# DATA SHEET  DB 31a-16

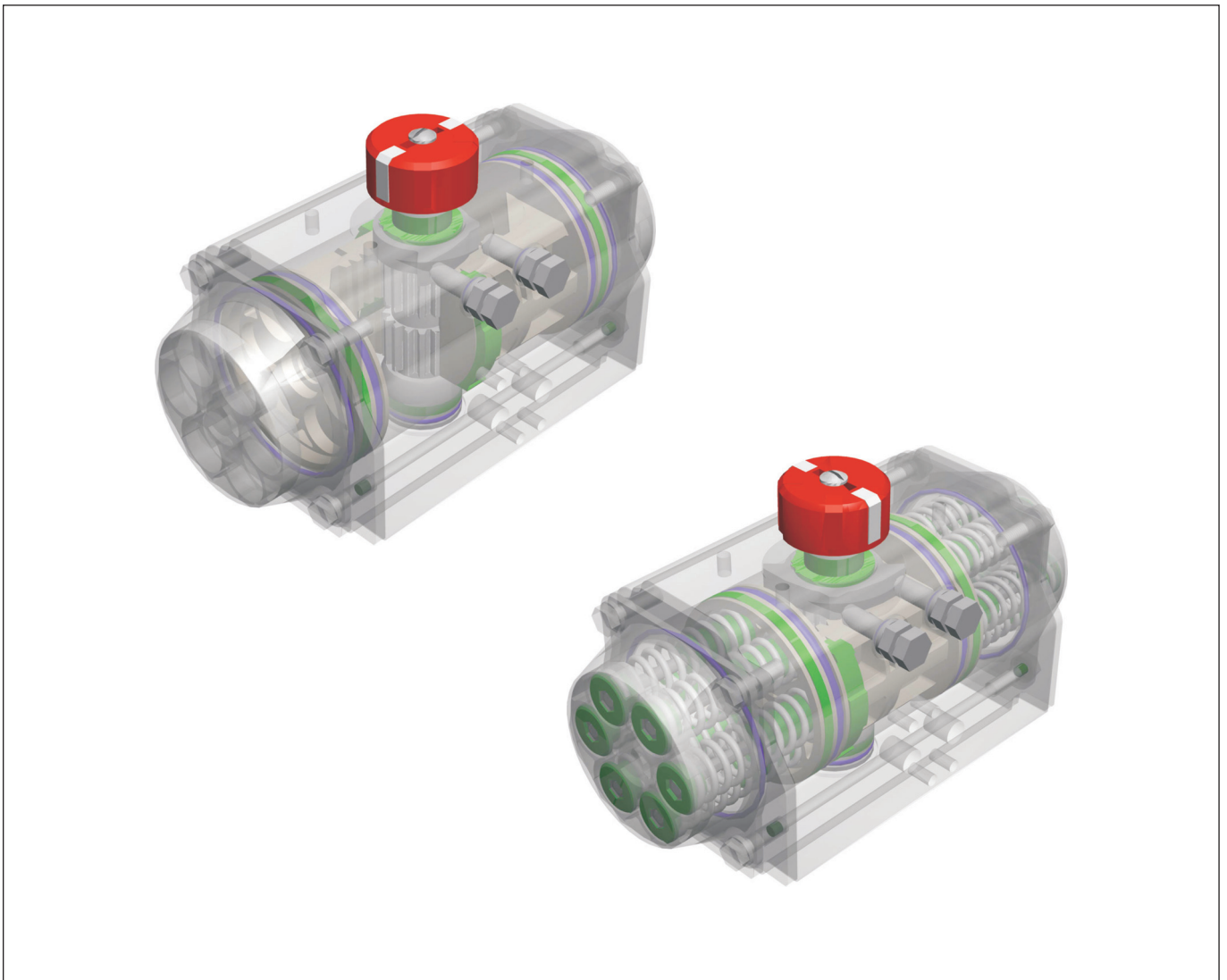## BR 31a · Quarter-turn actuator
### Version DAP / SRP · Principle and Lay-out of the Quarter-turn actuator

CE

## Applications

Single-acting or double-acting piston actuators for butterfly valves, ball valves and other final control elements with rotary closure members. Particularly suitable for high process requirements in chemical plants:

- **Opening angle 90°**
- **Temperatures -40°C to +80°C**

Edition September 2024

# Principle and Lay-out
# of the Quarter-turn actuator BR 31a - Type DAP

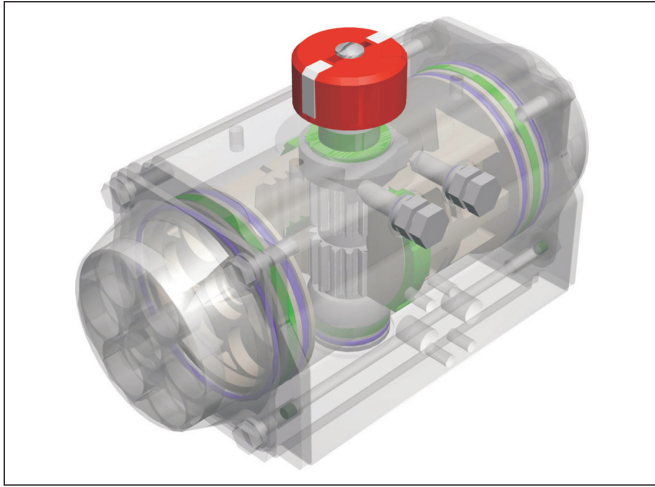## Principle of the double acting actuator



**Fig. 1:** *Schematic representation of a double acting actuator*

When port „2" is under pressure and port „4" is vented, both pistons move to the end positions, this then causes the drive shaft to start turning.

By exchanging the pistons, it is possible to turn the drive shaft in the opposite direction.



**Fig. 2:** *Principle of the double acting actuator under air pressure*

When port „4" is under pressure, and port „2" vented, then both pistons move to the middle position.

This also causes the drive shaft to start turning. By exchanging the pistons, it is possible to turn the drive shaft in the opposite direction.
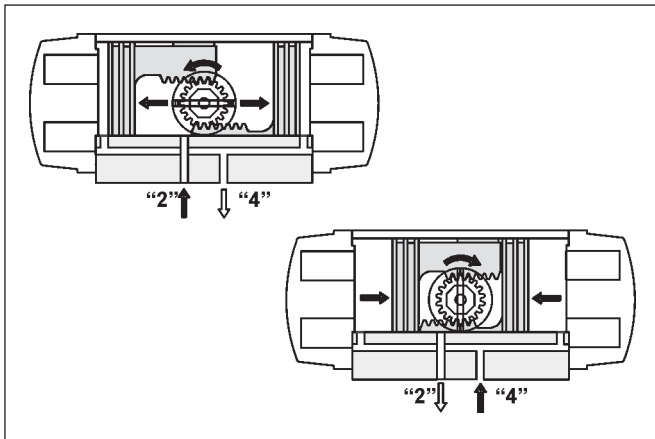
With the rack and pinion construction, the out put torque of the actuator is obtained by multiplying the piston force (given by air supply) with the shaft radius ( lever or arm, see fig. 3) less friction loss ( efficiency).

The advantage of this construction, is the constant (linear) output torque (see fig. 4) in clockwise - and anti clockwise direction.
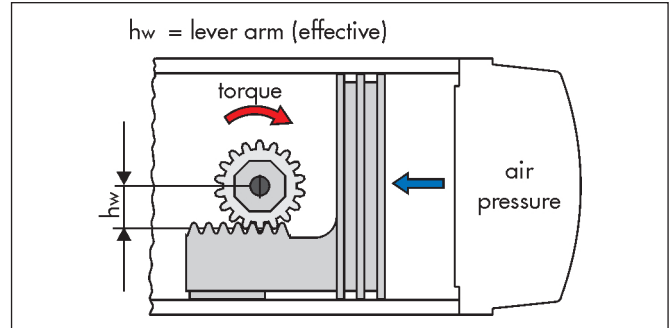


