



EXOFOS SERIES

EXTREME PRESSURE (EP) ADDITIVES FOR
LUBRICATING OILS AND METALWORKING FLUIDS

KEY BENEFITS

- Excellent Extreme-Pressure (EP) properties
- Enhancing lubricity
- Corrosion control
- Good temperature resistance
- Compatible with a wide range of base oils
- Compatible with other additives
- Ashless

GENERAL INFO & USES

EXOFOS SERIES – acidic phosphate esters. EXOfos products are very useful additives for lubricants due to their excellent extreme pressure (EP) properties, but they are also very effective emulsifiers for water-soluble metalworking fluids, corrosion inhibitors and wetting agents. Phosphate-esters are versatile products, used in many different applications such as metalworking and metal cleaning, architectural finishes, textile wetting, and hard surface detergency. EXOfos products are manufactured with inherent mono- and diester content and will have residual phosphoric acid, alkoxylated and non-alkoxylated.

KEY APPLICATIONS

- gear oils
- metalworking fluids
- high-temperature lubricants
- greases
- hydraulic fluids

CLASSIFICATION & LABELLING

In order to obtain this information, please refer to the Safety Data Sheets. These documents are available upon request from your sales representative.

STORAGE & SHELF LIFE

Please see our respective Technical Data Sheet for general safety guideline. These documents are available upon request from your sales representative.

DELIVERY

Tank wagons or tanker trucks made of stainless steel, plastic containers with a capacity of 1 m³, steel or plastic drums with a capacity of 200 dm³ and other packaging as agreed with the customer.



PRODUCTS

EXOfos PB-103 – recommended for aluminium and copper alloys. EXOfos PB-103 provides good EP properties and also wetting capability. Product is stable in the alkaline environment. Phosphorus content is 6-7%.

EXOfos PB-133 – recommended as an additive to soluble oils and semi-synthetic metalworking fluids. Product provides good EP properties, it can be used in applications with materials like aluminium and copper. EXOfos PB-133 is stable in the alkaline environment.

EXOfos PB-136 – recommended as an additive to soluble oils and semi-synthetic metalworking fluids. Product provides good EP properties, it can be used at work with materials such as aluminium and copper. EXOfos PB-136 is a good wetting agent and exhibits great resistance to both acidic and alkaline environment.

EXOfos PB-139 – recommended as an additive to synthetic metalworking fluids. Water-soluble product, exhibits good wettability and resistance to both alkaline and acidic environment. EXOfos PB-139 is a solubilising agent for water systems.

EXOfos PB-184 – phosphate-ester with 4-5% phosphorus content. Product with superb EP properties. Recommended as an additive for lubricants working at high loads and water miscible lubricants. The product has also a great emulsifying capability. EXOfos PB-184 supports corrosion inhibition for steel, aluminium and copper materials.

EXOfos PB-253 – product designed especially for solvent-based applications. Soluble in many different organic solvents. EXOfos PB-253 is a very good wetting agent and lubricating additive.

EXOfos PB-264 – multifunctional additive for neat oils and water-miscible lubricants. This product provides excellent extreme-pressure (EP) properties, as well as emulsifying capability and great resistance to the alkaline environment. EXOfos PB-264 is a suitable product to work with materials such as aluminium or ferrous metals.

EXOfos PA-080S – hydrophobic product with high content of phosphorus (11-12%), intended to be applied mainly in oils and greases. A suitable product to work with ferrous metals and aluminium. In addition, EXOfos PA-080S supports corrosion inhibition on ferrous metals. One of the biggest advantages of this product is its anti-foaming property as an additive to mineral base oils. Product requires REACH registration.

EXOfos PA-1300 – highly hydrophobic additive intended to be applied mainly in oils and greases. EXOfos PA-1300 exhibits EP as well as anti-wear (AW) properties, therefore it can be used as universal additive for application in wide range of conditions. EXOfos PA-1300 is a suitable product for steel and aluminium materials. Product requires REACH registration, hence sales volume limitations in Europe apply.

EXOFOS - TYPICAL PROPERTIES

Parameter	EXOfos PA-080S	EXOfos PA-1300	EXOfos PB-103	EXOfos PB-133	EXOfos PB-136	EXOfos PB-139	EXOfos PB-184	EXOfos PB-253	EXOfos PB-264
CAS	12645-31-7	52933-07-0	52019-36-0	9046-01-9	9046-01-9	9046-01-9	39464-69-2	68071-35-2	68511-37-5
INCI	2 ethylhexyl phosphate	isotridecyl phosphate	PEG-3 decyl phosphate	PEG-3 isotridecyl phosphate	PEG-6 isotridecyl phosphate	PEG-9 isotridecyl phosphate	PEG-4 oleyl phosphate	PEG-3 C12-15 alkyl phosphate	PEG-4 lauryl phosphate
Appearance¹⁾	liquid	liquid	liquid	liquid	liquid	liquid	liquid	liquid	liquid
AV [mg KOH/g]³⁾	290-350	135-155	160-190	140-160	90-150	87-117	135-160	135-170	150 – 180
P-content [%]³⁾	11–12	8-9	6-7	5-6	3-4	3-4	4-5	5-6	6-7
pH value⁵⁾	2.0–3.0 ^{b)}	2.5-3.0 ^{c)}	2.0-2.5 ^{a)}	1.5-3.0 ^{a)}	1.0-2.5 ^{a)}	2.0-3.0 ^{a)}	2.0–3.0 ^{b)}	1.0-2.5 ^{a)}	2.0–3.0 ^{b)}
Solidification point [°C]⁶⁾	<-20	<-20	<-20	<-20	~ -15	~ -2	~ -4	~ +7	~ +2
Density at 25°C [g/cm³]³⁾	~ 1.02	~ 0.96	~ 1.06	~ 1.02	~ 1.05	~ 1.07	~ 1.03	~ 1.01	~ 1.04

