Subsea Control Fluid

OB200

OIL BASED SUBSEA CONTROL FLUID

TECHNICAL SUMMARY MANUAL

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1.0 PRODUCT OVERVIEW

OB200 Environmental Oil Subsea Control Fluid

OB200 is an 'environmental oil' based Subsea Control Fluid capable of operation at up to 200 °C / 392 °F.

OB200 matches the key characteristics of traditional oil based subsea fluids (such as the Brayco Micronic range) but at a fraction of the cost and with a significantly improved environmental profile boasting a Yellow status (Norway), OCNS Class E with no substitutable components (UK), and is expected to meet GOM toxicity requirements.

OB200 can be used to 'top up' existing systems running on Brayco Micronic fluids and is fully compatible in all proportions.

OB200 has been extensively tested for compatibility and stability with materials and fluids commonly used in subsea systems and we standby to assist with material mapping of individual systems prior to conversion.

Offshore Environmental Oils Ltd (OEO) has been producing subsea fluids for many years and our fluids have been used in 100+ projects around the world.

At OEO, in addition to pushing technical boundaries with our high performance products, we have begun producing cheaper and more environmentally acceptable alternatives to 'older' more traditional mainstream technology. This has spawned OB200 which offers real cost savings to Operators while improving their environmental profile.

In addition to OB200, our new 'value range' includes a range of low cost environmental oil based equivalents to mineral oil and an oil based umbilical storage fluid designed to bring operators large savings during project installation.

OB200 is fully compatible with Brayco Micronic SV/3 (and SV/B) and can be used to replace such fluids in existing systems where a stronger focus on environmental discharge is required.

DOCUMENT REVISION HISTORY

Issue No.	Revision	Issue Date	Authorised by	Position
1	0	January 2018	D. Gleeson	R&D Manager
2	0	February 2018	D. Gleeson	R&D Manager
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Please note that this document is subject to revision on a regular basis. Please ensure you have the latest revision before using this data in applications of a critical nature.

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Certificate No 2906- QMS-001

2.0 PHYSICAL PROPERTIES SUMMARY

Property	OB200	Test Method
Viscosity (cSt)		ASTM D445 IP71 ISO 3104
@ -20 °C	137.8	
@ 5 °C	32.8	
@ 20 °C	17.7	
@ 40 °C	9.0	
@80 °C	3.64	
@ 100 °C	2.70	
@ 140 °C	1.70	
Viscosity Index	149	ASTM D2270
Pour Point	<-40 °C	IP15
Minimum Operating Temperature	-30 °C	
Specific Gravity (g cm^{-3})		
@-25 °C	0.882	IP365
@ 5°C	0.863	
@ 20 °C	0.854	
@ 40 °C	0.829	
@80 °C	0.815	
@ 100 °C	0.803	
@ 175 °C	0.755	
Appearance	Clear, yellow liquid	
Flash Point /°C	>140 °C	ASTM D92 / IP36
Upper Temperature Stability	200 °C	
Cleanliness Level (Minimum)	17/14/12	ISO 4406
	NAS 6	NAS 1638
	6B/6C/6D/6E/6F	SAE AS4059
Shell 4 Ball Mean Wear Scar Diameter	Mean Wear Scar Diameter 0.519 mm	IP239/01 1 hour duration, 1475rpm rotation, 30 kgf load
Weld Load	180 kg	IP239/01 10 s, 1475 rpm
Solubility in Water	Insoluble	
Solubility in Mineral / Crude Oil	Soluble	
Coefficient of Thermal Expansion m^3/m^3 °C	0.00064	
Bulk Modulus N/m^2 ($x10^9$)	1.85	

Note these properties are typical for the product but do not constitute a specification

3.0 PRODUCT TESTING

3.1 THERMAL STABILITY

OB200 has undergone accelerated aging testing based on the procedures laid out in API 17F (4th edition, 2017) and the 8 months results shown below indicate it is considered fit for service at temperatures as high as 200 °C in accordance with API 17F specification. Testing of the fluid after 8 months aging was witnessed by an independent third-party assessor on behalf of an OEM.

