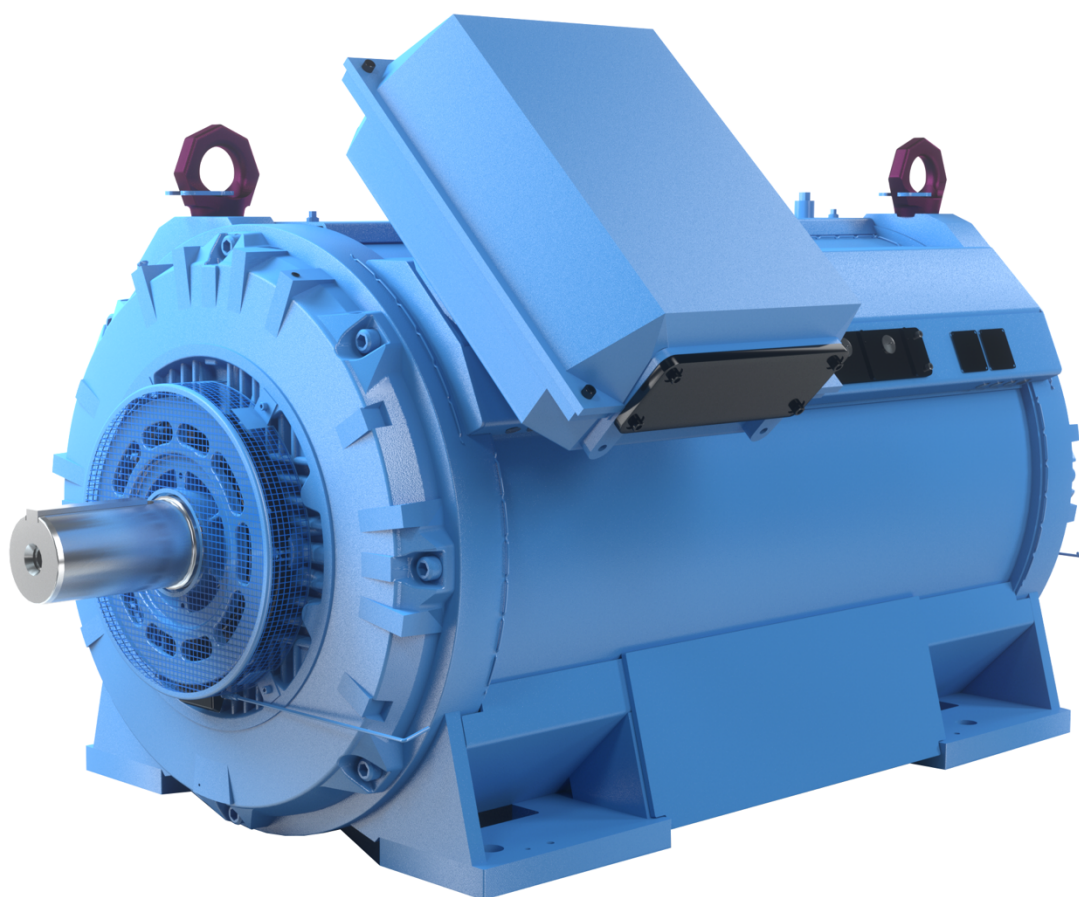

ABB IEC LOW VOLTAGE MOTORS, SEPTEMBER 28, 2017

10 good reasons to go water cooled

using ABB's M3LP 500 megawatt frame-size 500 motor



Executive summary

User demands for higher motor performance increases by the year or month. Today, motors must be smaller and lighter than ever before, but also stronger, more reliable and more energy efficient. Is that really a reasonable request? In fact, it is. Motors are becoming increasingly compact, and every year, more models are introduced which are compatible with the highest energy classes - IE3, IE4, or even IE5.

Motor operation is essential base technology in many industrial applications - especially in 24/7 variable speed drive (VSD) operation. But motor operation is also a significant cost item that many companies could reduce substantially. Continuous machine, process or system operation requires equally reliable motor operation. A requirement that is fulfilled by using robust equipment that will withstand even severely detrimental operating conditions.

