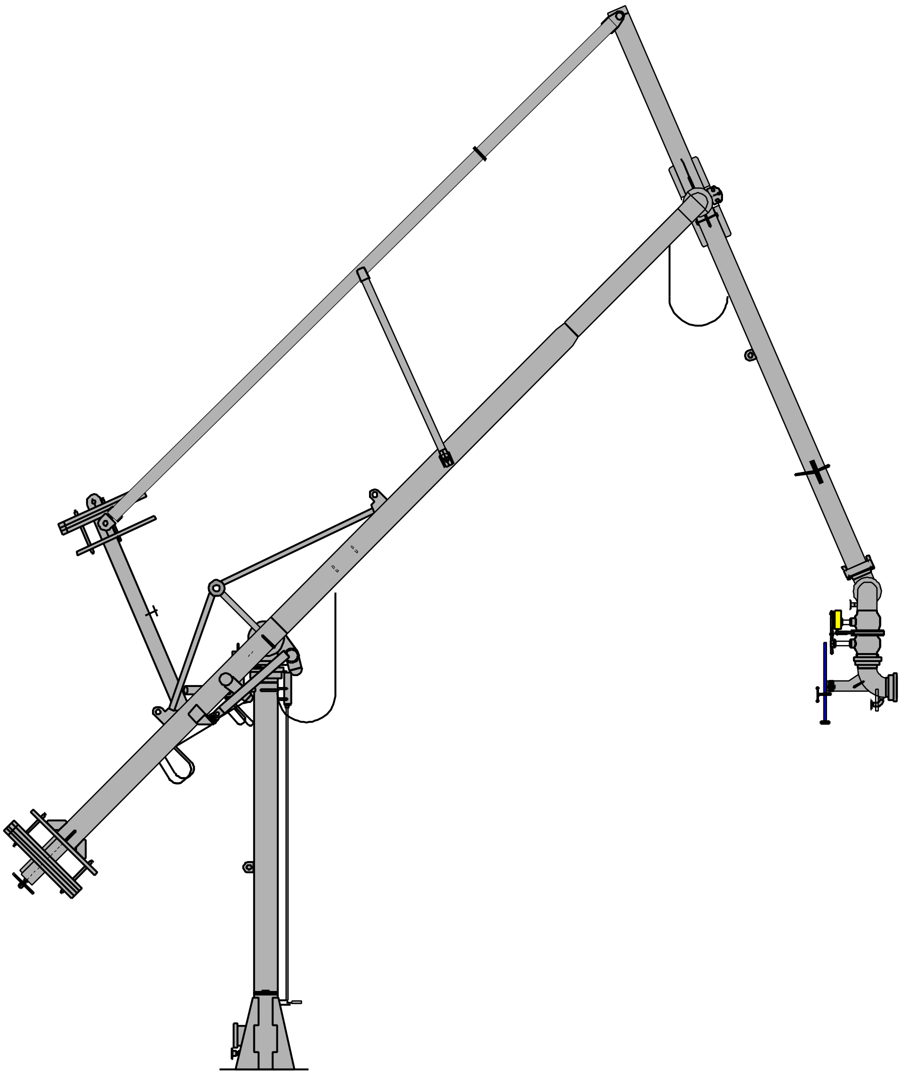
Some useful Data



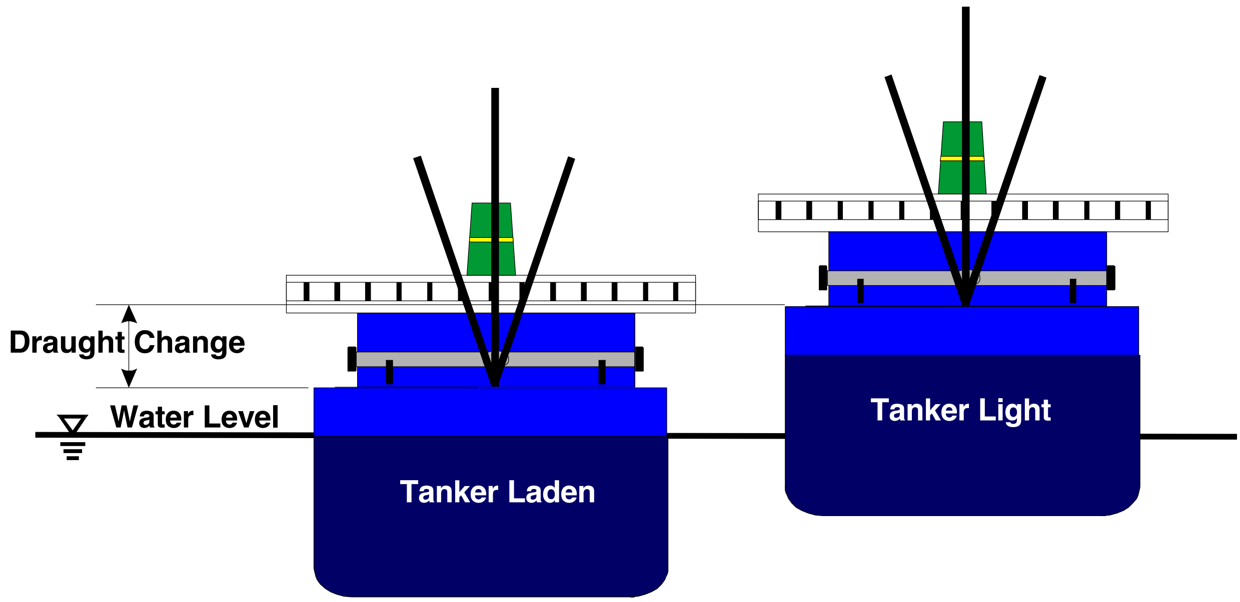
for the layout of Marine Loading Arms

EMCO WHEATON™

When designing Marine Loading Arms different parameters need to be considered

- **Draught Change**
- **Flange Set-Back**
- **Flange Spacing**
- **High / Low Water**
- **Flange Set-Back & Flange Spacing**
- **Drift & Surge**
- **Envelope**
- **Flow-rates**
- **Loading time**
- **Manual or Hydraulic**

Draught Change



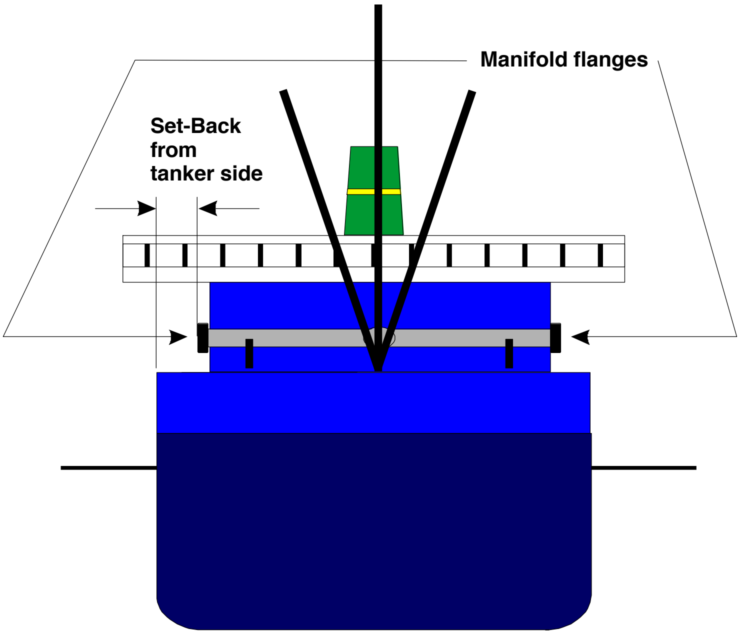
Vessels raises out of the water because they are discharged

