

SKF LubriLean

Minimal Quantity Lubrication (MQL) for Dry Machining Processes



Internal minimal quantity lubrication



External minimal quantity lubrication



An aerosol is generated in the MQL equipment's reservoir and fed through the rotating spindle or turret to the tool. With an optimal setting, the metered quantity of oil is completely used up without any residue being left.

Metered lubricant is atomized by compressed air in a spray nozzle. That produces micro-droplets that make their way together with the carrier air to the friction point without any mist being formed.

Conversion from wet machining to dry machining in the production process results in the following benefits:

Cut costs

- No need for cooling lubricants
- No need for machine tool components like lubricant filters and conditioning systems
- No disposal costs for chips and cooling lubricants
- No need to wash workpieces

Improve productivity

- Significant reduction of production time (30-50%)
- Higher cutting efficiency
- Tool lives increased by as much as 300%
- Reliable control of production processes

Utilize a technological advantage

- Solutions for OEMs and retrofitters
- Parallel use of wet and dry machining
- Better surface finish

The path from wet to dry machining

Productivity and the environment

In many cases, the driving force behind the introduction of dry machining is the recognition that today workpiece-related costs for cooling lubricants can be several times higher than tool costs. Moreover, the handling of cooling lubricants is causing problems, including the burden they place on employers and the environment.

Since there is no need for a cooling-lubricant cycle in the value-added process, there is a direct reduction of costs. Experience shows that productivity is significantly improved at the same time: production times are cut by as much as 50% regardless of the production job and choice of tools. Since there is no need to clean workpieces, the process chain is shortened and further costs saved as a result. Internally, a conversion of production processes from wet to dry machining helps to motivate personnel; externally it contributes to a better corporate image.

In addition, lawmakers and statutory accident insurance associations are enacting stricter laws and regulations in reaction to the hazards posed by cooling lubricants. For a company, that means not only more responsibility and new obligations vis-à-vis the personnel but also, and above all, higher costs.

Wide-scale introduction of dry machining in the production sector makes it possible to avoid the economic and ecological problems entailed by wet machining.

The use of minimal quantity lubrication significantly reduces process costs and protects the environment.

Technology and use

An overall MQL system of the single-duct type consists of harmonized components that work together to lubricate the cutting area. In practice, that means the end user does not have to optimize any, or only a few, components for his part-related cutting task (rewriting NC programs, choosing tools, optimizing processes).

It is very easy for a user to install a minimal quantity lubrication system with a single-duct aerosol feed. The MQL units of the SKF LubriLean group require very little maintenance and do not wear, because they are free from movable components. Single-duct MQL equipment is integrated into time-proven and mature machine-tool components. Single-duct MQL systems can be integrated in turning machines with tool turrets.

While day-to-day production operations are being converted to MQL technology, it is possible to alternatively perform wet and dry machining on one and the same machine with SKF system solutions. Mixed MQL/wet machining thus permits a seamless switchover to minimal quantity lubrication. So SKF LubriLean makes it possible to gradually convert a company's range of products to MQL technology.

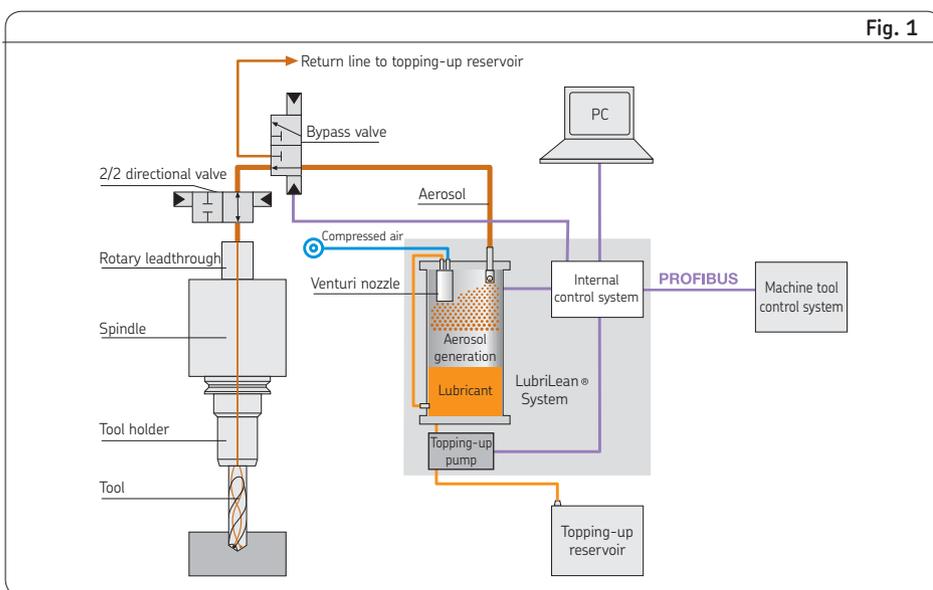


Fig. 1
SKF LubriLean – Minimal Quantity Lubrication System in Modern Machining Centers

Basics of minimal quantity lubrication

Design and function

With MQL, the lubricating between the tool and workpiece is done with a flow of air containing finely dispersed droplets of oil, a so-called aerosol.

The systems described here contain a special aerosol generator that can produce aerosols with an oil droplet size of $\cong 0.5 \mu\text{m}$. Thanks to this small size, the droplets of oil have hardly any inertia or rate of fall.

That makes it possible to transport the aerosol over long distances, via sharp deflections or through high-speed rotating tool spindles without any notable demixing, so all the lubricant particles are fed to the tool's cutting edge.

Effective lubrication of the cutting process can be achieved with extremely small amounts of oil. Higher productivity is achieved due to higher cutting speeds and longer tool lives. And there is no need to condition or dispose of cooling lubricants.

