

Surface Buoyancy



PRODUCT BROCHURE

Surface Buoyancy

Shipping never stops and neither can you if you want to keep your clients happy.

Trelleborg Marine Systems take the pressure off by understanding your environment and applying the local knowledge of a worldwide workforce to your unique needs.

Only Trelleborg have experienced engineers in R&D, design, manufacturing, testing, installation and maintenance. That means we have the know how and the end-to-end capabilities to ensure your systems keep performing at their optimum level.

For the very best end-to-end solutions that come with unrivalled lifecycle value and peace of mind, Make Certain with Trelleborg Marine Systems.

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Surface Buoyancy

Trelleborg Marine Systems is a world leader in the design and manufacture of Surface Buoyancy products.

The size and diversity of the marine marketplace makes it one of the most challenging environments to work in. It is a global market that covers a breadth of applications, and requires high quality, engineered solutions that work onshore, offshore and onboard.

Our proven competencies in polymer engineering and the production of buoyancy products enables us to service the commercial sector with a comprehensive range of resilient foam buoys and fendering solutions. Ensure your provider can deliver the right solution for you, on time and on budget, wherever you are in the world.

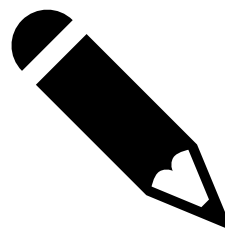


WHAT END-TO-END REALLY MEANS

When you choose Trelleborg you ensure your expectations will be met, because we deliver a truly end-to-end service – retaining vigilance and full control at every stage.

CONSULTATION

Consultation to assist you at the earliest stage of your project, with full technical support available from our global office network



CONCEPT

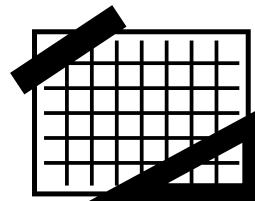
Conceptual design in our local office – with full knowledge of local standards and regulations, delivered in your language

DESIGN

Concepts taken to our global design center in India where our team generates 3D CAD designs, application-engineering drawings, bill of materials, Finite Engineering Analysis and calculations

MANUFACTURE

Designs for all components sent to appropriate Trelleborg manufacturing facilities. Steel fabricated by trusted partner and rubber is manufactured in Trelleborg facilities

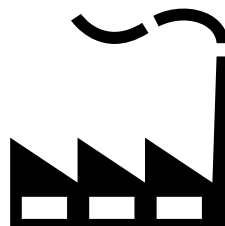


TESTING

Full testing conducted routinely during all stages of manufacture, from laboratory tests on material samples to full scale Factory Acceptance Tests

INSTALLATION

Dedicated project management from solution design right the way through to on site installation support



MAINTENANCE

Full after sales support, including product training, operator training, spare parts and maintenance program

Polyethylene Navigation Buoys

Trelleborg Marine Systems has secured an exclusive agreement with one of the industry's leading experts in the field of Rotational Moulding to manufacture these state of the art aids to navigation (AtoNs). Manufactured using the very latest polyethylene technology, the new range is modular in design, robust, impact resistant, colour-fast and provides excellent resistance to the effects of UV degradation.

We offer buoys ranging from 1.25 to 3.6 meters in diameter. This standard range is augmented by bespoke products meeting your exact specifications or specialist needs. The flat base design of all products in the range ensures buoys stay upright in low-tide situations, are easily stored on vessel deck prior to installation and the galvanized steel core ensures absolute stability in rough seas and product integrity.

The buoys are built to last in extreme conditions. Even if the skin is punctured, the closed cell foam filled polyethylene hull sections negate water absorption and keep it fully operational. This makes the range especially good for housing and protecting technical equipment such as monitoring technology.

The range has been designed for ease of installation and transportation. They can be shipped in sections and assembled or dissembled quickly on-site.

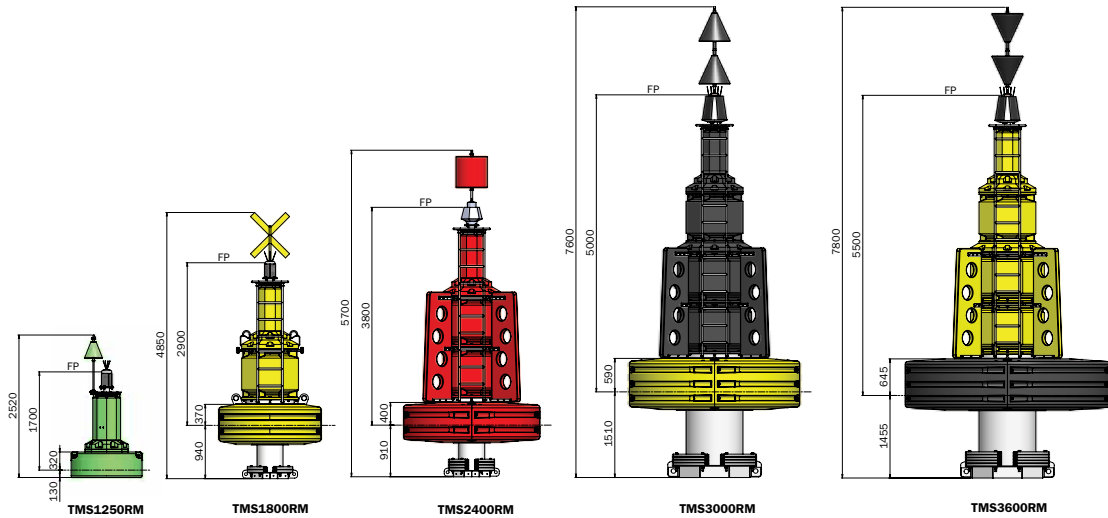
The design of our Rotationally Moulded Polyethylene Buoys is meant to give customers the best of both worlds. They are lighter than steel, provide excellent performance and longevity and cost less. Maintenance is easy and at lower overall cost and a wide range of competitively priced accessories are available.



The Rotationally Moulded range is easily stored on vessel deck prior to installation.

