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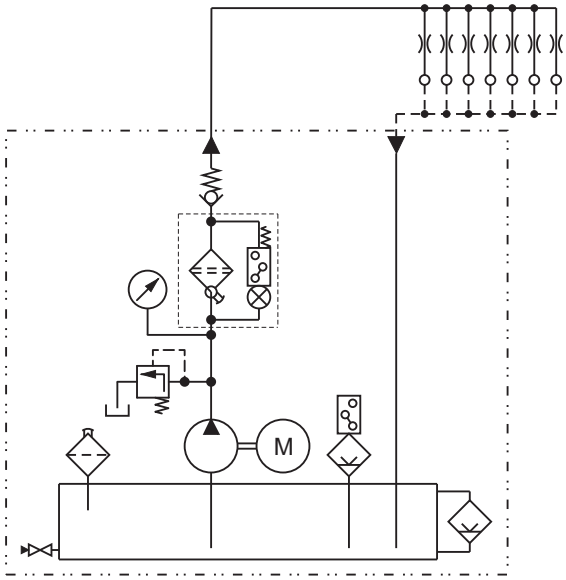
BEKA Nederland B.V. Wagenmakerij 11 4762 AV Zevenbergen tel. +31 168 371 538 fax. +31 168 338 329 info@beka.nl www.beka.nl

Oil circulating - central lubrication systems are used in all industry sectors e.g. glide- and roller bearing, sliding way and gear lubrication.

Operation

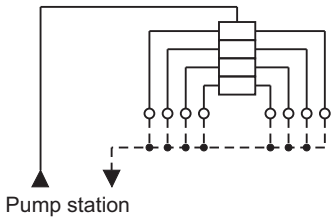
The volume flow, delivered by a pump unit, can be distributed to the lubrication points in different ways.

Throttle system



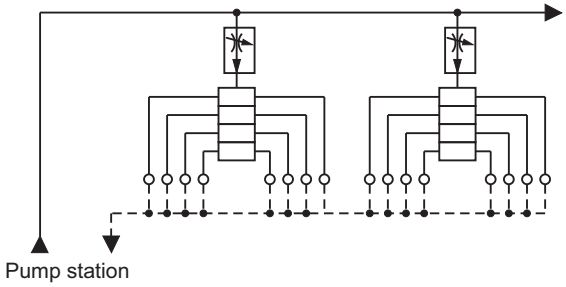
A common distribution of lubricant onto the lubrication points at large volume flows, is the one via fix adjusted throttles. The distribution is also possible directly via branched pipe lines, whereas you have to observe, to match the pipe cross-sections and pipe lengths if the parts are not equal. However, please also pay attention to the fact that this way of distribution requires a monitoring of the lubrication volume , which is only possible with a high expense. At smaller volume flows, the use of such a distributor system makes no sense as the throttle cross-sections and thus the volume flows at pollution are changing.

Progressive system



The volume flow, delivered by the pump station, is distributed to the lubrication points via progressive distributors. The distribution can be done directly by a progressive distributor at a little number of lubrication points. Large numbers of lubrication points requires the distribution via a main distributor with downstreamed secondary distributors.

Progressive system with flow control valve



In many cases, the progressive distributors of the main pressure line are supplied with lubricant via fixed or adjustable flow control valves, which are connected parellel. This is done as the possibility of lubricant distribution via one main progressive distributor is only limited due to a large volume flow of the pump, number of lubrication points or its distances.

When installing the system please observe, that the delivery pump - gear pumps are mainly used - always has to return the surplus lubricant back to the reservoir via a pressure limiting valve.

The individual distributor groups can be monitored for function and min. volume flow exactly and in an economic way, when installing e.g. a limit stop switch at the progressive distributors.

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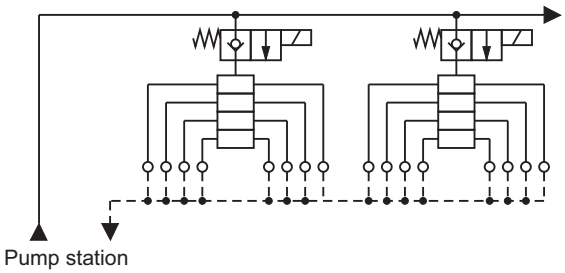
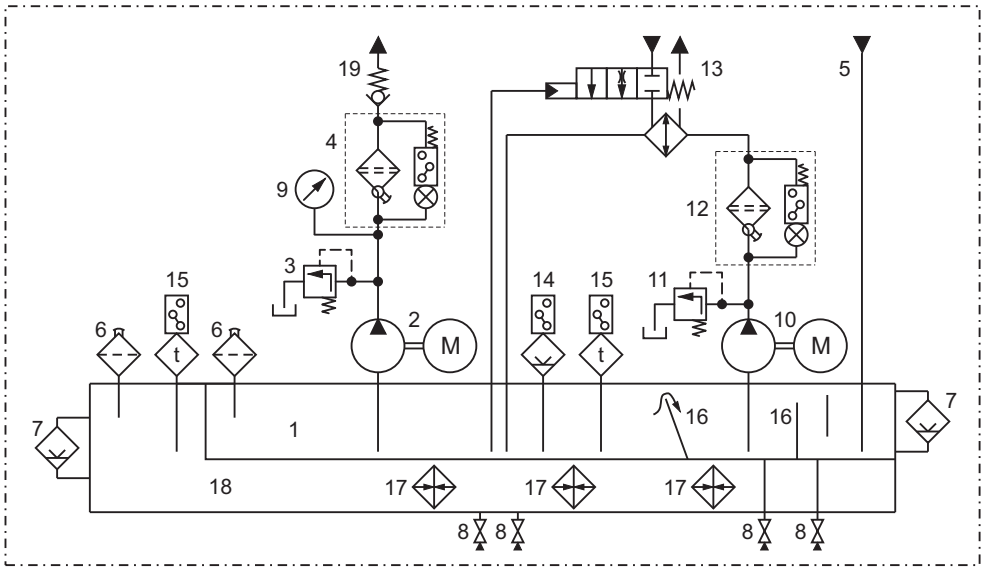
Description oil circulation - central lubrication systems

Sectional system



At the sectional system, progressive distributors, and main progressive distributors with downstreamed secondary distributors are determined, parallel to the main pressure line via solenoid valves or via the number of distributor circulations with following break time in which the solenoid valves are closed. This systems are also used as consumption lubrication systems.

Pump station



The installation of the pump station is done according to the type and the use of the system.

Apart from the min. installation consisting of:

1. Reservoir
2. Pump unit
3. Pressure limiting valve
4. Filter
5. Oil return line connection
6. Oil filling- and ventilation cover
7. Oil level indicator

the following devices can be installed in addition:

8. Oil drain cock
9. Pressure gauge
10. Pump unit for partial flow filter and -cooling with
11. Pressure limiting valve
12. Partial flow filter
13. Oil/water or oil/air cooling with control unit
14. Level switch for oil level monitoring
15. Temperature sensor or controller
16. Oil smoothing and overflow walls in the reservoir.
17. Heating in order to warm the oil to the necessary operating temperature
18. Thermo oil tank for the heating up and the temperature conservation of the cirulating oil.
19. Pressure connection (plug valve)