Vessels sink into the water because they are charged

The below table gives some typical data:

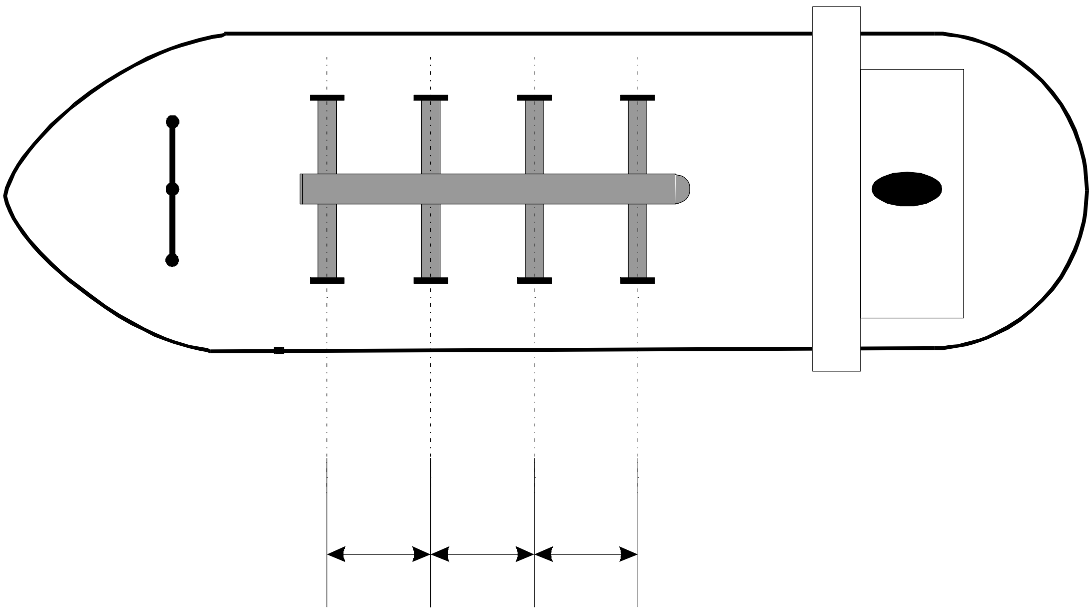
TANKER DEADWEIGHT TONNAGE (DWT TONS)	TYPICAL DRAUGHT CHANGE (m)
1.000	2.5
5.000	4.0
10.000	5.5
20.000	6.5
50.000	10.0
100.000	12.0
250.000	16.0

Flange Set-Back



TANKER DEADWEIGHT TONNAGE (DWT TONS)	TYPICAL VESSELS IN SERVICE Min. Set-Back (m)	Max. Set-Back (m)
1.000	2.1	3.0
5.000	2.4	4.9
10.000	3.7	6.1
20.000	4.0	6.1
50.000	4.6	6.1
100.000	4.6	6.1
250.000	4.6	6.1

Flange Spacing

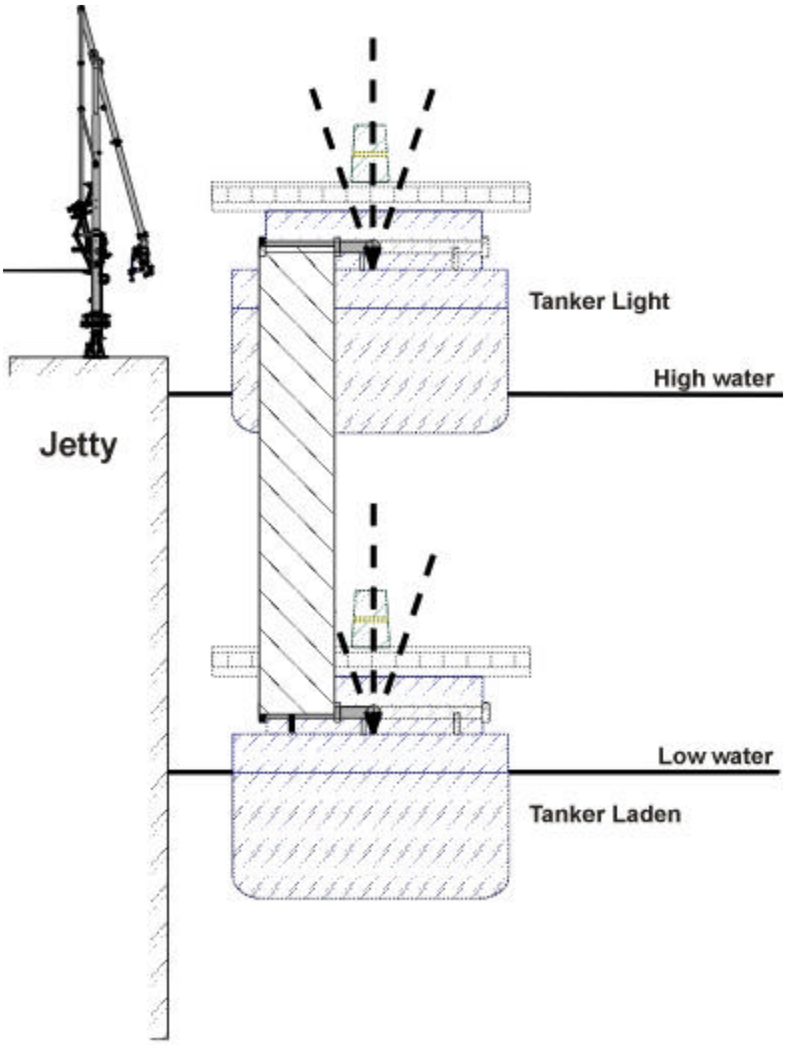


Tanker flange spacing

TANKER DEADWEIGHT TONNAGE (DWT TONS)	TYPICAL VESSELS IN SERVICE		
	FLANGE DIA. (INCHES)	FLANGE SPACING	
		Minimum (m)	Maximum (m)
1.000	6 – 8	0.6	1.5
5.000	6 – 10	0.8	1.5
10.000	6 – 12	0.9	1.5
20.000	8 – 12	1.1	2.4
50.000	10 – 16	1.2	3.0
100.000	12 – 20	1.5	3.0
250.000	16 – 24	1.8	4.0