Polyethylene Navigation Buoys

TMS RM Navigation Buoy Standard Range



Specifications

TMS RM Navigation Buoy Standard Range

SPECIFICATIONS					
PHYSICAL					
SIZE	TMS1250RM	TMS1800RM	TMS2400RM	TMS3000RM	TMS3600RM
Application	Coastal, Estuary, River	Offshore coastal, Estuary, River	Offshore coastal	Offshore coastal	Offshore coastal
Diameter (mm / inches)	1250 / 49 ^{3/16"}	1800 / 70 ^{7/8"}	2400 / 94 ^{1/2"}	3000 / 118 ^{1/8"}	3600 / 141 ^{3/4"}
Overall weight (kg / lbs)	135 / 297	700 / 1543	1020 / 2250	2100 / 4630	2300 / 5070
Adjustable ballast (kg / lbs)	0 / 0	160 / 352	320 / 706	800 / 1764	1000 / 2205
Overall height (mm / inches)	2520 / 99 ^{3/16"}	4850 / 190 ^{15/16"}	5700 / 224 ^{7/16"}	7600 / 299 ^{3/16"}	7800 / 307 ^{1/16"}
Maximum focal plane height (mm / inches)	1700 / 66 ^{15/16"}	2900 / 114 ^{3/16"}	3800 / 149 ^{5/8"}	5000 / 196 ^{7/8"}	5500 / 216 ^{9/16"}
Nominal freeboard (mm / inches)	320 / 12 ^{5/8"}	370 / 14 ^{9/16"}	400 / 15 ^{3/4"}	590 / 23 ^{1/4"}	645 / 25 ^{3/8"}
Nominal draft (mm / inches)	130 / 5 ^{1/8"}	940 / 37 ^{0/0"}	910 / 35 ^{13/16"}	1510 / 59 ^{7/16"}	1455 / 57 ^{5/16"}
Minimum freeboard (mm / inches)	170 / 6 ^{11/16"}	150 / 5 ^{7/8"}	200 / 7 ^{7/8"}	300 / 11 ^{13/16"}	400 / 15 ^{3/4"}
Maximum draft (mm / inches)	280 / 11 ^{0/0"}	1160 / 45 ^{11/16"}	1110 / 43 ^{11/16"}	1800 / 70 ^{7/8"}	1700 / 66 ^{15/16"}
Gross buoyancy (kg / lbs)	550 / 1213	1720 / 3792	3020 / 6658	6920 / 15256	9680 / 21340
Reserve buoyancy (kg / lbs)	415 / 915	860 / 1896	1680 / 3704	4020 / 8863	6380 / 14065
Submergence (kg/cm, lbs/inch)	12.5 / 70.0	24.0 / 134.4	44.5 / 249.2	70.6 / 395.4	102 / 571.2
Visual area (Without day mark) (m ² / ft ²)	0.93 / 10	2.30 / 25.75	3.50 / 37.66	5.96 / 64.13	6.52 / 70.16
Visual area (With day mark – CAN shape) (m ² / ft ²)	--	2.72 / 29.27	5.24 / 56.38	7.70 / 82.85	8.26 / 88.88
Visual area (With day mark – CON shape) (m ² / ft ²)	--	2.68 / 28.84	4.96 / 53.37	7.42 / 79.84	7.98 / 85.86
Minimum mooring weight (kg / lbs)	50 / 110	145 / 320	250 / 552	400 / 882	400 / 882
Maximum mooring weight (kg / lbs) (To maintain minimum freeboard)	205 / 452	510 / 1125	840 / 1852	1980 / 4365	2430 / 5357
CONSTRUCTION					
Float	Rotationally moulded UV stabilized virgin polyethylene, MDPE, 11mm thick filled with closed cell polyurethane foam.				
Superstructure	Rotationally moulded twin skin design MDPE, virgin polyethylene 9mm thick.				
Integrated, mooring/lifting steel core	Galvanized steel				
Radar reflector	Echomax				
Colours	As specified per IALA recommendations.				

Note : Specifications subjected to change or variation without notice.

Elastomer Navigation & Marker Buoys

Our navigation and marker buoys are commonly used to replace heavy and cumbersome steel buoys. They are easily lifted on site using smaller maintenance vessels, are highly stable and can be used in shallow water.

Trelleborg Marine Systems produce marker buoys with the whole flotation core manufactured from resilient, closed cell polyethylene foam. The foam is thermolaminated around internal steelwork and encapsulated within a tough, abrasion resistant, polyurethane elastomer skin.

Use of a polyethylene core, rather than conventional polyurethane ensures that even if the skin is punctured the buoy will not sink as it will not absorb water, therefore extending lifespan and reducing maintenance costs. The high impact absorption capacity of this material also makes the buoys self-fendering.

Polyurethane elastomer is self colored and will not attract marine growth. It is durable, flexible and resistant to both abrasion and ultra violet degradation.

In extreme operating conditions the skin can be further strengthened with use of a suitable reinforcement. The buoys can be colour coded to suit "IALA" standards.

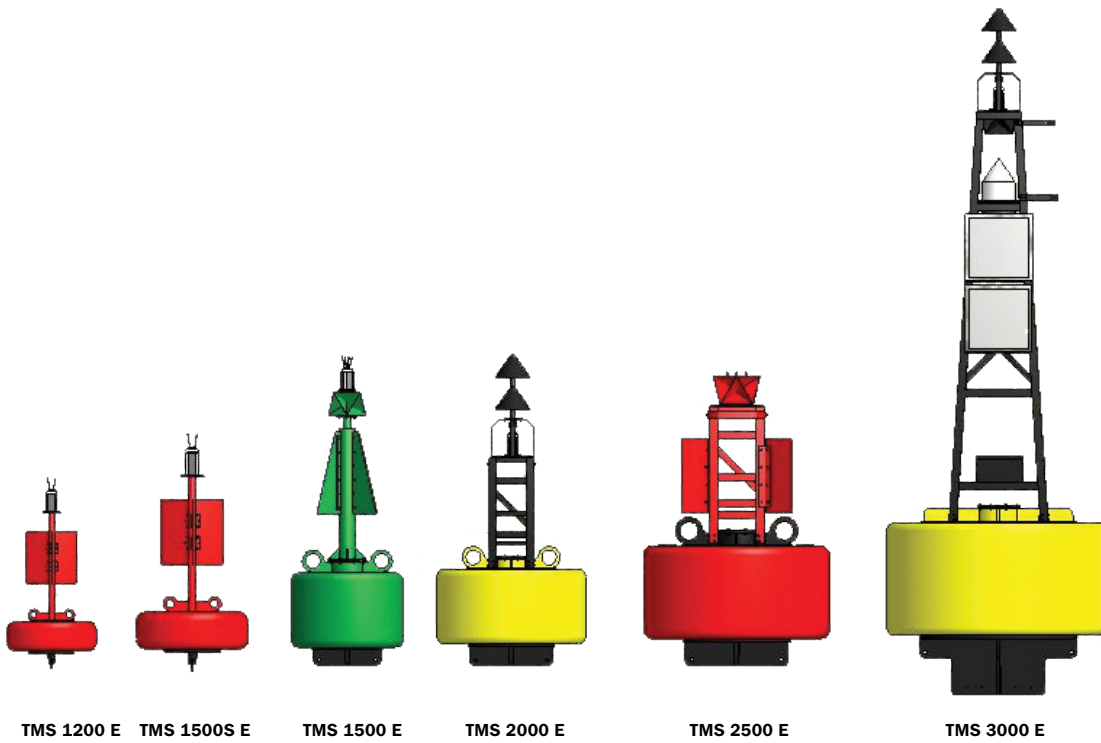
Trelleborg Marine Systems manufacture resilient polyethylene foam buoy bodies in a wide range of diameters and nett buoyancies.

