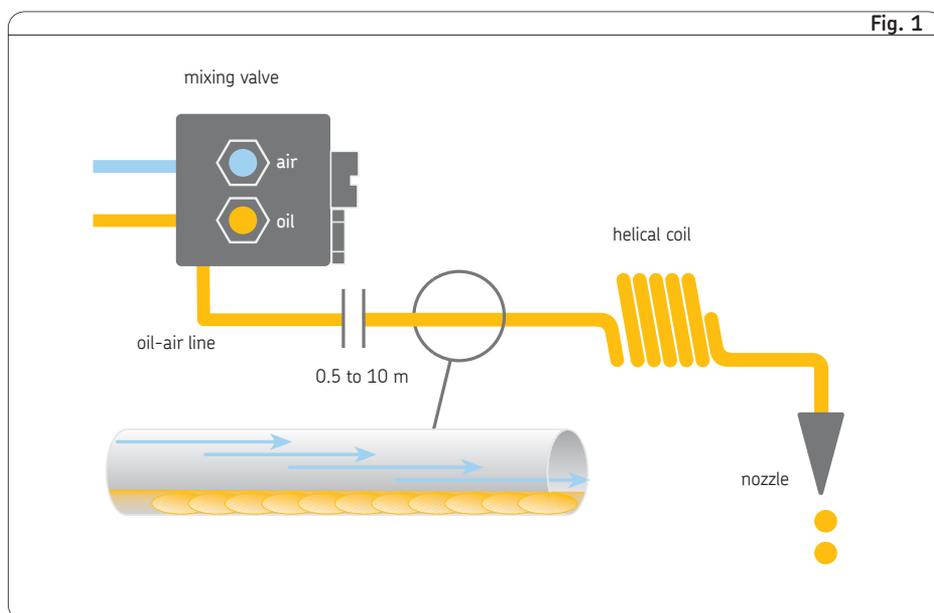




Oil+Air Systems

for the lubrication of spindles, linear guides, rack pinions



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 breathe; 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, fail 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 put up with.

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 quantities required. For-life 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 $n \cdot dm$ from < 1 to $1.5 \cdot 10^6 \text{ mm} \cdot \text{rpm}$.

Not only that, grease change intervals, in conjunction with the replacement of spindles, are greatly and disproportionately shortened within the speed range of $n \cdot dm$ from $> 10^6 \text{ mm} \cdot \text{rpm}$ – 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 obtain approximate oil needs:

$$Q = w \cdot d \cdot B$$

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 lubricant is 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

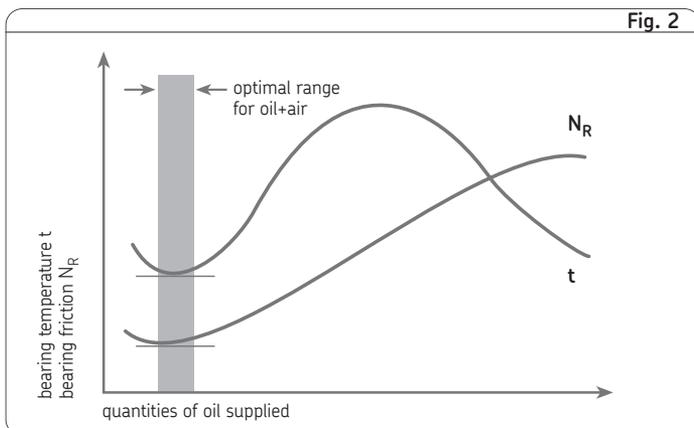
The air has to be dry and filtered; filter fineness $< 5 \mu\text{m}$. A water separator of the kind customary with compressed air products, and preferably one with semiautomatic emptying, is adequate for the separation of water.

The quantity of air required for faultless transport of the oil in tubing with an internal diameter of 2.3 mm ranges from roughly 1000 to 1500 l/h. This value applies to oil in viscosity 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.

Lubricant feed (criteria, bearing type, etc.)