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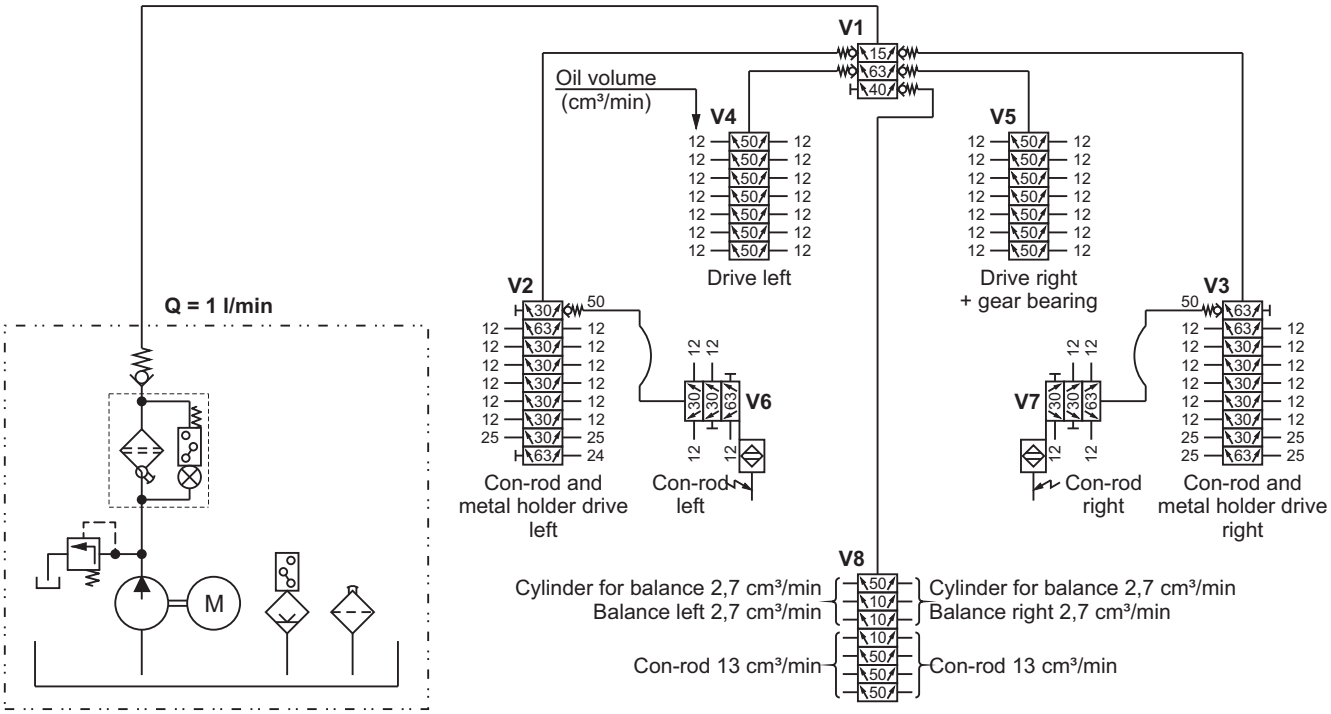
Installation and calculation of an oil circulation - central lubrication system

Create a scheme according to number and order of lubrication points. The following scheme shows an example of the BEKA progressive distributor type SX-4.



The volume flow which is delivered by the pump, is distributed by the main progressive distributor to the secondary distributors, respectively by the secondary distributors to the lubrication points in relation to the distributor code numbers. In order to monitor the function of the oil circulating system and the hose lines for rupture simultaneously, the distributor cycles of the secondary distributors V6 and V7 are electronically evaluated by means of an installed proximity switch. Due to the fact that the monitored progressive distributors are in third generation, the number of distributor strokes can be reduced by 50 % of the theoretical stroke number because of the counterpressure at the lubrication points. This has to be considered when adjusting the monitoring precision.

In this example, the pump of the pump station has a volume flow of 1 l/min. The volume flows to the individual lubrication points have to be calculated. Please also observe that the output of lubricant at progressive distributors types SX-4 is carried out at the outlet in front of the metering element (see arrows).

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Calculation of lubricant volumes at the outlets 1...X of V1

Formula $$qi\ V1\ (1...X)\ [cm^3/min] = \frac{Q\ [cm^3/min] \times ki}{\Sigma\ ki}$$

Calculation at the outlets to the progressive distributors V2 ... V5 + V8:

$$qi\ to\ V2 + V3\ [cm^3/min] = \frac{1000\ [cm^3/min] \times 63}{(\Sigma\ ki = 15 + 15 + 63 + 63 + 40 + 40) = 236} = 267\ cm^3/min$$

$$qi\ to\ V4 + V5\ [cm^3/min] = \frac{1000\ [cm^3/min] \times 40}{(\Sigma\ ki = 15 + 15 + 63 + 63 + 40 + 40) = 236} = 170\ cm^3/min$$

$$qi\ to\ V8\ [cm^3/min] = \frac{1000\ [cm^3/min] \times 2 \times 15}{(\Sigma\ ki = 15 + 15 + 63 + 63 + 40 + 40) = 236} = 127\ cm^3/min$$

Calculation at the outlets of the progressive distributor V3:

$$qi\ to\ V6\ [cm^3/min] = \frac{267\ [cm^3/min] \times 2 \times 63}{(\Sigma\ ki = 4 \times 63 + 14 \times 30) = 672} = 50\ cm^3/min$$

$$qi\ \ outlet\ ki\ 30\ [cm^3/min] = \frac{267\ [cm^3/min] \times 30}{(\Sigma\ ki = 4 \times 63 + 14 \times 30) = 672} = 12\ cm^3/min$$

$$qi\ \ outlet\ ki\ 2 \times 30\ [cm^3/min] = \frac{267\ [cm^3/min] \times 2 \times 30}{(\Sigma\ ki = 4 \times 63 + 14 \times 30) = 672} = 24\ cm^3/min$$

$$qi\ \ outlet\ ki\ 63\ [cm^3/min] = \frac{267\ [cm^3/min] \times 63}{(\Sigma\ ki = 4 \times 63 + 14 \times 30) = 672} = 25\ cm^3/min$$

The calculation for further progressive distributors is done in the same way.

Calculation of the theoretical stroke number of the progressive distributor

Formula $$hi\ V6 + V7\ [min^{-1}] = \frac{Q\ V6\ [cm^3/min]}{\Sigma\ qi\ [cm^3]}$$

$$hi\ V6 + V7\ [min^{-1}] = \frac{50\ [cm^3/min]}{(\Sigma\ qi = 4 \times 0{,}3 + 2 \times 0{,}63) = 2{,}46\ [cm^3]} = 20\ strokes/min$$

ki = *Metering code at outlet "i"*
vi = *Metering volume at outlet "i" (cm³)*
qi = *ejected lubricant volume at outlet "i" (cm³/min)*
Q = *supplied lubricant volume to the progressive distributor (cm³/min)*
hi = *number of distributor strokes (min^{-1})*
V1...X = *Progressive distributor no. 1 ... X*

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Pump station

The dimensioning of reservoir and version of the pump station has to be brought into line with the existing conditions and operating requests.
In general you can, regarding the reservoir volume, start from the assumption, that the oil is circulated 3x per hour and that there is enough reserve to collect the oil which is in the machine, and will flow back after the machine's standstill.
Define the pump's capacity so, that the loss of pressure resulting from pipe lines, distributor systems and counterpressure, overcomes at the lubrication points.
Provide a sufficient volume flow reserve at oil circulating systems with throttle distributors and flow control valves.
In order to ensure a safe operation of oil circulation systems with lubricant supply via throttle- or flow control valves, a part of the delivered volume flow has to be returned to the reservoir via a pressure limiting valve. That is done to maintain a constant pressure in the main line.
The volume flow reserve should be at approx.
10 - 20 % at max. operating temperature. In order to avoid cavitation, observe the min. permissible pressure at the pump's suction connection. In general the min. permissible pressure is at 0,7 bar absolute. Furthermore, the flow speed of 1,5 m/sec in the suction line must not be exceed.

Approximation formula for the pressure calculation at the suction connection under consideration of suction height and oil viscosity (without loss of throttle by quarter bend).

$$d\,[mm] = 2{,}87 \times \sqrt[4]{\frac{\nu\,[mm^2/s] \times l\,[m] \times Q\,[l/min] \times \rho\,[kg/m^3]}{(p\,[m\,Ws] - h\,[m] \times 10^3}}$$

Pipe lines

Apart from the pressure drop by the distributor system (flow control valves, progressive distributors etc.) also the one of the pipe lines has to be observed.