The buoy bodies can be supplied "plain", or fitted with the relevant marker or navigation equipment – e.g. beacons, solar powered or dry cell batteries, radar reflectors etc. A typical range of buoy diameters from 1 to 5 meters are available but Trelleborg will manufacture precisely to client specifications when required.



Marker Buoy complete with Daymark and solar powered beacon.

Elastomer Navigation & Marker Buoys



Specifications

Trelleborg Navigation Buoy Range

	TMS 1200 E	TMS 1500S E	TMS 1500 E	TMS 2000 E	TMS 2500 E	TMS 3000 E
Buoy Diameter	1200mm	1500mm	1500mm	2000mm	2500mm	3000mm
Hull Depth	400mm	500mm	1000mm	1000mm	1500mm	1500mm
Hull Material	Elastomer	Elastomer	Elastomer	Elastomer	Elastomer	Elastomer
Hull Freeboard	200mm	250mm	500mm	500mm	750mm	750mm
Superstructure Material	Steel	Aluminum	Aluminum	Aluminum	Aluminum	Aluminum
Radar Reflector	If Required	If Required	20mtr ² equiv. echo	35mtr ² equiv. echo	35mtr ² equiv. echo	35mtr ² equiv. echo
Focal Height	2.0m	2.5m	3.0m	4.0m	5.0m	6.0m
Lifting Eyes	Single Point Tilt Eye	Single Point Tilt Eye	2 Large eyes for Easy-lift	2 Large eyes for Easy-lift	2 Large eyes for Easy-lift	2 Large eyes for Easy-lift
Mooring Eyes	Single Point	Single Point	4 (2x2)	4 (2x2)	4 (2x2)	4 (2x2)
Ballast	Adjustable Plates	Adjustable Plates	Adjustable Plates	Adjustable Plates	Adjustable Plates	Adjustable Plates
Total Air Weight	158kg	334kg	633kg	1070kg	1871kg	3390kg
Reserve Buoyancy	306kg	572kg	1310kg	2467kg	6000kg	8615kg
Water Depth	Dry-out to 10m	Dry-out to 20m	Dry-out to 30m	Dry-out to 40m	Dry-out to Open Sea	Dry-out to Open Sea

NB: Dimensions and weights are nominal and subject to change according to customer requirements.

Suitcase Anchor Pendant Buoys

Manufactured from resilient, closed cell polyethylene foam, Trelleborg Marine Systems' Suitcase Anchor Pendant Buoys (APBs) are designed to withstand the rigorous conditions associated with the offshore industry.

Designed specifically with large flat surfaces for safe and secure storage on board anchor handling vessels, Trelleborg Marine Systems' APBs have an enviable reputation for quality and performance.

Trelleborg Marine Systems Suitcase Anchor Pendant Buoys are constructed by laminating resilient polyethylene foam around a central steel member with a number of internal load distribution plates, together with large gussets welded in position. This resilient polyethylene core ensures that the buoy is completely self fendering (i.e. soft buoy). The rectangular shape also allows easy and safe storage and transportation.

The whole core is encapsulated within a self colored thick polyurethane elastomer protective coating which is resistant to abrasion and to ultra violet degradation.



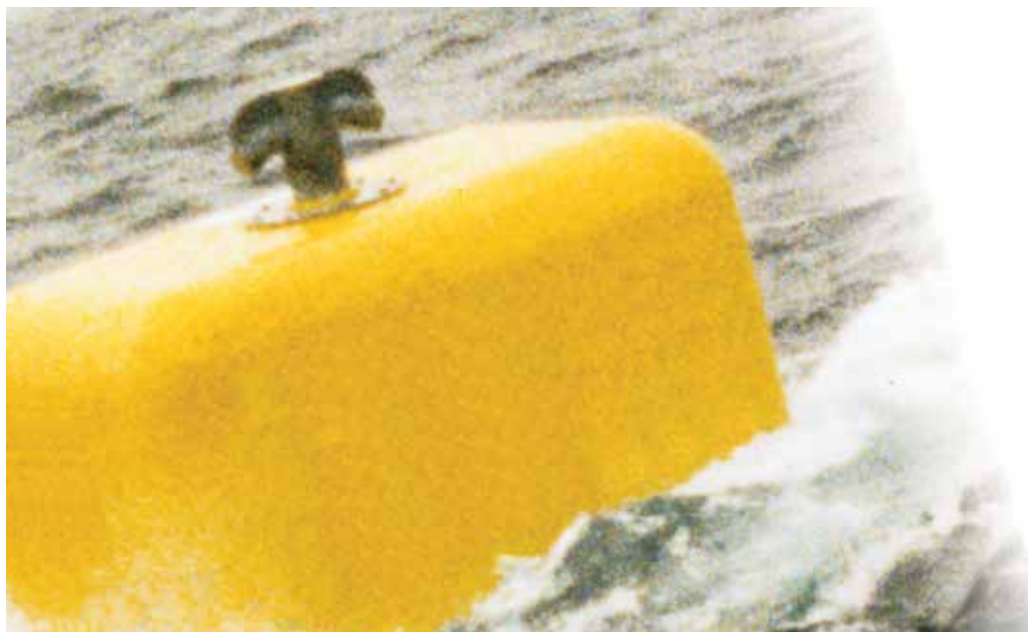
APB complete with solar powered beacon.



Consignment of APBs 'for hire'.



Chain-Through-Buoys and APBs in storage at Shell's yard in Aberdeen.



An 18,000 kg suitcase type Anchor Pendant Buoy on station in the North Sea.

Suitcase Anchor Pendant Buoys

The closed cell structure of the resilient polyethylene foam core means that the buoy will not absorb water, even if the skin is punctured therefore maintaining buoyancy and functionality.

The table below shows a range of standard sizes only, other sizes or specific buoyancy/ dimensions required can be evaluated on

application. A variety of steelwork options, e.g. anchor cross, pad eye, swivels etc. (see diagram) are available.

Standard colors are orange or yellow but other colors are available on request. Further options include internal radar reflectors, reflective tape and navigation lights.

