MoorMaster® is a vacuum-based automated mooring technology that eliminates the need for conventional mooring lines. Remote controlled vacuum pads recessed in, or mounted on the quayside or pontoons, moor and release vessels in seconds. MoorMaster automated mooring eliminates the need for mooring lines with automated vacuum pads that moor and release vessels in seconds at the push of a button. MoorMaster dramatically improves safety and operational efficiency, optimises the ship-to-shore interface, and in many cases enables ports to make infrastructure savings.

Works with virtually all vessels
Thanks to its modular design and vacuum pads that attach to any flat surface, MoorMaster is used with a wide variety of vessels and applications, irrespective of vessel size and design. MoorMaster systems are used to moor ferries as well as 400m container ships and bulk carriers of more than 300m.
Benefits

Mooring in less than 30 seconds
• Faster turn-around times and more ship calls result in improved productivity
• Reduced energy consumption and emissions from tugs and vessel thrusters
• Reduced cruising speeds result in reduced energy consumption
• More than 90% reduction in emissions during ship berthing due to reduced use of tugs and ship engines
• Fast and simple connection to shore power
• Reduced erosion of seabed driving cost savings

Mooring at the push of a button by one remote operator
• Frees up resources such as tugs and hands-on crews
• Reduces risk of mooring accidents as personnel are removed from hazardous working areas
• Mooring can be undertaken from any location, thereby reducing reliance on personnel present at the berth

Vessel overhang
• No infrastructure investment needed to berth larger vessels since MoorMaster only needs to attach to the parallel sideboard of the vessel
• Quay length can be “virtually” extended as vessels’ bows can overhang the end of the quay
• Any vessel can use the berth, even vessels that are longer than the berth

Reduced vessel motion due to advanced control system
• Increased productivity for ship loading/unloading operations
• Improved pier utilisation due to closer vessel spacing
• Real-time monitoring of mooring processes and forces
• Superior vessel control due to patent protected Active Control technology
• MoorMaster can potentially reduce breakwater extension requirements

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• MoorMaster can potentially reduce breakwater extension requirements
Twenty years after the first MoorMaster system entered service, this unique technology remains the only widely used vacuum mooring technology on the market. Over the years, Cavotec has developed MoorMaster systems for a wide range of applications and customer requirements.

**Container**
MoorMaster closes the technological gap between container ships and today’s highly automated facilities, and is increasingly seen as part of fully automated port design.

MoorMaster secures vessels up to and including Super Post-Panamax vessels with a capacity of more than 20,000 TEUs in a matter of seconds, enabling loading operations to begin more quickly and reducing vessel motion, thereby increasing crane moves per hour.

**Ro/Pax and Ro/Ro**
Cavotec has supplied MoorMaster to a wide variety of Ro/Ro and ferry applications that reduce mooring times, thereby allowing more time for passenger and vehicle boarding and disembarking, or lower cruising speeds.

Shorter mooring times reduce fuel consumption as well as air pollution and noise at terminals, which are often located close to city centres.

**Electric vessels**
In close co-operation with customers, Cavotec has led the development of innovative solutions for e-vessels since 2014. By the end of 2020, our automated mooring and charging solutions will be used at more than 60 sites.

MoorMaster keeps vessels in position for safe charging and allows thrusters to be shut off, drastically reducing energy consumption.

**Bulk**
MoorMaster has been in operation at major bulk terminals in Australia and Europe for more than a decade. The technology improves safety and productivity, while reducing the need for infrastructure investment.

MoorMaster also contributes to improved efficiency in the oil and gas sector by providing innovative systems that safely moor LNG and tanker vessels, thereby making loading and offloading operations faster and safer.

**Locks**
MoorMaster hands-free mooring is revolutionizing the operation of locks: shortening lockage time, eliminating dangerous rope-handling activities, increasing safety, and enabling greater vessel throughput.