Formula for calculating the pipe cross-section:

$$d\,[mm] = \sqrt[4]{\frac{6{,}79 \times \nu\,[mm^2/s] \times l\,[m] \times Q\,[l/min] \times \rho\,[kg/m^3]}{p\,[bar] \times 10^3}}$$

Supplementary to this, the following flow speeds must not be exceed:

Operating pressure	to	25 bar = 3 m/s
	to	50 bar = 4 m/s
	to	100 bar = 5 m/s
	>	100 bar = 7 m/s

Layout sufficiently dimensioned pipe lines with the necessary gradient for the oil return into the reservoir, in order to prevent a back draft and overflow of bearings and chambers in the machine.
Return lines, whose oil has to flow back by own gradient, must not be filled completely.
The oil flows on the surface, with the highest speed. The flow speed reduces at the tube wall. Ensure a sufficient air supply.

We recommend the following forumla for the return line calculation:

$$G\,[\sin\alpha] = \frac{188 \times \nu\,[mm^2/s] \times Q\,[l/min] \times \rho\,[kg/m^3]}{d^4\,[mm] \times 1000}$$

$$G\,[\%] = \frac{188 \times \nu\,[mm^2/s] \times Q\,[l/min] \times \rho\,[kg/m^3]}{d^4\,[mm] \times 10}$$

d	= *pipe nominal width (mm)*
ν	= *kinematic viscosity (mm²/s)*
l	= *pipe length (m)*
Q	= *volume flow of pump (l/min)*
p	= *pressure at pump's suction side (m Ws)*
h	= *suction height (m)*
ρ	= *density of pressure liquid (kg/m³)*
G	= *pipe gradient*

Viscosity at operating temperature

Technical data sheets for oils include, as a rule, details about the kinematic viscosity at 40 and 100 °C. When calculating the pipe lines but also when determining pressure drop in the distributor system (progressive distributors etc.), the kinematic viscosity which occurs at operating temperature has to be used. The following viscosity temperature sheet is for determining the viscosity for every oil at all operating temperatures, if the line for an oil with 2 known viscosity details is extended over both directions.

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Subject to alterations!

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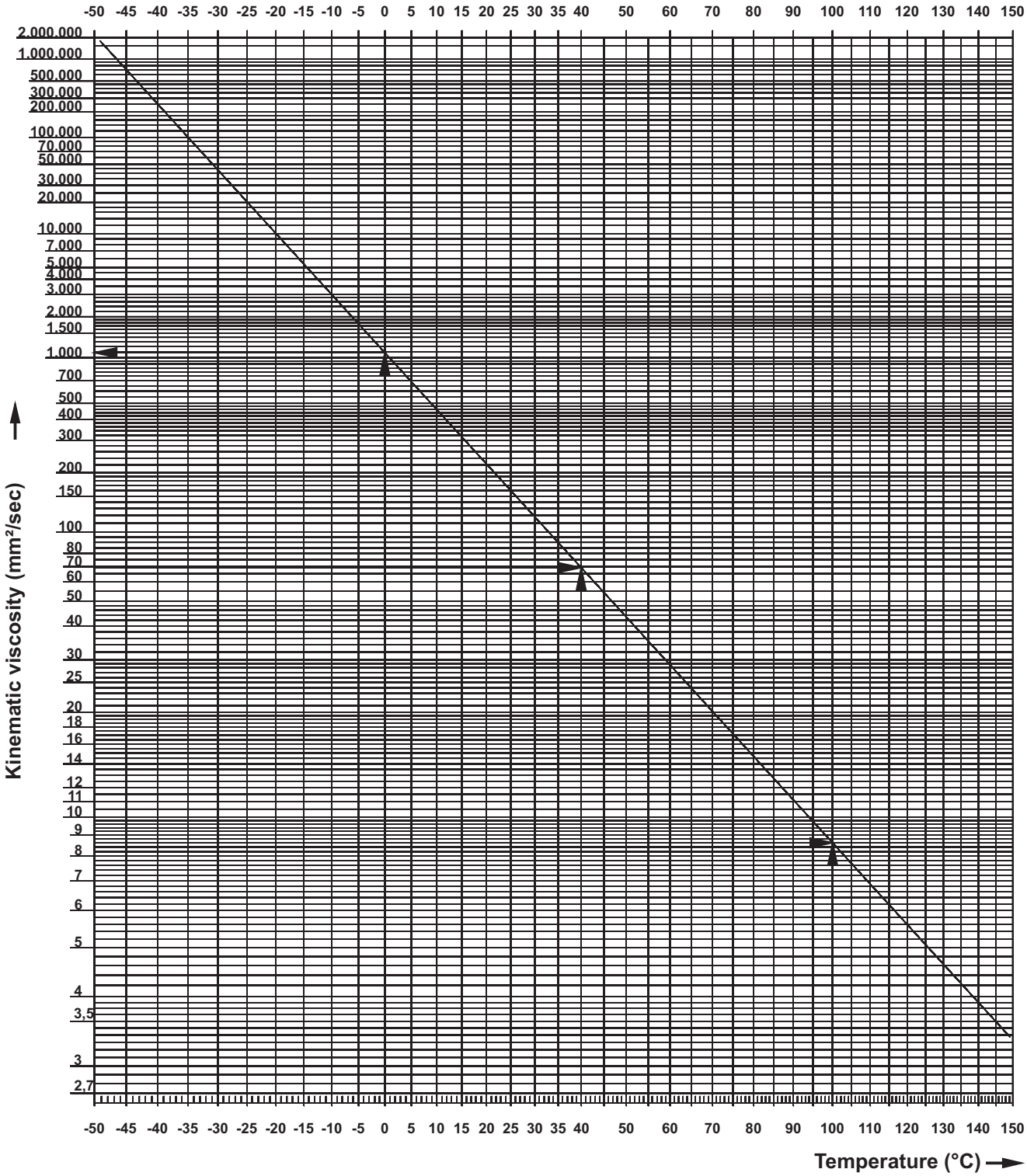
Description oil circulation - central lubrication systems

Viscosity - Temperature - Sheet



Example: Oil ISO VG 68

Specification: viscosity at 40 °C according to technical data sheet: 68 mm²/s

Specification: viscosity at 100 °C according to technical data sheet: 8,6 mm²/s

Result: viscosity at 0 °C according to diagram: 1.080 mm²/s

Annotation: beside the details fo the kinematic viscosity in mm²/s also the description centistokes (cSt) is common.

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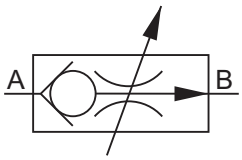
Use

The flow control valve supplies e.g. cylinders in hydraulic systems and friction points in central lubrication systems with an adjustable oil volume flow, which is not depending on pressure fluctuations and is mostly viscosity independent.

The volume flow can be adjusted at a knurled thumbscrew with fine regulation. Please observe the diagrams on the next page. The adjustment screw is secured against unauthorized adjustment by a protection cap, which can be provided with a lead seal.

A new regulation system makes self-cleaning of the throttle system also for smallest adjustable volume flows possible. The system of pressure regulators and comparator throttles even can purify itself when washed up particles are bigger than the cross section of the throttle.

