MacDermid Offshore Solutions

Oceanic HW 500 Series
Oceanic HW 500E Series

Subsea Production Control Fluid

General Description

Oceanic HW fluids are water based hydraulic media specifically formulated for use in modern subsea production control systems. Their low viscosity promotes optimum system response, while a sophisticated additive package provides a high degree of protection against wear, corrosion and microbiological degradation. The Oceanic HW fluids have been developed in close consultation with component manufacturers, and are now in worldwide use, helping to achieve maximum production system safety and reliability.

A new addition to the Oceanic HW 500 Series, Oceanic HW 500 "E" Series has excellent environmental characteristics and meets OCNS 2007 Compliance in the North Sea, with no substitution warnings. Oceanic HW 540E is based on similar technology and physical properties as Oceanic HW 540, with an improved environmental profile. Oceanic HW 500 E Series is completely compatible with Oceanic HW 500 Series and can be readily used to 'top up' systems already using Oceanic HW 500 Series.

Salient Features

Low Viscosity Oceanic HW fluids offer extremely low viscosity when compared with mineral oil or synthetic hydrocarbon types. This allows systems to be designed with optimum response, particularly where control is required over long distances, and through small-bore control lines.

High Lubricating Ability Metal-to-metal shear seal control valves encountered in modern sub-sea systems demand excellent lubrication and anti-wear properties. Oceanic HW 500 Series has provided excellent lubrication for 20 years in the sub-sea systems, known widely for its lubricating abilities. Particular care has been taken to maintain, and in fact, improve the lubrication and anti-wear provided by Oceanic HW 540 in the new "E" variation.

The following Falex lubrication test, (an industry recognized lubricant test) demonstrates both reduced torque and enhanced anti-wear characteristics:

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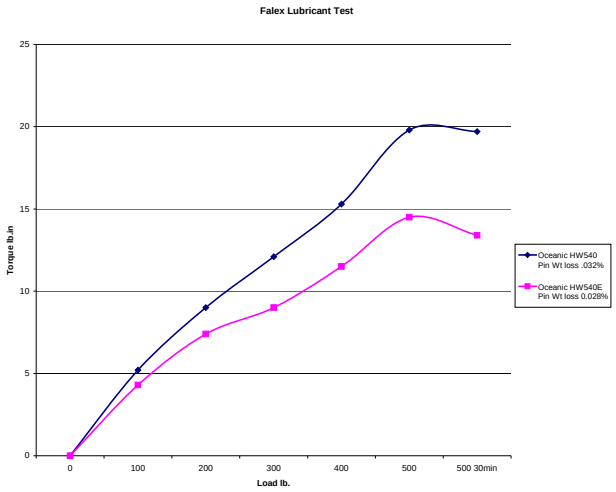
Lubrication Chart Oceanic HW 540 vs. Oceanic HW 540E



Fluids for all Geographical Conditions

By providing a range, rather than a single fluid, MacDermid Offshore Solutions has allowed the choice of the fluid that will give the best response in the environment in which it is to be used. For low temperatures, a high glycol content is required, and here a penalty has to be paid in the form of a slightly higher viscosity due to the heightened glycol level. The correct fluid to use is therefore the one having the correct pour point for the worst ambient conditions to be encountered, while still having the lowest possible viscosity. In general:

- Oceanic HW 525 is most commonly used in the Gulf of Mexico and Brazil (HW 525P with fluorescent dye), where temperatures rarely fall below -10°C (14°F).
- Oceanic HW540 may be used in warm climates if desired or where temperatures range from 0°C to -20°C (32°F to –4°F) (e.g. North Sea & Canada).
- Oceanic HW560 is reserved for those areas where temperatures range from -20°C (-4°F) to as low as -50°C (-58°F) (e.g. Northern Russia, Northern North Sea).

Maximum Operating Temperatures

All Oceanic HW Fluids are rated with a 10°C (18°F) safety margin. Hence, a fluid rated by MacDermid to 90°C (194°F) is capable of 100°C (212°F). Oceanic Fluids will maintain all properties when exposed to maximum operating temperatures for extended periods. Oceanic HW 500 Series is currently rated to a Maximum Operating Temperature of 90°C (194°F). Please contact our Sales or Technical Staff for more details: +1-713-472-5081 (US) or +44-1942-501-000 (UK) or see www.macdermid.com/offshore for additional contacts.

