

# Counterbalance Valve BVD

**RE 95522/10.08** 1/12  
Replaces: 04.08

## Data sheet

Series 41  
Size NG20, 25  
Nominal pressure 350 bar  
Peak pressure 420 bar  
for travel drives, winch drives and track drives



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## Features

- Space-saving installation due to compact design and direct mounting on A2FM(E) and A6VM axial piston motors (series 63)
- Available as a complete set with A2FM(E) and A6VM axial piston motors (series 63) and GFT gear units; test stand run as standard.
- Standard service line ports according to SAE J518
- Integrated brake release valve, with and without pressure reduction
- High efficiency due to low flow resistance
- Easy optimization options during commissioning due to modular design.

# Ordering Code / Standard Program

|            |    |    |    |    |   |           |    |   |          |    |    |    |    |
|------------|----|----|----|----|---|-----------|----|---|----------|----|----|----|----|
| <b>BVD</b> |    |    |    |    | / | <b>41</b> |    | - | <b>V</b> |    |    |    |    |
| 01         | 02 | 03 | 04 | 05 |   | 06        | 07 |   | 08       | 09 | 10 | 11 | 12 |

## Valve type

|    |                                     |            |
|----|-------------------------------------|------------|
| 01 | Counterbalance valve, double-acting | <b>BVD</b> |
|----|-------------------------------------|------------|

## Size

|    |                                   |           |
|----|-----------------------------------|-----------|
| 02 | Flow, max. $q_{v \max}$ 220 l/min | <b>20</b> |
|    | Flow, max. $q_{v \max}$ 320 l/min | <b>25</b> |

## Control range (pressure when brake piston starts/stops opening)

|    |                                     |          |
|----|-------------------------------------|----------|
| 03 | 7...30 bar (travel drive)           | <b>F</b> |
|    | 20...40 bar (winch and track drive) | <b>W</b> |

## Ports (size classification)

|    |                    |                          |           |               |           |           |
|----|--------------------|--------------------------|-----------|---------------|-----------|-----------|
| 04 | NG                 | A2FM/E./181              | A2FE./171 | A6VM./370     | A6VM./380 |           |
|    | 20                 | 28, 32, 45 <sup>1)</sup> |           |               |           | <b>16</b> |
|    |                    | 56, 63                   |           |               | 55        | <b>17</b> |
|    |                    | 80, 90                   |           |               | 80        | <b>27</b> |
|    |                    |                          | 107, 125  | 107           |           | <b>28</b> |
| 25 | 107, 125, 160, 180 |                          |           | 107, 140, 160 | <b>38</b> |           |

## Ports for brake release

|    |   |          |
|----|---|----------|
| 05 | with high pressure  | <b>S</b> |
|    | with reduced high pressure 21 <sup>+4</sup> bar (brake release valve) | <b>L</b> |

## Series

|    |                   |           |
|----|-------------------|-----------|
| 06 | Series 4, Index 1 | <b>41</b> |
|----|-------------------|-----------|

## Long cover

|    |                   |          |
|----|-------------------|----------|
| 07 | B-side (standard) | <b>B</b> |
|    | A-side            | <b>A</b> |

## Seals

|    |                        |          |
|----|------------------------|----------|
| 08 | FKM (fluor-caoutchouc) | <b>V</b> |
|----|------------------------|----------|

## Piston version

|    |   |           |
|----|---|-----------|
| 09 | 100% of max. flow $q_{v \max}$ (see size) | <b>01</b> |
|    | 75% of max. flow $q_{v \max}$ (see size)  | <b>02</b> |
|    | 50% of max. flow $q_{v \max}$ (see size)  | <b>03</b> |

## Residual opening in piston

|    |   |            |
|----|---|------------|
| 10 | Without residual opening (obligatory for winches) | <b>K00</b> |
|    | With residual opening $\varnothing$ 1.2           | <b>K12</b> |
|    | $\varnothing$ 1.6                                 | <b>K16</b> |
|    | $\varnothing$ 1.8                                 | <b>K18</b> |
|    | $\varnothing$ 2.0                                 | <b>K20</b> |

<sup>1)</sup> Intermediate plate necessary for all three sizes

# Ordering Code / Standard Program

|            |    |    |    |    |   |           |    |   |          |    |    |    |    |
|------------|----|----|----|----|---|-----------|----|---|----------|----|----|----|----|
| <b>BVD</b> |    |    |    |    | / | <b>41</b> |    | - | <b>V</b> |    |    |    |    |
| 01         | 02 | 03 | 04 | 05 |   | 06        | 07 |   | 08       | 09 | 10 | 11 | 12 |

