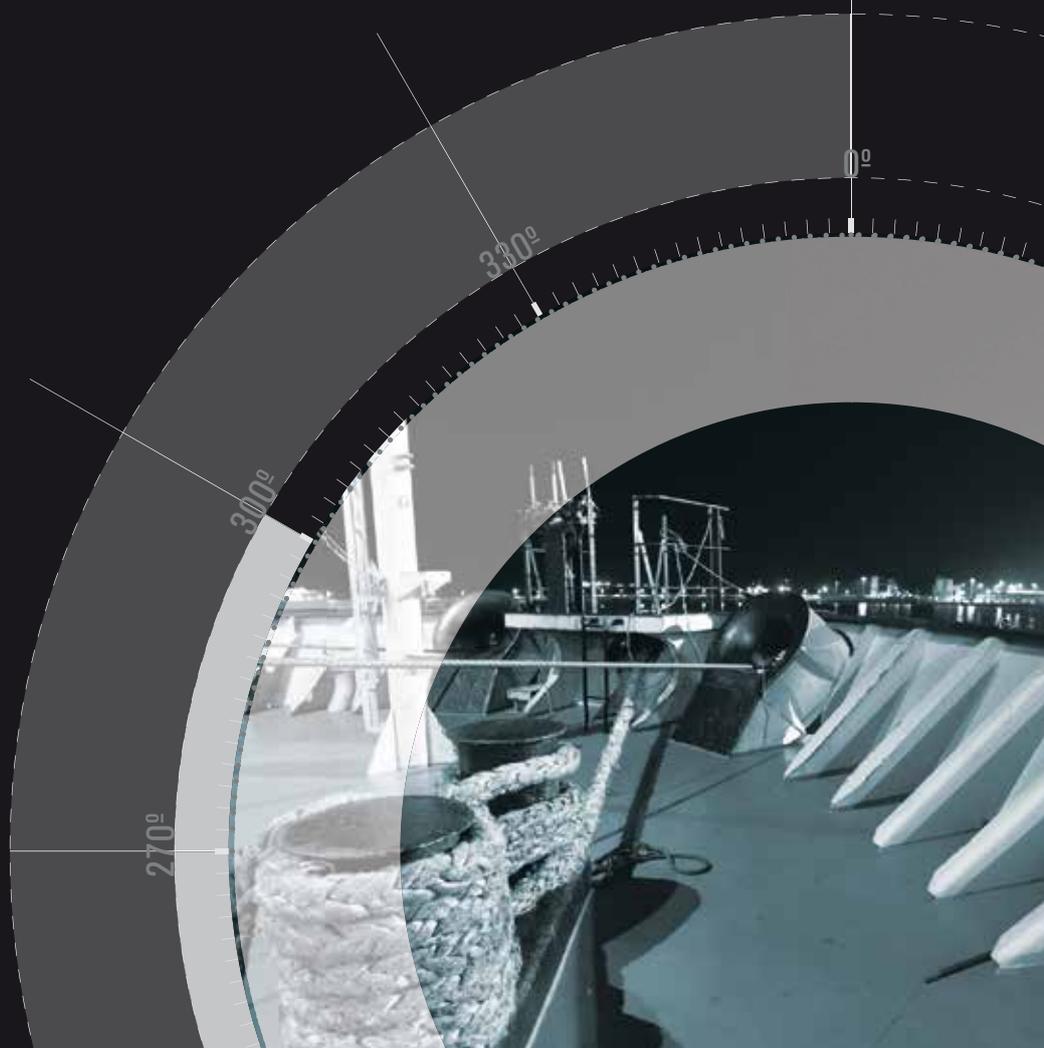


PROTECTION
PERFORMANCE
COMPARISON
BIOTAC MP – PROTECT MORE

CASTROL BIO RANGE
STERN TUBE/THRUSTER/GEAR LUBRICANTS, HYDRAULIC FLUIDS AND GREASE



IT'S MORE THAN JUST OIL. IT'S LIQUID ENGINEERING.



Equipment, personnel and environmental protection through performance excellence

On-board ship, exposed deck equipment is subjected to very harsh operating conditions. The usual rigors of mechanical movement and metal-to-metal contact are combined with adverse environmental factors such as salt water contamination, moisture and sometimes humid atmospheres. Such conditions present a real threat to metal surfaces, whether equipment is working or not in use, and have the potential to impact equipment reliability and safety on-board ship.

Reliable deck equipment is a necessary part of safe and economic operation of the ship and applies to all marine vessels from container ships and ferries to cruise liners and military vessels. Greases and lubricants, that are capable of providing the necessary protection against friction and wear, are an essential part of equipment maintenance for reliability and safety. Additionally, adequate resistance to water and corrosion must be ensured across a wide range of geographical climates.

A further critical issue is human safety. To reduce exposure of personnel to danger in a working environment with many potential hazards, all equipment must be maintained in prime condition and protected from wear and corrosion. Apart from the failures that can result from poor maintenance, unnecessary maintenance activities can lead to higher levels of exposure for deck crew. It is also key for grease and lubricants to be able to withstand deck conditions from the Arctic to the Equator.

