MoorMaster™ AUTOMATED MOORING

CAVOTEC

WE CONNECT THE FUTURE

A UNIQUE TECHNOLOGY

MoorMaster™ is a vacuum-based automated mooring technology that safely holds even the largest 450,000 DWT bulk vessels and Super-postpanamax container vessels, and eliminates the need for conventional mooring lines.

Remote controlled vacuum pads, recessed in, or mounted on the quayside and attached to hydraulic actuated arms, extend, attach and moor ships in a few seconds.

Time is money

Save up to 1.5 hours for mooring your vessel as MoorMaster™ normally requires only 30 seconds for mooring, and just 10 seconds to detach. (Conventional mooring normally takes between 20 and 90 minutes involving mooring gangs, ships' crews, pilots and tugs).

A proven revenue booster

MoorMaster™ improves operational efficiency and reduces environmental impact. Sophisticated electronic hydraulic controls minimise vessel movement (surge, sway and yaw) to maintain the vessel's position with millimetre accuracy. MoorMaster™ units can also be used to warp the vessel position without the need for vessel's own steam or the help of tugs.

Operational efficiency and safety

One-person operation, with either a single port officer or the captain of the vessel using a Cavotec smart radio remote control. Automatic adaptation to tidal and draft changes enables the client to better utilise personnel who are no-longer required to work in high risk zones.

Infrastructure cost savings

MoorMaster™ units can be programmed to hold vessels at set distances from the fender line. Furthermore, units only attach to the parallel body of the ship, making berth overhang possible. The need for berth extensions or mooring dolphins may therefore be eliminated in some cases. Proper hydrodynamic studies may even indicate that breakwater arrangements might be unnecessary with a MoorMaster™ system in place.

A core element of strategic environmental planning

Vessels using MoorMaster™ are "all secure" far quicker than those using conventional mooring techniques. This enables engines to be shut down much sooner, and reduces the amount of time tugs are required. MoorMaster™ thus results in emission reductions of more than 90 per cent.

Permanent online monitoring and visualisation

MoorMaster™ incorporates continuous load monitoring and sophisticated alarm functions relayed in real time to operations personnel onshore, onboard and/or in the port control office. Alerts can be sent to pagers, mobile phones and other devices.

Advantages and benefits

Port

- Faster vessel-turnaround enables larger number of ship calls.
- Cargo and crew transfer can start earlier.
- Increased cargo throughput.
- Improved utilisation of tug fleet: tugs leave ships much earlier and return just prior to departure.
- Mooring gangs not required.
- Improved utilisation of terminal length if berthing distances reduced.
- Vessels longer than berths can be moored with overhang, enabling substantial savings on quay extensions or dolphin investments.
- Restricted waterways not disturbed.
- In some cases, MoorMaster™ may eliminate the need for breakwater construction.
- Personnel safety improved.
- Personnel injuries during mooring reduced to a minimum.
- Potential reduction in insurance premiums.
- Mooring load status constantly monitored and event logs can be reviewed.
- Less wear and tear on fenders.
- Cargo operation less dependent on weather conditions.
- Vessel creep during port stay eliminated.
- Improved service for shippers.
- Reduced use of the vessel's propulsion system and of tugs and line boats diminishes fuel consumption and emissions.
- Faster connection to shore power, where available.
- Aid for development of STS Automation.