## Damping during closing

|    |              |                          |                        |                    |                  |              |
|----|--------------|--------------------------|------------------------|--------------------|------------------|--------------|
| 11 | Throttle pin | Comparative surface area | 0.0361 mm <sup>2</sup> | Designation on pin | 25               | <b>D2500</b> |
|    |              |                          | 0.0520 mm <sup>2</sup> |                    | 3                | <b>D0300</b> |
|    |              |                          | 0.0836 mm <sup>2</sup> |                    | 38 <sup>2)</sup> | <b>D0400</b> |
|    |              |                          | 0.1762 mm <sup>2</sup> |                    | 55               | <b>D0600</b> |
|    |              |                          | 0.2798 mm <sup>2</sup> |                    | 69 <sup>3)</sup> | <b>D0800</b> |

## Flushing cavity

|    |         |                                      |            |
|----|---------|--------------------------------------|------------|
| 12 | Plugged |                                      | <b>S00</b> |
|    |         | With ori-<br>fice (only<br>for A6VM) | <b>S12</b> |
|    |         | Ø 1.2                                | <b>S16</b> |
|    |         | Ø 1.6                                | <b>S18</b> |

<sup>2)</sup> Standard for travel drives

<sup>3)</sup> Standard for winch and track drive

## Ordering information

When placing the order, the following information is necessary to ensure correct settings at our test stands:

- **Motor ordering code**
- **Counterbalance valve ordering code**
- **Flow**
- **Application (e.g. excavator, winch etc.)**
- **Pressure setting of the secondary pressure relief valves in the motor**

Gear unit and/or counterbalance valve and axial piston motor can be ordered as ready-assembled and tested units.

## Type selection (Ordering Code)

### Size

depends on the necessary flow rate and the available motor port plates.

### Control range

defines the pressure range at which the brake piston starts to open.

For travel drives in wheeled vehicles, use code "F":

The control piston opens at a differential pressure between A and B of 7 bar. In this case, the brake is not operated via the port for brake release on the counterbalance valve.

For winch and track drives, use code "W"

The control piston opens at a differential pressure between A and B of 20 bar. This ensures that the mechanical park brake actuated via the brake release port is fully opened (generally at 18 bar) before the brake piston opens.

### Ports

depend on the motor size used.

The line ports A and B on the motor port plates are of different distance and diameter. To choose the appropriate connection, please refer to the table in the ordering code and on page 10.

For A2FM/E, sizes 28, 32 and 45, a intermediate plate is required between motor port plate 181 and the counterbalance valve. This intermediate plate is automatically included when motor and counterbalance valve are ordered as a set.

### Brake release

The integrated pressure reduction valve is necessary when the mechanical brake on the gear unit cannot handle the full system pressure.

The maximum permitted brake release pressure must be agreed with the winch manufacturer. The brake release valve limits the high pressure to 21...25 bar (4 bar tolerance). It opens at about 10-14 bar.

### Piston version ...

depends on the maximum flow across the counterbalance valve.

If for instance the maximum operational flow is only some 110 l/min while using a size 20 counterbalance valve which features a nominal flow of 220 l/min, then select the 50% control piston (code „03“). This ensures smooth operation.

If the desired flow is not within the range of the pistons supplied, please contact us.

### Residual opening in piston ...

ensures soft stopping of wheeled vehicles. In winch applications, any residual opening is prohibited, since otherwise the load would not stay suspended. Therefore select code "K00".

### Damping

defines the closing speed of the counterbalance valve. The higher the value, the faster the valve closes.

For the initial layout (prototype), we recommend the following damping:

- for wheel drives: D0400
- for winches and track drives: D0800

### Flushing cavity

supplies motor flushing oil via an internal port. Only available for A6VM.

# Design and Safety Instructions

Failure to observe any of the following points can lead to uncontrolled working conditions with serious personal injury and material damage:

- The counterbalance valve does **not** replace the mechanical park brake. Provide appropriate mechanical brake systems.
- Counterbalance valves are only used in open circuit.
- System optimization for the first prototype is recommended with regard to the valve block, axial piston motor, counterbalance valve and park brake.
- The counterbalance valve and main control valve must be matched to one another.
- If a park brake is installed, it must not close until after the counterbalance valve has closed. Otherwise excessive wear will be caused to the brake linings.
- Comply with the maximum control pressure of the park brake. If necessary, use the integrated pressure reduction valve as a brake release valve with reduced high pressure (code "L")
- The counterbalance valve converts the entire kinetic energy/potential energy into heat during the braking/lowering process. Consequently, ensure sufficient cooler and/or tank capacity.
- Counterbalance valves should be operated in combination with close-by secondary pressure relief valves, in order to protect the motor against pressure spikes. The motor port plates for direct installation of the counterbalance valve (A2FM: plate 181; A2FE: plate 171/181; A6VM: plate 370/380) already contain these secondary pressure relief valves.
- Auxiliary boost pressure at port S of the counterbalance valve reliably reduces the risk of cavitation due to lack of fluid in the low-pressure line. Ensure sufficient boost pressure and flow.
- The axial piston motor and counterbalance valve should always be ordered as a complete set. This ensures optimal matching and combined testing.
- If motor and counterbalance valve are ordered separately, consult our application engineers for the appropriate motor version.

