

## Balanced Valve

Model: FD...1X



- ◆ Size 12/16/25/32
- ◆ Maximum working pressure 315 bar
- ◆ Maximum working flow 560 L/min

### Contents

|                                         |       |
|-----------------------------------------|-------|
| Function description, sectional drawing | 02    |
| Circuit examples                        | 03    |
| Models and specifications               | 04    |
| Functional symbols                      | 04    |
| Technical parameters                    | 05    |
| Characteristic curve                    | 05    |
| Component size                          | 06-09 |

### Features

- Pilot operated check valve no leakage
- The balanced valve controls the return flow Q2 according to the flow Q1 on the opposite side of the actuator
- With cylinders the area ratio ( $Q_2=Q_1\phi$ ) must be considered
- By-pass valve, flow freely in the opposite direction
- External superimposed secondary pressure relief valve (for flange connection only)

The balanced valve is used to prevent "out of control" of hydraulic cylinder or motor caused by load in hydraulic system. It can also prevent pipe bursting.

The balanced valve mainly includes the valve body (1), main spool (2), pilot part (3), control spool (4), damping spool (5) and orifice (6). When lifting load, the fluid flows from A to B to open the main spool (2). If the load pressure fails (e.g. pipe break), the main spool closes immediately as the chamber (8) is connected with load pressure.

#### Lowering the load (circuit examples)

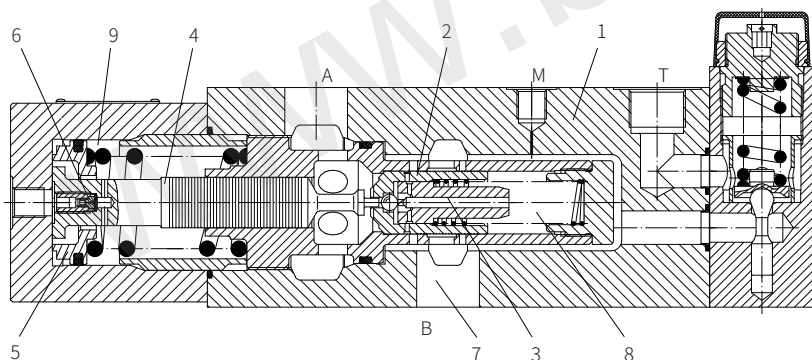
The direction of flow is from B to A. Port A is connected to tank through the directional valve. The piston rod side of the cylinder has a flow applied which corresponds to the working condition. The relationship between the control pressure at port X and the load pressure at port B is 1:20.

When the control pressure is reached, the main spool opens. The pilot body (3) is lifted off its seat by the control spool (4), and the chamber (8) is de-compressed by its inner hole and port A to tank. At the same time, the load pressure in port B doesn't act on the chamber (8) any more due to the longitudinal movement of the pilot part (3) within the main spool. Then the main spool (2) is unloaded. The reverse side of the control spool (4) at the main spool (2) lies against the collar of the damping spool (5).

To open the main spool, the control pressure in port X depends on the spring in the chamber (9). When the valve open, the pressure is 20bar, and it is 50bar when fully open. The relationship between the opening area, cracking pressure and differential pressure determines the flow to the actuator via the connection of B to A. It depends on the inlet flow on the other side of the actuator to prevent the actuator "runaway". The operation of the controlled lowering is not affected even if there is a pipe break between the directional valve and port A in the balanced valve.

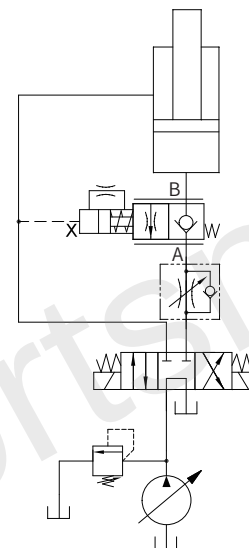
Note on the opening and closing times of balanced valve:

- Throttling of the opening sequence is via orifice (6) in the control spool (4) and both sides of the damping spool (5).
- The closing of the balanced valve is almost no throttling.
- When being used together with cylinder, a throttle check valve (meter-out control) can be set in the control line of port X to affect the closing time.
- When being used together with the motor, a throttle check valve should not be set in the control line of port X, in this condition it is recommended to control the closing time of the direction valve.



