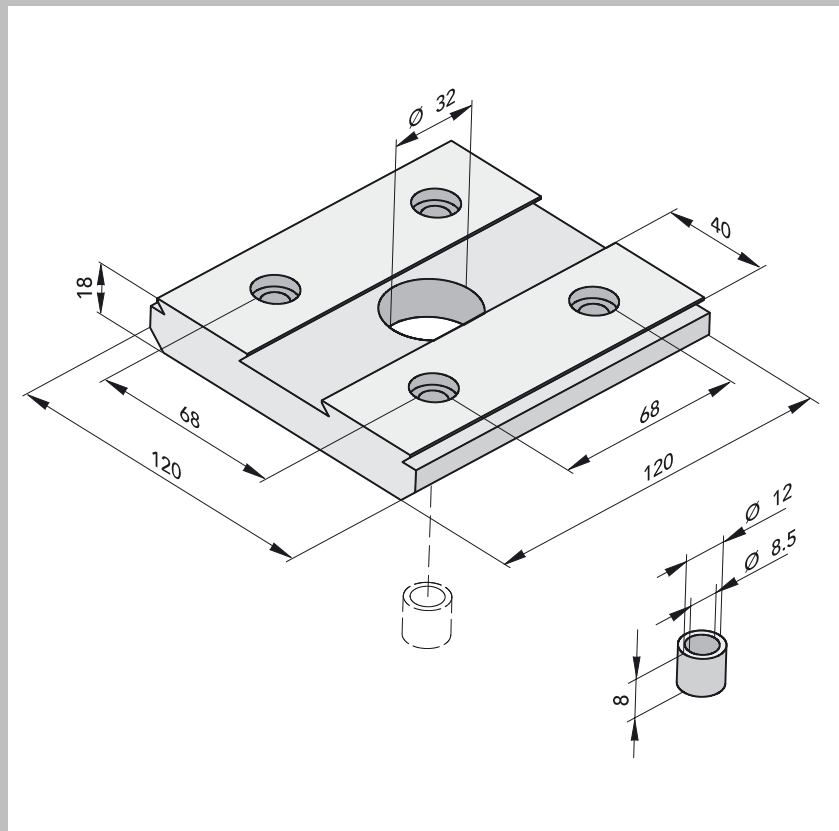
Ref. No.
SLR-24-80-40

black
45086



ADAPTER PLATE ADP-40

for Rotary Drive DAP-3



For fixing the Rotary Drive DAP-3 on Quick-Set® aluminum built-on units, black anodized aluminum. The delivery is made with the required four centering bushes.

Weight

0.566 kg

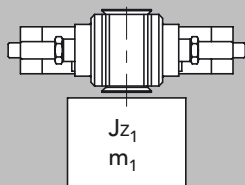
Ref. No.
ADP-40

black
45338

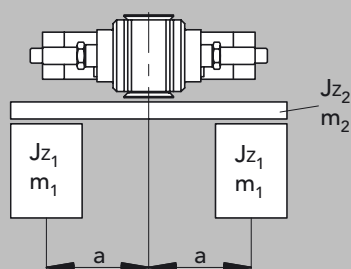
CALCULATION EXAMPLES

Checking the application

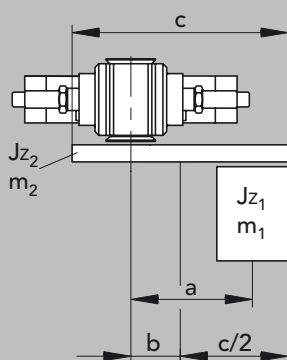
Position of attached parts



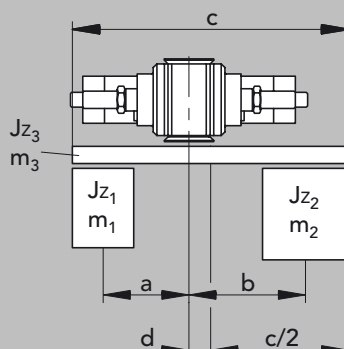
Position of rotary axis		
vertical	horizontal	inclined
$J_{tot} = J_{z1}$		
$m_1 < m_{adm}$	Check M1	Check M1 Check F1 _{adm} Check F2 _{adm}



Position of rotary axis		
vertical	horizontal	inclined
$J_{tot} = 2 \cdot (J_{z1} + m_1 \cdot a^2) + J_{z2}$		
$\Sigma m_{1...m2} < m_{adm}$	Check M1	Check M1 Check F1 _{adm} Check F2 _{adm}