The above safety measures and instructions must be adapted to the application and extended if necessary.

## Technical Data

### Hydraulic fluid

Please refer to the detailed information in our catalog sheets concerning the choice of hydraulic fluids and application conditions (see cross-references on page 11).

### Table of values

| Size  |              |       |                  | 20               | 25               |
|---|--------------|-------|------------------|------------------|------------------|
| Operating pressure  | p            | bar   | Nominal pressure | 350              | 350              |
|   |              |       | Peak pressure    | 420              | 420              |
| Flow, max.  | $q_{v \max}$ | l/min |                  | 220              | 320              |
| Opening pressure of brake piston  | p            | bar   | BVD.F            | 7                | 7                |
|   |              |       | BVD.W            | 20               | 20               |
| Pressure at which brake piston finishes opening                               | p            | bar   | BVD.F            | 30               | 30               |
|   |              |       | BVD.W            | 40               | 40               |
| Pressure reduction valve for brake release (fixed values)<br>Opening pressure | p            | bar   | BVD...L/         | 21 <sup>+4</sup> | 21 <sup>+4</sup> |
|   |              |       | BVD...L/         | 10 <sup>+4</sup> | 10 <sup>+4</sup> |
| Weight, approx.   | m            | kg    |                  | 9                | 15               |

# Technical Data

## Characteristics

### Size 20

#### BVD 20...16 and 20...17

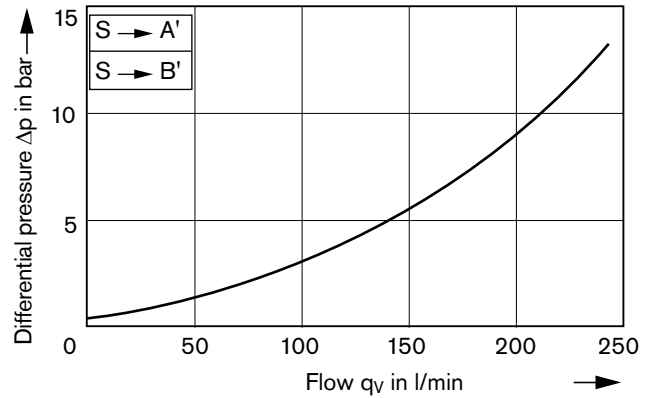
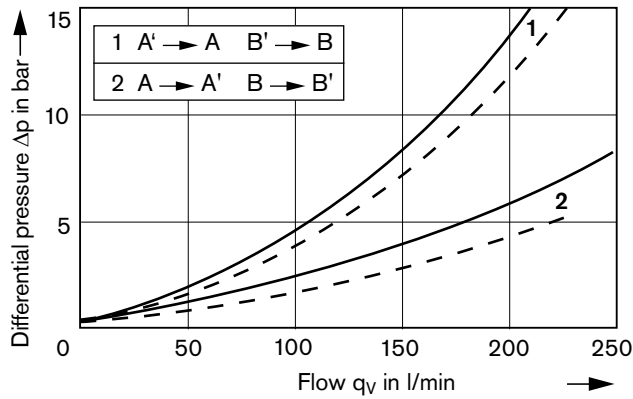
(Service line ports A, B ..... 3/4 in) \_\_\_\_\_

#### BVD 20...27 and 20...28

(Service line ports A, B ..... 1 in) - - - - -

#### BVD 20 - boost characteristic

(Boost port S ..... M22x1.5)



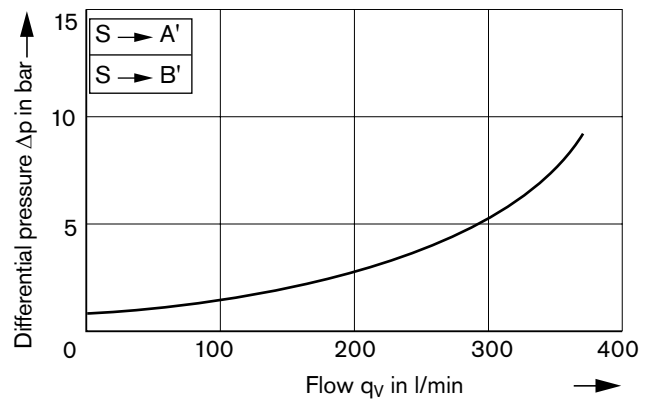
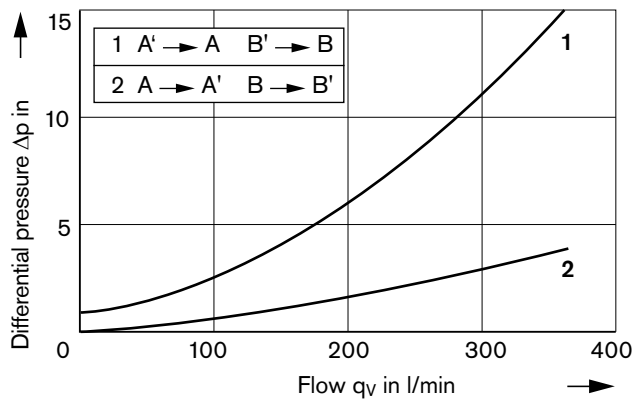
### Size 25