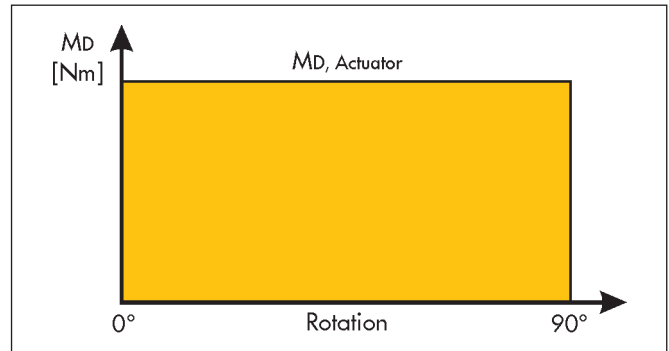**Fig. 3:** *Top view of a double acting actuator under pressure*



**Fig. 4:** *Principle of the torque (double acting)*

## Lay-out example of a double acting actuator

- Specified by the manufacturer
  valve - torque                                             = 40 Nm
- Safety factor           = 40 Nm + 20 %          = 48 Nm
- Available air supply                                     = 5 bar

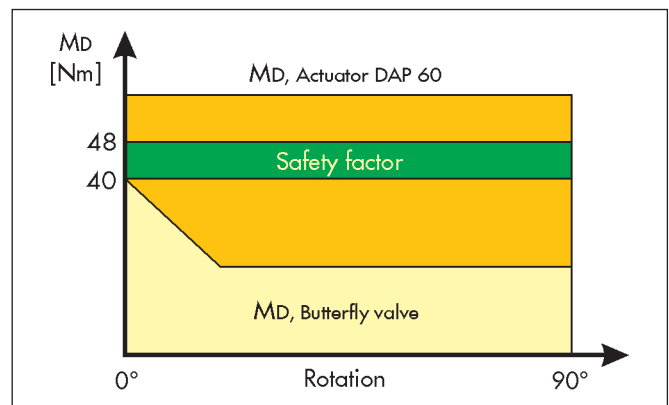The double acting actuator, which at 5 bar reaches at least 48 Nm, is the DAP 60.



**Fig. 5:** *Principle of the sizing a double-acting actuator*

# Principle and Lay-out
# of the Quarter-turn actuator BR 31a - Type SRP

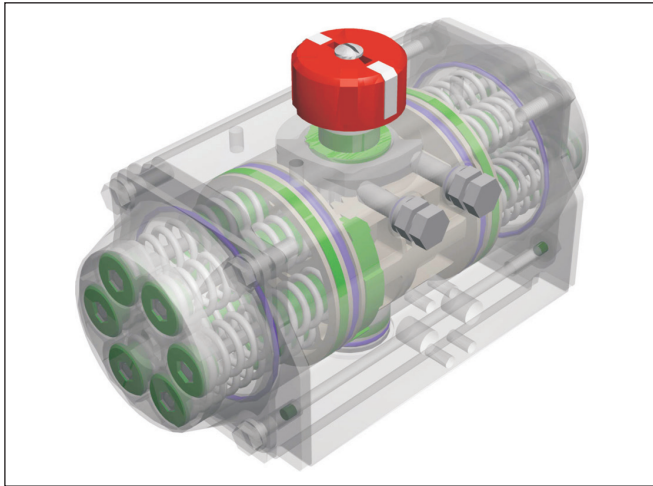## Principle of a single acting actuator



**Fig. 6:** *Schematic representation of a single acting actuator*

When port „2" is under pressure and port „4" is vented, both pistons move to the end position, this causes the springs to compress, and the drive shaft starts turning.

It is also possible to turn the drive shaft in the opposite direction by exchanging the pistons.
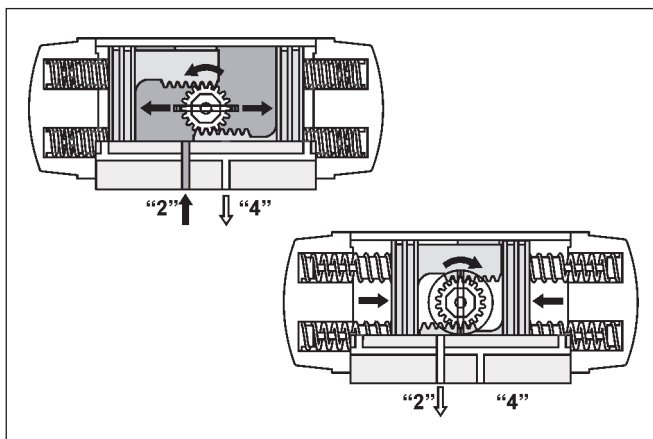


**Fig. 7:** *Principle of the double acting actuator under spring pressure*

Because of the spring return force, safety closing of the valve by loss of air, or power failure is guaranteed.