At some 13 locks to date, MoorMaster systems are mounted on vertical rails inside lock chamber walls to secure ships during the lockage process as they are raised or lowered while keeping them at a fixed distance from the lock wall.
MoorMaster first entered service in 1999 at a ferry application in New Zealand. At this point, MoorMaster was a bold challenge to thousands of years of conventional mooring methods.

Today, MoorMaster is a widely accepted technology that has performed more than 800,000 mooring operations, with a 100 per cent safety record, at ferry, bulk handling, Ro-Ro, container and lock applications all around the world. Cavotec engineers continue to develop MoorMaster and are perfecting new ways the technology can be used to improve safety, operational efficiency and realise infrastructure savings.

References

Container
- Port of Salalah, Oman: 09
- Port of Ngqura, South Africa: 10
- Port of Beirut, Lebanon: 11

Ro/Pax and Ro/ro
- SeaRoad, Australia: 13
- Port of Helsinki, Finland: 14
- Wightlink, UK: 15

Electric vessels
- Norled, Norway: 17
- Fjord1, Norway: 18
- ASKO Maritime, Norway: 19

Bulk
- Port Hedland, Australia: 21
- Port of Narvik, Norway: 22
- ECONNECT Energy, Norway: 23

Locks
- St. Lawrence Seaway, Canada and USA: 25
Located on the Arabian Peninsula, Port of Salalah is perfectly positioned to serve the Asian-European trade. The transhipment terminal is partly owned and operated by APM Terminals and serves as one of Maersk’s hub terminals.

The port first trialled MoorMaster in 2004 and today it has MoorMaster systems installed at its four most used container berths. The systems speed up mooring and increase loading productivity for the port. The systems reduce idling and shorten turnaround times for ships.

During the local monsoon season, Kahreef, the port is battered by long waves. The MoorMaster systems mitigate the impact of the long waves to allow maintained productivity and safety even with the world’s largest container vessels.

Cavotec also has an ongoing maintenance contract for the MoorMaster systems with a local Cavotec team embedded at the port.

I was a captain of a container ship, and frequently moored my vessel at the Port of Salalah using Cavotec MoorMaster. Despite challenging berthing conditions due to long waves, Cavotec MoorMaster makes mooring safe, easy and fast.

Visiting captain at the Port of Salalah.
Having determined that it would be economically unviable to extend the existing breakwater to protect a new 500m quay extension, the Port of Beirut needed a solution to mitigate wave-induced vessel motion at the unprotected berth. Studies demonstrated the superiority of MoorMaster over mooring lines in these conditions, and the port opted to implement MoorMaster having also considered the added benefits of faster vessel turnaround times and increased safety at the terminal.

The MoorMaster system covers the entire 500m extension of the 1,100m long quay no. 16. The MM200C mooring units are mounted in pairs with one unit on each side of each fender. Each pair shares a slim and service-friendly power unit, with hydraulic and vacuum services.

The MM200C system has all the typical characteristics of the MoorMaster product including remote operation, active vessel position control, self-diagnostics, and the ability to operate in temperatures up to +35°C.

References – Container

Port of Ngqura, South Africa

Product: MM200C
Type: Face-mounted
Systems: One multi-unit system
Moorings: Three to four a week
Vessels: Container ships up to 366m LOA
Operator: Transnet
Owner: Transnet
In operation: Since 2015

Transnet National Ports Authority awarded a contract to Cavotec for automated mooring at the Port of Ngqura’s container terminal located on South Africa’s east coast. Cavotec designed, manufactured, and installed a MoorMaster system at the container berth D100. The system moors container ships from 1,500 TEU up to 13,000 TEU and 366m LOA.

The Port of Ngqura experiences significant long wave effects and high winds, especially during winter, causing excessive movement in the ships along the quay wall which interferes with crane operations. As a result, there is considerable downtime in cargo operations which affects the terminal’s efficiency targets.

With the MoorMaster system, Berth D100 has a far higher threshold for operations than other berths at the port. Customers request berth D100 as they know that their vessels will be safe and productivity high.

In addition to the supply of the MoorMaster equipment, Cavotec took full responsibility for the turnkey scope of the project, including hydrodynamic mooring analysis, civil works, and electrical distribution.

