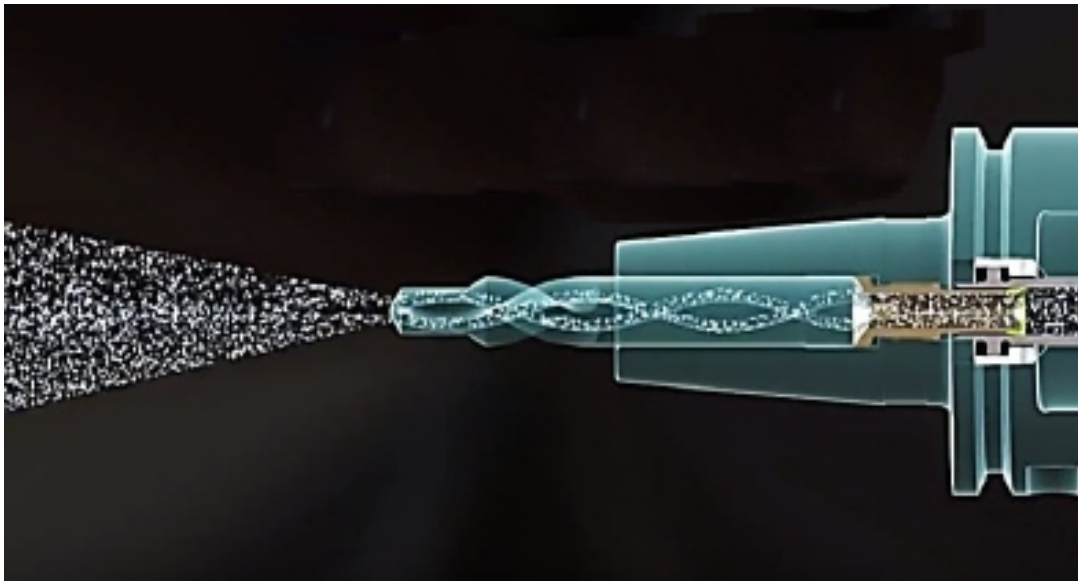


Minimum Quantity Lubrication technology for tools with internal feed



MQL systems for tools lubrication
from inside with lubricant supply through spindles,
revolvers and tool holders
for
machine tools, machining centers, turning centers

in partnership with

Mechanics Department of Milan
Polytechnic University.

HPM Technologie GmbH

- Con riserva di modifiche senza preavviso -

Product Line LS 35 PRO

MQL systems with advanced technology for internal tool lubrication.

The MQL systems LS35 PRO are based on the advanced technology with optimised performance and state-of-the-art communication interface.

Venturi nozzles controlled by proportional valves with high reaction speed are used to generate and control high quality aerosol flow under variable production conditions.

The electronic control technology patented by MWM makes available a specific IFX-F sensor, which measures the percentage of oil contained in the aerosol stream conveyed to the tool, provides a signal to the CNC and guarantees a 100% safe process.

LS35 PRO systems have the following main features:

- Dynamic aerosol generation** is a key feature to allow a high-level lubrication process with a better performance. Most MQL systems available in the market offer just a static aerosol generation.
- Automatic flow control** offers maximum flexibility of use for any type of machining: using either very small tools (eg: \varnothing 1 mm driller) and large tools (eg: \varnothing 25 mm milling tool). The operator can choose between several available lubrication parameters, differentiated in terms of air pressure and/or oil concentration, and associate the most suitable to each tool.
- Short response time** allows to shorten the machining process. This important feature assumes great relevance when, in particular, machining centres equipped with automatic tool change are used: the MQL system changes the lubrication parameters in less than 0.1 second.
- Process safety and continuous monitoring** guarantee the execution of a reliable process. Ongoing communication with the CNC allows the operator to be constantly informed on the process status.

All relevant information is displayed in a functional synoptic screen available on a user-friendly touch screen integrated in the MQL unit. The LS35 PRO model with double proportional valve and touch screen, has no equal on the current market and has much higher performance, features, precision, flexibility and ease of use than competing systems.

For maximum MQL process safety, the flow of the aerosol produced is monitored by the optoelectronic oil-mist sensor IFX-F, which provides continuous feedback to the LS35 PRO system by monitoring the amount of oil in the aerosol stream to the tool.

The MQL System with Feedback via oil-mist optical sensor is an international MWM patent («Process and system for controlling sprayed lubrication with instantaneous measurement of lubrication flow»).

