

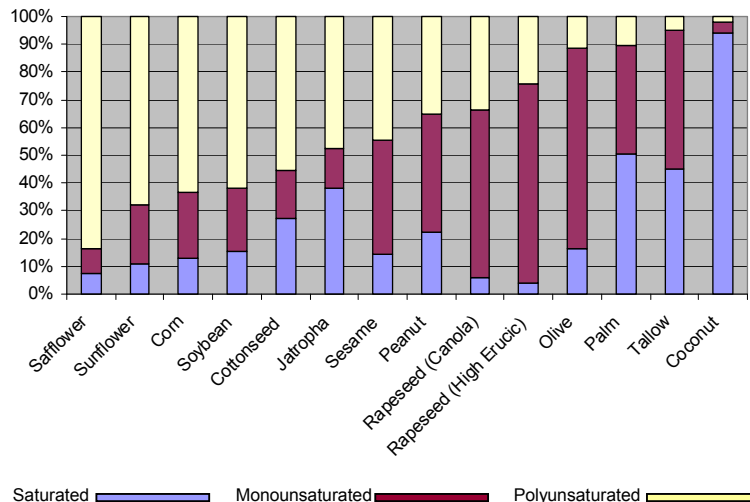
**DiesoLIFT™ BD-3** is a unique composition specially elaborated for the stabilization of biodiesel bases of various origins and the corresponding biodiesel fuel blends (B5 – B10 – B20 – B30) used in automotive diesel engines (passenger cars, trucks, buses, locomotives and railcars, power generation, etc). Made of a complex mixture of chemical molecules, **DiesoLIFT™ BD-3** provides exceptional protection against premature and developing oxidation, and remarkable storage stability and deposit control.

**DiesoLIFT™ BD-3** includes a powerful anticorrosion system that limits the catalytic effect of metals and extends storage time.

**DiesoLIFT™ BD-3**'s recommended dosage varies between 0.03 et 0.2 % depending on the origin of the biodiesel to be treated.

**DiesoLIFT™ BD-3** does not modify the characteristics of biodiesel (B100) according to the EN12214 specification, nor does it modify the EN 590 characteristics of biodiesel blends (B5 - B7 - B10 - etc).

### Compared stability of various vegetable oils



Though the use of Biodiesel is rapidly expanding, fueled by various legislations or local or regional initiatives, Biodiesel itself is showing some very noticeable deficiencies:

- Lesser energy value, leading to increased fuel consumption and reduced engine power output
- Limited oxidation and storage stability
- Tendency to deposits formation
- Low temperature properties

These limitations are greatly exacerbated with:

- the increasing content of biodiesel in fuel blends (B5-B7-B10-B20-B30...)
- the recourse to biodiesel made from vegetable or animal fats of diverse origins with questionable stability to make up for the limited resources of certain crops and the competition with human consumption.

BHT (Butylated hydroxytoluene) is the product commonly used as a fair stabilizer for current productions of biodiesel and blends up to B5. It is a known fact however that BHT offers limited protection when biodiesel concentration increases and alternate biodiesel productions of lesser qualities are used.

**DiesoLIFT™ BD-3** was therefore developed to fill the gap and offer the optimum protection required by the industry. **DiesoLIFT™ BD-3** is more powerful and cost-effective than any other stabilizer currently offered on the market.

Other competitive products have also been developed for the same purpose. *DiesoLIFT™ BD-3* has been tested against BHT and the products considered to be the Market Top Performers and consistently outperformed them.