Aging Temp / °C	Aging Time	Appearance (relative to unused fluid)	Qualitative description of separation in fluid	Weight of solids recovered (mg/L of fluid)	Specific Gravity @ 20 °C	Lubricity (IP239 Shell 4 ball, 1 h wear test, 30 kg load, 1460 rpm) Mean Wear Scar Diameter	Viscosity @ 40 °C / cSt
None	None	Clear and bright pale yellow fluid	None	<50	0.854	0.519 mm	8.99
210	2 Months	Clear and bright pale yellow fluid	None	31	0.854	0.524 mm	8.87
210	6 months	Clear and bright yellow fluid	None	17	0.854	0.517 mm	9.27
210	8 months	Clear and bright yellow fluid	None	13	0.854	0.505 mm	9.28

Low temperature stability studies have also been undertaken, with OB200 remaining visually unchanged after aging at -30 °C for 6 months.

3.2 COMPATIBILITY WITH BRAYCO MICRONIC SV/3

Extensive compatibility studies have been undertaken with Brayco Micronic SV/3 in accordance with the API 17F specification including: -

- Compatibility at 5, 20, 70 °C.
- % v/v mixing ratios of 90:10, 75:25, 50:50, 25:75 and 10:90 at each temperature.

In all cases, the changes to the appearance, viscosity or pour point of the mixtures of OB200 and Brayco Micronic SV/3 or SV/B after 4 weeks all meet the acceptance criteria of the specification and were confirmed by an independent third-party laboratory.

In addition to the standard 4 weeks testing, the OB200 – Brayco Micronic SV/3 mixture testing above has been extended to 8 months currently based on the API 17F protocol and is currently ongoing. Using the Arrhenius equation acceleration profile (for every 10°C increase the reaction rate doubles), at a test temperature of 70 °C for 8 months, this equates to approximately 700 years at 4 °C.

OB200 – Brayco Micronic SV/3 mixtures have also been tested at 150 °C for 1 month based on the above API 17F criteria to ensure mixed fluid compatibility at higher temperatures. Testing shows the fluids meet the acceptance criteria of the API 17F specification and are continuing.

Please contact us for a full report on the compatibility on OB200 with Brayco Micronic SV/3.

3.3 COMPATIBILITY WITH CONTROL, COMPLETION AND OPERATIONAL FLUIDS

Extensive compatibility studies have been undertaken with a range of commonly used control, completion and operational fluids based on the API 17F specification. Fluids tested for compatibility include: -

- Brayco Micronic SV/3, CLEO, HDEO^{EP}, USF 04.
- Aqualink HT804, Oceanic HW443, Oceanic HW540, Oceanic HW540E, Oceanic HW740R, Pelagic 100, Transaqua HT-2.
- Calcium chloride and bromide, zinc bromide, potassium and caesium formate brines.
- Separator crude oil, 35% Hydrochloric Acid, Methanol, Monoethylene Glycol, Silicon Oil.

Please contact us for the detailed compatibility results for each fluid.

3.4 METAL COMPATIBILITY

OB200 has undergone compatibility testing with a wide range of metals based on API 17F specification and our results after 12 weeks aging at 70 °C show the materials meet the requirements of the test after 12 weeks aging as shown overleaf. The materials listed in the API 17F specification were reviewed by an independent third-party assessor on behalf of an OEM.

Metals compatibility after 12 weeks immersed in OB200 at 70 °C

6% Ni Bonded Tungsten Carbide	Becol (UNS C17200)	Monel Alloy 400
9Cr1Mo Alloy 18-22C	Brass CZ101 (UNS C22000)	Monel Alloy K500
10% Ni Bonded Tungsten Carbide	Brass CZ102 (UNS C23000)	MP35N
17 – 4 – PH	Brass CZ106 (UNS C26000)	Multicore 1.2mm Wire Lead solder, 296 – 301°C Melting Point, 93.5% Lead, 5%
AlCNC10	Brass CZ108 (UNS C27200)	
AISI A29 4340	Brass CZ120 (UNS C37700)	Nibron Special
AISI A350 LF2	Brass (UNS C46400)	Nickel Aluminium Bronze 2.1504
AISI 410	BS 735A50 (Spring Steel)	Nitronic 50
AISI 420	Chrome Core	Phosphor Bronze PB102
AISI 440C	Copper	Silicon Nitride
AISI 515-60 (UNS K02401)	CuAl10Ni	Stainless Steel 304
AISI 51B60H Spring	DGS1043	Stainless Steel 316 Plate, Nut and Bolt
AISI 1040	Duplex 9490	Stainless Steel 316 Galvanic Couple with Carbon Steel Nut and Bolt
AISI 4130	Elgiloy	
AISI 4140	Hidron I30	Stainless Steel 316 Ti
AISI 6150	Inconel 625	Stainless Steel 416
Alloy 450 (UNS S45000)	Inconel 718	Stainless Steel 431
Aluminium 6082-T6	Inconel 725	Super Duplex AM8831
Aluminium Bronze ASTM B418	Inconel 725 GV50H	Titanium
Aluminium Bronze HM9843	Inconel 825	Toughmet 3 AT110 (UNS C72900)
Aluminium Bronze UNS C63000	Inconel 925	Tungum (UNS C69100)
A182 F22 (UNS K21590)	KR16	Umbilical TP19D
A182 F51 (UNS S31803 Super Duplex)	Kvaernar Umbilical	Zirconia
A182 F53 (UNS 32750 Super Duplex)	Magnesium	
A182 F55 (UNS S32760 Super Duplex)	Mild Steel	