#### BVD 25...38

(Service line ports A, B ..... 1 1/4 in)

#### BVD 25 - boost characteristic

(Boost port S ..... M27x2)



The above specifications are based on:

- Oil viscosity  $\nu = 41 \text{ mm}^2/\text{s}$
- Oil temperature  $\vartheta = 50 \text{ }^\circ\text{C}$
- Brake piston fully open
- Piston code 01 (100%  $q_{v \text{ max}}$ )

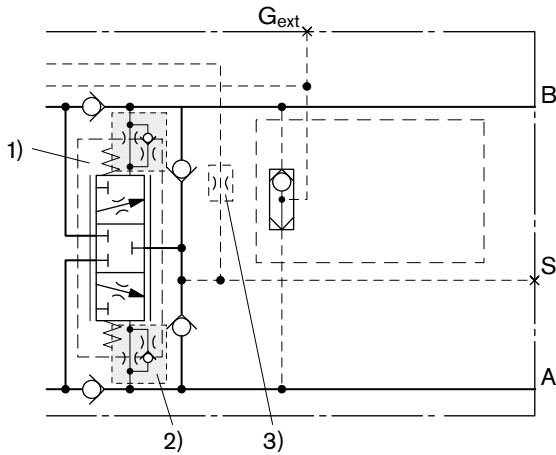
# Operation

Travel/winch counterbalance valves are designed to reduce the danger of overspeeding and cavitation of axial piston motors in open controls. Cavitation occurs if the motor speed is greater than it should be for the given flow during braking, downhill travel or decrease in motor load.

## BVD circuit diagram

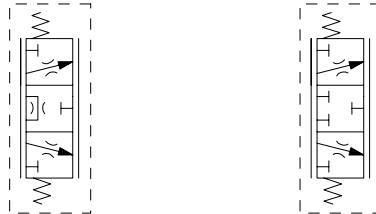
Counterbalance valve with shuttle valve and  $G_{ext}$  (plugged).

Ordering code designation "S" for brake release via port  $G_{ext}$ .



### 1) Residual opening

Brake piston with residual opening (K..) without residual opening (K00)



### 2) Damping



### 3) Flushing cavity...

...plugged (S00)

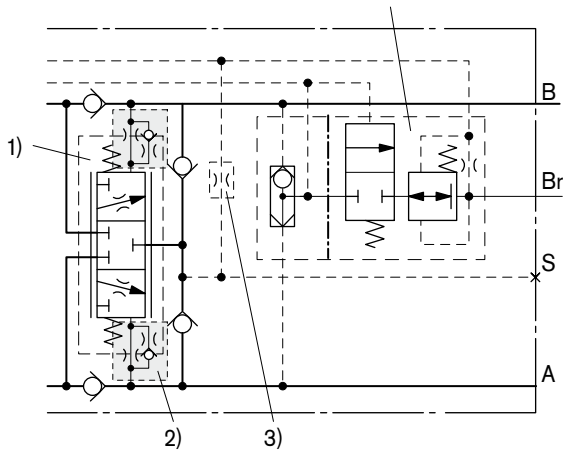


...with orifice (S..)



Counterbalance valve with shuttle valve, brake release valve and port Br.

Ordering code designation "L" for brake release port Br.