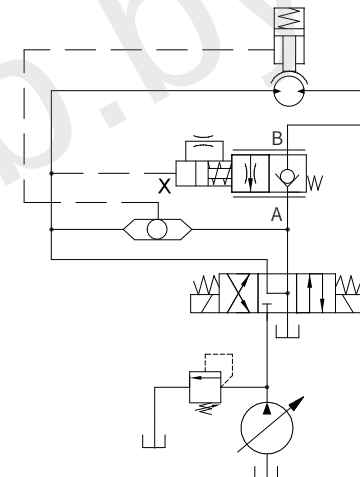
#### Cylinder with single rod

For safety, a closed center directional valve should be always used.



#### Hydraulic motor

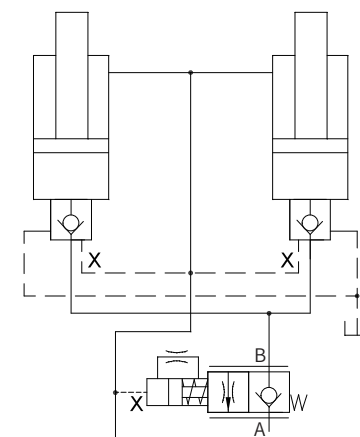
To make sure the brake can be operated, the two oil ports of the directional valve must be connected to the tank in the neutral position. If the brake is externally operated, then it could use a closed central directional valve.



Note:

Two balanced valves can not be used to control two mechanically synchronized cylinder as it is impossible to maintain the same synchronized pressure in two cylinders. Therefore, it is necessary to install two hydraulic operated check valves type SL in the cylinder, and the balanced valve is installed in the common line. In this case, the load pressure can not exceed 200bar.

In order to avoid shaking caused by the loss of pressure at control port X because of fast falling speed, it is recommended to install a throttle check valve at port A of the balanced valve to limit the falling speed.

