



FMC Technologies

Chiksan[®] Marine Loading Systems

FMC Technologies is the oil and gas industry's leading supplier of fluid loading transfer systems. FMC offers customers advanced technology in transfer operations providing innovating designs, systems, packages and services to the oil, gas, petrochemical and chemical industries.



design team and the careful selection of manufacturing and assembly techniques, materials and other supplied products. The FMC Loading Systems equipment is designed to operate problem free for years without major overhauls. We know that our expectation as a Loading Systems manufacturer of innovative, cost effective, high quality and reliable equipment has only come and will only come from satisfied customers.

Quality Control and Testing

Based on ISO 9001, all parts and components are inspected prior to be used in an FMC Loading Systems product. The hydraulic/electric control systems are tested to simulate the same operating conditions as will be encountered when installed. Very high standards are applied whenever quality, safety, or product reliability are concerned. These test procedures ensure that the FMC Loading Systems equipment will perform as expected upon arrival at site. As part of the standard procedures, customers are invited to visit FMC design and manufacturing facilities during the final tests performance in order to check that specifications are met.

FMC Loading Systems combines advanced technology and state-of-the-art solutions to satisfy the most stringent customer demands.



Keys areas of product expertise are:

- Loading/unloading systems for sea going tankers, barges, truck and railcars
- Skid-Mounted Loading and Measuring systems
- Transfer pigging systems

Solutions are available for handling a complete range of fluids at ambient, elevated and cryogenic temperatures.

FMC Loading Systems has unsurpassed global experience:

- First marine loading arm in the world, 1956
- First LNG marine loading arm supplied, 1963
- First 24" constant motion LNG swivel joint withstanding 5,000 000 cycles, 2005
- First MLA's for FSRU (side by side), 2006

For over 50 years, with many thousands of Chiksan® Marine loading Arms in service worldwide, FMC has been the pioneer and leader in the field of liquid cargo transfer. From simple manual arms to the most sophisticated multi-arm installation, FMC has the experience and capability to meet your specific needs.

FMC Chiksan Marine Loading Arms installations are the modern answer to fluid loading requirements where the operational reliability of the equipment has a high impact on the cost and smooth operation of the portside installation.

FMC Chiksan Marine Loading systems meet all your loading/unloading requirements whether from river barges to the largest crude oil tankers.

Long term commitment

FMC is committed to the long term successful operation of the Chiksan Marine Loading Arms supplied. The commitment starts with the experience gained over the years by our skilled



Welding shop



Assembly shop

Description of a marine loading arm

A Marine Loading Arm is an articulated pipe system for the transfer of liquids or gases. This may be manoeuvred manually or hydraulically.

A marine loading arm comprises several components namely:

- base riser
- Inboard arm
- Outboard arm

The articulation is assured by swivel arrangements. These arrangements (or styles) allow for complete movement in all planes.

All the swivels incorporated in the styles have in situ replaceable ball races. This exclusive feature ensures the long life of the swivel. This results in lower maintenance costs and downtime whereas conventional swivels showing signs of wear need to be completely replaced at substantial cost and longer delivery.

Models

RCMA: the rotary counterweighted Marine Arm is fully balanced in all positions, the counterweights being combined into one rotating assembly to balance both inboard and outboard arms.

DCMA: the double counterweighted Marine Arm is fully balanced in all positions. Separated counterweights are used to balance the inboard and outboard sections of the arm.

RCMA-S / DCMA-S: the RCMA-S and the DCMA-S are RCMA or DCMA type loading arm with a support structure to a product line. The product line and the structure are connected together at the end of the outboard structure through a horizontal rotation and at the base riser through two coaxial rotations. The other horizontal articulations, therefore, remain parallel but may displace independently in the vertical plane.

FBMA: the fully Balanced Marine arm is fully balanced in all positions with two separate counterweights.