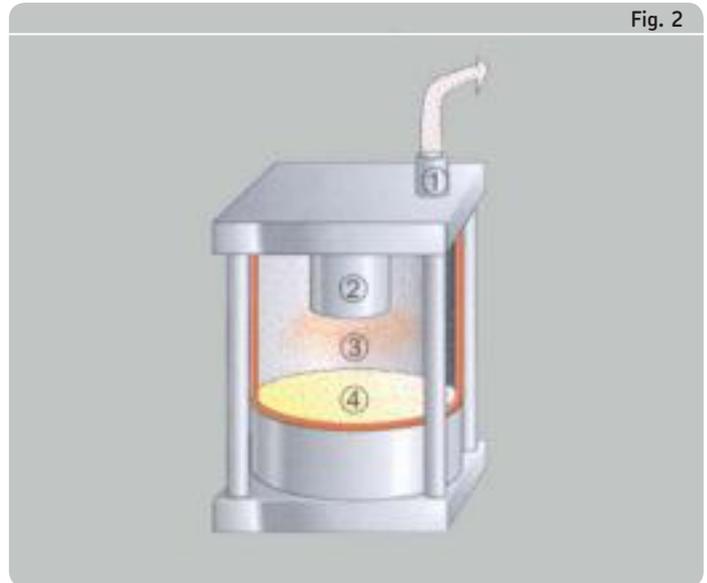


Fig. 2
 1) Aerosol transport
 2) Aerosol generator
 3) Lubricant particles
 4) Lubricant

How the aerosol works

The size and distribution of the droplets of oil in the aerosol are very homogenous with SKF LubriLean minimal quantity lubrication systems since the aerosol is atomized under controlled conditions.

That results in the following physical advantages:
 In addition to the high degree of surface wetting, extremely fine particles of lubricant also reach inaccessible spots on the workpiece.

Difficult through-feed tasks with deflections of the kind found in the turrets of turning machines can also be handled. Also, the transport of aerosol to the active site does not present any problem in the case of milling machines running at speeds of more than 20 000 rpm.

Lines as long as 20 m from the minimal quantity lubrication system to the machining site are likewise no problem for these installations.

The friction, and thus the transfer of heat from the chip to the tool and workpiece, is reduced. Optimal lubrication during removal of the chips in the chip groove not only permits higher machining speeds but also results in a much better workpiece surface finish.

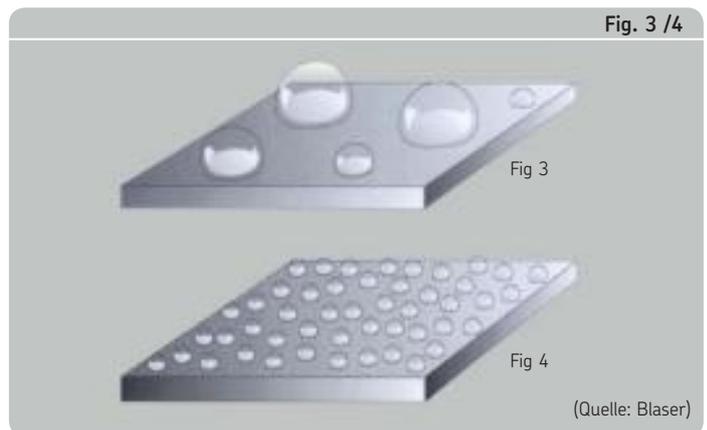


Fig. 3 (conventional processes):
 Poor wetting of the workpiece and tool due to uncontrolled atomization of the air/oil droplets at the nozzle.

Fig. 4:
 SKF LubriLean droplets wet the workpiece evenly due to much smaller, homogenous droplets.

Internal Minimal Quantity Lubrication (MQL) with DigitalSuper / Vario

How it works

A fine aerosol with an homogenous particle size of ~ 0,5 µm is produced in the reservoir from a lubricant and compressed air with a special nozzle system. Thanks to the small particle size, the aerosol passes through the rotating spindles of machining centers or through the winding ducts of turrets on modern turning centers without any demixing taking place en route. Dependable machining is assured by such loss-free transport.

Modern machining centers with a large number of tools require individual control of the aerosol quantity by stored-program control (SPC) of the machine tools. This control possibility is provided by the SKF LubriLean DigitalSuper system. The aerosol quantity and

composition required for the respective tool and cutting task are set by valves switched with M or H commands from the machine's control system.

The required aerosol quality is adjusted with the SKF LubriLean Vario system by manual regulation of the air pressure and quantity of lubricant.

Advantages

- Can be used in nearly every production process in machining centers (optimally defined droplet size $\cong 0.5 \mu\text{m}$)
- Short response times (tool change)
- No moving parts (wear-free)
- Specially suitable for small tools and high cutting speeds
- Simple integration in machine tool systems (retrofitting, standard production)

Transport of the aerosol through lines as long as 20 m is no problem for SKF LubriLean DigitalSuper and Vario systems.

A ball valve has to be installed directly upstream of the spindle inlet or turret to assure short response times despite long transport routes.

A "bypass" system can be optionally integrated in the aerosol feed (Fig. 1, page 2) to achieve shorter response times – related to the supply of altered quantities of aerosol.

The production of aerosol is not stopped during the tool change. The newly required amount of aerosol is produced instead.

The aerosol is directed through a 3/2-way ball valve. That makes sure the new quantity of aerosol is available right away when the process starts.

The aerosol produced during the tool change can be routed directly into the exhaust system or – if the system is optionally outfitted with an additional topping-up reservoir – through a demixing device.

