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SCHMIERTECHNIK
DropsA

Minimal Quantity Lubrication (MQL) Systems in Metal Cutting

Excellence in
Minimal Quantity Lubrication

Traditional metal machining – still in line with the times?

Example of Flood Coolant for cooling and lubricating when mechanically machining components.

Requirements and problems when using coolant emulsion (CE)

To use CE effectively, a coolant system with recirculating pumps is required and coolant reservoirs along with the piping. Furthermore, special systems are required for cleaning or drying the workpieces, as well the swarf before recycling.

- The transport required for removal requires approved licensed disposal companies, with considerable associated logistical costs, generates high costs and, when not done properly, leads to environmental pollution.
- In-house preparation requires the use of tank systems and preparation systems which remove the metal particles from the cooling lubricant using expensive (in the best case waste-free and self-cleaning) filter systems and collect these, for example, as bricket.
- Even in the case of good recycling the risk exists that the smallest swarf particles are fed to the tool and are included in the cutting process.
- To prevent the failure of the CE through microbial degradation processes, biocides harmful for the environment are used.
- There is a corrosion hazard in the case of a drop in the pH value through the increase of acidic metabolic products in the CE.
- In particular, water-mixed CE emulsions only, even when well maintained, have limited service lives and must then be replaced in conjunction with a machine cleaning process.

Company responsibility: Occupational Health and Safety

Through constant contact by employees with CE in the relevant production areas health hazards and extended downtimes become a real problem.

According to the BIA-Report (publication of the German Federal Institute for Occupational Health and Safety), the figure corresponding to skin disorders is 26 % of all occupational illnesses in the metal sector of which 33 % can be attributed to lubricants:

- CE, or rather the microorganisms they contain, trigger skin disorders, infections and allergic reactions.
- They cause irritations to the eyes, mucous membranes and respiratory tracts.
- For some workers it is no longer possible to work using such machine tools due to these illnesses.

Legal requirements require compliance with increasingly strict regulations by any production company. The German Hazardous Substances Ordinance (GefStoffV) ensures the protection of man and the environment from substance-related damage. Amongst other requirements, it stipulates the adoption of measures for the protection of workers whose tasks involve handling hazardous substances and restricts the use of specific hazardous substances, preparations and products. The Federal Ministry for Work and Social Affairs (BMAS) in this respect publishes, in the Technical Rules for Hazardous Substances (TRGS 900), the relevant workstation limit values which the employer must undertake to check regularly.

Skin allergies and illnesses caused by coolant emulsions.

Conventional metal machining processes using coolant emulsions are still used, in spite of innovative developments (MQL), that reduces costs as well as health and environmental risks.

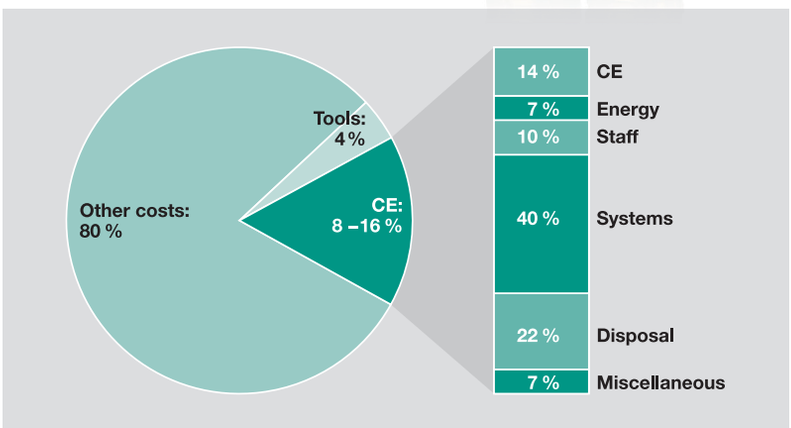
MQL – the efficient alternative

Minimal quantity lubrication technology (MQL) in the metal cutting processes is in the position to combine the highest productivity with ecological and health benefits. The undisputable reduction alone in the consumption of coolant emulsions makes, in many respects, improvements in the entire metal processing sector and, of course, for man and the environment. In order to assess the benefits it is worth taking a look at the details.

The MQL principle

The main feature of MQL is the feeding of the exact metered quantity of oil directly to the tool operating area. Heat is dissipated primarily via the swarf. Other features of the machining process are:

- "Virgin" MQL oil is always used at the machining point. This has a positive effect on the quality of the workpieces being machined.
- This process only requires a very low power output for transporting the MQL oil.
- The MQL vaporises virtually completely and immediately at the tool cutting edge.
- The machining system and the workpieces remain virtually oil-free.
- The swarf is dry and can be recycled directly.



**Coolant Emulsion costs in the series production of traditional metal machining.
(Source: Statist. Federal Office)**

Calculation example: Medium-sized company, two-shift operation/one machine tool

Lubrication with coolant emulsion	Euro
Power: for cooling units/pumps. 25,000 kWh/year (pumps, high pressure coolant skids, etc) >25 % energy consumption by the machine	2,500
Time required: 30 hours per year Filling/topping off/inspection/maintenance/set-up time for coolant emulsion	2,250
CE emulsion: 10,000 litres per year	2,500
CE disposal: 2x year	300
Machine downtimes: Downtime caused by coolant emulsion	1,000
Total	8,550

Minimal quantity lubrication	Euro
Power: approx. 200 kWh/year	20
Time required: 4 hours per year Inspection/set-up time/topping off	300
Fluid medium oil: 60 litres per year	480
Compressed air: 20,000 m^3	320
Total	1,120

Two large oil tankers would be required to hold the hazardous waste resulting from the use of CE of approx. 1 million tons generated in Germany alone every year.
(Volume incl. waste generated indirectly such as polishing sludge, oil binding agent or oily cleaning

Try dry …

Dry using minimal quantity lubrication technology *instead of drying !*

The virtually dry machining process that comes from applying minimal quantity lubrication technology means that laborious cleaning and drying of the machine and workpieces is virtually eliminated.