High / Low Water

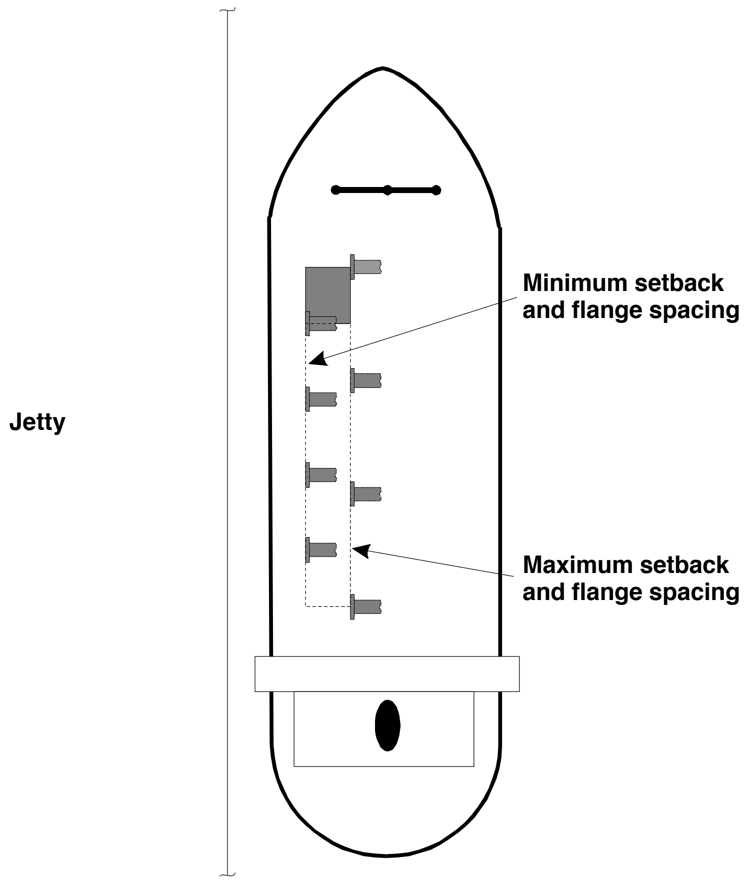
Elevation of vessels as a result of change in water levels needs to be considered.



Limiting factors are:

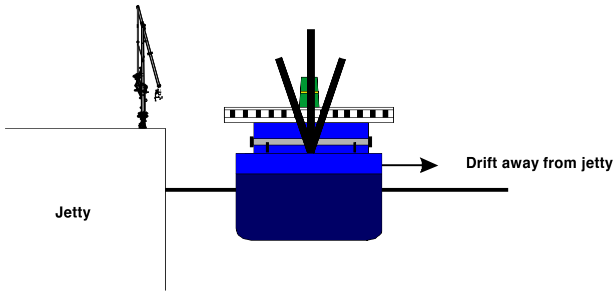
- smallest vessel laden at lowest low water
- biggest vessel light at highest high water

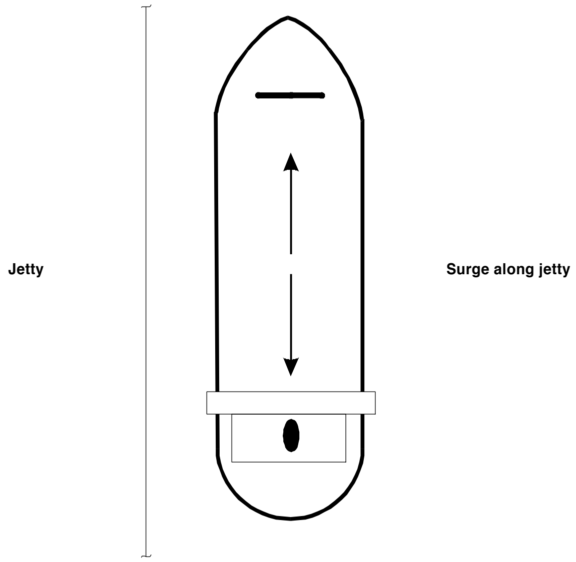
Flange Set-Back & Flange Spacing



Flange set back and spacing need to be covered by the operating envelope of a Marine Loading Arm

Drift & Surge





As a safety requirement drift and surge of a tanker need to be considered for the layout of a Marine Loading Arm.

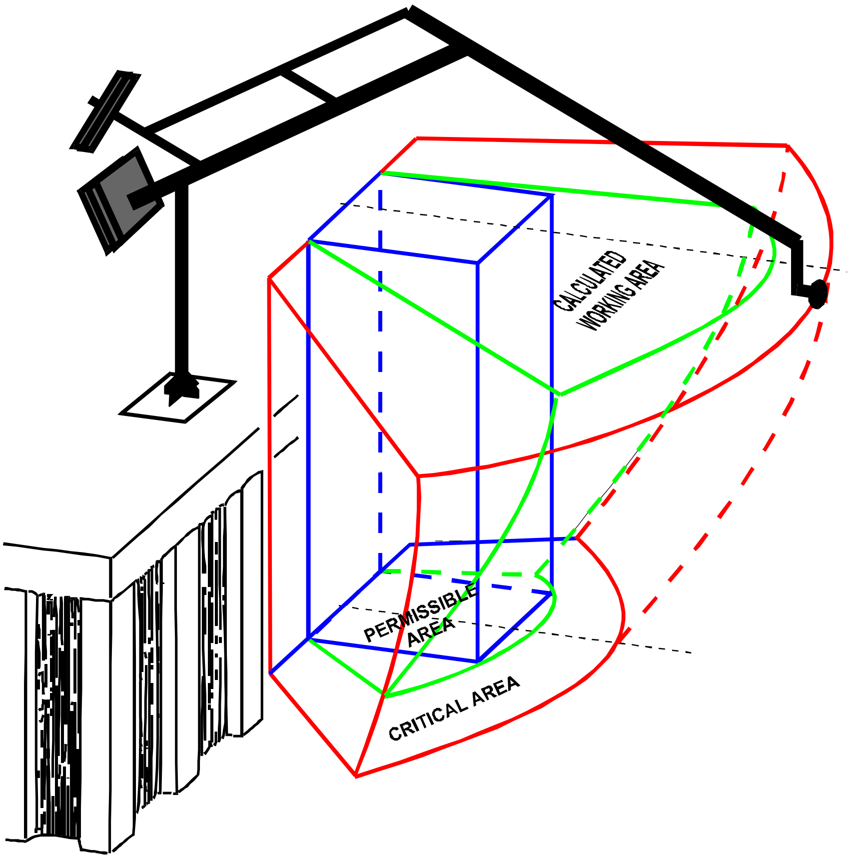
The below table gives a guideline.

TANKER DEADWEIGHT TONNAGE (DWT TONS)	TYPICAL DRIFT AND SURGE FIGURES (m)
5.000	1.5
50.000	3.0
100.000	4.6
250.000	4.6 ~ 6.0

Envelope

The final envelope is a combination of the range of movements as mentioned above:

- Tanker draught changes combined with tide levels
- Tanker manifold set-back combined with drift
- Tanker manifold spacing combined with surge



This sketch shows the actual volume that can be swept by a unit extended to its maximum reach.

This increased volume should not be taken as an enlarged envelope since stresses and manifold loads can be considerably higher in certain portions of this increased area.

Typical flow rates & flange connection for marine units

BORE SIZE (INCHES)	MAX. FLOW-RATE (TONS / HOUR)	RANGE OF FLANGES TO WHICH UNITS MAY BE CONNECTED (INCHES)		
6	500	6	4	
8	1.100	8	6	
10	1.750	10	8	6
12	2.250	12	10	8
16	4.000	16	(14)	12
20	6.000	20	16	(uncommon size)
24	10.000	24	20	(uncommon size)

Tabulated values are for Emco Wheaton GmbH MLA's based on crude oil at average fluid velocities of approx. 8 m/sec through the pipe.