1) Visual method at RT

2) PN-EN ISO 4630

3) In-house method

4) PN-ISO 4741 (modified)

5) PN-EN 1262

6) PN-ISO 1392

a - 1% in water

b - 1% in ethanol: water 50:50

c - 1% in ethanol: water 75:25

EXTREME-PRESSURE PERFORMANCE

Four-ball extreme-pressure (EP) tests in paraffinic group I base oil according to ASTM D2783 (1760 rpm, 10 s)

Sample	Last nonseizure load [N]	Weld point [N]
Paraffinic base oil (ISO VG 22)	392	981
Base oil + 3% EXOfos PA-083S	1236	1569
Base oil + 3% EXOfos PA-1300	981	1236
Base oil + 3% EXOfos PB-133	981	1569
Base oil + 3% EXOfos PB-184	981	1961
Base oil + 3% EXOfos PB-264	1236	1569

Four-ball anti-wear performance for EXOfos PA-1300 according to ASTM D4172 (method B: 1200 rpm, 1 h, 75°C, 40 kg)

Sample	Average scar diameter [mm]
Paraffinic base oil (ISO VG 22)	0.84 ± 0.04
Base oil + 0.5% EXOfos PA-1300	0.45 ± 0.03

OTHER FEATURES

Solubility of EXOfos series products (PN-EN 13955: 25°C, 5%[w/w])

Product	Demineralized water	Methanol	Ethyl ether	Acetone	Paraffinic base oil	Naphthenic base oil	Rapeseed oil	Rapeseed oil methyl esters (RME)	Extraction naphtha
EXOfos PA-0805	● 2)	●	●	●	●	●	●	●	●
EXOfos PA-1300	●	●	●	●	●	●	●	●	●
EXOfos PB-103	● 1)	●	●	●	●	●	●	●	●
EXOfos PB-133	● 1)	●	●	●	●	●	●	●	●
EXOfos PB-136	● 1)	●	●	●	●	●	●	●	●
EXOfos PB-139	●	●	●	●	●	●	●	●	●
EXOfos PB-184	● 1)	●	●	●	●	●	●	●	●
EXOfos PB-253	● 1)	●	●	●	●	●	●	●	●
EXOfos PB-264	● 1)	●	●	●	●	●	●	●	●

● soluble ● insoluble ● partially soluble

1) – soluble after neutralization

2) – partially soluble after neutralization

FERROUS MATERIALS CORROSION TESTS:

Herbert method (PN-M-55789)

Test method description: steel chips are placed on cast iron plate and wetted with analysed solution. The corroded area is evaluated after 24 h. The results are in the range of H0 to H6, where H0 is the best result, H6 – the worst.

Tests performed for products neutralized by triethanolamine to pH value 7-8 in demineralized water.

Concentration	EXOfos PB-264	EXOfos PA-0805	EXOfos PB-184	EXOfos PB-139	EXOfos PA-1300	EXOfos PB-103	EXOfos PB-133
5%	H0	H0	H0	H0	H0	H0	H3
3%	H2	H2	H0	H4	H4	H4	H4

Chip/filter paper method (DIN-51360)

Test method description: cast iron chips are placed on a filter paper and wett with analysed solution. The corroded area is evaluated after 2 h.

Tests performed for products neutralized by Triethanolamine to pH value 7-8 in demineralized water. In table below the minimum concentrations of EXOfos series products needed to obtain 0 result (any signs of corrosion) are demonstrated.

EXOfos PA-080S	EXOfos PA-1300	EXOfos PB-184
1%	1%	2%

PCC Group is still developing this group of products. We welcome opportunities to create new EXOfos series products which could fulfil the specific demands of our clients.







PCC Exol S.A.
Sienkiewicza St. 4
56-120 Brzeg Dolny
Poland

Please visit our capital group business platform:
www.products.pcc.eu



Information in this catalogue is believed to be accurate and to the best of our knowledge, but should be considered as introductory only. Detailed information about our products is available in TDS and MSDS. Suggestions for product applications are based on the best of our knowledge.

The responsibility for the use of products in conformity or otherwise with the suggested application method and for determining product suitability for your own purposes rests with the user.

All copyright, trademark rights and other intellectual and industrial property rights and the resulting rights to use this publication and its contents have been transferred to PCC EXOL S.A. or its licensors. All rights reserved.

Users/readers are not entitled to reproduce this publication in whole or in part, nor are they entitled to reproduce it (excluding reproduction for personal use) or to transfer it to third parties.

Permission to reproduce it for personal use does not apply in respect to data used in other publications, in electronic information systems, or in other media publications. PCC EXOL S.A.– shall not be responsible for data published by users.

pcc

*More than
Chemistry*