Innovative and proven technology for health and the environment

Issues such as ecology, energy saving and protection of the environment, as well as occupational health and safety, are of increasing importance. Given that the ecological benefits of the MQL is astonishing, bielomatik has set itself high goals and standards in order to achieve sustainable working processes.

Through MQL there is an overall considerable reduction in primary energy consumption and in CO_2 emissions as compared to classic CE.

- According to the BGI 718, machine operators are exposed to much higher emissions than in the case of MQL when wet machining. In particular in the outflow from the machine tool the emissions during MQL are cut in halve compared to flood lubrication.
- Through the use of MQL the tremendous drop in health risks leads to a clear reduction in skin and respiratory tract disorders and the resulting inability to work.

Quality, cost savings and environmental protection in harmony

The use of MQL ensures sustainable production from many perspectives:

- In new plants, acquisition costs and subsequent service costs are clearly reduced without recirculating pumps and cooling reservoirs.
- New top-of-the-range MQL lubricants offer a cost advantage through the small volume required compared to CE in traditional machining.
- Higher machining speeds lead to shorter cycle times and an increase in productivity by up to 15 %.
- An even tool temperature leads to a clearly higher durability and service life.
- The total calculation for the achievable savings made from MQL in production costs is calculated as up to 15 %.

Design study for an MQL 1-channel system.

BLUEcoMPETENCE Alliance Member

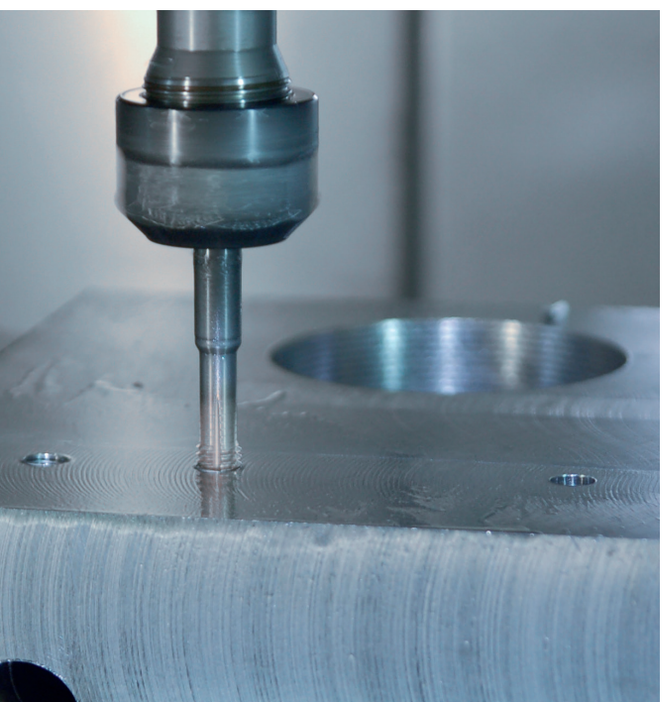
Partner of the Engineering Industry Sustainability Initiative

2013, Bielomatik's efforts to put sustainable engineering, ecological, social and economic aims into the focus of its entrepreneurial activities were awarded by the VDMA federation with the title *Blue Competence Alliance Member.*

Minimal quantity lubrication technology has become a proven manufacturing solution

During the mid 1990s solutions to dry machining and minimal quantity lubrication were systematically developed. bielomatik was an early participant in the relevant research projects and forms part of the avant-garde in minimal quantity lubrication technology.

The health advantages have, in the meantime, led to the Institute also requesting in its rules that in the case of activities requiring coolant emulsions (BGR/GUVR 143) the companies are directly required to use dry machining or minimal quantity lubrication.



Thread Forming with the MQL 2-channel system.

MQL is an Innovative technology that has evolved and come into its own

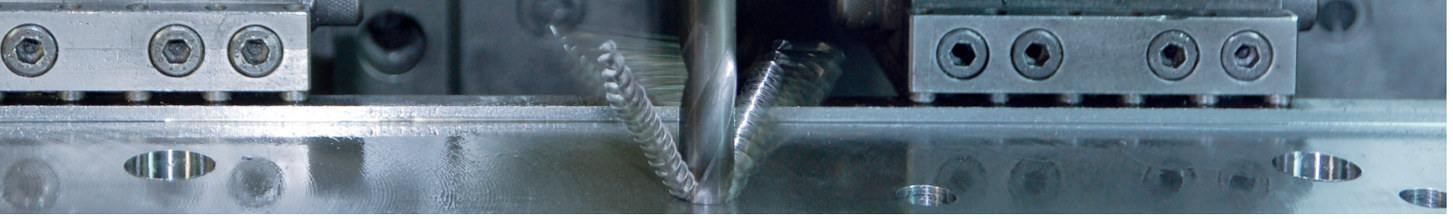
In the last ten years, MQL systems have proven themselves at bielomatik and in the market place due to their, in many respects, outstanding process in the cutting or mechanical machining of parts. Nowadays, tools are available for all applications.

In the automotive sector minimal quantity lubrication technology can no longer be overlooked. In the case of large car manufacturers it has long since been standard practice, now medium-sized companies have followed the trend and opted for MQL.

With DIN 69090 there is a new standard for minimal quantity lubrication technology. It stipulates the terms and definitions for the system elements in the entire MQL system for cutting with tools with a geometrically specified cutting edge, predominantly for using rotating tools. Furthermore, it specifies the technical perquisites and requirements for MQL machine tools and standards for cutting surfaces between machine tool and the MQL system.

In order to machine 20 motor blocks with MQL it is sufficient to lubricate with an average quantity of 50 ml per hour.

All other information with regard to the MQL subject can be consulted in the publication BGI 718 of the BGHM Institute for Wood and Metal.



The complete minimal quantity lubrication technology

Bielomatik offers both MQL 1-channel and MQL 2-channel systems. We know the benefits and application perameters of both systems and can therefore offer the best solution to meet customer requirements.