For light spirits, liquefied gases and chemicals, flow velocities should be lowered to approximately 5 m/sec and the overall flow-rate reduced accordingly

The weight of fluid in a unit together with operating wind pressure applies loads to the ship's flange

The range of flange connections given shows the smallest size of steel flange to which a given size of unit may be safely connected.

Details are based on customer's experience with their products. Emco Wheaton GmbH will assist in final design.

Typical marine unit combinations for a range of tanker sizes

TANKER DEAD-WEIGHT TONNAGE (DWT TONS)	FLANGE DIA. (INCHES)	TYPICAL TIME TO UNLOAD (h)	SUGGESTED MARINE UNIT COMBINATIONS, NOT INCLU-DING BUNKERING OF TANKER
1.000	6 – 8	3	1 x 6"
5.000	6 – 10	6	2 x 8"
10.000	6 – 12	9	2 x 8"
20.000	8 – 12	12	3 x 8"
50.000	10 – 16	12	4 x 10"
100.000	12 – 20	18	4 x 12"
250.000	16 – 24	18	4 x 16"

The table shows typical combinations of loaders related to tanker size to give a reasonable turn round time at the jetty.

The larger tankers are often dependant on high tide conditions for approaching or leaving the installation and hence a multiple of 12 hours is the ideal solution. Allowing 18 hours for loading or unloading leaves about 6-7 hours for mooring, connecting and disconnecting, port formalities etc.

For small tankers the unloading is usually controlled by the available pump capacity.

Where a range of tankers is to be served, consideration must be given as to whether large diameter arms could be connected to the smallest tankers.

Where a number of products are to be handled, the prime consideration may be the need to segregate the products to prevent contamination. This can give installation up to 6 or 8 arms, but not all can be used simultaneously.

Installations can include more than one size of marine unit.

Manual or Powered operation of Emco Wheaton Marine Units

UNIT SIZE (INCH)	RECOMMENDATIONS
6	**Manual operation recommended – Power operation available**
8	**Manual operation recommended – Power operation available**
10	**Manual operation recommended for arm lengths up to 8.5 x 8.5 m** **Powered operation recommended for arm lengths above 8.5 x 8.5 m**
12	**Powered operation recommended**
16	**Powered operation recommended**
20	**Powered operation recommended** (uncommon size)

Units may be manually controlled or hydraulically powered as tabulated

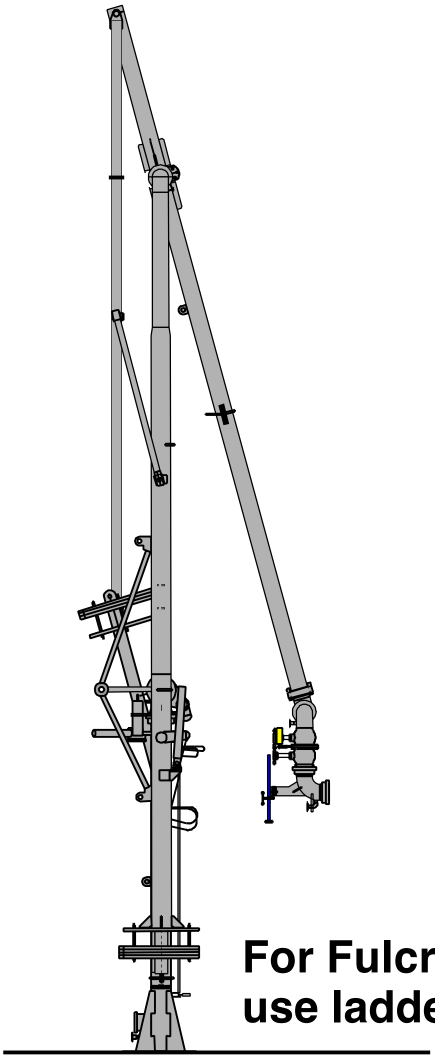
Manual and hydraulic units should not be mixed on the same jetty

Units can be offered as manual control but be supplied with mountings for future fitment of hydraulics

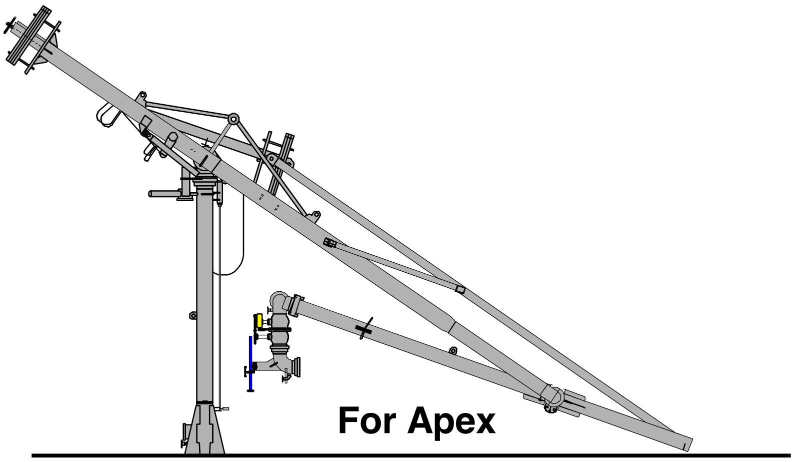
It is impractical to fit brackets for hydraulics after a unit has been erected on a jetty

Emco Wheaton GmbH will assist in final design based on site conditions, final length of MLA's and equipment fitted to the arm.