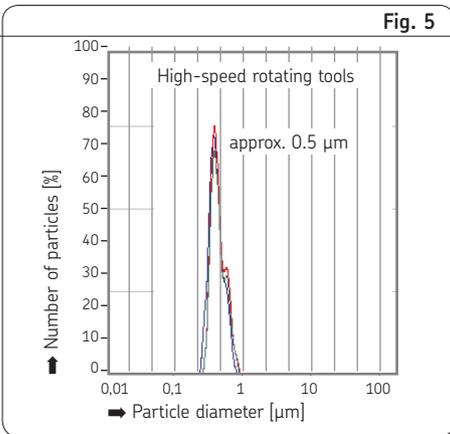
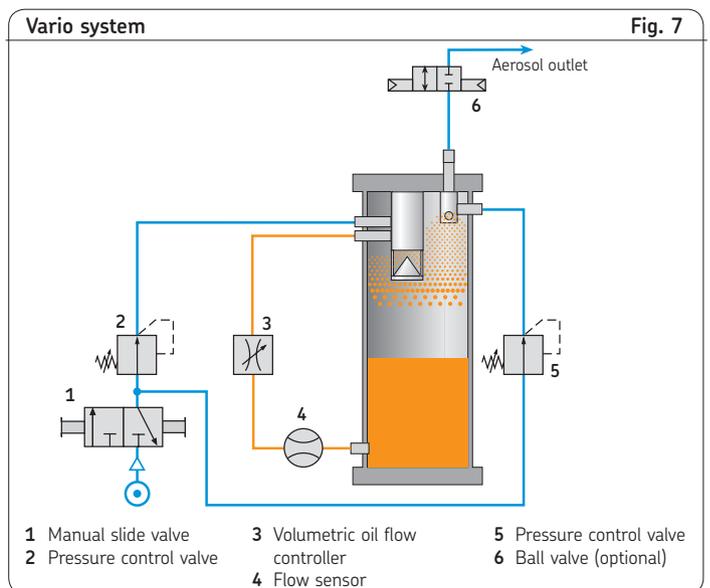
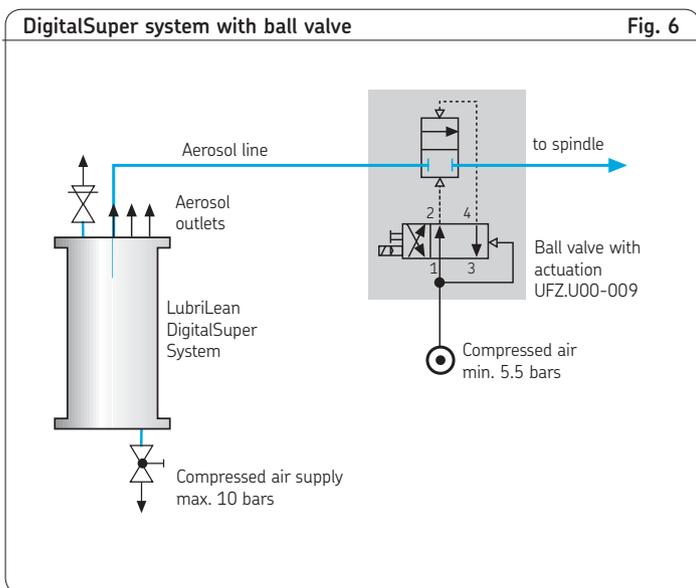


Fig. 5
Distribution of particle size with DigitalSuper and Vario

See important product usage information on the back cover.



External Minimal Quantity Lubrication (MQL) with Basic / Smart

How it works

The SKF LubriLean Basic and Smart minimal quantity lubrication system consists of a lubricant reservoir, one or more mixture regulation units and lubricant lines with spray nozzles.

The compressed air fed to the system pressurizes the lubricant reservoir resulting in the lubricant being transported separately (= dual ducts) through a system of ducts and lines to the spray nozzle.

What is meant by a double-duct function?
Regulation of the required quantities of lubricant and atomizing air as well as adjustment of the lubricant reservoir's internal pressure are done by hand via the control valves mounted on the lubricant reservoir.

The lubricant lines are coaxial lines so that the lubricant and atomizing air can be transported separately to the spray nozzle. The nozzle is a binary nozzle, since two different substances are mixed with each other.

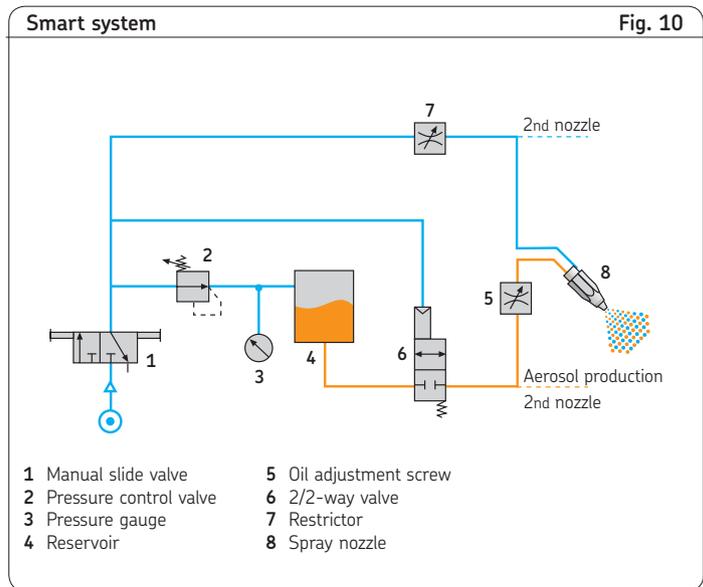
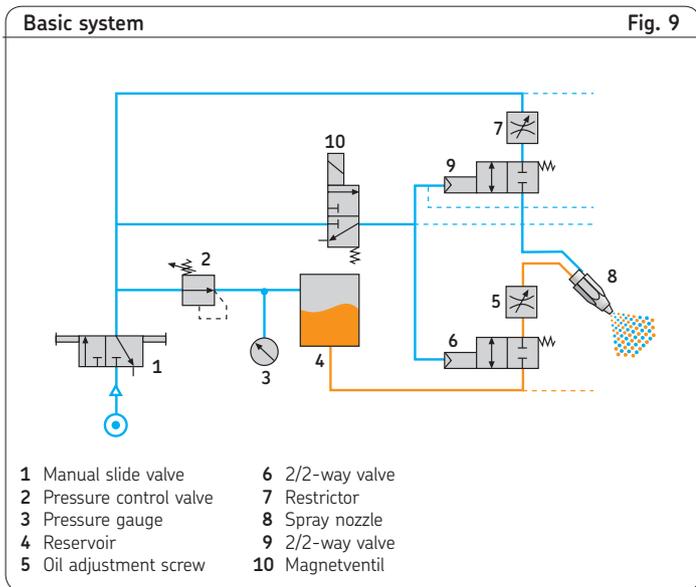
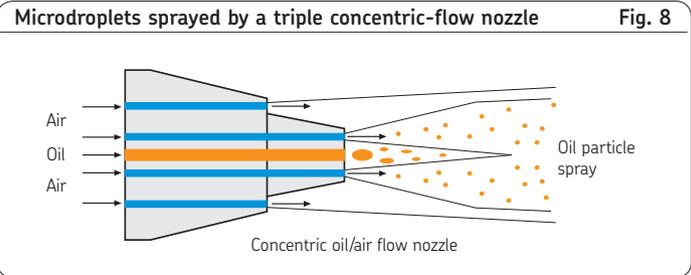
Spray nozzles