The line, e.g. flexible 4 x 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 is 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 lubricant is 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 it is advisable to install a second nozzle, and correspondingly more if even larger bearings are involved. When lubricant is fed through the outer ring, one single bore will suffice for most applications.

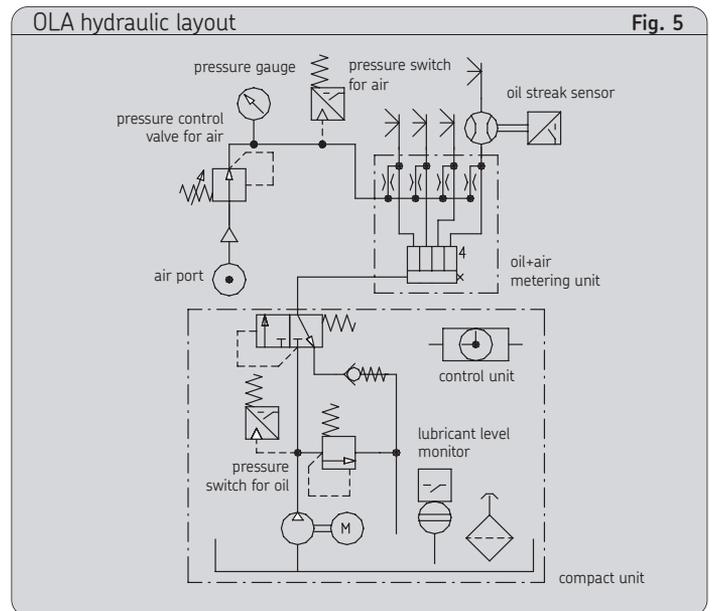
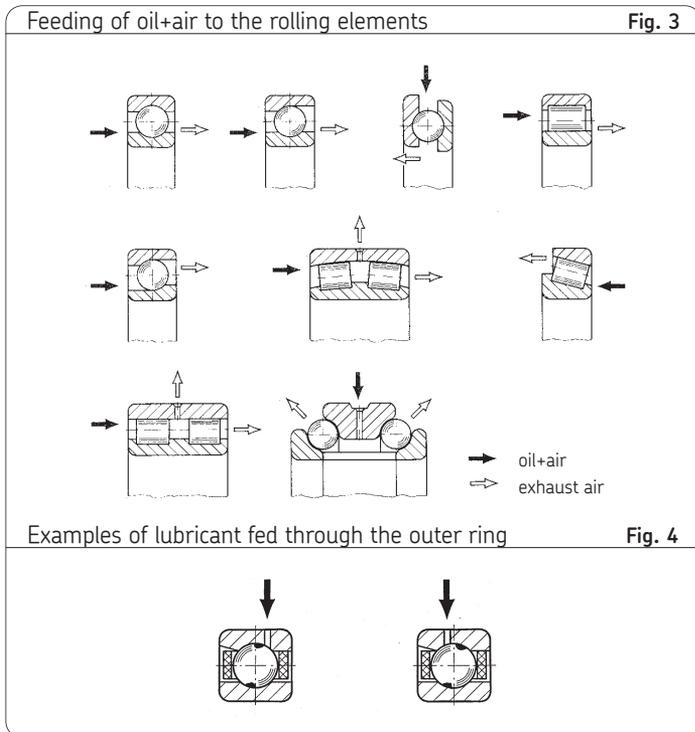
The indicated air pressure is generally enough to penetrate the air vortexes produced by rapidly spinning bearings. Higher air pressures needed in individual cases will not impair the function-ing of the overall system. A drain must be provided for the oil delivered to keep an oil sump from forming.

