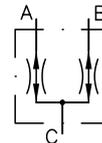


Flow divider (flow distributor), type TQ

Pressure p_{\max} = 350 bar

Flow $Q_{CN \max}$ = 200 lpm

Share ratio = 1:1



1. General

• Task

Flow dividers type TQ are self-regulating valves, which largely irrespective of the pressure differentials at the operating connections A and B, divide a flow Q_C entering at C into two equal output flows, Q_A and Q_B . Alternatively, in the opposite direction they can retain both partial flows Q_A and Q_B at equal rates, and combine them into one overall flow Q_C .

• Mounting and function

Two hardened and ground control pistons, flexibly linked to one another, are arranged in a steel housing in such a way that they can be easily displaced and centered in the center position (neutral position) by springs. Orifice boreholes connected one behind another in the two control pistons form throttle points with constant and variable cross-sections between the single flow connection and the two part flow connections. When an appreciable flow rate is present, pressure drops occur at these throttle points, which bring the pistons into the control position as well as balancing out any pressure difference, which may have arisen between the two part flows as a result of load differences at the connected consumer units. Accordingly, the total pressure drops between the two part flow connections and the single common connection are always of the same value; depending on the physical connection between flow resistance and flow rate, this also results in two equally high part flow rates.

• Application

The valves are used in situations where two hydraulic consumers, fed by one pump but without any forced mechanical connection, are controlled by a common directional valve and are intended to move in and out simultaneously, without influencing one another despite differing load levels. Where hydraulic consumers of equal size are involved, this produces a certain synchronized motion, although this is dependent on the division precision of the flow distributor and the internal leakage losses of the consumers (e.g. as with hydraulic motors) and the volumetric elasticity of the system (oil compressibility, hose expansion etc.). Division precision is not a constant value, but dependent on a variety of operational parameters (see sect. 3.2), and may change in the course of a work cycle, depending for example on the load proportions. Flow dividers can therefore only fulfil the task of flow equalizer valves if a division error of a few percent is permissible and without any disturbing influence. Therefore truly exact synchronized flow control cannot be achieved. Other devices are required for this (such as mechanical flow dividers working on the gear wheel or piston principle), or proportional or servovalves for high demands, which are guided by continuous scanning of the stroke and angle of rotation. The influence of the viscosity of the pressure medium on division precision is negligible, but it becomes noticeable by way of the consumer leakage losses mentioned above. Synchronization differentials in hydraulic cylinders are balanced out in each case at the final stroke position.

2. Types available, main data

2.1 Valves with equal dividing ratio

Order example:

TQ 32-A 3

Table 1: Basic type, size

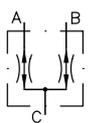
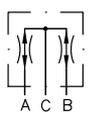
Connection mode	Coding	Port size ISO 228/1 (BSPP) or JIS B 2351	
		C	A, B
Pipe connection 	21-A	G 3/8	G 1/4
	21 JIS		
	22-A	G 3/8	G 3/8
	22 JIS		
	32-A	G 1/2	G 3/8
	32 JIS		
	TQ 33-A	G 1/2	G 1/2
	33 JIS		
Manifold mounting 	3P-A	see dimensional drawings in sect. 4.2	
	TQ 4P-A		
	5P-A		

Table 2: Flow

Available for basic type	Coding	Rated total flow $Q_{CN}^{2)}$ approx. lpm	Final pos. balance ³⁾ approx. lpm	
				
TQ 21.-A to TQ 33.-A and TQ 3P-A	0,78	3.8	0.2	0.1
	1,1	7.5	1.6	1
	1,6	15	1.6	1
	2,3	30	2.5	1.5
	3	45	4	1.7
	3,5	60	5	2
TQ 43-A TQ 4P-A	4	80	6.5	3
	5	120	9	5
TQ 54-A TQ 5P-A	5,5	140	12	6
	6,8	200	15	7

1) Not for TQ 21.; $Q_{CN} \approx 70$ lpm. Only for applications, where a greater dividing error is no problem (approx. $\pm 8...10\%$)

2) Guideline for the permissible flow in at port C. In this case, a flow resistance prevails in the flow directions $C \rightarrow A$ and $C \rightarrow B$ (and vice versa, when two flows are joint) of about 30 bar, see Δp -Q curves

3) If (in the case of hydraulic cylinders) the advancing end comes to a standstill at the limit stop, the other end will follow according to the specified balance flow (approx. value); see note under section 5.