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Corrosion Protection Oceanic HW fluids offer liquid corrosion protection of ferrous metals and other metals commonly used in offshore hydraulic systems. Additional Oceanic products containing vapor-phase corrosion inhibitors are available for storage and transport requirements.

Stability Oceanic HW fluids are extremely resistant to the effects of contamination by seawater and / or microorganisms such as bacteria and fungi, although every effort should be made to avoid these conditions from occurring. The high stability of the additive pack reduces the possibility of flocculation and precipitation taking place, and if a monitoring program is operated, advanced warning of impending problems will allow corrective action to be taken well before the system safety and reliability can be seriously impaired.

Discharge into Marine Environments

Discharge in U.K. Sector of North Sea The Oceanic HW range of subsea production control fluids is included in the U.K. Notification Scheme for the Selection of Chemicals for Use Offshore. Under this scheme, the U.K. Department of Energy has studied the chemical composition and toxicological effects on marine organisms of the Oceanic HW fluids. A customer copy of the HOCNF data or CEFAS template is available on request.

U.K. Class E Oceanic HW 540 and Oceanic HW 540E have been attributed Class E status; hence notification is not required provided that the usage rate does not exceed 1,000 long tons (tones) per annum per installation. Oceanic HW 540E meets the stringent 2007 requirements and has been awarded a Class E, valid until late 2008. Oceanic HW 540 has been awarded Class E until October, 2006.

Gulf of Mexico The Environmental Protection Agency promulgated regulations effective November, 2004. Oceanic HW 500 Series and 500 E Series meet the new requirements and has been approved in both Region 6 and Region 4. A Certificate of Conformance is available to environmental professionals, please consult with our U.S. Technical Staff.

Brazil Oceanic HW 500 Series is acceptable for use in Brazil.

Norway In recent years, Norwegian authorities review sub-sea control fluids on a case-by-case basis. Oceanic Fluids are available for the most environmentally sensitive areas on the planet.

Discharge in Other Waters Oceanic products have been used worldwide, many countries rely on operators to choose Best Management Practice based on US or UK requirements.

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Typical Physical Properties

Oceanic HW	510	525	525 P	540	540 P	540 E	560
Appearance	Blue Liquid	Blue Liquid	Fluorescent Blue Green Liquid	Blue Liquid	Fluorescent Blue Green	Clear Pink Liquid	Blue Liquid
Viscosity (cSt) @ -20°C -4°F 0°C 32°F 20°C 68°F 40°C 104°F	 Solid 3.1 2.3 1.0	 Solid 4.8 2.4 1.5	 Solid 4.8 2.4 1.5	 18 7.6 3.6 2.1	 18 7.6 3.6 2.1	 20 7.1 3.0 2.0	 40 12 6.3 2.9
Pour Point °C (°F)	-4 (25)	-10 (14)	-10 (14)	-25 (-13)	-25 (-13)	-25 (-13)	-50 (-58)
Specific Gravity 15.6°C (60°F)	1.019	1.039	1.039	1.061	1.061	1.055	1.075
pH Value	9.4	9.4	9.4	9.4	9.4	9.3	9.4
Thermal Conductivity $W.m^{-1}.K^{-}$	0.561	0.443	0.443	0.470	0.470	0.470	0.410
Coefficient of Thermal Expansion (volumetric) per °C	0.00040	0.00042	0.00042	0.00047	0.00047	0.00047	0.00051
Specific Heat CapacityJ $kg^{-1}.K^{-1}$	3997	3721	3721	3445	3445	3445	3077

Note: The properties stated in this document are typical for the product, but do not constitute a specification. NAS 1638 Class 6 (as filled into container)

YES WE CAN

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Material Compatibility

Metals Oceanic HW Fluids are compatible with all ferrous and yellow metal alloys from cast iron to 316 stainless steel and including exotic alloys such as the inconel and duplex ranges. Zinc and Cadmium plating may be slightly affected, and should be avoided. (Passivated cadmium plating is acceptable chemically, but porosity may permit moisture absorption and "lifting" of the plate.