Emco Wheaton Marine Units
in parked & maintenance positions

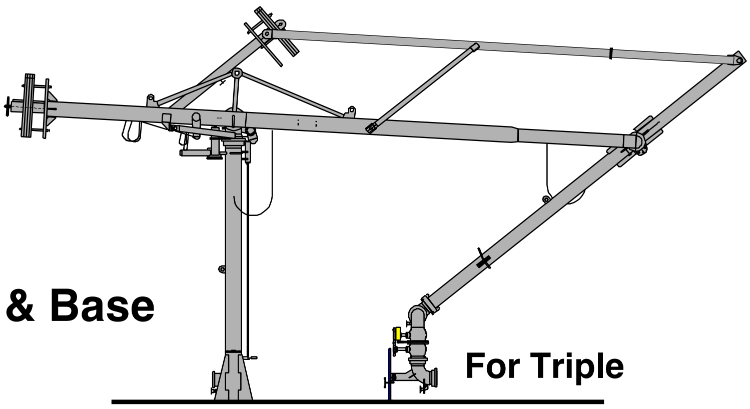


For Fulcrum & Base
use ladders



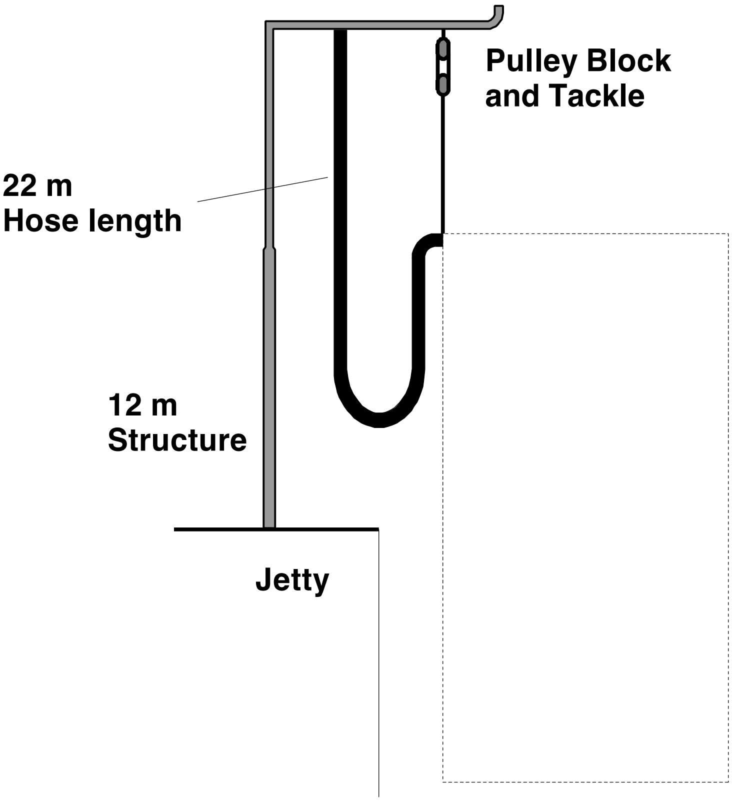
For Apex

It might be necessary to slew the arm to a position, where space is available

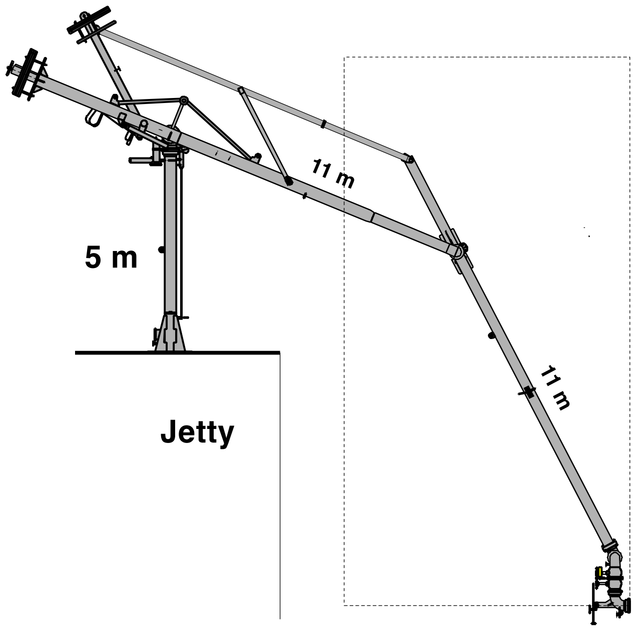


For Triple

Hose or Marine Loading Arm



- Requires large handling structure
- Requires continuous adjustment during loading cycle to control pulley and hose wear
- Hoses require regular pressure testing
- Replacement hoses are expensive to keep in stock
- Manual operation difficult
- Several men needed to connect to ship's flange
- Occupies large area on jetty



- Does not require supporting structure
- Automatically adjusts to the envelope position
- Does not require regular pressure testing
- Replacement swivel joint seals are inexpensive to keep in stock
- Minimum personnel needed

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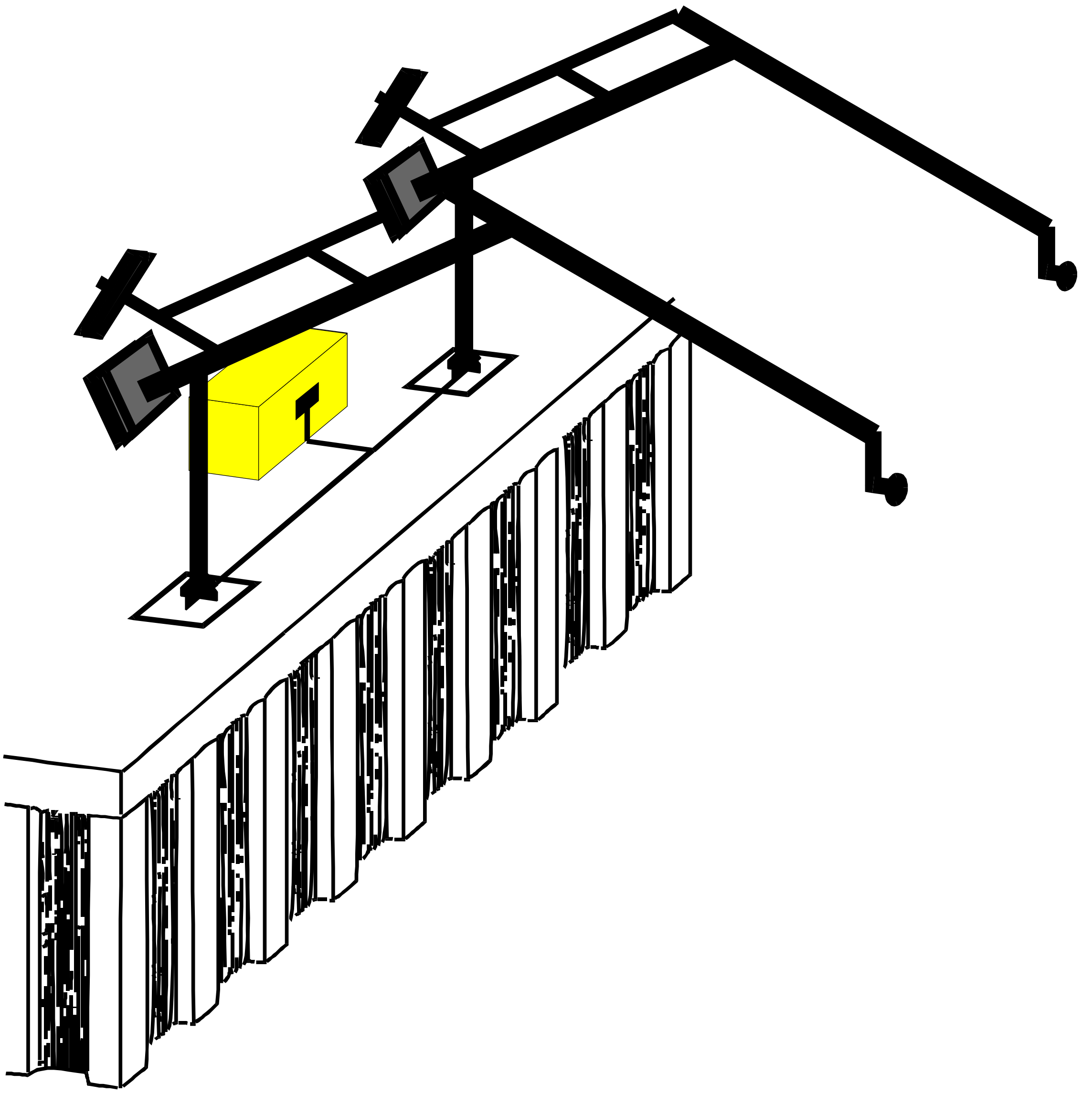
Marine Loading Arms typical Jetty installation



Sufficient space for hydraulic and/or electric cabinet needs to be incorporated in customers pipeline routing on jetty.

