



Minimum Quantity Lubrication (MQL) and Cryogenic Cooling
in machining processes

MQL AND CRYOGENIC COOLING in machining processes

BeCold equipment technology combines Minimum Quantity Lubrication (MQL) with cooling provided by liquid CO₂. The **combination of these two systems** results in excellent machining performance.

HRE Hidraulic offers different **BeCold** equipment series which can be adapted to different needs.

WHY USE cryogenic machining?

As a result of the industrial sector becoming highly competitive, **reducing production costs** together with the use of technologies with **lower environmental impact** are vital in the development of new applications.

BeCold equipment is fitted with an innovative system which combines Minimum Quality Lubrication (MQL) and CO₂ cryogenic cooling to achieve performances equivalent or sometimes even better than traditional wet machining.

Removing or reducing conventional cutting fluids is paramount to succeed and the advantages offered by Cryogenic Machining make it the best option. The **benefits** are the following:

cost SAVING

- * Cutting fluids consisting of mineral oils or synthetic fluids, represent between 8 and 16 % of part manufacturing costs.
- * Furthermore, drilling fluids require treatment at the end of their useful-life which may multiply x 2 or even x 4 their purchasing price.
- * Cryogenic Machining eliminates the use of drilling fluids, directly wiping out all costs related.

production BENEFITS

- * Increased cutting speed
- * Reduced tool wear
- * Maintained surface integrity

environmental BENEFITS

- * Approximately 30% of cutting fluids used in machining processes are lost through leaks or attached to chips, and ultimately released to the environment.
- * In addition to environmental impact, these fluids are a health hazard for employees who have to use them.
- * Cryogenic Machining would eliminate these risks.
- * MQL uses minimum quantities of biodegradable oils and CO₂ captured from a primary process and later reused in a secondary industrial process as recycled gas, maintaining the inherent environmental harmlessness of Cryogenic Machining.

BECOLD what is it and how does it work?

BeCold units combine a **MQL** system with a **CO₂ cooling system**. As a result, this combination of both technologies achieves tool cooling and lubrication during the machining process.



BCD-VS1-XXX



BCD-VS1-XXX

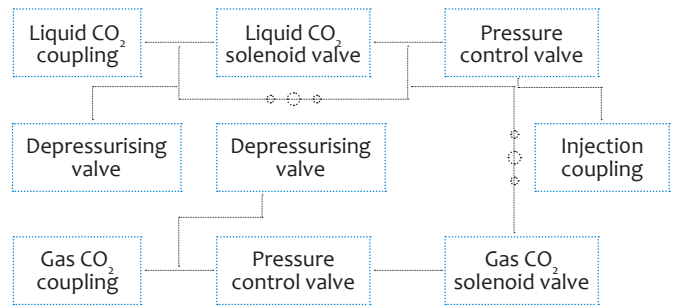
BECOLD cryogenic system (CO₂)

The cryogenic system contributes to machining by using carbon dioxide as a cutting fluid. The system is specially designed to prevent dry ice forming inside ducts as well as when injected in the cutting area. The following Figure shows a simplified diagram of its components.

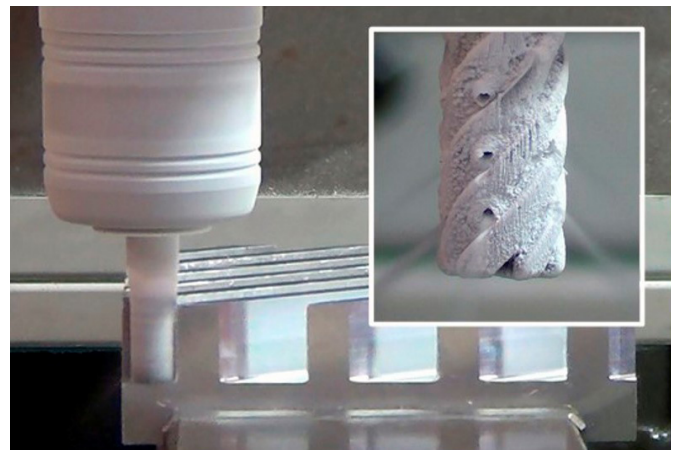
The CO₂ injection system provides cooling with CO₂ transition from the liquid to the gas phase once injected in machine-tools.