The aerosol required at the process point is produced at the nozzle outlet. The lubricant and required atomizing air are fed through coaxial lines from the minimal quantity lubrication system to the spray nozzle. The lubricating mixture is formed at the nozzle outlet by the Venturi principle. Carrier air flowing past the oil outlet sweeps the lubricant along with it and turns it into extremely fine lubricant particles.

The concentric oil/air flow that results from this special design keeps the jet from expanding and causes the aerosol to be delivered to the process spot with pinpoint accuracy. As a result, contamination of the surroundings with excess aerosol is successfully prevented.

Advantages

- Conventional machine tools can be easily retrofitted
- Simple adaptation
- Fast response
- High process reliability
- No dripping nozzles after shutdown
- Large spray distances achievable (up to 300 mm)
- Small amount of jet spray
- Better surface finish
- No lubricant residue on workpiece or chips
- Greater workplace safety and environmental hygiene
- Fast amortization of system due to longer tool lives



Applications of the SKF LubriLean Systems

DigitalSuper

Machining centers
Turning centers

The DigitalSuper 2 is available for use on machining centers with double spindles or turning machines with two turrets.



Vario

Turning, milling, drilling

Special applications
(e.g. multispindle machines)



VarioPlus

Turning, milling, drilling

Retrofitting of turning and machining centers

Also suitable for small tools



VarioSuper

Machining centers
Turning centers
Special machines



Basic / Smart

Drilling, milling, broaching, tapping, thread forming

Universal milling machines

Applications with up to two (Smart) or eight (Basic) lube points



Technical Data

		DigitalSuper	Vario	VarioPlus	VarioSuper	Basic	Smart
Metal housing		●	●	●	●	●	●
Capacity [liters]		1.8	1.8	1.8	1.8	3	0.3; 0.5; 0.8
Internal lubrication		●	●	●	●	–	–
External lubrication		●	●	●	●	●	●
Compressed air port [bars]		min. 6 opt. 8 max. 10	≥ 4	≥ 4			
Actuation	standard	24 V DC	Manual slide valve	24 V DC	24 V DC	Manual slide valve	Manual slide valve
	optional	–	24 V DC	–	–	24 V DC	24 V DC
Level monitoring	4 points	●	○	●	○	○	–
	2 points	–	○	–	●	○	–
Visual filling level indicator		●	●	●	●	●	●
Flow sensor		●	–	–	–	–	–
Pressure monitoring		●	–	–	●	–	–
Number of outlet ports		1 to 3	1 to 3	1 to 3	1 to 3	1 to 8	1 to 2
Air consumption [Nl/min]		15 - 300 **)	15 - 300 **)	15 - 300 **)	15 - 300 **)	≈ 50 per outlet	≈ 50 per outlet
Oil quantity [ml/h]		1 - 150 **)	1 - 150 **)	1 - 150 **)	1 - 150 **)	5 - 100	5 - 100
Mounting position		vertical	vertical	vertical	vertical	vertical	vertical
Weight empty [kg]		25	6.1	6.3	9.5	5	4