Ship

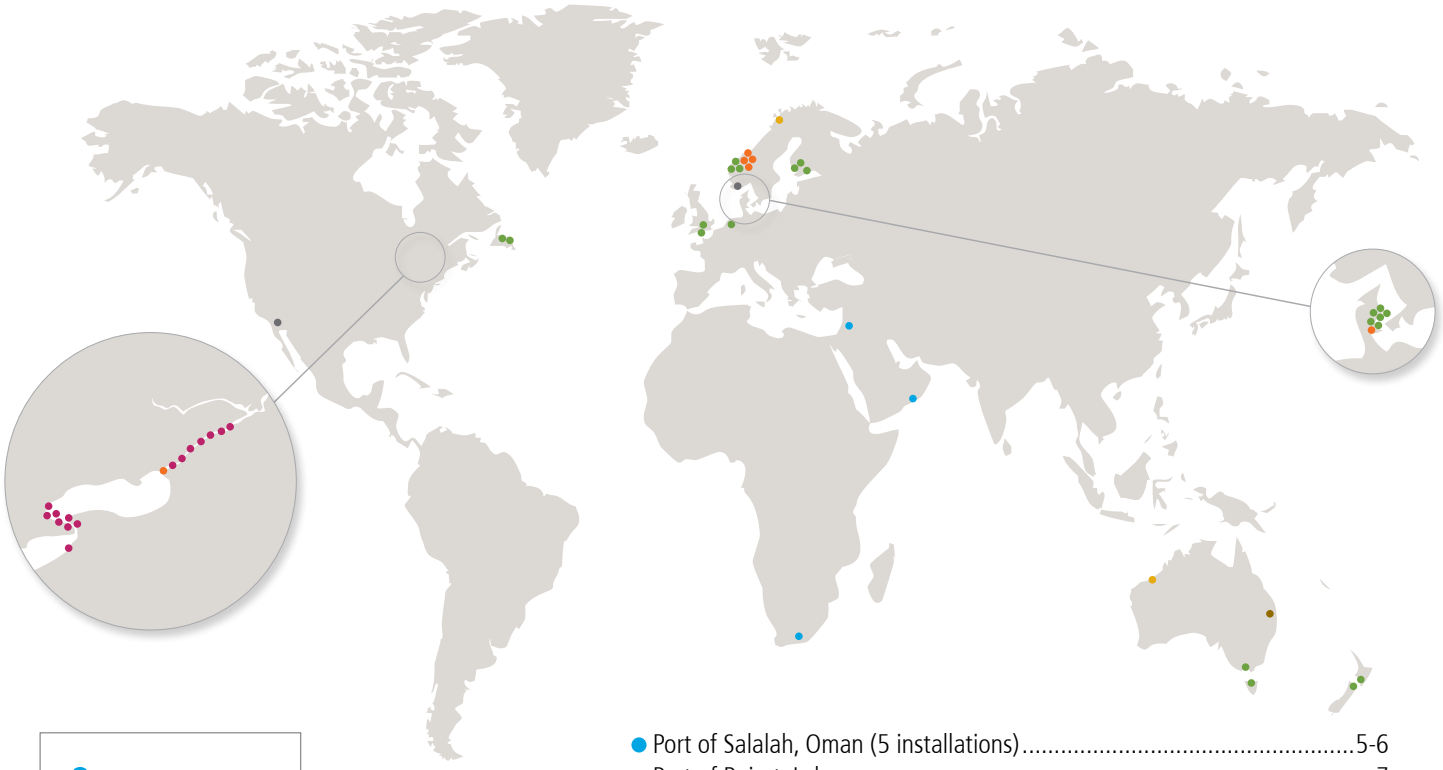
- Potential slower cruise speeds for vessels.
- Cargo and crew transfer can start earlier.
- Improved utilisation of pilots' time: pilots are able to disembark immediately after the fast mooring and return just prior to departure.
- Ship's crew can use their time for more productive jobs and keep uninterrupted rest hours.
- No need for crew to modify rope arrangements due to tidal and draft changes.
- Improved personnel safety.
- Mooring loads and status known at all times.
- Less wear and tear on ropes, winches, ship's hulls and plating.
- Automatic ship repositioning facility results in fuel saving for vessels.
- Reduced use of the vessel's propulsion system and of tugs during berthing diminishes fuel consumption and emissions.

More than 300 MoorMaster™ units in service at some 100 unique sites worldwide by 2020.

MoorMaster™ systems have successfully completed more than 500,000 automated mooring operations to Q4 2018. By 2020, approximately 500,000 such operations will be made each year.

MoorMaster™ REFERENCES

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 450,000 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.



- Container handling
- Bulk
- Ferry & Ro/Ro
- Dredging
- Locks
- Ship-to-ship
- Installation pending

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- 4 ferry terminals for Sør Trøndelag Kommune, Norway – *Expected operation Q1-19*
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- 6 ferry terminals for Boreal Sjø, Norway – *Expected operation Q4-19*
- 24 ferry terminals for Fjord1, Norway – *Expected operation Q1-20*
- 5 ferry terminals for Ontario Transport – *Expected operation Q2-20*

Berth 1 Port of Salalah Oman

Product:	MM200C[17]
Type:	Front mounted
Capacity:	12 x 200kN = 240 tonnes
Moorings:	3-4 times a week
Route:	Global
Vessel names:	Various
LOA:	Container vessels up to 392m
Operator:	APM Terminals
Owner:	Port of Salalah
In operation:	Since 2009

As of 2016, MoorMaster™ systems were in use at three of the Port of Salalah's six container berths, where they moor vessels of up to 392m LOA. In 2017, a fourth berth will be equipped with MoorMaster™. This latest installation has a holding force of 2,400 kN, provided by 12 MM200C[17] units.