As fieldbus communication protocol: PROFINET and CPU-I/O are provided as communication standards in industrial networks.



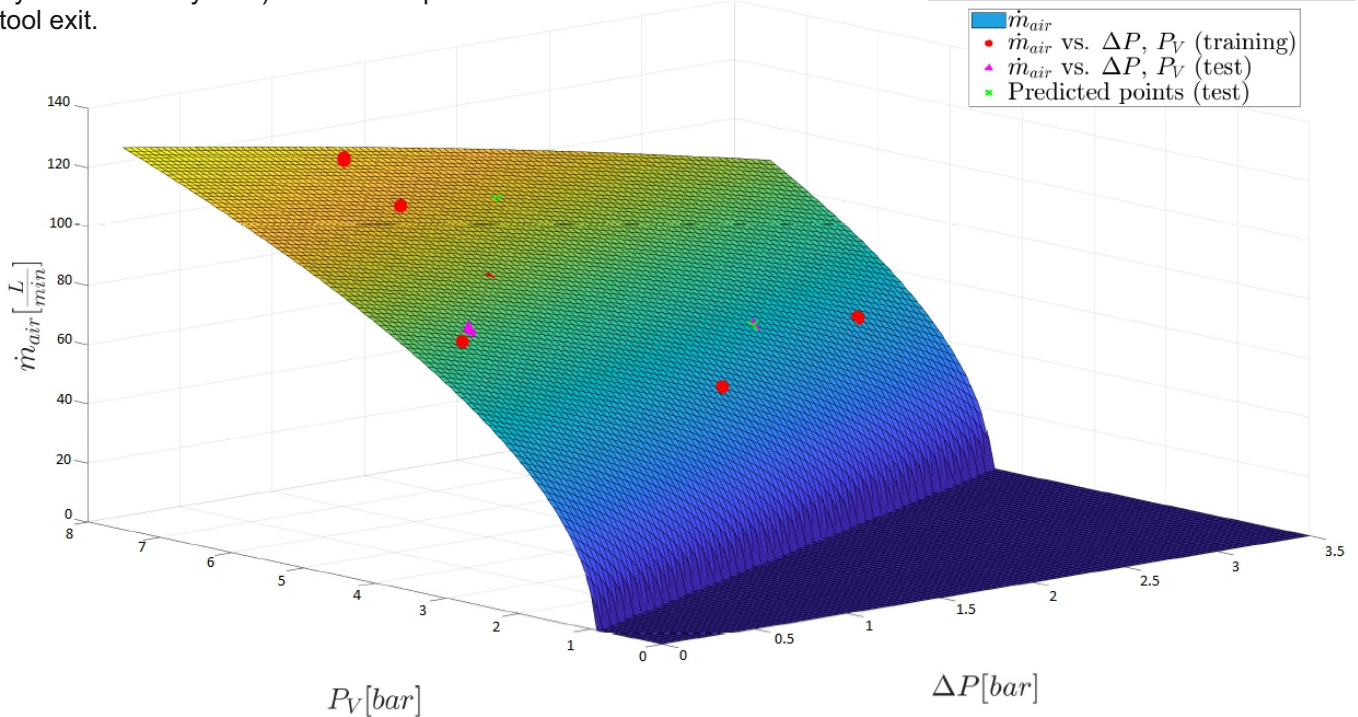
Functional tests and validation obtained from Polytechnic University

All functionalities of the LS35 PRO systems have been validated during strict evaluation tests carried out by the Mechanics Department of Milan Polytechnic University.

Very important empirical models have been developed, which in fact give an idea of the performance of the LS 35 PRO system.

From a macroscopic point of view, the models describes the complex air-oil mixing phenomena that take place. In this way it was possible to evaluate the effects of the air and oil flow parameters in conjunction with the cutting parameters (thrust force, torque and drilling power). Only in this condition can all the fundamental parameters of the machining process really be evaluated.

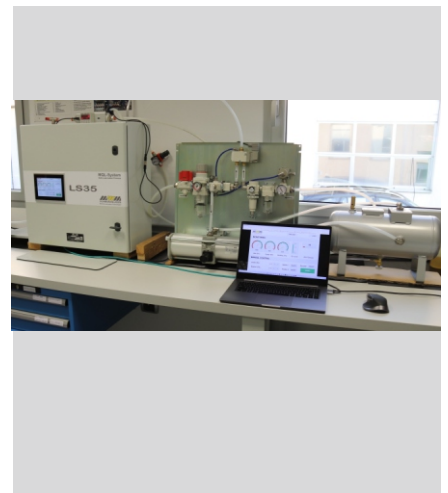
After obtaining the coefficients for the expressions from equipment tests, each model can be used to determine the pressure parameters (controlled by LS 35 PRO system) so to obtain precise values of air or oil flow rate at the tool exit.