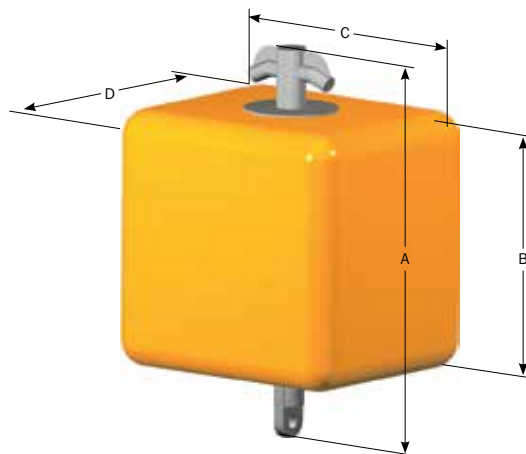
Suitcase Anchor Pendant Buoy Specifications						
Buoy type	Nominal buoyancy (tonne)	Weight in air (kg)	'A' (mm)	'B' (mm)	'C' (mm)	'D' (mm)
APB 2.5	2.5	500	2322	1600	1850	1100
APB 3	3	570	2322	1600	1850	1300
APB 4	4	670	2520	1800	2000	1400
APB 6	6	1448	3350	2200	1990	1740
APB 8	8	1600	3350	2200	2290	1940
APB 10	10	1950	3850	2700	2400	1900
APB 12	12	2100	4080	2900	2400	2100
APB 14	14	2650	4140	2900	3000	2000
APB 16	16	2900	4240	3000	3350	2000
APB 18	18	3250	4670	3450	3350	2000
APB 20	20	3425	5290	3450	3250	2375
APB 30	30	4500	6070	4850	3250	2450

All figures are nominal and may be subject to change.

Options



Anchor Handling Cross



Typical Anchor Pendant Buoy Pad Eye



Chain-Through type, detailing replaceable wear liner

Modular Anchor Pendant Buoys

Trelleborg Marine Systems offers two types of surface modular Anchor Pendant Buoy:

- Standard Modular Anchor Pendant Buoy
- Donut Modular Anchor Pendant Buoy



Standard Modular Buoys

Standard Modular Anchor Pendant Buoy

Standard Modular Anchor Pendant buoys consist of removable, interchangeable modules with discrete end modules and center modules assembled onto central steelwork and fixed in position with retaining flanges, making up buoys ranging from 1Te to 100Te nett buoyancy.

This system allows for the number of center modules to vary according to the nett buoyancy required. By adding or subtracting the center modules, buoys can be redeployed on future projects, making them a viable and cost effective option.

Each module is manufactured from a high performance, low density rigid polyurethane foam core, totally encapsulated within a rigid polymer skin. The polyurethane core is lightweight and closed cell in nature and will not absorb water even if the skin is punctured. The modules are for surface use only and should not be submerged and subjected to hydrostatic pressure.

Nominal skin thickness is 12-14mm and is colored bright yellow. The skin provides protection for the flotation core against impact damage during deployment and recovery from the vessel.

Fabricated from carbon steel to BS EN 10 025, the standard steelwork consists of a central tubular section with an anchor handling cross at one end and a pad eye capable of accepting a shackle at the other.

The steelwork is blast cleaned and coal tar epoxy painted. The buoy is assembled by threading the modules onto the central steelwork. Location spigots placed between adjacent modules ensure alignment and prevent rotation during deployment, and the modules are also keyed to the end flanges to further prevent rotation.

The end flanges are welded into position, should extra modules be required or removed the weld is ground away and the flange removed.



Modular Buoy on location offshore Canada.



Donut Modular Buoys



LB200 pipelay barge deploying Trelleborg Marine Systems Buoys.

Modular Anchor Pendant Buoys

Donut Modular Anchor Pendant Buoy

For over twenty years Donut Modular Anchor Pendant Buoys have been successfully manufactured and supplied by Trelleborg Marine Systems, mainly for pipe laying operations.

They were first introduced in the mid 1980's to replace traditional heavy steel buoys which were outlawed in the North Sea as they posed a danger to fishing and other vessels.

The "donut" modular system typically comprises of 2 or 4 removable and interchangeable modules which rotate around a central steel skeleton or frame. A nett buoyancy range from 4Te to 40Te is achievable.

The buoyancy modules (donuts) are constructed by spiral winding and thermo-laminating polyethylene foam

onto a central steel spool, producing an energy absorbing core which is then encapsulated within a tough polyurethane elastomer protective skin. The resilient core ensures that the buoy is completely self fendering and the buoy is also resistant to abrasion and ultra violet degradation.

Trelleborg Marine Systems Modular Anchor Pendant Buoy systems can be manufactured to suit any specific size or buoyancy requirement.

Although standard production colors are yellow or orange, Trelleborg Marine Systems will manufacture modular buoys in other colors to meet specific customer requirements.

Optional items include internal radar reflectors, reflective tape and navigation lights.



All figures are nominal and may be subject to change.

Mini Modular Buoy			
Nett buoyancy (kg)	No. end modules	No. center modules	Total no.
1,800	2	–	2
3,300	2	1	3
4,800	2	2	4
6,300	2	3	5
End module: L: 1740. W: 1740. H: 600. Center module: L: 1740. W: 1740. H: 675.			
Standard Modular Buoy			
7,000	2	–	2
10,500	2	1	3
14,000	2	2	4
17,500	2	3	5
21,000	2	4	6
End module: L: 2350. W: 2350. H: 1100. Center module: L: 2350. W: 2350. H: 750.			
Mega Modular Buoy			
14,500	2	–	2
21,750	2	1	3
29,000	2	2	4
36,000	2	3	5
43,000	2	4	6
End module: L: 3000. W: 3000. H: 1300. Center module: L: 3000. W: 3000. H: 1000.			



*Typical nett buoyancies are shown although the buoys can be manufactured to suit client requirements.

Donut Modular Buoy		
Nett buoyancy* (kg)	No. of modules	Diameter (meters)
4,000	2	2.0
8,000	2	2.3
11,000	2	2.95
16,500	2	3.17
23,000	2	3.18
30,000	2	3.4

General Surface Support Buoys

Trelleborg Marine Systems's General Surface Support Buoys are manufactured from a polyethylene thermolaminated foam core encapsulated within a self-colored polyurethane outer skin. Used extensively in single point mooring (SPM) systems, the three main types of support buoy are:



Cylindrical Buoy (CB)

- Removable clevis plate/eye.
- Central tension member designed to suit the client's Safe Working Load.



Chain-Through Buoy (CTB)

- Central tube for chain to pass through.
- Chain locking device, on one end or both, securing the buoy to the chain.



Pick-Up Buoy (PU)

Trelleborg Marine Systems general purpose pick-up buoys are used for mooring, marker and pick-up duties.

