SKF LubriLean
Minimal Quantity Lubrication (MQL) for Dry Machining Processes

Internal 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.

External minimal quantity lubrication
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.
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 $\geq 0.5 \, \mu m$. 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.

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.
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 de-mixing 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 ≥ 0.5 µm)
- 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)

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.

DigitalSuper system with ball valve

![DigitalSuper system with ball valve](image)

Fig. 6

Vario system

![Vario system](image)

Fig. 7

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. multis spindle 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

<table>
<thead>
<tr>
<th></th>
<th>DigitalSuper</th>
<th>Vario</th>
<th>VarioPlus</th>
<th>VarioSuper</th>
<th>Basic</th>
<th>Smart</th>
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<tr>
<td>Metal housing</td>
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<td>1.8</td>
<td>3</td>
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<td>●</td>
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<tr>
<td>Compressed air port [bars]</td>
<td>min. 6 opt. 8 max. 10</td>
<td>min. 6 opt. 8 max. 10</td>
<td>min. 6 opt. 8 max. 10</td>
<td>min. 6 opt. 8 max. 10</td>
<td>≥ 4</td>
<td>≥ 4</td>
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<td>Flow sensor</td>
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<td>Number of outlet ports</td>
<td>1 to 3</td>
<td>1 to 3</td>
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<td>1 to 8</td>
<td>1 to 2</td>
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<tr>
<td>Air consumption [Nl/min]</td>
<td>15 - 300 **)</td>
<td>15 - 300 **)</td>
<td>15 - 300 **)</td>
<td>15 - 300 **)</td>
<td>= 50 per outlet</td>
<td>= 50 per outlet</td>
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<tr>
<td>Oil quantity [ml/h]</td>
<td>1 - 150 **)</td>
<td>1 - 150 **)</td>
<td>1 - 150 **)</td>
<td>1 - 150 **)</td>
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<td>Mounting position</td>
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<tr>
<td>Weight empty [kg]</td>
<td>25</td>
<td>6.1</td>
<td>6.3</td>
<td>9.5</td>
<td>5</td>
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**depending on choice of tool cooling duct diameter.**

- not available
- standard
- optional

*) depending on choice of tool cooling duct diameter.
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

VarioPlus
Order No. UFV10-009

Compressed air connection for hose 7-8 mm diam.

Flow meter

Oil drain screw

Filling level indicator

Aerosol outlet (3x optional) with quick connector for tube 12 mm diam.

Screw plug for manual filling hexagon socket 12 mm

1) For socket connector DIN EN 60947-5-2
VarioSuper
Order No. UFV20-001

Compressed air connection for tube 7-8 mm diam.

Filling level indicator

Aerosol outlet (3x optional) with quick connector for tube 12 mm diam.

Fill coupling with quick connector for tube 30 mm diam.
Basic
Order No. UFB20- ...
(max. 8 lube points)
Installation lines must be ordered separately
(see page 13)

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

Dimension / Reservoir
*) 129 / 0.3 l
200 / 0.5 l
300 / 0.8 l
**) 156 / 0.3 l
227 / 0.5 l
327 / 0.8 l
Accessories

Ball valve 2/2-way
Order No. UFZ.U00-128
Operating pressure max. 100 bars

Ball valve 3/2-way
Order No. UFZ.U00-041
Operating pressure max. 100 bars

1) see pressure temperature diagram
**Accessories**

**Aerosol monitor**
Order No. AM1000

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**Technical data AM1000**
- **Medium**: aerosol for MMS
- **Typical droplet ø**: 0.5 to 5 µm
- **Max. perm. pressure**: 10 bars
- **Max. throughput**: 800 Nl/min
- **Ambient temperature**: 0 to +60 °C
- **Mounting position**: upright, as drawn
- **Degree of protection**: IP 54 (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-adapter**: 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-ended M12x1 female connector and molded cable 179-990-600
- **single-ended M12x1 female right angle connector and molded cable 179-990-601**

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

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**Basic line installation, coaxial, complete**
- **Material**: PU

<table>
<thead>
<tr>
<th>Order No.</th>
<th>Length</th>
<th>Order No.</th>
<th>Length</th>
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<td>10 m</td>
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<td>20 m</td>
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</table>

**Basic line installation, coaxial, complete**
- **Material**: Steel sheathing

<table>
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<tr>
<th>Order No.</th>
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<td>UFZ.U00-067</td>
<td>5 m</td>
<td>UFZ.U00-079</td>
<td>15 m</td>
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<tr>
<td>UFZ.U00-068</td>
<td>10 m</td>
<td>UFZ.U00-069</td>
<td>20 m</td>
</tr>
</tbody>
</table>
SKF LubriLean – Minimal Quantity Lubrication

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

<table>
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<tr>
<th>Type of lubricant</th>
<th>Order No.</th>
<th>Can size [liters]</th>
<th>Base</th>
<th>Density at +20 °C [g/cm³]</th>
<th>Viscosity at +40 °C [mm²/s]</th>
<th>Flash point [°C]</th>
</tr>
</thead>
<tbody>
<tr>
<td>LubriOil</td>
<td>OEL...-LUBRIOIL *)</td>
<td>2.5; 5; 10</td>
<td>fetty acid ester</td>
<td>0.92</td>
<td>47</td>
<td>265</td>
</tr>
<tr>
<td>LubriFluid F100</td>
<td>OEL...-LUBRI-F100 *)</td>
<td>2.5; 5; 10</td>
<td>higher alcohol</td>
<td>0.84</td>
<td>25</td>
<td>184</td>
</tr>
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</table>

*) 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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