

# SOUTHWEST RESEARCH INSTITUTE®

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FUELS AND LUBRICANTS RESEARCH DIVISION

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September 30, 2014

Hydac Technology Corporation  
Attn: Mr. Daniel Zoller  
2260 City Line Road  
Bethlehem, PA 18017

Via e-mail: Daniel.Zoller@hydacusa.com

Subject: Letter Report for Southwest Research Institute® Project No. 08.15496.01.101  
“Filter Testing” (P.O. #202808, W.O. 14-236)

Dear Mr. Zoller:

Southwest Research Institute (SwRI®) is pleased to provide the following filter test results for  
The filter description(s) are provided Table 1 below.

- SAE J1488- Emulsified Water/Fuel Separation Test Procedure

**Table 1. Filter Details**

SwRI Filter ID	Filter Description
FL14-1923	One Filter inside Hydac Housing

## 1.0 WATER REMOVAL EFFICIENCY TEST PER SAE J1488

SAE J1488 is a performance test for the effectiveness of fuel/water separators in removing emulsified water from fuels. Ultra Low Sulfur Diesel (ULSD) is circulated in the stand in a single pass flow loop while de-ionized water is injected upstream of the circulation pump to create the emulsion. Water content in the fuel is recorded upstream and downstream of the fuel/water separator throughout the test to determine the water removal efficiency.

The interfacial tension (IFT) of the base fuel is adjusted to the target value by adding Glyceryl Monooleate to the fuel. In this evaluation, the base fuel had an interfacial tension of 36.7 mN/m and the simulated biodiesel had an interfacial tension equal to 13.8 mN/m.



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**Table 2. SAE J1488 Test Parameters for Water Challenge**

Test Parameters	Conditions
Flow Rate	16 GPM
Test Fuel	ULSD without Monooleate, followed by testing with Monooleate
Target IFT	Fuel as received, followed by $15 \pm 2$ mN/m
Water Challenge	2,500 ppm

A summary of the test results is provided in Table 3. The complete data sheets are provided in Appendix A.

**Table 3. Summary of Results**

SwRI Filter ID	FL14-1923	FL14-1923 with Monooleate
Test Filter Number	1	2
BOT IFT (mN/m)	36.7	13.8
Water Removal Efficiency (%)	95.4	98.1
Total Test Time (minutes)	150	150

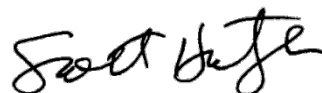
If you have any questions, please do not hesitate to contact me at (210) 522-2102 or by e-mail at [kristi.rutta@swri.org](mailto:kristi.rutta@swri.org).

Prepared by:



Kristi Rutta, Senior Laboratory Technician  
Fuel Systems & Contamination Research  
Fuels & Lubricants Technology Department

Approved by:



Scott A. Hutzler, Manager  
Fluids Filtration and Handling Research  
Fuels & Lubricants Technology Department

KR/rs

Attachment

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cc: G. Bessee, SwRI (via e-mail)  
rrecordcopyb, SwRI (via e-mail)

*This report must be reproduced in full, unless SwRI approves a summary or abridgement.*

**APPENDIX A**  
**SAE J1488 RESULTS**

Fuel/Water Separation Test Stand  
SAE J1488/SAE J1839 Data Sheet

<b>Client:</b>	Hydac	<b>Test Number:</b>	1
<b>Project Number:</b>	15496.01.101	<b>Filter ID:</b>	FL14-1923
<b>Test Engineer:</b>	K. Rutta	<b>Test Date:</b>	9/24/2014
<b>Test Fluid:</b>	ULSD	<b>Test Fluid Flow Rate (GPM):</b>	16
<b>Water Injection Rate (mL/min):</b>	-	<b>Test Temperature (°C):</b>	25°C
<b>Water Saturation Limit (ppm):</b>	2500	<b>Vacuum/Pressure:</b>	Pressure