Routing of hydraulic pipe is also based on details of jetty. Emco Wheaton GmbH will assist customer in detailed design.

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Wind Velocities

wind force	description term	range of wind speed (m/s)	range of wind speed (knots)
0	Calm	0 - 0.2	< 1
1	light air	0.3 - 1.5	1 - 3
2	light breeze	1.6 - 3.3	4 - 6
3	gentle breeze	3.4 - 5.4	7 - 10
4	moderate breeze	5.5 - 7.9	11 - 16
5	fresh breeze	8 - 10.7	17 - 21
6	strong breeze	10.8 - 13.8	22 - 27
7	moderate gale	13.9 - 17.1	28 - 33
8	gale	17.2 - 20.7	34 - 40
9	strong gale	20.8 - 24.4	41 - 47
10	storm	24.5 - 28.4	48 - 55
11	violent storm	28.5 - 32.6	56 - 63
12	hurricane	32.7 - 36.9	64 - 71
13	hurricane	37.0 - 41.1	72 - 80
14	hurricane	41.2 - 46.1	81 - 89
15	hurricane	46.2 - 50.9	90 - 99
16	hurricane	51.0 - 56.0	100 - 108
17	hurricane	> 56	> 108
conversion factor of m/s to km/h = 3.6			

Typical Tide & Wind Speed Data

	Tide Change*	Wind Speed
Persian Gulf		
Kuwait	3.00 m	160 kph
Iraq	3.60 m	160 kph
Oman	2.30 m	158 kph
Mediterranean		
Turkey	0.7 m	145 kph
Algeria	1.5 m	148 kph
Libya	0.5 m	135 kph
North America		
Vancouver	3.20 m	160 kph
New Brunswick	9.50 m	160 kph
U.K.		
Milford Haven	6.40 m	180 kph
Flotta/Orkneys	3.23 m	200 kph
Fawley	4.00 m	150 kph
Killingholme	8.00 m	160 kph
Other Sites		
Korea	3.50 m	193 kph
Norway	2.00 m	129 kph
Nigeria	1.05 m	140 kph
Port of Aratu/Brazil	2.33 m	116 kph
Wellington/New Zealand	1.00 m	193 kph
Cape Lambert/Australia	5.80 m	241 kph
Hong Kong	2.70 m	212 kph

* Difference between LWST & HWST

Typical Marine Loading Arm Specification

GENERAL

The vendor shall design, fabricate complete and deliver ex works, FOB, or CIF job site point of manufacture the following Marine Loading Arms with all necessary equipment to load and unload tankers and barges. The equipment shall be manually operated or fully powered. Based on given Specification.

EQUIPMENT

- (Q'ty.) (Size) Fully counterbalanced Marine Loading Arms.
- (Q'ty.) Complete set of hydraulic cylinders, valves, tubing and hoses fitted to the Arm to move the Marine Loading Arm throughout its full operating range.
- Power Pack/Console to hydraulically power the Marine Loading Arms
- (Qty.) (Size) Couplings

DEFINITIONS

For the purpose of definition, the Owner shall be named as the Contractor and the manufacturer shall be the Vendor / Builder.

SPECIFICATIONS

The following specifications shall be used

- ANSI-B 31.3 - Chemical Plant & Petroleum Refinery Piping
  ASME Section VIII - Pressure Vessels Division
- ASME-Section IX - Welding and Brazing Qualifications
- SSPC - Steel Structures Painting Council, Volume 1 and 2
- IEC – International Electrotechnical Commission
- CENELEC – European Committee for Electrotechnical Standardisation
- VDE – Association of German Electrical Engineers

Typical Marine Loading Arm Specification

The above specifications are typical. It is not intended that the design be limited sole by these. Latest Editions shall prevail in all circumstances.

DOCK

The dock data is shown on Figure 1. When the unit is parked, no part of the Marine Loading Arm or its attachments shall project beyond the face of the dock.

VESSEL DATA

The Marine Loading Arm shall be designed to (load and unload) vessels ranging in size from (the smallest) to (the largest). The vessel data is shown on Figures 2 and 3.

OPERATING CONDITIONS

The following **ambient conditions** prevail:

Maximum Ambient Temperature	°C
Minimum Ambient Temperature	°C
Maximum Parked Wind Speed	$m\ s^{-1}$
Maximum Operating Wind Speed	$m\ s^{-1}$
Exposure	(A/B/C/D)
Seismic Conditions	exist / not exist
Seismic Zone	(0/1/2/3/4)

PRODUCT DATA

All materials of construction including the seals shall be suitable for the following products and conditions:

Product	(Proper Name)
Chemical Formula	(...)
Specific Gravity	Kg/dm^3
Design Pressure	bar g
Design Temperature	°C
Viscosity at operating temperature	cSt
Flow-rate	m^3/hr
Maximum velocity in product pipe	m/sec
Maximum allowable pressure loss	bar g

Typical Marine Loading Arm Specification

MARINE LOADING ARMS

The Marine Loading Arms shall comprise a riser mounted on the dock, an inboard Arm pivotally mounted to the riser, an outboard arm pivotally mounted to the inboard Arm and a ships end triple swivel connection pivotally mounted to the Outboard Arm.

The pivotal connections shall be made by using elbows and a minimum of six swivel joints These members form the fluid tight product path between the dock pipe-work and the vessel.

The six swivels allow freedom of movement of the Arms in 3 planes to satisfactorily follow all movements of the vessel within the design envelope including drift, surge, pitch, roll, and change in elevation.

The inboard Arm, outboard Arm and triple swivel shall be fully balanced by means of 2 or more groups of steel counterweights.

The Arm shall be balanced in the dry condition.

The triple swivel assembly shall be balanced so that the connecting flange face remains vertical for all positions of slew angle for easy and safe connection to the ships manifold.

The balancing of MLA with counterweights shall be so situated that in manual operation or in the event of power failure the inboard arm slowly rises and the outboard arm slowly closes to allow easy parking.

The out of balance forces from the Arms may be transmitted either directly to the counterweights or indirectly by means of non adjustable rigid linkages.

The inlet flange on the dock shall be (**X**") and the outboard flange size (**Y**")

The connection to the vessel shall be made by means of a (bolted flange or coupling).

The vendor shall supply the following flanged reducing adapters to allow bolting to various sizes of flanges.

In the event it is necessary to mate with manifolds of a lesser size than the Arm connection or with manifolds constructed in cast iron, the vendor shall prove that safe working stresses are not exceeded. In the event that stresses are too high without, a support jack shall be supplied as an integral part of the Arm.

SWIVEL JOINTS

All swivel joints shall have split flange joints for ease of seal exchange. Each joint shall be capable of being lubricated without dismantling. Swivel joints shall have hardened ball races capable of carrying all possible load combinations (e.g. pressure, axial, radial loads and bending moments). Swivels in the ships end triple swivel can be single race (less weight of single race swivel is an advantage). Swivels in the other 3 positions of the Arm shall be double race. Single races of a hardness less than 450 BH (~ 43 RC) are considered unsuitable for this service, as are double races of a hardness less than 550 BH and multi-race swivels with exchangeable races.