Key Components of an MLA: Chiksan Swivel Joints

Swivel joints allow the rotation between two items of a product line whilst ensuring no product leakage, when under pressure or vacuum.

Main characteristics are:

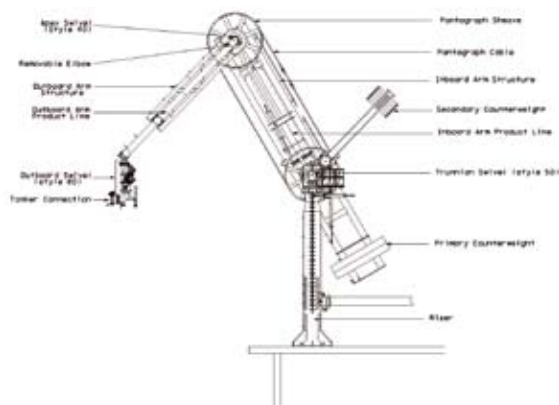
- used for temperature from -46°C (-50°F) to $+232^{\circ}\text{C}$ ($+450^{\circ}\text{F}$)
- in situ replaceable snap in ball races
- used for pressures: ANSI 150, ANSI 300 or for compressed natural gas (CNG)



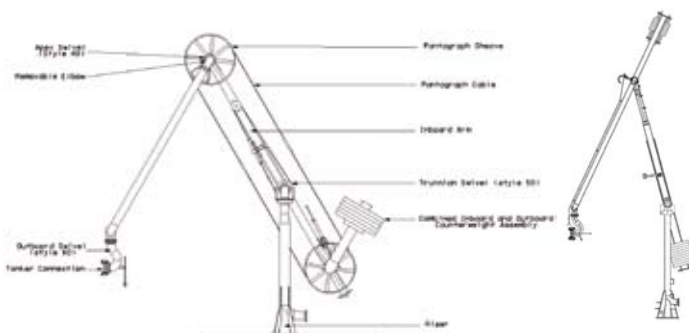
Swivel joint for petroleum products



Swivel joint for cryogenic products
(-196°C / -321°F)



Type DCMA/S



Type RCMA



Type FBMA



Overall safety of operations

The FMC couplers allow to connect or disconnect the marine loading arms to the tanker manifold flange. This makes faster and more efficient operations and also enhances the safety of the operators.

Manual Quikcon Coupler

The Chiksan® manual Quikcon couplings have three or more clamp assemblies to connect to the ship's manifold flange. The clamps jaws are opened and extended quickly by rotating the exposed large hex headed end of each drawbolt counter clockwise. One "O" ring fitted in a groove of the manual Quikcon coupling flange ensures a positive sealing. A key feature of this coupler is that it can be connected to a large number of flange thicknesses. The Chiksan® manual Quikcon makes manual flanging operations faster ever before without the use of special tools. This can be used on new or existing arm as well as on hoses.

Hydraulic Quikcon Coupler

The Quikcon is a hydraulically operated Quick Connect/Disconnect Coupler (QCDC) based on the Chiksan® Quikcon Manual design. During the operation, the jaws of the clamp rotate simultaneously to the correct position as the clamp open or close across the tankers manifold flange. The Hydraulic Quikcon offers faster mating of flanges than possible through manual flanging operations, another FMC innovation for improved operator safety and reduce turnaround time of the tanker.



Hydraulic Chiksan Coupler

For even quicker flanging operations, the hydraulic Quick Connect/Disconnect Coupler allows for connecting up to three different manifold flange diameters without the use of adaptors.



Emergency Release System (ERS)

Allows for almost instantaneous disconnect of the arms from the vessel in the case of an emergency. The ERS system may incorporate various types of single or double valve arrangements to prevent product spillage to meet OCIMF (Oil Companies International Marine Forum) specifications and/or EN 1474 regulations in European Union countries.

Cordless

The Cordless is a compact lightweight control unit which permits the arm selection and movement control from any desired point including the tanker deck manifold area.



