

COMPLETE MARINE PORT SOLUTIONS PROVIDER
**MARINE SHEET PILES, PIPE PILES, RUBBER FENDERS,
MOORING BOLLARDS, AND CATHODIC PROTECTION**

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ESC Marine Systems

MOORING BOLLARDS | MARINE RUBBER FENDERS | CATHODIC PROTECTION

2026 EDITION



A large cargo ship is docked at a pier. In the foreground, a concrete pier with yellow bollards and black mooring equipment is visible. The ship has a red hull and a white superstructure. The sky is blue with some clouds.

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ESC MARINE RUBBER FENDER SYSTEM

Marine Rubber Fenders are critical for the energy absorption of a berthing vessel into the berth structure. A single tanker can be over 500,000 tons so safe energy absorption in worst case scenarios is paramount. The marine fenders primary job is to protect the berthing structure without damaging the vessel hull for all potential vessel types, sizes and approach scenarios. ESC offers a full range of fender options to compliment its marine steel piling products.

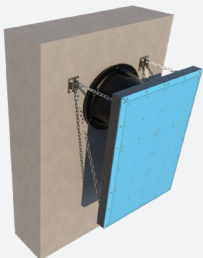
ESC has strategic partnerships with manufacturers with over 20 years of experience delivering marine fender system solutions to Asia, North America, Central & South America, Europe and Middle East. ESC's global network provides an end-to-end solution that is customized to project requirements providing detailed support in close proximity to its valuable clients.

ESC offers complete Marine Rubber Fender Systems

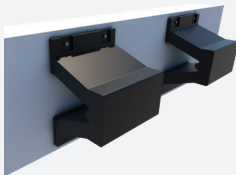
- ✓ Full range of fender types, sizes and rubber grades
- ✓ Manufacturers certified to ISO 9001
- ✓ Experienced design engineers for berthing energy calculations & fender selection and detailed design of fender and frontal panels to PIANC 2002, BS 6349:4 & EAU 2004
- ✓ Intimate understanding for integration into berthing structure
- ✓ Highly skilled and experienced front panel fabricators
- ✓ High quality mixture of natural, synthetic rubbers from reputable and prequalified suppliers with strict quality control
- ✓ Global supply network in Asia and Europe
- ✓ Full suite of in-house testing equipment all the way up to 4410 kips (2,000 tonnes) compression

FENDER COMPONENTS & TYPES AVAILABLE

- ✓ Cone & Cell Fenders up to 22 short tons (20 tonnes) unit weight
- ✓ Arch Fenders (option for frontal PE pads) up to 13'-1 1/2" (4m) length
- ✓ Element Fenders
- ✓ Other extruded/moulded fenders—cylinder, roller, D fender
- ✓ Pneumatic & Foam Fenders
- ✓ Full Frontal Panels Fabrication—low friction UHMW PE Pads, Open and Closed Steel Frames
- ✓ Anchoring Bolts & Brackets
- ✓ Shear, Weight & Tension Chains



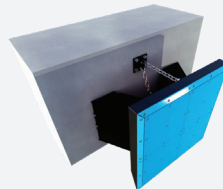
CONE



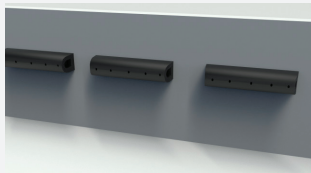
ARCH



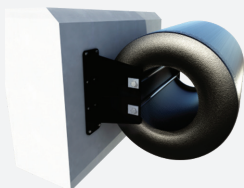
PNEUMATIC



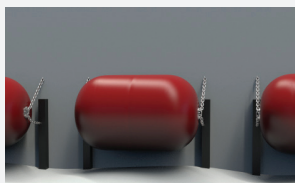
ELEMENT



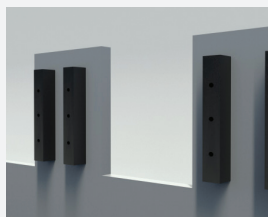
D FENDER



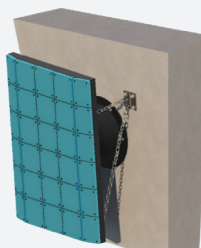
CYLINDRICAL



FOAM-FILLED



SQUARE



CELL

DESIGN PROCESS



DESIGN STANDARDS

- Code of Practice for Design of Fendering and Mooring Systems: BS 6349: Part 4 (2014)
- PIANC WG33 Guidelines for the Design of Fenders (2002)
- Recommendations of the Committee for Waterfront Structures, Harbours and Waterways (EAU 2012)
- Dock Fenders – Rosa 2000 Edition No.1
- Design of Piers And Wharves: Unified Facilities Criteria UFC 4-152-01 (2005)
- Guidelines for the Design of Maritime Structures – Australia: AS4997 (2005)
- Engineering Standards for Port & Harbour Structures Design Manual —Philippine Ports Authority (2009)
- Determining and Reporting the Berthing Energy and Reaction of Marine Fenders: ASTM F2192-05 (2005)
- Recommendations for the design and construction of berthing and mooring structures ROM 2.0.11
- Ships and marine technology—high pressure floating pneumatic fenders: ISO 17357-2002