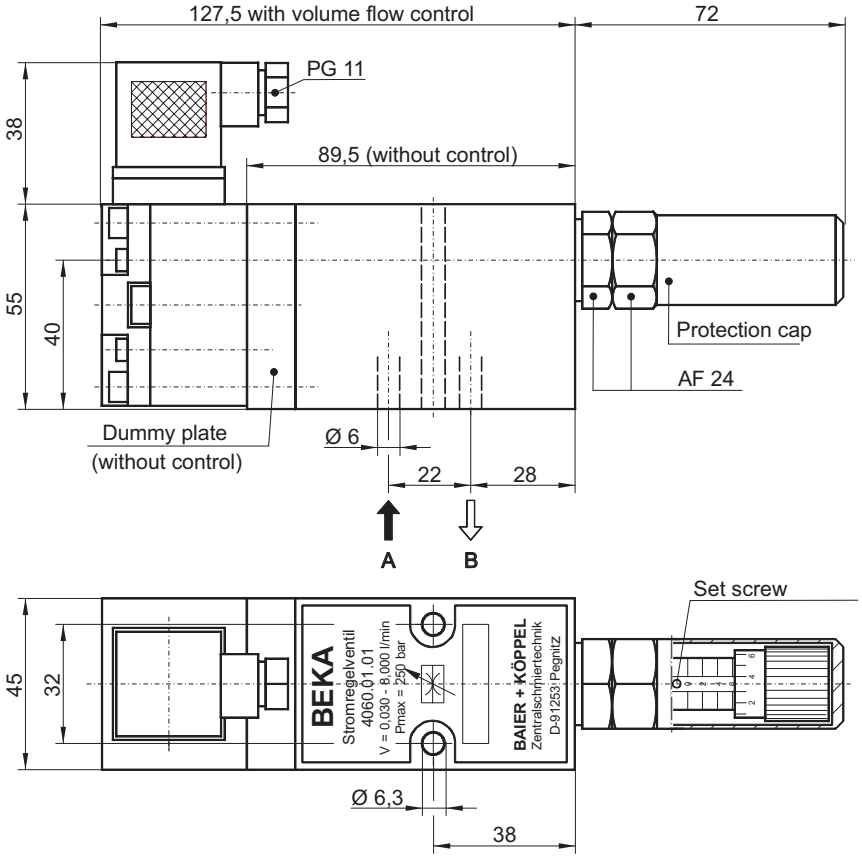
Symbol according to DIN ISO 1219



Technical data

Range of operating pressure:	10 to 250 bar
Pressure loss (Dp):	7 bar
Medium:	oil on synth. and mineral base
Viscosity range:	10 to 1000 mm²/s
Volume flow range:	0,1 to 8 l/min
Temperature range:	0 °C to 60 °C
Installation position:	optional
Material:	steel, barnished
Weight (without control):	1,650 kg
Scope of delivery:	with screws DIN 912 M6x65

Dimensional drawing



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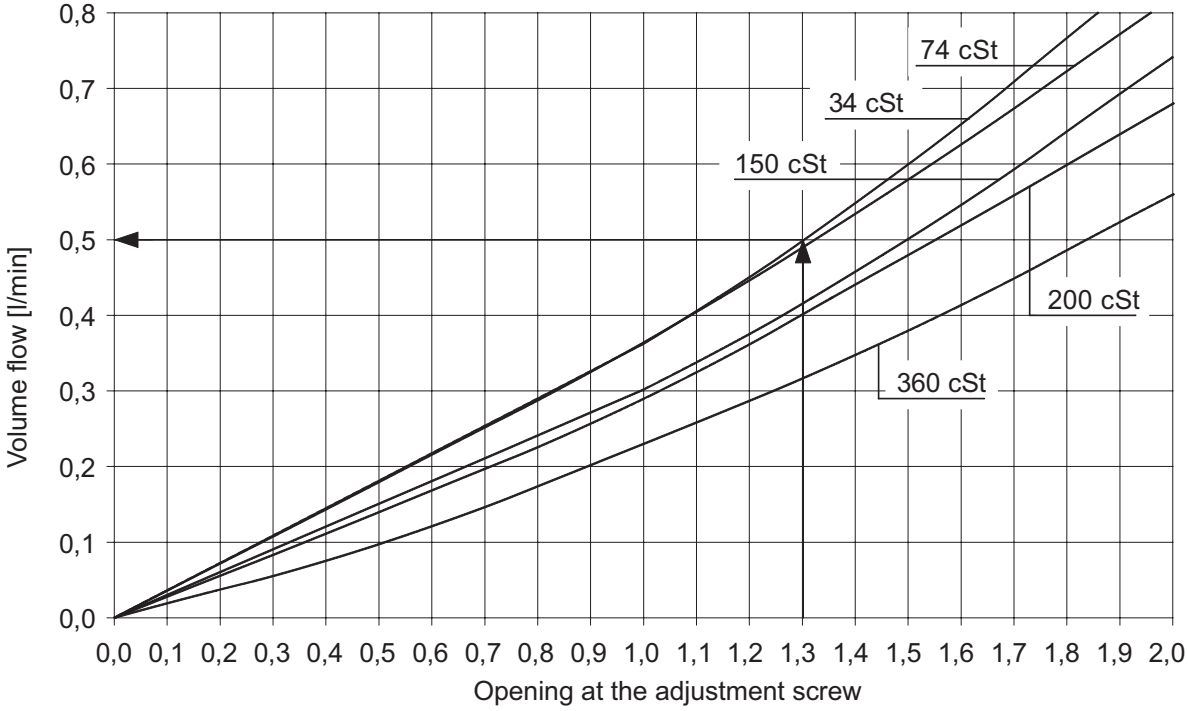
Order key for type 4060*

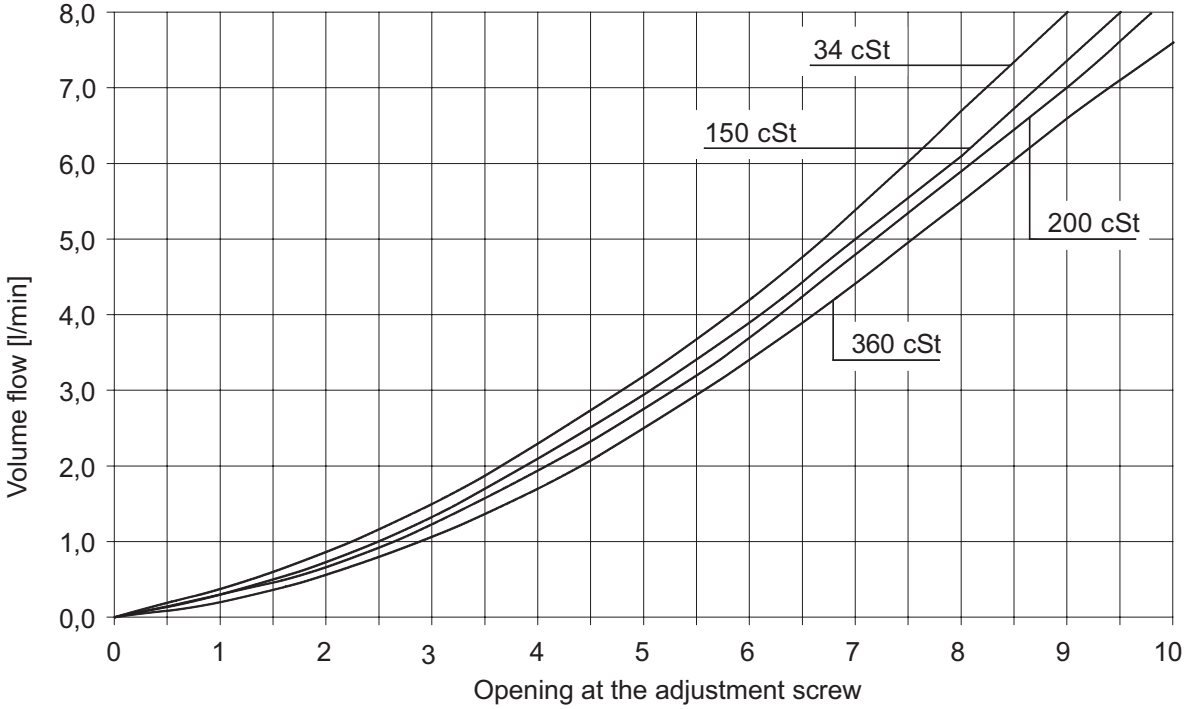
Type number	4060*		4060 11 01
Code	4060		
Volume flow control	without	with, measurement volume 1,2 cm³/r (standard)	
Code	01	11	
Design	01		
Code	01		

* See order information for connection plate with plug-in sieve at the respective progressive distributor (SXW-1 resp. SXW-2)

Volume flow diagram 1, lower adjustment range



Volume flow diagramm 2, total adjustment range



These curves show the measurement values of the viscosity in mm²/s (cSt) with mineral oils at test temperature.