	DiesoLIFT BD-3	BHT	Market's Top Performer
Stabilizer Performance	• • •	•	• •
Price	• •	• • • •	•
Cost / Efficiency	• • •	• •	• •
Physical Form	• • •	•	•
Anticorrosion Protection	• • •	--	--
Fuel Economy	• • •	--	--
Emissions Control	• • •	--	--

## DiesoLIFT™ BD-3

- ✓ Protects biodiesel blends against oxidation, degradation and performance drop
- ✓ Extends storage stability
- ✓ Allows biodiesel to meet and exceed current standards and specifications
- ✓ Provides additional protection against metal contamination
- ✓ Confers fuel efficiency and emissions control performance to biodiesel
- ✓ Is in liquid form, thus simplifying application and usage

## Physical & Chemical Characteristics

Density @ 15°C	ISO 12/25:	1.015	g/ml
Viscosity @ 40°C	ISO 3104:	141	mm <sup>2</sup> /sec
Viscosity @ 100°C	ISO 3104:	10	mm <sup>2</sup> /sec
Pour point	ISO 3016:	-15	°C
Metal content	ICP:	nil	

## PERFORMANCE DATA IN B100 BIODIESEL (PURE BIODIESEL)

### 1. EN 14112 Rancimat Oxidation Stability Test (hours induction time @ 110°C)

#### Rape Biodiesel

B100	B100 + <b>0.1 % DiesoLIFT™ BD-3</b>	B100 + <b>0.1% BHT</b>	B100 + <b>0.2 % DiesoLIFT™ BD-3</b>	B100 + <b>0.2% BHT</b>	En 14214 Specification B 100
4.0	>10.0	6.1	>20.0	8.7	>6.0

#### Comparative data with commercially available stabilizers

	Hours @ 110°C
Rape Biodiesel pure	4.0
<b>+ 0.2% DiesoLIFT™ BD-3</b>	<b>&gt; 20</b>
+ 0.2% BHT (Butylated Hydroxytoluene)	8.7
+ 0.2% Butylated Hydroxyanisole	12.5
+ 0.2% Alpha-tocopherol	4.4
+ 0.2% Octylated butylated diphenylamine	5.4
+ 0.2% Phenolic thioether	14.3
+ 0.2% Trisnonylphenyl phosphite	6.4
+ 0.2% 2,5 ditert-pentyhydroquinone	15.1
+ 0.2% Butylated phenol	6.8
+ 0.2% Diphenylamine derivative	5.8
+ 0.2% 2,6 diter-butyl 4 methylphenol	9.8
+ 0.2% tridecyl ester	4.0
+ 0.2% Benzene propamoic acid	8.6
+ 0.2% Alphanaphtylamine	4.0

#### Extremely unstable biodiesel base

B100	B100 + <b>0.2 % DiesoLIFT™ BD-3</b>	B100 + <b>0.2% BHT</b>	B100 + <b>0.2% Market's top performer</b>	En 14214 Specification B 100
0.17	>6.0	1.2	3	>6.0

## Higher Stability Biodiesel

B100	B100 + <b>0.05 % DiesoLIFT™ BD-3</b>	B100 + <b>0.10% DiesoLIFT™ BD-3</b>	En 14214 Specification B 100
6.24	8.55	10.36	>6.0

**DiesoLIFT™ BD-3** compares extremely favorably against competitive products and shows an exceptional ability to improve Rancimat oxidation stability above the EN 14214 minimum specification of 6 hours induction time, in biodiesels of various stability levels.