ESC MARINE RUBBER FENDER SYSTEM

DESIGN, MANUFACTURE, TESTING & QUALITY TESTING

PRELIMINARY DESIGN & BUDGETING

ESC can complete a preliminary assessment and design of the most appropriate fender system to allow budgeting and estimation for projects. ESC can complete this even with a limited information set.

DETAILED DESIGN

ESC has developed software that assist in calculating berthing energies for the project's complete vessel range which are then used to specify the optimal fender configuration which includes rubber fender selection, frontal panel sizing and location, chain and anchor design and if appropriate cathodic protection design. These calculation is conforming to BS 6349: Part 4, PIANC guidelines and other standards. Full manufacturing and layout drawings are produced to enable high quality production and comprehensive detailing for installation on site.

MANUFACTURING

ESC's fender product line is comprehensive, with over 50 profiles and various rubber grades (low reaction to super high reaction force) to select from. The frontal pad fabrication facility (complete with blasting and painting) is in close proximity to the fender facility which makes factory visits and ex-mill logistics more convenient and efficient. Components such as chains and anchors are produced by pre-qualified manufacturers also in close proximity to the facilities.

QUALITY ASSURANCE

Marine Fender Rubber is an engineered material that exhibits optimal properties in terms of cost, energy absorption, wear resistance, UV resistance and more. An engineered mixture of additives is used to improve the overall mechanical and wear properties of the material. The rubber utilised comes from the highest quality sources and is inspected and testing in accordance with the ISO 9001 Quality Management System. Some parameters tested are: tensile strength, elongation at break, compression set, hardness, density, seawater resistance, tear resistance, ozone resistance, abrasion resistant, bond strength and ageing.



MARINE FENDER PROJECT PHOTOS



D FENDER



CONE FENDER



ARCH FENDER



CONE FENDER



CYLINDRICAL FENDER



FENDER PANEL



PNEUMATIC FENDER



CYLINDRICAL FENDER



PNEUMATIC FENDER



ESC MOORING BOLLARDS

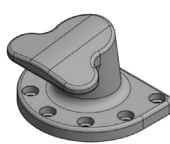
Marine mooring bollards provide a simple yet efficient method for fulfilling mooring requirements to allow safe securing of vessels next to jetties, wharves, berths and dolphins in ports and harbors. ESC can offer a wide range of cast iron or steel bollards in various sizes, grades and capacities.

ESC bollards are designed and manufactured in accordance to standards and guidelines such as BS6349: Part 4 and PIANC. Bollards are safety critical components and ESC strives to provide bollards with superior service life and resistance to physical and corrosive environments.

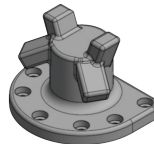
ESC offers a full range of Mooring Bollards

- ✓ Cast iron and steel bollards in a range of configurations.
- ✓ Up to 300 ton capacity
- ✓ Complete with anchoring sets
- ✓ Corrosion Protection Coating options—primer, epoxy coating, galvanized, duplex (galvanized & painted)
- ✓ Fully customizable as bollards vary significantly between ports and countries.