Bielomatik MQL 1-channel system

In the MQL 1-channel system an aerosol is produced thanks to the patented bielomatik multiple nozzle technology. This is fed to the tool via the aerosol line, rotary union and the spindle or the turret.

The use of the bielomatik MQL 1-channel system is in cutting processes with low to medium spindle speeds It can even to be used where the spindle has a complex inner geometry.

Depending on the design, oils with low viscosity can be used. Typical areas of application are transfer lines with machines with turret tool.

In known processes the system can also be used for machining centers. Furthermore, this system is also suitable for retrofits.

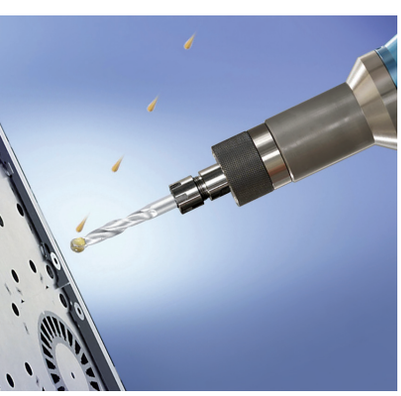
- Easy installation in your machine.
- User-friendly operation.
- Integrated control system
- Easy control of tool parameters via I/O coupling or PROFIBUS.
- Suitable for up to approx. 16,000 rpm spindle speed.
- Use of standard rotary unions.
- Existing machines can be easily retro-fitted.
- CE/MQL switchover possible.

Bielomatik MQL 2-channel system

The Bielomatik MQL 2-channel system is also suitable for highly dynamic processes with high spindle speeds because oil and air are combined very close to the process being performed.
Typical application cases are machining centers with frequent tool change.
In the case of the Bielomatik MQL 2-channel system an oil film is transported by air in the direction of the tool. Exact dosing is also possible for small tools such as the supply of tools with a higher lubricant requirement. There is no contamination of the machine during the tool change.
The “chip to chip” time can by very short due to the quick response time of MQL 2-channel system.

The oil feed can be calibrated and independently of the speed.

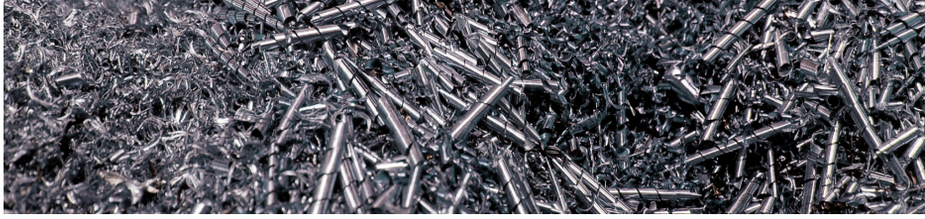
- Extremely fast response times.
- Accurate dosing capability between 5 and 500 ml/hour.
- Integrated control system
- Simple control of tool parameters via M-code functions.
- It can even used for small tools with cooling channels < 1 mm.
- Suitable for up to approx. 40,000 rpm spindle speed.
- It is also suitable for tools with a high lubricant consumption.



