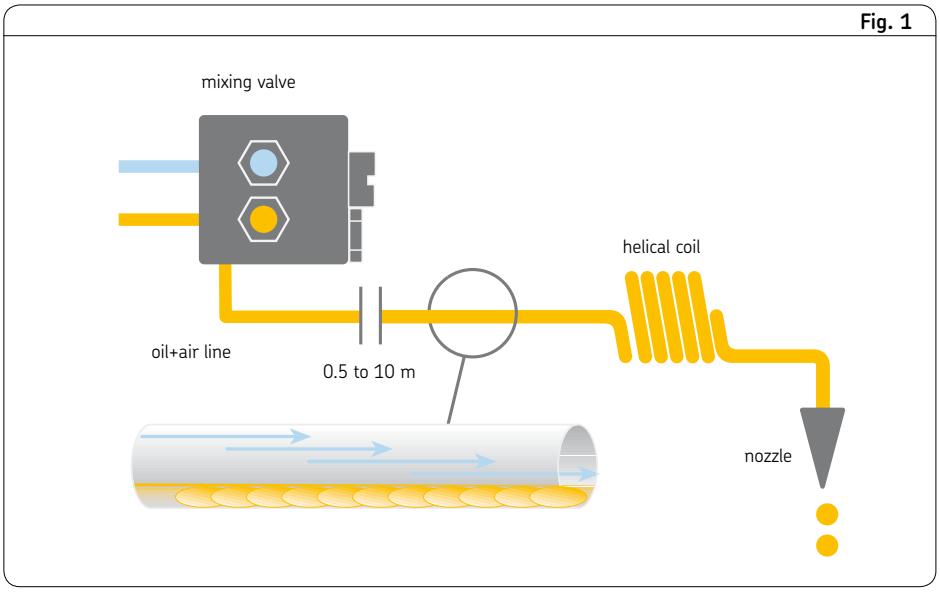
Oil+Air Systems

for the lubrication of spindles, linear guides, rack pinions, chains, assembly processes

Fig. 1



Better machining
performance due to better speed characteristics (up to some 2 200 000 mm × rpm in the case of rolling bearings).

Higher reliability due to clean bearings:
continuous supply of fresh lubricant in the right amounts; system-related sealing air protects bearings from outside contamination.

Less lubricant
As much as necessary, as little as possible – for more safety and environmental hygiene; metered quantities for each friction point to meet the precise need, but some 90% less consumption compared with oil-mist lubrication; no mist, clean air to breath; no repack period compared with grease lubrication.

Functional principle and application
Oil+air lubrication is minimal quantity metering. A drop of oil is pulled apart in streaks by a current of air in a narrow tube. It is then transported in the direction of the lube point (Fig. 1). The bearing is continuously supplied with fine droplets of oil from the outlet nozzle. The carrier air leaves the bearing nearly free of oil.

The main applications are found in the field of mechanical engineering, where high demands are made on defined lubrication: assurance of high efficiency with low wear and long service life, especially in the case of tool spindles.

Fundamentals of oil+air lubrication

Example: rolling bearings

Many engineering fields are calling for the speeds of spindles and shafts on rolling bearings to be raised beyond the values cited in rolling bearing catalogs, e.g. in the case of bearings for grinding and milling spindles in order to increase cutting speeds. To meet this demand, decisive importance is attached not only to the design of the bearing assemblies but also to the choice of an appropriate lubrication system.

Conventional lubrication systems (e.g. splash lubrication), for which the values in rolling bearing catalogs were also prepared, break down in such cases because friction-related losses, and thus the temperature, rise beyond permissible limits due to hydrodynamic losses in the lubricant itself.

In a circulating-oil lubrication system with simultaneous cooling, it may be possible to reduce the temperatures, but higher power losses and greater machine-/seal-related complexity would have to be endured.

The diagram (Fig. 2) shows that the best values in respect to friction-related losses and temperature are achieved with a minimal supply of oil.

Small quantities of lubricant can best be fed to bearings using the principle of oil+air lubrication, since lubricant quantities can be precisely metered out with this system. In the case of oil-mist lubrication, however, it is hardly possible to supply individual bearings on a reliable and constant basis with the small quanties required. Lifetime lubrication is very suitable and is often used.

But the limits on its use for grease lubrication are to be found at a speed characteristic of **n × dm from < 1 to 1.5 × 10^6 mm × rpm**.

Not only that, grease change intervals, in conjunction with the replacement of spindles, are greatly and disproportionately shortened within the speed range of n × dm from > 10^6 mm × rpm – even when special grease is used. For higher speed characteristics, oil+air lubrication is therefore an appropriate system that can, of course, also be used when low speed characteristics are involved.

Quantity of lubricant

The quantity of lubricant depends greatly on the type of bearing, number of rows, width, etc. It is therefore advisable to consult the bearing supplier in every case when specifying the amount of lubricant required. The literature contains the following formula to calculate approximate oil needs:

$$Q = w \times d \times B$$

in which

Q = quantity in mm^3/h
w = coefficient = 0.01 mm/h
d = internal bearing diameter in mm
B = bearing width in mm

In practice, however, the values obtained with this formula had to be increased 4- to 20-fold. That makes it quite clear that the actual amount of lubricant per bearing has to be empirically arrived at for every specific case. In tests, lubricant quantities of 120 to 180 mm^3/h have proved to be favorable, for example, for spindle bearings. The quantity of lubricantis best divided up into 6 to 10 injection cycles per hour.

Demands on the lubricant

Oils belonging to ISO grades VG 32 to VG 100 have proved to be very suitable. In particular, oil with EP additives is particularly recommended when high loads and low speeds are involved.

Oil with a viscosity lower than ISO VG 22 should be avoided, since the load-carrying capacity might no longer suffice in the event of large loads, the result being shorter bearing life. Oil with a higher viscosity can be used.

Oils with molykote additives, on the other hand, should not be used, since with these oils there is the risk of molykote particles forming deposits in the nozzle bores, thus clogging them. Moreover, the bearing clearance can be critically diminished due to plating with molykote particles.

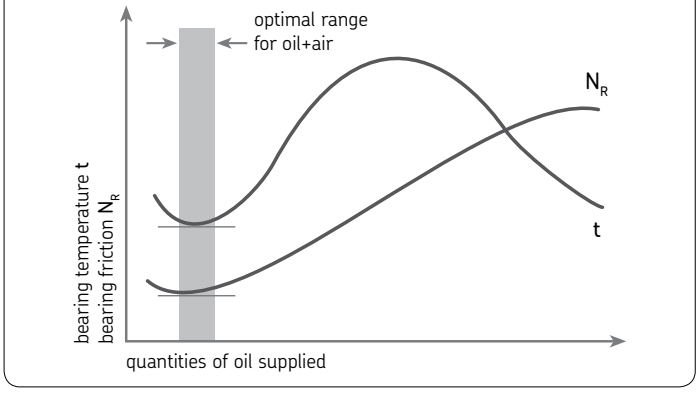
Compressed air

The air has to be dry and filtered; filter fineness < 5 µm.
A water separator of the kind customary with compressed air products, and preferably one with semiautomatic emptying, is adequate for the separation of water.