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-US) 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-US)

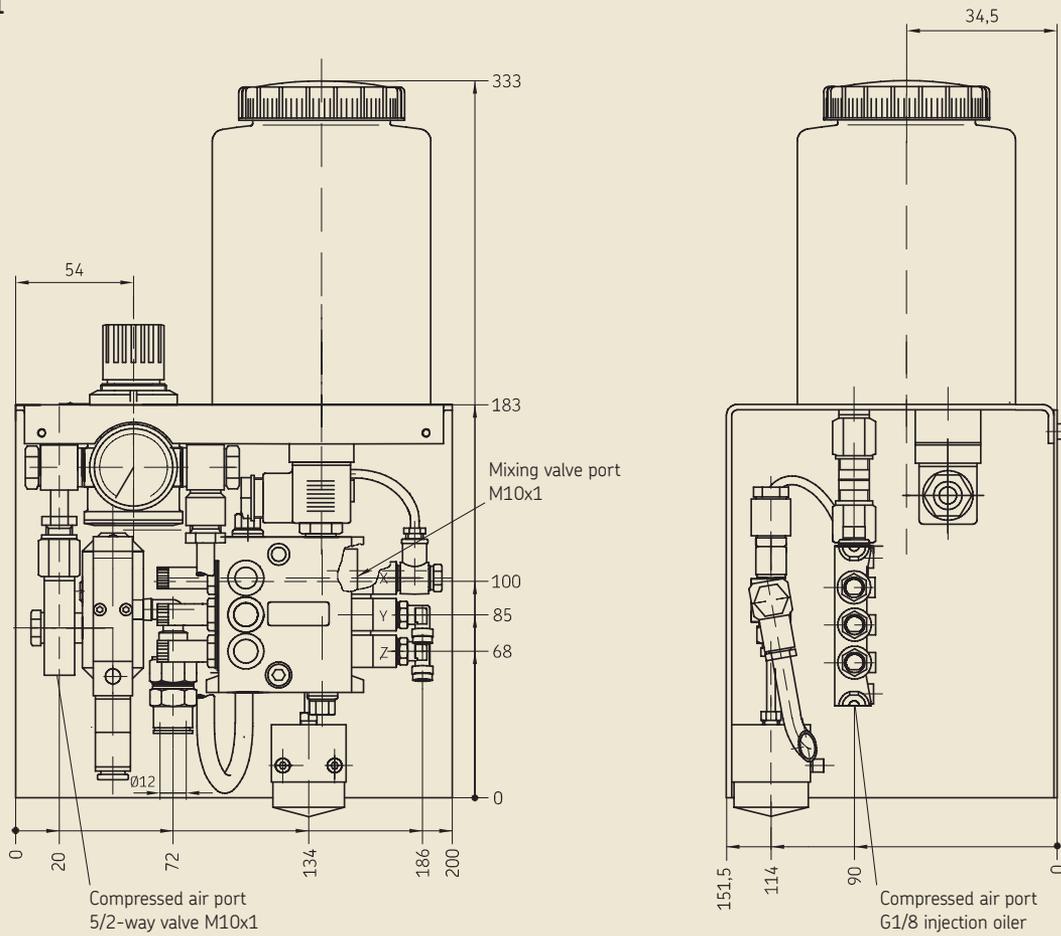
The components can be purchased either as a unit (type OLA) or individually. It is advisable to order components individually when the complete unit cannot be installed on the machine.



Choice of equipment

Order No.	Lube points	Unit	Mixing valve	Special features
OLA04-23001	4	MKU2-KW3-22001	MV204-20	integrated control unit IG38-20-I
OLA04-53002	4	MKL2-KW3-23041	MV204-20	integrated control unit IG54-20-I (see page 5 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-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-S1	MV32 342-422-000	installed in Rittal cubicle, 15 µm oil pressure filter, GS300 flow sensor
OLA31-03-S1	3	501-303-024	MV51	without control, KW1 5-port flow volume divider (see page 6 for technical data)
OLA04-03101	4	MFE5-KW3-S12	MV204-20	without control, 3 µm oil pressure filter, pressure switch for min./max. pressure (versions to VW specs)
OLA20-00003	20	without	2x MV204-20 2x MV206-20	modular version with directional air valve, air pressure switch, pressure switch for min./max. oil pressure
OLA40-04	4	PW-88-4	MV204-20	without control, pneumatically actuated pump
OLA58-04-V57	4	MFE5-BW7-V57-F	MV204-20	without control, electronic pressure switch, 3 µm pressure filter,
OLA70-00	0	MF5-KW3	without	without control, 3 µm pressure filter, 5 µm air filter, baseplate for modular OLA