# Operation

## Circuit diagram – Travel counterbalance valve BVD..F

### Application example

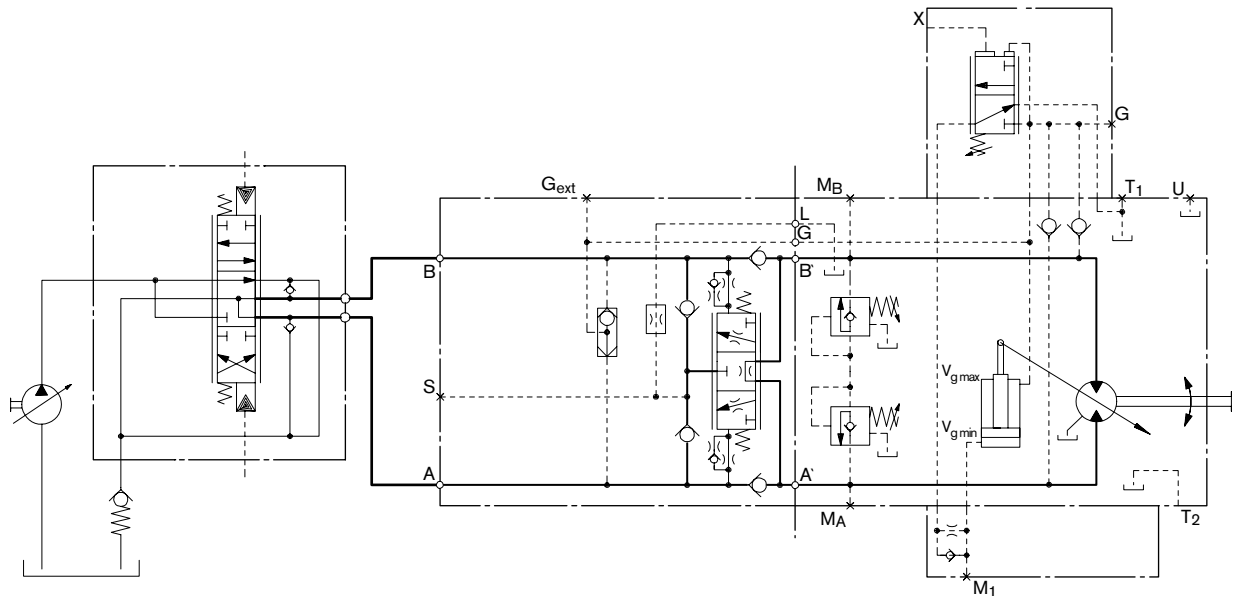
Travel drive for wheeled excavators

e.g. A6VM80HA1T/63W-VAB380 + BVD20F27S/41B-V03K16D0400S12

Variable motor with high pressure related control and hydraulic override (HA1T), port plate with integrated pressure-relief valves, prepared for mounting a counterbalance valve (380).

Travel counterbalance valve, size 20 with 50% piston (03) for approx. 110 l/min, internal residual opening in piston for smooth braking (K16),

high damping rate (D0400), internal flushing cavity to motor with 1.2 mm orifice (S12).



## Circuit diagram – Winch counterbalance valve BVD..W

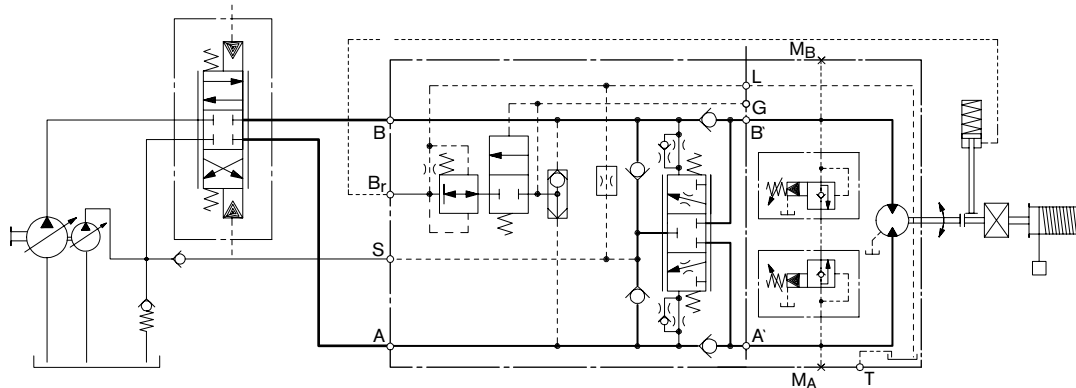
### Application example

Winch drive in cranes; track drive in crawler excavators

e.g. A2FE160/61W-VAL181 + BVD25W38L/41B-V02K00D0600S00 mounted on a GFT-W Rexroth winch gear unit

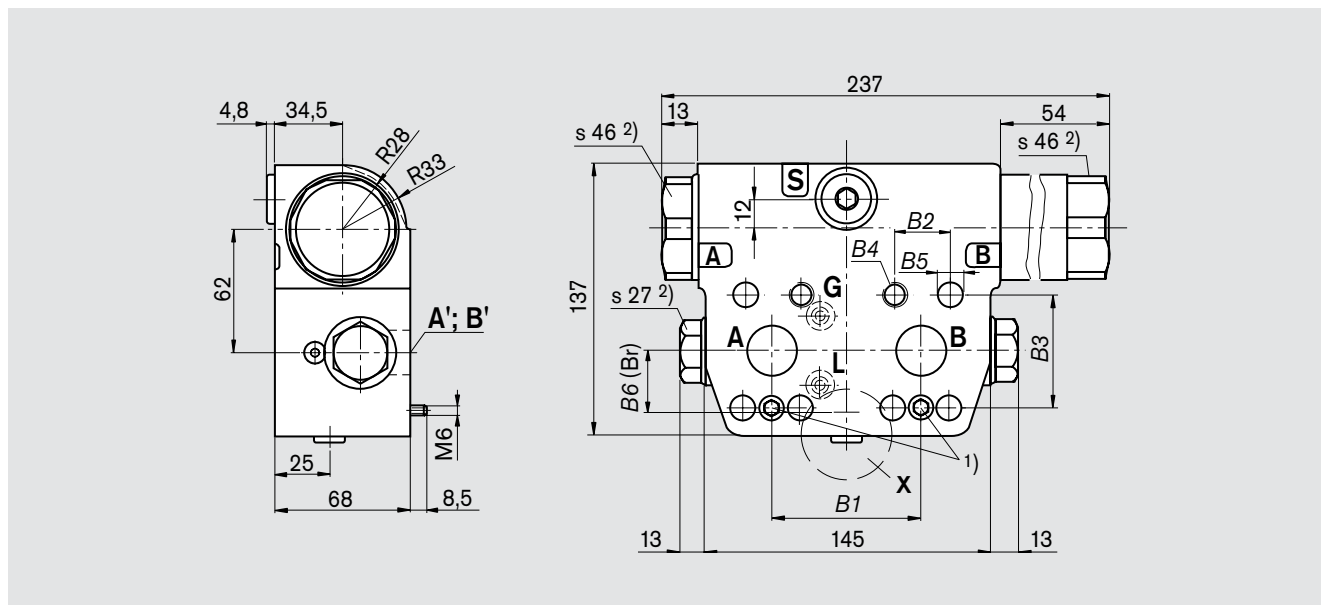
Fixed motor with port plate with integrated pressure-relief valves for mounting a counterbalance valve (181).