Port of Beirut, Lebanon

Product: MM200C
Type: Face-mounted
Systems: One multi-unit system
Moorings: Four to five a week
Vessels: Container ships up to LOA 350m
Operator: Port of Beirut
Owner: Port of Beirut
In operation: Since 2014

Having determined that it would be economically unviable to extend the existing breakwater to protect a new 500m quay extension, the Port of Beirut needed a solution to mitigate wave-induced vessel motion at the unprotected berth.

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The MM200C system has all the typical characteristics of the MoorMaster product including remote operation, active vessel position control, self-diagnostics, and the ability to operate in temperatures up to +35°C.
In 2003, the second and third MoorMaster systems ever installed entered service for Australia’s SeaRoad shipping company that operates Ro/Ro traffic between Melbourne and the island of Tasmania.

One MoorMaster system was introduced at each end of the route to improve safety. SeaRoad soon discovered that the systems provided additional benefits including improved flexibility and the faster start of loading/offloading operations.

Each MoorMaster system initially consisted of four MM400A units, each rated at 40 tonnes. In 2016 each system was upgraded with one additional unit to accommodate the addition of a new-build vessel to SeaRoad’s fleet. In 2021, SeaRoad introduced a new, longer vessel and therefore integrated the new, next generation MoorMaster NxG units into the existing systems.

Both the new vessels are longer than the berth, and because MoorMaster only attaches to the flat hull along the parallel body of the vessel, SeaRoad avoided a costly berth extension.

The application also offers the considerable advantage of being able to move vessels along the berth to make ramp angles more favourable as draft levels change.

Over the past 17 years, our MoorMaster systems have been extremely consistent, and Cavotec’s support exemplary. We’re extremely excited to be the first company to install the next generation of MoorMaster as we introduce larger tonnage to meet our customers’ demands.

General Manager Marine, SeaRoad.

**SeaRoad, Australia**

**Product:** MM400A and NxG

**Type:** Top-mounted

**Systems:** Two multi-unit systems

**Moorings:** One a day

**Route:** Melbourne – Devonport

**Vessels:** SeaRoad Mersey II, Liekut

**LOA:** 182m, 210m

**Operator:** SeaRoad Holdings Pty Ltd

**Owner:** SeaRoad Holdings Pty Ltd

**In operation:** Since 2003

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General Manager Marine, SeaRoad.
The Port of Helsinki is committed to reducing the carbon footprint of harbour operations through its Carbon Neutral programme. Auto-mooring systems at the busiest berths play a vital part in the successful reduction of vessels’ carbon emissions. As our passenger terminal is centrally located, nearby residential areas, reducing the impact of harbour operations is of the utmost importance to us.

Harbour Master, Passenger Services, Port of Helsinki.

Wightlink installed MoorMaster as part of a major upgrade of their terminals at Portsmouth and Fishbourne in the UK, which also included the purchase of a new-build vessel. With a LOA of 89m, the new vessel would have required the pier in Portsmouth to have been extended to ensure safe conventional mooring.

Introducing MoorMaster MM400E mooring units into the design of the upgraded terminal in Portsmouth meant that it was no longer necessary to extend the pier, thereby substantially reducing the cost of the project. Since MoorMaster only attaches to the flat hull along the parallel body of the vessel, it allows the vessel to overhang the existing quay.

Wightlink also chose to install MoorMaster at the Fishbourne terminal to shorten vessel turn-around and eliminate dangerous line-handling at both ends of the operation.

This is part of Wightlink’s major investment in future services. We estimate MoorMaster will cut our turnaround time by three minutes to 15 minutes which will help us improve our punctuality.

Project Director, Wightlink.