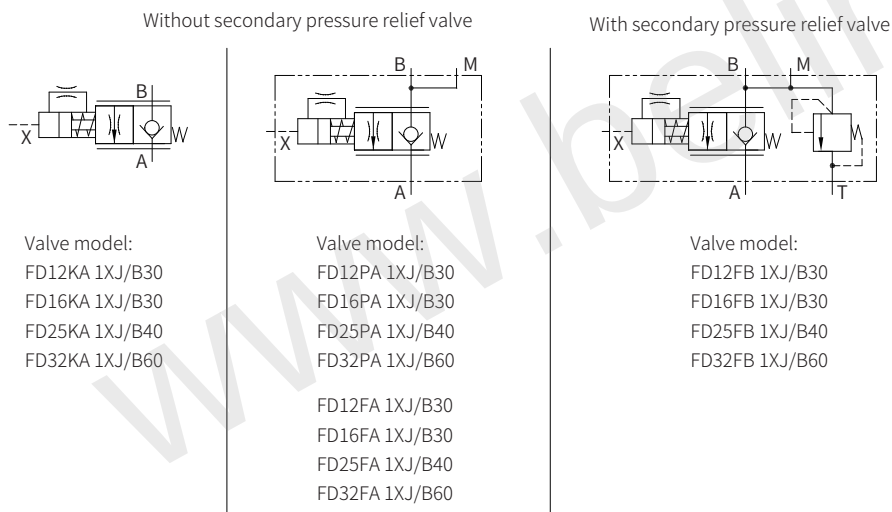


## Models and specifications

|                                                                                                                          |                          |    |                                                                                                                                                              |
|--------------------------------------------------------------------------------------------------------------------------|--------------------------|----|--------------------------------------------------------------------------------------------------------------------------------------------------------------|
| size 12<br>size 16<br>size 25<br>size 32                                                                                 | =12<br>=16<br>=25<br>=32 | 1X | *                                                                                                                                                            |
| manifold mounting<br>subplate mounting<br>SAE flange connection                                                          | =K<br>=P<br>=F           |    |                                                                                                                                                              |
| without secondary pressure relief valve=A<br>with secondary pressure relief valve =B<br>(for SAE flange connection only) |                          |    |                                                                                                                                                              |
| 10 to 19 series<br>(10 to 19 series installation<br>and connection size unchanged)                                       | =1X                      |    |                                                                                                                                                              |
|                                                                                                                          |                          |    | more information<br>in text<br>No code = G thread<br>2= metric thread                                                                                        |
|                                                                                                                          |                          |    | sealing material<br>No code = NBR seals<br>V= FKM seals<br>(consult for other seals)                                                                         |
|                                                                                                                          |                          |    | the working pressure of the<br>secondary pressure relief valve<br>(SAE connection only)                                                                      |
|                                                                                                                          |                          |    | B00= without orifice<br>B30= orifice $\Phi 0.3$ (FD12;16)<br>B40= orifice $\Phi 0.4$ (FD25)<br>B60= orifice $\Phi 0.6$ (FD32)<br>(other orifice on required) |

03

## Functional symbols

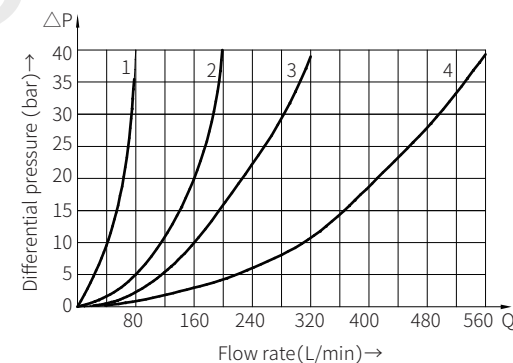


0648

## Technical parameters

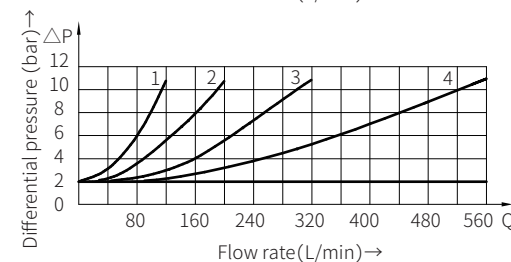
|                                                         |                    |                                                                             |
|---------------------------------------------------------|--------------------|-----------------------------------------------------------------------------|
| Working pressure, oil port A, X                         | bar                | to 315                                                                      |
| Working pressure, oil port B                            | bar                | to 420                                                                      |
| Pilot pressure, oil port X<br>(Flow control range)      | bar                | Minimum 20 to 35, maximum 315                                               |
| Cracking pressure, A to B                               | bar                | 2                                                                           |
| Setting pressure for secondary<br>pressure relief valve | bar                | to 400                                                                      |
| Flow                                                    | L/min              | 80 (size 12), 200 (size 16), 320 (size 25), 560 (size 32)                   |
| Area ratio of pre-opening                               |                    | $\frac{\text{Poppet seat area}}{\text{Area of pilot spool}} = \frac{1}{20}$ |
| oil temperature range                                   | °C                 | -30 to +80 (NBR seal), -20 to +80 (FKM seal)                                |
| Viscosity range                                         | mm <sup>2</sup> /s | 10 to 800                                                                   |
| Hydraulic oil                                           |                    | Mineral hydraulic oil or phosphate hydraulic oil                            |

## Characteristic curve

(Measured when using HLP 46,  $t_{oil} = 40^\circ\text{C} \pm 5^\circ\text{C}$ )


Characteristic curve for differential pressure and flow rate, measured at the throttle position: Throttle fully open ( $P_x=60\text{bar}$ ) B→A