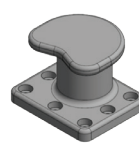
STANDARD DESIGNS



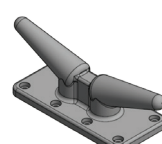
T-HEAD



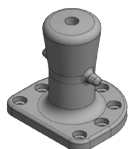
T-HORN



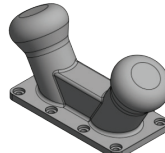
KIDNEY



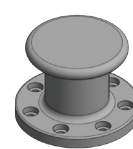
CLEAT



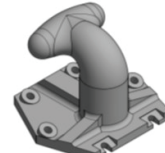
SINGLE BITT



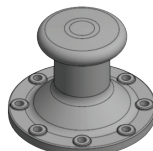
DOUBLE BITT



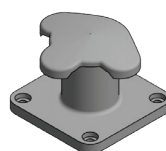
PILLAR



T HEAD JAPANESE DESIGN



PILLAR JAPANESE DESIGN



TRICORN

STANDARD RANGE

SECTION	RATING (TONS)																	
	1	5	10	15	20	25	30	35	50	70	75	80	100	125	150	200	250	300
T-Head			✓	✓		✓	✓	✓	✓			✓	✓	✓	✓	✓	✓	✓
T-Horn				✓			✓		✓			✓	✓		✓	✓		
Kidney				✓			✓		✓				✓		✓	✓		
Cleat	✓	✓	✓	✓	✓	✓	✓	✓										
Single Bitt			✓	✓			✓		✓		✓		✓		✓	✓		
Double Bitt					✓		✓		✓		✓		✓		✓	✓		
Pillar			✓	✓			✓		✓				✓		✓	✓		
Pillar Japanese Design				✓		✓		✓	✓	✓			✓		✓	✓		
T-Head Japanese Design		✓	✓	✓		✓	✓	✓	✓	✓			✓		✓	✓		
Tricorn							✓		✓				✓		✓	✓	✓	✓

MATERIAL SPECIFICATION

ESC bollards are produced to the highest specifications. The table gives indicative standards and grades but many other options are available on request.

MATERIALS	STANDARD(S)	GRADE(S)
Ductile Cast Iron	BS EN 1563	EN-GJS-450-10/ 500-7/ 600-3
	ASTM A536	65-45-12/ 70-50-5/ 80-55-6
	GB/T 1348	QT450-10/ QT500-7/ QT600-3
Cast Steel	ASTM A27	65-35/ 70-40/ 80-50
	ASTM A148	80-50
	GB/T 11352	ZG230-450/ ZG340-640
	EN 10293	G20Mn5
Anchor Bolts (galvanized)	ISO 898	Gr. 4.8/ 8.8 (galvanized)
	BS 3692	Gr. 4.8/ 8.8 (galvanized)
	ASTM F1554	Gr. 105 (galvanized)

BOLLARD SELECTION & LAYOUT

Bollards should be designed and laid out according to local standards. Some of the following aspects are to be considered in the design of the berth:

- ✓ Mooring patterns and line types, sizes and angles
- ✓ Changes in draft during loading/unloading of the vessel
- ✓ Wind and current forces
- ✓ Swell, wave and tidal forces
- ✓ Other abnormal environmental loadings

Mooring loads should be calculated where possible, but the following table can be used as an approximate

guideline, also noting that if the berth is expected to experience adverse weather conditions, the bollard capacity should be increased by 25% or greater.

ESC bollards can cope with horizontal angles of $\pm 90^\circ$ (except for pillar bollards which is in all horizontal angles) and vertical angles up to 60° depending on bollard type.

Design codes recommend that bollards are frequently placed at 15-30m intervals, often at the same spacing as fenders (either at the same point as fenders or midway). Another approximate guide is 15% of the length of the shortest ship.

DISPLACEMENT	APPROX. BOLLARD RATING
Up to 2,000 tons	10 tons
2,000—10,000 tons	30 tons
10,000—20,000 tons	60 tons
20,000—50,000 tons	80 tons
50,000—100,000 tons	100 tons
100,000—200,000 tons	150 tons
Over 200,000 tons	200-300 tons

COATING SYSTEMS

Exposed to a very corrosive marine environment, bollards require a durable coating system. Standard coatings for a very high corrosive environment are in accordance to BS EN ISO 12944 C5-M. Other high performance paint system, in various colors and thicknesses, can be factory applied on request.

Bollard bodies can also be supplied with hot-dip galvanized (HDG) coating on a special request basis.

Regular maintenance for bollards are needed for wear and abrasion from ropes. Cast steel bollards need frequent painting to retain full strength for it is more susceptible than ductile iron bollard.



SIGNAL YELLOW

SIGNAL BLUE

SIGNAL BLACK

BROWN

MARINE GRAY

SIGNAL RED

Other color options available upon request, please contact ESC for information.