The quantity of air required for faultless transport of the oil in tubing with an internal diameterof 2.3 mm ranges from roughly 1000 to 1500 l/h. This value applies to oil inviscosity grades ISO VG 32 to ISO VG 100. Higher values have to be reckoned with in the case of oils with a higher viscosity or ones with a different adhesiveness.

The air pressure has to be adjusted so that this amount can be put through every line, with due consideration given to pressure losses in the line and storage of the quantity involved. The air pressure available at the unit's inlet port (network) should amount to 6 bars.

Fig. 2



Lubricant feed (criteria, bearing type, etc.)

The line, e.g. flexible 4×0.85 plastic tubing in which the transport of oil can easily be seen by eye, can be laid so that it rises or falls. The minimum length of the line is 1 m. The maximum line length can easily amount to 10 m.

If the distance between the unit and bearing point should be less than 1 m, this line must be laid as a helical coil. With very long lines, it is advisable to lay the feed tube as close as possible to the bearing point using a helical coil with some 5 turns. The middle axis of the coil should either be horizontal or at an angle of roughly 30° to the horizontal.

After the compressed air is turned off, the oil from the coil line should collect in the bottom of the coil so the bearing is supplied with oil again shortly after the compressed air is switched back on again.

Avoid changes in the cross section, especially when bends are involved. If they cannot be avoided, gradual transitions must be provided for. In the case of tubing connections (as few as possible) see to it that no oil can be lost or collect.

The way the lubricant is fed to the bearings depends entirely on the type of bearing and the bearing assembly's design features (cf. Fig. 3). In the case of single-row bearings, it is possible for the lubricant to be introduced into the bearing from the side.

The nozzle bore should be at the level of the inner ring and should in no case be aligned directly with the ball cage. In the case of bearings that exert the pumping force in one direction (e.g. angular contact ball bearings), the oil must be fed in this direction. If at all possible, the oil should be introduced into the bearing assembly by way of a nozzle piece with a length that depends on the bearing size. The diameter of the nozzle ranges from 0.5 to 1 mm.

It is also possible to feed the lubricant into the outer ring (cf. Fig. 4). When this is done, see to it that the lubricantis not introduced into the pressure zone between the ball and outer ring.

In the case of double-row cylindrical rolling bearings, the oil should be sprayed in from the side at the level of the outer ring raceway. It is then distributed nearly uniformly to both rows of bearings.

In the case of outer rolling-bearing dimensions of 150 to 280 mm, you should install a second nozzle and possibly more if larger bearings are involved.When lubricantis fed through the outer ring, one single bore will suffice for most applications.

The indicated air pressure is generally enough to penetrate the air vortexes produced by rapidly spinning bearings. Higher air pressures needed in individual cases will not impair the functioning of the overall system.

A drain must be provided for the oil delivered to keep an oil sump from forming. The diameter of this drainage hole must amount to at least 5 mm.

Components of an oil+air system

- Pressure control valve for air
- Pressure gauge for the air pressure
- Pressure switch for min. air pressure
- Oil+air metering unit with built-in piston distributors
- Compact unit with gear pump and the set of valves required for pressure relief and limitation, with oil pressure switch, float switch, with control unit IG54-20 (leaflet 1-1700-3-EN) or the like or
- Gear pump unit with the set of valves required for pressure relief and limitation, with float switch. The control unit and oil pressure switch have to be installed separately in this case.
- Oil streak sensor GS4011 or GS6011 (leaflet 1-1704-EN)

The components can be purchased either as a unit (type OLA) or individually. It is advisable to order components individually when the complete unit cannot be installed on the machine.

Fig. 3

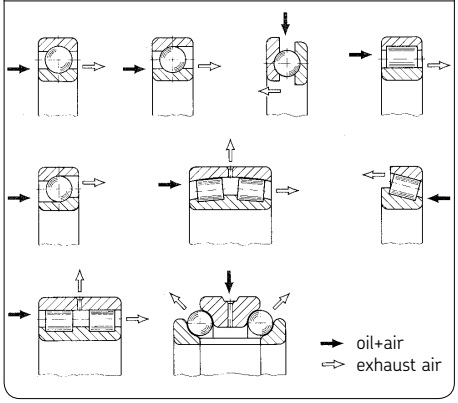


Fig. 3
Feeding of oil+air to the rolling elements

Fig. 4

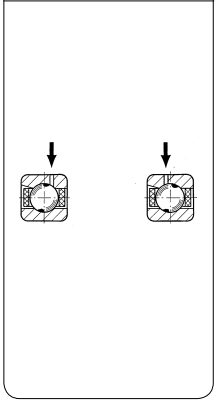
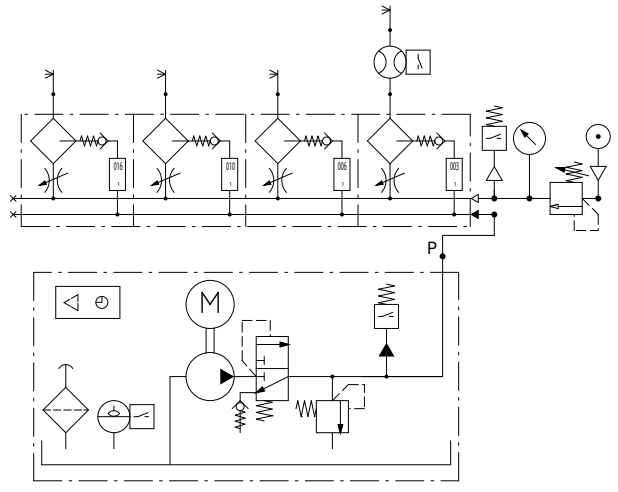
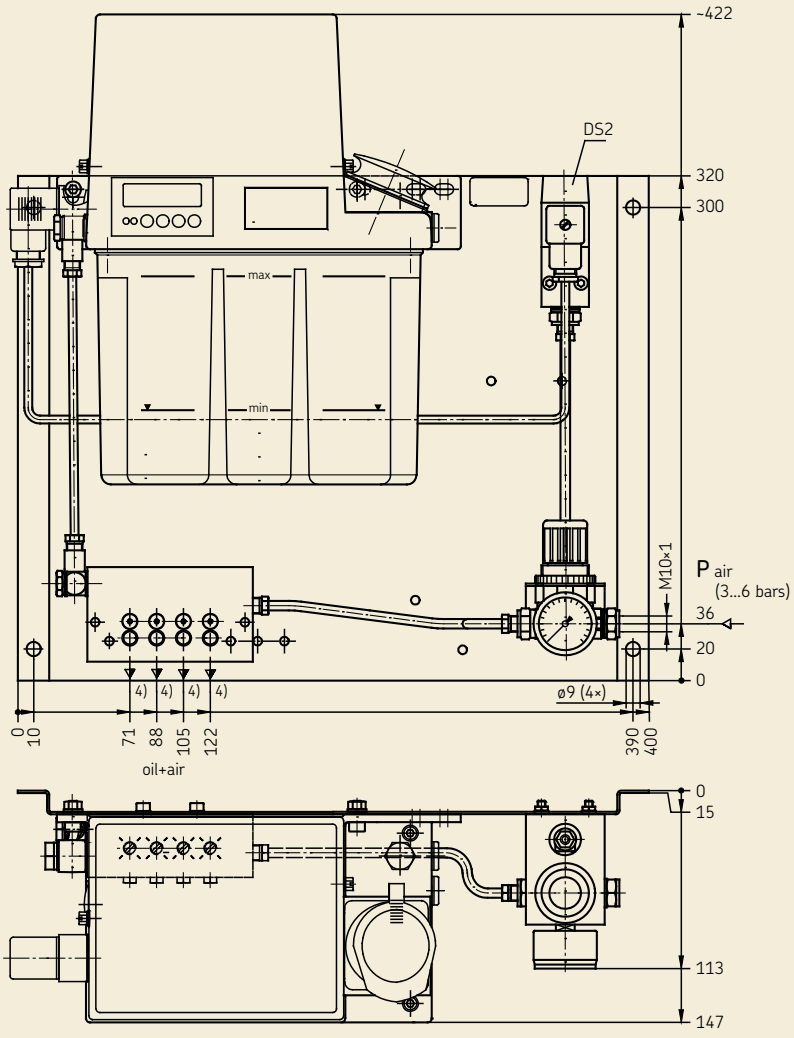