ABB's water-cooled M3LP 500 megawatt motor offers all the above benefits. Thanks to its efficient cooling, it has a very low operating temperature. Which, in turn, is an important reason it has such a high power density, i.e. a favorable power per kg motor.

Unlike air cooling, water cooling makes motors insensitive to air pollution. No air intake, no risk of particles getting inside the motor, thus increasing its reliability. Without a noisy fan operating, and without any ventilation air flowing, a water-cooled motor is a lot quieter than the corresponding air-cooled motor.

With up to two megawatts of output power, the M3LP 500 is ABB's largest low-voltage water-cooled jacket motor to date. A motor whose specification will match, or even exceed, customers' most optimistic wish lists.

Background

Industrial demand for power keeps increasing. Components, products and systems are getting bigger with higher capacities - demanding more and more power and energy for their operation. Consequently, production systems need to be scaled up, too, just as the transportation systems that bring the products to customers around the globe.

This trend calls for ever more powerful electric motors, used throughout the distribution value chain - from extraction of raw materials to shipping and distribution of the finished products. A second trend running in parallel with industrial demand for power is the need for more compact motors, as floor space is getting more and more expensive and harder to come by - especially in the world's denser urban regions.

Technology advancement enables ever-higher motor power densities. More power can be gained using less material and energy - both important factors to reduce carbon emissions and climate change. This coincides neatly with today's increasing demand for water-cooled megawatt-class motors - such as the M3LP 500 from ABB. Water-cooled motors are on the increase thanks to e.g. their excellent power density and operating reliability.



In our most densely populated areas, floor space is becoming increasingly expensive - calling for more power-dense motors such as ABB's M3LP 500 megawatt-class, water-cooled frame-size 500 motor.

Introduction

This paper presents the most important benefits of using ABB's water-cooled motors in industrial applications, focusing specifically the new M3LP 500. This megawatt-class motor - named after its frame-size 500 and ABB's largest water-cooled motor to date - was originally designed for use in marine applications such as propulsion, thrust and on-deck machinery applications.

However, the characteristics of water-cooled motors make them a cost-effective alternative to traditional air-cooled motors for a wide range of other industrial applications as well. These motors are particularly suitable for use in confined spaces or in damp, dusty or dirty environments, i.e. conditions not uncommonly found throughout industry.

Industries	Applications
Mining	Pumps
Metals	Compressors
Water and wastewater	Fans
Wind power	Wind-turbine generators
Printing	Extruders
Textile	Paper machines
Rubber and plastics	Printing presses
	Mills
	Conveyer belts
	Kilns
	Chippers
	Mixers
	Cranes
	Hydropower plants
	Tunnel-boring machines

ABB's M3LP 500 megawatt-class, water-cooled frame-size 500 motor is suitable for use in a wide range of industry segments and applications.

10 good reasons to go water cooled

Water-cooled motors are attracting increased attention from motor users in many industrial segments and applications. This whitepaper outlines the 10 most important benefits motor users enjoy when implementing ABB's M3LP 500 water-cooled motor.