Aluminum rubbing contacts must be avoided. Non-rubbing aluminum surfaces are acceptable if hard-anodised. Some coatings may be affected such as Tungsten Carbide but this depends upon the application and binder used. Nickel binders and binders using chrome are usually acceptable except at high temperatures (over 80°C) (over 176°F) please consult MacDermid Sales or Technical Staff if in any doubt.

Elastomers and Plastics Common O – ring materials such as Nitrile, common Fluoroelastomers, Buna N, Buna A, Silicone and Neoprene are all acceptable. Some seal materials such as common Fluoroelastomers can be attacked by the amines in water-based hydraulic fluids at temperatures over 70°C (158°F). For higher temperatures MacDermid Offshore Solutions recommends materials such as Chemraz (particular grades), Peek & HNBR.

Seal materials such as Teflon (P.T.F.E.) are also acceptable, but composites such as common Fluoroelastomers impregnated cotton should be avoided, as they may absorb moisture and swell over extended periods. Polyurethane and Porous gasket materials should be avoided. Thermoplastics as used as linings in umbilical hose bundles are generally acceptable.

Compatibility testing of metals and seals is available; please consult with our Technical Staff.

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Compatibility of Control Fluids Oceanic HW500 Series is designed to be compatible with other Oceanic products, including: Oceanic HW 443, ND & R,
Oceanic HW 640, Oceanic HW 700 Series, Oceanic SW40 and Oceanic EPF.

Filter Elements Some impregnated paper types lose structural strength in contact with aqueous fluids. Recommended filter media are woven polypropylene or glass fibre.

Paints Most paints used in the offshore industry are compatible with Oceanic HW Fluids. The most satisfactory results may be obtained with Nylon, Phenolic or 2 part Epoxy based coatings.

Fluid Cleanliness

To fall into line with the requirements of modern subsea production control system design, MacDermid makes every effort to ensure that the Oceanic HW fluids are supplied in as clean a condition as is possible, minimizing the possibility of scoring of the surfaces of vital seal faces. After manufacture, all Oceanic HW fluids are processed through a 1-micron (absolute) rated filtration medium, before being put into containers. The product is filtered to NAS 1638 Class 6 prior to being filled into new plastic drums. Microscopic analysis of water-based fluids is preferred over automatic particle counters. For all goods dispatched a Certificate of Conformity can be requested documenting this fact.