Fig. 4
Examples of lubricant fed through the outer ring

OLA hydraulic layout — Fig. 5



Example: compact unit unit and oil+air mixing valve – OLA04-53002



Technical data

Gear pump unit

Lubricant	oil based on mineral oil or on synthetic basis, compatible with NBR elastomers, plastics, copper and its alloys
Operating viscosity	20 to 1000 mm^2/s
Reservoir capacity	3 l
Reservoir material	SAN
Operating pressure	30 +1/–2 bars
Operating temperature	+10 to +40 °C
Delivery rate	0.2 l/min; 0.24 l/min
Type of enclosure (IEC 60529)	IP54
VDE 0530 mode	S3, 20% (1.25 to 25 min)
Voltage/frequency	50 Hz / 60 Hz, 115 V AC or 50 Hz / 60 Hz, 230 V AC

Motor

Speed	2700 rpm, 3300 rpm
Input power	105 W, 125 W

with built-in thermal circuit breaker

Pressure switch

Type of contact	NO
Switching pressure	20 bars

Float switch

Function	opens when lubricantat critical level

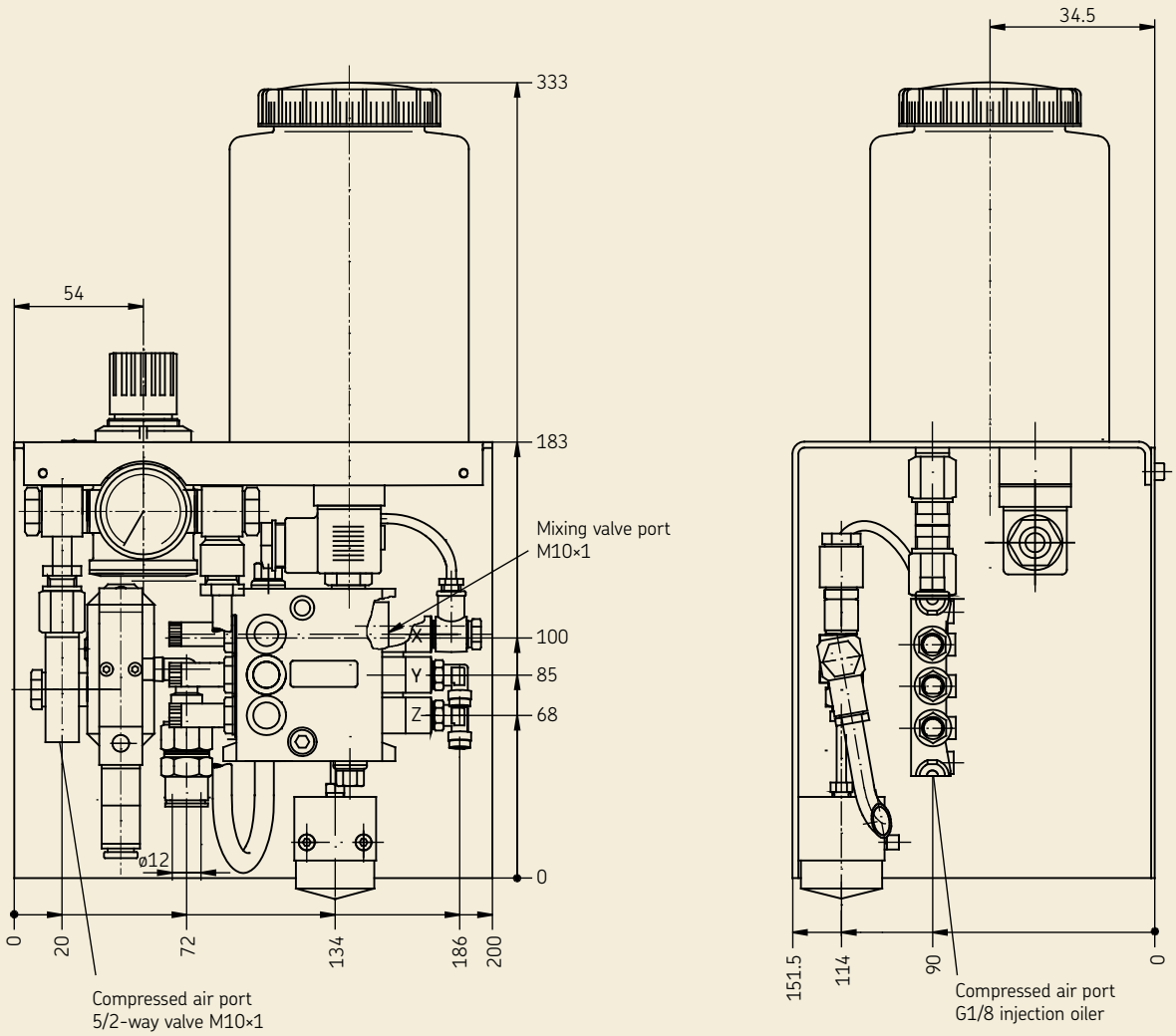
Control unit

Model designation	IG54-20-S4-I
Interval time	1 to 99 min, factory setting 10 min
Contact time	max. 60 s