Coatings Compatibility after 12 weeks immersed in OB200 at 70 °C

36CrNiMo4 (OEM)	Inconel 725 Silver Coated	Sermagard 1105 + Everslik1201 + Xylan 1400 (CWST)
Electroless Nickel Plated	Molycoat D-7409 (CWST)	
Everslik 1201 (OEM Specification)	Niklad ELV811 Coated A182 F22	Xylan 1014 (CWST)
Everslik 1201 (CWST)	Rislan	Xylan 1052 (CWST)
Everslik 1201 + 1301 (CWST)	Sermagard 1105 (CWST)	Xylan 1400 (CWST)
Everslik 1301 (CWST)	Sermagard 1105 + 1280 (OEM Specification)	Xylan 1424 (CWST)
Inconel 718 Gold Coated		Zinc Phosphate Coated Mild Steel
Inconel 718 Silver Coated	Sermagard 1105 + Everslik 1201 (CWST)	

Bonding Compatibility after 12 weeks immersed in OB200 at 70 °C

Stainless Steel 304 – Araldite 2012	Stainless Steel 304 – Loctite 242	Stainless Steel 304 – Loctite 401

Metals compatibility after 12 weeks immersed in OB200 with 10% Sea Water at 70 °C

6% Ni Bonded Tungsten Carbide	Brass CZ106 (UNS C26000)	Monel Alloy 400
10% Ni Bonded Tungsten Carbide	Brass CZ108 (UNS C27200)	Monel Alloy K500
17 – 4 – PH	Brass CZ120 (UNS C37700)	MP35N
AlCNC10	Brass (UNS C46400)	Nitronic 50
AISI 410	BS 735A50 (Spring Steel)	Nibron Special
AISI 420	Chrome Core	Nickel Aluminium Bronze 2.1504
AISI 440C	Copper	Phosphor Bronze PB102
AISI 515-60 (UNS K02401)	CuAl10Ni	Silicon Nitride
AISI 51B60H Spring	DGS1043	Stainless Steel 304
AISI 4130	Duplex 9490	Stainless Steel 316 Plate, Nut and Bolt
AISI 4140	Elgiloy	Stainless Steel 316 Galvanic Couple with Carbon Steel Nut and Bolt
Alloy 450 (UNS S45000)	Hidron I30	
Aluminium Bronze ASTM B418	Inconel 625	Stainless Steel 316 Ti
Aluminium Bronze HM9843	Inconel 718	Stainless Steel 416
Aluminium Bronze UNS C63000	Inconel 725	Stainless Steel 431
A182 F22 (UNS K21590)	Inconel 725 GV50H	Super Duplex AM8831
A182 F51 (UNS S31803 Super Duplex)	Inconel 825	Titanium
A182 F53 (UNS 32750 Super Duplex)	Inconel 925	Toughmet 3 AT110 (UNS C72900)
A182 F55 (UNS S32760 Super Duplex)	KR16	Tungum (UNS C69100)
Becol (UNS C17200)	Kvaernar Umbilical	Umbilical TP19D
Brass CZ101 (UNS C22000)	Mild Steel	Zirconia
Brass CZ102 (UNS C23000)		

Coatings Compatibility after 12 weeks immersed in OB200 with 10% Sea Water at 70 °C

36CrNiMo4 (OEM)	Inconel 718 Silver Coated	Sermagard 1105 + Everslik 1201 (CWST)
Electroless Nickel Plated	Inconel 725 Silver Coated	Xylan 1014 (CWST)
Everslik 1201 (OEM Specification)	Niklad ELV811 Coated A182 F22	Xylan 1400 (CWST)
Everslik 1201 + 1301 (CWST)	Rislan	Xylan 1424 (CWST)
Everslik 1301 (CWST)	Sermagard 1105 + 1280 (OEM Specification)	Zinc Phosphate Coated Mild Steel
Inconel 718 Gold Coated		