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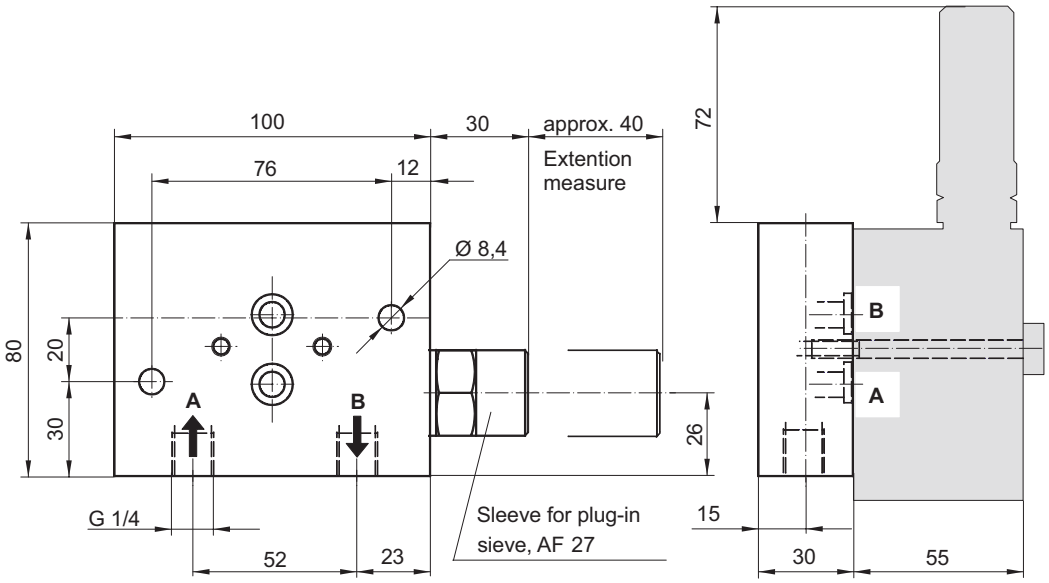
Valve plate (separate)

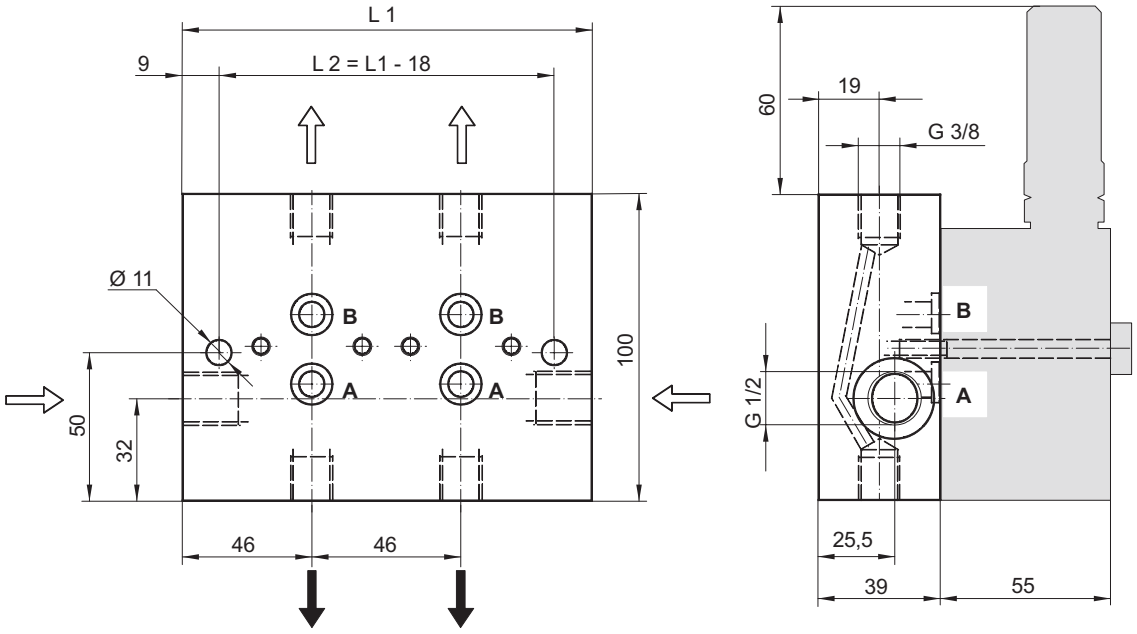
Use

For flanging flow control valves.

Dimensional drawing, one outlet, with plug-in sieve (Model 1)



Dimensional drawing, without plug-in sieve (model 2)



L 1 = 46 + 46 x number of outlets

Order-number valve plate

Mod.	Plug-in sieve (mm)	Code
1	MW* 0,1	01
1	MW* 0,3	03
2	without plug-in sieve	02
Mod	**No. of outlets**	**Code**
1	1	01
2	2 to 10	02 bis 10

4061 xx xx

* MW = Maschenweite - mesh size

Technical data

Material:	aluminium
Scope of delivery:	valve plate, sealing ring (NBR), plug-in sieve (only at model 1)
Weight (without control unit) model 1:	0,70 kg
Basic weight at model 2:	0,50 kg
Excess weight from 1. outlet, p. outlet:	0,25 kg

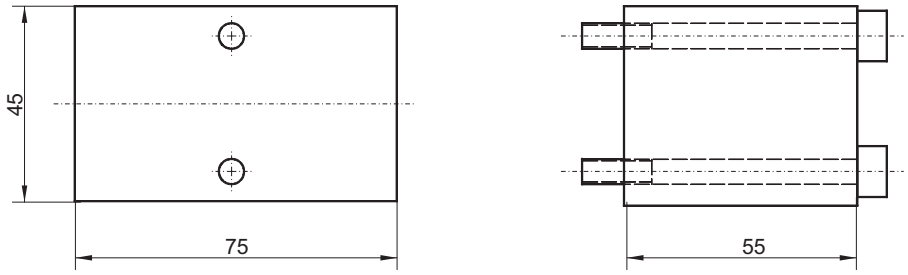
Subject to alterations!

Dummy element

Use

For assembly on the connecting plate instead of the flow control valve.

Dimensional drawing



Order-number

Dummy element:	40600000

Technical data

Material:	aluminium
Weight:	0,45 kg
Scope of delivery:	with screws DIN 912 - M6x65

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Use

Flow limiting devices are primarily used in oil circulating systems for the supply of friction points.

The volume flow rate can be adjusted stepwise by changing the various orifice disks at the range of 0,1 to 9,0 l/min.
The simple exchange of the orifice disks enable a subsequent change of the flow rate values, also at the machine. The special adjusting unit causes that the volume flow rate is constantly independent from pressure and viscosity.

BEKA flow limiting devices can directly be installed in front of progressive distributors of the types SXW-1 and SXW-2, by means of a connection plate with plug-in sieve. Different base plates for the installation of up to 6 flow limiting devices are listed in the accessories.

The electric monitoring of the volume flow rate at the flow limiting device is done via a proximity switch. If the volume flow rate falls below the value of approx. 70 %, a malfunction signal is send. The installation can be done subsequently.

Please take into account a reserve capacity of approx. 20 % above the theoretical flow rate values as well as a pressure differential in front and after the flow limiting device of approx. 5 bar.