All General Surface Support Buoys have a flotation core manufactured from resilient closed cell polyethylene foam, thermolaminated around internal steelwork and encapsulated within a tough, abrasion resistant polyurethane elastomers skin. Use of a polyethylene foam core rather than conventional polyurethane foam ensure the buoy will not absorb water even if the skin is punctured, increasing the lifespan of the product and reducing maintenance costs. The resilient material makes the buoys self fendering with a high impact absorption capacity.

The durable and flexible polyurethane elastomer is self colored and does not attract marine growth. It is resistant to both abrasion and ultra violet degradation. For extreme operating conditions the skin can be reinforced to add further strength. Trelleborg Marine Systems's standard range of general surface support buoys is extensive starting with a 90kg marker to 6,000 kg and larger chain support buoys.



Floating Hose Pick-Up Buoys.

General Surface Support Buoys

Specifications

Cylindrical Buoys					
Buoy type	Buoyancy (kg)	Length of body (mm)	Length overall (mm)	Diameter (mm)	Weight in air (kg)
CB 1000	1000	1550	2200	1080	375
CB 1250	1250	1550	2200	1160	380
CB 1500	1500	2000	2666	1130	445
CB 2000	2000	2000	2666	1290	485
CB 2500	2500	2000	2666	1400	515
CB 2900	2900	2000	2666	1510	595
CB 3500	3500	2000	2666	1630	625
CB 3900	3900	2000	2666	1705	650



All figures are nominal and may be subject to change.

Chain-Through Buoys					
Buoy type	Buoyancy (kg)	Length of body (mm)	Length overall (mm)	Diameter (mm)	Weight in air (kg)
CTB 1500	1500	2000	2666	1195	520
CTB 1750	1750	2000	2666	1260	545
CTB 2000	2000	2000	2666	1325	560
CTB 2250	2250	2000	2666	1395	580
CTB 2500	2500	2000	2666	1450	610
CTB 2750	2750	2000	2666	1505	630
CTB 3000	3000	2000	2666	1565	658
CTB 3500	3500	2000	2666	1680	750
CTB 4500	4500	2000	2666	1900	880



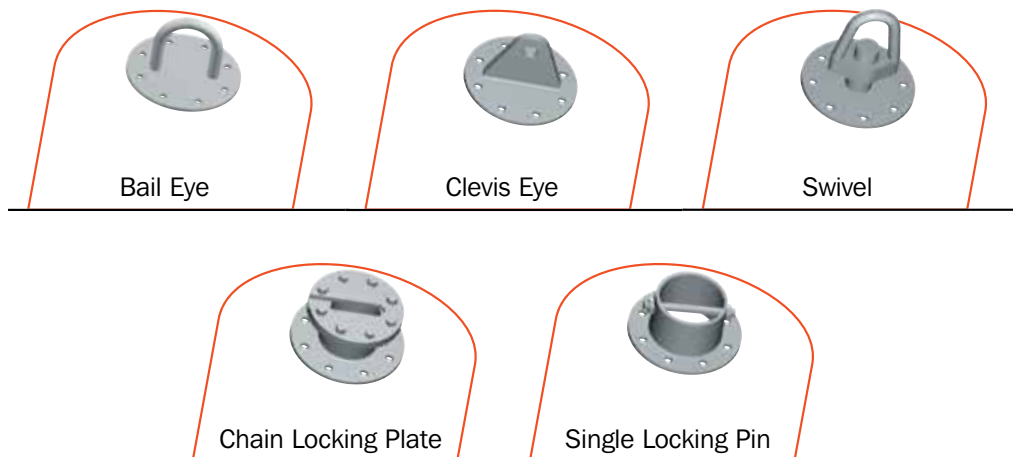
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Pick-Up Buoys						
Buoy type	Buoyancy (kg)	Length of body (mm)	Length overall (mm)	Diameter (mm)	SWL (tonne)	Weight in air (kg)
PU 90	90	665	1000	515	1.2	42
PU 225	225	914	1570	690	16	120
PU 400	400	914	1570	900	16	155
PU 800	800	914	1570	1150	16	180



All figures are nominal and may be subject to change.

Options



Telemark™ Cable Marker Buoys

Market research undertaken by Trelleborg Marine Systems indicated a requirement for cable lay vessels servicing the submarine telecommunications industry to have a flexible, user friendly, low maintenance buoy system.

As there is limited onboard stowage, cable lay vessels need to maximise cable deployment lengths on every trip.

Working with Global Marine Systems Ltd., Trelleborg Marine Systems designed, and now manufacture the Telemark™ modular buoy.

The Telemark™ buoy is typically used as a marker/mooring buoy where the end of the fibre optic cable is attached to the buoy allowing the cable ship to return to shore.

Upon reaching the end of the cable the position is marked and tied and subject to the depth of water the weight of the cable to be supported varies. The modular construction of the Telemark™ modular buoy affords the crew the ability to form a buoy with suitable nett buoyancy.



Preparing Telemark™ buoy for deployment.



Deployed Telemark™ buoy.

The buoy is constructed from thermolaminated, resilient polyethylene closed cell foam encapsulated with a protective layer of polyurethane elastomer around a custom designed steel column.

Buoyancy modules are added or removed from the steel column offering a minimum and maximum nett buoyancy value in the range of 3 – 12Te.

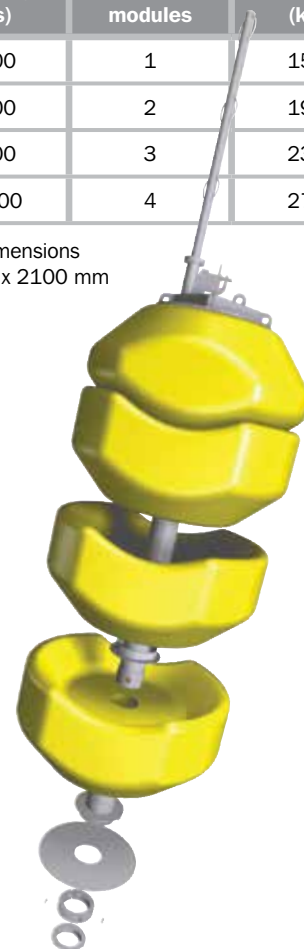
The buoy is manufactured with two flat sides which allow safe on deck stowage and cost effective container transportation.

Cable lay vessels can now save valuable onboard space and operate with a reduced number of buoys – with buoyancy variations available to suit ocean depths or coastal waters.

A range of smaller mini modular 1,800 – 6,300kg nett buoyancy units are also available.