2.2 VUnequal dividing ratios

The smaller part flow is always at connection

Note:

Max. part flow at $Q_{A \max} = 0.5 Q_{CN}$!

For Q_{CN} of the respective metering orifice coding (flow spec.) refers to table 2 in sect. 2.

Valves with unequal flow ratio: The perm. inlet flow $Q_{C \text{ perm}}$ is always lower than the Q_{CN} . It can be determined with share parameter

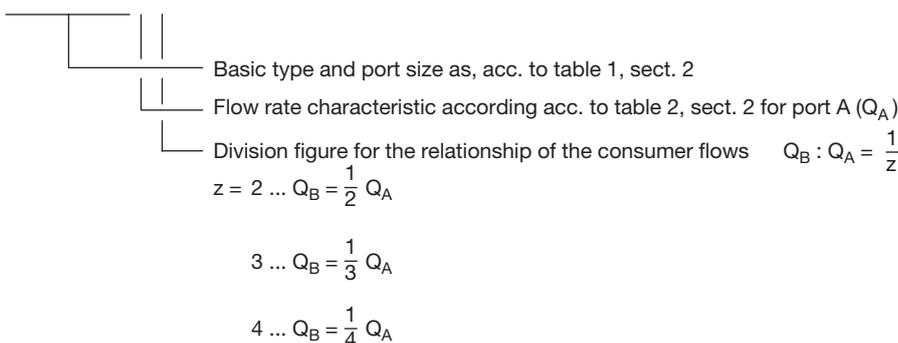
$z = 2, 3, 4$ $Q_{C \text{ perm}} = Q_{A \max} + Q_{B \max}$ applies in general or $Q_{C \text{ perm}} = 0.5 Q_{CN} \left(1 + \frac{1}{z} \right)$

Available versions:

- A 1,1/2
- A 1,6/2
- A 2,3/1,4
- A 2,3/2
- A 2,3/3
- A 2,3/4
- A 3/1,5
- A 3/2
- A 3/3
- A 3,5/2
- A 3,5/3
- A 3,5/4
- A 4/1,4 ¹⁾
- A 4/2 ¹⁾
- A 4/3 ¹⁾
- A 4/4 ¹⁾

Order example:

TQ 32 - A 3/2



- A 4/1,5
- A 4/2
- A 4/3
- A 4/4
- A 5/2
- A 5/3
- A 5/5
- A 5/1,5
- A 5,5/2
- A 6,8/2
- A 6,8/3

1) Not for TQ 21.; Q_{CN} , 70 lpm. Only for applications, where a greater dividing error is no problem (approx. $\pm 8...10\%$)

2.3 Valves only for division C → A, B

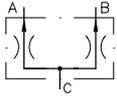
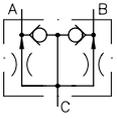
Share ratio 1:1

Order example: **TQ 32 R-B 2,3**



Flow
(see table 2, coding 0.78 to 4)

Table 3: Basic type, size

Connection mode	Coding	Port size ISO 228/1 (BSPP)		Symbols	Remarks	
		C	A, B			
Pipe connection	TQ	21-B	G 3/8	G 1/4	 <p>No return flow</p>	Valves featuring only a mono metering spool are only suited for flow direction C → A, B. Return flow in reverse direction is not permissible with type TQ 21-B... to TQ 33-B... .
		22-B	G 3/8	G 3/8		
		32-B	G 1/2	G 3/8		
		33-B	G 1/2	G 1/2		
		43-B	G 3/4	G 1/2		
		54-B	G 1	G 3/4		
	TQ 32 R-B	G 1/2	G 3/8		Features an internal by-pass check valve. This enables free, but not metered return flow. Examples: Grab buckets or forks wich are intended to open quickly by grafitational force and are intended to strike against integrated stops in order to knock free any material which may still be clinging to them.	