## 2. Storage Stability (24 weeks) - ASTM D4625/Standard Test Method for Distillate Fuel Storage Stability (mg/kg)

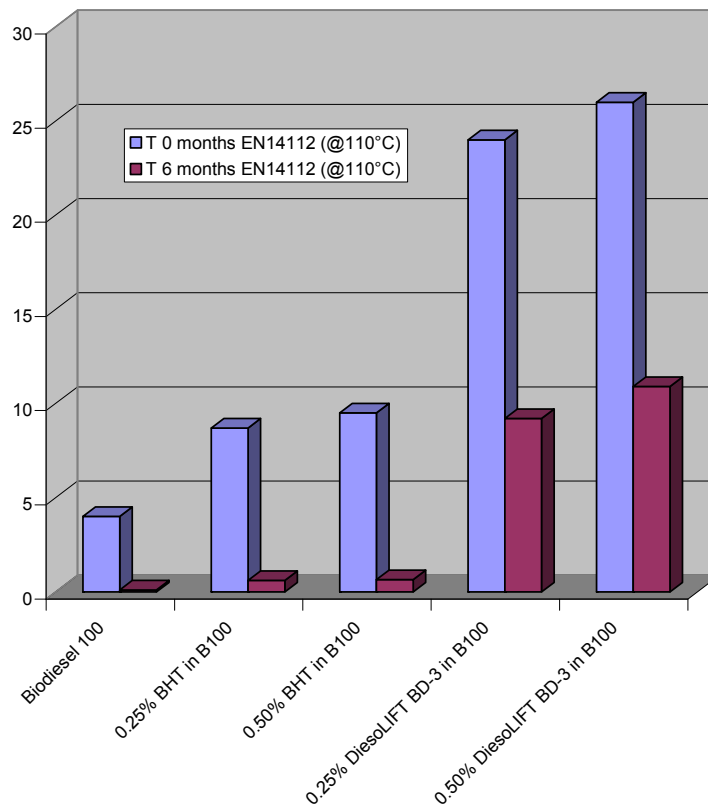
	Rape Biodiesel	Rape Biodiesel + <b>0.2% DiesoLIFT™ BD-3</b>	Rape Biodiesel + <b>0.2% BHT</b>
@ 43°C - mg/kg	250	5	75
@ 80°C - mg/kg	>1000	60	165

Comparative data with commercially available stabilizers @ 80°C

	Result (mg/kg)
Rape Biodiesel	> 1 000
<b>+ 0.2% DiesoLIFT™ BD-3</b>	<b>60</b>
+ 0.2% BHT (Butylated Hydroxytoluene)	165
+ 0.2% Propyl Gallate	641
+ 0.2% Butylated Hydroxyanisole	108
+ 0.2% Octylated butylated diphenylamine	174
+ 0.2% Phenolic thioether	290
+ 0.2% Trisnonylphenyl phosphite	176
+ 0.2% 2,5 ditert-pentyhydroquinone	126
+ 0.2% Butylated phenol	231
+ 0.2% Hydroxyethylated amino ethylamine	330
+ 0.2% Diphenylamine derivative	> 1 000
+ 0.2% 2,6 diter-butyl 4 methylphenol	211

**DiesoLIFT™ BD-3** dramatically extends Biodiesel's long-term storage through the control of deposits formation.

### 3. Storage Stability – EN 14112 Rancimat Oxidation Stability Test (hours induction time @ 110°C)



**DiesoLIFT™ BD-3** maintains biodiesel's performance for at least 6 months at a treat rate of 0.25%.

## Performance data in B5 Biodiesel Blend

### 1. ISO 12205/ASTM D2274 Oxidation Test

#### Standard Test Method for Oxidation Stability of Distillate Fuel

- Procedure B (48 hours @ 110°C) - “severized” method (mg/kg)
- Procedure C (procedure B + isooctane wash) - “severized” method (mg/kg)

Fluids	Insolubles after 48 hours Procedure “B” mg/kg	Insolubles after iso-octane wash Procedure “C” mg/kg
EN 590 Diesel Fuel	100	18
B5 Biodiesel Blend	>3000	43

B5 Biodiesel Blend		
+ 0.01 % BHT	290	20
+ 0.01 % DiesoLIFT™ BD-3	10	4

**(0.01% stabilizer in B5 blends equates to 0.2% or 2000 ppm stabilizer in B100)**

Comparative data with commercially available stabilizers in procedure “C”, the most severe conditions:

Fluids	Insolubles after iso-octane wash Procedure “C” mg/kg
EN 590 Diesel Fuel	18
B5 Biodiesel Blend	43
<b>B5 + 0.01 % DiesoLIFT™ BD-3</b>	<b>4</b>
B5 + 0.01 % BHT	20
B5 + 0.01 % Propyl Gallate	15
B5 + 0.01 % Alpha tocopherol	360
B5 + 0.01 % Octylated butylated diphenylamine	192
B5 + 0.01 % Phenolic thioether	16
B5 + 0.01 % Trisnonylphenyl phosphite	17
B5 + 0.01 % 2,5 ditert-pentyhydroquinone	140
B5 + 0.01 % Butylated phenol	33
B5 + 0.01 % Hydroxyethylated amino ethylamine	36
B5 + 0.01 % 2,6 diter-butyl 4 methylphenol	20

**DiesoLIFT™ BD-3** controls very efficiently the formation of deposits in B5, even in very severe conditions. It also dramatically outperforms BHT.