The behaviour of the air flow rate predictive model (for example) is presented in the figure above, where the blue/yellow surface represent the model response surface; the red and green dots represent the results in terms of air flow rate obtained during the Training and Test phases of the LS35 PRO system, the pink triangles represents the experimental results obtained during the validation tests, according to the prediction models defined before.

The LS35 PRO system adapts the lubrication parameters (air pressure, oil pressure and oil-mist flow rate) to the specific machining operation proposed on the basis of the models developed and in the knowledge of the studies carried out and instantly verifies the result by means of an optical feedback oil-mist sensor IFX-F.

Based on these results, the MQL LS35 PRO system has demonstrated itself to be an extremely effective, accurate, reliable and currently unmatched MQL system. Furthermore, a quicker setting of MQL parameters can be done when setting new operations with new tools.



MQL: the modern industrial tools lubrication standard

Minimum quantity lubrication (MQL) has gained its way into the area of metal cutting machining and has been already proved as the alternative to conventional wet processing in many applications. Unlike conventional wet lubrication systems, which flood the piece with high quantities – circulated - of metalworking fluids, minimum quantity lubrication uses a few milliliters of lubricant per hour in the machining process. Since the beginning of the 2000s the technical, environmental and economic advantages given by the adoption of MQL have convinced many mechanical companies, starting in Germany and Japan, to gradually shift their machining processes from water-mixed metalworking fluids to MQL. Today MQL for internal tools lubrication represents the new industrial standard for more and more manufacturers in different countries and industries such as automotive, aerospace, pneumatic components, ensuring the production of complex pieces with drastically reduced environmental pollution and almost dry.

Suitable applications:

MQL systems can be used for tools lubrication in almost all mechanical processes, both with chip removal as well as in the forming/rolling processes, on any type of modern CNC machine tool, for different work materials with highly reliable lubrication process.

Machine tools:

- Portal milling machines
- Turning and milling centers
- Flexible production systems
- Double spindle machine tools
- Multiple spindle heads
- Transfer machines

Machining:

- Milling
- Turning
- Threading
- Tapping
- Drilling
- Deep hole drilling
- Reaming
- Rolling

Materials:

- Aluminum and its alloys
- Steel and alloy steel
- Cast iron
- Brass
- Titanium

MQL technology is based on continuous supply of extremely small amounts of lubricant to the cutting point. During machining, the lubricating medium significantly reduces the friction between chip and cutting face, thus generating less heat which is largely dissipated via the chips. The use of MQL-compatible tools facilitates quick chip removal. As a result the tool lasts longer, the cutting speed increases, the surface quality improves and the entire machining process is completed in a shorter time and at lower costs.



MQL system advantages

- Minimized lubricant consumption (on average: 20 ml/h)
- No water consumption
- Chips and machined parts nearly dry (no oil soiling)
- Elimination of the metalworking fluid (emulsion) system
- Savings on energy consumption compared to emulsion
- No need to prepare and dispose of used metalworking fluid
- No thermal shock on the tool cutting edge
- Longer tool life
- Higher cutting speed
- Better surface quality
- Optimal execution of deep holes, even with $L / D > 30$
- Complete visibility over the on-going process (no scattering)
- Clean working environment, compliance with health and environmental regulations

Consumption in comparison

Whole oil:

- oil: 10x - 100x liters / hour
- electricity: high

Water-miscible metalworking fluids (emulsions):

- emulsion: 100x - 1.000x liters/hour (concentration 5%: 5 -50 liters/hour oil)
- electricity: very high

MQL:

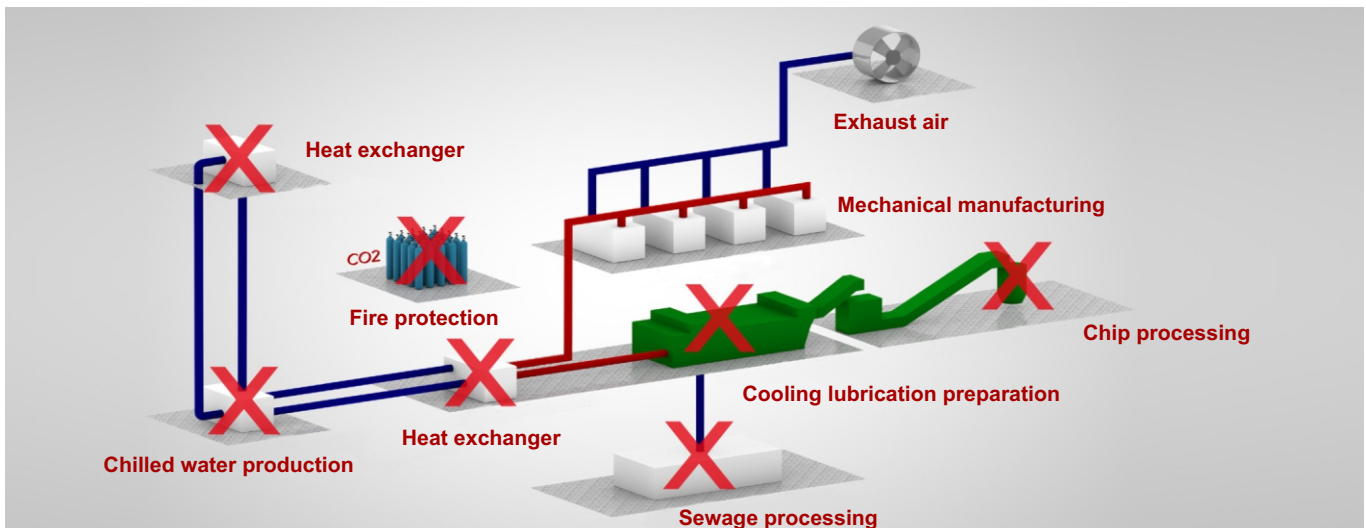
- compressed air: 1.000x liters/hour
- oil: 5 to 65 ml / hour (0.005-0.065 liters / hour)
- water: null for the process; optional washing at cycle end
- electricity: very low

With MQL, for each individual process (piece/operation) the cost incidence due only to the lubricant consumption (oil) is cents of a Euro on average, while the cost incidence due to the tool can be estimated in the range of cents of Euro or more, on average.



Potential savings with MQL in series production

Dry machining with MQL technology offers enormous savings potentials in series production. The traditional method based on coolant requires several devices, for example to cool and clean the emulsion, process the wet chips, and treat the waste water. All these devices are not needed when using MQL instead.



MQL technology for tool lubrication with internal feed, single channel

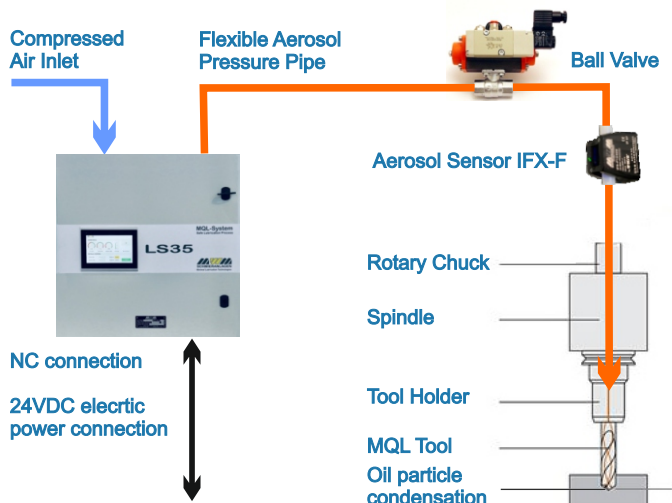
The lubricant medium used for MQL is a very fine mixture of compressed air and nebulized oil droplets, sized from 0.1 to 1 micron, defined as “aerosol” and generated inside a specific MQL system. The aerosol is continuously conveyed to the cutting zone, through flexible pipes and channels inside the rotating spindle, the tool holder and the tool.

The oil particles get condensed in small droplets right at the exit of the tool, and are precisely addressed to hit the tool cutting edge. The oil lubricates the contact surfaces between tool and work piece, while the high speed air flow helps to evacuate the chips. Minimum quantities of fresh oil are precisely metered and almost entirely consumed during the tool cutting time, giving the advantage to keep dry pieces and chips.

Lubrication parameters must fulfill different requirements: tools, materials, machines and machining data. Lubrication parameters refer to the absolute volumetric air flow and the relative volumetric oil flow rate (oil quantity) and should be carefully chosen for an optimal process execution.

