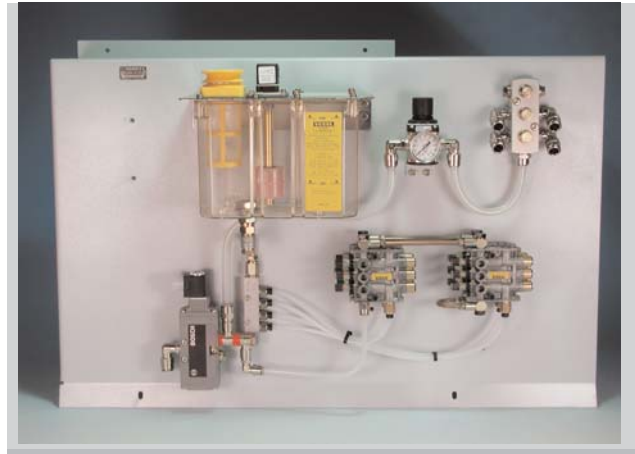


for the lubrication of spindles, linear guides, rack pinions



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

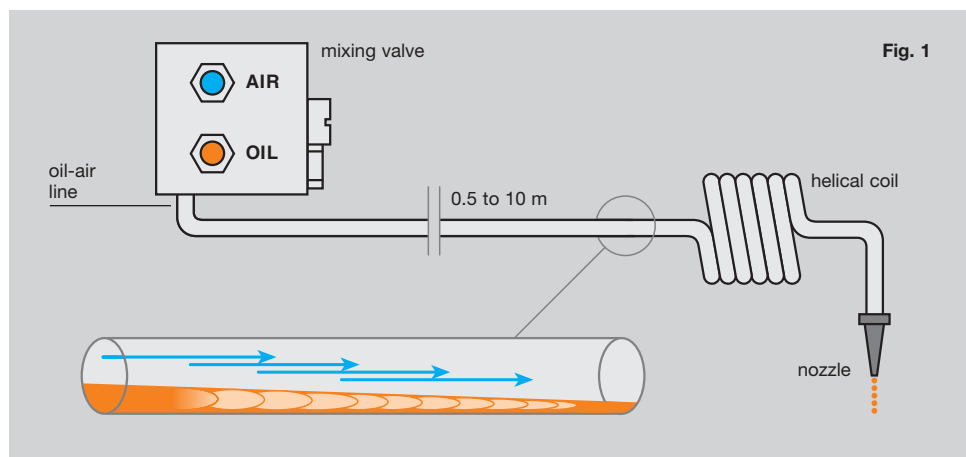
Less lubricant

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 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

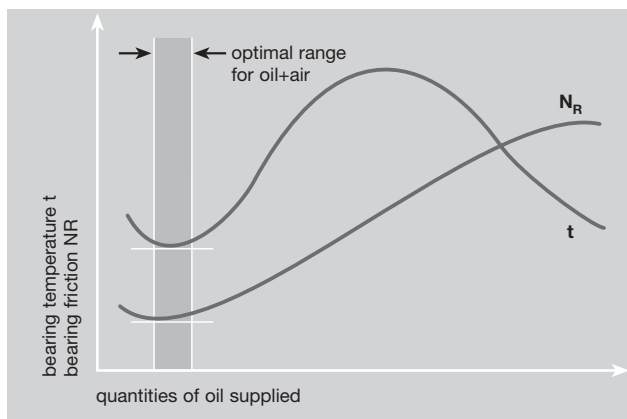
Example: rolling bearings

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, 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 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 $n \cdot d_m$ from < 1 to $1.5 \cdot 10^6$ 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 $n \cdot d_m$ 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 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 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. 1). 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 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. 2). 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.