Symbol according to DIN ISO 1219

Technical data

Operating pressure without add-ons:	5 to 200 bar
Operating pressure with signal transmitter:	5 bis 85 bar
Necessary differential pressure between inlet and outlet:	≥ 5 bar
Lubricant:	oils on synthetic and mineral base
Operating viscosity:	20 to 600 mm²/s
Ambient and lubricant temperature: (Pay attention to operating viscosity!)	
without add-on	0 to 100 °C
with signal transmitter	0 to 90 °C
Installation position:	optional
Housing material:	aluminium anodized
Protection class: with signal transmitter	IP 67
Weight (standard model):	386,4 g
Scope of delivery:	
with fastening screws DIN 912 - M6x45	

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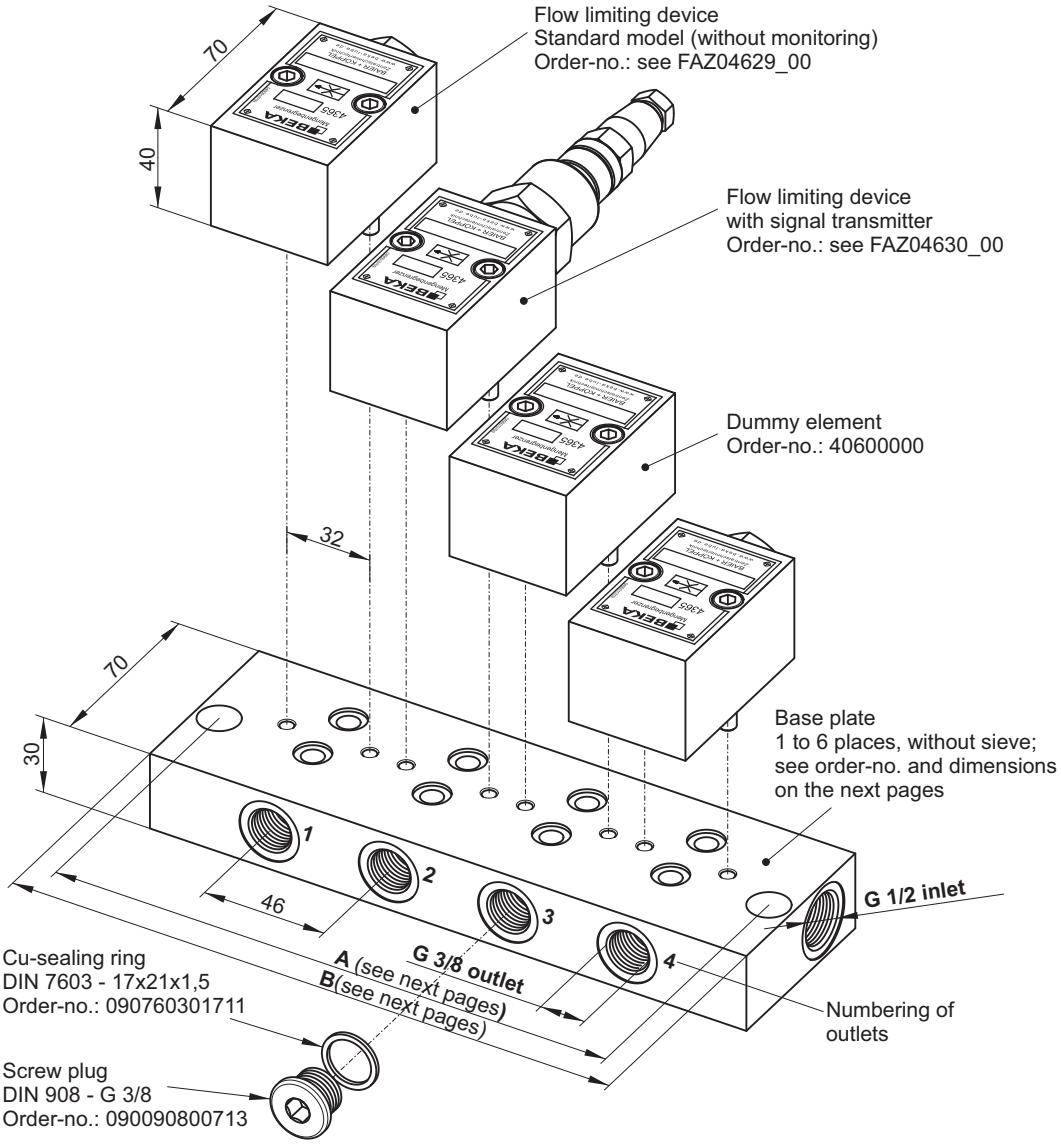

Order key for flow limiting device with base plate type-no. 4367

e.g.: **4367**	**GE12L**	**GE08L**	**110SG**	**120K**	**000**	**180K**	**200K**	**000**
Type-.no.			*Outlet 1**	*Outlet 2**	*Outlet 3**	*Outlet 4**	*Outlet 5**	*Outlet 6**

Inlet-fitting	Outlet-fitting
G1/2 (w/o)	G3/8 (w/o)
GE06L	
GE08L	
GE10L	
GE12L	
GE15L	
GE18L	
GE22L	-

Volume flow (l/min)***	Orifice disk-Ø (mm)	Code	Moni-toring
-	Dummy element** 40600000	000	-
Codes see table Orifice disk Ø and flow rate values			K = no SG = signal trans.

* Numbering of outlets see drawing of base plate
** Outlets at dummy elements are equipped with screw plugs
*** further orifice disks-Ø on demand

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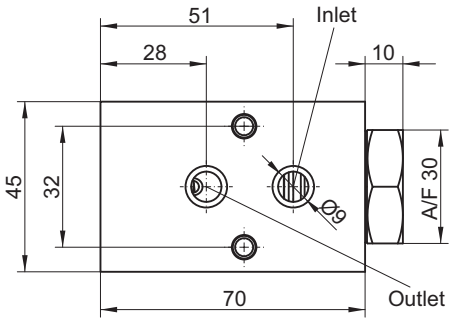
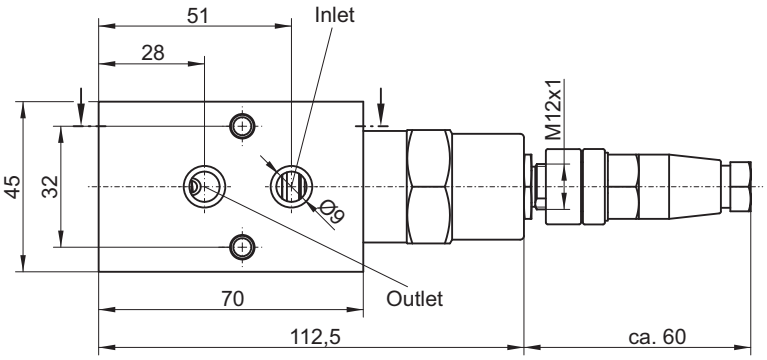
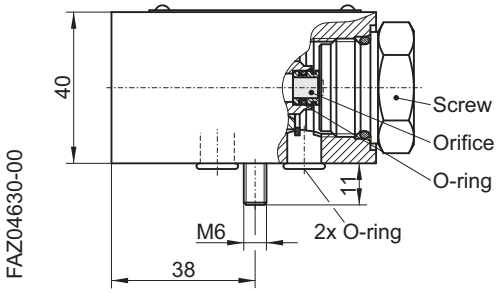
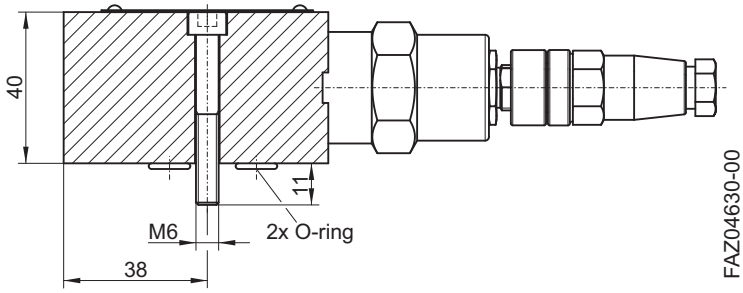
Standard model
(without monitoring)

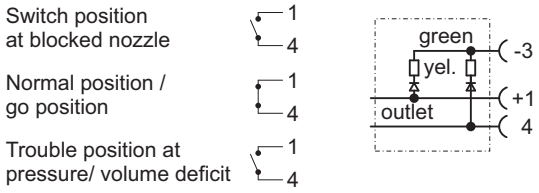


with signal transmitter









Order key for flow limiting device without base plate type-no. 4365

4365 01 110 000

Type number	4365	
Code	4365	
Monitoring	without	with signal transm. 24 V
Code	01	02
Orifice disk Ø (mm)	see table orifice disk-Ø (next page)	
Code	see table orifice disk-Ø (next page)	
Special models		

Order key for spare part orifice disk* acc. to F4365/05-00

F4365/05-00 110

Article number*	F4365/05-00
Code	F4365/05-00
Orifice disk Ø (mm)	see table orifice disk-Ø (next page)
Code	see table orifice disk-Ø (next page)

***For a replacement orifice disk, please order also an o-ring, order no. 09037710031641**

Subject to alterations!