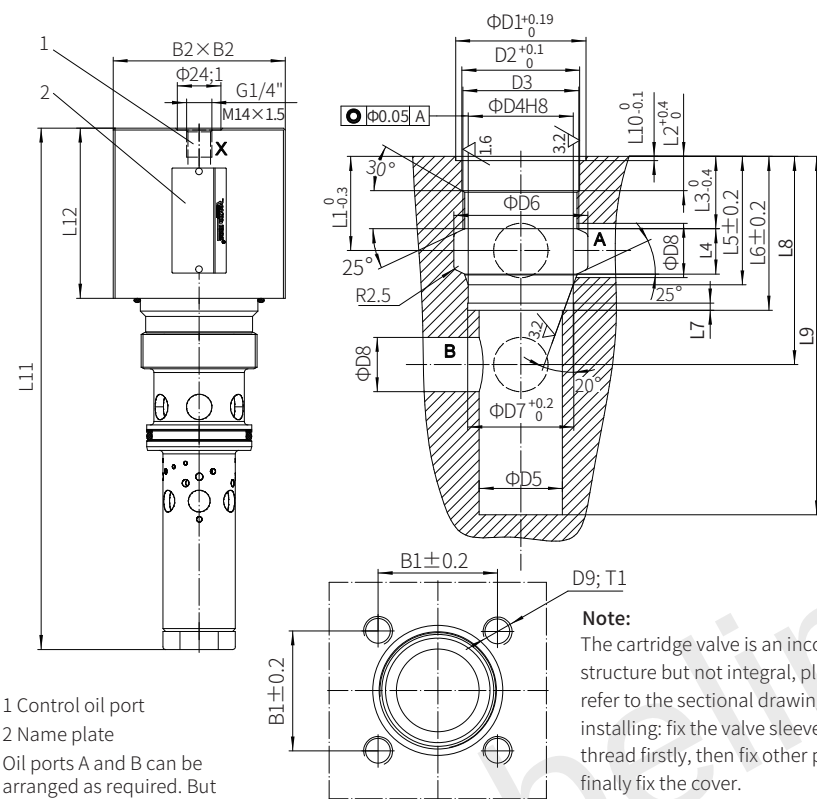
1=size 12  
2=size 16  
3=size 25  
4=size 32



Characteristic curve for differential pressure and flow rate, measured over the check valve A→B

0649

Valves for manifold mounting (cartridge valves)



- 1 Control oil port
- 2 Name plate

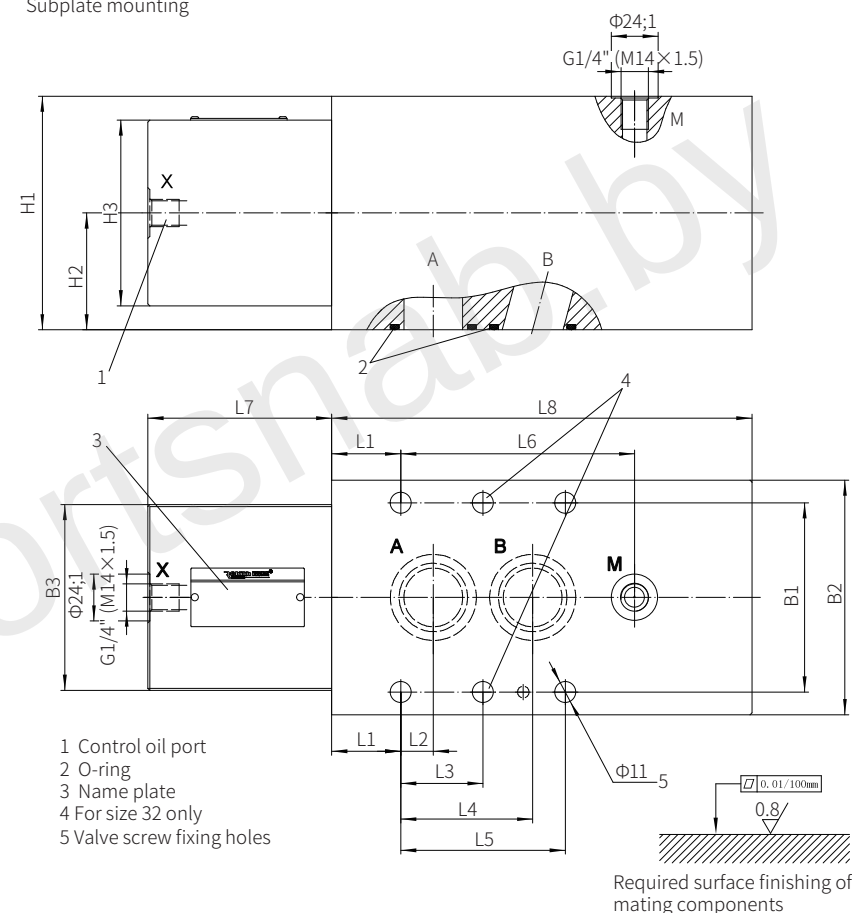
Oil ports A and B can be arranged as required. But the valve fixing screw holes must not be damaged.