Interfacial Tension (mN/m)		
	Before Additive	After Additive
BOT	36.72	-
EOT	38.256	-

<b>Amount of ULSD in Sump (Gallons)</b>	25
<b>Amount of Monooleate Added (mL)</b>	-

DSEP		
	Before Additive	After Additive
BOT	93	-
EOT	0	-

<b>Density of fuel (g/cm<sup>3</sup>)</b>	0.825
<b>Density of water (g/cm<sup>3</sup>)</b>	0.998

<b>Refractive Index</b>	1.463
<b>Baseline Water Content (ppm)</b>	117

Sample Identification	Time (minutes)	Upstream Water Content (ppm)	Downstream Water Content (ppm)	Free Water Content (ppm)	Turbidity %	Water Drained (mL)	Differential Pressure (psi)
1	0	121	117	-	-	0	4.5
2	10	2730	138	21	90.0	450	5.8
3	30	2705	318	201	88.5	1300	5.9
4	50	2462	273	156	87.2	1100	6.0
5	70	2682	208	91	84.1	1500	6.0
6	90	2425	211	94	82.3	1600	6.0
7	110	2686	239	122	79.9	1600	6.0
8	130	2480	217	100	78.5	1300	6.2
9	150	2579	243	126	76.8	1400	6.4

<b>Average Water Content (ppm):</b>	231
<b>Time Weighted Average Water Removal Efficiency:</b>	95.4
<b>Water from Test Housing (mL):</b>	10250
<b>Water from Cleanup Filters (mL):</b>	2500

<b>Actual Test Time (min)</b>	150
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<b>Average Upstream (ppm)</b>	2593.63
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Fuel/Water Separation Test Stand  
SAE J1488/SAE J1839 Data Sheet

<b>Client:</b>	Hydac	<b>Test Number:</b>	2
<b>Project Number:</b>	15496.01.101	<b>Filter ID:</b>	FL14-1923
<b>Test Engineer:</b>	K. Rutta	<b>Test Date:</b>	9/25/2014
<b>Test Fluid:</b>	ULSD with Monooleate	<b>Test Fluid Flow Rate (GPM):</b>	16
<b>Water Injection Rate (mL/min):</b>	-	<b>Test Temperature (°C):</b>	25°C
<b>Water Saturation Limit (ppm):</b>	2500	<b>Vacuum/Pressure:</b>	Pressure

Interfacial Tension (mN/m)		
	Before Additive	After Additive
BOT	40.914	13.815
EOT	-	14.592

<b>Amount of ULSD in Sump (Gallons)</b>	25
<b>Amount of Monooleate Added (mL)</b>	210

DSEP		
	Before Additive	After Additive
BOT	97	0
EOT	-	0

<b>Density of fuel (g/cm<sup>3</sup>)</b>	0.825
<b>Density of water (g/cm<sup>3</sup>)</b>	0.998

<b>Refractive Index</b>	1.463
<b>Baseline Water Content (ppm)</b>	151

Sample Identification	Time (minutes)	Upstream Water Content (ppm)	Downstream Water Content (ppm)	Free Water Content (ppm)	Turbidity %	Water Drained (mL)	Differential Pressure (psi)
1	0	179	151	-	-	0	10.1
2	10	2539	176	25	77.4	400	7.5
3	30	2636	180	29	76.4	900	6.8
4	50	2712	151	0	76.4	1500	6.9
5	70	2456	179	28	76.3	1000	6.9
6	90	2513	190	39	76.3	1500	6.8
7	110	2356	269	118	75.6	1000	6.7
8	130	2596	221	70	75.7	900	6.7
9	150	2657	211	60	75.6	1000	7.0

<b>Average Water Content (ppm):</b>	197
<b>Time Weighted Average Water Removal Efficiency:</b>	98.1
<b>Water from Test Housing (mL):</b>	8200
<b>Water from Cleanup Filters (mL):</b>	9000

<b>Actual Test Time (min)</b>	150
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<b>Average Upstream (ppm)</b>	2558.13
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