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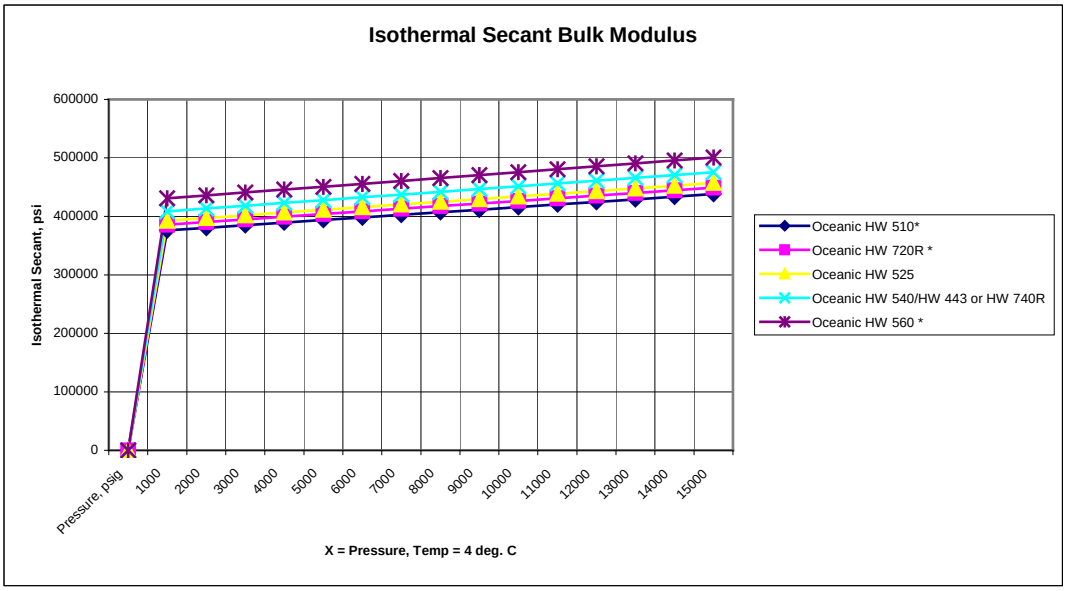
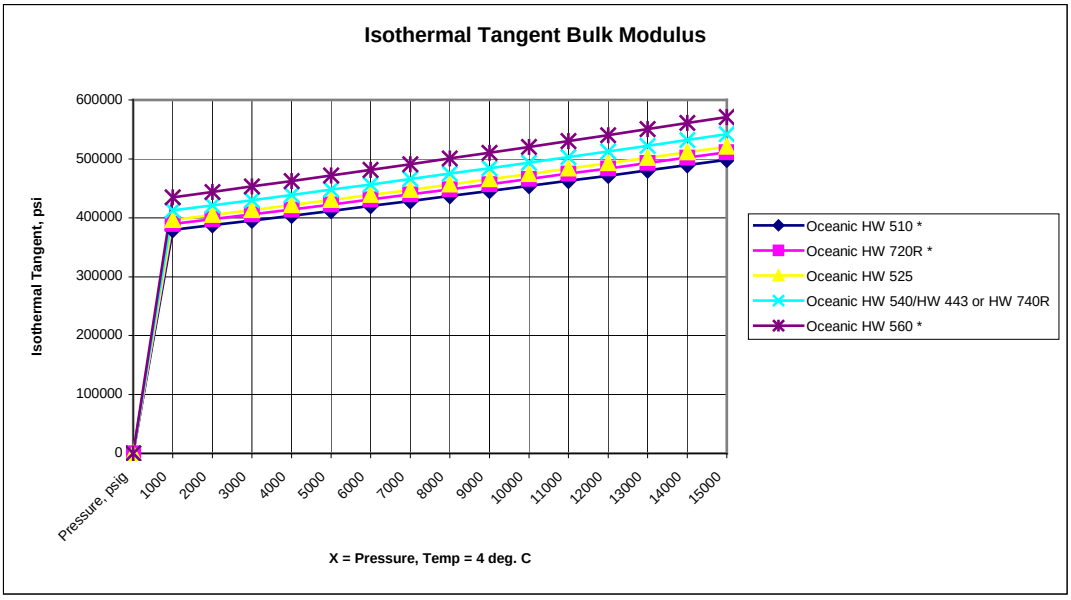

Isothermal Secant Bulk Modulus
Isothermal Secant, psi
600000
500000
400000
300000
200000
100000
0
Pressure, psig
1000
2000
3000
4000
5000
6000
7000
8000
9000
10000
11000
12000
13000
14000
15000
X = Pressure, Temp = 4 deg. C
Oceanic HW 510*
Oceanic HW 720R *
Oceanic HW 525
Oceanic HW 540/HW 443 or HW 740R
Oceanic HW 560 *


Isothermal Tangent Bulk Modulus
Isothermal Tangent, psi
600000
500000
400000
300000
200000
100000
0
Pressure, psig
1000
2000
3000
4000
5000
6000
7000
8000
9000
10000
11000
12000
13000
14000
15000
X = Pressure, Temp = 4 deg. C
Oceanic HW 510 *
Oceanic HW 720R *
Oceanic HW 525
Oceanic HW 540/HW 443 or HW 740R
Oceanic HW 560 *

Oceanic HW 510 & HW525

Bulk Modulus @ 4°C (39°F)