Typical Marine Loading Arm Specification

The swivels have to be designed to the following safety factors:

Brinelling:	1.50
Leakage:	2.00
Structural failure:	3.50 for liquid hydrocarbons (4.0 for liquefied hydrocarbon gases)

Seal faces must be 316 stainless steel clad or equal. Seals must be suitable for the products and temperatures. Riser and apex swivels shall have additional devices to allow re-packing without dismantling major portions of the Arms.

ACCESSORIES

STORM LOCKS

Each Arm shall have mechanical locks to lock the inboard Arm during high winds in both the vertical and slew planes. The outboard Arm may be held using the handling line on manual Arms and a shut off valve on powered Arms.

VACUUM BREAKER

To facilitate Arm drainage, each Arm shall be fitted with a vacuum breaker (and non-return valve for the hazardous fluids). This shall be operated from the ships end of the outboard Arm. It shall be spring-loaded normally closed. Due to its inaccessibility it is recommended that this valve be from stainless steel.

DRAIN VALVES

It is essential that Arms are empty of fluid when disconnected from the ship. Checks are necessary to ensure this is the case. Drain points (and valves) shall be fitted at the lowest point in the riser and the triple. (6" to 8" MLA's - 1" diameter; 10" and larger MLA's 1½" to 2" diameter size).

WASHING CONNECTIONS

Two-inch (2") washing connections can be fitted at the base of the riser and the bottom of the outboard Arm if required by product or process.

Typical Marine Loading Arm Specification

SUPPORTS

A permanently attached adjustable support jack located in an optimum position near the last swivel shall be fitted on Arms where the manifold stresses exceed specified maximum without them. Range of adjustment should be 18" to 60", approximately measured from the terminal flange centre-line. The load rating should be suitable for the size of Arm. (Over design of this feature may strain the manifolds)

GROUND LUBRICATION SYSTEM

Each Marine Loading Arm shall be fitted with a simple swivel lubrication system to allow lubrication of the base fulcrum apex and triple swivels.

COUPLINGS

Manual	Refer to Camlock Couplings (details available on request)
Hydraulic	Refer to M.I.B. (details available on request)

POWER SYSTEM

Hydraulically powered units shall be fitted with (3) directly connected hydraulic cylinders to power the inboard Arm up and down, the outboard Arm in and out and the whole structure left and right. Devices other than cylinders normally exhibit excessive free wheeling loads and maintenance and are not preferred. The cylinders shall be sized at 110% of the sum of the following:

- Wind Loads
- Cylinder and Swivel Friction
- Any out of balance moments

A freewheel control valve shall be mounted at the base of each Arm containing relief valves for each mode and direction and means to make up volumetric changes due to freewheeling cylinder movement without undue back pressure. This valve shall be selected from the console as necessary to allow the Arm to be moved under power. This valve shall fail to the freewheel condition in the event of hydraulic or electrical failure. Each cylinder line per hydraulic control unit shall be fitted with an independent speed control. These valves must not restrict flow during freewheeling. Pressure relief valves shall protect the pump circuit and each cylinder line. Cylinder lines requiring various pressures must be fitted with pressure reducing valves. Hydraulic tubing and fittings shall be permanent and in 304 stainless steel. Suitable high-pressure hose shall be used for articulation. (Rubber hose cannot be considered permanent and shall be fitted with plated steel fittings).

Typical Marine Loading Arm Specification

The system shall be protected by return filters to give the recommended degree of filtration required by the valve and pump manufacturers. For installations of low utilisation and operations entirely visible from the dock level, manual lever directional valves are recommended. Installations of frequent utilisation, using power couplings, servicing tankers with deck at high elevations not visible from the dock, solenoid operated directional valves are recommended. These valves shall be operated by means of push buttons mounted on the console or on a pendant plugged into the ships end of the Arm. In the event of power failure, the Arm shall be balanced so as to return slowly to the parked position more or less.

ELECTRICAL

All equipment must be suitable for CENELEC Class 1, Zone 1, ... and must be explosion proof if required by product or location.

TYPICALLY SEQUENCE OF OPERATIIONS

- Unlock console and start up system.
- Ship's end pendant is carried aboard ship.
- Select required unit on the selector valve.
- Release storm latches on selected unit.
- Using shore end controls move unit until terminal connection is in line with ship's flange.
- Shore operator now selects ship control on shore.
- Using ship's end controls, connect unit to the ship's flange.
- Select freewheel by selecting the next unit on the unit selector valve.
- To park unit, operate unit selector valve and disconnect from ship's flange using the ship's end pendant.
- Reselect shore controls on shore pendant, move unit to the parked position and refit parking locks.
- Finally select free wheel on unit selector valve.

Typical Marine Loading Arm Specification

PROTECTIVE COATINGS

Small parts and fasteners shall be zinc plated or galvanised. All external surfaces to be prepared and primed with an inorganic zinc rich primer as minimum. Coating need to specified by customer.

ASSEMBLY TESTING AND INSPECTION

Arms shall be assembled complete with all accessories and hydrostatically tested prior to shipment. All pipes welding shall be subjected to 10% radiography (as minimum).

SUPPORT SERVICES

The vendor shall include in his proposal the services of competent personnel to supervise field erection, installation and training. This shall incur no extra cost and the vendor shall state the number of days of job site support he has included in his price.

SPECIAL SERVICES

The vendor shall perform a stress analysis proving the integrity of the Marine Loading Arm. This analysis shall include analysing the Arm in the parked position with parked wind effects or seismic effects; the Arm moving between the parked position and the vessel; the Arm in the operating position connected to the vessel with or without operating wind loads, empty or full of fluid at all positions within the manifold.
For multiple Arm installations, the vendor shall perform model or drawing checks to ensure adequate clearances between Arms is maintained both in the case of operating and parked Arms.

Advantages of Emco Wheaton Marine Loading Arms

The Loading Arms offered are the Emco design which are of all steel double counterweighted construction.

The Loading Arms are designed specifically with the following criteria in mind: -

a. Strength, long life and easy operation
b. Minimum maintenance
c. Simplicity of maintenance (no special tools)

The following features are used in the design: -

1. To reduce wind loadings and consequent stresses in the arm, extensive use is made of circular sections as the wind coefficient is greatly reduced.

   i. e. Wind coefficient — Cf = 0.7 for Circular Sections
   Cf = 2.0 for Flat Sections

   All balance weights are located at the rear of the pedestal to reduce wind loads, particularly when stowed.

2. The outboard arm is moved and balanced via a rigid pantograph link. This link is maintenance free with all linkage pins manufactured from stainless steel. The pins are mounted in self-lubricating bearings, giving life-long maintenance free operations under normal conditions.

   Other loading arm manufacturers use wire rope for the outboard arm linkage which requires frequent inspection and maintenance, or alternatively, balance weights are located at the apex which induces high wind loads, makes swivel maintenance difficult and increases the stress in the pipe-work.