**) depending on choice of tool cooling duct diameter.

– not available

● standard

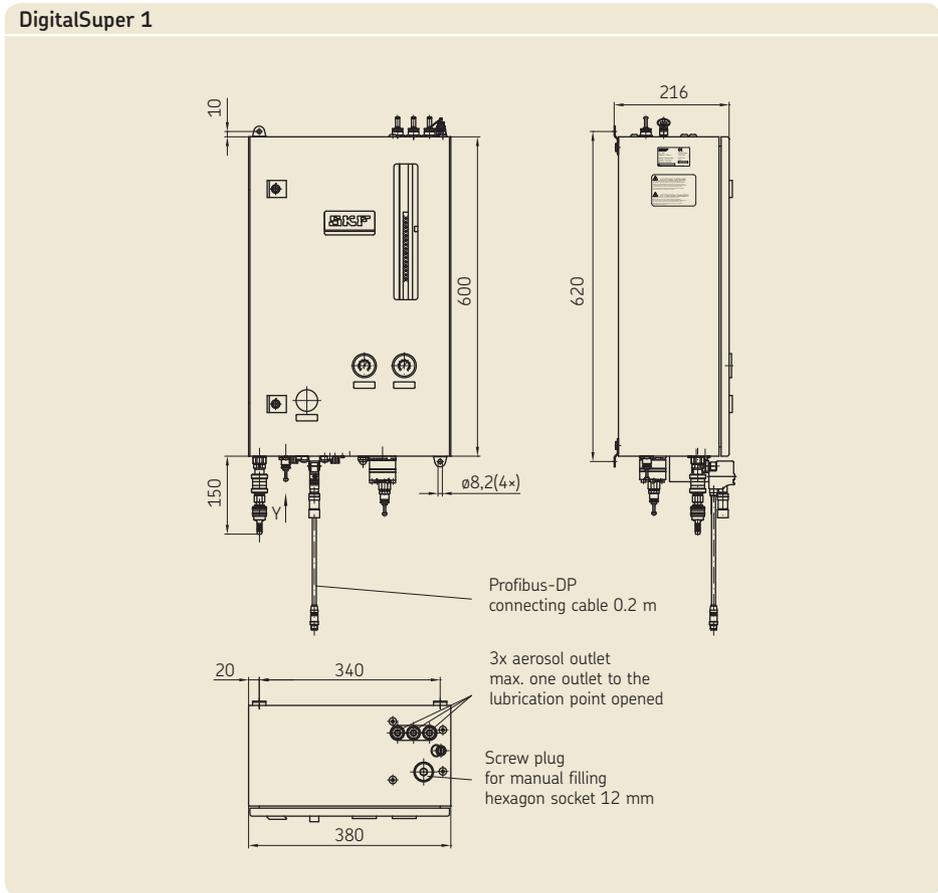
○ optional



DigitalSuper 1

Order No. UFD10-020

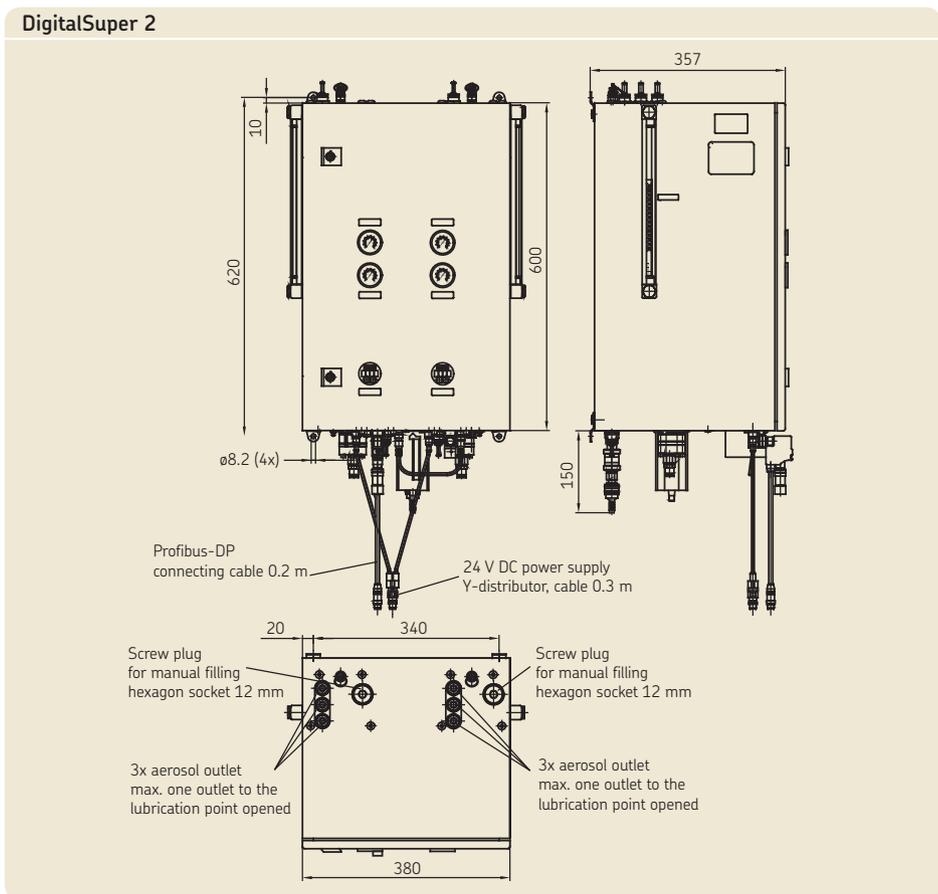
For further technical information, see brochure 1-5109-EN