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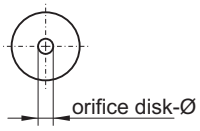
Flow limiting device

Table volume flow and orifice disks-Ø

for order key series-no. 4367, 4365 or article-no. F4365/05-00

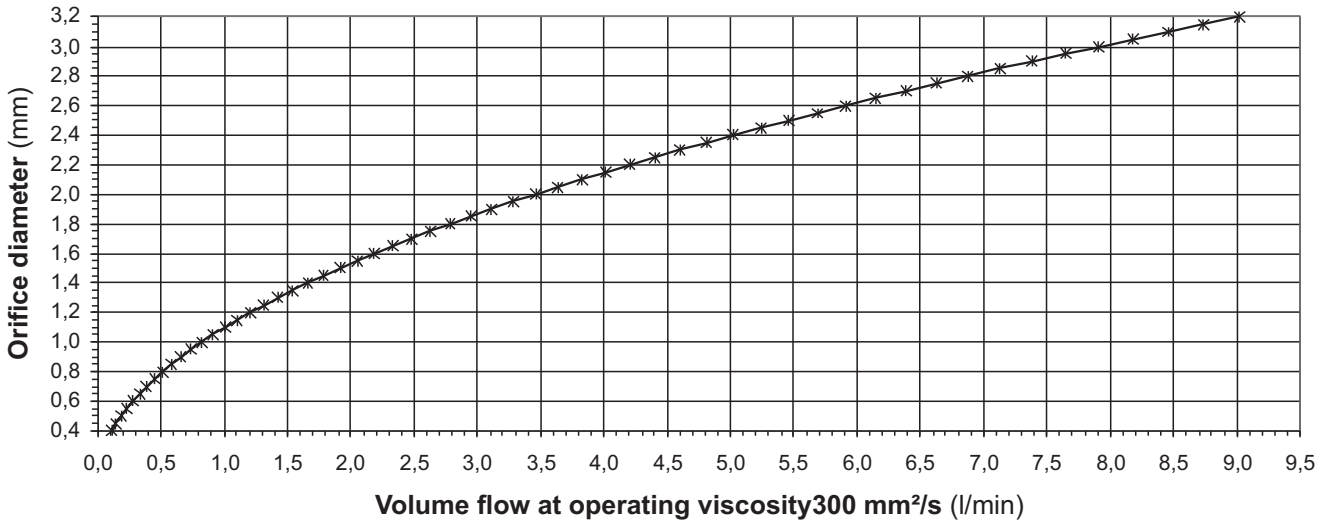


Flow (l/min)**	Orifice-Ø * (mm)	Code
0,11	0,40	040
0,15	0,45	045
0,19	0,50	050
0,23	0,55	055
0,28	0,60	060
0,33	0,65	065
0,39	0,70	070
0,45	0,75	075
0,51	0,80	080
0,59	0,85	085
0,66	0,90	090
0,74	0,95	095
0,82	1,00	100
0,91	1,05	105
1,01	1,10	110
1,10	1,15	115
1,21	1,20	120
1,31	1,25	125
1,42	1,30	130
1,54	1,35	135
1,66	1,40	140
1,79	1,45	145
1,92	1,50	150
2,05	1,55	155
2,19	1,60	160
2,33	1,65	165
2,48	1,70	170
2,63	1,75	175
2,79	1,80	180

Flow (l/min)**	Orifice-Ø * (mm)	Code
2,95	1,85	185
3,12	1,90	190
3,29	1,95	195
3,46	2,00	200
3,64	2,05	205
3,82	2,10	210
4,01	2,15	215
4,21	2,20	220
4,40	2,25	225
4,61	2,30	230
4,81	2,35	235
5,02	2,40	240
5,24	2,45	245
5,46	2,50	250
5,68	2,55	255
5,91	2,60	260
6,15	2,65	265
6,38	2,70	270
6,63	2,75	275
6,88	2,80	280
7,13	2,85	285
7,38	2,90	290
7,64	2,95	295
7,91	3,00	300
8,18	3,05	305
8,45	3,10	310
8,73	3,15	315
9,02	3,20	320

* other orifice-Ø on demand
** values are valid at an operating viscosity of 300 mm²/s

Diagram



Subject to alterations!

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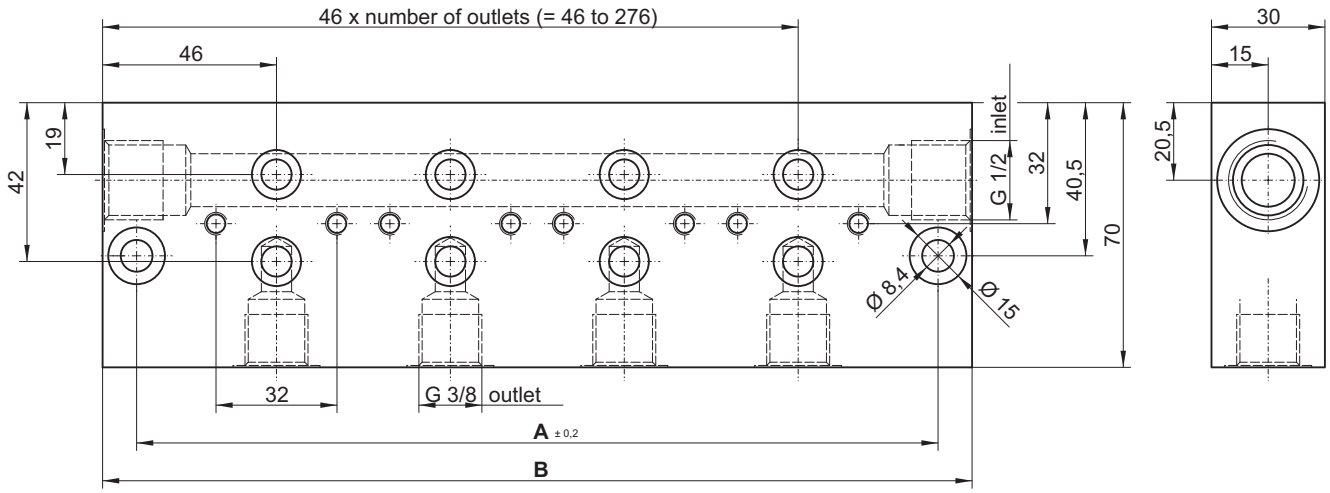
Base plate 1 to 6-outlets without plug-in sieve



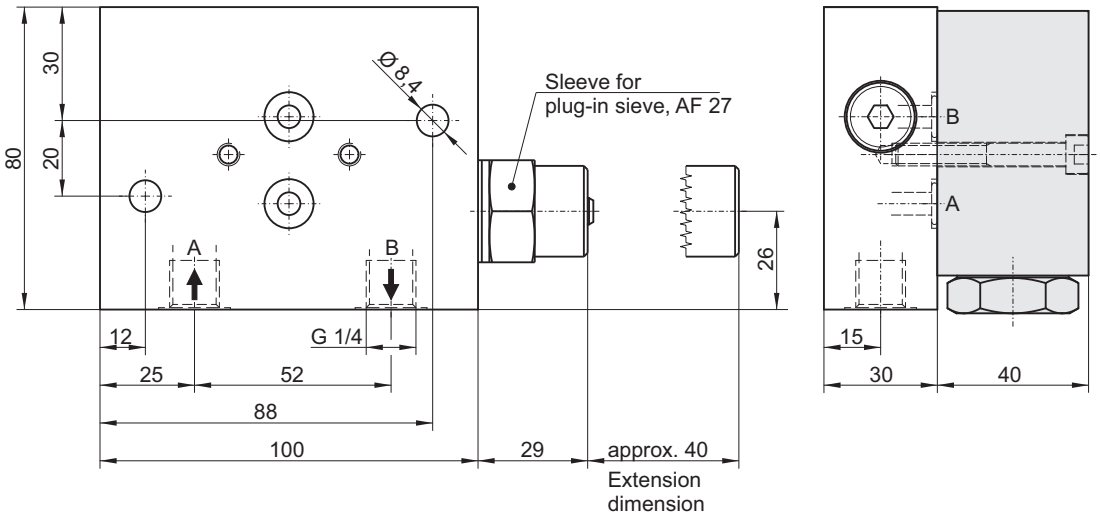
Dimensions table and oder-no.
Base plate 1 to 6 outlets without plug-in sieve