Telemark™ Buoys		
Nett buoyancy (kgs)	No. of modules	Weight in air (kgs)
3,000	1	1514
6,000	2	1916
9,000	3	2318
12,000	4	2720

Module dimensions
2500 mm x 2100 mm



Mooring Buoys

Trelleborg Marine Systems Mooring Buoys are rapidly replacing traditional steel mooring buoys due to their low maintenance, self fendering resilient foam bodies and their ease of handling and repair while offshore.

The same construction method used to produce Trelleborg Marine Systems' floating foam fenders are used to produce Trelleborg Marine Systems' Mooring Buoys.

Resilient closed cell polyethylene foam is thermolaminated around a central tubular steel frame forming a flexible, impact resistant flotation core. The foam core is then coated in a high performance elastomer skin and two flanges are welded in position to secure the foam core firmly in place.

Connecting steelwork, e.g. pad eyes, quick release hooks and anchor handling crosses can be specified to suit client requirements.



Trelleborg CRP Mooring Buoy easy to handle, complete with beacon.

Standard specifications		
Nominal nett buoyancy (kg)	OD (meters)	Height (meters)
5,000	2.5	1.5
10,000	3.3	1.5
15,000	3.5	2.0
20,000	4.0	2.0

All figures are nominal and may be subject to change.



10,000kg Trelleborg Marine Systems Mooring Buoy offshore, Greece.

Chain Through & Chain Tire Net Floating Foam Fenders

Trelleborg Marine Systems chain through and chain tire net floating fenders are specifically designed to withstand the high energy impact occurring during berthing of all vessels and ship to ship transfers in open sea. A chain tire net provides even further energy absorption and protection.



Trelleborg Marine Systems Foam Fenders on location in Portugal.

Floating foam fenders are used in ports and harbours around the world where users range from the largest oil tankers to small passenger ships. Many naval vessels also insist on foam fenders as they are non-marking, cannot deflate and require minimal maintenance.

These fenders provide high energy absorption with a low reaction force – making them superior to similar sized pneumatic fenders.

By eliminating valves, inflation gear and constant pressure checks, Trelleborg CRP floating foam fenders need little or no maintenance.

Trelleborg Marine Systems fenders are constructed from energy absorbing polyethylene foam encapsulated within a resilient polyurethane elastomer. The polyethylene foam is bonded together by a continuous thermo-laminating process, eliminating the use of adhesives which can break down under long and arduous use.



Trelleborg Marine Systems Foam Fenders protecting Allseas BV 'Lorelay' pipelay vessel.

Chain Through & Chain Tire Net Floating Foam Fenders

The reinforced polyurethane elastomer skin is resistant to abrasion, ultra-violet degradation and temperature fluctuations. If the skin of the fender is damaged, the effect on performance is negligible. The closed cell foam interior will not absorb water, therefore the fender will not sink.

The standard colour is orange for high visibility with options for black, grey or other colors available on request. Fenders are available complete with chain tire net or alternatively a flexible central tension member. Mooring assemblies including

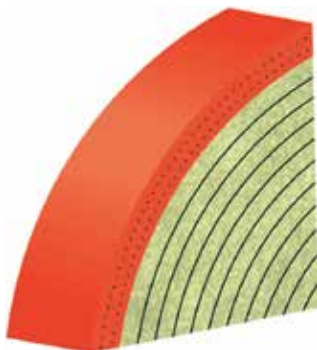
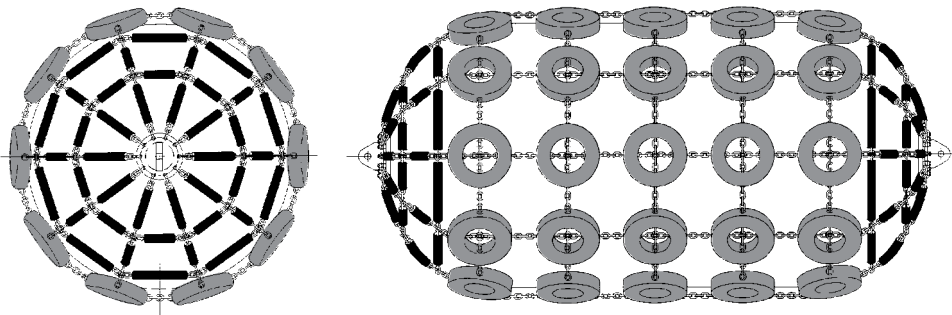
swivels, shackles and chains are available, as is a complete installation service if required.

The extensive range of standard sizes offered is supplemented by Trelleborg Marine Systems design service to produce fenders conforming to precise customer requirements.

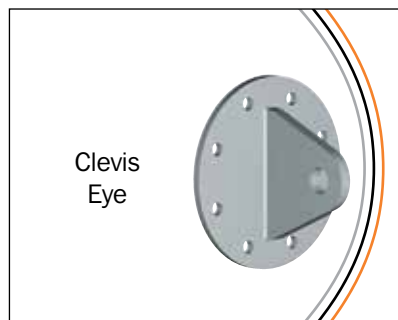
Trelleborg Marine Systems design engineers are pleased to assist in defining the correct specification and quantity to suit any application.

Foam Fender specifications				
Nominal	Actual	60% Deflection		Weight with chain tire net (kg)
Dia. x Length (meters)	Size over chain tire net (meters)	Energy absorption (tonnes)	Reaction force (tonnes)	
1.0 x 1.5	1.35 x 1.9	4.1	19.5	365
1.2 x 2.0	1.6 x 2.5	8.2	32.25	490
1.5 x 2.5	1.9 x 3.0	16	50.5	565
1.5 x 3.0	1.9 x 3.5	20.2	63.5	950
2.0 x 3.0	2.5 x 3.5	33.1	78	1300
2.0 x 4.0	2.5 x 4.5	48.1	113.5	1650
2.5 x 5.5	3.0 x 6.0	93.5	200	3100
3.3 x 6.5	3.9 x 7.0	210	300	6950
3.5 x 8.0	4.1 x 8.5	300	405	9250

All figures are nominal and may be subject to change.



Foam Fender construction.



The standard colour is orange for high visibility with options for black, grey or other colors available on request. Fenders are available complete with chain tire net or alternatively a flexible central tension member. Mooring assemblies including swivels, shackles and chains are available, as is a complete installation service if required.

Small Boat Fendering Systems

Trelleborg Marine Systems originally developed its range of small boat fenders to replace the highly vulnerable pneumatic units used on rigid inflatable boats (RIBs).

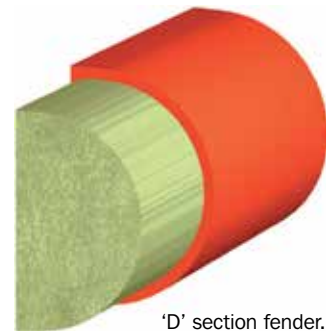
More recently this 'Small Boat' fendering system has been supplied to replace extruded rubber fenders. A major problem in the use of extruded rubber fendering is the resultant heavy topside weight. This problem is compounded when, in a capsized situation, the hollow section fills with water. Trelleborg Marine Systems therefore extended its fendering range to replace the extruded sections, creating a lightweight permanently buoyant alternative which will not absorb water.