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 mm²/s
 Reservoir capacity 1 l
 Injection oiler 3-port type
 Delivery rate 0.015 to 0.03 ccm

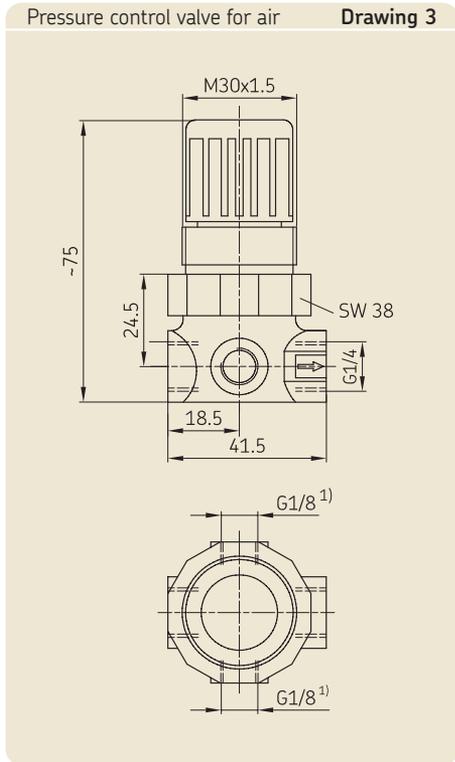
Float switch network function: NC type
 Switching voltage 230 V
 Switching current 0.5 A
 Switching capacity 30 VA

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

Please indicate voltage when ordering

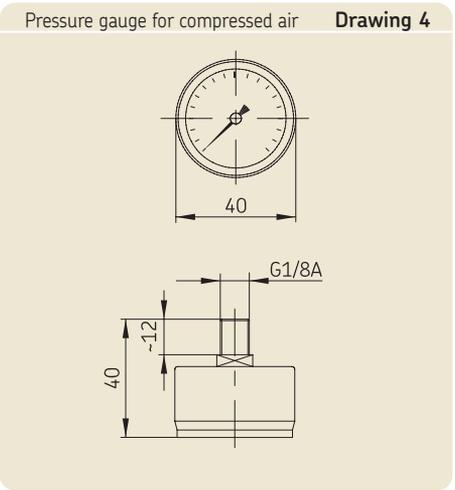
Accessories



to drawing 3
Order No. 231-900-025
 Max. primary pressure 20 bars
 Temperature +20 °C to +65 °C

1) port for pressure gauge

to drawing 4
Order No. 169-101-606
 Display range 0 to 16 bars



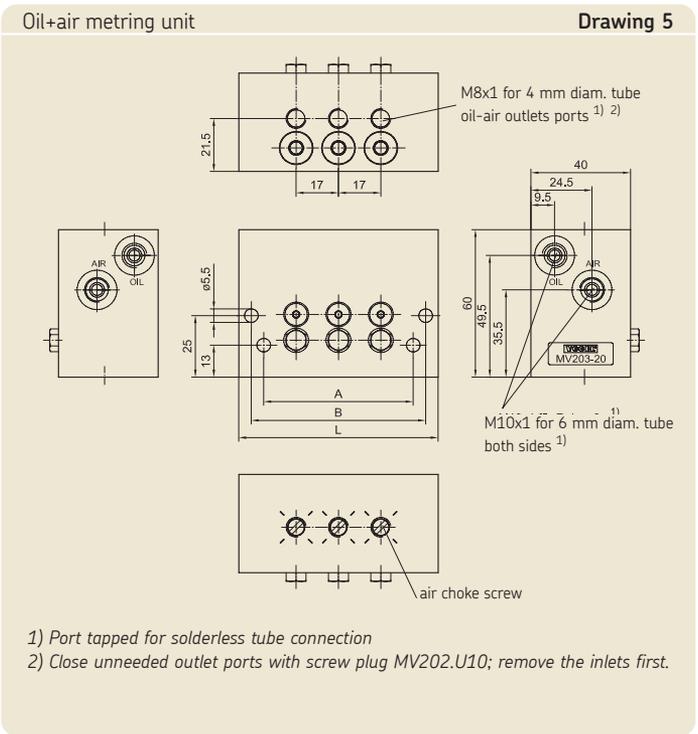
Oil+air metering unit

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; 0.03; 0.06; 0.1 and 0.16 ccm per outlet port