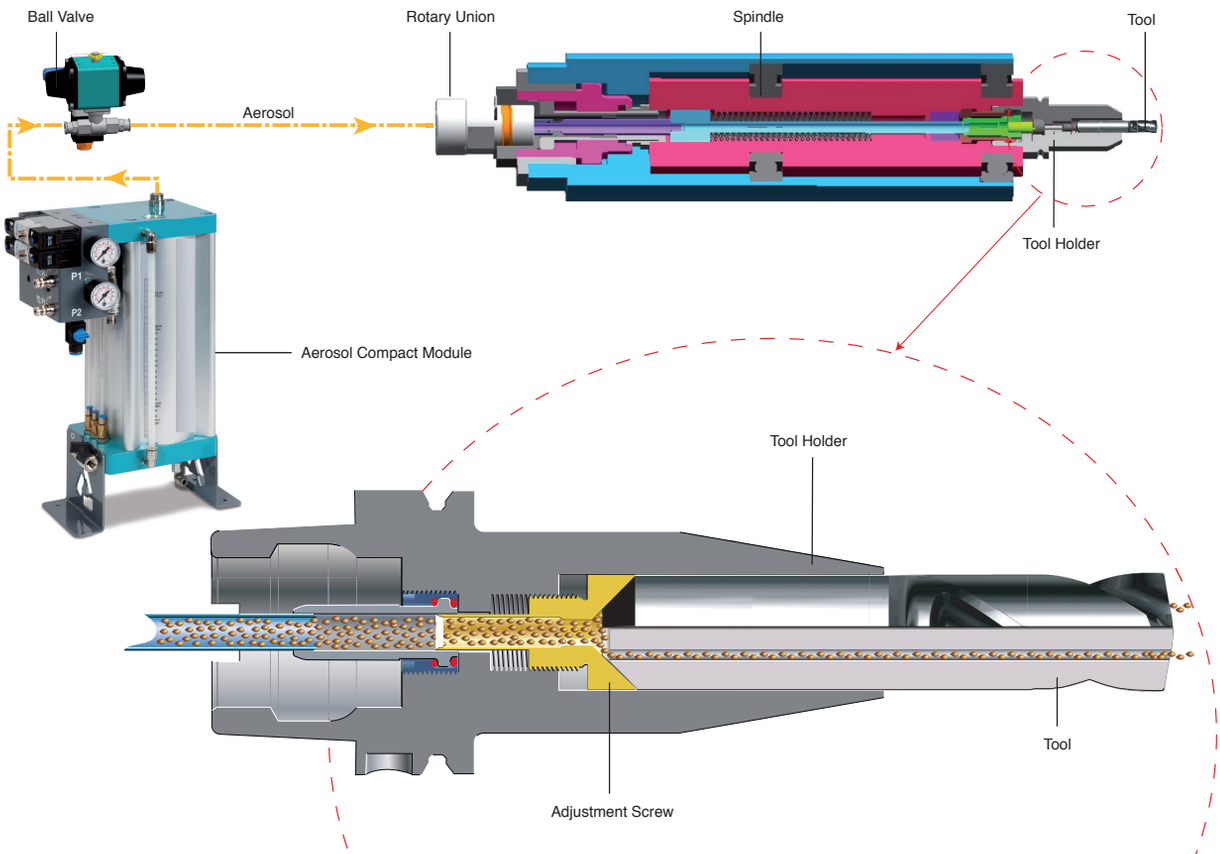
Bielomatik MQL external system

The external MQL system by Bielomatik injects the lubricant drops in the tool via a quick valve. During this, a distance of up to 800 mm can be bridged between the valve and tool. The drop hits the exact point where it is needed. The alignment of the swivelling quick valve on the respective tool is automatic. The external system can also be combined with the internal MQL 2-channel system in order to be able to supply tools without a feeding channel.

- It can be used in combination with the MQL 2-channel system.
- No spray.
- Exact lubricant dosing.
- Pure oil is used.
- Compensation of different tool lengths through pivoting valve.



Bielomatik MQL 1-channel system: For a variety of uses

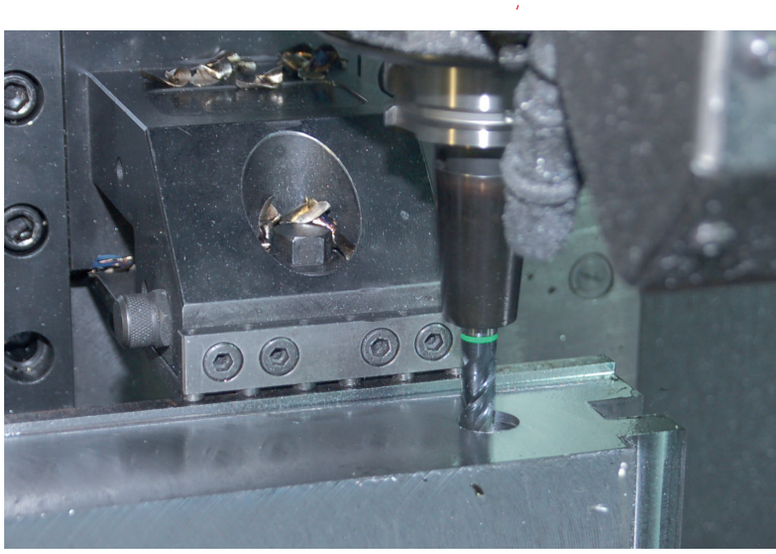


Characteristics

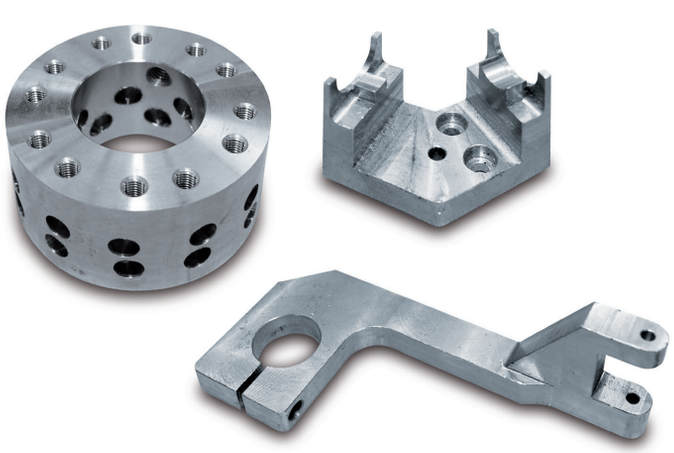
- Generation of oil mist (Aerosol) in front of the spindle using compressed air.
- Feeding of the aerosol using a rotating spindle.

Features

- Oil feed according to the speed.
- Maximum oil quantity according to the airflow or the feeding channel of the tool.
- Transfer possible via angled channels.
- Applications 5–10 bar compressed air possible.
- Through the tool and external applications.



Milling a workpiece with the MQL 1-channel system.



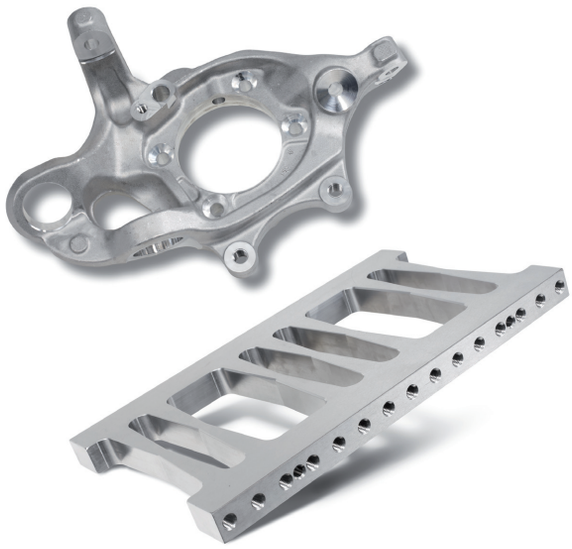
Bielomatik MQL1-channel system: Compact and professional

MQL 1-channel system B1-210

MQL 1-channel system B1-610

The compact MQL 1-channel systems B1-210 und B1-610

- Reduced space required in and at the machine through less installation space, compact dimensions and modular structure.
- User-friendly in particular through the easy adjustment of the oil quantity.
- Easy commissioning.
- Easy to retrofit.
- 3 aerosol nozzles which can be switched manually.
- Easy assembly: base/wall-mounted.
- Design B1-610 with 6 remote controllable versions (control of the parameters via solenoid valves).
- Optional: pressure and filling level detection, thereby providing functional safety.
- Optional: refill unit 10 liters can refill even during production.



The dry swarf after the machining process: The blue color clearly shows that the heat dissipation is performed efficiently via the swarf.