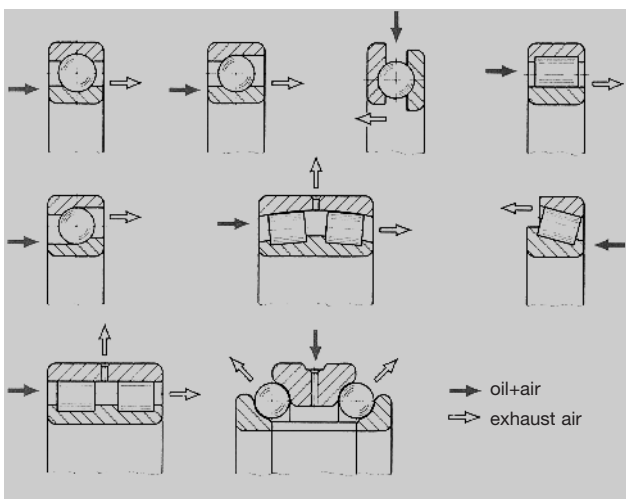


Fig. 1 feeding of oil+air to the rolling elements



Fig. 2 examples of lubricant fed through the outer ring

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 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 **G54-20** (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 GS 4011 or GS 6011** (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.

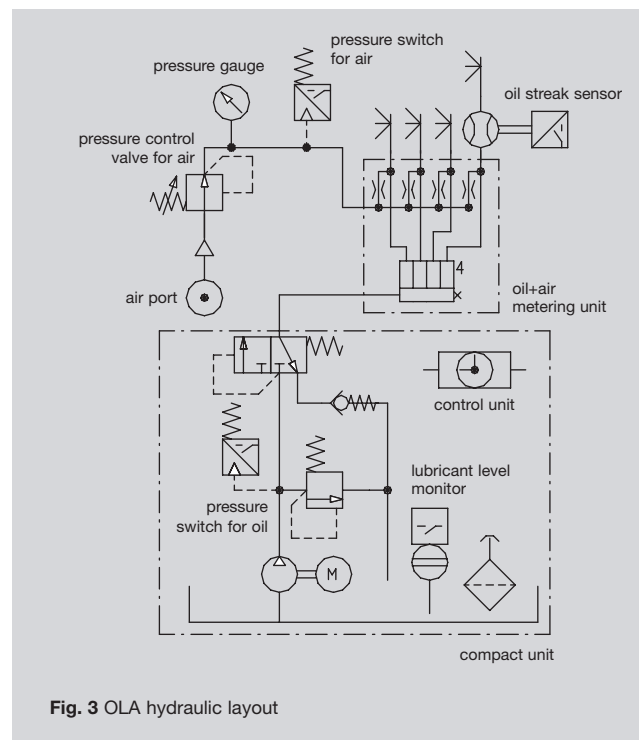
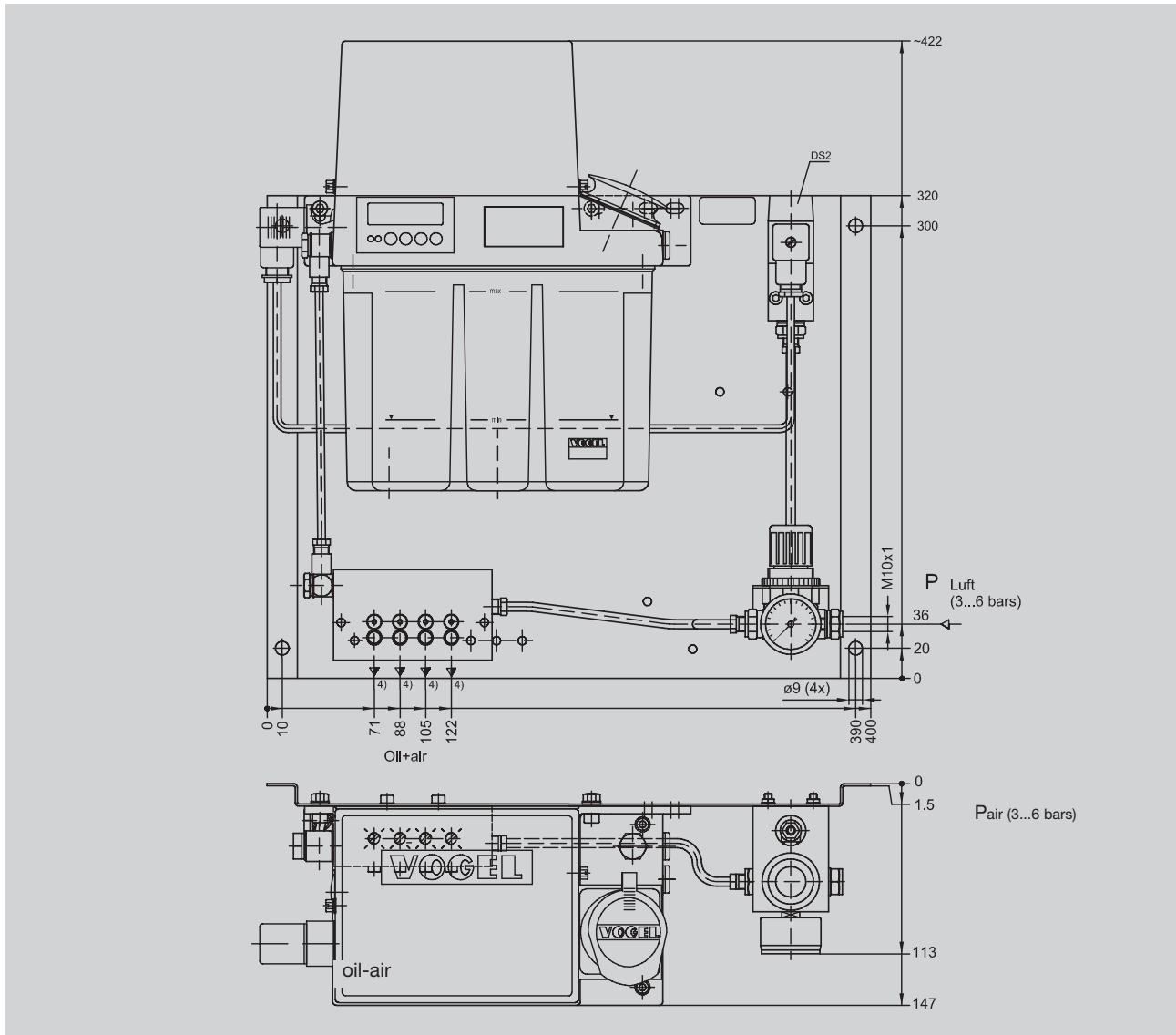