Order No.	Number of outlets	Metering per outlet [ccm]	Dimensions		
			L	A	B
MV-201-20	1		40	20	22
MV-202-20	2		55	43	45
MV-203-20	3		80	60	70
MV-204-20	4	optionally	105	77	95
MV-205-20	5	0.01; 0.03;	130	94	120
MV-206-20	6	0.06; 0.1; 0.16	130	111	120
MV-207-20	7		155	128	145
MV-208-20	8		155	145	145

Please indicate metering rate when ordering

Metered quantity [ccm]	Metering nipple	Marking
0.01	not exchangeable	1
0.03	exchangeable	3
0.06	exchangeable	6
0.10	exchangeable	10
0.16	exchangeable	16



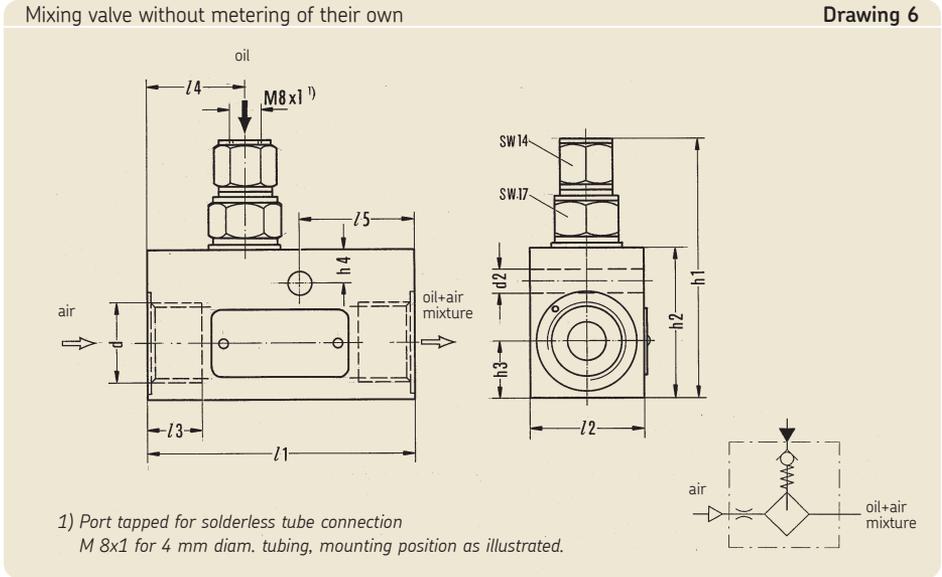
Technical data

Minimum air pressure 3+0.5 bars
 Minimum oil pressure for metering
 with 0.01 ccm 17 bars
 with 0.03; 0.06; 0.1 ; 0.16 ccm 13 bars
 Preferred mounting position oil+air outlet ports pointing down or up

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-US, 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 (cf. illustration on page 9 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.



Order No.	d	l1	l2	l3	l4	l5	h1	h2	h3	h4	d2	associated connectors			associated sealing ring
												ø 8 tube	ø 10 tube	ø 12 tube	
161-300-313	G1/2	70	30	14.5	26	30	69	40	15	9	6.5	267-001.13	410-171	267-001.15	DIN7603-A21x26-CU
161-300-315	G1	105	40	18.5	45	-	79	50	22	-	-	-	-	-	-