DigitalSuper 2

Order No. UFD20-020

For further technical information, see brochure 1-5109-EN

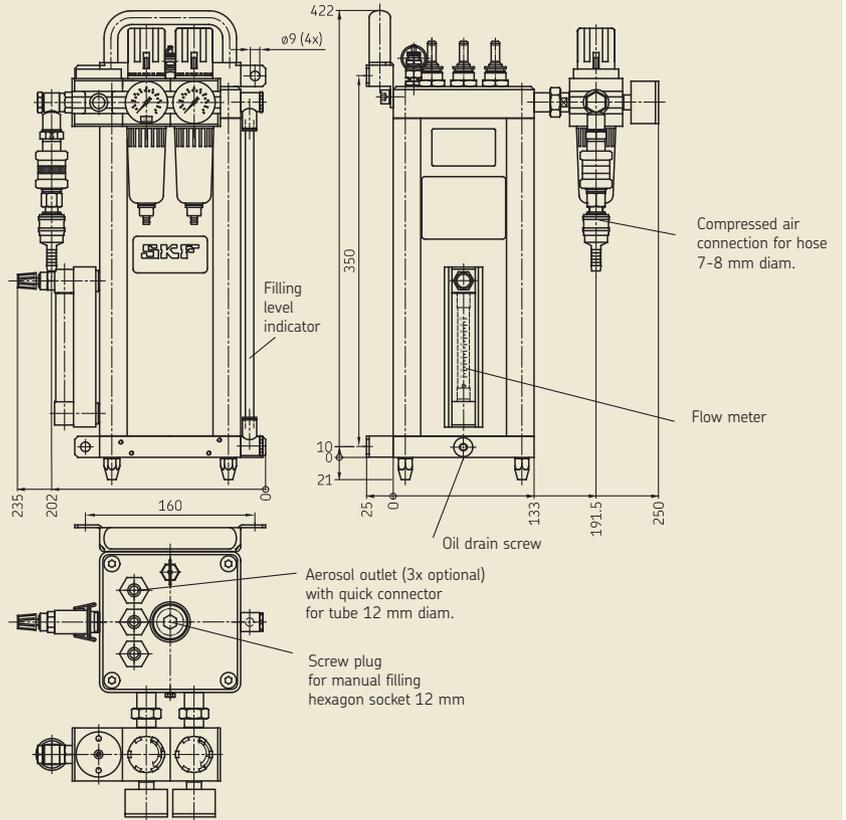




Vario

Order No. UFV10-001-2

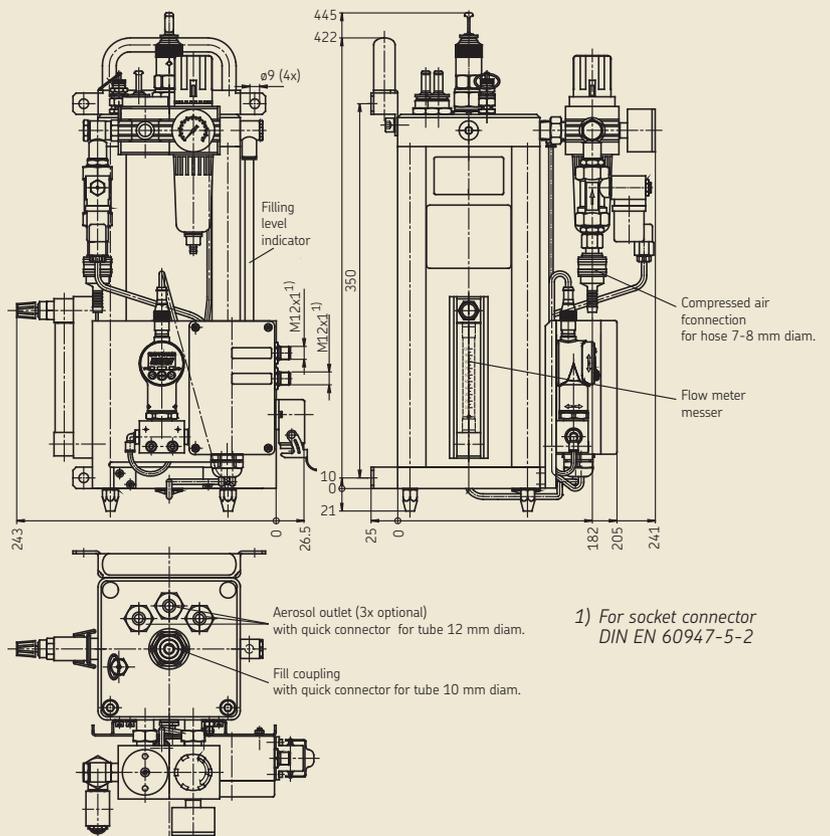
Vario



VarioPlus

Order No. UFV10-009

VarioPlus

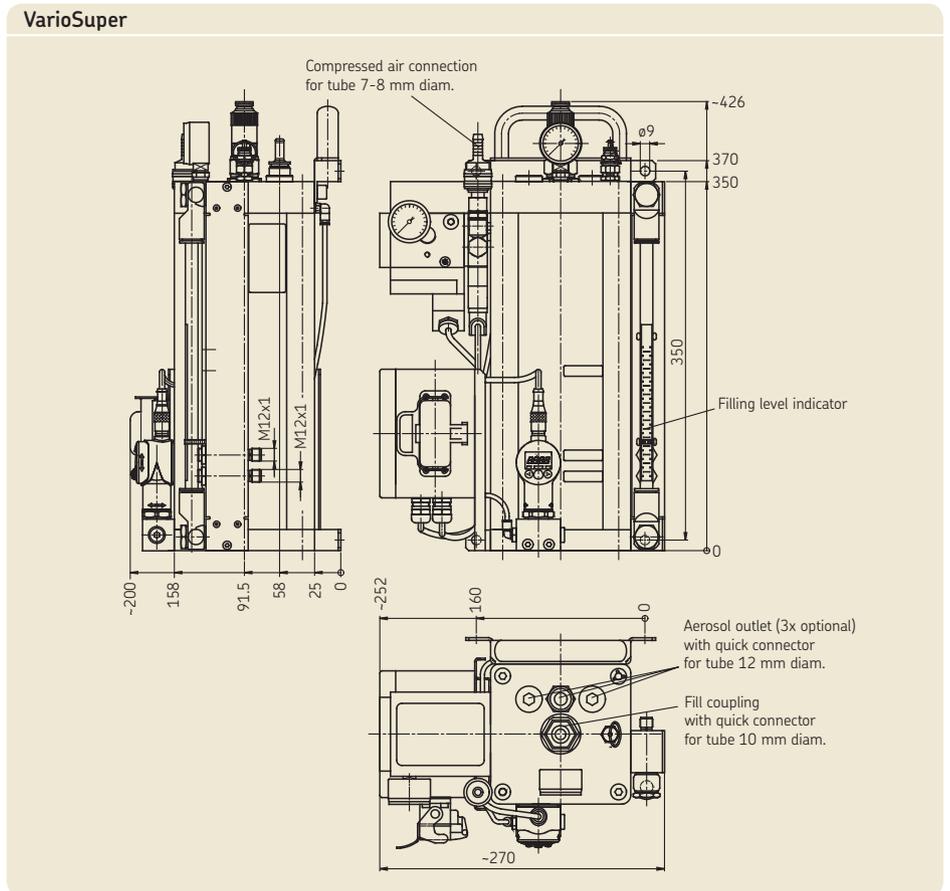


1) For socket connector
DIN EN 60947-5-2



VarioSuper

Order No. Ufv20-001

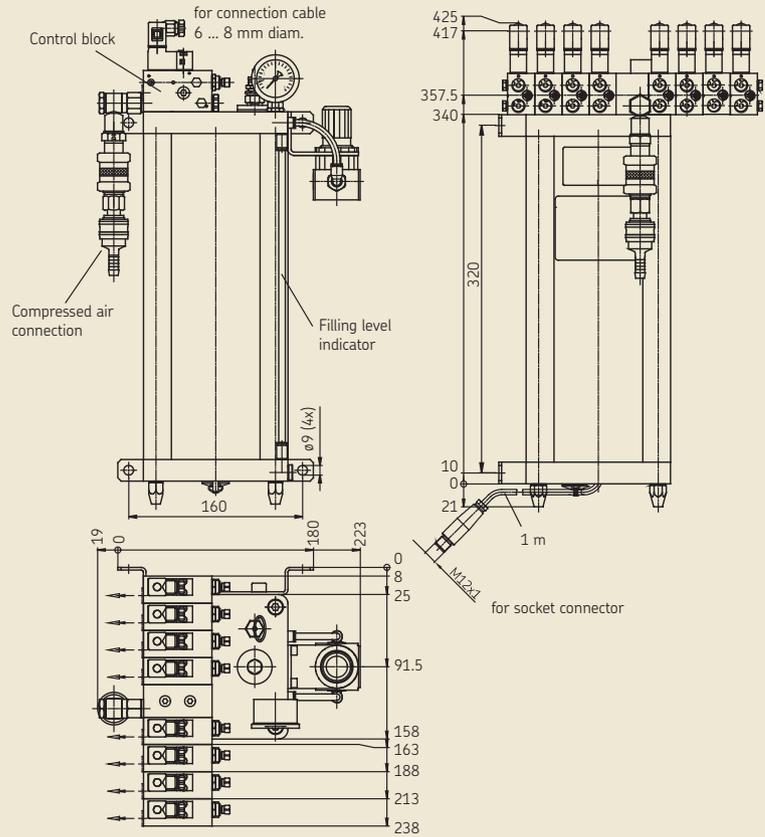




Basic

Order No. UFB20- ...
 (max. 8 lube points)
 Installation lines must be ordered separately
 (see page 13)