Compressed air switch DS2, adjustable switching pressure

Set for	1 to 10 bars, 3 bars
Switching frequency	200/min
Switching capacity:	
Ohmic load	6 A/24 V DC, 0.5 A/230 V AC
Inductive load	6 A/24 V DC, 3 A/230 V AC

Example: oil reservoir, injection oiler, flow volume divider – OLA31-03-S1



Technical data

Lubricant . . . . . oil based on mineral oil or on synthetic basis, compatible with NBR elastomers, plastics, copper and its alloys
Operating viscosity . . . . . 20 to 1100 mm^2/s
Reservoir capacity . . . . . 1 l
Injection oiler . . . . . 3-port type
Delivery rate . . . . . 0.015 to 0.03 cm^3

Float switch network function: NC type
Switching voltage . . . . . 230 V
Switching current . . . . . 0.5 A
Switching capacity . . . . . 30 VA

Air, pressure control valve
Primary pressure . . . . . 0 to 16 bars
Secondary pressure . . . . . 0.5 to 10 bars
Pressure gauge display range. . 0 to 10 bars

Air, 5/2-way valve, electrically actuated
Rated pressure . . . . . 10 bars
Rated flow . . . . . 450 l/min
Pressure, min. . . . . 2 bars

Oil+air metering units

Mixing valves **with** metering of their own

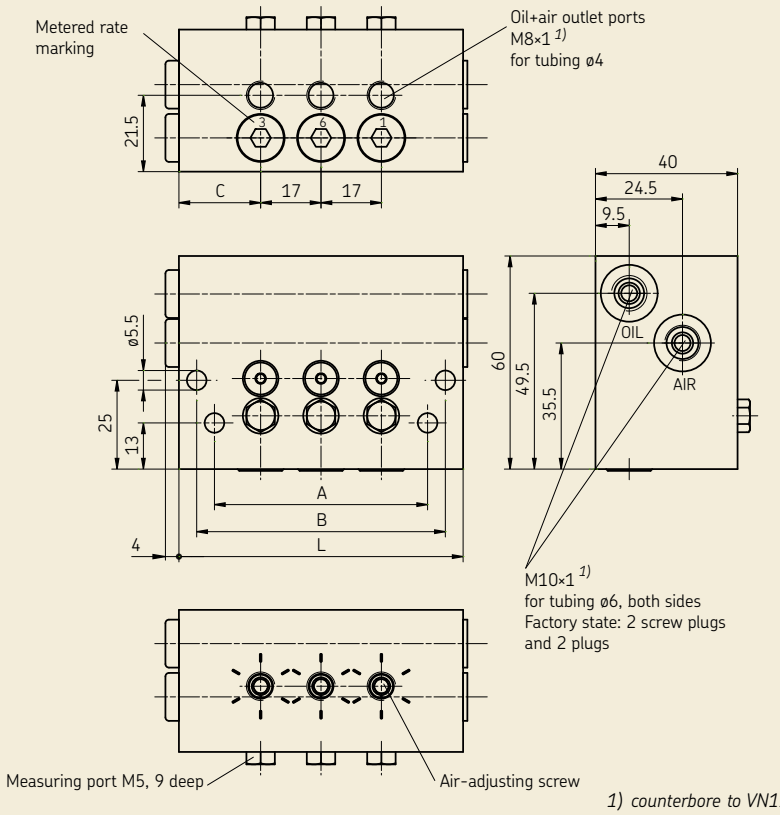
See important product usage information on the back cover.

The oil+air metering unit is designed as a compact unit.
When more than 8 lube points are involved, another metering unit – with a separate air feed – has to be provided for.
Every outlet port has to be connected to a lube point. The metering bores can be selected between 0.01; 0.02; 0.03; 0.06; 0.10 and 0.16 cm³ per outlet port.

Please indicate the metering rate when ordering. Indicate from left to right (in direction shown in the drawing).

Order example:
MV203-20: 0.03 cm³, 0.06 cm³, 0.01 cm³,

MV20.-20 / MV20.-20-S8 (MV203-20 / MV203-20-S8 illustrated)



1) counterbore to VN114

Technical data

Operation pressure
- Air . . . . . 3 to 10 bars
- Oil . . . . . 17 to 40 bars

Temperature range . . . . . 5 to 80 °C
Seals . . . . . NBR or FKM
Mounting position . . . . . any

Oil+air metering units

Order No.	Number of outlets	Seals	Dimensions L	A	B	C
MV201-20 MV201-20-S8	1	NBR FKM	40	20	22	20
MV202-20 MV202-20-S8	2	NBR FKM	55	43	45	19
MV203-20 MV203-20-S8	3	NBR FKM	80	60	70	23
MV204-20 MV204-20-S8	4	NBR FKM	105	77	95	27
MV205-20 MV205-20-S8	5	NBR FKM	130	94	120	31
MV206-20 MV206-20-S8	6	NBR FKM	130	111	120	22.5
MV207-20 MV207-20-S8	7	NBR FKM	155	128	145	26.5
MV208-20 MV208-20-S8	8	NBR FKM	155	145	145	18

Metering screws

Metered quantity [cm³]	Marking	Metering nipple	Seals
0.01	1	only exchangeable by SKF	NBR / FKM
0.02	2	only exchangeable by SKF	NBR / FKM
0.03	3	MV202.13-K MV202.13-K-S8	NBR FKM
0.06	6	MV202.16-K MV202.16-K-S8	NBR FKM
0.10	10	MV202.20-K MV202.20-K-S8	NBR FKM
0.16	16	MV202.26-K MV202.26-K-S8	NBR FKM