The primary reason for the Port of Salalah to use MoorMaster™ vacuum mooring is to dampen vessel surge motion that occurs during the Khareef season, when surges up to +/- 2.5m occur with conventional mooring lines.

Cargo handling efficiency drops by between 30 and 40 per cent during this period. MoorMaster™ holds vessels in a stable position, (±50- 100mm), and also eliminates vessel creep, thus maintaining operational efficiency.

Due to the speed with which the MoorMaster™ units operate - attaching in 30 seconds and detaching in 10 - the port is able to optimise the use of pilots and tugs, as both are able to leave vessels earlier and return later.

Major shipping lines such as MSC and Maersk use the MoorMaster™ berths at Salalah.

Port of Salalah Oman

Product:	MM400E[15]
Type:	Deck mounted
Capacity:	Berths 3-6 each with 8x400kN = 320 tonnes
Moorings:	3-4 times a week
Route:	Global
Vessel names:	Various
LOA:	Up to 399m
Operator:	APM Terminals
Owner:	Port of Salalah
In operation:	Since 2015

In 2014, the Port of Salalah opted to install MoorMaster™ 400E units at its container berths 5 and 6.

"MoorMaster™ mitigates the impact of the long waves typical during the Khareef season in Salalah and supports faster mooring of vessels which facilitates quicker turn around and less idling of vessels and berths." Credit: Lloyd's List, One Hundred Ports, 2017, Salalah Port, Oman.

Eight of the MoorMaster™ MM400E[15] units were installed per berth to ensure there was sufficient capacity to hold larger container vessels during the Khareef.

The capacity to hold larger ships improved the port's offering to customers, and eliminated any productivity loss due to vessel movement during the Khareef.

Another 2 installations each of 8 x MM400E[15] was completed for 2 berths during 2016-17.

Cavotec also has an ongoing maintenance contract for the MoorMaster™ systems at the port.

Port of Beirut, Lebanon

Product:	MM200C[17]
Type:	Shore-based
Capacity:	42 x 200kN = 840 tonnes
Moorings:	4-5 vessels a week
Route:	Global
Vessel names:	Various
LOA:	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.

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. A total of 42 MM200C[17] units have been installed, and these were commissioned in early 2014. The units are mounted in pairs with one unit on each side of each fender. Each pair shares a slimline and service friendly hydraulic and vacuum service enclosure that have been designed for temporary immersion during storm conditions when waves can overtop the berth.

The MM200C[17] 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.

Port of Ngqura, South Africa

Product:	MM200C[17]
Type:	Front mounted
Capacity:	26 x 200kN = 520 tonnes
Moorings:	3-4 times a week
Route:	Global
Vessel names:	Various
LOA:	up to 366m
Operator:	Transnet
Owner:	Transnet
In operation:	Since 2015

Transnet National Ports Authority (TNPA) awarded a contract to Cavotec for automated mooring units at the Port of Ngqura's container terminal.

Cavotec designed, manufactured and installed 26 MoorMaster™ MM200C[17] units for a container berth at the port which is located on South Africa's East coast. The system moors container ships from 1,500 TEU up to 13,000 TEU and 366m LOA.

In addition to the supply of the MoorMaster™ equipment, Cavotec undertook a hydrodynamic mooring study to verify unit numbers and location, and trained local technicians in Cavotec´s Italian manufacturing plant.

Additionally Cavotec took full responsibility for the installation work including civil works and electrical distribution.

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 a lot of downtime in cargo operations affecting the terminal's efficiency targets. With the MoorMaster system, Berth D100 has a much higher threshold for operations than the other berths with customers requesting D100 knowing the vessel is going to be safe and productivity high.

Cavotec currently has an ongoing contract with the Port to supply onsite support and maintenance.

Port Hedland, Australia

Product:	MM200C[17]
Type:	Front mounted
Capacity:	14 x 200kN = 280 tonnes
Moorings:	1 time every second day
Route:	Global
Vessel names:	Panamax and mini-Capes
LOA:	up to LOA 295m
Operator:	Pilbara Ports Authority, PPA
Owner:	PPA
In operation:	Since 2010

Fourteen MoorMaster™ MM200C[17] units, with a total capacity of 2,800kN, spaced at 14m intervals, are installed at Port Hedland in Western Australia. The MoorMaster™ units moor dry bulk carriers of up to 135,000 DWT, 295m LOA.