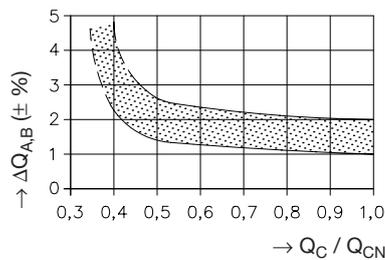
3. Additional data

Nomenclature	Spool valve
Installation position	Any
Operating pressure	$p_{max} = 350 \text{ bar}$
Flow	$Q_{CN} = 3.8 \dots 200 \text{ lpm}$, see table 2
Surface protection	Valve housing zinc galvanized
Pressure fluid	Hydraulic oil conforming DIN 51524 part 1 to 3: ISO VG 10 to 68 conform. DIN 51519; Viscosity range: Viscosity during start min. approx. 4; max. approx. 1500 mm ² /s; opt. service: approx. 10 ... 500 mm ² /s Also suitable are biologically degradable pressure fluids type HEPG (Polyalkylenglykol) and type HEES (Synth. Ester) at service temperatures up to approx. +70°C.
Temperature	Ambient: approx. -40° ... +80°C; ÖI: -25° ... +80°C; take note of viscosity ranges! Start temperature down to -40°C are allowable (Pay attention to the viscosity range during start!), as long as the operation temperature during subsequent running is at least 20K higher. Biological degradable pressure fluids: Pay attention to manufacturer's information. With regard to the compatibility with sealing materials do not exceed +70°C.

Mass (weight)	Type	TQ 21. TQ 22.	TQ 32. TQ 33.	TQ 43	TQ 54	TQ 3P-A	TQ 4P-A	TQ 5P-A
	approx. kg	0.6	0.6	1.5	3	0.7	1.6	3.1

Dividing precision depends on total flow Q_C . This should be between 50...100% of Q_{CN} . Below 50% of Q_{CN} , division precision starts to drop. In this case a valve with the next smaller flow coding should be selected

The dividing precision is also dependent on the pressure differential between the consumer ports A and B. If the pressures are the same or only slightly diff. ($\leq 20 \text{ bar}$), the dividing error is about $\pm 1 \dots 2\%$. Where higher pressure differentials are involved, the dividing error increases and amounts to approx. $\pm 2 \dots 2.5\%$ at a differential of about 100 bar for the flow characteristics A 0.78...2.3 may rise to $\pm 3 \dots 5\%$ with larger characteristic values, and is approx. $\pm 5 \dots 7\%$ at A 6.8.



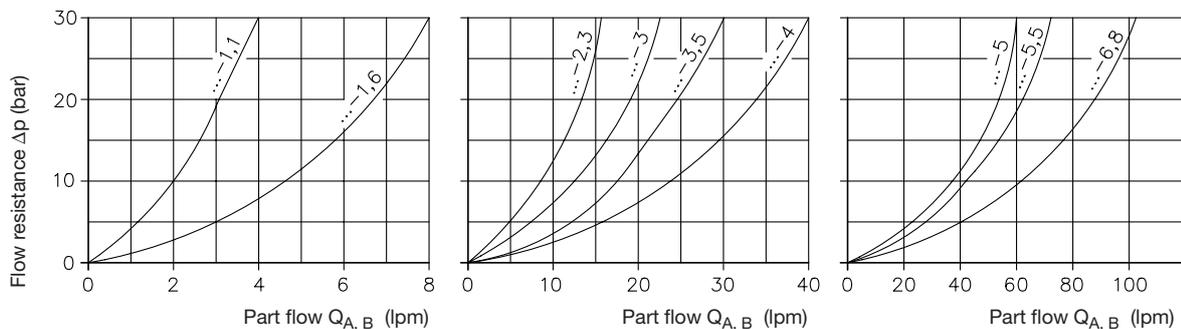
Dividing error

$$Q_{A, B} = f \left(\frac{Q_C}{Q_{CN}} \right) \text{ in \% of } Q_{A, B} = \frac{1}{2} Q_C$$

at equal load pressures or low pressure differentials between the connections A and B