## Performance data in B10 Biodiesel Blend

### **1. Improvement of biodiesel blends obtained from the field**

B10#1 and B10#2 are two B10 blends that have shown stability deficiencies in the field.

#### **1.1. EN 14112 Rancimat Oxidation Stability Test (hours induction time @ 110°C)**

B10#1	B10#1 + 0.1 % DiesoLIFT™ BD-3	B10#2	B10#2 + 0.1 % DiesoLIFT™ BD-3
9.30	26.17	6.44	27.96

#### **1.2. EN 12662 Contamination test (mg/kg)**

B10#1	B10#1 + 0.1 % DiesoLIFT™ BD-3	B10#2	B10#2 + 0.1 % DiesoLIFT™ BD-3
5	<1	4	2

#### **1.3. ISO 12205/ASTM D2274 Oxidation Test – Procedure A/standard procedure (mg/kg)**

B10#1	B10#1 + 0.1 % DiesoLIFT™ BD-3	B10#2	B10#2 + 0.1 % DiesoLIFT™ BD-3
2	1	14	3

#### **1.4. ISO 12205/ASTM D2274 Oxidation Test – Procedure B/48 hours @ 110°C (mg/kg)**

B10#1	B10#1 + 0.1 % DiesoLIFT™ BD-3	B10#2	B10#2 + 0.1 % DiesoLIFT™ BD-3
1481	728	1881	1123

## 1.5. ISO 2160 Copper Corrosion Test

B10#1	B10#1 + <b>0.1 % DiesoLIFT™ BD-3</b>	B10#2	B10#2 + <b>0.1 % DiesoLIFT™ BD-3</b>
1b	1a	1b	1a

At a 0.1% treat rate, **DiesoLIFT™ BD-3** performs remarkably:

- it greatly improves the Rancimat oxidation stability of both blends.
- it lowers significantly the contamination observed with the B10 blends.
- it reduces dramatically the deposits formed by the B10 blends: 50% reduction with B10#1, 40% with B10#2
- it protects the blends further against copper corrosion, bringing back the ratings to the best possible reading, 1a (from 1b).

## 2. Testing of various biodiesels in B10 blends in comparison with one of the market's top performer

### Severized EN 14112 Method: modified Rancimat (115°C)

Fluid	Rancimat Hours @ 115°C
Rape biodiesel (B100)	2.14
B10 from Rape Biodiesel	11.38
B10 from Rape Biodiesel + 100 ppm DiesoLIFT™ BD-3	18.65
B10 from Rape Biodiesel + 200 ppm DiesoLIFT™ BD-3	28.85
B10 from Rape Biodiesel + 500 ppm DiesoLIFT™ BD-3	40.52
B10 from Rape Biodiesel + 100 ppm market's top performer	13.93
B10 from Rape Biodiesel + 200 ppm market's top performer	19.11
B10 from Rape Biodiesel + 500 ppm market's top performer	29.07
Sunflower Biodiesel (B100)	0.48
B10 from Rape Biodiesel	0.40
B10 from Sunflower Biodiesel + 100 ppm DiesoLIFT™ BD-3	3.48
B10 from Sunflower Biodiesel + 200 ppm DiesoLIFT™ BD-3	4.58
B10 from Sunflower Biodiesel + 500 ppm DiesoLIFT™ BD-3	10.41
B10 from Sunflower Biodiesel + 100 ppm market's top performer	2.64
B10 from Sunflower Biodiesel + 200 ppm market's top performer	3.02
B10 from Sunflower Biodiesel + 500 ppm market's top performer	5.44

Fluid	Rancimat Hours @ 115°C
Soybean biodiesel (B100)	0.49
B10 from Soybean Biodiesel	3.80
B10 from Soybean Biodiesel + 100 ppm DiesoLIFT™ BD-3	6.07
B10 from Soybean Biodiesel + 200 ppm DiesoLIFT™ BD-3	8.92
B10 from Soybean Biodiesel + 500 ppm DiesoLIFT™ BD-3	15.40
B10 from Soybean Biodiesel + 100 ppm market's top performer	4.49
B10 from Soybean Biodiesel + 200 ppm market's top performer	5.03
B10 from Soybean Biodiesel + 500 ppm market's top performer	9.55

The “Top Performer” stabilizer tested in this study against DiesoLIFT™ BD-3 is a product recently introduced commercially on the market.