Position Monitoring System (PMS Plus)

The FMC Position Monitoring System (PMS Plus) offers an enhanced control of the loading arms, and safety of the terminal using the following functions:

- Constant monitoring of the outer flange position for each arm installed on the jetty
- Alarms redundancy with the proximity switches
- Pre-alarm feature

It ensures the interface in the control room (on a PC) and provides the following additional functions:



- Real time display of the arms position and instances before alarms
- Recording of all the events on the installation, to be used for diagnostic and expertise
- Telemaintenance of the installation

Control panel/Power unit

The panel console displays permanent information relative to the status of the arms and controls the overall movement of the arms. The entire power unit generates hydraulic flow including all the electrical components to manoeuvre the marine loading arms and actuate their accessories.



Loading/unloading for crude oil, petroleum and refined products

FMC offers from the simplest to the most sophisticated loading arms in diameters up to 24" (600 mm).



Loading/unloading for LPG, ammonia etc...

The ever increasing demand for LPG and ammonia has demonstrated the need for specialized arms equipped with the latest emergency release systems and monitoring devices. FMC has been in the forefront of these innovations.



Others applications

Piggable loading arms

This exclusive FMC design has been developed to meet our customer's latest requirements in transfer operations and safety. It has also been tailored to provide existing or new terminals with flexible operations based on field proven experience to reduce turnaround time of vessels and foot-print. As a result FMC offers solutions that combine piggable Marine Arms with emergency release capabilities and fully automated piggable manifolds behind the Arms to handle a large number of products.



Integrated Projects

By combining the strengths, capabilities and experience acquired in oil and gas terminals, FMC is able to supply not only loading arms but also all associated equipment for marine terminals to deliver complete, integrated topside packages.

FMC Loading Systems can integrate and deliver:

- Chiksan® Marine Loading Arms
- Manifolds and process piping
- Metering
- Terminal Management Systems
- Firefighting Equipment
- Access Gangways & Towers
- Mooring Hooks

FMC uses its own capabilities which include: Basic engineering, complete detailed engineering package, manufacture and supply of equipment, and site erection assistance

Benefits :

- Reduced capital investment
- Single source supply, responsibility and guarantee
- Enhanced safety and reliability of the operation and of the terminal
- Factory tested equipment
- Reduced overall operating and maintenance costs

Mobile installations

Standard systems and jumper assemblies may be supplied mounted on road or rail trailers to provide loading speed and efficiency at terminals with limited dock space or where dock space is used more often for other than liquid cargoes.



Marine loading arms for special applications

High temperature transfer of products such as tar, bitumen, liquid sulphur, phosphorous... can be successfully carried out by using special jacketed arms/swivels using steam/oil/hot water to assure the required viscosity of the product.



Onshore/offshore LNG systems

As good locations for new land based terminals become rare and difficult for permitting, there is a trend towards onshore “exposed location” terminals without breakwater protection to cut down cost for offshore terminals based on a GBS (Gravity Based Structure), fixed jetties, a FLNG (Floating LNG terminal) or FSRU (Floating Storage and Regasification Unit). Such LNG installations require high technology offloading systems to ensure reliability and a higher level of enhanced safety compared to standard land based terminals.

Onshore - Conventional Jetties



In general connecting and or disconnecting will only be made at land based terminals when the relative motion between the flange of the hydraulic Chiksan QC/DC (Quick Connect Disconnect Coupler) of the arm and the LNG-C manifold flange is less than 0.3 to 0.4m depending on the relative velocity of wave induced motion period.

Offshore Installations:

As expected, offshore offloading installations are subject to more pronounced continual movements of the LNG carrier manifold flange.

The desired goal is to transfer LNG with the same level of safety and reliability as at “standard” terminal.