COLOR OPTIONS

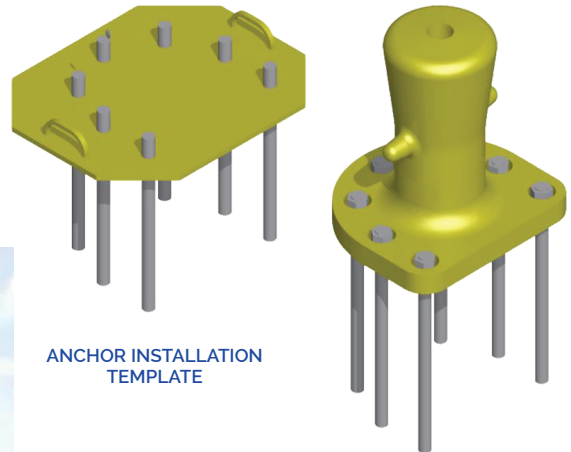


BOLLARD INSTALLATION

Bollards must be installed correctly for a long and trouble-free service life. Anchors should accurately be installed with a template of the bolting pattern, which ESC can supply on request. Once the grout has cured to full strength, anchors can be tightened to the design preload. A thread loosening compound is frequently applied to allow future removal for replacement. Where possible, recessing the bollard in the concrete is more beneficial than surface mounting.

Fixing options for bollards include:

- ✓ Surface Mounting
- ✓ Recess Mounting
- ✓ Retrofitting
- ✓ Through bolting
- ✓ Structural Steel Mounted



QUALITY ASSURANCE

Bollards are safety critical items and quality is paramount. Independent third party witnessing of test is available at additional cost on request. A typical quality documentation package will include:

- ✓ Dimensioned drawings of bollard and accessories
- ✓ Bollard and anchorage calculations (if required)
- ✓ Inspection and test plan
- ✓ Certificate of conformance
- ✓ Physical, chemical and material properties report for casting and anchorages
- ✓ Installation guidelines

MARINE MOORING BOLLARDS

PROJECT PHOTOS



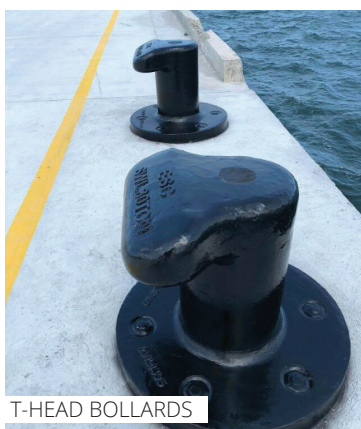
HORN BOLLARDS



T-HEAD BOLLARDS



CLEAT BOLLARDS



T-HEAD BOLLARDS



SINGLE BITT BOLLARDS



DOUBLE BITT BOLLARDS



HORN BOLLARDS



CLEAT BOLLARDS



T-HEAD BOLLARDS



ESC CATHODIC PROTECTION

Cathodic Protection involves electrically connecting a sacrificial element that preferentially corrodes instead of the sheet pile or steel structure. Sacrificial elements are typically constituted of an alloy of aluminium, magnesium and zinc depending of the water conditions. It may be used as a supplementary form of corrosion protection on top of the corrosion coating system. ESC can offer it's experience in the design, specification and integration of a Cathodic Protection System for submerged Sheet Piles. ESC can supply sacrificial anodes of various dimensions and configurations in Aluminium or Zinc alloys. ESC can provide a full suite of items, such as reference electrodes, test points, mounting brackets, bolts, wiring and more.

ESC offer anodes specially designed for sheet pile, combi wall and pipe pile applications in a variety of sizes. Other custom sizes can be cast.

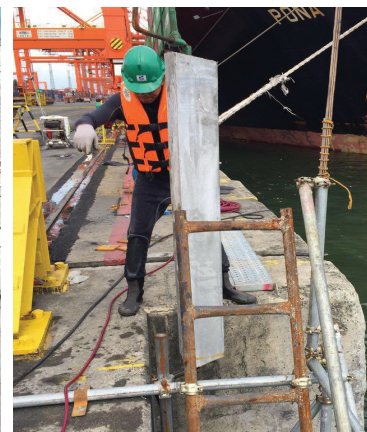
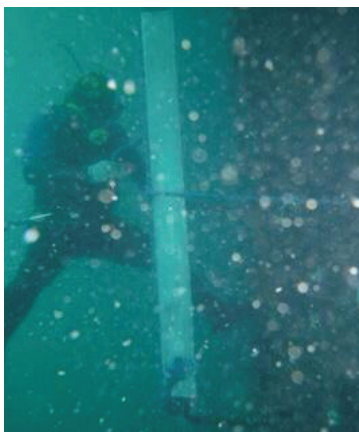
PROJECTS WE CATER TO

- Ports & Jetties
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- Underground Pipelines
- Ships, Barges, Pontoons
- Subsea Pipelines
- Storage Tanks
- Reinforcement in Concrete Structures

QUALITY PRODUCTS



CATHODIC PROTECTION PROJECT PHOTOS





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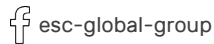
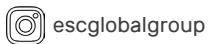


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