

Safety, health and environmental aspects of Escaid™ fluids for drilling applications

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Escaid™ fluids deliver advantages for onshore and offshore drilling fluid applications. They enhance the safety, health and environmental properties of non-aqueous drilling fluids (NADFs) by providing low total aromatic content and low polycyclic aromatic hydrocarbon (PAH) content, with a range of flash points. Escaid fluids¹ meet the requirements for the Oil and Gas Producers Association (OGP) Group III category, the highest base fluid classification².

Safety and health effects

Escaid fluids have flash points higher than those of traditional diesel base fluids. Higher flash points feature lower exposure to vapor and improved safety in high temperature drilling conditions. The Escaid fluids portfolio offers a range of flash points and volatilities to meet the specific needs of your drilling operation.

Providing better industrial hygiene and the safest possible working conditions are important for today's drillers.

Escaid™ fluids:

- have low subchronic adverse effects
- have low order of acute toxicity by the oral, dermal and inhalation routes of exposure
- are not labelled as potential carcinogens, and are not expected to be skin sensitizers in humans
- are not mutagenic using in vitro or in vivo genotoxicity assays
- improves worker safety versus group I or II² base fluids due to lower aromatic contents

Working with fluids implies potential exposure to evaporative emissions. To help you assess acceptable exposure, base fluids are assigned a specific Occupational Exposure Limit (OEL). The OEL is listed on each product's Safety Data Sheet (SDS).

The OEL is defined as the maximum airborne concentration of a substance that does not create an unreasonable safety risk for workers being exposed 8 hours/day, 5 days/week. They are expressed in units of mg material per cubic meter of air. Other human health attributes for Escaid fluids, and the vapor OELs for Escaid fluids and diesel are shown in the tables.

Escaid fluids – human health effects	
Acute oral	LOW LD ₅₀ > 5 g/kg
Acute inhalation	LOW LC ₅₀ > Saturated vapor concentration
Skin irritation	MILD
Sensory irritation	NON-IRRITANT Alarie assay ³
Genotoxicity	NEGATIVE Ames ^{4,5} , In vitro chromosome aberration ⁵ , In vivo chromosome aberration ⁴
Subchronic	LOW NOAEL = 1000 mg/kg/day (13-week oral) NOAEL = 5220 mg/m ³ (12-week inhalation) ³
Carcinogenicity	NOT EXPECTED TO BE CARCINOGENIC Based on negative genotoxicity data and low subchronic toxicity

Example of ExxonMobil OEL values	
OEL – Escaid fluids	1200 mg/m ³ *
OEL – Diesel	200 mg/m ³ **

*Source: ExxonMobil recommended OEL - RCP - TWA

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Environmental effects

- Readily biodegradable (OECD 301F – freshwater)
- Potential for ultimate biodegradation in marine environments (OECD 306 – seawater)
- Octanol / water partition coefficient LogKow > 6.5 (OECD 117)
- Low environmental toxicity
- Low total aromatic and PAH contents
- Escaid 110, 115, 120 and 120 ULA fluids fulfill the requirements for “synthetic fluid” defined by OSPAR^a

Escaid™ fluids have low acute toxicity effects on marine or fresh water species. Because of the low water solubilities of these products, and the expected partitioning of residues to air, chronic exposure of aquatic organisms in the water column to residues of Escaid fluids is unlikely. As a result, long-term adverse effects to aquatic organisms are not expected under single (e.g., accidental release) or intermittent release conditions.

Due to their low toxicity, Escaid fluids are not classified for the environment under the European Union Classification Labelling and Packaging of Substances and Mixtures (CLP) or the Globally Harmonized System of Classification and Labeling of Chemicals (GHS).

In addition, Escaid fluids are readily biodegradable per OECD 301F (freshwater) test methodology, which is accepted in global chemical regulatory programs such as GHS classification and REACH. Escaid fluids also showed >60% biodegradation based on ThOD per OECD 306 (seawater) test methodology, indicating the potential for ultimate biodegradation in the marine environment. It is generally accepted that if a substance degrades in one media, e.g., freshwater or seawater, it will degrade in other media, e.g., soil, under most environmental conditions. Some example ecotoxicity and biodegradation data for Escaid fluids are presented in the tables below.



^aOSPAR Convention for the protection of the marine environment of the northeast Atlantic; Annex 18 Ref 7.8a, OSPAR Decision 2000/3.