Screw plugs

Order No.	Seals
MV202.U10	NBR
MV202.U10-S8	FKM

Oil+air micrometering unit

Mixing valves **with** metering of their own

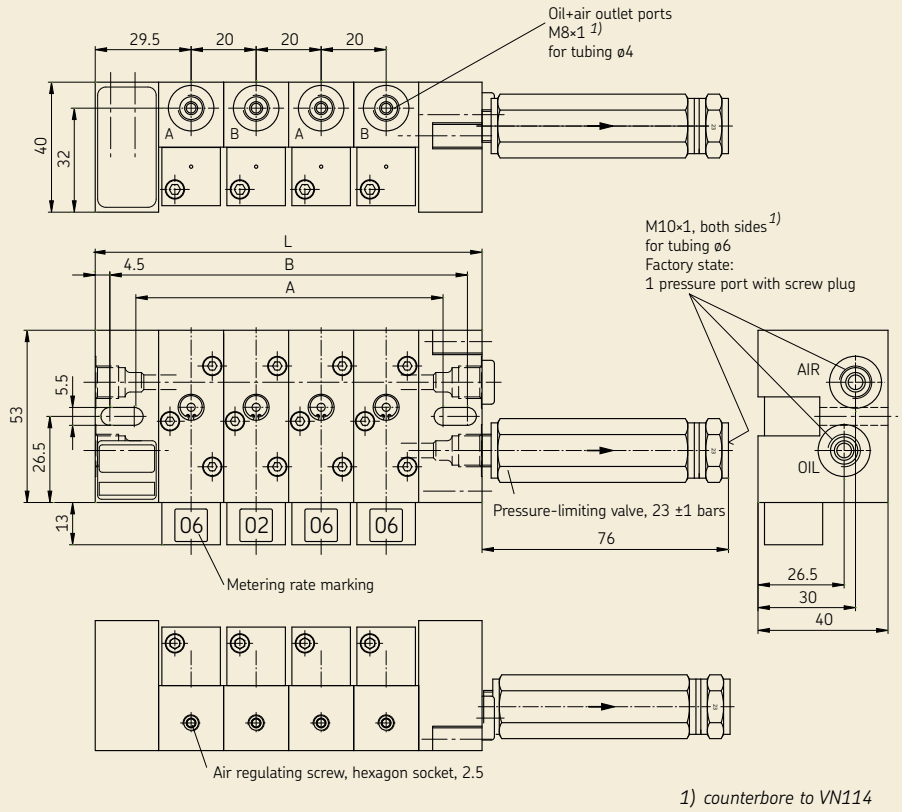
The MV 50x Group in modular design supplements the MV20x-20 Group.
Oil+air units with MV20x metering units can be expanded with the MV50x.

The metering of the MV50x covers low rates of 0.002 and 0.006 cm³.

Please indicate the metering rate when ordering. Indicate from left to right (in direction shown in the drawing).

Order example:
MV504: 0.006 cm³, 0.002 cm³, 0.006 cm³, 0.006 cm³

MV50x (MV504 illustrated)



1) counterbore to VN114

Technical data

Operating pressure	
Air	3 to 10 bars
Oil	25 to 40 bars
Perm. operating viscosity	40–200 mm²/s
Temperature range	5 to 80 °C
Seals	FKM
Mounting position	preferably as illustrated

Please note:
If an odd number of oil+air outlet ports are required, assign one outlet a metering rate of "0 mm³".

Oil+air micrometering units

Order No.	Oil+air outlets	Dimensions L	A	B
MV502	2	7955	70	
MV504	4	119	95110	
MV506	6	159	135	150

Metering per outlet/actuation [cm³]	Metering rate marking
0	0
0.002	02
0.006	06

Mixing valves **with** metering of their own

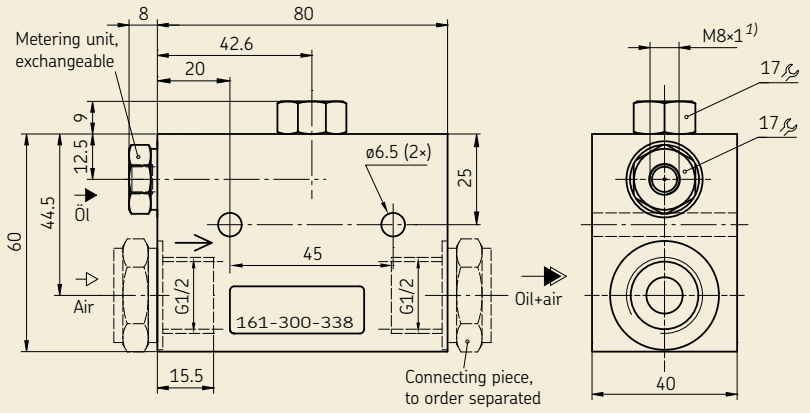
Unlike the mixing valves **without** metering of their own, these have a built-in piston distributor that sees to the metering of oil.

The oil port of the mixing valve must be connected directly to the mainline of a single-line centralized lubrication system without any further in-line piston distributor.

The desired quantity of oil, 0.03; 0.06 or 0.10 cm³, can be selected with exchangeable metering nipples (see table).

Prefilter oil with 10 µm fineness.

161-300-338



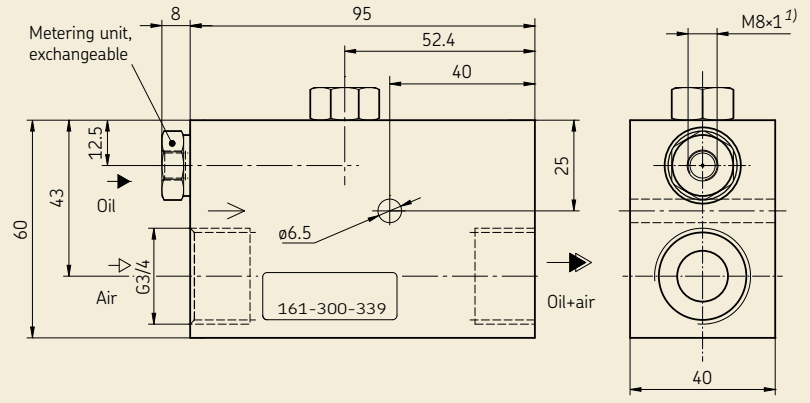
1) Port tapped for solderless tube connection for tubing ø4

Mixing valves with metering of their own

Order No.	Air line connection
161-300-338	G1/2
169-000-339	G1

Mounting position as illustrated.

161-300-339



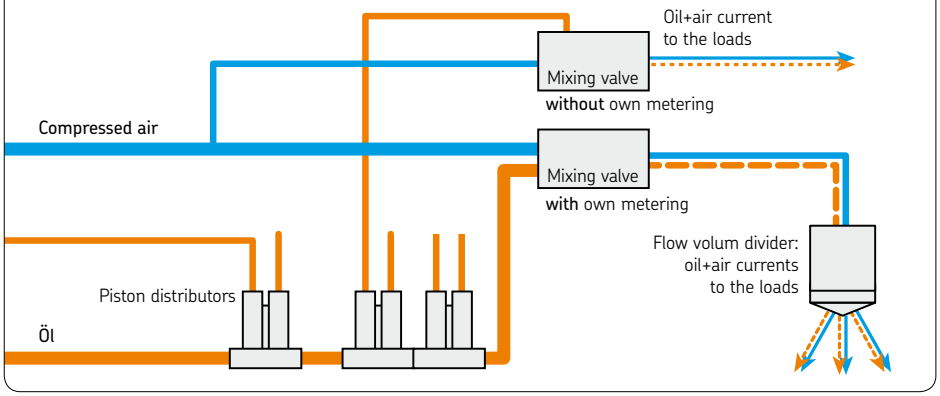
1) Port tapped for solderless tube connection for tubing ø4

Metering unit, exchangeable

Order No.	Metering [cm³]	Marking
321-403G4	0.03	3
321-406G4	0.06	6
321-410G4	0.10	10

Please indicate order No. of desired metering unit.