Disadvantages encountered with Wire Rope System

a. Frequent dressing with lubrication required

b. Wires are subject to corrosion (not easily visible)

c. Broken single strands lead to accelerated breakage of adjacent strands

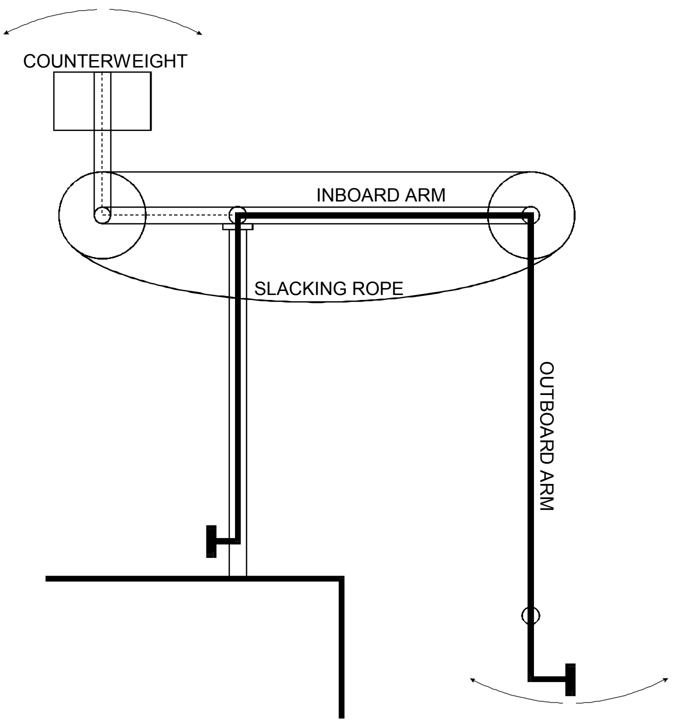
d. Wire and pulleys are subject to wear

e. Wire suffers loss in cross-sectional area due to strain

f. Wire slip on pulleys causing loss of balance

g. Regular inspection and load testing required

h. Inherent slack and natural catenary lead to imperfect balance



Because of the slacking ropes the counterweight tends to move uncontrolled either to the left or the right when being in vertical position.

This movement is a very impulsive one and puts a tremendous stress impact on the complete design

We know from customers who were using this design, that stress effect can destroy the ropes

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Advantages of Emco Wheaton design

a. Site adjustable double counterweights for accurate balancing of inner and outer arm.

b. Movable elbows fitted at pedestal head and apex swivels for ease of seal changing without dismantling the arm.

c. The small included angle between inner and outer arms, when the loading arm is stowed, minimises the space required on the jetty and the possibility of clashing between adjacent arms.

d. The offset weight design prevents any possibility of counterweights fouling adjacent arms.

e. The most important feature of a loading arm is the swivel joint. These joints are required to be capable of resisting high bending and axial load combinations due to wind and arm attitude while retaining low torque characteristics and simple maintenance.

f. The rigid pantograph link used to move and balance the outer arm is maintenance free, with all linkage pins being manufactured in stainless steel. The pins are mounted in self-lubricating bearings, giving life-long maintenance free operation, and ensuring constant perfect balance.
This system obviates the need for wire-lines, which are subject to stretching (causing an out of balance situation and corrosion with possibility of wire-line failure).

g. Due to the self-carrying product piping the pressure drop within the Emco Marine Loading Arm is always lower than the corresponding Marine Arm of the competition.

h. Hydraulic cylinder pistons for inner and outer arms and slew motion are made of stainless steel. Pistons are inside the body in Marine Loading Arm parking position.

i. The control system can be designed to utilise sets of control valves which allows the arm to be in a controlled (locked) condition at any position.

Comparison Emco Wheaton design
Cable Wheel design

Movement and balance of outboard arm is achieved by means of a rigid pantograph link. Adjustable double counterweights are used for accurate balancing of inner and outer arm. Both of the above increase the reliability and safety of a Marine Loading Arm as they ensure a stable structure, that imposes minimum loads to the ship's flange, and can withstand high pressures caused by severe winds.

Due to the fact, that no cables / wheels are used for balancing maintenance cost are kept to a minimum.

The customer does not need:

- Craneage for seal replacement work
- Permanent tightening of cables
- Permanent greasing of cables
- Scaffolding for cable maintenance

Breaking or slippage of cables exposing personnel to dangerous situations can not occur.

Comparison Swivel Joint design

As opposed to the design of most of our competitors, who use snap in ball raceways the raceways of Emco Wheaton swivel joints are direct incorporated and flame hardened up to 600 BHN (~ 57 HR C) having a hardness depth of 3 mm. This ensures, that the swivel joints have an extremely long, trouble free lifetime / operation, requiring lubrication on a regular basis only.

All swivels of the Emco Wheaton design have integral flanges allowing easy replacement of seals, even triple swivels.

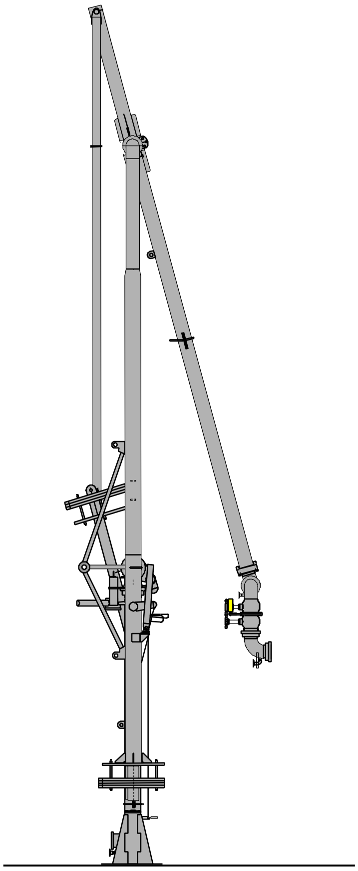
These features also ensure the safety of a Marine Loading Arm as a leakage of a swivel joint can impose harm to environment and man.

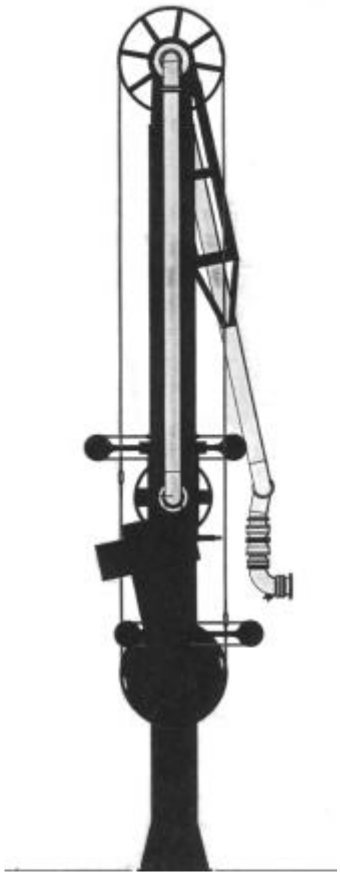
Also flame hardened raceways are capable of withstanding high bending and axial load combinations due to heavy winds.

We are frequently refurbishing Marine Arms which have been in service for about 20 years, and most swivels are in excellent condition and can be put back into service without refurbishment.

Our experience and information from operators who use arms with replaceable raceways is not good, as over the years the groove that holds the snap in raceway can suffer from corrosion or distortion eventually requiring the replacement of complete body and sleeve.

Marine Loading Arm Self Support Type vs. Separate Support Structure Type





Self Supporting Arm

Small Surface

→ Low Loads Imposed by Wind

→ Low Loads Imposed into Jetty

Loading Arm with Supporting Structure

Great Surface

→ High Loads Imposed by Wind

→ High Loads Imposed onto Jetty

EMCO WHEATON™