The units and vessels at the 270m long berth, located at the harbour mouth, are exposed to strong tidal currents and hydrodynamic effects created by passing ships. The maximum size of vessels (LOA 295m) is longer than the berth itself that was originally designed for LOA 200m bulk carriers.

MoorMaster™ has thus enabled the PPA to accept larger vessels and thereby increase capacity without the need for costly infrastructure investment. Furthermore, MoorMaster™ comprehensively addresses critical personnel and vessel safety concerns of the PPA.

These MoorMaster™ units are built to withstand the harsh environmental conditions at the port: up to 2 kn current, 7m tidal variations, vast amounts of fine iron ore dust and extreme heat (+45°C).

Bulk terminals

Port of Narvik, Norway

Product:	MM200C[17]
Type:	Front mounted
Capacity:	18 x 200kN = 360 tonnes
Moorings:	2-4 times a week
Route:	Global
Vessel names:	Various carriers up to 185,000 DWT
LOA:	up to 305m
Operator:	LKAB
Owner:	LKAB
In operation:	Since 2016

Cavotec supplied 18 MoorMaster™ MM200C[17] units for international minerals group LKAB's new iron ore berth in Narvik, northern Norway, on behalf of the PEAB construction and civil engineering group. The scope of the order included manufacture of the mooring units and comprehensive technical support.

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[17] 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.

Ports of Hou & Sælvig, Denmark

Product:	MM400A[10]
Type:	Shore-based
Capacity:	1 x 400kN = 40 tonnes
Moorings:	14 times a day
Route:	Hou – Sælvig (Samsø)
Vessel name:	Prinsesse Isabella
LOA:	99m
Operator:	Samsø Rederi
Owner:	Samsø Rederi
In operation:	Since 2015

Samsø municipality in Denmark, and local ship operator, Samsø Rederi, won a 10-year concession to run the Hou-Sælvig passenger ferry route. A new-build 99m-long LNG ferry was ordered for the service.

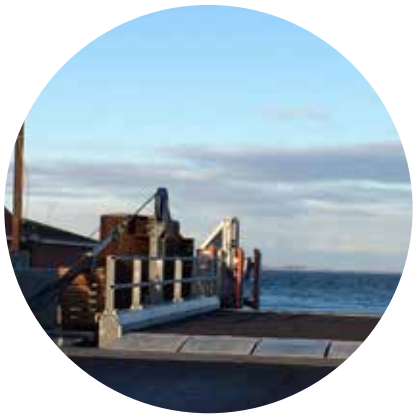
In addition to the new vessel, Samsø Rederi decided to use a MoorMaster™ system, similar to that of the former operator on the route, Færgen A/S.

As the new ferry is using a king-pin system in the linkspan, only one MoorMaster™ MM400A[10] unit is required to moor the seaward end of the vessel. The MoorMaster™ system is equipped with an AIS system that detects the proximity of the ship to the berth ensuring optimised use of the system.

Cavotec included an additional feature: high water level mode. This enables the quick, one button push, alteration of the attachment position in the event of extreme high water at the berth.

From the wheelhouse, the captain controls the mooring which is completed in approximately 30 seconds after the stern end is secured with the ramp king-pin.

Automated handling methods are important for the client to enable fast and efficient operation on this frequent service route with minimum crew onboard and no shoreside personnel.



Ports of Spodsbjerg, Taars, Kalundborg & Ballen, Denmark

Product:	MM400A[10]
Type:	Shore-based
Capacity:	400kN = 40 tonnes per machine
Moorings:	36 times* / 5 times** a day
Routes:	Spodsbjerg – Tårs / Kalundborg – Ballen
Vessel names:	Lolland, Langeland & Samsø
LOA:	99m / 91m
Operator:	Færgen A/S
Owner:	Færgen A/S
In operation:	Since 2012

Danish ferry operator Færgen purchased their first MMTM system in 2008, after winning the right to operate the Hou-Samsø route. On losing the route in 2014, Færgen refurbished the units, and installed them at the nearby Ballen-Kalundborg route.

The 91m-long ferry, Samsø, currently serves the the Kalundborg-Ballen route. Five times a day, the ferry is quickly moored by MoorMaster™ using an advanced, but simple control system from the bridge of the ship.