By exchanging the pistons, it is possible to turn the drive shaft in the opposite direction.
The operating torque for spring return actuators, is determined by means of the force of air pressure i.e. spring package. (see fig. 8 to 13).
The application torque is calculated by multiplying the air pressure output i.e. spring pressure output, on the pistons, with the corresponding lever arm. There are two cases to determine:

### ■ First case:

The output torque is generated by air supply pressure at port „2" after compressing the springs, this is called „air torque". In this case, the air pressure forces the pistons to move, which accordingly turns the shaft, from 0° - 90°.
Preset by the pressure springs, the output torque run, progresses along the characteristic line of the spring. (see fig. 9). Beginning at (0°) the largest, and ending at, (90°) the smallest torque.
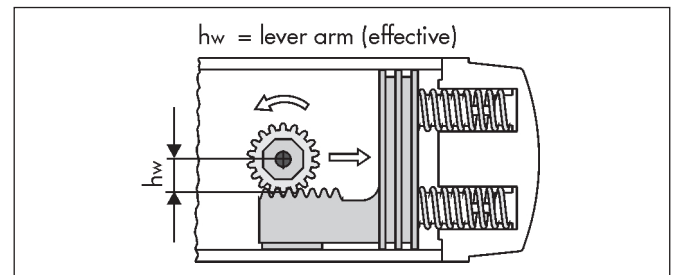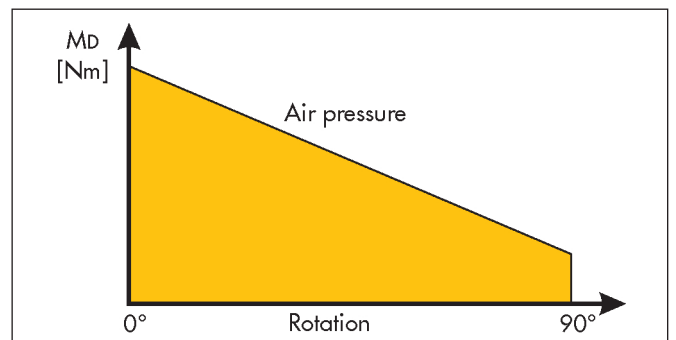


**Fig. 8:** *Top view of a single-acting actuator*



**Fig. 9:** *Principle of the air torque*

### ■ Second case:

The output torque is generated by the spring return force of the springs on the pistons ( when air failure ).

This is specified as „Federmoment". In this case the largest output torque is by 90° and the smallest at 0°.
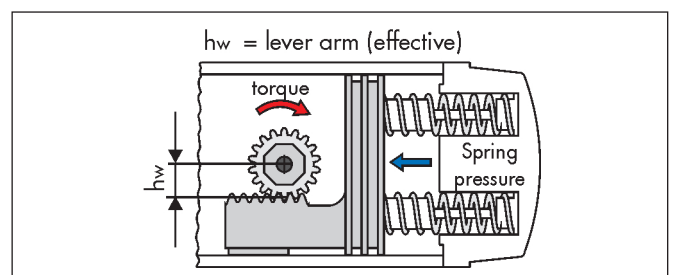The process (see fig. 11) is also based on the characteristic line of the spring.



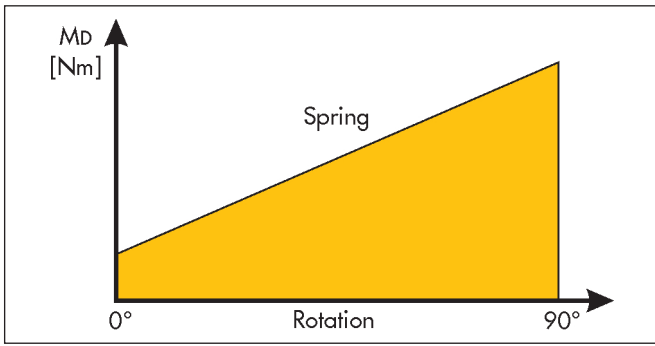**Fig. 10:** *Top view of a single-acting actuator*

**Fig. 11:** *Principle of the spring torque*

The AT-Actuators have been optimised according to the previous described cases, so that they achieve a balanced torque, when the number of springs corresponds to the air pressure in bar (4 bar <=> 4 springs on each side, see fig. 12).