Flow volume divider

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

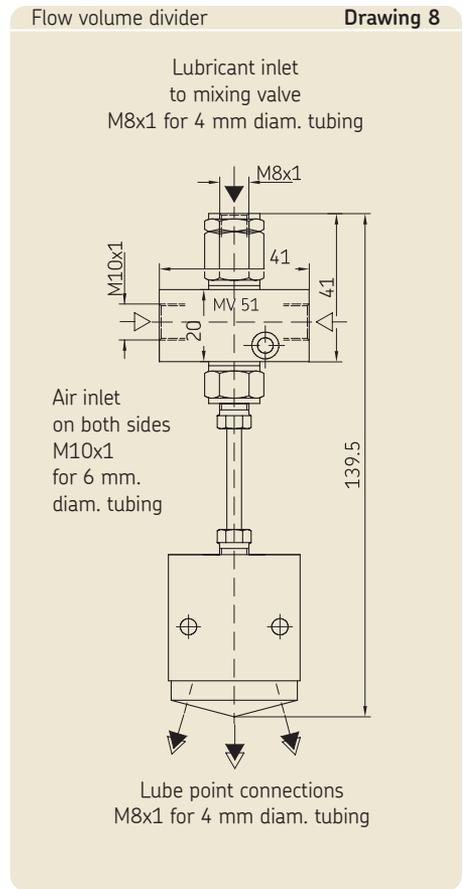
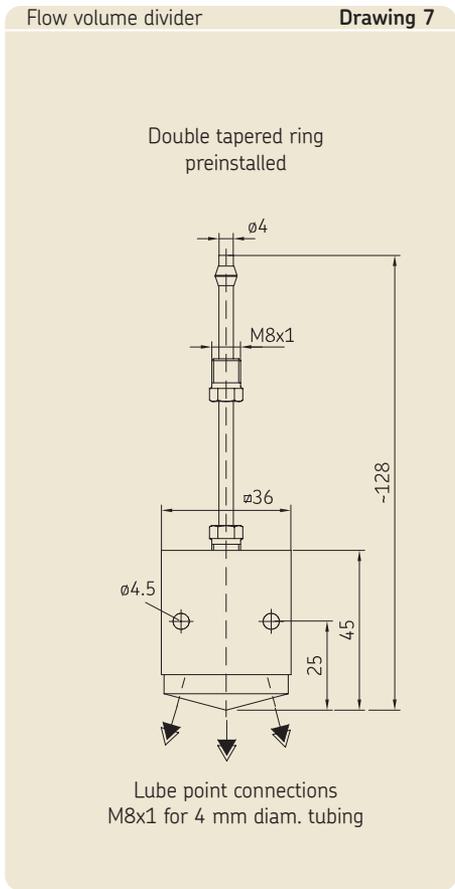
The outlet ports should be as free of pressure as possible, but differences in length of up to 0.5 m do not play any role in the secondary lines.

to drawing 7

Order No.	Lube points
169-000-182	2
169-000-183	3
169-000-184	4
169-000-185	5
169-000-186	6

to drawing 8

Order No.	Lube points
169-000-252	2
169-000-253	3
169-000-254	4
169-000-255	5
169-000-256	6



Mixing valves with metering of their own

Unlike the mixing valves on page 8, 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 main line of a single-line centralized lubrication system without any further in-line piston distributor.

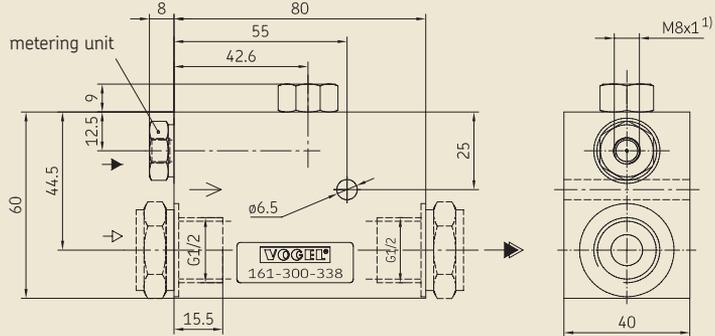
The desired quantity of oil, 0.03 - 0.06 - 0.10 ccm, can be selected with exchangeable metering nipples (cf. table).
 Prefilter oil with 10 µm fineness