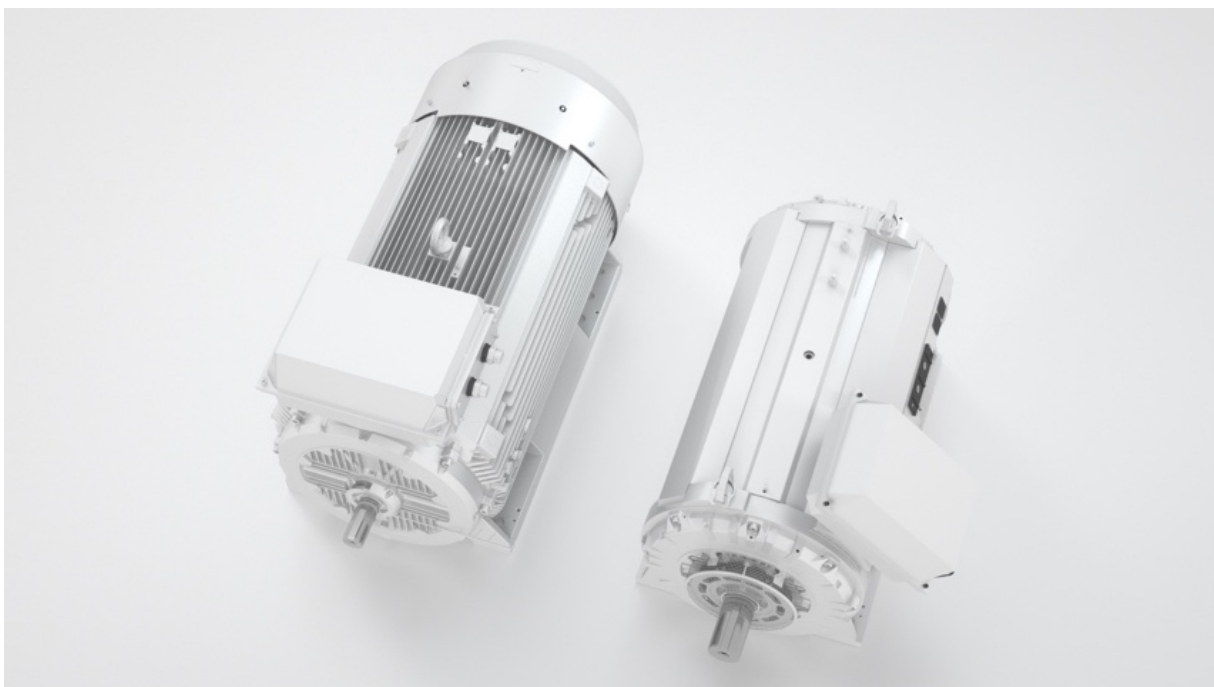
Reason #1.

High power density

The M3LP 500 is a powerful, yet highly compact motor. Its high power density means it has a relatively high power output in relation to its size. As industrial floor space is becoming increasingly costly, many motor users value power density highly and consider it an important quality in a motor. Thanks to the favorable power-size ratio, users can save space by shifting to a smaller water-cooled motor, or, increase the output without stepping up in motor size.

The superior power density is the result of the efficiency of water as a cooling media. Consequently, with a cooler operating temperature, more power can be extracted from a water-cooled motor's material. The M3LP 500 has a media temperature of 38°C/100°F and a cooling-media flow of 60 liters (15 U.S. gallons) per minute, which is approximately market average.

The cooling media inside ABB's motors can be used in most cooling media circuits available. So, there is no need for special adaptation or other time-consuming configuration work before deploying the motor.



Thanks to the superior power density of a water-cooled motor, users enjoy a high output for any given motor size. The M3LP 500 (right) is about 20 percent smaller than a corresponding air-cooled motor with similar output power.

Reason #2.