Optional refill unit with 10 liter capacity.

MQL 1-channel system B1-3010

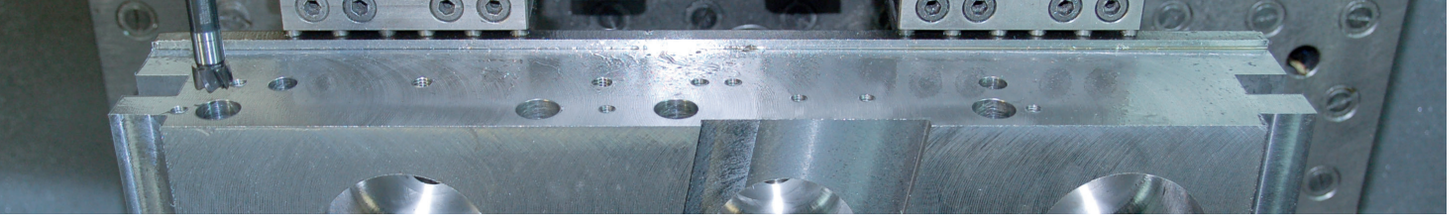
The Professional MQL 1-channel system B1-3010

- Integrated control system with PLC (field bus or I/O coupling).
- Easy application of the system.
- Standard use of standard valves.
- 4 point filling level monitoring, pressure monitoring (System/container pressure) are standard equipment.
- Optional: refill unit 10 liters.

Technical data	B1-210	B1-610	B1-3010	B1-3060
Filling quantity	1.8 liters	1.8 liters	1.8 liters	1.8 liters
Input pressure compressed air	5–10 bar	5–10 bar	5–10 bar	5–10 bar
Setting lubricant quantity	Manual	Manual	Automatic	Automatic
Setting options	1 x	6 x	30 x	30 x
Setting pressure stages	Mechanical	Mechanical	Automatic	Automatic
Selectable pressure stages	1 x per pressure regulator	2 x per pressure regulator	9 x per proportional valve	9 x per proportional valve
Operation	On/off per ball valve with 24 V	On/off per ball valve, control of the parameters via solenoid valves	PLC (Field bus or IO coupling)	Remote control PLC (Field bus or IO coupling)
Pressure monitoring	Pressure gauge	Pressure gauge	Pressure gauge / Pressure transducer	Pressure transducer
Filling level monitoring 4-point	**X**	**X**	**O**	**O**
Manual refill	**O**	**O**	–	–
Automatic refill	**X**	**X**	**O**	**O**
Dimensions	460 x 290 x 170 mm	460 x 290 x 170 mm	720 x 380 x 220 mm	595 x 265 x 170 mm

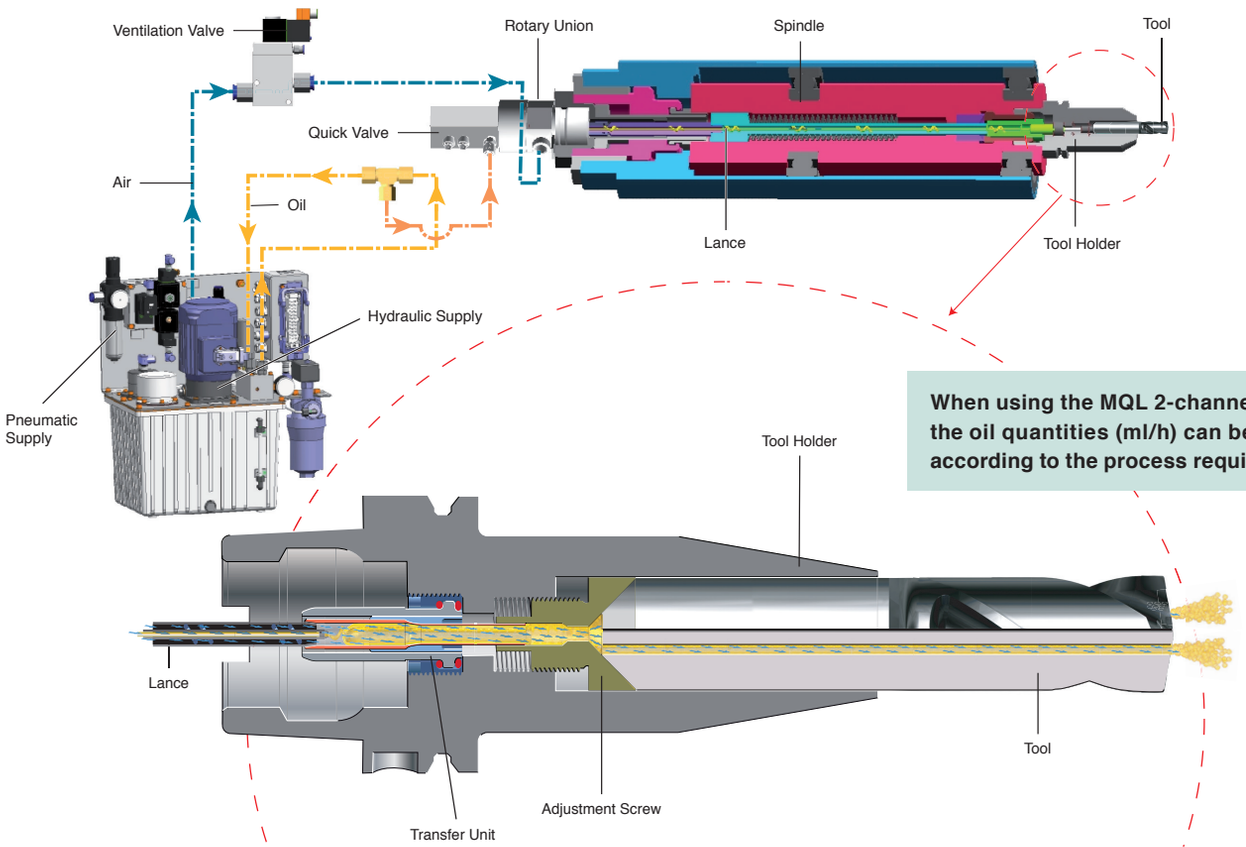
Application fields (recommended)				
Transfer machines	●	□	□	□
Transfer centers	●	□	□	●
Balancing machines	●	●	□	□
Portal milling machines	●	●	□	□
Boring mills	●	●	□	□
Compact milling centers	□	●	●	●
Machining centers	□	□	●	●
Double and multi-spindle machining centers	□	□	□	●