Winch counterbalance valve, size 25 with pressure reduction valves for brake release pressure (L), with 75% piston (02) for approx. 240 l/min, without internal residual opening (K00, obligatory for winches), low damping rate (D0800).



Other A6VM and A2FM/E axial piston motors can alternatively also be used.

# Dimensions, Size 20



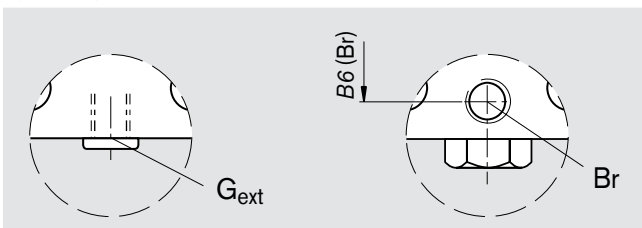
1) Countersink  $\varnothing 11 \times 6.5$  and through-hole  $\varnothing 6.6$  for 2x M6 mounting screws for fixing the counterbalance valve to the motor. In order to prevent incorrect assembly, the mounting screws must be used (included in the delivery contents)

2) Width across flats

### Detail X

With shuttle valve and  $G_{ext}$  port (code S)

With shuttle valve, brake release valve and Br port (code L)



|                    | B1 | B2   | B3   | B4       | $\varnothing B5$ | B6   |
|--------------------|----|------|------|----------|------------------|------|
| <b>BVD 20...16</b> | 66 | 23.8 | 50.8 | M10x1.5  | 10.5             | 25.5 |
| <b>BVD 20...17</b> | 75 | 23.8 | 50.8 | M10x1.5  | 10.5             | 27.0 |
| <b>BVD 20...27</b> | 75 | 27.8 | 57.2 | M12x1.75 | 13               | 27.0 |
| <b>BVD 20...28</b> | 84 | 27.8 | 57.2 | M12x1.75 | 13               | 27.0 |

### Ports

| Designation | Operation                            | Standard       | Size <sup>1)</sup>               | Peak pressure (bar) <sup>2)</sup> | Status |   |
|-------------|--------------------------------------|----------------|----------------------------------|-----------------------------------|--------|---|
| A, B        | Service line port, fixing thread A/B | Version 16, 17 | SAE J518 <sup>3)</sup><br>DIN 13 | 3/4 in<br>M10x1.5; 15 deep        | 420    | O |
|             |                                      | Version 27, 28 | SAE J518 <sup>3)</sup><br>DIN 13 | 1 in<br>M10x1.75; 16 deep         | 420    | O |
| S           | Boost port                           | DIN 3852       | M22x1.5; 14 deep                 | 30                                | X      |   |
| Br          | Brake release, reduced high pressure | Version L      | DIN 3852                         | M12x1.5; 12.5 deep                | 30     | O |
| $G_{ext}$   | Brake release, high pressure         | Version S      | DIN 3852                         | M12x1.5; 12.5 deep                | 420    | X |

### O-rings for connection to mounted axial piston motor

|        |   |                |               |                      |
|--------|---|----------------|---------------|----------------------|
| A', B' | Service line port                                     | Version 16, 17 | AS 568 A      | 24.99x3.53 (S-FKM90) |
|        |   | Version 27, 28 | AS 568 A      | 32.92x3.53 (S-FKM90) |
| G      | High pressure for A6VM motor HA control (with O-ring) | DIN 3771       | 9x2 (N-V80G1) |                      |
| L      | Flushing (with O-ring)                                | DIN 3771       | 9x2 (N-V80G1) |                      |

<sup>1)</sup> Please observe the general instructions for the max. tightening torques on page 12

<sup>2)</sup> Short-term pressure spikes may occur depending on the application. Please keep this in mind when selecting testers and armatures.