| Model  | B1 | B2 | D1 | D2 | D3    | D4 | D5 | D6 | D7   | D8 | D9  | T1 | L1 | L2 | L3 | L4   | L5   |
|--------|----|----|----|----|-------|----|----|----|------|----|-----|----|----|----|----|------|------|
| FD12KA | 48 | 70 | 54 | 46 | M42x2 | 38 | 34 | 46 | 38.6 | 16 | M10 | 16 | 39 | 16 | 32 | 15.5 | 50.5 |
| FD16KA | 48 | 70 | 54 | 46 | M42x2 | 38 | 34 | 46 | 38.6 | 16 | M10 | 16 | 39 | 16 | 32 | 15.5 | 50.6 |
| FD25KA | 56 | 80 | 60 | 54 | M52x2 | 48 | 40 | 60 | 48.6 | 25 | M12 | 19 | 50 | 19 | 39 | 22   | 65   |
| FD32KA | 66 | 95 | 72 | 65 | M64x2 | 58 | 52 | 74 | 58.6 | 30 | M16 | 23 | 52 | 19 | 40 | 25   | 71   |

| Model  | L6 | L7 | L8  | L9  | L10 | L11 | L12 | Valve fixing screw/Tightening torque | M <sub>n</sub> (Nm) | Weight |
|--------|----|----|-----|-----|-----|-----|-----|--------------------------------------|---------------------|--------|
| FD12KA | 60 | 3  | 78  | 128 | 2.3 | 191 | 65  | four M10x70 GBT70.1-10.9             | 60                  | 3.5kg  |
| FD16KA | 60 | 3  | 78  | 128 | 2.3 | 191 | 65  | four M10x70 GB/T70.1-10.9            | 60                  | 3.5kg  |
| FD25KA | 80 | 4  | 105 | 182 | 2.3 | 253 | 75  | four M12x80 GB/T70.1-10.9            | 95                  | 5.6kg  |
| FD32KA | 85 | 4  | 115 | 198 | 2.3 | 289 | 94  | four M16x100 GB/T70.1-10.9           | 196                 | 8.0kg  |

**Note:**  
The cartridge valve is an incompact structure but not integral, please refer to the sectional drawing when installing: fix the valve sleeve with thread firstly, then fix other parts, finally fix the cover.

### Subplate mounting



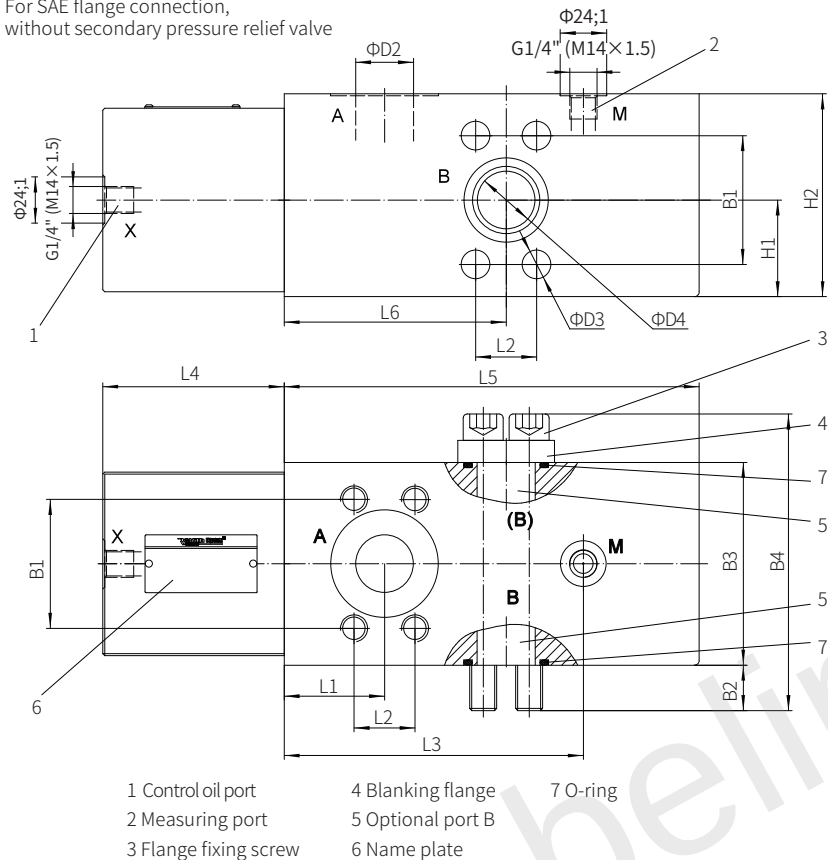
| Model  | B1   | B2  | B3 | H1  | H2   | H3 | L1   | L2   | L3   | L4   | L5   | L6   |
|--------|------|-----|----|-----|------|----|------|------|------|------|------|------|
| FD12PA | 66.7 | 85  | 70 | 85  | 42.5 | 70 | 31.8 | 7.2  | -    | 35.8 | 42.9 | 73.2 |
| FD16PA | 66.7 | 85  | 70 | 85  | 42.5 | 70 | 31.8 | 7.2  | -    | 35.8 | 42.9 | 73.2 |
| FD25PA | 79.4 | 100 | 80 | 100 | 50   | 80 | 38.9 | 11.1 | -    | 49.2 | 60.3 | 109. |
| FD32PA | 96.8 | 120 | 95 | 120 | 60   | 95 | 35.3 | 16.7 | 42.1 | 67.5 | 84.2 | 119. |