In most cases, tools with small inner channels diameter (<0.5 mm) require high pressure and lean aerosol mixtures, the other way around for large tools/larger channels.

The MQL system can be mounted anywhere on the machine tool, even far from the spindle: the micronized oil droplets can be conveyed by the compressed air, notwithstanding unfavorable circumstances, allowing aerosol transportation over long distances, up to 30 meters.



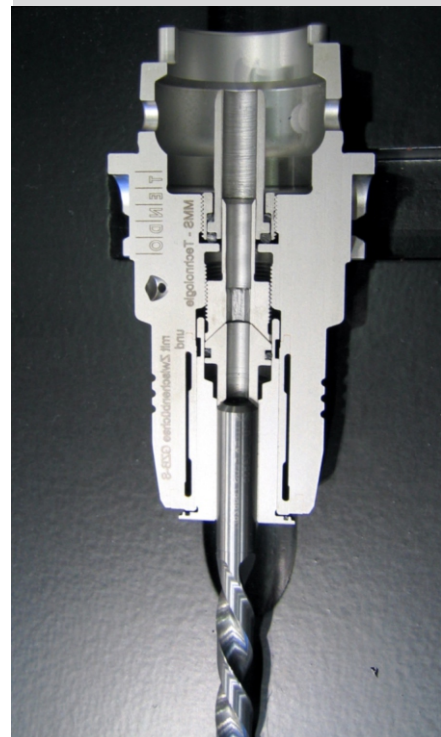
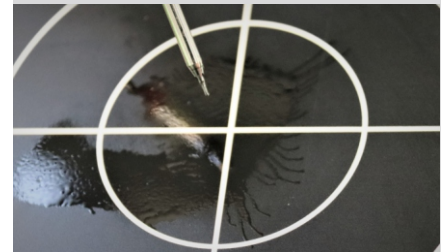
The choice of tools and lubricants suitable for MQL is a key factor to get maximum benefit from the use of MQL technology.

Tools play an important role in the process: their geometry and finishing influence chips removal and friction, while the internal channels feeding the lubricant must be adapted to the machining operation and allow a high speed aerosol to precisely hit the tool cutting edge.

A reduced channel diameter in proximity of the cutting area increases the flow speed: without this fundamental feature the aerosol cannot condense properly and oil fog is generated, bringing to increased oil consumption and lower efficiency. The ideal diameter is 1.8 mm, in practice ranging between 0.2 and 2.2 mm.

Lubricants. Only synthetic (or vegetable) oils must be used for MQL, in particular, fatty alcohol for aluminum and EP synthetic esters for steel. Lubricants containing mineral oil components or additives should not be used due to the inhibition of micro oil particles generation.

In addition, when using MQL it is advisable to turn down the use of emulsion as the water-based mix will compromise the achievement of the many benefits of the minimal lubrication.



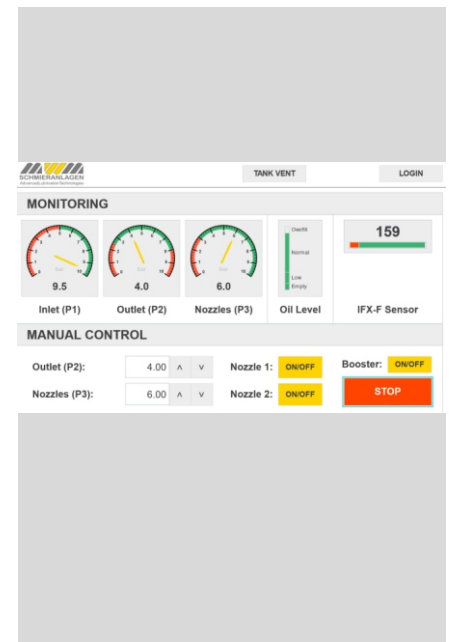
MWM systems for internal tool lubrication

MWM delivers easy to install MQL systems for internal tool lubrication and fully equipped with all the necessary accessories.

For communication optimization: MQL systems with electronic control and interface for data exchange are available for selecting the lubrication parameters, monitoring the functional status, communicating alarm messages to the machine CNC.

For operational flexibility: MQL systems which can lubricate multiple tools in simultaneous operation when the same parameter can be shared.

For complex machining processes: double MQL systems are also available which simultaneously provide two different tools with different MQL parameters. They fulfil all of the functions available on single MQL units, but can supply two different points of consumption simultaneously and independently of each other, with the ideal amounts of lubricant, i.e. turning centers with two revolvers in simultaneous operation.