Fig. 6



Connecting pieces (to order separated)

Order No.	Tube diam.
267-001.13	6
410-171	8
267-001.15	10

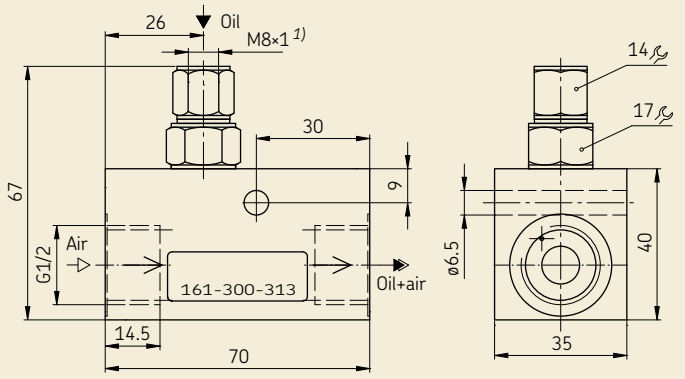
Sealing ring, order No.: DIN7603-A21×26-CU

Mixing valves **without** metering of their own

If no space is available for the direct installation of a mixing head like the ones in leaflet 1-5012-5-EN, it is possible to insert a mixing valve directly into the compressed-air line and as close as possible to the load.

Branching to a number of loads is possible (see Fig. 6 on page 8 below). For their oil supply, mixing valves without metering of their own require a metering piston distributor of an intermittently operated single-line centralized lubrication system or an injection oiler.

161-300-313



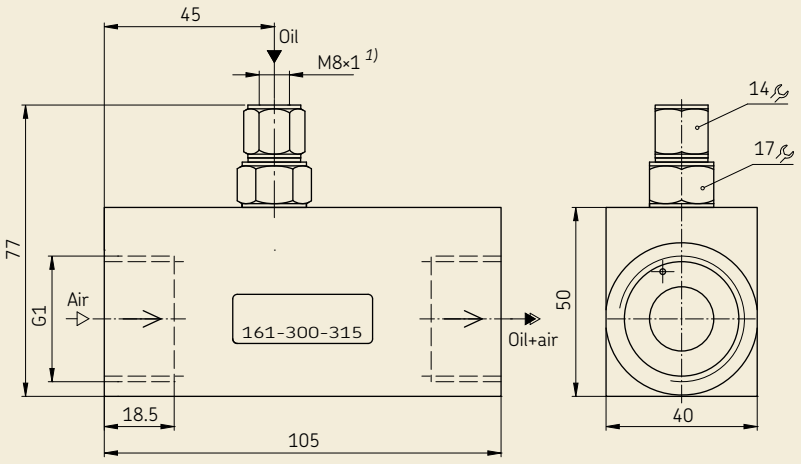
1) Port tapped for solderless tube connection for tubing ø4

Mixing valves without metering of their own

Order No.	Air line connection
161-300-313	G1/2
161-300-315	G1

Mounting position as illustrated.

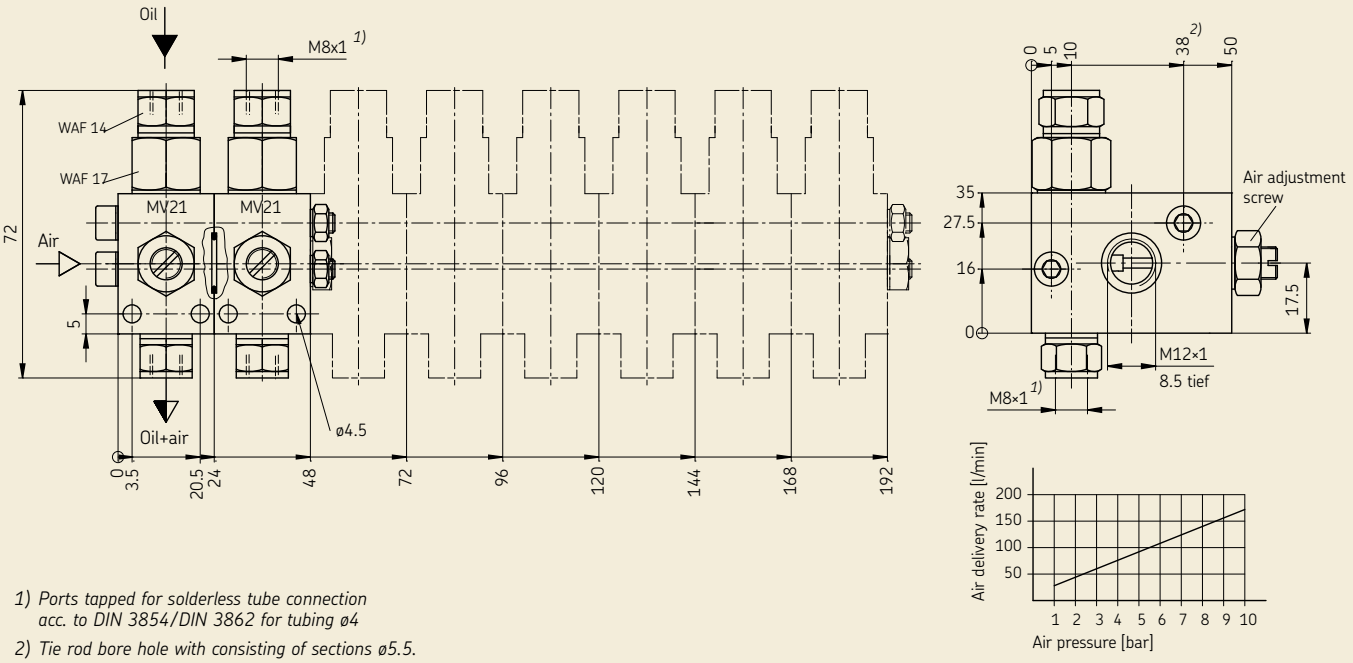
161-300-315



1) Port tapped for solderless tube connection for tubing ø4

Mixing valves **without** metering of their own

MV21 ... MV38



1) Ports tapped for solderless tube connection acc. to DIN 3854/DIN 3862 for tubing ø4

2) Tie rod bore hole with consisting of sections ø5.5.