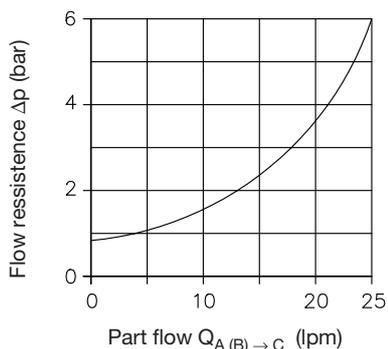
Type TQ...-A.. TQ...-B..

Δp -Q-Characteristic curves



Additional data for type TQ 32 R-B

Δp -Q-Characteristic curves for return flow

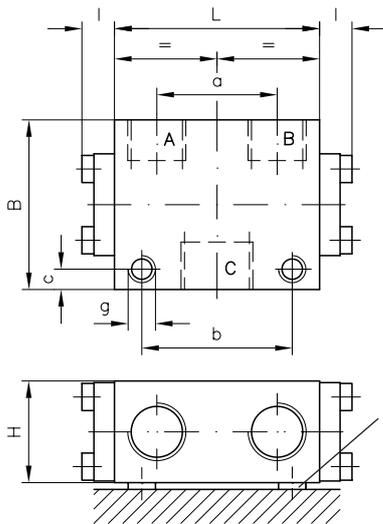


Oil viscosity during measurement 60 mm²/s

4. Dimensions

4.1 Pipe connection design

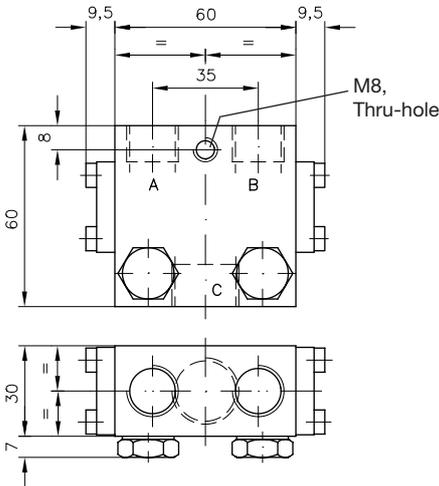
Type TQ 21 to TQ 54



Type	H	B	L	a	b	c	g	l
TQ 21	30	50	59.6	34.8	44	6	M8, thru-hole	9.5
TQ 21 JIS				31				
TQ 22				34.8				
TQ 22 JIS				31				
TQ 32	30	60	66	34.8	44	8		9.5
TQ 32 JIS				35				
TQ 33				36				
TQ 33 JIS	35							
TQ 43	40	60	80	50	60	6	M8, 10 deep front and back, core bore is a thru-hole	15
TQ 54	50	80	104	60	80	10		15

Caution:
Do not distort the housing by forcing it against the securing plane. Insert shims as spacers to even out irregularities

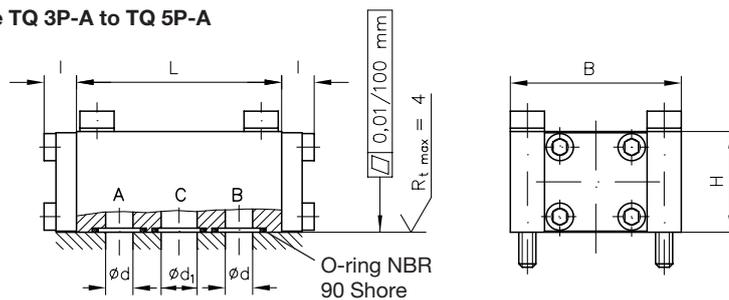
Type TQ 32R - B..