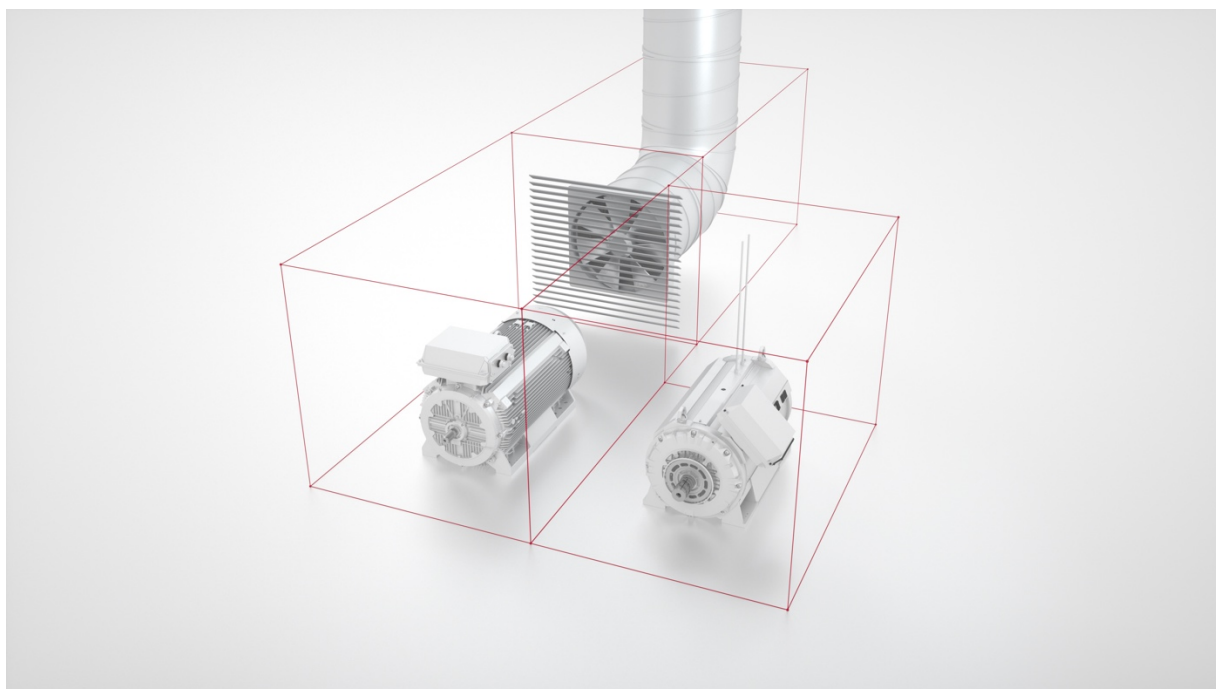
No ventilation needed

Air-cooled megawatt motors require an extensive and continuous supply of air for their cooling. Keeping these motors cool is therefore a challenge, especially when they are used for applications in heat-sensitive environments, for example driving a conveyer in a mine or a kiln in a cement factory.

However, dedicated motor ventilation adds to total motor operation costs. A ventilation system is also space demanding, which is particularly troublesome onboard ships or in many urban installations, where space is scarce and costly. Here, an air-cooled motor, with bulky fans and ducts, would take up too much floor space. A water-cooled motor uses up a lot less space.

In some industrial applications, there may also be safety risks associated with air-cooled motors. If there is dust or dirt present, a water-cooled motor may be preferable due to e.g. its lower frame temperature and the absence of dirt-collecting cooling ribs.

There are production environments which are extremely sensitive to draught, thus ruling out air-cooled motors as an option. One example is extrusion of PET bottles, which is very sensitive to air-flow variations in the production facility. Since they come without external fans, water-cooled motors do not generate any air circulation at all - making them ideal for such environments.



A water-cooled motor needs no separate air ventilation. Without the need for bulky ventilation ducts, fans and other ventilation equipment, the M3LP 500 (right) takes up a lot less space than a corresponding air-cooled motor.

Reason #3.
Smart design

Casted aluminum rotor

The main advantage of ABB's casted aluminum rotor is it keeps down the motor's total weight. The rotor's design is robust, and delivered in one piece, it is also maintenance-free - as opposed to a copper rotor, whose bars must be regularly tightened or re-welded.

Longer bearing life with bearing cooling fans

The M3LP 500 motor comes delivered with bearing cooling fans. Together with the inherently lower motor temperature of a water-cooled motor, the fans allow for improved uptime and longer bearing lifetime.

Large terminal box

The terminal box of the M3LP 500 is larger than most comparable motors from other suppliers. It is therefore easier to install cables, thus simplifying and speeding up motor implementation. When upgrading, many motor users have experience of cumbersome cable installation and therefore request a larger terminal box than on their previous motors.