| Model  | L7 | L8  | Valve fixing screw/Tightening torque | M <sub>A</sub> (Nm) | Weight |
|--------|----|-----|--------------------------------------|---------------------|--------|
| FD12PA | 65 | 140 | four M10x100 GB/T70.1-10.9           | 60                  | 9.3kg  |
| FD16PA | 65 | 140 | four M10x100 GB/T70.1-10.9           | 60                  | 9.3kg  |
| FD25PA | 75 | 200 | four M10x120 GB/T70.1-10.9           | 60                  | 18kg   |
| FD32PA | 94 | 215 | four M10x140 GB/T70.1-10.9           | 60                  | 28kg   |

## Component size

Size unit: mm

For SAE flange connection,  
without secondary pressure relief valve



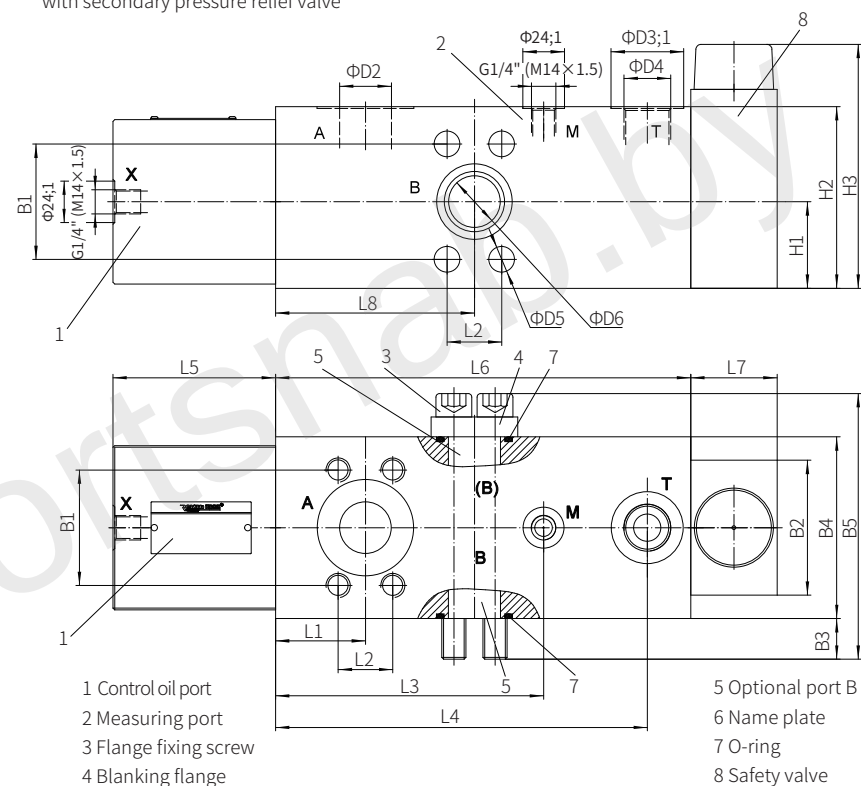
| Model  | B1   | B2   | B3  | B4  | D1 | D2 | D3   | D4 | D5  | H1 | H2  | L1 | L2   | L3  | L4 |
|--------|------|------|-----|-----|----|----|------|----|-----|----|-----|----|------|-----|----|
| FD12FA | 50.8 | 16.5 | 72  | 110 | 43 | 18 | 10.5 | 18 | M10 | 36 | 72  | 39 | 23.8 | 105 | 65 |
| FD16FA | 50.8 | 16.5 | 72  | 110 | 43 | 18 | 10.5 | 18 | M10 | 36 | 72  | 39 | 23.8 | 105 | 65 |
| FD25FA | 57.2 | 14.5 | 90  | 132 | 50 | 25 | 13.5 | 25 | M12 | 45 | 90  | 50 | 27.8 | 148 | 75 |
| FD32FA | 66.7 | 20   | 105 | 154 | 56 | 30 | 15   | 30 | M14 | 50 | 105 | 52 | 31.8 | 155 | 94 |