References – Ro/Pax and Ro/Ro

Wightlink, UK

Product: MM400E
Type: Top-mounted
Systems: Two multi-unit systems
Moorings: 30 times a day
Route: Portsmouth-Fishbourne
Vessels: Various
LOA: 62-89m
Operator: Wightlink Ferries
Owner: Wightlink Ferries
In operation: Since September 2017

Port of Helsinki, Finland

Product: MM400E
Type: Top-mounted
Systems: Two multi-unit systems
Moorings: Nine times a day
Route: Helsinki - Tallinn
Vessels: Tallink Star, Tallink Megastar and Finlandia
LOA: Up to 212m
Operator: Port of Helsinki
Owner: Port of Helsinki
In operation: From March 2017

MoorMaster has been in use at a Ro/Pax berth since 2016, and a second system was installed in 2021. From 2021, the connecting berths in Tallinn are also equipped with MoorMaster, enabling vessels to sail between the ports without needing to use mooring lines at either end of the route.

Rapid mooring and release enables ships’ engines to be shut down faster in port, reducing harmful emissions. Every minute saved in port also increases the amount of time that ships can spend at sea, making it possible for ships to cruise at lower speeds, which saves fuel and further reduces emissions.

A case study using a tool developed by DNV GL Maritime Advisory has shown the first MoorMaster system installed in 2016 reduces carbon emissions by 8,000 tonnes per year and reduces 16 tonnes NOx at the berth alone. This is the equivalent of removing some 5,000 diesel cars from the streets of Helsinki.

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Project Director, Wightlink.
In 2014, Cavotec won a ground-breaking order to supply both automated mooring and charging for the world’s first fully battery powered ferry, Ampere. The systems were installed on two frequent-use ferry berths, Lavik and Oppedal, operated by Norled in western Norway.

By using MoorMaster the ferry’s thrusters can be switched off for nine minutes during each 10-minute boarding process, thereby saving power and reducing the load on the battery.

The integration with the automated charging system enables fully efficient and safe charging during each port stay.

With more than 15,000 calls per berth and year, the electrification of the vessel operations has improved air quality and reduced fuel cost significantly.

Subsequently, Norled equipped a second electric ferry route between Sydnes and Utbøja route with MoorMaster.

**Norled, Norway**

<table>
<thead>
<tr>
<th>Product: MM200E and MM200K</th>
<th>Type: Top-mounted</th>
</tr>
</thead>
<tbody>
<tr>
<td>Systems: Four single-unit systems</td>
<td></td>
</tr>
<tr>
<td>Moorings: Up to 40 times a day</td>
<td></td>
</tr>
<tr>
<td>Route: Lavik-Oppedal &amp; Sydnes-Utbøja</td>
<td></td>
</tr>
<tr>
<td>Vessels: Ampere and other electric ferries</td>
<td></td>
</tr>
<tr>
<td>LOA: Up to 86m</td>
<td></td>
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<tr>
<td>Operator: Norled</td>
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<tr>
<td>Owner: Norled</td>
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</tr>
<tr>
<td>In operation: Since 2015</td>
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</tbody>
</table>

In operation since 2015, Norled equipped a second electric ferry route between Sydnes and Utbøja route with MoorMaster.
In 2020, Cavotec was awarded a historic order for the automated mooring and charging of the world’s first zero-emission and fully autonomous fleet of Ro/Ro vessels. ASKO Maritime, the shipping arm of Norway’s largest grocery distributor, will benefit from MoorMaster NxG in its Oslo Fjord operations where the fully electric ships will sail autonomously from port to port thereby replacing two million kilometres of truck transport, reducing CO2 emissions by 5,000 tonnes every year.

Fast and automated mooring will enable vessel thrusters to be shut off in port, thereby drastically reducing energy consumption and extending battery lifetime. The MoorMaster NxG is re-designed from the ground up for smart installation, operations, and maintenance.

The MoorMaster system will save us huge amounts of energy and is a key enabler of autonomous operations. Since we won’t need to use the powerful bow and side thrusters in port, our electric vessels will use less energy and also extend the battery lifetime. The MoorMaster technology is perfect to complement to our new ships – using modern technology for a futuristic fleet.

Chief Executive Officer, ASKO Maritime.