<sup>3)</sup> Only dimensions according to SAE J518

O = open, must be connected (plugged on delivery)

X = plugged (in normal operation)





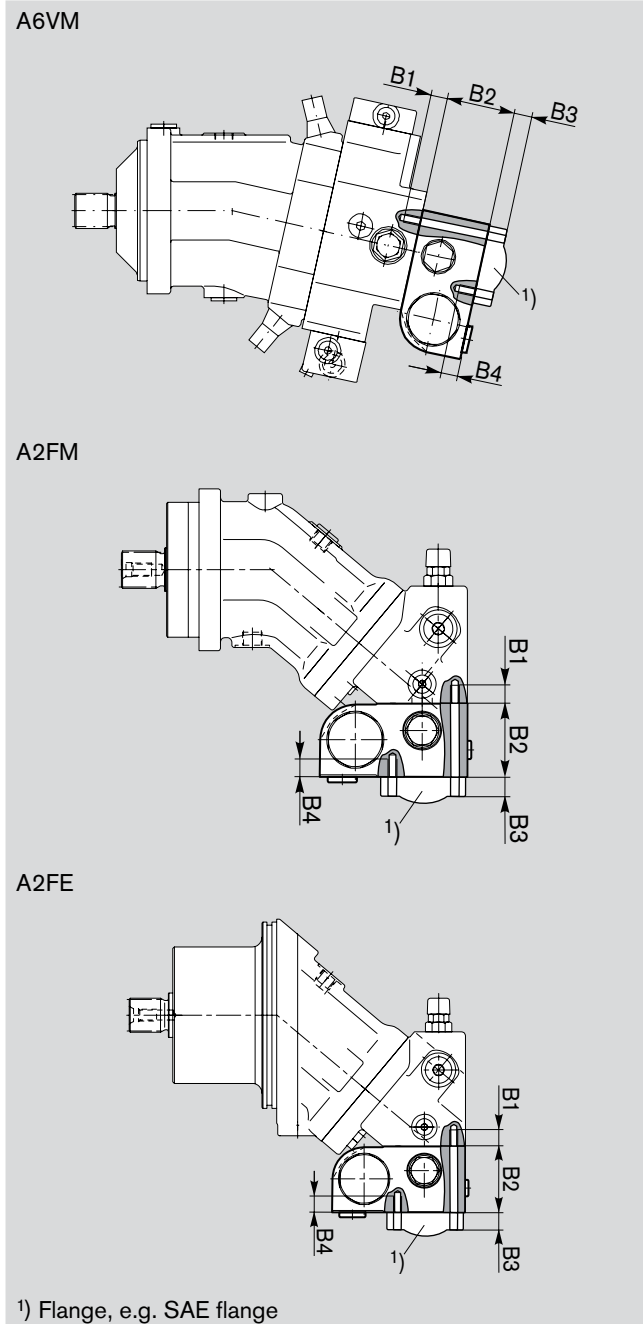
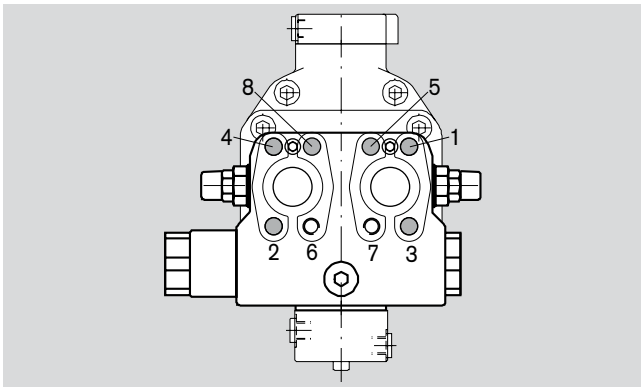
# Fixing the Counterbalance Valve

When delivered, the counterbalance valve is attached to the motor using 2 tacking screws. Do not remove the tacking screws when connecting the service lines. If the counterbalance valve and motor are delivered separately, the counterbalance valve must first be attached to the motor port plate using the provided tacking screws. In both cases, the final attachment of the counterbalance valve to the motor is by the connection of the service lines, e.g. using SAE 4-bolt flanges. A total of 6 screws with thread lengths  $B1+B2+B3$  and 2 screws with thread lengths  $B3+B4$  are required.

When tightening the screws, it is imperative that the sequence 1 to 8 (as shown in the adjacent diagram) be adhered to and carried out in two phases.