Mixing valve with metering of their own

Drawing 9

Order No. 161-300-338

For G 1/2 air line connection



Metering [ccm]: 0.03; 0.06; 0.10
 Sealing ring: DIN7603-A21x26-CU
 Mounting position as illustrated

associated connecting pieces
 for tubing ø 8: 267-001.13
 for tubing ø 10: 410-171
 for tubing ø 12: 267-001.15

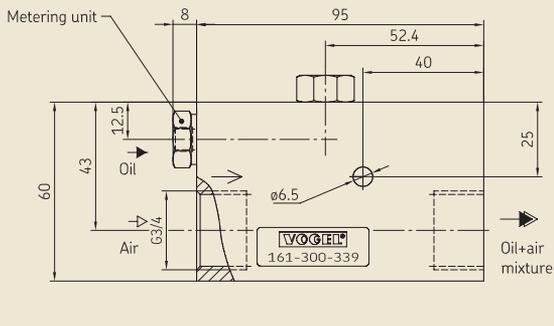
1) Port tapped for solderless tube connection for 4 mm diam. tubing (main line connection)

Mixing valve with metering of their own

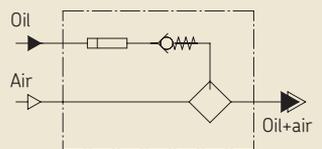
Drawing 10

Order No. 161-300-339

For G 3/4 air line connection



Hydraulic layout



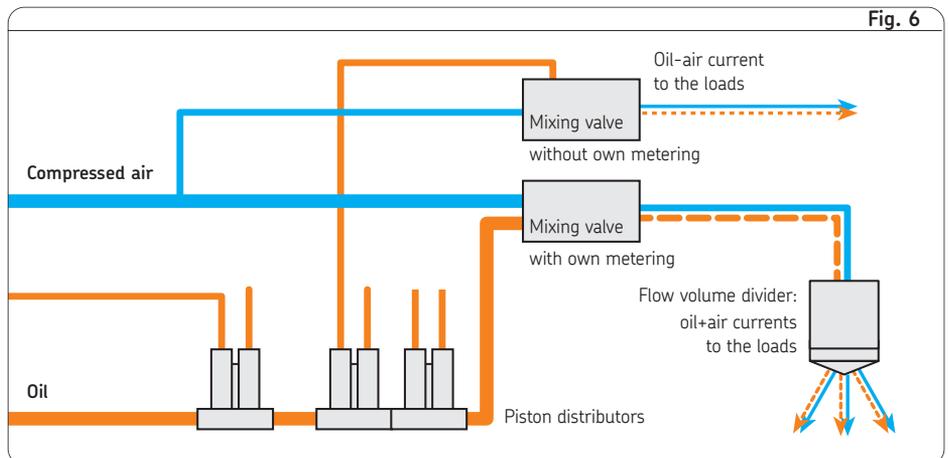
Metering [ccm] : 0.03; 0.06; 0.10
 Mounting position as illustrated

1) Port tapped for solderless tube connection for 4 mm diam. tubing (main line connection)

Metering unit, exchangeable

Please indicate order No. of desired metering unit.