For certain applications it is generally possible to create an unbalanced torque (see fig. 13).

For this purpose, only the number spring packs to be used on each side is different to the incoming air pressure (e.g. 6 springs at 5,5 bar, or reversed).

With a spring return application of the actuator, two designs can be offered:
air failure closing and air failure opening.

## Lay-out example of a single acting actuator

■ **Safety closing by constant torque (by air failure):**

- Specified by the manufacturer
  valve - torque                                        = 80 Nm

- Safety factor
  (individual acc. customer) =80 Nm + 20 %      = 96 Nm

- Available air supply                                 = 5 bar

For these mentioned settings, the selected AT-actuator is the SRP 300 - 5 with the following characteristics:

Spring torque by 0°        = 105 Nm
Spring torque by 90°       = 165 Nm

Air torque by 0°           = 172 Nm
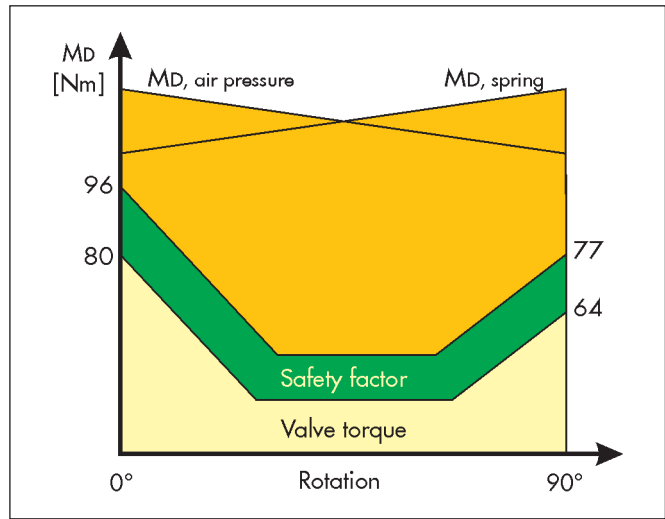Air torque by 90°          = 112 Nm



**Fig. 12:** *Principle of balanced torque*

■ **Safety opening by irregular torque ( by air failure):**

- Specified by the manufacturer
  valve- torque                                         = 45 Nm

- Safety factor
  (individual acc. customer) = 45 Nm + 20 %     = 54 Nm

- Available air supply                                 = 5,5 bar

For the above mentioned settings, the selected actuator is the SRP 150 -5, with the following characteristics:

Spring torque by 0°        = 50,7 Nm
Spring torque by 90°       = 78,8 Nm

Air torque by 0°           = 95,6 Nm
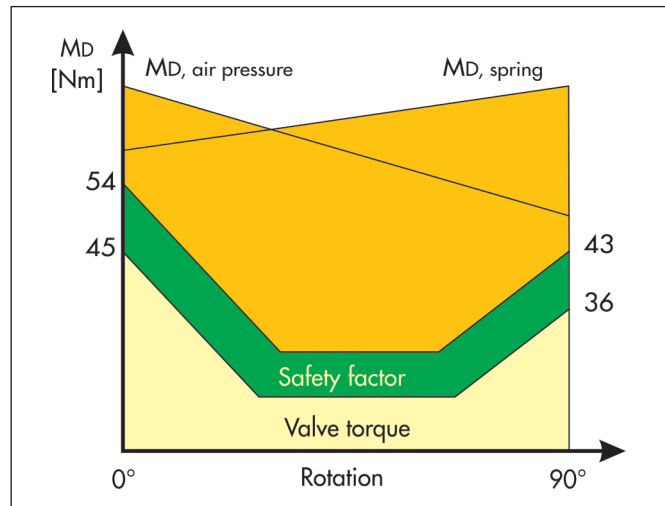Air torque by 90°          = 67,5 Nm



**Fig. 13:** *Principle of unbalanced torque*