Reason #4.
Flexible design

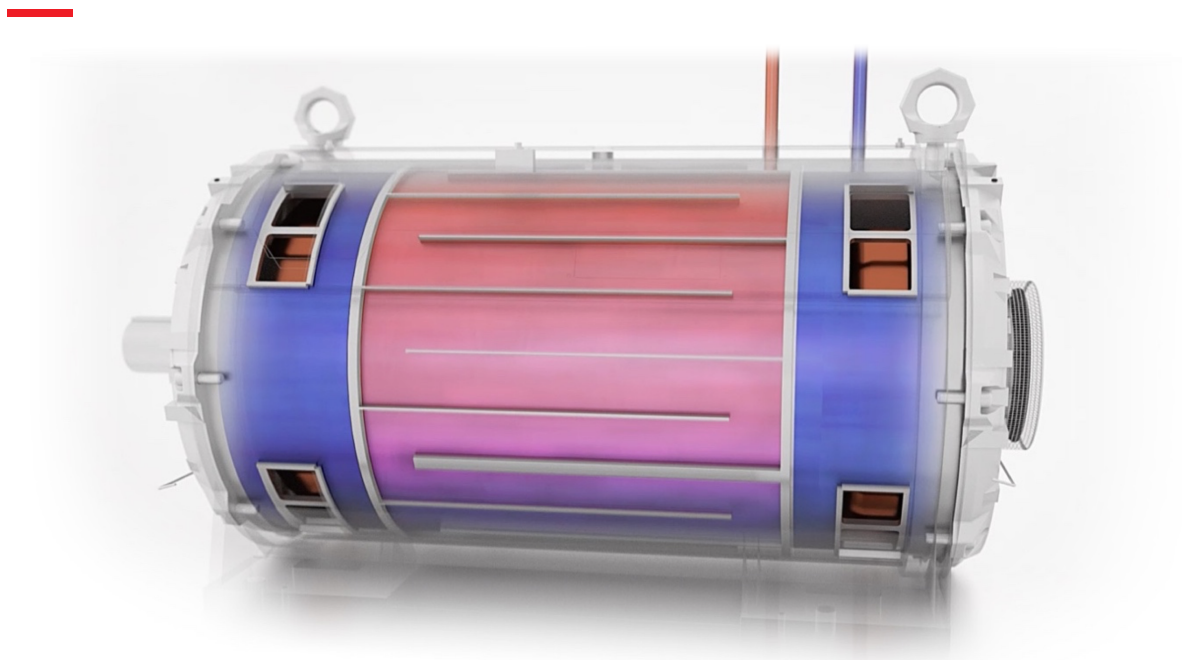
ABB's widely known design flexibility is as applicable to the M3LP 500 motor as to any other motor from ABB. You can have your motor perfectly customized according to your specific need as we are able to design it using a wide range of selectable components and optional features.

Balancing grades, bearing and lubrication options, heating elements, insulation systems, painting systems, stator winding sensors, bearing temperature sensors, terminal box configurations, cable entry configurations, encoder options and brake options - they are all selectable, offering practically endless customization possibilities.

Reason #5.
Smart use of existing infrastructure

With today's increasing cost of floor space, every square-meter counts and must be used efficiently. Constructing a ventilation system specifically for motor cooling is an expensive and space demanding undertaking. Especially when replacing a motor in an existing location. In contrast, a water-cooled motor can use cooling infrastructure already existing in the building: its ordinary tap-water supply system.

Water-cooled motors are easy and cost-effective to implement - so long as there is fresh water drawn into the building - especially when replacing one existing water-cooled motor with a new one. The availability to fresh water makes it easy and less costly to implement other related water-cooled equipment, too, e.g. water-cooled variable speed drives (VSDs), which would otherwise require setting up specific purpose-built cooling pumps.



Water cooling is a highly effective cooling method, allowing more power per kilogram to be extracted from the motor compared to a conventional air-cooled motor.

Case study

Smart use of existing infrastructure

Industry segment: Wastewater treatment

Application: Water pumping

When in need of motor output upgrading, a European wastewater company turned to ABB. Given the space constraints in the existing motor location, the customer had installed water-cooled motors from the beginning. When it was time to upgrade, it was therefore only natural to continue using water-cooled motors.

The company turned to ABB to place an order for more powerful water-cooled replacement motors. Thanks to the motors' compactness - and with tap-water supply already in place - it was possible to use the existing location and infrastructure to cool the motors and their VSDs - without work-intensive modifications.

Reason #6.**Reliable in harsh environments**

Equipped with a steel frame and high-quality coating, the motor features excellent resistance to corrosion and dust accumulation. It is equipped with labyrinth seals, which allow it to withstand intrusion of humidity, dust or particles. Water-cooled motors are easy to keep clean.