Metal compatibility testing to API 17F also requires testing at 10 °C above the maximum operating temperature to be undertaken with approval after 6 months testing. A summary of the results after aging for 7 or 8 months is tabulated below, showing that neat OB200 has excellent compatibility with 17-4-PH and Stainless Steel 316 with corrosion rates of ≤0.1 µm per annum and corrosion rates ≤1.1 µm per annum in the presence of 10% sea water. Testing of the fluid after 7 or 8 months aging was witnessed by an independent third-party assessor on behalf of an OEM.

Metal Compatibility at Maximum Operating Temperature + 10 °C

Aging time	Metal	Metal Appearance	Appearance of fluid (solids / sludge)	Initial Weight / g	Aged Weight / g	Weight Loss / mg	Corrosion rate (µm per annum)
2 months	17 – 4 – PH (UNS S17400)	Clear and bright	Clear and bright yellow fluid, no solids	100.1940	100.1936	0.4	0.10
				99.9559	99.9557	0.2	0.05
				99.4854	99.4850	0.4	0.10
	Stainless Steel 316	Clear and bright	Clear and bright yellow fluid, no solids	18.6157	18.6156	0.1	0.02
				18.5486	18.5484	0.2	0.04
				18.5696	18.5695	0.1	0.02
8 months	17 – 4 – PH (UNS S17400)	Clear and bright	Clear and bright yellow / orange fluid, no solids	99.7090	99.7090	0.0	0.00
				99.4562	99.4557	0.5	0.03
				99.5360	99.5364	-0.4	-0.02
	Stainless Steel 316	Clear and bright	Clear and bright yellow / orange fluid, no solids	15.1348	15.1344	0.4	0.02
				15.2247	15.2243	0.4	0.02
				15.2365	15.2362	0.3	0.01

Metal Compatibility with 10% Sea Water at Maximum Operating Temperature +10 °C

Aging time	Metal	Metal Appearance	Appearance of fluid (solids / sludge)	Initial Weight / g	Aged Weight / g	Weight Loss / mg	Corrosion rate (µm per annum)
2 months	17 – 4 – PH (UNS S17400)	Slight dulled	Two phases, OB200 clear*, sea water clear, very slight mobile deposits	4.9240	4.9222	1.8	2.59
				4.9108	4.9089	1.9	2.73
				4.9299	4.9282	1.7	2.44
	Stainless Steel 316	Clear and bright	Two phases, OB200 clear*, sea water clear, very slight mobile deposits	18.4932	18.4898	3.4	0.62
				18.5953	18.5915	3.8	0.69
				18.5767	18.5731	3.6	0.66
7 months	17 – 4 – PH (UNS S17400)	Darkened / Black	Two phases, OB200 clear, orange*, sea water clear, colourless	4.9237	4.9214	2.3	0.95
				4.9368	4.9354	1.4	0.58
				4.8889	4.8863	2.6	1.08
	Stainless Steel 316	Darkened / Brown / Black	Two phases, OB200 clear, orange*, sea water clear, colourless	18.6333	18.6293	4.0	0.21
				18.5034	18.4997	3.7	0.20
				18.3472	18.3436	3.6	0.19

* OB200 is clear and bright on removal from the oven; however, it then becomes hazy on cooling due to the fluid being fully saturated with sea water, the fluid then clears upon standing.

3.5 ELASTOMER COMPATIBILITY

The results for OB200 after 3 months aging show good compatibility with a range of elastomers in testing based on the API 17F specification with the elastomers under test tabulated below.