Mixing valves without metering of their own

Order No.	Number of outlets	
MV21	1	
MV32	2	
MV33	3	
MV34	4	
MV35	5	mounted as manifold
MV36	6	
MV37	7	
MV38	8	

Technical data

Delivery medium . . . . . oil on a petroleum basis or synthetic basis compatible with NBR elastomers, plastics, copper and copper alloys
Operating viscosity . . . . . up to 3 000 mm^2/s
Oil pressure . . . . . 5 bars
Metering externally . . . . . 0.003 ... 0.2 cm^3

Operating medium
Compressed air . . . . . max. 10 bars
Delivery at 10 bars . . . . . 172 l/min

Mounting position . . . . . any

Mixing valves **without** metering of their own

Mixing valves without metering of their own

Order No.	Number of outlets
MV51	1
MV57	7

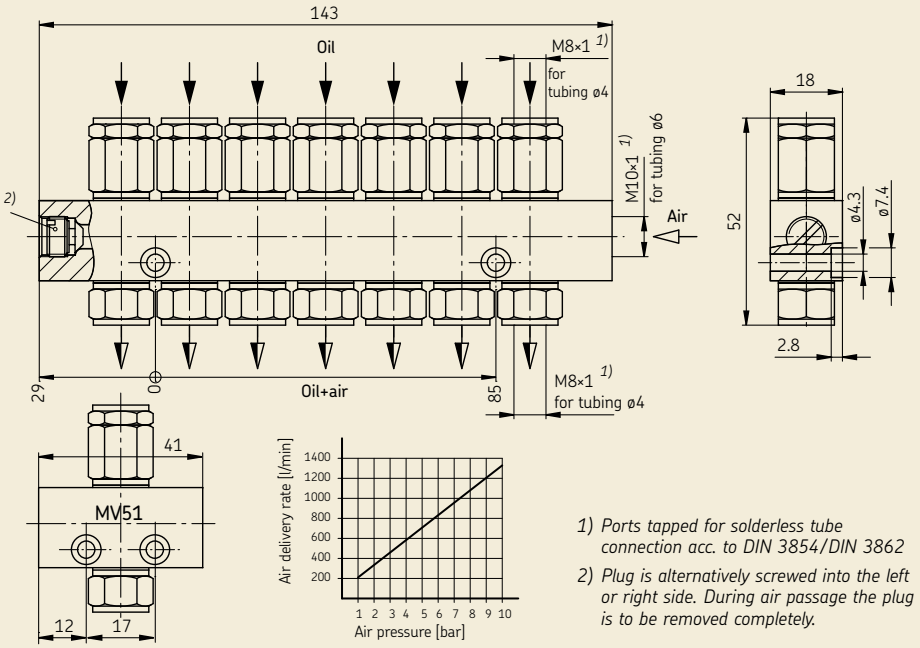
Technical data

Delivery medium
oil on a petroleum basis or synthetic basis
compatible with NBR elastomers,
plastics, copper and copper alloys
Operating viscosity . . . . up to 3 000 mm²/s
Oil pressure. . . . . 5 bars
Metering externally . . . . 0.003 ... 0.2 cm³

Operation medium
Compressed air . . . . . max. 10 bars
Delivery at 10 bar . . . . 1329 l/min

Mounting position . . . . as illustrated

MV51 / MV57



1) Ports tapped for solderless tube connection acc. to DIN 3854/DIN 3862

2) Plug is alternatively screwed into the left or right side. During air passage the plug is to be removed completely.

Flow volume divider

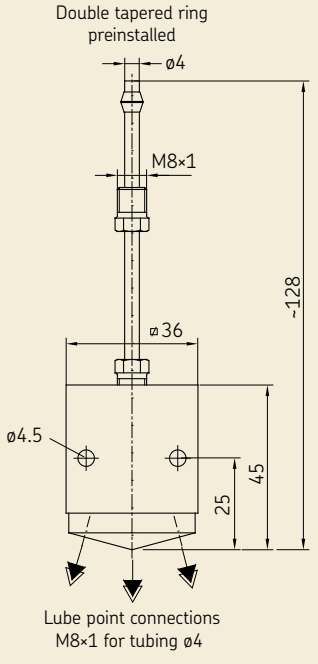
Contributors designed for uniform apportionment of oil+air or fluid grease+air currents to 2 or more lube points.

The outlet ports should be as free of pressure as possible, but differences in length of up to 0.5 m do not play any role in the secondary lines.

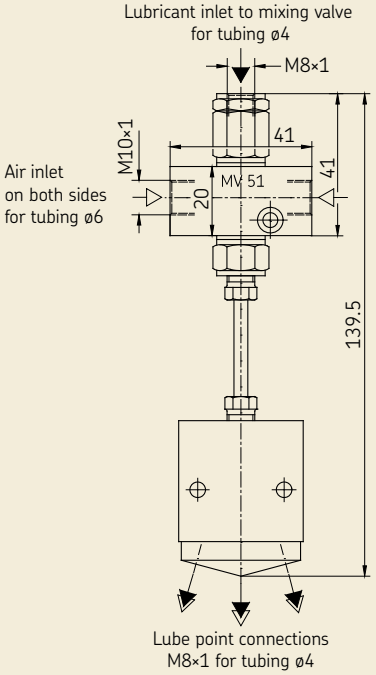
Flow volume divider

Order No.	Lube points
169-000-182	2
169-000-183	3
169-000-184	4
169-000-185	5
169-000-186	6
169-000-252	2
169-000-253	3
169-000-254	4
169-000-255	5
169-000-256	6

169-000-182/-186



169-000-252/-256



Accessories

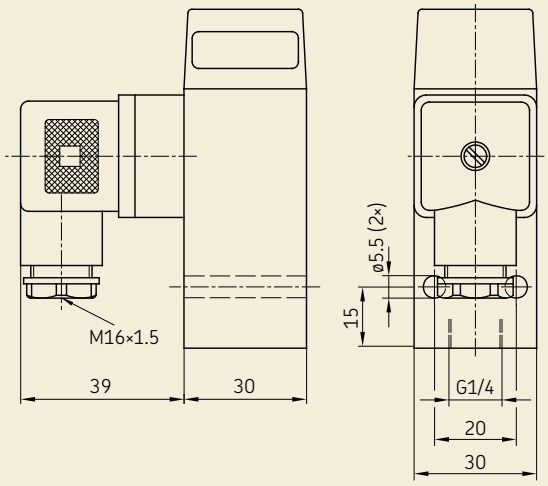
Pressure switch for air

Order No. 176-271-000

Technical data

Switching pressure	1 to 10 bars (adjustable)
Reset differential	10% (non-adjustable)
Switching frequency	200/min
Max. voltage	250 V
Switching capacity	
Ohmic load	6 A at 24 V DC and 0.5 A at 230 V DC
Inductive load	6 A at 24 V AC and 3 A at 230 V AC
Type of enclosure	IP 65