In addition, with the exposure of deck equipment to water and the atmosphere, lubricants for on-deck applications are vulnerable to wash-off, with the associated potential for the release of harmful chemicals into the sea. The challenge for both ship operators and lubricant formulators is to maintain equipment performance and reliability whilst ensuring the environmental impact of any lost grease is minimised.

Continuing to meet growing expectations

Development of lubricants that provide improved environmental performance without compromising equipment reliability has been a challenge for Castrol's Technology Teams.

Claims for 'environmentally responsible' products are widely made but can sometimes be misleading. To provide more clarity, Castrol has worked with legislators to develop environmental performance standards appropriate to the marine environment.

Operators need to be assured that the products they select meet acceptable standards in terms of performance. Key performance attributes required for on-deck greases include protecting machinery from wear and salt water corrosion by maintaining a lubricant film, separating metal surfaces under high load, and resisting wash-off by water across a wide range of operating temperatures.

Also desirable for a deck grease is a light colour to facilitate visual checks of both the grease and the machinery condition, which can help to keep equipment maintenance and operating costs at a minimum. Operational safety enhances personnel safety and all factors which reduce the risk of failure and consequent hazard are critical.

Key environmental requirements

In addition to physical performance is the increasing demand for greases that protect the marine environment. Characteristics such as improved biodegradation, reduced bioaccumulation and toxicity and increased renewability are desirable in such products.

Early attempts to introduce lubricants with a lower environmental impact resulted in marine use of products intended for automotive and agricultural equipment, with obvious compromises in performance as a result.

Important purpose designed Castrol products such as Spheerol SX2 and BioTac EP2 have led the way in ensuring high operating standards in recent times; while developing ever improving environmentally acceptable lubricants such as BioTac MP.

Development integrates performance, safety and sustainability

Castrol Spheerol SX2 has long provided a high performing, multi-purpose grease solution for marine vessel operators. More recently, Castrol BioTac EP2 was introduced as a more environmentally sensitive alternative for wire-rope dressing.

The Marine Technology Team has been working to combine the benefits of Spheerol SX2 and BioTac EP2 in a single product that is capable of meeting the demands of today's marine industry for

lubrication performance, mechanical and safety performance and sustainability.

The solution, Castrol BioTac MP, is a multi-purpose, on-deck grease within the Castrol BioRange. Using a multi-purpose product to meet both performance and environmental requirements enables the ship operator to save time and money. With a multi-purpose grease solution, there is less risk of misapplication and training requirements can be reduced. Simplified stocking and less tied up capital are further advantages. At the same time, operators can be confident of enhancing their own environmental profile.

To ensure that BioTac MP effectively covers all the exacting performance and environmental requirements, extensive laboratory testing and on-board trials have been completed.

Performance testing has included a comprehensive range of industry standard bench tests evaluating, among other attributes, water resistance, salt water corrosion protection, low temperature mobility and load carrying capability. Environmental testing has also extended beyond biodegradability to include static sheen formation, toxicity to two different marine species and an assessment of the product's bioaccumulation potential.

In order to understand more fully the advances in lubrication, an extensive summary of BioTac MP and comparison with existing Castrol on-deck products is given overleaf.

The evidence for superior Mechanical and Environmental performance

A comprehensive range of standard tests for BioTac MP, in comparison with Spheerol SX2 and BioTac EP2, shows that BioTac MP equals or out performs these leading products in the key areas.

FEATURE	RELEVANT TEST OR TECHNIQUE	TEST DESCRIPTION	SPHEEROL SX 2*	BIOTAC EP2* (WIRE ROPE COMPARISON ONLY)	BIOTAC MP*	WHAT BIOTAC MP OFFERS
Colour	Visual inspection		Brown	Creamy White	Creamy White	Due to its white colour, BioTac MP stains less than dark greases and better shows contamination, making visual inspection far easier.
Strand formation tendency	Visual inspection		Moderate strand formation	Limited strand formation	Limited strand formation	Limited strand formation helps to minimise the safety risk posed by grease strings on deck, as well as the potential for water pollution caused by grease run-off.
Corrosion Protection	Emcor Test (Synthetic Sea Water), IP 220	The Emcor Corrosion test determines the capability of a grease to protect against rust in standard bearings, with no load, after 168hrs. At the end of this period the outer race of the bearing is examined for corrosion and a rating given between 0 (no corrosion) and 5 (severe corrosion)	0	1	0	BioTac MP is specifically developed for use in marine applications, providing good resistance to the effects of salt water and corrosion.
Low temperature flow properties	Flow Pressure DIN 51805 (deg C)	The Flow Pressure Test determines the pressure required to push an amount of grease through a specific test nozzle at a given temperature. This test gives an indication of the low temperature pumpability properties of the grease. The value gives an indication as to the lowest temperature at which the product may still be mobile.	-20	-35	-35	BioTac MP retains its ease of application and flow at lower temperatures than mineral-based alternatives.
High Base oil Viscosity	Kinematic Viscosity ISO 3104 (cSt)	Kinematic Viscosity determines the resistance to flow of a liquid under gravity. A sample of the base oil, in a glassware, is placed in a fluid bath for 30 minutes at constant temperature. The kinematic viscosity is the product of the measured flow time (for the oil to flow under gravity through the capillary under controlled conditions) and the calibration constant of the viscometer. A higher oil viscosity provides better film strength which can benefit lubricant performance under loaded conditions.	180	105	500	BioTac MP provides a strong oil film to give better protection than a lower viscosity oil at slow speeds and high loads.
Load carrying capability	Four Ball Weld Load DIN 51350-4 (N)	Four Ball Weld Load DIN 51350-4 (N): The Four Ball Test determines the capability of a lubricant to protect metal surfaces from wear under loaded conditions. In this test 3 balls are static and in the same plane and a top ball is pressed onto those three balls. Grease is placed between the 4 balls. The top bearing rotates while increased pressure is applied to the bottom bearings. When the lubricant fails, the balls weld together. The Weld Point is the load at which the test balls weld together.	4000	2400	4000	Good protection of equipment under loaded conditions to minimise wear.