Following the succes of MoorMaster™ on the Samsø route, in 2012, Færgen installed MoorMaster™ 400 systems at ferry berths in Tårs and Spodsbjerg, which connect the islands of Lolland and Langeland.

Rapid mooring is achieved with a kingpin solution combined with a MM400A[10] unit at the bow of the vessel. The MoorMaster™ unit automatically adjusts to tidal conditions, thereby ensuring that the vessel is constantly held in an optimal position.

The two double-ended ferries run 36 crossings a day. Short turnaround times and limited crew numbers are vital to this high-frequency operation.

Operated by wifi and radio communication, mooring sequencies are conducted from the bridge. This allows the ship's crew to focus on passengers without having to rely on shore-based crew.

* *In each of the ports of Spodsbjerg and Tårs*
** *In each of the ports of Kalundborg and Ballen*

Ports of Melbourne & Devonport, Australia

Product:	MM400A[10]
Type:	Shore-based
Capacity:	5 x 400kN = 200 tonnes (per site)
Moorings:	1 time a day
Route:	Melbourne – Devonport
Vessel names:	SeaRoad Tamar, SeaRoad Mersey, SeaRoad Mersey II
LOA:	118m, 149m, 182m
Operator:	SeaRoad Holdings Pty Ltd
Owner:	SeaRoad Holdings Pty Ltd
In operation:	Since 2003

MoorMaster™ automated mooring technology first saw service in Australia at the port of Melbourne, on a dedicated berth used by two Ro-Ro vessels; the SeaRoad Tamar, (149 metres, 13,697 tonnes displacement), and the SeaRoad Mersey, (118 metres, 7,928 tonnes displacement).

The MoorMaster™ system consists of four MM400A[10] units, each rated at 40 tonnes. The units are positioned in pairs, forward and aft of the amidships line. Similar to the MoorMaster™ systems employed at Picton, New Zealand, these MM400A[10]s are activated from the bridge wing, extending to attach to the ship's hull.

To accommodate displacement caused by local tide variations and draft change, this system employs the patented 'stepping' method.

The application also offers the considerable advantage of being able to shift vessels along the berth for slight adjustment to make ramp angle more favorable due to draft change.

The system has been in daily operation since 2003. In 2016 the system was upgraded to accommodate a new build vessel to SeaRoad's fleet. This upgrade included refurbishing the existing units and supplying an additional unit for each berth due to larger size of this new vessel.

Port of Marlborough, New Zealand

Product:	MM400A[10]
Type:	Shore-based
Capacity:	2 x 400kN = 80 tonnes
Moorings:	3 times a day
Route:	Picton – Wellington
Vessel name:	Kaitaki
LOA:	181m
Operator:	Interislander
Owner:	KiwiRail Ltd
In operation:	Since 2005

The introduction of a new and longer vessel for the Picton to Wellington route in 2005 required the extension of the Picton pier – if conventional mooring ropes were used.

Avoiding the cost of extending the pier by at least 60 metres or driving piles for mooring platforms, KiwiRail opted to install two MoorMaster™ 400A[10] units at the end of the pier.

Picton now enjoys the benefits of safe, swift and efficient operations, while having also made considerable capital expenditure savings.

Port of Wellington, New Zealand

Product:	MM400A[10]
Type:	Shore-based
Capacity:	2 x 400kN = 80 tonnes
Moorings:	3 times a day
Route:	Wellington – Picton
Vessel name:	MV Aratere
LOA:	180m
Operator:	Interislander
Owner:	KiwiRail Ltd
In operation:	Since 2011

The MV Aratere underwent a major re-fit that included an additional 30m of length (now LOA 180m). This would require that the existing rail berth in Wellington be lengthened.

By implementing MM400A[10] units for the bow mooring KiwiRail were able to avoid lengthening the pier and thereby save both project cost and time.

Two MM400A[10] units were especially modified to reduce the overall height due to possible interference issues with other vessels using the berth.

Port of Den Helder, Netherlands

Product:	MM400A[10]
Type:	Fixed to a floating terminal
Capacity:	2 x 400kN = 80 tonnes
Moorings:	16 times a day
Route:	Texel – Den Helder
LOA:	LOA 110m & 130m ferries
Operator:	Teso
Owner:	Teso
In operation:	Since 2014

Teso runs a high frequency ferry route between Den Helder and the island of Texel with two passenger ferries.