**Fjord1, Norway**

- **Product:** MM200K, MM400E, and NxG
- **Type:** Top-mounted
- **Systems:** 38 single-unit systems
- **Moorings:** Up to 52 times per day
- **Route:** 19 ferry routes across Norway
- **Vessels:** Various, electric and/or hybrid
- **LOA:** Up to 106m
- **Operator:** Fjord1
- **Owner:** Fjord1
- **In operation:** Since 2018

In 2017, Norwegian transport provider Fjord1 won the Anda-Lote ferry route concession for a 10-year period. The Anda-Lote service was the first of many Fjord1 ferry routes to benefit from MoorMaster automated mooring.

Prior to the introduction of MoorMaster, Fjord1 car and passenger ferries used their thrusters to hold vessels in position at berth throughout port stays, resulting in high fuel or energy consumption.

MoorMaster moors ferries in a matter of seconds, allowing ship engines to be shut down. This is vital to maximise battery charging time at berth and reduce energy consumption.

Many of the MoorMaster units at these berths are integrated with innovative automated charging systems that charge ferry battery packs even during short port stays.

The units are operated remotely from the bridge, thereby reducing the safety risks associated with mooring for personnel and vessels.

In all, 38 ferry berths are currently operated using MoorMaster, with another two sites set to introduce the next generation MoorMaster technology, NxG, in 2023.

**ASKO Maritime, Norway**

- **Product:** NxG
- **Type:** Top-mounted
- **Systems:** Two single-unit systems
- **Moorings:** Two autonomous, electric vessels
- **Route:** Horten to Moss
- **Vessels:** Two autonomous, electric vessels
- **LoA:** 76m
- **Operator:** ASKO Maritime
- **Owner:** ASKO Maritime
- **In operation:** From 2022

In 2020, Cavotec was awarded a historic order for the automated mooring and charging of the world’s first zero-emission and fully autonomous fleet of Ro/Ro vessels. ASKO Maritime, the shipping arm of Norway’s largest grocery distributor, will benefit from MoorMaster NxG in its Oslo Fjord operations where the fully electric ships will sail autonomously from port to port thereby replacing two million kilometres of truck transport, reducing CO2 emissions by 5,000 tonnes every year.

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The MoorMaster NxG is re-designed from the ground up for smart installation, operations, and maintenance.
The Port of Port Hedland is the world’s largest bulk export port, located in the Pilbara Region of Western Australia. In 2010 the port installed a MoorMaster system on a 270m long iron ore berth designed for 200m bulk carriers. Thanks to the MoorMaster system, the berth can now accept vessels up to 295m LOA. This results in an increase in capacity without the need for a costly infrastructure investment.

There are seven-meter tides at the berth and 12-meter draft change of the vessels. If tensioned mooring lines were used, these would constantly need to be re-tensioned and could cause snap-backs accidents. With MoorMaster, the tidal changes are handled completely automatically, and the personnel is kept safe.

Vessels can only enter and leave the port in specific tidal windows. By mooring some 30–40 minutes faster, the vessel has time to load more iron ore within its allotted slot at the berth, which means more revenue.

The berth is located at the harbour mouth and is exposed to strong tidal currents up to two knots, hydrodynamic effects created by passing ships, and extreme heat (+45°C). The MoorMaster system is designed to withstand all these harsh environmental conditions at the port as well as vast amounts of fine iron ore dust.

“We don’t operate lines under tension on this berth. With the high tidal range here on Port Hedland there is a risk that lines will snap under high tension. We don’t run this risk and obviously don’t put the people on the wharf under risk of being injured by parting lines.”

Operations Supervisor, Port Hedland.