* typical values

FEATURE	RELEVANT TEST OR TECHNIQUE	TEST DESCRIPTION	SPHEEROL SX 2*	BIOTAC EP2* (WIRE ROPE COMPARISON ONLY)	BIOTAC MP*	WHAT BIOTAC MP OFFERS
Bioaccumulation potential	Molecular weights of the components, % non-bioaccumulative	Substances with a molecular weight >700 will not bioaccumulate (according to OSPAR definition) due to steric hindrance (too large to pass through gill or cell membranes).	20	n/a	>70	Castrol BioTac MP contains significantly reduced levels of potentially bioaccumulative components compared to conventional mineral oil based grease. 'Bioaccumulative' describes a component's tendency to accumulate in the fatty tissues of organisms and enter the food chain
Marine toxicity	ISO 14669:1999. (Acartia tonsa).	Toxicity of a substance to North Sea marine copepods (Acartia tonsa). Toxic effect is measured over 48 hours to determine the concentration at which 50% mortality is observed.	<1,000	>1,000	>1,000	BioTac MP has significantly reduced toxicity to marine crustaceans when compared to a conventional mineral oil based grease – this means reduced potential to harm marine life.
	EPA 821-R-02-14 Method 1007, (mg/l). (Mysidopsis bahia).	Toxicity of a substance to Gulf of Mexico marine shrimps (Mysidopsis bahia). Toxic effect is measured over 7 days to determine the no observed effect concentration.	<2,000	>10,000	<7,000	
Marine biodegradability	OECD 306 – Biodegradation in sea water, max %@28day	Substances are added to closed bottles of seawater collected from the coast. Biodegradation over 28 days is measured by analysing dissolved oxygen depletion.	<10%	20-60%	20-60%	BioTac MP has superior marine biodegradation when compared to a conventional mineral oil based grease – this means an increased tendency to be broken down naturally in the sea.
Sheen	EPA Static Sheen Test	Product is added to a container of seawater and an observation made as to whether it produces a sheen (iridescence, gloss, or increased reflectance).	Sheens	No sheen	No sheen	BioTac MP does not sheen. Preferable not to sheen as in constant contact with water i.e. no leak detection capability required.
Renewability	Renewable content (%)	Calculation made of the % of substances derived from renewable sources.	<10	n/a	>55	BioTac MP has enhanced renewability when compared to a conventional mineral oil based grease.

* typical values

Contributing to a sustainability strategy

All users of the sea are encouraged by environmental and regulatory interests to take responsibility for the sustainable use of our precious marine environment.

An important contribution to total marine sustainability, the use of environmentally acceptable lubricants has far reaching benefits. Increasing product biodegradation in the marine environment, while minimising toxicity and bioaccumulation,

is essential in mitigating the longer term consequences of chemical discharges into the sea.

Marine environmental legislation is developing continuously, and use of lubricants is now being subjected to similar pressures as those restricting anti-fouling paints.

Parallel to this is the increasing environmental awareness of freight companies, port operators, governments, travel and tour companies and their

customers, the travelling public. A demonstrable corporate social responsibility policy towards the marine environment is now an important influence in purchasing and contract decisions, and may be subject to keen external scrutiny.

BioTac MP, developed and tested in laboratory, proved at sea

On-deck lubrication and protection are essential, and Castrol recognises that users must have complete confidence in a product's

total performance. Thorough testing against established mechanical standards, and properly monitored and approved environmental testing, should be supported by trialling in actual marine and day-to-day working ship conditions. Developed on this basis, BioTac MP on-deck grease has a central role as part of Castrol's environmentally responsible BioRange of greases and lubricants for deployment throughout a ship; the company is committed to further development of the BioRange.

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