176-271-000



Nozzles

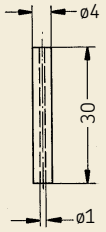
- Spraying of chains, tooth flanks of gear trains, slideways
- to wet workpiece surfaces

Nozzles

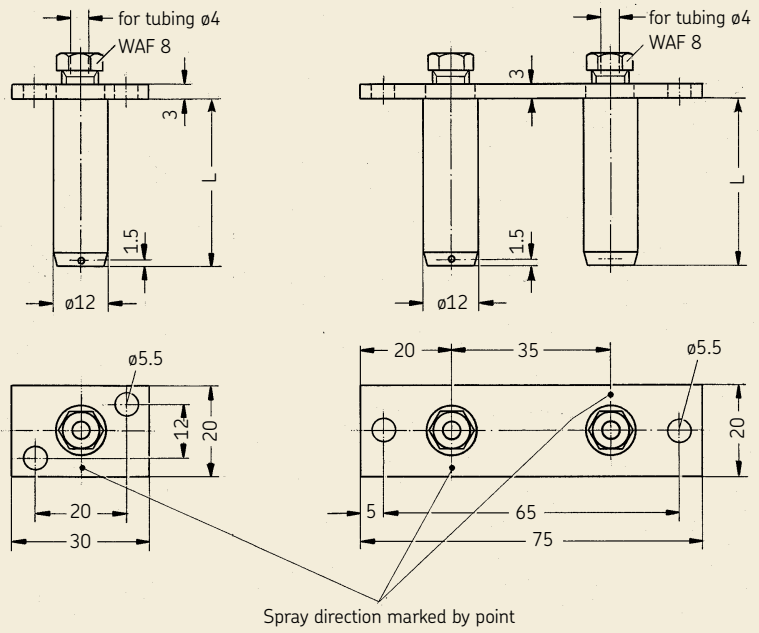
Order No.	Number of nozzles
169-000-101	1
169-000-102	2

P-89.29

P-89.29



169-000-101 **169-000-102**



For rolling-bearing lubrication with radial feed
***L** = desired length*

Accessories

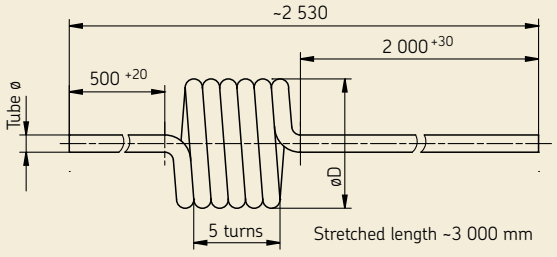
Helical coil

It is advisable to use flexible plastic tubing to connect the unit to the friction point.

Helical coil

Order No.	Tube ø	øD
828-090-004	4×0.85	30 ±2
828-090-019	6×1.25	42 +6

828-090-0xx



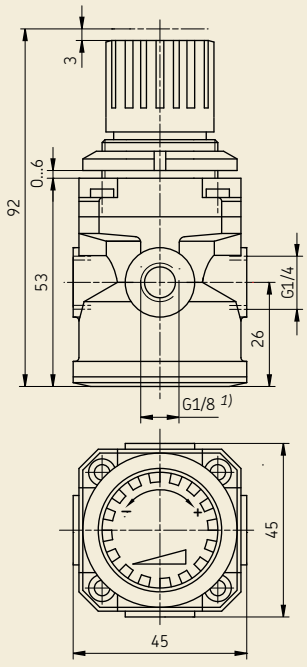
Reducing valve

Order No. 231-900-028

Technical data

Type	membrane controller
Primary pressure max.	0 to 16 bars
Secundary pressure	0.5 to 10 bars
Ambient temperature	0 to +80 °C
Seal	NBR

231-900-028



1) port for pressure gauge

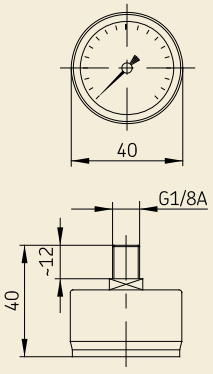
Pressure gauge for compressed air

Order No. 169-101-606

Display range 0 to 16 bars

Sealing ring for pressure gauge is to order separated.
Order No. 248-610.03

169-101-606



Choice of equipment, examples

Order No.	Lube points	Unit	Mixing valve	Special features
OLA04-23001	4	MKU2-KW3-22001	MV204-20	integrated control unit IG38-30-I
OLA04-53002	4	MKL2-KW3-23041	MV204-20	integrated control unit IG54-20-S4-I (see page 4 for technical data)
OLA04-03102	4	MKU2-KW3-20011	MV204-20	without control, 1 µm filling filter
OLA03-53301	3	MKL2-KW3-23041	MV203-20	integrated control unit IG54-20-S4-I, 5 µm air filter, 1 µm oil pressure filter
OLA16-01-S1	1	501-301-024	MV21	integrated control, KW1 5 µm air filter, 3 µm oil filter, GS300 flow sensor
OLA29-02	2	MFE5-KW3-2	MV32 342-422-000	installed in Rittal cubicle, 25 µm oil pressure filter, GS300 flow sensor
OLA31-03-S1	3	501-303-004	MV51	without control, KW1 5-port flow volume divider (see page 5 for technical data)
OLA04-03101	4	MFE5-KW3-2-S12	MV204-20	without control, 3 µm oil pressure filter, pressure switch for min./max. pressure
OLA72-02	2	501-303-028	MV57.U1	pneumatic pulse generator 233-900-000
OLA01-52004	1	MKU1-KW2-20005+428	MV201-20	with control (switch cabinet), 5 µm filter, oil-streak sensor, helical coil

Order No. 1-5012-3-EN
Subject to change without notice! (07/2009)

Important product usage information
All products from SKF may be used only for their intended purpose as described in this brochure and in any instructions. If operating instructions are supplied with the products, they must be read and followed.
Not all lubricants are suitable for use in centralized lubrication systems. SKF does offer an inspection service to test customer supplied lubricant to determine if it can be used in a centralized system. SKF lubrication systems or their components are not approved for use with gases, liquefied gases, pressurized gases in solution and fluids with a vapor pressure exceeding normal atmospheric pressure (1013 mbars) by more than 0.5 bar at their maximum permissible temperature.
Hazardous materials of any kind, especially the materials classified as hazardous by European Community Directive EC 67/548/EEC, Article 2, Par. 2, may only be used to fill SKF centralized lubrication systems and components and delivered and/or distributed with the same after consulting with and receiving written approval from SKF.

Further brochures

1-1704-EN	Flow monitors and Sensors
1-1700-3-EN	Control Units
1-9201-EN	Transport of Lubricants in Centralized Lubrication Systems

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