<table>
<thead>
<tr>
<th>Port Hedland, Australia</th>
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<tbody>
<tr>
<td><strong>Product:</strong> MM200C</td>
</tr>
<tr>
<td><strong>Type:</strong> Face-mounted</td>
</tr>
<tr>
<td><strong>Systems:</strong> One multi-unit system</td>
</tr>
<tr>
<td><strong>Moorings:</strong> One time every second day</td>
</tr>
<tr>
<td><strong>Vessels:</strong> Panamax and mini-Capes up to LOA 295m</td>
</tr>
<tr>
<td><strong>Operator:</strong> Pilbara Ports Authority</td>
</tr>
<tr>
<td><strong>Owner:</strong> Pilbara Ports Authority</td>
</tr>
<tr>
<td><strong>In operation:</strong> Since 2010</td>
</tr>
</tbody>
</table>
ECONNECT Energy – previously Connect LNG – has developed a jetty-less transfer system for transferring LNG from ship to shore or shore to ship without costly fixed infrastructure. The system, IQuay™, consists of a semi-submersible platform that is connected to the shore with hoses. Cavittec supported ECONNECT Energy throughout the development of the IQuay. In 2017, Gas Natural Fenosa commissioned the first IQuay™ system, it included an ATEX and class-certified MoorMaster system. No modifications were required to achieve CLASS certification.

In 2016, Cavittec supplied a MoorMaster system for international minerals group LKAB’s new iron ore berth in Narvik, northern Norway. The units moor bulk carriers of up to 185,000 DWT and 305m LOA. This is the first MoorMaster bulk handling application in Europe, and the first located within the Arctic Circle.

The MM200C units for this project are built to withstand the harsh winters and demanding operational conditions common to its location. The LKAB facility at Narvik ships 15-20 million tonnes of iron ore every year. The MoorMaster units ensure vessels are moored quickly, safely and remain in position to ensure fast and efficient loading operations.

An automated warping feature has also been added to allow the operator to warp bulk carriers without the use of mooring gangs and tugs.

ECONNECT Energy, Norway

Product: MM400E EX
Type: Top-mounted on semi-submersible platform
Systems: One multi-unit systems
Moorings: Once a day
Vessels: LNG carriers
Operator: Gas Natural Fenosa
Owner: Gas Natural Fenosa
In operation: Since October 2017

Port of Narvik, Norway

Product: MM200C
Type: Face-mounted
Systems: One multi-unit system
Moorings: Two to four times a week
Vessels: Bulk carriers up to 185,000 DWT and 305m LOA
Operator: LKAB
Owner: LKAB
In operation: Since 2016

References – Bulk
The St. Lawrence Seaway connects the Great Lakes of the US and Canada with the Atlantic Ocean. Due to MoorMaster hands-free mooring installed in all high-lift locks, vessels are able to make this journey without ever putting out a mooring line.

In 2007, Cavotec began working with St Lawrence Seaway Management Corp (SLSMC) to develop a MoorMaster system for use in their locks. Today, MM400L systems are installed at 13 lock sites where changes in water levels range between 13 and 18 metres. The systems are remotely operated up to four hours away from the locks themselves and eliminate dangerous mooring line handling as vessels descend the locks. As MoorMaster can attach to virtually any vessel, it has increased the pool of vessels that can use the Seaway from around 800 with special “Seaway fittings” to all 8,000 vessels worldwide that fit in the locks. It also improved the vessels’ crew rest time without the need to manage deck winches during lockages.

Due to fast mooring and faster draining/filling through reduced vessel motion, the systems shorten each lockage by seven minutes, equating to three to four hours of potential time savings on a roundtrip transit. With an average time to pass a lock of 45 minutes, this represents a productivity increase of more than 15%.

### St. Lawrence Seaway, Canada and USA

**Product:** MM400L
**Type:** Face-mounted recessed into a lock wall
**Systems:** 16 multi-unit systems
**Moorings:** Four to five times a day in each lock
**Vessels:** Various
**LOA:** Up to 225m
**Operator:** SLSMC and SLSDC
**Owner:** SLSMC and SLSDC
**In operation:** Since 2014
Have Cavotec contact you!

Visit www.cavotec.com/contact-us to get in touch with your local Cavotec office.

You can also visit www.cavotec.com/moormaster to learn more about the technology.

MoorMaster is a registered trademark in the EU, USA, Canada, Brazil, India, New Zealand, Australia and Norway, as well as an international WIPO registration.

Disclaimer: specifications are subject to change without notice.

Issued September 2021.