Elastomer compatibility at 70 °C (3 month aged) for OB200

AC 155 (Accuseal)	HNBR H9T20 (Trelleborg)	PEEK 450G (Victrex)
AC 157 (Accuseal)	HNBR KB163 90 Shore A (Parker)	PEEK 1000 (OEM)
AC 173 (Accuseal)	Hytrel 6356 (Du Pont)	PEEK W4685 (Parker)
Acetal (OEM)	Hytrel 7246 (Du Pont)	PEEK W4738 (Parker)
Arlon 1555 (Greene Tweed)	NBR K09G 90 Shore A (Pimseal)	Polyamide-Imide (Solvay)
Carbon Fibre (Carbon Fibre Seal Company)	NBR N107-90 (Parker)	POM (polyoxymethylene) (OEM)
Chemraz 510 (Green Tweed)	NBR N300-90 (Parker)	Polypropylene (Direct Plastics)
Chemraz 600 (Green Tweed)	NBR N552-90 90 Shore A (Parker)	PVC (Direct Plastics)
Ducoflex Hose Grade 350-13-33-06T (Duco)	NBR N674-70 70 Shore A (Parker)	PTFE (OEM)
Epichlorohydrin Bladder (OEM)	NBR N702-90 (Parker)	Torlon 4203 Polyamide-Imide (Solvay)
FFKM PFR06HC 90 Shore A (Solvay)	NBR N756-75 (Parker)	Turcon M12 (Trelleborg)
FFKM PKR95HT 90 Shore A (Solvay)	NBR N1059-90 (Parker)	Turcon T05 (Trelleborg)
FKM FOR 7352 (Solvay)	NBR N4263 (Parker)	Turcon T40 (Trelleborg)
FKM FOR 9381 92 Shore A (Solvay)	NBR N4274 Polypak (Parker)	Turcon T42 (Trelleborg)
FKM P757 92 Shore A (Solvay)	NBR N7023 70 Shore A (Trelleborg)	Turcon T46 (Trelleborg)
FKM P959 93 Shore A (Solvay)	NBR 8021 (Pimseal)	Turcon T51 (Trelleborg)
FKM PL855 91 Shore A (Solvay)	NBR 8095 (Pimseal)	Ultra High Molecular Weight Polyethylene (UHMWPE)
FKM VBR X856 90 Shore A (Clwyd)	NBR 8097 (Pimseal)	
FKM V70GA 70 Shore A (Trelleborg)	NBR 8100 (Pimseal)	Viton 8006 (Pimseal
FKM VPL85540 92 Shore A (Solvay)	NBR N9002 90 Shore A (Trelleborg)	Viton 8096 (Pimseal)
FKM VPL 85730 91 Shore A (Solvay)	NBR70 K6 (GAPI Compounds)	Viton 8101 (Pimseal)
FKM PL958 91 Shore A (Solvay)	NBR Solesele Type G (James Walker)	Viton Extreme 90 Shore A (Clwyd)
FKM V1238-95 95 Shore A (Parker)	NBR Univoil 80 (James Walker)	Viton FR20/70 (James Walker)
Fluoroloy Q9 (Saint Gobain Seals)	Neolastic NBR (Neolastic)	Viton V747-75 (Parker)
GRP Fibreglass (OEM)	Nylon 11 (OEM)	Viton V858-95 (Parker)
HNBR 8026 (Pimseal)	Orkot TXM C338 (Trelleborg)	XLPE Umbilical (OEM)
HNBR N4007 90 Shore A (Parker)	Orkot C380 (Trelleborg)	XNBR 90 (Parker)
HNBR 8097 (Pimseal)	Orkot TLM (Trelleborg)	Zurcon Z80 (Trelleborg)
HNBR H8T30 (Trelleborg)	Orkot TXMM (Trelleborg)	

OB200 has been found to be incompatible with silicone and EPDM materials tested to date, which is typical for oil-based fluids.

High temperature elastomer compatibility testing to API 17F testing also requires 3 months testing at 10 °C above the maximum operating temperature to be undertaken with FFKM 90 (Chemraz 510), PTFE and PEEK. These materials have been tested and all meet the requirements of API 17F after aging for 3 months for a maximum operating temperature of 200 °C

Please note that while testing based on API 17F (Annex C) is considered one of the most robust standard elastomer testing regimes available, this does not qualify elastomers for use at the test temperature and is instead an accelerated test to provide compatibility information at typical storage and operational temperatures. To be more specific, in line with the Arrhenius rate equation, testing for 3 months at 70 °C provides an accelerated compatibility profile covering up to 2 years at 40°C during storage, and 20+ years at seabed temperatures. If materials are to be used at temperatures above 40°C for periods in excess of 2 years, then further testing at elevated temperatures would be recommended to confirm compatibility.

3.6 FLUID LUBRICITY AND WEAR

3.6.1 Shell 4 Ball Test

Lubricity testing using the Shell 4 ball method as described in the API 17F specification have been undertaken by an independent testing laboratory and are outlined below.