ExxonMobil Chemical Fluids				
Ecotoxicity	Escaid 110	Escaid 115	Escaid 120	Escaid 120 ULA
Fish				
Oncorhynchus mykiss	96-hr LL ₀ = 10,000 ppm	96-hr LL ₀ = 10,000 ppm ⁶	96-hr LL ₀ = 10,000 ppm	96-hr LL ₀ = 10,000 ppm ⁷
Pimephales promelas	96-hr LL ₀ = 750 mg/l	96-hr LL ₀ = 750 mg/l ⁶	96-hr LL ₀ = 1000 ppm	96-hr LL ₀ = 1000 mg/l ⁷
Cyprinodon variegatus	96-hr LL ₅₀ = 8958 mg/l	96-hr LL ₅₀ = 8958 mg/l ⁶	96-hr LL ₅₀ = 8958 mg/l ⁶	96-hr LL ₅₀ = 8958 mg/l ⁶
Scophthalmus maximus			96-hr LL ₀ = 10,000 ppm	96-hr LL ₀ = 10,000 ppm ⁷
Invertebrates				
Chaetogammarus marinus	96-hr LL ₀ = 10,000 ppm	96-hr LL ₀ = 10,000 ppm ⁶	96-hr LL ₀ = 10,000 ppm	96-hr LL ₀ = 10,000 ppm ⁷
Mysidopsis bahia	96-hr LL ₀ = 80,000 ppm	96-hr LL ₀ = 80,000 ppm ⁶	96-hr LL ₀ = 80,000 ppm ⁶	96-hr LL ₀ = 80,000 ppm ⁶
Tisbe battagliai			48-hr LL ₀ = 10,000 ppm	48-hr LL ₀ = 10,000 ppm ⁷
Algae				
Skeletonema costatum	72-hr NOEC = 10,000 mg/l	72-hr NOEC = 10,000 mg/l ⁶	72-hr NOEC = 10,000 mg/l	72-hr NOEC = 10,000 mg/l ⁷
Sediment re-worker (Invertebrate)				
Corophium volutator	10-d LC ₅₀ = 1432 mg/kg		10-d LC ₅₀ = 493 mg/kg	

hr = hours, d = days

Environmental Fate	Escaid 110	Escaid 115	Escaid 120	Escaid 120 ULA
Aerobic biodegradation (freshwater)				
OECD 301F	64% in 28-d	68% in 28-d ⁷	68% in 28-d	63% in 28-d
Aerobic biodegradation (seawater)				
OECD 306	67% in 28-d ¹¹	64% in 28-d ⁸	64% in 28-d ⁸	64% in 28-d ¹¹
Environmental partitioning				
Octanol/water partition coefficient, LogKow (OECD 117)	> 6.5	> 6.5 ⁸	> 6.5 ⁸	> 6.5

hr = hours, d = days

Polycyclic aromatic hydrocarbon (PAH) content

The U.S. EPA regulates the PAH⁹ content of base fluids because PAHs are comprised of priority pollutants¹⁰. Escaid™ fluids have PAH content of less than 0.001 wt% (10 ppm), achieving “enhanced mineral oil” (EMO) status.

Non-Aqueous Fluid	Base Fluid Type	OGP Grouping ²	% PAH Content ¹⁰
Oil-based muds	Diesel	Group I	3-10 vol%
Low toxicity mineral oil-based muds	Various	Group II	< 0.35 and > 0.001 wt%
Enhanced mineral oil-based muds	Escaid 110 fluid Escaid 115 fluid Escaid 120 fluid Escaid 120 ULA fluid	Group III	< 0.001 wt%
Synthetic-based muds	IOs, LAOs, PAOs, synthetic paraffins, esters, ethers, acetals	Group III	< 0.001 wt%

References:

- Escaid fluids represent Escaid 110, 115, 120 and 120 ULA fluids produced in Baytown, Antwerp and Singapore
- “Environmental aspects of the use and disposal of non aqueous drilling fluids associated with offshore oil & gas operations,” International Association of Oil & Gas Producers, Report No. 342, May 2003
- Based on readacross from C9-13 mixed alkanes
- Based on readacross from C10-13 mixed alkanes
- Based on readacross from C13-16 mixed alkanes
- Based on readacross from Escaid 110
- Based on readacross from Escaid 120
- Based on readacross from Escaid 120 ULA
- PAH content expressed as phenanthrene by US EPA Method 1654A, “PAH Content of Oil by High Performance Liquid Chromatography with a UV Detector”
- U.S. EPA 40 CFR Parts 9 and 435, Federal Register Vol. 66, No. 14, January 22, 2001, pages 6864, 6866, and 6896
- Emulsifier used



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F0415-687E96

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