Following increased pressure from municipalities to improve air quality in port areas, Teso decided to change the berthing procedures from the ferries running their engines during the entire time at berth, to idling after a few seconds.

This was made possible by installing two MoorMaster™ units on a floating pontoon, each providing 400kN of holding force, to safely secure the vessel at the touch of a button on the Cavotec on-board radio remote control.

Teso now benefits from rapid and safe mooring, less fuel consumption and wear on engines. Along with a happy crew on the vehicle decks with the reduction in engine noise while alongside.

The MM400A[10] system has all the typical characteristics of the MoorMaster™ product including remote operation, active vessel position control, self-diagnostics and the ability to operate from -25 to +40° C temperature range.

Ports of Lavik & Oppedal, Norway

Product:	MM200E[15]
Type:	Shore-based
Capacity:	1 x 200kN = 20 tonnes
Moorings:	16 times a day
Route:	Lavik-Oppedal (crossing the Sognefjord)
Vessel name:	Ampere (Battery driven) and 2 conventional ferries
LOA:	86m
Operator:	Norled
Owner:	Norled
In operation:	Since 2015

Cavotec won a unique order to manufacture fully integrated MoorMaster™ automated mooring and Alternative Maritime Power/Automatic Plug-in System (AMP/APS) electrical supply systems for two Norled frequent-use ferry berths in western Norway. Servicing the world's first fully battery powered ferry, Ampere, these are the first systems in the world that integrate automated mooring & automated shore to ship APS!

The systems have been installed at the Lavik and Oppedal passenger ferry berths, and are used by the catamaran-hulled ferry, run by Norwegian ferry operator Norled. The 86m long vessel has a capacity for around 120 cars and 360 passengers, and makes 17 crossings of the Sognefjord daily.

The MoorMaster™ units are operated by Cavotec hand-held radio remote controls by the ship's captain from the bridge of the vessel, and signals to the APS unit when the ship is secure, whereafter a laser sensor then guides the AMP connector to a hatch in the ship's superstructure, connecting to the ship's battery to start charging.

By using MoorMaster™ the ferry's propeller system can be switched off for nine minutes during each 10-minute boarding process, thereby saving power. With around 17,000 port calls made annually, the air quality improvement and fuel cost savings compared to using conventional mooring and power systems is considerable.

Ports of Anda & Lote, Norway

Product:	MM200K[12]
Type:	Shore-based
Capacity:	1 x 200kN = 20 tonnes / per berth
Moorings:	52 times a day per berth
Route:	Anda – Lote
Vessel names:	Gloppefjord & Eidsfjord
LOA:	106m
Operator:	Fjord1
Owner:	Statens Veivesen
In operation:	Since 2018

Fjord1 won the concession of the route for a 10 years' period and Anda-Lote was the first of many Fjord1 routes to realise the benefits of MoorMaster™ automated mooring.

MoorMaster™ is now in service with one of the world's most innovative ferries.

The system is used to moor two car and passenger ferries on the Anda-Lote service in Norway. The vessels are moored fifty-two times a day for five minutes at a time.

The MoorMaster™ units are integrated with an innovative system that charges the ferries' battery packs. The units are operated from the bridge, and ensure safe mooring while reducing risks to staff and the vessels. The system also helps reduce emissions. A radio remote control system, also manufactured by Cavotec, is available as a back-up.

The rapid mooring and release times achieved by MoorMaster™ are vital to maximise battery charging times at these two berths – applications that are set to be replicated across Norway and beyond.

Ferry & Ro/Ro terminals

Ports of Parainen & Nauvo, Finland

Product:	MM200K[12]
Type:	Shore-based
Capacity:	1 x 200kN = 20 tonnes
Moorings:	60-80 times a day
Route:	Parainen-Nauvo
Vessel name:	Elektra
LOA:	98m
Operator:	Finferries
Owner:	Finferries
In operation:	Since June 2017

Finland's first electrically-powered ferry, Elektra, is automatically moored and charged with Cavotec equipment.

The system integrator was Siemens. Cavotec supplied the MoorMaster™ automated mooring equipment, and 1MW APSTowers at the Parainen and Nauvo berths.

A vacuum-based MoorMaster™ unit ensures rapid mooring, thereby maximising the amount of time available to charge the Elektra's batteries during brief port calls.