3.6.1.a One Hour 4 Ball Wear Test

The results obtained for the one-hour wear tests at 30 kg load at 1475 (+/-25) rpm are shown below in table 2 with the mean wear scar diameters measured for OB200 demonstrating >50% reduction in wear than the acceptance criteria of 1.2 mm.

Lubricant	Scar Diameter Rubbing Direction Ball 1 (mm)	Scar Diameter Right Angle Direction Ball 1 (mm)	Scar Diameter Rubbing Direction Ball 2 (mm)	Scar Diameter Right Angle Direction Ball 2 (mm)	Scar Diameter Rubbing Direction Ball 3 (mm)	Scar Diameter Right Angle Direction Ball 3 (mm)	Average Scar Diameter MWSD (mm)	Comments
OB200	0.5306	0.5102	0.5306	0.5000	0.5306	0.5102	0.519	Wear scar oval

3.6.1.b 4 Ball Weld Point Load

The results obtained for the weld load tests at 1475 (+/-25) rpm. The initial test load showed that OB200 passes the API 17F specification requiring a weld load of >120 kg.

Lubricant	Initial Test Load (kg)	Initial Seizure Load (kg)	Weld Point Load (kg)	Duration of Load steps (sec)	RPM	Comments
OB200	10	80	180	10	1475	

3.7 OEM VALVE QUALIFICATION STATUS

The table below summarises the OEM valve qualification status for OB200.

Manufacturer	Valve	Test Summary
Aker	LP Selector DCV (Pilot 380 Bar, Supply 569 Bar)	25,000 cycles functionality test - passed No fluid leakage when energised & deenergised. Drop out pressure, interflow latch in and drop outs within specification throughout test - passed Post testing visual assessment by OEM - passed
Aker	Choke Valve (Pilot and Supply Pressure 379/379 Bar)	1,000,000 cycles. No fluid leakage when energised & deenergised. Drop out pressure, interflow latch in and drop outs within specification throughout test - passed
Aker	HP Selector DCV 380 Bar pilot & 1034 Supply pressure	25,000 cycles functionality test - passed No fluid leakage when energised & deenergised. Drop out pressure, interflow latch in and drop outs within specification throughout test – passed Post testing visual assessment by OEM - passed
Bifold	690 Bar Mono-stable FPS10/S3(M16PR)/M2/32/NC/N/3-24D/90S/FLA/PT(BLK)	25,000 cycles functionality test - passed No fluid leakage when energised & deenergised. De-latch pressure, max and min WP leakage & max and min pressure response to minimum voltage within specification throughout test - passed Post testing visual assessment by OEM - passed
Webster	DCV (ex Toni Field) (Pilot & Supply pressure 345 Bar)	5000 cycles functionality test to SFS TP5196. Checks to include leakage, interflow, latch in and drop outs.

In addition to the above, DCV testing to simulate the conversion of a system from Brayco Micronic SV/3 to OB200 by testing sequential mixtures of Brayco and OB200 has been undertaken successfully using an Aker LP Selector DCV valve (Pilot & Supply pressure 379 Bar). Specifically, a 25,000 cycles functionality test was undertaken with the following fluid mixtures: -

Cycles	% v/v Brayco Micronic SV/3	% v/v OB200
0 – 5,000	100	0
5,000 – 10,000	75	25
10,000 – 15,000	50	50
15,000 – 20,000	25	75
20,000 – 25,000	0	100

The mixed fluid samples successfully completed the 25,000-cycle test program well within the operational requirements of the valve manufacturer.

Please contact us for a full report on the DCV testing summarised above.

3.8 SEA WATER CONTAMINATION

Static testing

Static compatibilities of OB200 with 5 and 10% sea water in accordance with API 17F have been undertaken across a range of temperatures. OB200 shows only a slight haze in the oil phase when cooling from 70 °C.

Dynamic testing.