In the first phase the screws should be tightened to 50% of their tightening torque before being tightened to maximum tightening torque in the second phase (see table below).

| Thread | Strength class | Tightening torque in Nm |
|--------|----------------|-------------------------|
| M10    | 10.9           | 75                      |
| M12    | 10.9           | 130                     |
| M14    | 10.9           | 205                     |



1) Flange, e.g. SAE flange

| Axial piston motor         | A2FM/E             | A2FM/E             | A6VM               | A2FM/E              | A6VM                | A2FE                | A6VM                | A2FM/E             | A6VM             |
|----------------------------|--------------------|--------------------|--------------------|---------------------|---------------------|---------------------|---------------------|--------------------|------------------|
| NG                         | 28, 32, 45         | 56, 63             | 55                 | 80, 90              | 80                  | 107, 125            | 107                 | 107, 125, 160, 180 | 107, 140, 160    |
| Dimension B1 <sup>1)</sup> | M10x1.5<br>17 deep | M10x1.5<br>17 deep | M10x1.5<br>17 deep | M12x1.75<br>18 deep | M12x1.75<br>15 deep | M12x1.75<br>17 deep | M12x1.75<br>15 deep | M14x2<br>19 deep   | M14x2<br>19 deep |
| Dimension B2               | 78 <sup>2)</sup>   | 68                 | 68                 | 68                  | 68                  | 68                  | 68                  | 85                 | 85               |
| Dimension B3               | Customer-specific  |                    |                    |                     |                     |                     |                     |                    |                  |
| Dimension B4               | M10x1.5<br>15 deep | M10x1.5<br>15 deep | M10x1.5<br>15 deep | M12x1.75<br>16 deep | M12x1.75<br>16 deep | M12x1.75<br>16 deep | M12x1.75<br>16 deep | M14x2<br>19 deep   | M14x2<br>19 deep |

<sup>1)</sup> Minimum necessary screw insertion depth  $1 \times \varnothing$

<sup>2)</sup> Including intermediate plate

## Port Types

|   | NG20             |        |      |        |      |          |                | NG25               |               |
|---|------------------|--------|------|--------|------|----------|----------------|--------------------|---------------|
|   | 16               | 17     | 27   | 28     |      |          | 38             |                    |               |
| Ordering code   | 16               | 17     | 27   | 28     |      |          | 38             |                    |               |
| Service line port A and B   | 3/4 in           |        |      | 1 in   |      |          | 1 1/4 in       |                    |               |
| Boost port S (plugged)  | M22x1.5; 14 deep |        |      |        |      |          | M27x2; 16 deep |                    |               |
| Spacing between service line ports (A'-B')  | 66               | 75     |      |        | 84   |          | 84             |                    |               |
| For mounting on axial piston motor  | A2FM/E           | A2FM/E | A6VM | A2FM/E | A6VM | A2FE     | A6VM           | A2FM/E             | A6VM          |
| Size  | 28, 32, 45       | 56, 63 | 55   | 80, 90 | 80   | 107, 125 | 107            | 107, 125, 160, 180 | 107, 140, 160 |
| Motor port plate required (with secondary pressure-relief valves, mutual bleed-off) | 181              | 181    | 380  | 181    | 380  | 171      | 370            | 181                | 380           |

## Cross-References

|   |          |
|---|----------|
| Mineral oil _____                                 | RE 90220 |
| Environmentally acceptable hydraulic fluids _____ | RE 90221 |
| HF hydraulic fluids _____                         | RE 90223 |
| A2FM _____  | RE 91001 |
| A2FE _____  | RE 91008 |
| A6VM _____  | RE 91604 |
| Hydrotrac GFT _____                               | RE 77110 |
| Moblex GFT-W _____                                | RE 77502 |

# General Instructions

- The BVD counterbalance valve is designed to be used in open circuits.
- Project planning, assembly and commissioning of the axial piston unit with counterbalance valve require the involvement of qualified personnel.
- The service line ports and function ports are only designed to mounting hydraulic lines.
- During and shortly after operation, there is a risk of burns on the axial piston unit. Take suitable safety measures (e.g. wear protective clothing).
- There may be shifts in the characteristic depending on the operating state of the axial piston unit (operating pressure, fluid temperature).
- The data and note contained herein must be adhered to.
- The following tightening torques apply:
  - Threaded hole in axial piston unit:  
The maximum permissible tightening torques  $M_{Gmax}$  are the maximum values for the threaded holes that must not be exceeded. For values, refer to the following table.
  - Armatures:  
Observe the manufacturer's instruction regarding tightening torques for the used armatures.
  - Fixing screws:  
For fixing screws according to DIN 13, we recommend checking the tightening torque in individual cases as per VDI 2230.
  - Locking screws:  
For the metallic locking screws supplied with the axial piston unit, the required tightening torques of locking screws  $M_V$  apply. For values, refer to the following table.

| Thread size at ports |          | Max. permissible tightening torque of the threaded holes $M_{Gmax}$ | Required tightening torque of the locking screws $M_V$ | WAF hexagon socket |
|----------------------|----------|---|--|--------------------|
| M12x1.5              | DIN 3852 | 50 Nm   | 25 Nm  | 6 mm               |
| M22x1.5              | DIN 3852 | 210 Nm  | 80 Nm  | 10 mm              |
| M27x2                | DIN 3852 | 330 Nm  | 135 Nm   | 12 mm              |