Given the harsh operating environments in which they generally appear, maintenance procedures may be difficult to perform - making low maintenance requirements crucial. These factors combined make the M3LP 500 particularly reliable in harsh operating environments - including narrow, damp and dusty locations - where the corresponding air-cooled motor would be considerably less suitable.



Designed for harsh environments, the M3LP 500 is not concerned with damp, dirty or dusty operating conditions. Its steel frame, and particle and damp-proof sealing ensures highest reliability regardless of environment.

Reason #7.**Energy efficiency**

Today, efficiency is a main topic when it comes to motors - as companies opt to reduce their energy spending. There is growing interest in motors that are compatible to IE3, IE4 or even higher efficiency classes. Since water-cooled motors are often operated 24/7, using a VSD, high energy efficiency is important to reduce operating costs - and hence total cost of ownership (TCO).

One such example are pump stations in wastewater management, where everything comes down to operating reliability and economy. In these and other 24/7 industrial applications, water-cooled motors are becoming more and more popular and interesting alternative to conventional air-cooled motors.

Reason #8.

Lower network cost

Using water-cooled low-voltage motors, users can opt for leaner networks. There is no need for a high-voltage network, a big transformer, etc. Compared to a medium or high-voltage network, the cost for a low-voltage network is considerably lower.

While low voltage *does* require thicker cables, it enables more cost-efficient installation and a leaner electric design. Moreover, low voltage is preferable in energy solutions that involve batteries, solar energy, wind power or other alternative energy sources. Such mixed energy solutions are currently increasing rapidly.

Reason #9.

Operating benefits

In certain industrial applications, water-cooled motors are the only viable alternative, necessitated by specific production requirements. In some cleanroom production environments, air-cooled motors are disallowed because of the risk of contamination due to the uncontrolled air circulation arising from the presence of air-cooled motors in the room.

Conveyors may generate large vibrations, which may affect the motor driving it in a negative way. Motors in use to drive conveyors must therefore be designed specifically to withstand vibration. The M3LP 500 comes with a steel frame, which allows the motor to typically withstand higher load and vibration than a comparable air-cooled motor.



Extrusion of PET bottles is very sensitive to air circulation, disqualifying air-cooled motors due to the air circulation generated. In contrast, ventilation-free water-cooled motors are highly suitable.

Case study

Airflow-sensitive production

Industry segment: Food and beverage

Application: PET-bottle extrusion

PET bottles are typically produced using extrusion. This manufacturing method is extremely sensitive to any airflow occurring in the room - which is exactly what would happen if air-cooled motors were used, as the cooling fans would create a turbulent airflow.

Therefore, these motors are not used in extrusion applications, traditionally in favor of hydraulic motors. However, hydraulic motors are considerably more expensive than water-cooled motors, and the latter would generally do the job just as effectively.

Reason #10.

Fast and easy service

Although designed specifically for low maintenance requirements, even a water-cooled motor *does* require regular maintenance and occasional repairs. Servicing any megawatt-class motor is a time-consuming task, requiring days or weeks rather than hours. However, for such a large motor, the M3LP 500 is relatively easy to service. One important reason is that the motor has a casted rotor cage, which does not require recurring tightening of the rotor bars.

Maintenance stops are shorter since easy dismantling and assembling of the end shields were considered during the design of the motor. Standardized design of components, e.g. bearings, enables fast and easy replacement. Parts are available for ordering 24/7 in ABB's online spare parts network, Business Online. Professional support is provided globally through ABB's wide network of workshops and service partners.

As the M3LP 500 is built on standardized ABB technology, there is a high degree of interchangeability of spare parts - not only between different ABB's water-cooled motors, but between all ABB motors and many non-ABB motors as well. This enables a rational and cost-effective spare parts handling.



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About ABB

ABB (ABBN: SIX Swiss Ex) is a pioneering technology leader in electrification products, robotics and motion, industrial automation and power grids, serving customers in utilities, industry and transport & infrastructure globally. Continuing more than a 125-year history of innovation, ABB today is writing the future of industrial digitalization and driving the Energy and Fourth Industrial Revolutions. ABB operates in more than 100 countries with about 136,000 employees. www.abb.com

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