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



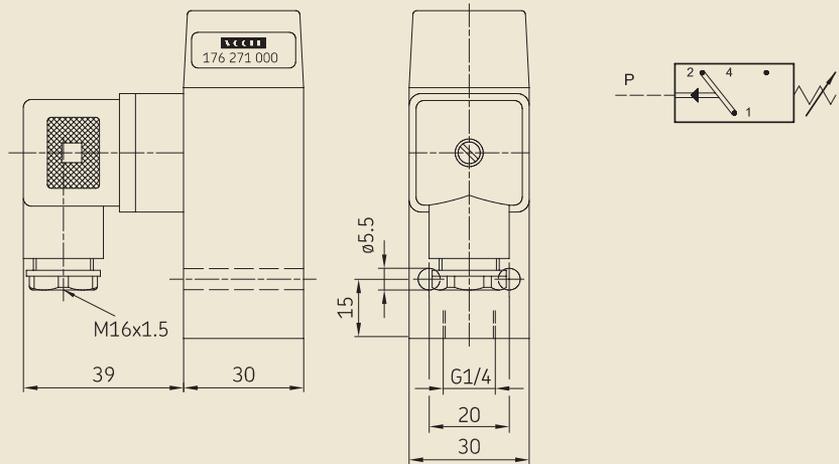
Technical data

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

Pressure switch for air

Drawing 11

Order No. 176-271-000



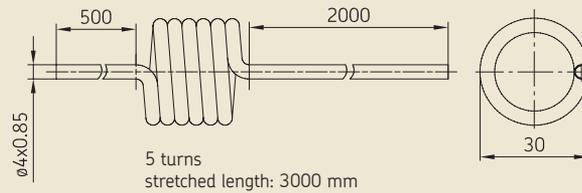
Helical coil

It is advisable to use flexible 4x0.85 plastic tubing to connect the unit to the friction point. The last end should be the form of a helical coil.

Helical coil

Drawing 12

Order No. 828-090-004



Nozzles

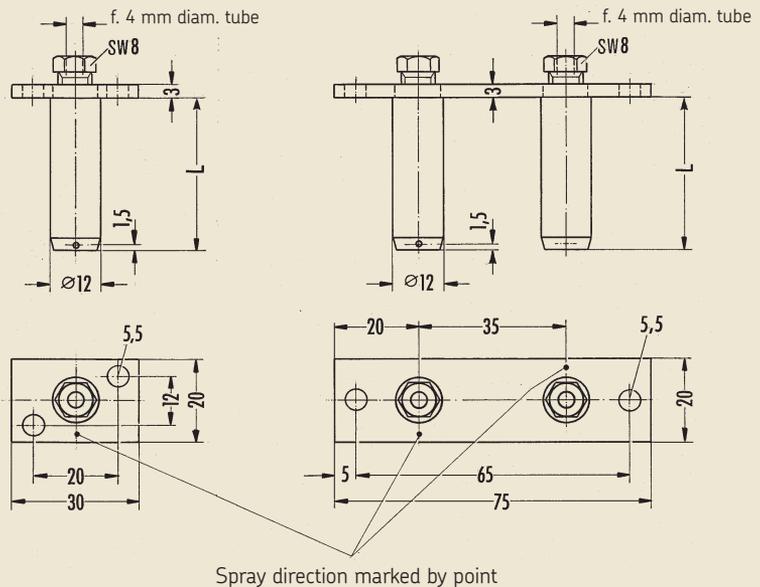
- spraying of chains, tooth flanks of gear trains
- slideways
- to wet workpiece surfaces

Nozzles

Drawing 14

Order No. 169-000-101

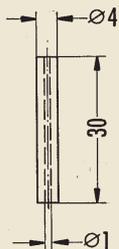
Order No. 169-000-102



Nozzle

Drawing 13

Order No. P-89.29



Oil-streak sensor, cf. leaflet 1-1704-US
Electronic control unit
 cf. leaflet 1-1700-3-US

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



Notice!

All products from VOGEL may be used only for their intended purpose. If operating instructions are supplied together with the products, the provisions and information therein of specific relevance to the equipment must be observed as well.

In particular, we call your attention to the fact that hazardous materials of any kind, especially the materials classified as hazardous by EC Directive 67/548/EEC, Article 2, Par. 2, may only be filled into VOGEL centralized lubrication systems and components and delivered and/or distributed with the same after consultation with and written approval from VOGEL.

All products manufactured by VOGEL are not approved for use in conjunction 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.

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Willy Vogel Aktiengesellschaft

SKF LubricationSolutions

Motzener Strasse 35/37 · 12277 Berlin · Germany

PF 970444 · 12704 Berlin · Germany

Tel. +49 (0)30 72002-0 · Fax +49 (0)30 72002-111

info@vogel.skf.com · www.vogelag.com · www.skf.com

Order No. 1-5012-3-US

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