Trelleborg Marine Systems small boat fendering systems are manufactured from high energy absorbing resilient closed cell polyethylene foam, encapsulated within a high performance polyurethane elastomer skin. This range represents a lightweight permanently buoyant solution which will not absorb water.

The elastomer skin is often further reinforced with layers of fabric materials for additional performance. The elastomer skin is often further reinforced with layers of fabric materials for additional performance.



Delta 11.4m 'daughter' rescue craft.



'D' section fender.



Delta's 7.4 fast patrol craft incorporating Trelleborg Marine Systems's high performance lightweight Fender Collar.

Small Boat Fendering Systems

This combination of well proven materials means that even in the unlikely event of damage to the skin the fender can neither deflate nor absorb water.

Trelleborg Marine Systems fenders can be fixed to the craft via a variety of methods including gluing, bolting or wire tensioning. The versatility of fixing combined with the range of profile shapes available provides perhaps the widest range of combinations and designs of fendering systems available today.

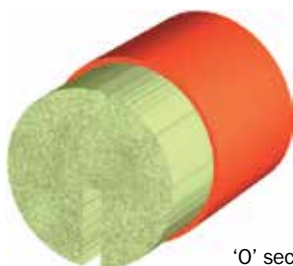
Maintenance is minimal as no regular air checks are necessary. This coupled with their main quality of being puncture proof means a cost effective and safe fendering system. The guarantee of high levels of serviceability means that Trelleborg Marine Systems foam fenders are often chosen for rescue boats, coastguard vessels and assault and support craft as used by the armed forces.



Trelleborg Marine Systems foam fender collar protecting Umoe Schat Harding's R6 fast rescue boat.



RNLi Mersey, Tamar, Trent and Severn class boats all fitted with Trelleborg Marine Systems fenders.



'O' section fender.



Reinforced 'D' section fender.



GKN Westland Hovercraft supplied to the Canadian coastguard.



RTK Marine's 606 Series for military use.

OCIMF Submarine Hose Floats

The introduction of the Fourth Edition of the Oil Companies International Marine Forum (OCIMF 1991) specified the required internal geometry of submarine hose floats. Therefore for the first time floats are fully interchangeable as all hoses constructed to the OCIMF 1991 specification must use standard size collars. Trelleborg Marine Systems manufactures a range of submarine hose floats to comply with this specification. The design incorporates years of experience and has been developed in conjunction with the world's leading hose manufacturers and system operators. The Trelleborg Marine Systems OCIMF float is a significantly improved product offering optimum durability and flexibility.

The floats are manufactured using the most advanced production methods and the highest quality materials. Trelleborg Marine Systems manufactures the floats

from the inside out. The solid foam core is manufactured then encapsulated in a tough resilient outer polyurethane shell producing a significantly superior product.

The range comprises seven different sizes, each to suit the hose size of the hose collars specified in the OCIMF regulations, namely 471mm, 495mm, 581mm, 697mm, 799mm, 876mm and 946mm.

The floats fully comply with all other requirements of the OCIMF specification including hose collar width, securing metalwork specification, markings and hydrostatic pressure testing requirements.

In addition Trelleborg Marine Systems has available a wide range of pre OCIMF 1991 float designs and sizes to suit 6" to 24" bore hoses. Full details are available on request.

Submarine Hose Float specifications					
Float size (mm)	Nett buoyancy of assembled float in seawater (kg)	Total weight of assembled float in air(kg)	K.I.D. (mm)	O.D. (mm)	W (mm)
471	80	56	471	835	450
495	114	67	495	904	500
581	130	80	581	990	500
697	190	92	697	1150	500
799	260	120	799	1250	600
876	281	128	876	1327	600
946	400	185	946	1346	850



All figures are nominal and may be subject to change.

- Suitable for any hose manufactured to OCIMF 1991 standards.
- Low profile to avoid interference with adjacent hose strings, mooring systems etc.
- Fully radiused internal bore to allow maximum hose flexibility (with the exception of the 946 size which has a parallel bore to suit hose end collars).
- Each half float of the same size is fully interchangeable.
- Deep water floats are available on request.
- Hinged design and simple to use tensioning system.

- Facilities for the attachment of ballast weights.
- Excellent appearance.



Dunlop Oil & Marine hose fitted with Trelleborg Marine Systems Submarine Hose Floats.

Floating 'Y' Pieces & Reducers

Trelleborg Marine Systems floating Y pieces are designed to split a single floating/offshore dredging hose into two. Floating Reducers have a conically shaped profile which is designed to reduce the diameter of an off-loading hose.



Trelleborg Marine Systems Submarine Hose Floats being deployed as part of a Single Point Mooring system.

Used in conjunction with OCIMF hoses for off-loading and transfer of oil/fluid from ship to shore, forming an important and integral part of the offshore system.

Both products incorporate standard pipework around which is built a buoyant layer of resilient polyethylene foam. The thickness of the polyethylene foam can be varied to match any specific buoyancy requirement. The layer is then coated with an abrasion resistant tough polyurethane elastomer skin, resistant to marine growth and therefore ideal for long term application.

This field proven design provides a buoyant connection well within the handling capabilities of tanker crews. Buoyant Reducers and Y Pieces can be supplied in almost any size.



Floating 'U' Piece ready for despatch.



Floating 'Y' Piece on location at Conoco's Tetney oil terminal.

Protection and Flotation

Flange Protectors

To obtain the required overall length, sections of oil export hose may be secured together using bolted flanges. However the presence of a flange creates a projection which can snag cables used during mooring and handling operations. This problem can be avoided by fitting Trelleborg Marine Systems flange protectors to the intermediate connections.

They comprise two profiled half shells which fit closely around the flange. The halves are secured together by a set of

metallic fasteners resulting in a smooth and continuous external profile to the oil export hose.

The flange protector body is moulded from tough and resilient polyurethane elastomer.

This material is highly resistant to impact and abrasion and is relatively unaffected by long term exposure to sea water.

The system design life will determine which fastener material is selected. Stainless steel is commonly specified.



Flange Protector on flexible pipe.

The protectors are available in a wide range of sizes to suit ASA 150 and ASA 300 flanges.

2"
3"
6"
8"
10"
12"
16"
20"
24"

Hawser Flotation

Trelleborg Marine Systems manufactures a complete range of floats for umbilicals, ropes, cables, wirelines, pick-up wires and many other applications. Floats are available for single and double hawser applications and can be produced as split-type or tubular.