Fig. 3 OLA hydraulic layout

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	MV204-2	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
OLA03-53001	2	MKL2-KW3-23041	MV203-20	integrated control unit IG54-20-I, 5 µm air filter, 1µm 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 (version to VW specs)
OLA20-00003	20	without	2 x MV204-20 2 x 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

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 1500 mm²/s
 Reservoir capacity 3 l
 Reservoir material SAN
 Operating pressure 30 +/-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 lubricant at critical level

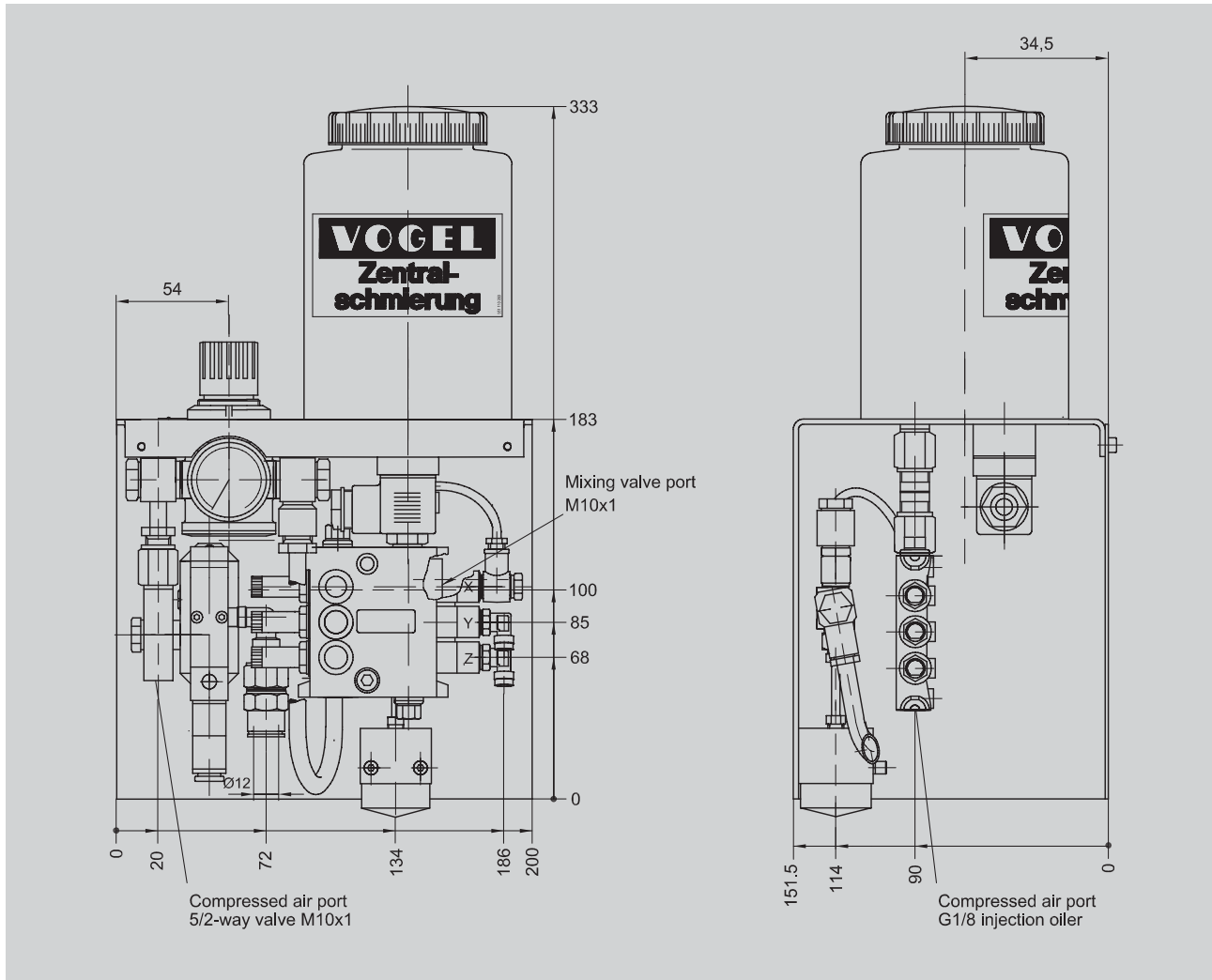
Control unit

Model designation IG54-20-S4-I
 Interval time 1 to 99 min
 Factory setting 10 min
 Contact time max. 60 sec