Sistemi MQL-LS standard	HPM LSJ-Basic	MWM LS30	MWM LS35	MWM LS35 PRO	HPM LSJ-Z36
Supply air pressure range(bar)	5÷16	5÷10	5÷16	5÷16	5÷10/16
Oil tank effective capacity (liters)	2	4	4	4	4
Proportional valves	—	1	1	2	2
Automatic oil refill	option	option	option	option	option
Response time	—	< 0,1 sec	< 0,1 sec	< 0,1 sec	< 0,1 sec
Optical sensor IFX-F (oil-mist detector)	option	option	option	option	option
Air flow control	—	option	option	option	option
Data exchange	—	I/O	PROFINET I/O	PROFINET I/O	I/O, P.NET, P.BUS

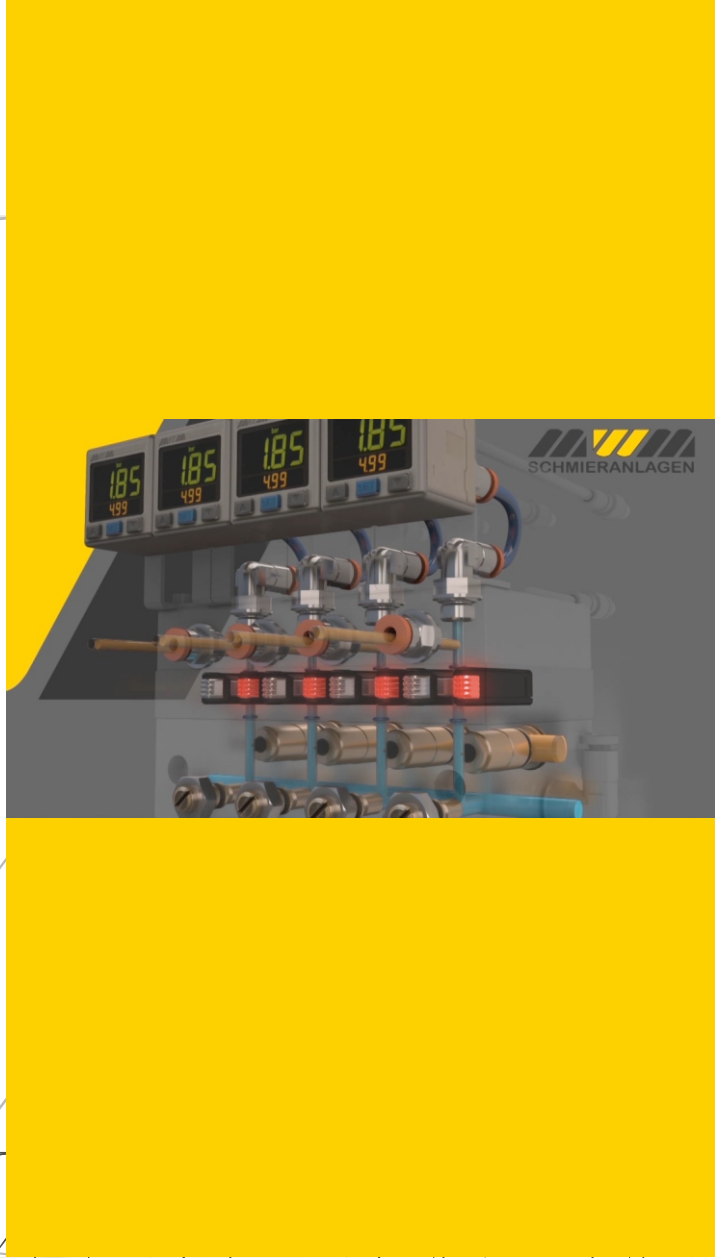
Most suitable MQL system choice

Whatever the tool or material, MWM experts can define the optimal solution. We can propose MQL systems able to meet any specific requirement, from the simplest to the most complex application.

MWM has developed a complete family of MQL systems at a competitive price. The adoption of the HPM technology allows to develop tailored solutions and achieve the best result, fitting the MQL system to the manufacturing process, to the tools and materials.

For detailed information please contact MWM: an expert technologist will be available to evaluate your manufacturing process and your needs.





MWM Schmieranlagen Srl
Via G.Galilei 4B I-20068 Peschiera Borromeo (Mi)
Tel:+39 02 550 112 44 Fax +39 02 551 948 78
website://www.mql.it e-mail: info@mql.it