The Elektra's power source consists primarily of batteries that are charged with shore power each time the vessel is berthed. The ferry has back-up diesel power for use in demanding icy conditions or in the event of a loss of battery power.

Due to the berths' high frequency of use, the MoorMaster™ units are active throughout the day and are not parked between moorings.

Ferry & Ro/Ro terminals

Port of Helsinki, Finland

Product:	MM400E[15]
Type:	Shore-based
Capacity:	6 x 400kN = 240 tonnes
Moorings:	6 times a day
Route:	Helsinki - Tallin
Vessel name:	Tallink Star & Megastar
LOA:	Up to 212m
Operator:	Port of Helsinki
Owner:	Port of Helsinki
In operation:	From March 2017

Port of Helsinki awarded Cavotec a contract for the delivery of six MoorMaster™ MM400E[15] units to be installed at the Länsisatama berth.

The units are used to moor passenger ferries on the Helsinki – Tallinn route. These vessels represent the larger end of the ferry spectrum with an LOA of up to 212m and are moored six times a day for up to one hour at a time.

The MoorMaster™ units are operated from the bridge with a remote control system also manufactured by Cavotec and will ensure safe mooring while reducing risks to staff and vessel while also reducing vessel emissions in the port.

While in this case the port environment is quite benign the system is also required to function in temperatures down to -25°C which are common in the Baltics during winter time.

The introduction of automated mooring at the Port of Helsinki is one of a number of initiatives undertaken with the support of the EU's TEN-T transport infrastructure programme.

Commissioned in 2016 the system has been in regular use since early March 2017 upon the arrival of Tallink's latest new-build vessel, Tallink Megastar.

Ports of Portsmouth & Fishbourne, United Kingdom

Product:	MM400E[15]
Type:	Shore-based
Capacity:	2 x 400kN = 80 tonnes
Moorings:	30 times a day
Route:	Portsmouth-Fishbourne
Vessel name:	Various
LOA:	62-89m
Operator:	Wightlink Ferries
Owner:	Wightlink Ferries
In operation:	Since September 2017

Wightlink began a major upgrade of their terminals at Portsmouth and Fishbourne which also included the purchase of a new-build vessel. With a 89m LOA this vessel required the pier in Portsmouth to be extended to ensure safe mooring. However, due to the layout of the port the extension faced many technical and regulatory hurdles.

Introducing MoorMaster™ MM400E[15] 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.

To further enhance the upgrade, a single MM400E[15] unit was also installed at Fishbourne on a specially designed beam to span two of the existing dolphins.

The system is intended for use by all Wightlink ferries using these two ports.

Ports of Bell Island & Portugal Cove, Canada

Product:	MM400E[15]
Type:	Shore-based
Capacity:	2 x 400kN = 80 tonnes / per berth
Moorings:	10 times a day
Route:	Bell Island – Portugal Cove
Vessel name:	Leigonaire
LOA:	70m
Operator:	Newfoundland and Labrador Ferries
Owner:	Department of Transportation
In operation:	Since mid-2018

Cavotec responded to a call for tenders for an automated mooring system issued by the Newfoundland Department of Transportation in mid-2015.

The MoorMaster™ units in this application moor a car and passenger ferry that operates on the Bell Island - Portugal Cove route. The vessel is moored 10 times a day for up to 30 minutes at a time.

The MoorMaster™ units are operated from the bridge of the ferry with a remote control system, also manufactured by Cavotec. This ensures safe mooring operations, reducing risks to personnel and the vessel, and reduces emissions.

The system functions year-round, including winter when temperatures often reach -25 degrees Celsius.

The decision to use MoorMaster™ meant that the berths did not need to be extended to accommodate the new, larger vessel.

Brisbane, Australia

Product:	MM200C[23]
Type:	Front mounted
Capacity:	8 x 200kN = 160 tonnes
Moorings:	2 times a day
Route:	Local area
Vessel name:	Dredging vessels
LOA:	183m
Operator:	Jan de Nul
Owner:	Jan de Nul
In operation:	Until December 2014 (for the duration of the dredging project)

Jan de Nul (JdN) had been contracted to reclaim land for the second runway at Brisbane Airport. This process involved dredging sand from the seabed and discharging at a fixed location on a 12-hour dredge – discharge cycle. During project planning, it was discovered that mooring the Charles Darwin hopper dredge by conventional methods during discharge, as required by the Brisbane Harbour Authority, would make it impossible for Jan del Nul to meet the stipulated project schedule. This challenge was overcome by utilising MoorMaster™.