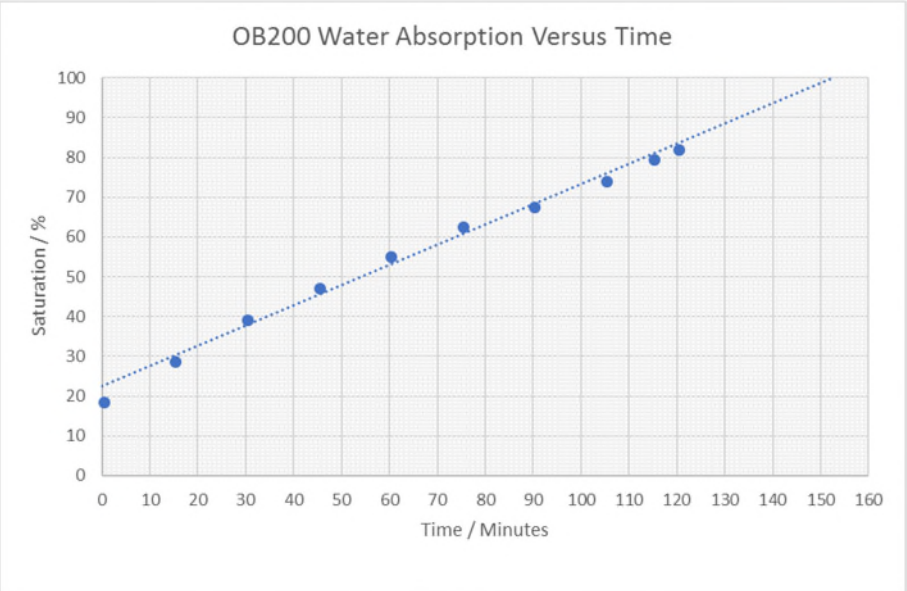
Dynamic compatibility testing has been undertaken in accordance with API 17F at 5 °C, with OB200 meeting the acceptance criteria when tested. The full results are available on request.

3.9 WATER ABSORPTION VERSUS TIME

The water absorption properties at 20 °C were determined by adding 20% w/w Artificial Sea Water to the fluid with continual gentle stirring such that the interface was not broken, and no vortex is formed and the saturation monitored at 15 minute intervals until 80% saturation is achieved.

The results are given below with OB200 reaching 80% saturation after 115 minutes.

Time / Minutes	% Saturation
0	19.0
15	29.2
30	39.5
45	47.5
60	55.5
75	62.9
90	67.9
105	74.4
115	80.0
120	82.4

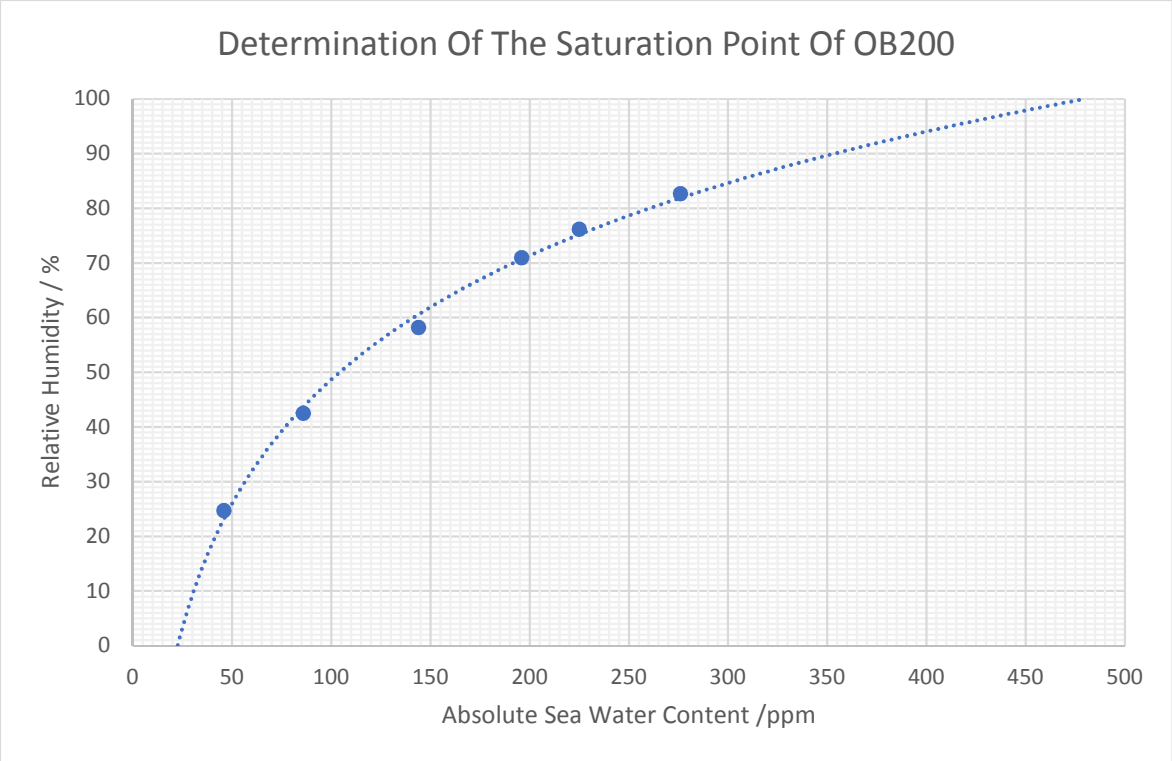


3.10 DETERMINATION OF SATURATION POINT

The saturation point of OB200 was also determined by dissolving known quantities of artificial sea water to a known quantity of OB200 (200.4 g) and measuring the absolute water content and saturation point.