No. of outlets / flow limiting device	1	2	3	4	5	6
Dim. A ± 0,2 (mm)	74	120	166	212	258	304
Dim. B (mm)	92	138	184	230	276	322
Order-no.: F4365/12-00...*	001	002	003	004	005	006

* Order example: F4365/12-00 004 (= basic plate 4-outlets)

Valve plate, one outlet with plug-in sieve

Order-no.: 40610101



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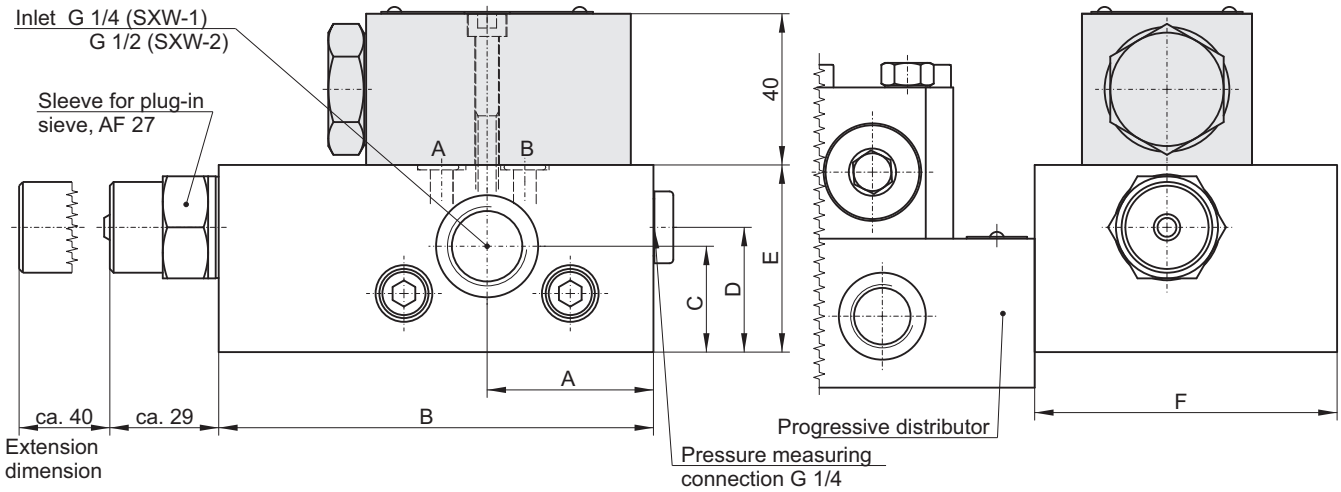
Connection plate for progressive distributor SXW-1 or SXW-2



Dim. (mm) SXW-1: A = 35,5; B = 105; C = 27; D = 30; E = 55; F = 60
SXW-2: A = 44; B = 115; C = 28; D = 33; E = 49,5; F = 80

Conn. plate for distributor	w. plug-in sieve (mm)	Order-no.
SXW-1	MW* 0,1	40620303
SXW-1	MW* 0,3	40620304
SXW-2	MW* 0,1	40620403
SXW-2	MW* 0,3	40620404

* MW = mesh size

Spare parts plug-in sieve (mm)	Order-no.
MW* 0,1	04410057
MW* 0,3	04410064

* MW = Maschenweite - mesh size

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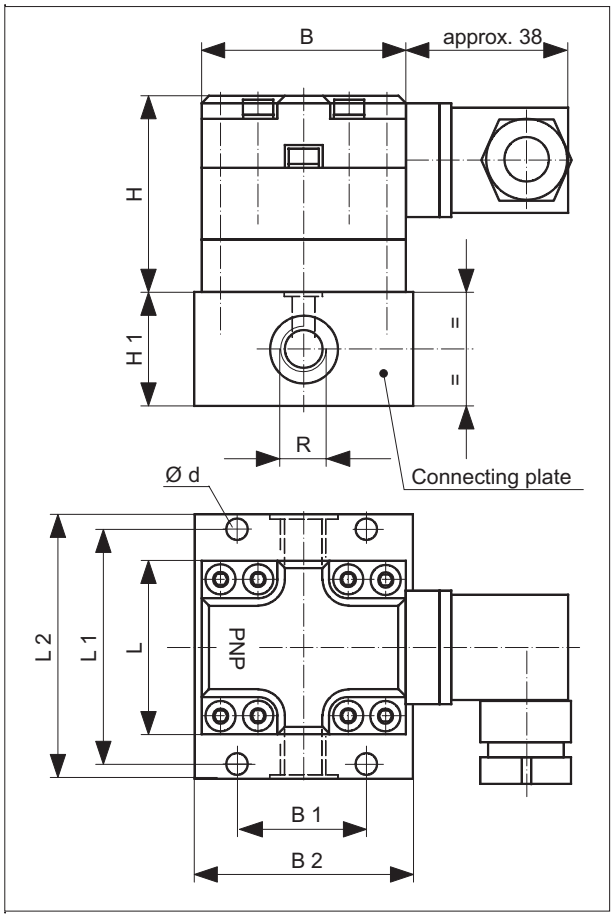
Use

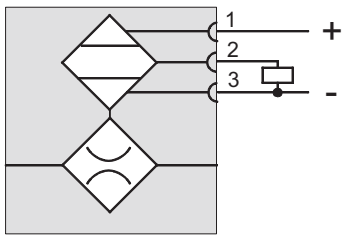
The control serves for the electronic monitoring of volume flows in central lubrication systems.
Two meshing gear wheels are rotated by the passing through medium. An electric signal is given with each revolution of the gear wheels. The signal transmitter operates semiconductor-controlled, touch- and contact free. The pulses are in a pulse duty ratio of 1:1 per gear wheel revolution.

Dimensional drawing



See the next pages for order data

Symbol and connection



Technical data

Operating pressure max.:	250 bar
Medium:	mineral oil
Viscosity range:	20 to 1000 mm²/s
Volume flow range:	0,05 to 12 (8) l/min
Chamber volume:	1,2 cm³/ revolution
Measurement volume:	1,2 cm³
Flow direction:	optional
Installation position:	optional
Voltage:	24 (16...30) V DC
Operating current damped:	30 mA
Operating current undamped:	2,9 mA
Switching current max.:	80 mA
Frequency max.:	100 Hz
Temperature range:	-10 to 60 °C
Weight:	see table
Material:	see table

Table sizes, weights and material

Dimensions (mm)	**FXE 250**
B	54
B 1	45
B 2	60
L	45
L 1	58
L 2	70
H	52
H 1	30
R	G 1/4
Ø d	6,3

Weight (kg)	
Control	0,70
Connecting plate	0,85

Material	
Control housing	St
Cover	Al
Connecting plate	St

State: 09.14EN
07-2-30-01

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Note

The volume flow control FXE 250 can also be attached directly to the flow control valves, see order-no. of flow control valve (4060...).

Identification

Measurement volume 1,2 cm³,
Transducer sensor: PNP 2
The controls' sensors are sustained short-circuit proof, reverse connect protected and overload proof.

Order-key for type number 4063, 4064

4063 12 1 0 2

Type number	4063 = volume flow control	4064 = only connecting plate
Code	4063	4064
Measur. volume (cm³/r)	1,2 (type 4063)	type 4064
Code	12	00
Operating pressure (bar)	250	630
Code	1	2
Material	standard (see description)	
Code	0	
Connecting plate	without	with, connection G 1/4 (FXE 250) with, connection G 1/2 (FXE 630)
Code	0	2 4

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