Both “Top Performer” and “DiesoLIFT™ BD-3” are highly superior to BHT in performance.

This study confirms that DiesoLIFT™ BD-3 is today's best stabilizer/antioxidant for biodiesel blends with the ability to meet future biodiesel blend specifications currently under development.

### **Pricing Information**

DiesoLIFT™ BD-3 is very conveniently priced compared to BHT and other Market Top Performers.

DiesoLIFT™ BD-3 is extremely cost effective.

*All data presented above was obtained from BfB Oil Research, a leading European petroleum testing facility, based in Belgium.*

*BfB is one of the few facilities BELAC/BELTEST.*

*BfB Oil Research is a member company of the Air Liquide Group.*

*BfB Oil Research Rue Phocas Lejeune, 10  
5032 Gembloux  
Belgium  
ph : +32(0) 81.58.53.00  
fax : +32(0) 81 58 53 08  
[info@bfblab.com](mailto:info@bfblab.com)  
[www.bfblab.com](http://www.bfblab.com)*



---

**ANNEX****Description of oxidation test employed****1. EN 14112 Rancimat Oxidation Stability Test**

- The operating principle of the Rancimat method sees a stream of air is blown through the sample at a temperature between 50 to 220°C, thus oxidizing the fatty acids in several stages.
- In principle oxidation takes place according to a radical chain mechanism, in which easily volatile oxidation products (chiefly formic acid) are finally formed. These are transferred by the stream of air into a measuring vessel containing deionised water, whose conductivity is continually being measured.
- Plotting conductivity against time produces oxidation curves, whose point of inflection is known as the induction time. These induction times are correlated with values determined by the more complicated Active Oxygen Method. The Rancimat principle is suitable for the determination of the oxidative stability of a wide range of natural oils and fats.

**2. Storage Stability - ASTM D4625/Standard Test Method for Distillate Fuel Storage Stability**

- Storage of a 400 ml sample of B100 at 43°C for 24 weeks (standard conditions)
- Storage of a 400 ml sample of B100 at 80°C for 24 weeks (“severized” procedure)
- Cooling down at room temperature and filtration
- Determination of total insoluble matters (mg/kg)

**3. ISO 12205/ASTM D2274 Oxidation Test  
Standard Test Method for Oxidation Stability of Distillate Fuel****Procedure A - Standard method**

- Ageing of a 350 ml sample of biodiesel blend at 95°C for 16 hours while oxygen bubbled through the sample at a rate of 3 liter/hour
- Cooling down at room temperature and filtration
- Determination of total insoluble matters


**Procedure B - Modified “severized” method**

- Ageing of a 350 ml sample of biodiesel blend at 110°C for 48 hours while oxygen bubbled through the sample at a rate of 3 liter/hour
- Cooling down at room temperature and filtration
- Determination of total insoluble matters

**Procedure C - Modified “severized” method**


- After procedure “B”, the sample is mixed 50/50 with isooctane
- Filtration after 24 hour standing
- Determination of total insoluble matters

**Study on Camelina Sativa biodiesel (Iodine Number = 155)  
 Courtesy of Montana State University Northern  
 Excerpt from an AOCS Presentation made in Seattle, May 08  
 Stabilization with DiesoLIFT™ BD-3**



Montana State University-Northern  
 Bio-Energy Innovation and Testing Center

## Evaluation of biodiesel derived from *Camelina sativa* oil



Nestor U. Soriano, Jr.

99<sup>th</sup> AOCS Meeting  
 Seattle, WA  
 19 May 2008