Jan de Nul were able to source eight MoorMaster™ MM200C[23] units from a previous Cavotec customer enabling a very short system delivery. Cavotec were contracted to re-factory test the units, provide engineering details to assist with dolphin construction, support installation and commissioning and re-warranty the units as new for a period of 12 months.

The reduced mooring times, from two hours to approximately 30 seconds, ensured the required schedule was not only achieved but the reclamation was completed ahead of schedule. Following the successful completion Jan de Nul removed the MoorMaster™ system which was placed in storage for future use.

Great Lakes Locks, Canada & USA

Product:	MM400L^{22}
Type:	Front mounted in lock wall
Capacity:	3 x 400kN = 120 Tonnes
Moorings:	4-5 times a day
Route:	Global
Vessel names:	Various
LOA:	up to 225m
Operator:	SLSMC
Owner:	SLSMC
In operation:	Since 2014

In 2007 Cavotec began working with St Lawrence Seaway Management Corp (SLSMC) to develop the best possible MoorMaster™ system for use in their locks. The initial installations were in the Welland Canal Lock 7 with two MoorMaster™ prototypes trialled.

Using the information gathered, SLSMC and Cavotec worked together to refine the system with improved capacity and performance to meet the demands of the entire SLSMC lock system and their customers. The result was a brand new Generation IV system, known as the MM400L^{22}.

The MM400L^{22} system is installed at 15 lock sites where water level change varies from 13-18 m. Approximately 97 per cent of all vessels transiting the seaway can be successfully moored with the MoorMaster™ systems. By the close of 2017 all ships passing through the seaway to and from the Great Lakes will benefit from automated mooring.

MM400L^{22} has all the typical characteristics of the MoorMaster™ product including remote operation, active vessel position control, self-diagnostics and the ability to operate from -25 to +50°C temperature range.

Ship-to-ship

US Navy, USA

Product:	MM100E^{60}
Type:	Shore-based
Capacity:	6 x 100kN = 60 tonnes
Moorings:	on purpose
Route:	N/A
Vessel names:	Military vessels
LOA:	N/A
Operator:	US Navy
Owner:	US Navy
In operation:	2016

In 2006 Cavotec was contacted by the US Navy through the Office of Naval Research (ONR) to investigate Ship-to-ship mooring for various vessel combinations. This research and development resulted in an order for a contract to supply six MM100E^{60} prototype units.

While the initial trials were completed mooring a fast catamaran moored to a barge in a sea state of three, the system has been designed with flexibility and portability in mind and has capability beyond these first vessels and sea state.

Other technologies developed during this exercise include variable vacuum to suit various hull constructions, mounting inside a ISO container for easy portability, articulated pads to enable attachment to curved hull surfaces and 3D scanning and tracking to enable attachment to a vessel that continues to experience significant movement.

The system successfully completed sea trials in San Diego in early 2016.
While this system is configured specifically for military applications, the technology developed can be utilised in the commercial sector possibly with different mechanical systems.

Connect LNG, Norway

Product:	MM400E[15] EX
Type:	Semi-submersible platform
Capacity:	2 x 400kN = 80 tonnes
Moorings:	Once a day
Route:	Various
Vessel names:	Santa Maria
LOA:	Various
Operator:	Gas Natural Fenosa
Owner:	Gas Natural Fenosa
In operation:	Since October 2017

Connect LNG approached Cavotec in 2012 with the concept for their Universal Transfer System (UTS). UTS makes transferring LNG from ship to shore or shore to ship less reliant on large, costly infrastructure.

Connect LNG wanted to ensure that the operation of the UTS was as safe and efficient as possible. To do this, they needed automated mooring.

Cavotec supported Connect LNG throughout the development of UTS. When Gas Natural Fenosa commissioned the first UTS system, Cavotec supplied the first ATEX certified and second CLASS (DNV-GL) certified MoorMaster™ units.

Along with modifications to ensure ATEX compliance, minor modifications were also made to enable a standard MoorMaster™ unit to be used. No modifications were required to achieve CLASS certification.

Following successful trials, the UTS and MoorMaster™ units will be relocated. This application is set to be the first of many UTS units deployed around the world.

We are present in:

Australia
China
Denmark
Finland
France
Germany
Hong Kong
India
Italy
The Netherlands
New Zealand
Norway
Singapore
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Sweden
Switzerland
Turkey
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