| Model  | L5  | L6  | T1 | Weight | O-ring (7) | Valve fixing screw          |
|--------|-----|-----|----|--------|------------|-----------------------------|
| FD12FA | 140 | 78  | 15 | 7.2kg  | 25x3.5     | 4 pcs M10x100 GB/T70.1-10.9 |
| FD16FA | 140 | 78  | 15 | 7.2kg  | 25x3.5     | 4 pcs M10x100 GB/T70.1-10.9 |
| FD25FA | 200 | 105 | 18 | 16kg   | 32.92x3.53 | 4 pcs M12x120 GB/T70.1-10.9 |
| FD32FA | 215 | 115 | 21 | 23kg   | 37.7x3.53  | 4 pcs M14x140 GB/T70.1-10.9 |

## Component size

Size unit: mm

For SAE flange connection,  
with secondary pressure relief valve



| Model  | B1   | B2 | B3   | B4  | B5  | D1 | D2 | D3 | D4   |         | D5   | D6 | D7  | H1 | H2  | H3  | L1 |
|--------|------|----|------|-----|-----|----|----|----|------|---------|------|----|-----|----|-----|-----|----|
|        |      |    |      |     |     |    |    |    | G    | Metric  |      |    |     |    |     |     |    |
| FD12FB | 50.8 | 49 | 16.5 | 72  | 110 | 43 | 18 | 34 | G1/2 | M22x1.5 | 10.5 | 18 | M10 | 36 | 72  | 118 | 39 |
| FD16FB | 50.8 | 49 | 16.5 | 72  | 110 | 43 | 18 | 34 | G1/2 | M22x1.5 | 10.5 | 18 | M10 | 36 | 72  | 118 | 39 |
| FD25FB | 57.2 | 78 | 14.5 | 90  | 132 | 50 | 25 | 42 | G3/4 | M27x2   | 13.5 | 25 | M12 | 45 | 90  | 145 | 50 |
| FD32FB | 66.7 | 78 | 20   | 105 | 154 | 56 | 30 | 42 | G3/4 | M27x2   | 15   | 30 | M14 | 50 | 105 | 145 | 52 |

| Model  | L2   | L3  | L4    | L5 | L6  | L7 | L8  | T1 | Weight | O-ring (7) | valve fixing screw |
|--------|------|-----|-------|----|-----|----|-----|----|--------|------------|--------------------|
| FD12FB | 23.8 | 105 | 141.5 | 65 | 162 | 38 | 78  | 15 | 9kg    | 25x3.5     | 4 pcs M10x100      |
| FD16FB | 23.8 | 105 | 141.5 | 65 | 162 | 38 | 78  | 15 | 9kg    | 25x3.5     | 4 pcs M10x100      |
| FD25FB | 27.8 | 148 | 198   | 75 | 225 | 50 | 105 | 18 | 20kg   | 32.92x3.53 | 4 pcs M12x120      |
| FD32FB | 31.8 | 155 | 215   | 94 | 240 | 50 | 115 | 21 | 28kg   | 37.7x3.53  | 4 pcs M14x140      |