X = Option **O** = Series ● = Recommendation □ = Use possible | Version: 02/11 | Subject to technical changes

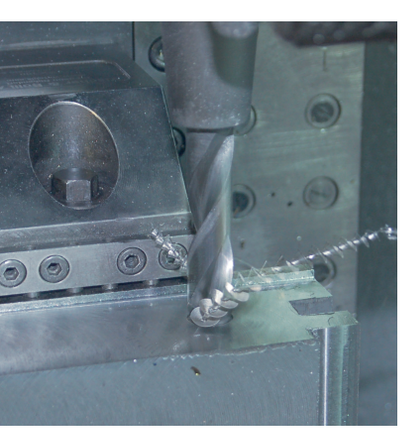


Grinding with the MQL 2-channel system.

Bielomatik MQL 2-channel system: Also used at higher speeds



When using the MQL 2-channel system the oil quantities (ml/h) can be selected according to the process requirements.



In the machining process the removal of swarf from the hole is supported by the use of compressed air.

Characteristics

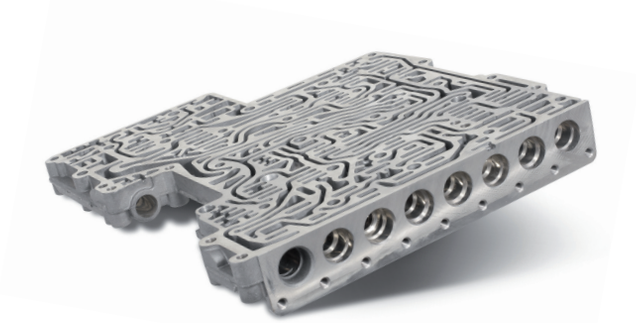
- Separate feeding of oil and air through spindle via rotating lance (inside and outside channel).
- Oil and air are transported together close to the process at the tool cutting surface.

Features

- The oil feed can be calibrated and independently of the speed.
- Maximum oil quantity independent from the airflow or the feeding channel of the tool.
- Very quick reaction (0.1 sec.); oil quantity change at the tool center point immediately active.
- MQL oils with higher viscosity up to max. 100 mm^2/s.
- Applications from 4 bar up to 10 bar of compressed air.

Application areas

- Nmax ca. 40,000 rpm.
- Machining centers (frequent tool change).
- Machine tools at high production rates.
- Tools with “high” oil consumption.
- Also demanding cutting processes such as e. g. deep hole drilling or thread cutting are possible without any problem.
- Set oil quantity can be checked.
- Due to tool independence high function reserve.



Advantages of MQL 2-channel system:

The oil dosing is carried out in the airflow inside the transfer pipe:

- **No contamination of clamping surfaces.**

Because of the transfer pipe forced guidance:

- **High speeds can be obtained.**

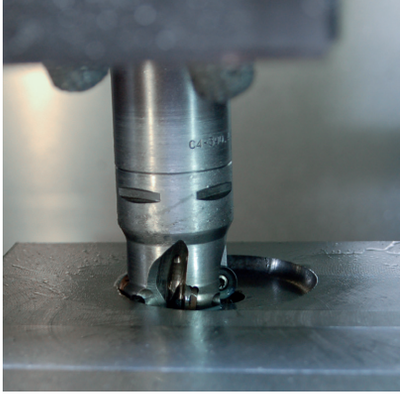
Change in condition directly at the effective point:

- **Highly dynamic process adaption.**

Only pure air in the spindle:

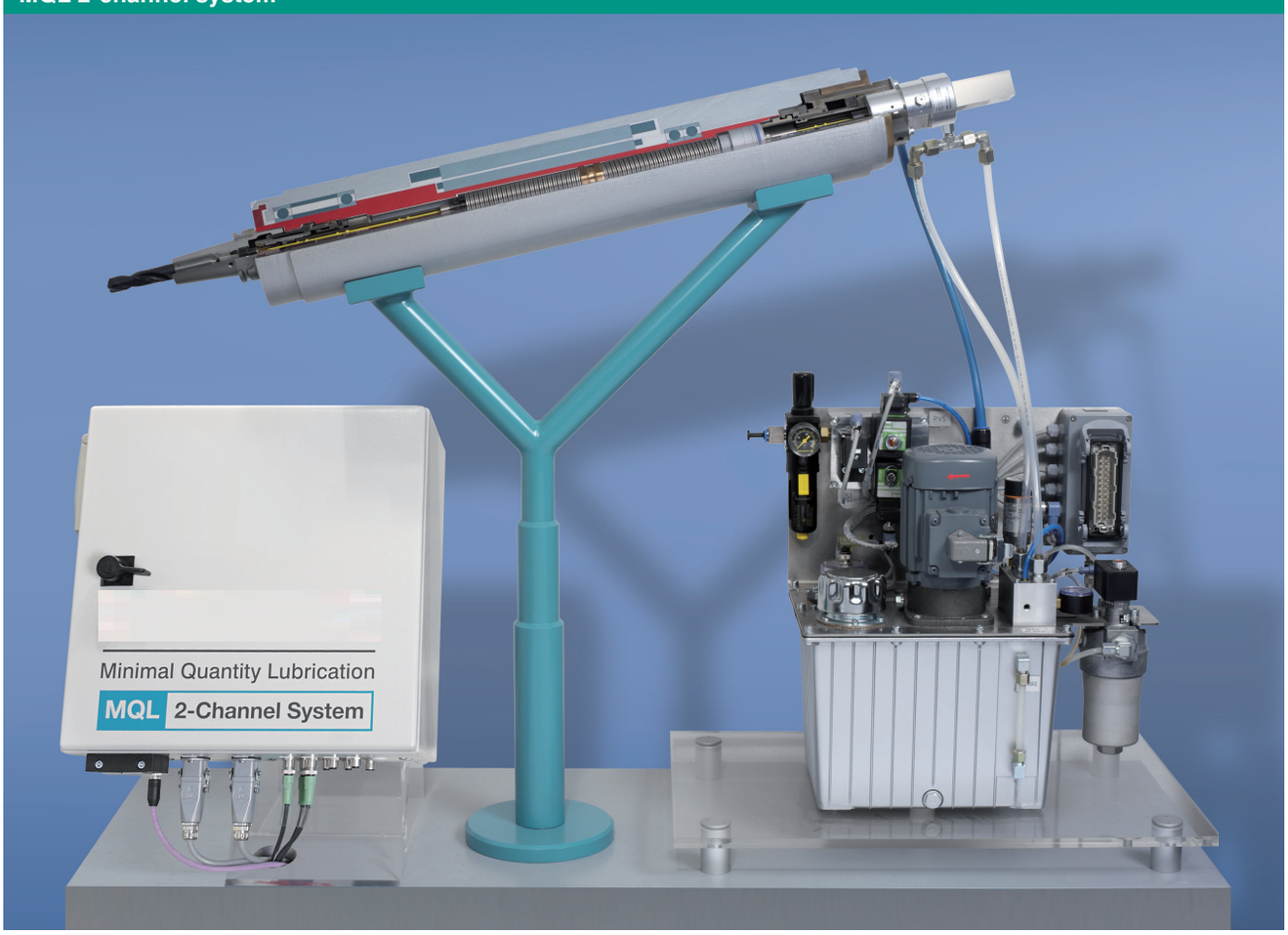
- **No contamination during the tool change (capillary effect).**

Deep hole drilling is, in particular, an application area of the MQL 2-channel technology.



Milling with the MQL 2-channel system.

MQL 2-channel system

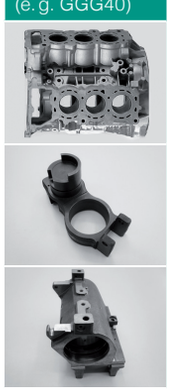


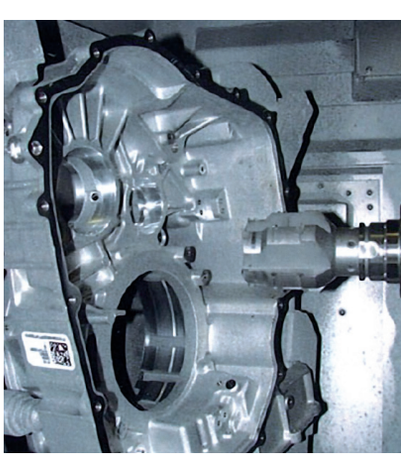
Other examples for the use of minimal quantity lubrication technology

Aluminium
(e. g. AlSi, die cast aluminium)

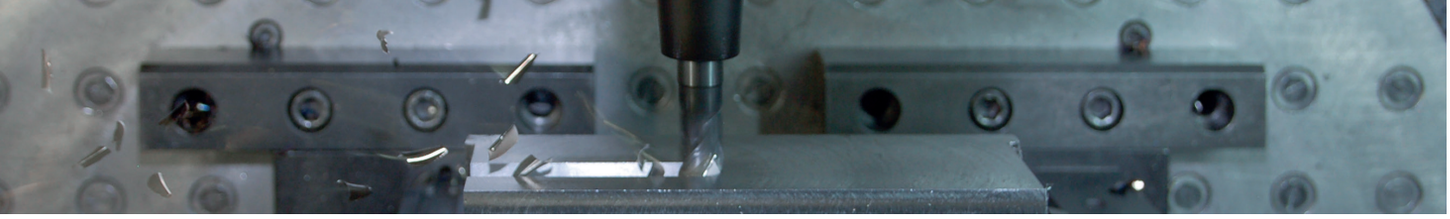
Steel
(e. g. ST-37,-52, C60, X..steels)

Casting
(e. g. GGG40)





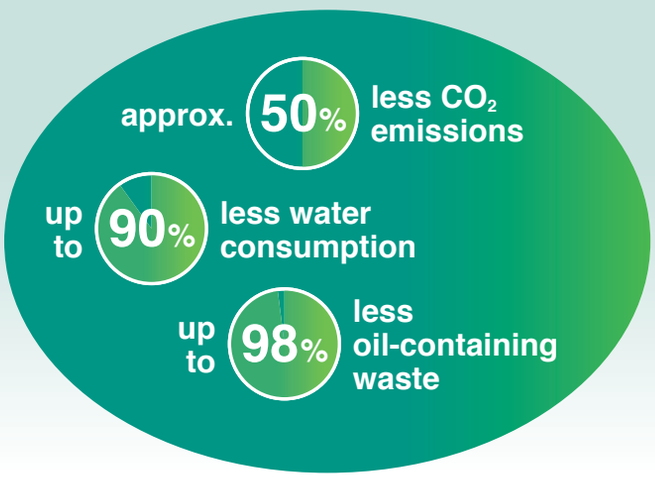
MQL machining of a 6 gear transmission housing.



Milling with the MQL 1-channel system.

The advantages of the Bielomatik MQL …

Quality, cost savings and environmental protection in harmony:



All advantages at a glance, this is what MQL offers you compared to wet machining:

- **Due to the higher cutting speed, processing time is reduced.**
- **Work piece are remain dry.**
- **Cleaning of parts is not necessary.**
- **No displacing of oil around the machine.**
- **Technical resources are not required for the maintenance of the emulsion system.**
- **The chips remain dry.**
- **Improved surface by using clean virgin lubrication.**
- **By eliminating thermo-shock stresses caused by coolant, tool life can be increased.**
- **Reduced investment on new machining lines.**

… try it for yourself with our test kit!