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

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

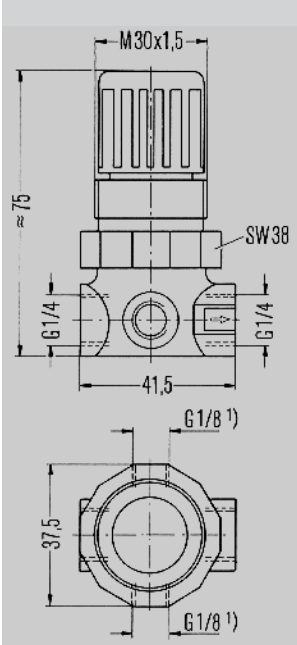
Rated flow 450 l/min

Pressure, min. 2 bars

Please indicate voltage when ordering

Accessories for oil+air lubrication

Pressure control valve for air

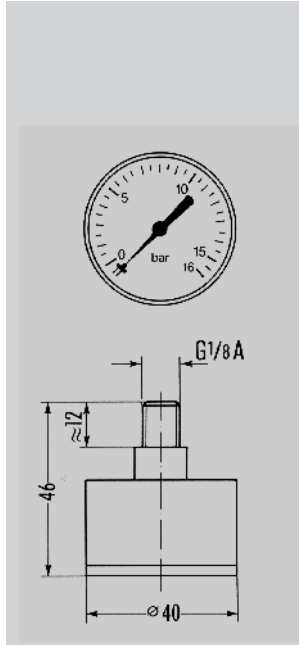


Order No. 231-900-025

Max. primary pressure 20 bars
Temperature +20 °C to +65 °C

1) port for pressure gauge

Pressure gauge for compressed air



Order No. 169-101-606

Display range 0 to 16 bars

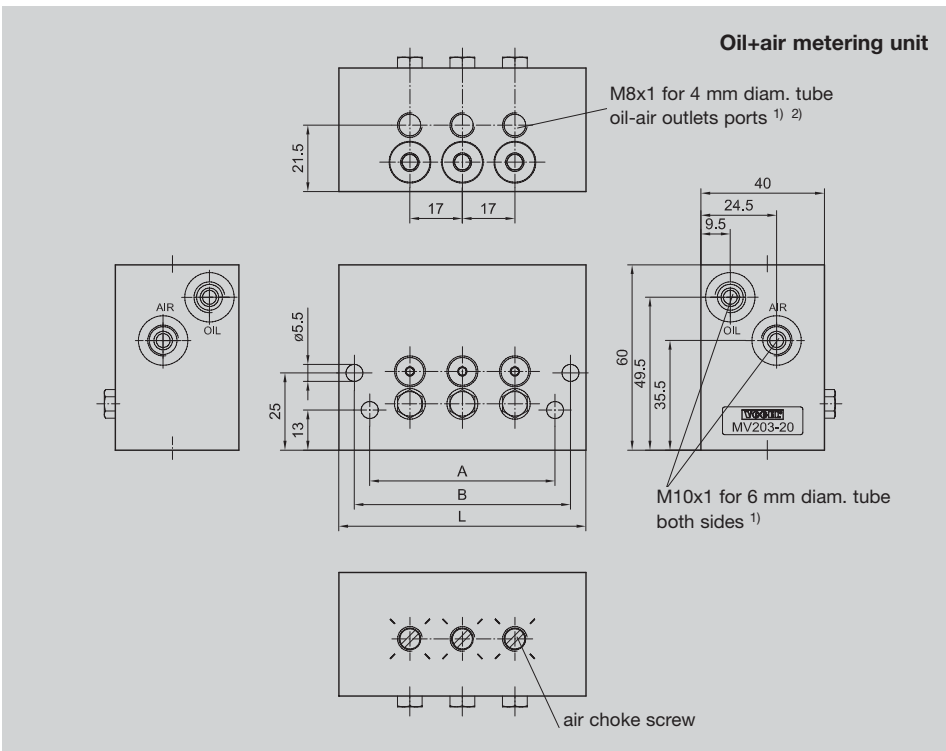
Oil+air metering unit

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]	Order key	Metering nipple	Marking
0.01	1	not exchangeable	1
0.03	2	exchangeable	3
0.06	3	exchangeable	6
0.10	4	exchangeable	10
0.16	5	exchangeable	16



Technical data

Minimum air pressure:
3^{+0.5} bars

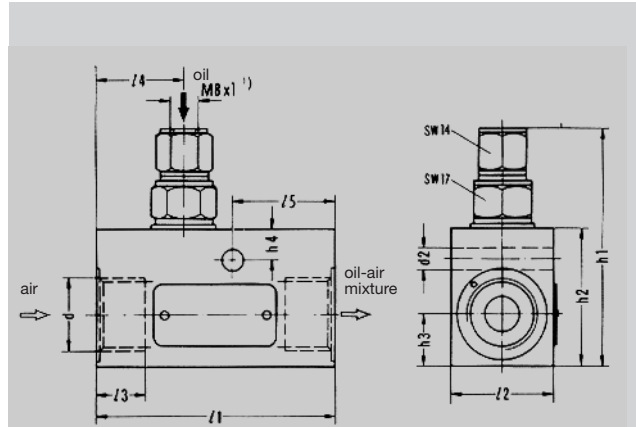
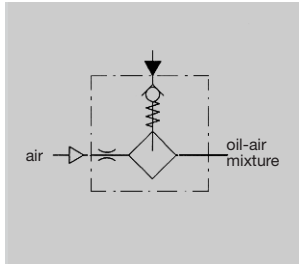
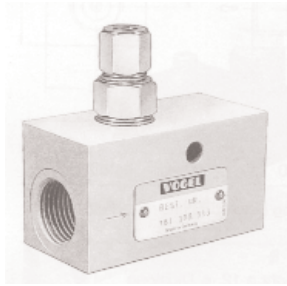
Minimum oil pressure for metering
with 0.01 ccm: 17 bars
with 0.03; 0.06; 0.1; 0.16 ccm: 13 bars