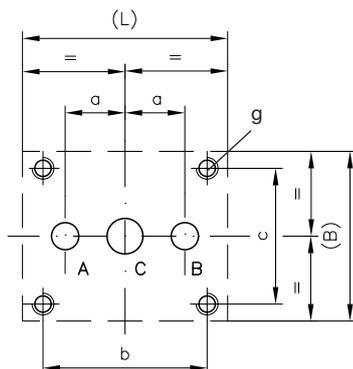
All dimensions are in mm, subject to change without notice!

4.2 Manifold mounting design

Type TQ 3P-A to TQ 5P-A



Hole pattern of the manifold (top view)



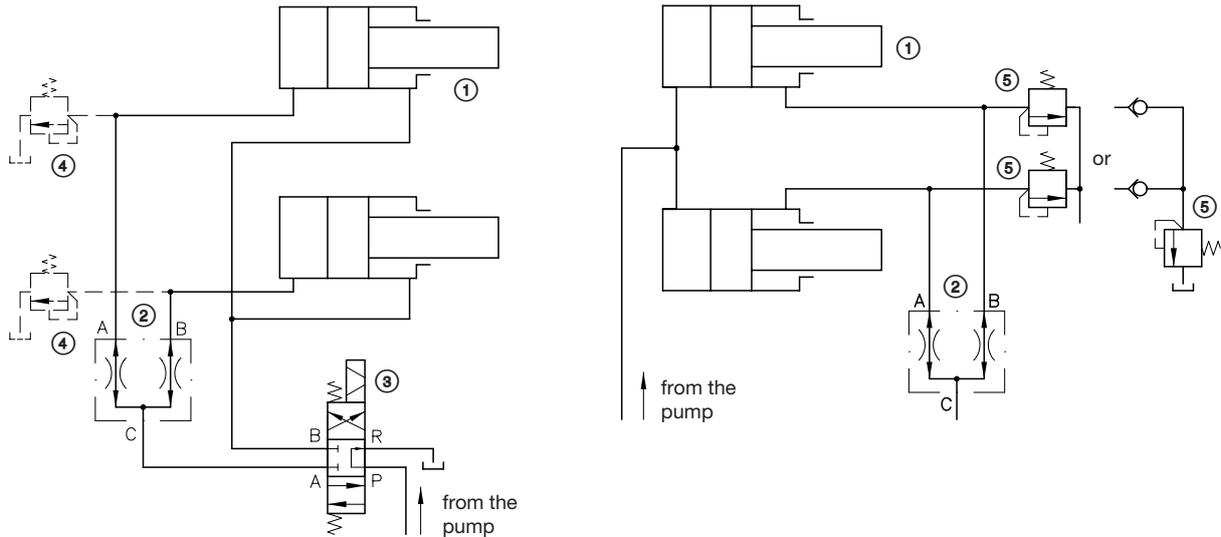
Type	H	B	L	a	b	c	d	d ₁	l
TQ 3P-A	30	50	60	17.5	48	40	8	10.5	9.5
TQ 4P-A	40	60	80	26	64	47	13	16	15
TQ 5P-A	50	80	104	31	80	63	15	20	15

Type	g	O-ring
TQ 3P-A	M6, 10 deep	12.42x1.78
TQ 4P-A	M8, 10 deep	18.72x2.62
TQ 5P-A	M10, 10 deep	31.42x2.62

All dimensions are in mm, subject to change without notice !