Hawser and umbilical floats are manufactured from closed cell polyethylene foam, encapsulated within a tough polyurethane elastomer skin.

This high performance outer casing is easily visible, resistant to ultra-violet degradation and will provide protection from abrasion and collision. The properties

of the material are such that they combine strength with flexibility.

Other advantages include quick and easy installation, and as the floats are produced in relatively short lengths, c. 1m, they can be individually replaced whilst additional flotation can be added cost effectively.

Diameter and length can be adjusted to suit any particular range of buoyancy required. Flotation modules can be fixed in a number of different ways and strapping recesses can be manufactured within the float if required. Banding and hire tools are available on request.



Mooring Hawser for Conoco TLP.

Booms

Since the mid 1980's Trelleborg Marine Systems has been involved with the design, manufacture and supply of various styles of floating boom arrangements.

Trelleborg Marine Systems boom floats have been used for the containment of oil, to create exclusion zones at sea (anti terrorist barrage for ships and other naval vessels), in lakes and rivers, to control floating debris and highlight areas of danger in a marine environment.

Safety booms are a robust and well proven method of protecting water intakes, pumping stations, level control sluices, weirs etc. from accidental boat incursions. They also help prevent boats, floating debris, and most importantly, people being carried over weirs or dragged into sluices if they lose power, and secure areas of harbours or basins where traffic is not permitted, and protect swing bridge parapets from drifting vessels.

Trelleborg Marine Systems floating booms are highly visible, can be designed to have the appropriate load carrying capacity and will give long service with minimum maintenance.

The modular construction allows booms to be manufactured to customer requirements and for length and diameter adjustment to suit particular applications. Trelleborg Marine Systems offers a choice of end mooring arrangements including ones which allow the boom to raise and lower to accommodate changing water levels.

The booms are self fendering and boat friendly in the case of a collision. If required the booms can be provided with

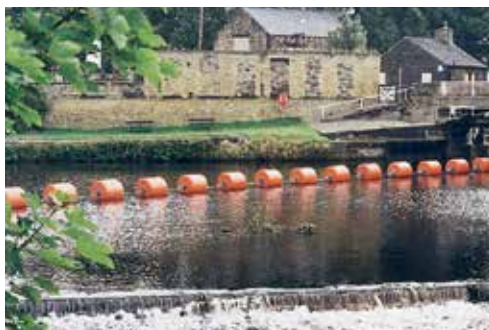
grab handles to offer a temporary haven for any person in difficulty in the water.

All components are designed to ensure installations can be carried out quickly and cost effectively. Trelleborg Marine Systems floating booms are manufactured using a buoyant lightweight foam core protected with an outer skin of abrasion and impact resistant polymer. These carefully chosen materials ensure that the booms are impact and wear resistant, UV stable and cannot absorb water.

As the boom could potentially save lives product reliability is of paramount importance and in the unlikely event of the modules being damaged the closed cell foam core will not fill with water and fail.



Sluice gate boom.



Weir boom.



Canal bridge protection.

Materials

Polyethylene Foam

Polyethylene foams are closed cell, flexible, resilient materials and are used for surface flotation, such as anchor pendant buoys, general surface buoys, rope floats and navigation buoys and fendering applications including floating foam

fenders and small boat fendering systems. These foams are chemically inert and are available in a range of densities from 15kg/m³ to 175kg/m³, in both sheet and roll form and are thermolaminated to produce the required shape.

Property	Value	Method
Density	30-36 kg/m ³	BS 4443
Tensile strength	250 kPa	BS 4443
Elongation at break	70%	BS 4443
Compressive strength (50% compression)	100 kPa	BS 4443
Thermal conductivity	0.040 W/mK	BS 874

This table shows a typical specification only.



Polyethylene foam – resilient and flexible.

Polyurethane Elastomer

Trelleborg Marine Systems uses a range of high performance systems which have been formulated to suit particular applications such as buoy outer skin materials, floating foam fenders, rope floats, hose floats and moulded solid elastomeric flange protectors, amongst others. These materials exhibit high load

bearing capacities along with excellent fatigue and abrasion resistance.

Polyurethanes are ideal coating materials for both surface and subsurface buoyancy. They provide hydrolysis and UV protection in addition to mechanical protection for the buoyancy elements.

Property	Value	Method
Density	1150 kg/m ³	BS 903
Tensile strength	11 MPa	BS 903
Elongation at break	275%	BS 903
Thermal conductivity	0.19 W/mK	BS 874

This table shows a typical specification only.



Polyurethane elastomer – tough and durable.

Materials

Polyurethane Foam

Rigid closed cell polyurethane foams can be formulated to give a wide range of physical properties. They are mainly used for 'rigid' surface products such as OCIMF submarine hose floats, but

specially designed systems can be used in subsea and thermal insulation applications provided they have a totally sealed outer skin.

Property	Value	Method
Density	110 kg/m ³	BS 4370
Tensile strength	1.22 MPa	BS 4370
Compressive strength (50% compression)	1.24 MPa	BS 874
Thermal conductivity	0.024 W/mK	BS 874

This table shows a typical specification only.



Polyurethane foam – rigid and versatile.



Polyurethane encapsulation of OCIMF hose float.

Disclaimer

Trelleborg AB has made every effort to ensure that the technical specifications and product descriptions in this catalogue are correct.

The responsibility or liability for errors and omissions cannot be accepted for any reason whatsoever.

Customers are advised to request a detailed specification and certified drawing prior to construction and manufacture. In the interests of improving the quality and performance of our products and systems, we reserve the right to make specification changes without prior notice. All dimensions, material properties and performance values quoted are subject to normal production and testing tolerances. This catalogue supersedes the information provided in all previous editions. If in doubt, please check with Trelleborg Marine Systems.

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Trelleborg is a world leader in engineered polymer solutions that seal, damp and protect critical applications in demanding environments. Its innovative engineered solutions accelerate performance for customers in a sustainable way. The Trelleborg Group has annual sales of about SEK 21 billion (EUR 2.3 billion, USD 3.2 billion) in over 40 countries. The Group comprises five business areas: Trelleborg Coated Systems, Trelleborg Industrial Solutions, Trelleborg Offshore & Construction, Trelleborg Sealing Solutions and Trelleborg Wheel Systems. In addition, Trelleborg owns 50 percent of TrelleborgVibracoustic, a global leader within antivibration solutions for light and heavy vehicles, with annual sales of approximately SEK 15 billion (EUR 1.7 billion, USD 2.3 billion) in about 20 countries. The Trelleborg share has been listed on the Stock Exchange since 1964 and is listed on NASDAQ OMX Stockholm.

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