Preferred mounting position:
oil+air outlet ports pointing down or up

- 1) Port tapped for solderless tube connection
- 2) Close unneeded outlet ports with screw plug MV202.U10; remove the inlets first.

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.

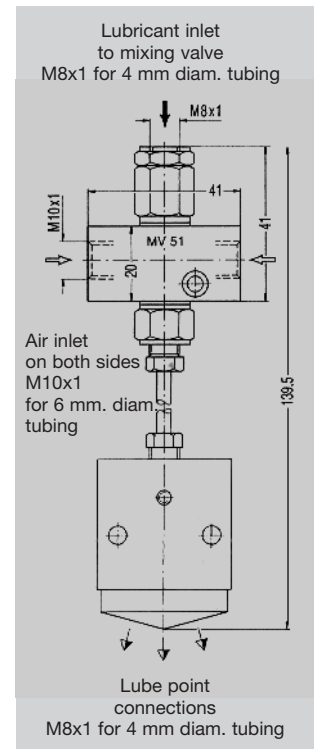
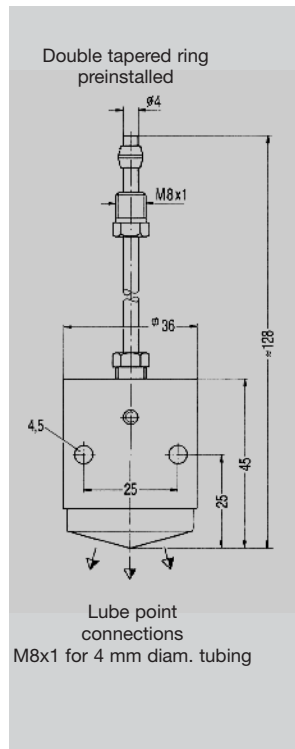


1) Port tapped for solderless tube connection
M 8 x1 for 4 mm diam. tubing, mounting position as illustrated

Order No.	d	l1	l2	l3	l4	l5	h1	h2	h3	h4	associated connectors			associated sealing ring	
											d2	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.



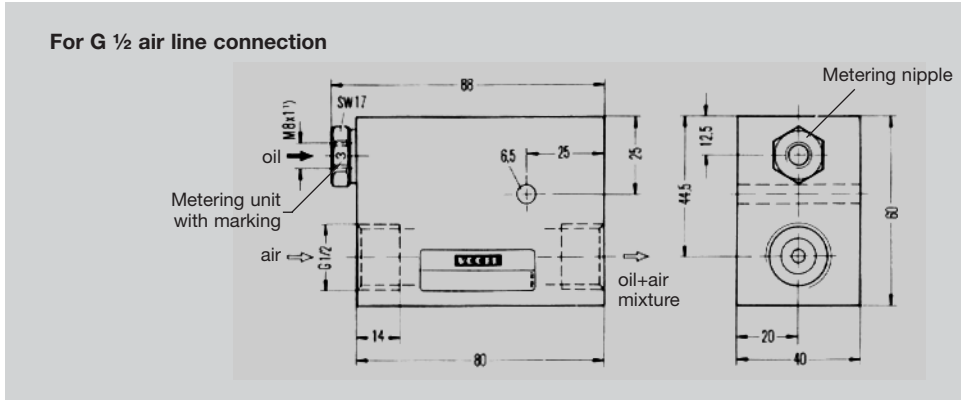
Order No.	Lube points
169-000-182	2
169-000-183	3
169-000-184	4
169-000-185	5
169-000-186	6

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.