At that moment, as it reaches a temperature of -78 °C a reduced cutting temperature is achieved and therefore the cutting process is optimised.

The relevance of a cryogenic system lies in its versatility during operation as it allows its activation-deactivation in short cycles, both in stand alone mode, and combined with micro-lubrication by MQL.



Cryogenic equipment assembly diagram



BECOLD
mql system

Minimum Quantity Lubrication (MQL) equipment is characterised by low lubrication consumption. The device generates an air flow where the lubricant is sprayed via compressed air being fed from a lubricant reservoir.

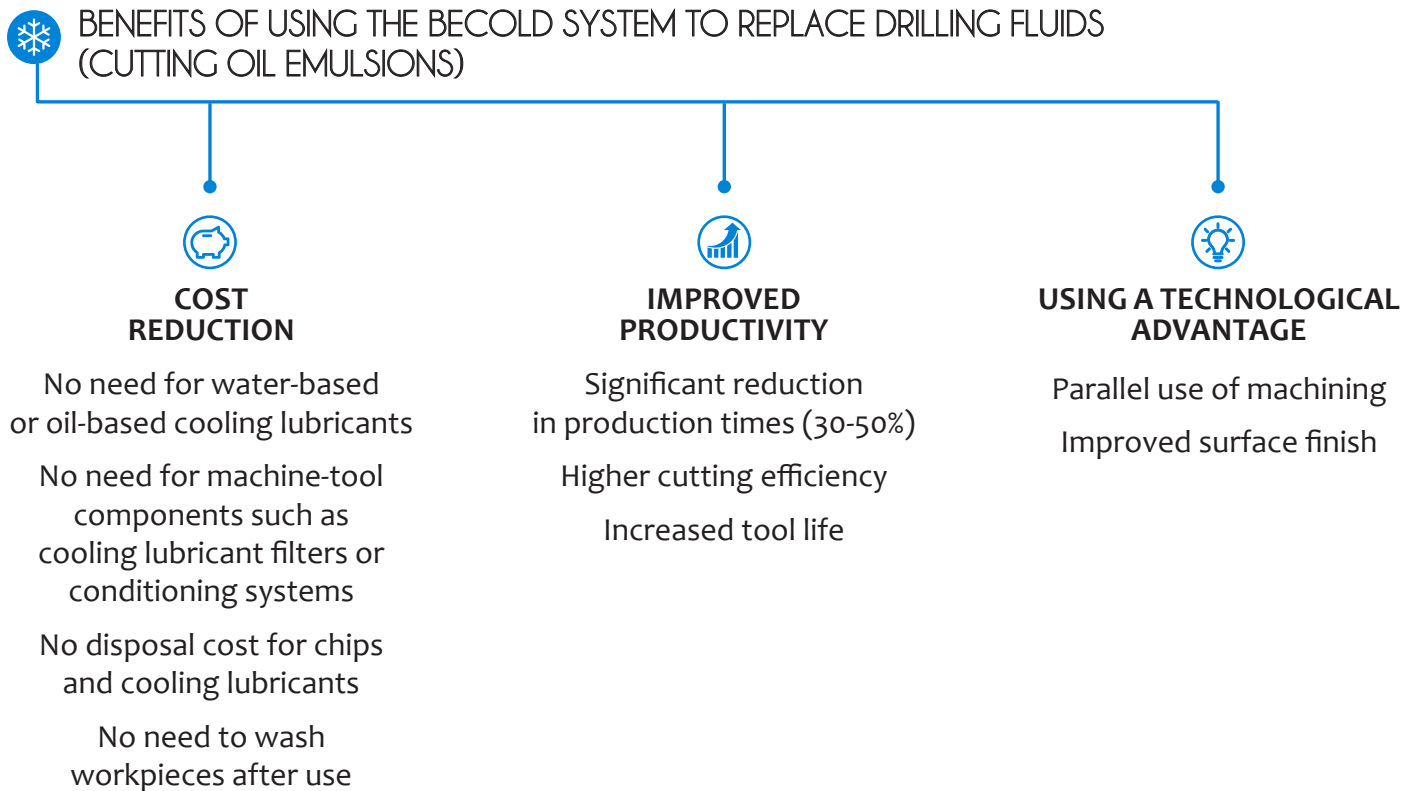
The MQL devices used are known as LubriLean Systems. The different MQL device models have different characteristics, but all provide a flow of compressed air containing finely dispersed droplets of oil that are injected in the cutting area. These systems can provide internal or external lubrication:

* **Internal MQL:**

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

* **External MQL:**

Measured lubricant is atomised by compressed air in a spray nozzle. This produces microdroplets that are conducted together with the carrier air to the application point without any mist being formed.



SAFETY

BeCold equipment uses carbon dioxide. CO₂ is injected in the cutting area to refrigerate the tool.

As CO₂ is an inert gas, its presence in the work area should not cause any problem to equipment. However, high levels of CO₂ may displace and reduce oxygen concentration in air, below safe levels recommended for human breathing.

To prevent potential hazards, installing an extractor fan in the machining equipment to remove CO₂ injected during the machining process, is recommended.

In addition, fitting sensors to ensure oxygen levels are maintained at the appropriate concentrations is also suggested.

main APPLICATIONS

Cryogenic Machining is particularly suitable for heat resistant alloys and hardened steels. Although these materials are difficult to machine, this device is capable of controlling heat impact caused by early tool breakages, while yielding good machining results.

BeCold equipment is capable of using both systems (lubrication and/or cooling) separately. Moreover, units can be operated in two ways: autonomous operation controlled by a PLC; or connected through an output to the machine tool where it can be controlled.

Finally, **two different MQL systems**, MQL Vario or MQL VarioSuper, are offered to meet user needs.

There are **FOUR BECOLD MODELS AVAILABLE:**

- * **BCD-V1-XXX.** With 'Vario' MQL equipment and PLC controller
- * **BCD-V2-XXX.** With 'Vario' MQL equipment and machine control
- * **BCD-VS1-XXX.** With 'VarioSuper' MQL equipment and PLC controller
- * **BCD-VS2-XXX.** With 'VarioSuper' MQL equipment and machine control

MILLING	Finishing	Tempered steel	<input type="radio"/>
		Inconel 718	<input checked="" type="radio"/>
	Roughing	Stainless steel	<input checked="" type="radio"/>
		Aluminium	<input checked="" type="radio"/>
		Cr-Ni steel	<input checked="" type="radio"/>
		Tool steel	<input type="radio"/>
		Titanium	<input checked="" type="radio"/>
		Structural steel	<input type="radio"/>
		Carbon / Glass fibre	<input checked="" type="radio"/>
		Plastics	<input checked="" type="radio"/>
DRILLING	Peck drilling	Titanium	<input checked="" type="radio"/>
		Carbon / Glass fibre	<input checked="" type="radio"/>
TURNING	Conventional	AISI 304L	<input type="radio"/>
		Hard-turning ASP23	<input checked="" type="radio"/>

Use is highly recommended due to many advantages

Similar to conventional process, with cost savings

BCD-V1-XXX

**BECOLD EQUIPMENT:
"CRYOGENIC - MQL VARIO" SYSTEM WITH PLC CONTROL**



MQL Vario model

This device consists of a Cryogenic cooling system (CO₂) together with the MQL SKF LubriLean System which comprises the MQL Vario model.

MQL Vario units offer good lubrication in turning, milling and drilling processes. These units are capable of operating on multiple spindle machines.

The possibility of internal and external lubrication by the tool is also available.

This device is fitted with a programmable automaton housed in an insulated internal metal cabinet and a touch-sensitive HMI frontal display, independent from the machine, which can be easily installed through a Plug & Play system.

Thanks to the PLC this device can be connected and start operating immediately without the need for programming, by simply selecting the lubrication / cooling program on touch-sensitive display.



BCD-V1-XXX

Cabinet dimensions: 500x500x300mm

BCD-V2-XXX.