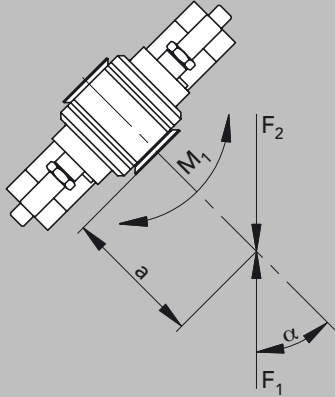
Position of rotary axis		
vertical	horizontal	inclined
$J_{tot} = J_{z1} + m_1 \cdot a^2 + J_{z2} + m_2 \cdot b^2$		
$m_1 + m_2 < m_{adm}$	Test	Test
	Check M1 Check M _H Check M _B	Check M1 Check F1 _{adm} Check F2 _{adm} Check M _H Check M _B



Position of rotary axis		
vertical	horizontal	inclined
$J_{tot} = J_{z1} + m_1 \cdot a^2 + J_{z2} + m_2 \cdot b^2 + J_{z3} + m_3 \cdot d^2$		
$\Sigma m_{1...m2} < m_{adm}$	Test	Test
	Check M1 Check M _H Check M _B	Check M1 Check F1 _{adm} Check F2 _{adm} Check M _H Check M _B

CALCULATION EXAMPLES

Checking the application



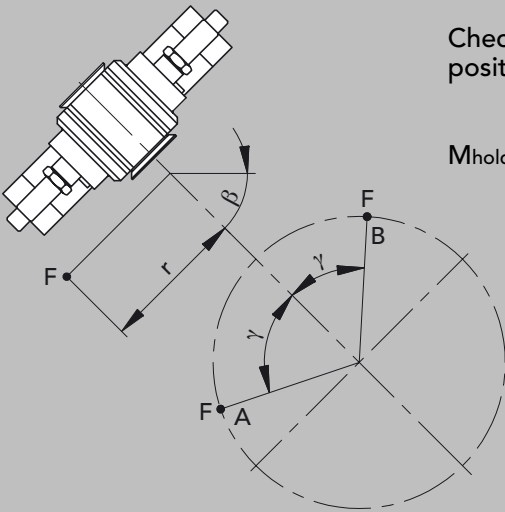
Checking the forces F_1 and F_2 and the torque M_1

$$F_{1 \text{ adm}} = \frac{F_{\text{adm}}}{\cos \alpha}$$

$$M_1 = F_{1 \text{ hold}} \cdot \sin \alpha \cdot a < M_{1 \text{ adm}}$$

$$F_{2 \text{ adm}} = \frac{F_{\text{adm}}}{\cos \alpha}$$

$$M_1 = F_{2 \text{ hold}} \cdot \sin \alpha \cdot a < M_{1 \text{ adm}}$$



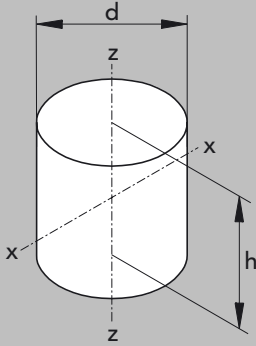
Checking the moving and holding torque M_B and M_H in the end positions A and B.

$$M_{\text{hold}} = F \cdot r \cdot \cos \beta \cdot \sin \gamma$$

N.B. In the formula insert the larger of the angles γ that occurs.

	DAP-1	DAP-2	DAP-3
m_{adm} [kg]	9	24	300
F_{adm} [N]	90	240	3000
$M_{1 \text{ adm}}$ [Nm]	5	15	100

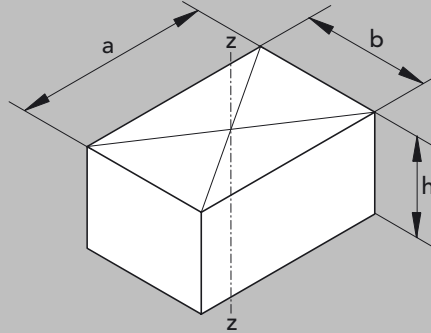
CALCULATING MOMENTS OF MASS INERTIA IN GENERAL



$$m = \frac{1}{4} \cdot \rho \cdot \pi \cdot d^2 \cdot h$$

$$J_z = \frac{1}{8} \cdot m \cdot d^2$$

$$J_x = \frac{1}{16} \cdot m \cdot \left(d^2 + \frac{4}{3} h^2 \right)$$



$$m = \rho \cdot a \cdot b \cdot h$$

$$J_z = \frac{1}{12} \cdot m \cdot (a^2 + b^2)$$

Jz	Moment of mass inertia with axis of rotation Z-Z	[kgcm ²]
Jx	Moment of mass inertia with axis of rotation X-X	[kgcm ²]
m	Mass	[kg]
ρ	Density	[kg/cm ³]
a	Length	[cm]
b	Width	[cm]
d	Diameter	[cm]
h	Height	[cm]