Two approaches are considered:

- Side by Side (SBS) LNG offloading:

To meet the operating requirements from a GBS (Gravity Based Structure), or from an FLNG (Floating LNG) export terminal, or from an FSRU (Floating Storage and Regasification Unit) with SBS offloading, FMC Technologies proposes solutions for non dedicated LNG carriers based on proven offloading technology. The use of the targeting system is one of the basic requirements.



Onshore - Exposed Locations

To meet the offloading requirements at onshore “exposed locations”, it has been necessary to review the main design requirements for the Chiksan Marine Loading Arms.

The Chiksan Marine Loading Arms have been enhanced with the following features :

- the Constant Motion Chiksan swivel joints in service in exposed locations since 1993
- the targeting system for connection/disconnection in severe sea states
- the hydraulic QCDC for connection/disconnection with no damage to the seal due to impact with the manifold flange
- the hydraulic system sized to accept high velocity motion during connection and once connected
- the reinforced support structure of the arm
- the design of the arm for rapid in situ maintenance without the need of outside lifting equipment.



- Tandem LNG offloading:

The FMC all metal BTT (Boom To tanker) system will operate in even more severe environments up to 5,5m in Hs sea states.

This was confirmed by the European Union Azure project that was headed by Technigaz (France) together with Chantiers de l'Atlantique (France), Bouygues Offshore (France), W.M Kellogg (U.K), and Ficanteri (Italy) and FMC for the offloading BTT system to be installed on an FPSO or an FSRU.

The model tests carried out on the one-fifth scale model of the BTT with its full scale hydraulic/electric control system and the LNG carrier motion simulator have confirmed the feasibility of operations including connection/disconnection offloading and emergency disconnection in a variety of sea states.



Should operating conditions be so severe that a mooring hawser will not offer the reliability required, the double pantograph system of the BTT can be used with the duplex yoke system developed by FMC Technologies.

Benefits of All Metal Offloading Systems

The all-metal designs of the LNG offloading systems used for offshore loading have the following inherent operational advantages:

- Field proven experience since 1963 worldwide up to 20" diameters.
- Have a design life expectancy up to 30 years
- Large operating envelope.
- Less pressure loss vs. hoses.
- Withstand higher operating pressures due to water hammer, or other causes, without rupture
- More flexible than 16" and larger diameter hoses. No kinking nor minimum bending radius.
- Lower maintenance costs over the life expectancy of the offloading system.

Worldwide after-market

As the world's oldest and largest supplier of fluid loading and transfer systems with thousands of arms in service throughout the world, FMC is totally committed to supplying not only the genuine spare parts for the life of the arms but also providing all the necessary assistance to meet immediate and long term customer needs in after sales and service. An FMC dedicated team staffed with about 20 trained and qualified persons assist customers worldwide 24 hours a day.

Once the product is delivered FMC follows closely its progress in the field maintaining records of its working condition service performed and site modifications.

This is carried out from strategically placed around the world to offer the customer the best possible assistance wherever whenever required. Amongst services offered are:

- Training of operators and maintenance engineers
- Erection and commissioning field assistance
- On going site contract with customer
- Supplying spare parts
- Preventive maintenance
- Repair/rebuilt in the event of damaging incidents
- Overhaul of existing marine installations
- Supply of retrofit and upgrading kits.



FMC loading systems core values

FMC Technologies is a global solutions provider built on a century-old foundation of world-class products and innovative customer solutions.

FMC Technologies focuses on providing value-added solutions to customer challenges that integrate technologies, systems, products and services. FMC Technologies is structured for optimal responsiveness to customer needs. We are committed to moving quickly and intelligently to capture market opportunities, create solutions-driven technologies, and drive growth and profitability.

FMC Technologies will continue to employ highly motivated, innovative people dedicated to providing solutions that will make our customers more successful in their endeavours. Our people will strive to be the team to call to help our customers meet their challenges.

FMC Technologies has been named the nation's "Most Admired Oil and Gas Equipment, Services" company, ranking first in its industry in FORTUNE magazine's 2005 and 2006 listings of "America's Most Admired Corporations".