Your 4 steps to the start of the MQL test:

1. Check basic prerequisites
- Internal supply
- Rotary union

2. Request test kit

3. Connect test kit
- Power supply 110 V (USA) 230 V (Europe)
- Supply with compressed air
- Aerosol line; ball valve; terminal

4. Let the test begin!

Would you like to apply the proven advantages of the minimal quantity lubrication and see the benefi t of your metal machining?

We are happy to provide you, under no obligation, with a Bielomatik MQL 1-channel system for a thorough practical test.

Our MQL test kit has a handheld operating terminal which enables testing without the time-consuming connection to the machine tool control system. The device can be moved and contains all the components for the easy, quick connection to machine tools.

If you are convinced by the advantages for carrying out the test, we are happy to provide you with a quotation for a Bielomatik MQL 1 or 2-channel system tailor-made to your requirements.

We promise you: the four test weeks will convince you!

Feel free to call or write to us.
Phone: (586) 566-1540
E-Mail: sales@dropsausa.com

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The prices of raw materials are increasing, there are fewer resources, energy costs are climbing fast – industrial firms are faced with tough challenges. Given the consequences of climate change sustainability is the very top priority. The sustainability of products and processes, as well as green technologies, are the centre of attention.

Bielomatik is already participating in positive developments in some areas:

- Minimal Quantity Lubrication (MQL) in metal cutting reduces the hazardous waste significantly, it combines high productivity with environmental and health benefits.
- In the automotive sector plastic parts help to save on weight and, therefore, on fuel.
- "Gas innovation price" for our energy-efficient gas convection welding process.
- Efficient stationery manufacturing systems support the illustration developments initiatives in emerging and developing countries.
- Die cut aluminium antennas on the basis of paper contribute to the sustainability of RFID converting.

The **Bielomatik corporate sustainability** initiative boosts the development of system designs with efficient process chains as well as production planning based on sustainability:

Sustainable Processes – sustainability in production and company processes

- Optimisation of materials and processes to be as environmentally friendly as possible, easy on resources and suitable for recycling.
- Reduction of the waste generated, consistent transfer for recycling.
- Production premises with intelligent solutions in energy, climate and ventilation technology, e. g. through the use of dissipated heat in buildings.
- CO_2 neutral trade fair stands.

Sustainable Products – sustainability in product features

- All new products are designed according to economic and ecological perspectives.
- The customer perceives visible benefit through increased performance, as well as a reduction in primary energy consumption and maintenance costs.

Sustainable Relations – sustainability in people's relationships with each other

- The company management provides employees with continuous professional training and a working environment that stimulates teamwork and solidarity.
- Protection of employees both on the customer's premises as well as in-house.
- Corporate objectives are conveyed both internally and externally to ensure that the entire company (worldwide) can identify with the objectives set and can participate in sustainability measures.
- Direct option for dialogue with employees regarding the company and its products.
- Support for fair trade.

Since the 1950s, Bielomatik has been making continuous progress in innovations in the key technologies paper processing, plastic welding, RFID transponder and minimal quantity lubrication technology. Since 2013 the company is listed in the VDMA encyclopedia "Best of German Engineering".

We are in favor of protecting intellectual property and support the VDMA campaign against product piracy: "Be sure it's original technology!" ".

PROCESSES
corporate
SUSTAINABILITY
PRODUCTS
RELATIONS

BLUEcoMPETENCE
Alliance Member
Partner of the Engineering Industry Sustainability Initiative

The Best of German Engineering
Das Lexikon des deutschen Maschinenbaus
aufgenommen:
bielomatik
We look further.

Choose the Original
Choose Success!

With a wide product range from the introductory model to the profile solution, bielomatik offers mature solutions for many metal cutting processes from a single source. Through the intensive use of MQL in internal production we have a direct relationship to practice and to day-to-day production requirements. Our ProActive Service offers:

- Personal care through our competent service team.
- Process support and consultation.
- Service hotline.
- Seminars and training in-house and on-site.
- Extensive spare parts storage with original parts.
- Individual spare parts packages/recommendations.

Opt for a forward-looking partnership which at all times guarantees you competent advice as well as efficient and safe production.

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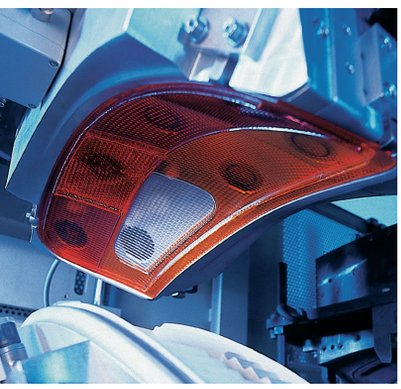
Lubrication technology for machines and for metal cutting

Minimal Quantity Lubrication Systems

- MQL 1-channel and 2-channel systems for metal cutting.

Central Lubrication Systems

- Single line lubrication systems for oil and fluid grease.
- Progressive lubrication systems for oil, fluid grease and grease.
- Circulation lubrication systems.
- Oil/air lubrication systems.
- Block lubrication systems.



Machines for welding and machining of plastics

- Hotplate welding machines.
- Infrared welding machines.
- Hot gas welding machines.
- Friction welding machines with linear vibration or rotation. For both infrared pre-heating can be integrated.
- Laser welding machines working with the quasi-simultanous and contour welding techniques.
- Ultrasonic welding machines for special applications.
- Thermal contact / Thermal impulse welding machines.
- High frequency welding machines.
- Complete automated welding lines including parts management by feeding systems, handling solutions. Machine concepts in all variations, e.g. rotary table or linear transfer design. Robots can be integrated depending on application.
- Equipment for machining, milling, cutting, assembling and testing of plastic components integrated in complete automated lines.

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