5. Typical circuit diagrams

5.1 Double-acting consumers



① Double-acting hydraulic cylinder, e.g. acc. to D 2055

② Flow divider type TQ... acc. to sect. 3.1

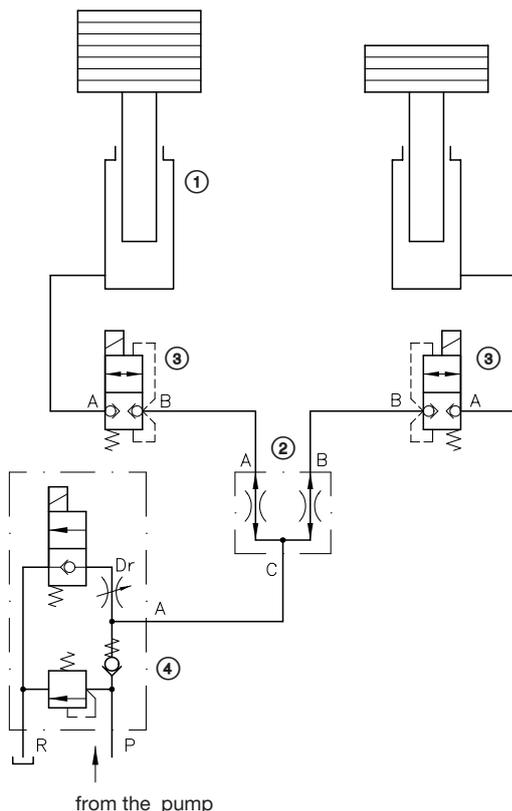
③ Directional spool valve

In the arrangement shown in the figure on the left, when the cylinder travels out (dividing motion), a flow resistance occurs at the flow divider for $Q_A = Q_B = 0.5 Q_C (= 0.5 Q_{pump})$, according to the $\Delta p-Q$ characteristic (sect. 3). When the cylinder travels in (joining the flows), the part flows Q_A and Q_B are larger due to the area ratios of the cylinder, and the pertinent flow resistance for the pump is likewise greater in the surface ratio. Particularly in borderline cases with Q_{pump} in the range Q_{Cmax} , it follows that connecting the flow divider to the piston side of the cylinder can be more satisfactory; take note of ⑤.

④ Pressure limiting valves (setting value as for pump safety valve) are then to be arranged if it is intended for the final position balance of the returning cylinder to take place without any speed limitation (see ③) in sect. 2.1). The pressure limiting valve which then responds, belonging to the first to reach the final stop, simulates a continued demand for pressure fluid for the flow divider, despite the piston being at a standstill.

⑤ Pressure limiting valves in an arrangement with the pressure divider on the piston side are always advisable, in order to avoid pressure transfers at final position compensation resulting from the cylinder surface differential. Pressure setting as for pump safety valve.

5.2 Single-action, weight-loaded consumer element (stroke devices)



Caution:

When loads are being lowered (part flows being joined), only a small backflow resistance prevails at connection C due to the directional valve being opened to the tank. The control diaphragm on the higher-loaded consumer side (at A in the diagram) does indeed balance the pressure differential with the lower-loaded consumer, but the part flows $Q_A = Q_B$ would be set which, according to the $\Delta p-Q$ characteristic in section 3, would be derived for $\Delta p =$ load pressure of the lower-loaded cylinder. In order to avoid excessively high lowering speeds, the return counterflow must be limited by an appropriate flow valve to values equal to or less than $\leq Q_{CN}$. In the example shown, this is achieved by the throttle provided in the stroke lowering valve, or by a drop-rate braking valve pamphlet D 6920, or by another device of equal value.

① Single-acting hyd. cylinder, weight-loaded

② Flow divider TQ see sect. 2.1

③ Leak-free seated valves, e.g. acc. to D 7765 or D 7300 designs of equal value, for blocking the cylinder lines at „Stop“ in any desired raised intermediate position. These prevent any uncontrolled volume exchange via ② from the higher to the lower loaded cylinder, and thus also prevents one cylinder moving in and the other moving out. If travel is always against the final stop without an interim stop, then the valves ③ are not required.

④ Lift/lower valve type HSV 21 acc. to D 7032.

The lowering speed can be adjusted by means of the throttle „Dr“.