Pressure, psig	HW 510 Isothermal Secant Bulk Modulus, psi	HW 510 Isothermal Tangent Bulk Modulus, psi	HW 525 Isothermal Secant Bulk Modulus, psi	HW 525 Isothermal Tangent Bulk Modulus, psi
1000	376022	379484	392697	396337
2000	380446	387452	397295	404661
3000	384868	395501	401893	413070
4000	389288	403629	406490	421564
5000	393710	411839	411088	430143
6000	398132	420133	415686	438808
7000	402556	428507	420284	447558
8000	406978	436962	424882	456393
9000	411400	445498	429480	465313
10000	415822	454117	434078	474319
11000	420243	462815	438675	483409
12000	424666	471597	443273	492586
13000	429088	480459	447871	501847
14000	433510	489402	452469	511193
15000	437932	498428	457067	520625

Oceanic HW540 & HW 560

Bulk Modulus @ 4°C (39°F)

Pressure, psig	HW 540 Isothermal Secant Bulk Modulus, psi	HW 540 Isothermal Tangent Bulk Modulus, psi	HW 560 Isothermal Secant Bulk Modulus, psi	HW 560 Isothermal Tangent Bulk Modulus, psi
1000	408633	412443	430690	434735
2000	413398	421108	435686	443872
3000	418164	429861	440685	453102
4000	422930	438704	445685	462428
5000	427696	447636	450683	471848
6000	432462	456656	455682	481360
7000	437227	465765	460678	490965
8000	441993	474963	465676	500666
9000	446759	484250	470675	510461
10000	451525	493626	475673	520349
11000	456290	503091	480671	530333
12000	461056	512645	485670	540409
13000	465822	522287	490668	550578
14000	470588	532019	485667	560844
15000	475354	541839	500665	571201

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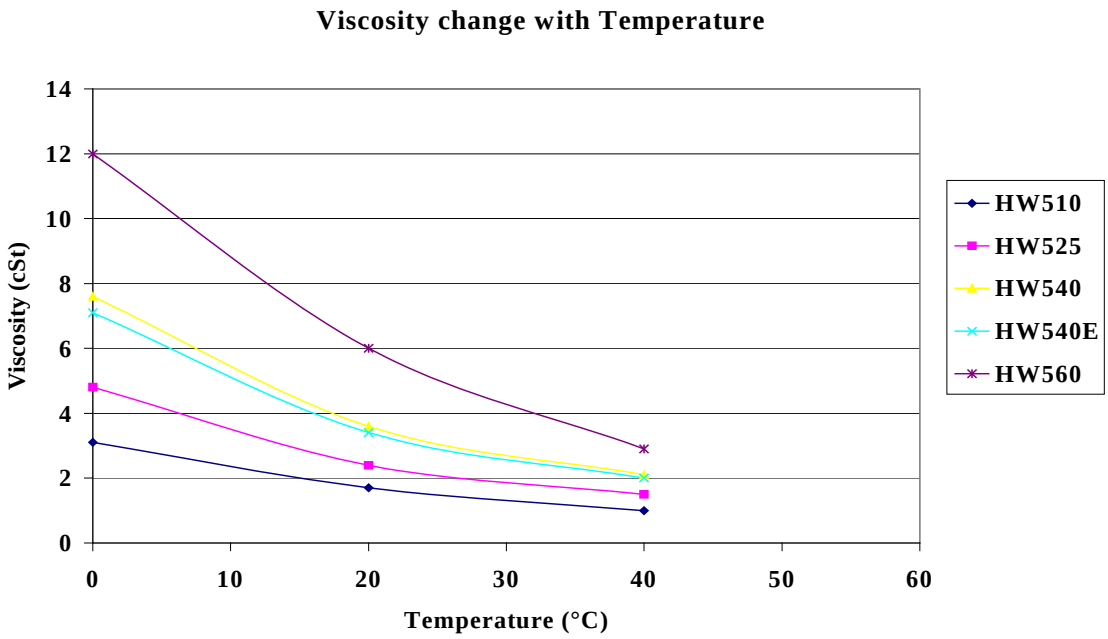
An independent laboratory has determined bulk Modulus results for MacDermid Offshore Solutions. Bulk Modulus results for Oceanic HW540, Oceanic HW443 and Oceanic HW443 ND are very similar, Oceanic HW 510 and Oceanic HW 560 are extrapolated.



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