The results are tabulated and plotted below and overleaf, with the saturation point for OB200 determined as 480 ppm artificial sea water.

Total Quantity of Water Added (g)	Absolute Water Content / ppm	Relative Humidity %
0	46	24.7
0.014	86	42.5
0.028	144	58.2
0.0425	196	71
0.0531	225	76.2
0.0637	276	82.7



3.11 DEWATERING CAPABILITY OF SYNTHETIC FLUID.

The purpose of this test is to verify that the moisture absorption process is reversible.

Water content (ppmw) and % saturation is measured by suitable methods; the testing was carried out using a Pall HPN021 oil drying unit, with a fluid flow rate of 21 L min-1 and a typical vacuum of 0.7 Bar. The moisture level equivalent to 80% saturation of OB200 was determined as 480 ppm water, with 30% saturation equivalent to 57 ppm water. The fluid was run through the drying equipment at 20 °C (±5 °C), and samples taken periodically for % saturation, using the moisture sensor and water content (ppmw). Testing was undertaken in triplicate with all three runs showing that OB200 comfortably meets the acceptance criteria laid out in API 17F as the water content is reduced from >80% saturation to <30% saturation within the 35 cycle limit.

3.12 FILTERABILITY.

300 ml (18.3 in^3) of control fluid is filtered under specified conditions through a 0.8 µm filter membrane at a controlled pressure drop of 0.05 MPa (7.25 psi). Filterability is calculated from the ratio of filtration near the start of filtration, to the filtration rate at specified higher filtered volume.

The results for OB200 are tabulated below and show that both the dry and wet oil exceed the requirements required in API 17F. Indeed, both the wet and dry oil give filterability results > 80%.

Fluid	Test 1	Test 2	Test 3	Average Filterability	API 17F
OB200 (dry)	98.1%	99.6%	99.7%	99.1%	Pass
OB200 (wet) + 0.5% Sea Water	94.0%	94.4%	93.5%	94.0%	Pass

3.13 THERMOPLASTIC COMPATIBILITY

The pressure cycling test for thermoplastics with a commonly used umbilical hose liner material is required to be tested in accordance with the API 17E (5th Edition). Samples are exposed in the fluid for three months at 70 °C (158 °F) or one year at 40 °C (104 °F), according to the API 17E test procedure.

Testing was undertaken independently by Subsea Fluid Services Ltd with OB200 meeting all requirements of the test.

A Kutting Nylon 11 DWP 345 Bar hose was tested for 3 months at 70 °C and gave a 3% change in the breaking load and -0.4% change in the elongation at break which is well within the permitted maximum change of +/- 50%.

SEM analysis showed the aged hose looked very similar to control samples, with no cracking or blistering present meeting the acceptance criteria.

No hoses burst during the aging period.

The service life of the hose was also calculated, giving 2022 years at 0 °C and 809 years at 10 °C.

The full, detailed report for this testing is available on request.

4.0 SOME MATERIALS TO AVOID

Listed below are several materials that have the potential to be incompatible with non aqueous hydraulic fluids in general: -

- Ethylene Propylene Rubber (EPR / EPDM).
- Silicone.
- Porous seal materials and gaskets (e.g. paper or cork).
- Impregnated paper type Filter Elements.
- Paint coatings -samples should be submitted for further test.

Please contact us if you require more specific information on any of these materials.

5.0 FLUID CLEANLINESS

OB200 is filtered to below AS4059 Class 6 B-F (equivalent to NAS 1638 Class 6) during manufacture and great care is taken during filling to ensure minimum particulate contamination.

6.0 PACKAGING OPTIONS

OB200 is available for purchase in the following pack sizes: -

- 208 Litre L-Ring plastic drums.
- 1,000 Litre IBC containers (palletised).
- Various Bulk Supply Options.