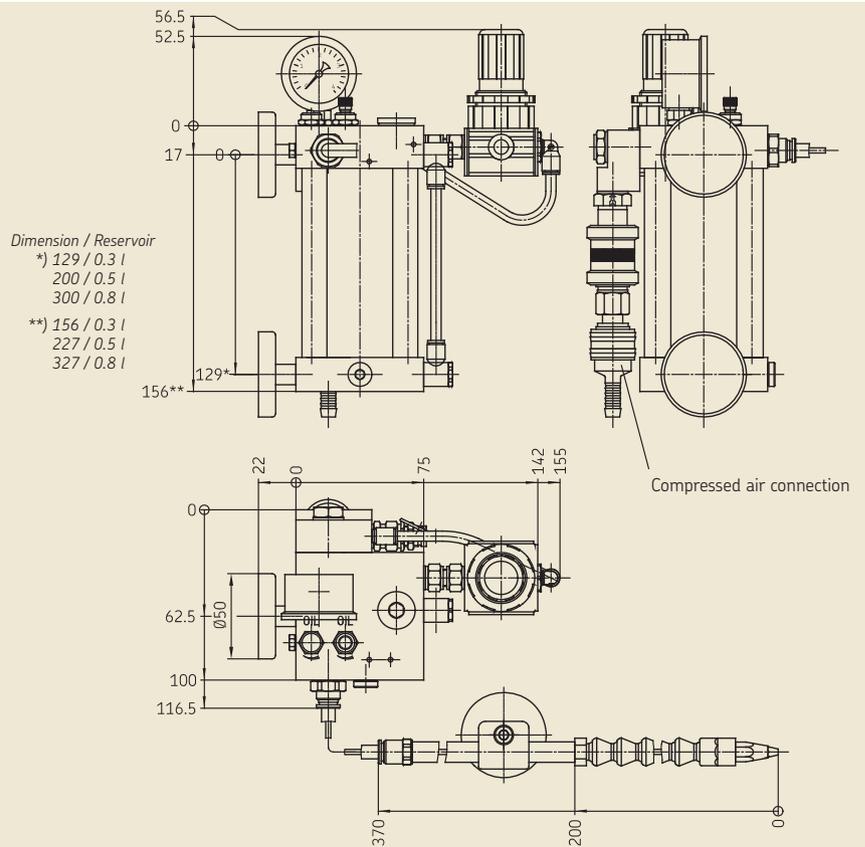
Basic



Smart

Order No.	Number of spray nozzles	Reservoir capacity
UFS20-001	1	0.3 l
UFS20-005	2	0.3 l
UFS20-002	1	0.5 l
UFS20-006	2	0.5 l
UFS20-003	1	0.8 l
UFS20-007	2	0.8 l

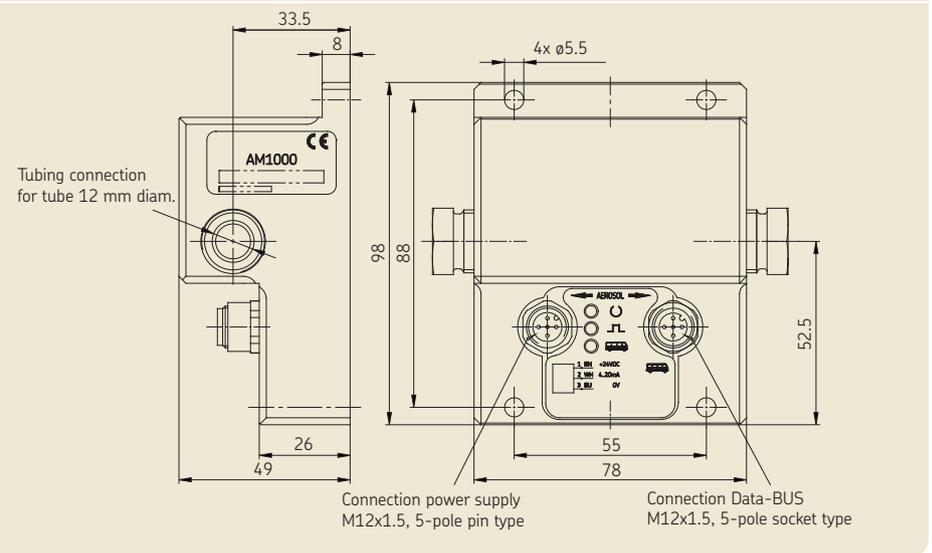
Smart



Accessories



Aerosol monitor



Aerosol monitor

Order No. AM1000

Technical data AM1000

Medium aerosol for MMS
 Typical droplet ø 0.5 to 5 µm
 Max. perm. pressure 10 bars
 Max. throughput 800 NI/min
 Ambient temperature 0 to +60 °C
 Mounting position upright, as drawn
 Degree of protection IP 54
 by enclosure (DIN EN 60529)
 Operating voltage 24 V DC ±25%
 Quiescent current consumption max. 60 mA
 Load current consumption max. 80 mA

Accessories for AM1000

Teach-adaptor UFZ.U00-137
 BUS cable 10 m UFZ.0370
 BUS cable 6 m UFZ.0369
 BUS cable 4 m UFZ.0375
 BUS cable 2 m UFZ.0368
 BUS cable 1 m UFZ.0374
 T-connector M12x1 * UFZ.0373
 cordset, 5 m
 single-endet M12x1 female connector
 and moldet cable 179-990-600
 single-endet M12x1 female right angle
 connector and moldet cable 179-990-601