Order No. 161-300-338

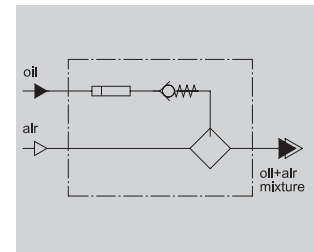
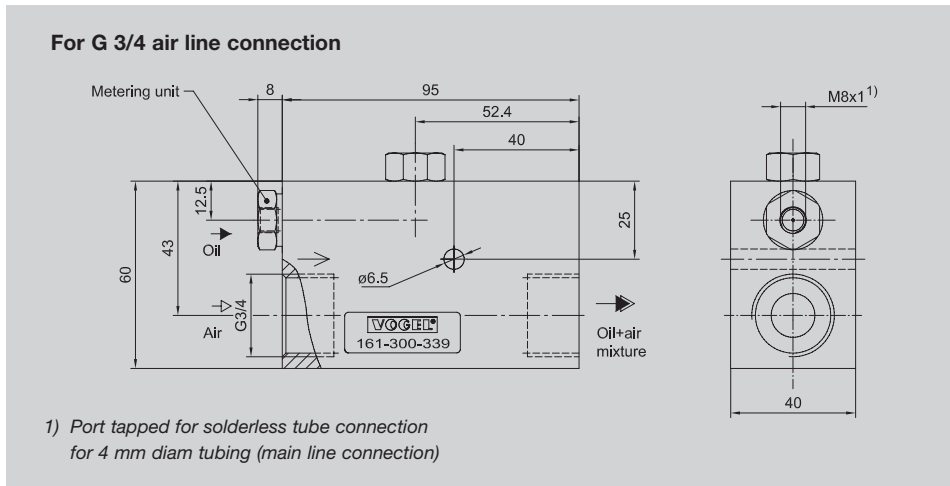
associated connecting pieces