BECOLD EQUIPMENT: "CRYOGENIC - MQL VARIO" SYSTEM WITH MACHINE CONTROL



MQL Vario model

This device consists of a Cryogenic cooling system (CO₂) together with the MQL SKF LubriLean System which comprises the MQL Vario model.

MQL Vario units offer good lubrication in turning, milling and drilling processes. These units are capable of operating on multiple spindle machines.

The possibility of internal and external lubrication by the tool is also available.

This unit can be operated from the machine directly connected via a Harting connector. The device is more suitable for fixed systems as it is controlled by a programme installed in the machine-tool.

This is the most economical model in the **BeCold** range.



BCD-V2-XXX
Cabinet dimensions: 500x500x300mm

BCD-VS1-XXX

BECOLD EQUIPMENT:
"CRYOGENIC - MQL VARIOSUPER" SYSTEM WITH PLC CONTROL



MQL Vario Super system

This device consists of a Cryogenic cooling system (CO₂) together with the MQL SKF LubriLean System which comprises the MQL Vario Super model.

The MQL Vario Super unit offers the highest performance in the LubriLean range. This device provides excellent lubrication and is suitable for machining centres as well as special parts.

Combined with CO₂ cooling, this system can work in workpieces with high and very low hardness.

The possibility of internal and external lubrication by the tool is also available.

This device is fitted with a programmable automaton housed in an insulated internal metal cabinet and a touch-sensitive HMI frontal display, independent from the machine, which can be easily installed through a Plug & Play system.

Thanks to the PLC this device can be connected and start operating immediately without the need to programming, simply selecting the lubrication / cooling program on touch-sensitive display.



BCD-VS1-XXX

Cabinet dimensions: 500x500x300mm

BCD-VS2-XXX

BECOLD EQUIPMENT: "CRYOGENIC - MQL VARIO SUPER" SYSTEM WITH MACHINE CONTROL



MQL Vario Super model

This device consists of a Cryogenic cooling system (CO₂) together with the MQL SKF LubriLean System which comprises the Vario MQL model.

The MQL Vario Super unit offers the highest performance in the LubriLean range. This device provides excellent lubrication and is suitable for machining centres as well as special parts.

Combined with CO₂ cooling, this system can work in workpieces with high and very low hardness.

The possibility of internal and external lubrication by the tool is also available.

This unit can be operated from the machine directly connected via a Harting connector. The device is more suitable for fixed systems as it is controlled by a programme installed in the machine-tool.



BCD-VS2-XXX

Cabinet dimensions: 500x500x300mm

FITTINGS: nozzles, hoses, pressure regulators and discharge valves

BeCold equipment injects cryogenic CO₂ and MQL lube mixture into the cutting area, using a set of different **nozzles** for MQL injection.

NOZZLES

Pivot nozzle
UFZ code U00-150
External lubrication for machining centres.



Special nozzle 1/8
UFZ code 0026
External lubrication for machining centres.



Special M6 nozzle
UFZ code 0113
External lubrication for turning centres.



In addition, several **types of hoses** can be installed according to the length and requirements needed for equipment operation.

HOSES

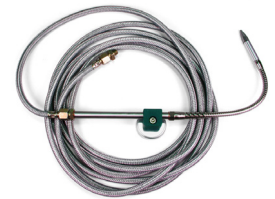
Installation hoses Material: PU

Code	Length
HRE. U00-070	5 m
HRE. U00-071	10 m
HRE. U00-080	15 m
HRE. U00-072	20 m



Installation hoses Material: Steel

Code	Length
HRE. U00-067	5 m
HRE. U00-068	10 m
HRE. U00-079	15 m
HRE. U00-069	20 m



Please order nozzles separately. See references in the above section.

PRESSURE REGULATOR

Code	Max. input pressure / Output range
033453	230 bar 0 ... 25 bar

Devices are fitted with two pressure regulators:
CO₂ gas inlet and outlet.



DISCHARGE VALVE

Code
21

Devices are fitted with two valves to depressurise and clean CO₂ gas and liquid circuits.



Collaborators



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