* for continuation of Data-BUS line for use with two AM1000 at UFD20-02x



Basic line installation, coaxial, complete

Material: PU

Order No.	Length	Order No.	Length
UFZ.U00-070	5 m	UFZ.U00-080	15 m
UFZ.U00-071	10 m	UFZ.U00-072	20 m



Basic line installation, coaxial, complete

Material: Steel sheating

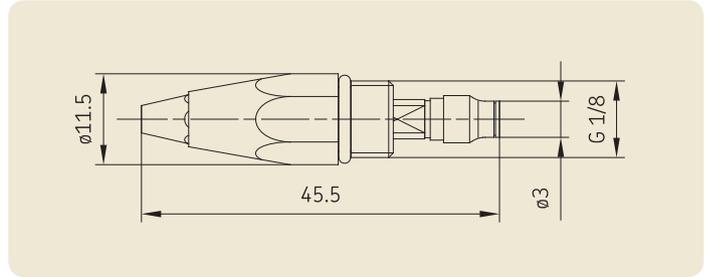
Order No.	Length	Order No.	Length
UFZ.U00-067	5 m	UFZ.U00-079	15 m
UFZ.U00-068	10 m	UFZ.U00-069	20 m

Accessories

Concentric flow nozzle

Order No. UFZ.U00-022

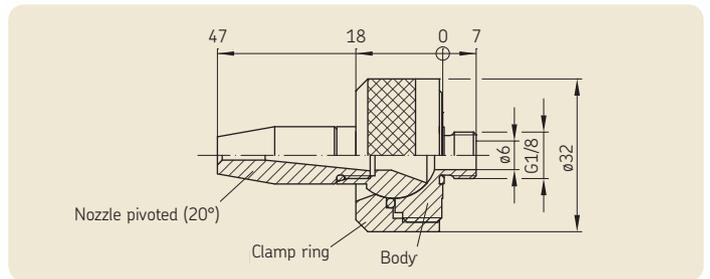
Application:
External lubrication for
SKF LubriLean Basic / Smart
systems



Nozzle pivoted

Order No. UFZ.U00-150

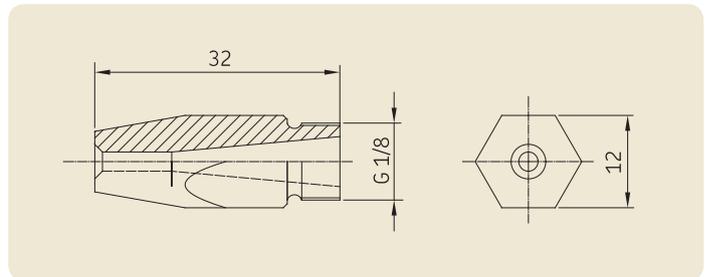
Application:
External lubrication for
SKF LubriLean DigitalSuper /
Vario systems for machining
centers



Special nozzle 1/8

Order No. UFZ.0026

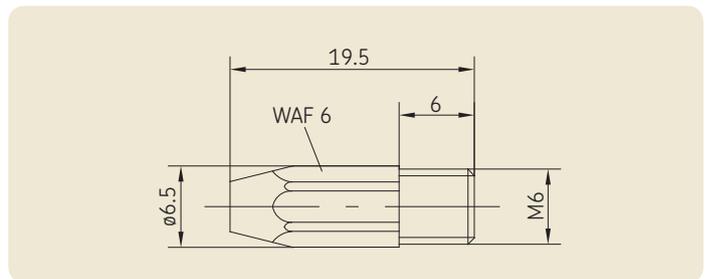
Application:
External lubrication for
SKF LubriLean DigitalSuper /
Vario systems for machining
centers



Special nozzle M6

Order No. UFZ.0113

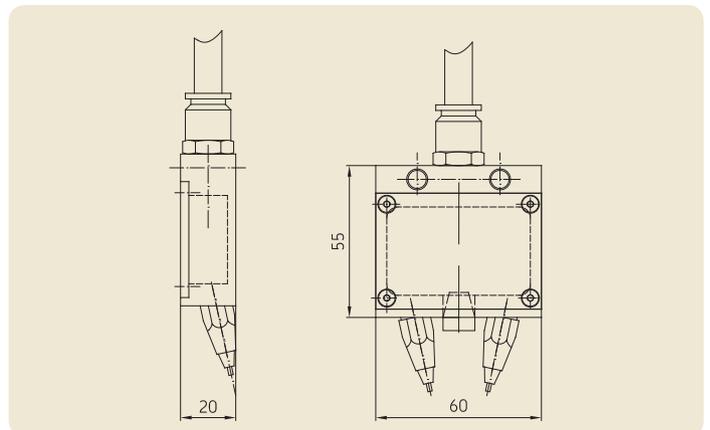
Application:
External lubrication for
SKF LubriLean DigitalSuper /
Vario systems for turning centers



Saw nozzle

Order No. UFZ.U00-037

Application:
External lubrication for
SKF LubriLean Smart / Basic
systems



MQL Lubricants

				DIN 51757	Test to DIN 51562	DIN ISO 2592
Type of lubricant	Order No.	Can size [liters]	Base	Density at + 20 °C [g/cm ³]	Viscosity at +40 °C [mm ² /s]	Flash point [°C]
LubriOil	OEL...-LUBRIOIL *)	2.5; 5; 10	fetty acid ester	0.92	47	265
LubriFluid F100	OEL...-LUBRI-F100 *)	2.5; 5; 10	higher alcohol	0.84	25	184

*) Please add the desired can size to the order No.
Order example: OEL5-LUBRIOIL

Order No. 1-5102-EN

Subject to change without notice! (07/2014)

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

- 1-5109-EN SKF LubriLean DigitalSuper
- 1-9201-EN Transport of Lubricants in Centralized Lubrication Systems
- 1-0999-EN SKF LubriLean improves ecological and economic efficiency

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