sealing ring:
DIN7603-A21x26-CU

Metering [ccm]
0.03; 0.06; 0.10

for tubing ø 8: 267-001.13
for tubing ø10: 410-171
for tubing ø12: 267-001.15

mounting position as illustrated

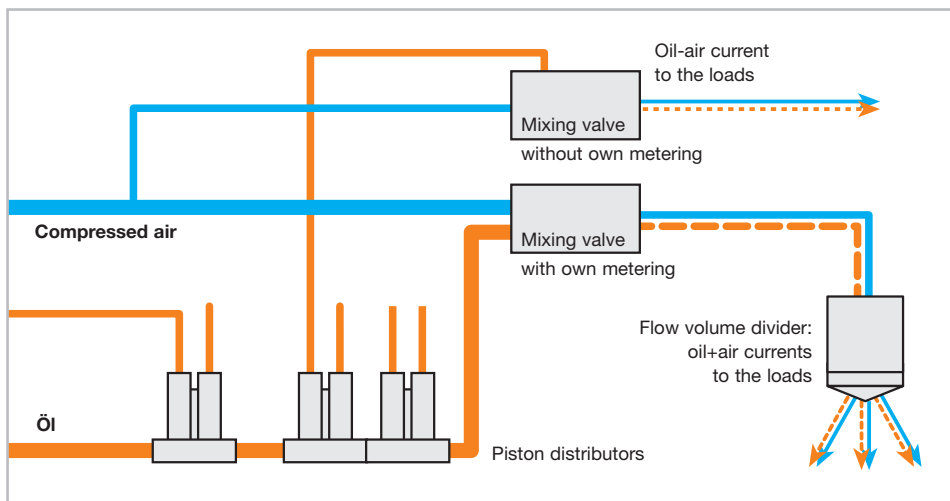


Order No. 161-300-339

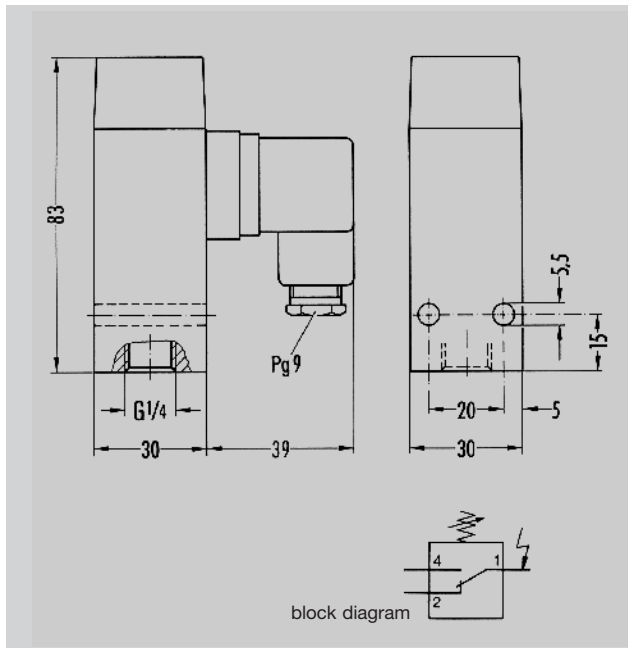
Metering [ccm]
0.03; 0.06; 0.10

Mounting position as illustrated

Metering unit, exchangeable	Order No.	Metering [ccm]	Marking
Please indicate order No. of desired metering unit	321-403G4	0,03	3
	321-406G4	0,06	6
	321-410G4	0,10	10



Pressure switch for air



Technical data

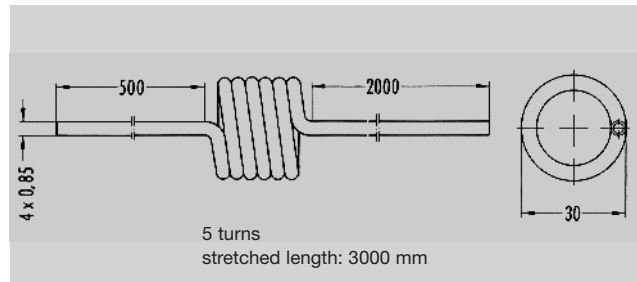
Switching pressure (adjustable) 1 to 10 bars
 Reset differential (non-adjustable) 10 %
 Switching frequency 200/min
 Max. voltage 250 V
 Switching capacity
 Ohmic load 6 A at 24 V DC and 0.5 A at 230 V DC
 Inductive load 6 A at 24 V AC and 3 A at 230 V AC
 Type of enclosure IP 65

Order No. 176-271-000

Oil-streak sensor, order No. GS 4011, GS 6011
 cf. leaflet 1-1704-US

Electronic control unit IG54-20
 cf. leaflet 1-1700-3-US

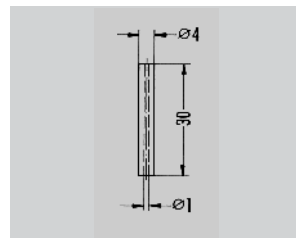
Helical coil



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.

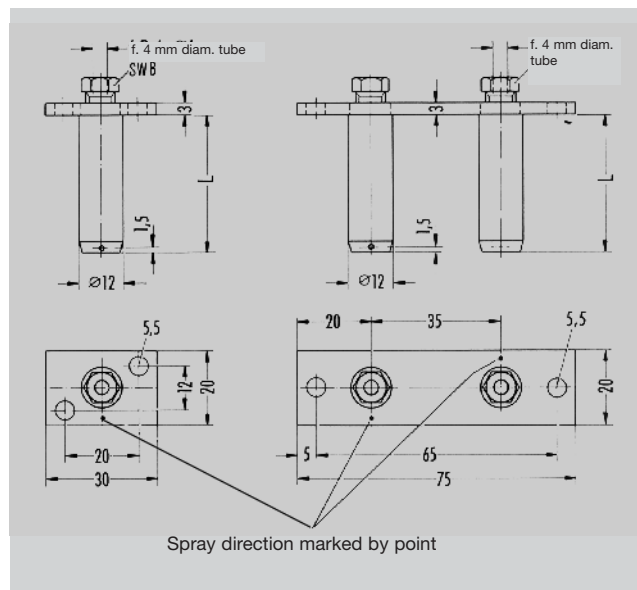
Order No. 828-090-004

Nozzles



Order No. P-89.29

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



Order No. 169-000-101

Order No. 169-000-102

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



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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.