Report Number: 116-ABI-19-010

SAFETY COMPLIANCE TESTING FOR FMVSS 116 MOTOR VEHICLE BRAKE FLUID

BMW Group DOT 4 Motor Vehicle Brake Fluid

Distributed By BMW North America, Inc.

Tests Conducted By:

ABIC International Consultants, Inc.
24 Spielman Road
Fairfield, NJ 07004

February 21 , 2019

FINAL REPORT

Prepared For:

U.S. DEPARTMENT OF TRANSPORTATION
NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION
OFFICE OF VEHICLE SAFETY COMPLIANCE (NEF-220)
1200 NEW JERSEY AVENUE, S.E.
WASHINGTON, D.C. 20590

Prepared By: Leonard Mackowiak

Approved By: Abraham I. Bakal, Ph.D

Approval Date: 2/21/19

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Accepted By:

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Technical Report Documentation Page

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7. Author(s) Leonard Mackowiak, Project Engineer		8. Performing Organization Report No. 3234	
9. Performing Organization Name and Address ABIC International Consultants, Inc 24 Spielman Road Fairfield, New Jersey 07004		10. Work unit no. 11. Contract or Grant No. DTNH22-14-D-00346L	
12. Sponsoring Agency Name and Address U.S. Department of Transportation National Highway Traffic Safety Administration Safety Assurance Office of Vehicle Safety Compliance (NEF-220)) 1200 New Jersey Avenue, SE Washington, D.C. 20590		13.Type of Report and Period Covered Final Test Report, July 25, 2019 to February 21, 2019 14. Sponsoring Agency Code NEF-220	
15. Supplementary Notes			
16. Abstract Compliance tests were conducted of BMW Group DOT 4 Motor Vehicle Brake Fluid in accordance with the specifications of the Office of Vehicle Safety Compliance Test Procedure No. TP-116-04 for the determination of FMVSS-116 compliance. The brake fluid tested meets all requirements			
17. Key Words Compliance Testing Safety Engineering FMVSS-116		18. Distribution Statement Copies of this report are available from: National Highway Traffic Safety Admin. Technical Information Services (NIO-120) 1200 New Jersey Avenue., SE Washington, DC 20590	
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Form DOT F1700.7 (8-72)

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PURPOSE: The purpose of the test was to determine if the production motor vehicle brake fluid supplied by the National Highway Traffic Safety Administration met the requirements of Federal Motor Vehicle Safety Standard No. 116 entitled " Motor Vehicle Brake Fluids ."

B. SECTION 2 - COMPLIANCE TEST DATA SUMMARY

DATA SHEET NO. 1 OF 3

GROUP No.: 10 LAB.: Report No. 116-ABI-19-010

BRAKE FLUID BRAND: BMW Group DOT 4 Motor Vehicle Brake Fluid

DISTRIBUTOR: Old World Industries, LLC

ADDRESS: 4085 Commercial Avenue, Northbrook, IL 60062

LOT I.D. / PACKAGE CODE: 031418; DOT GRADE: 4

INDICATE P - PASS OR F - FAIL		PASS	FAIL
1.	Boiling Point (ERBP)	P	
2.	Wet ERBP	P	
3.	Viscosity at -40°C (-40°F)	P	
	Viscosity at 100°C (212°F)	P	
4.	pH Value	P	
5.	Fluid Stability	P	
	High Temperature	P	
	Chemical	P	
6.	Corrosion:		
	Weight Change, mg/cm²		
	Tinned Iron	P	
	Steel	P	
	Aluminum	P	
	Cast Iron	P	
	Brass	P	
	Copper	P	
	Pitting or Roughening	P	
	Gelling of Mixture	P	
	Crystalline Deposit	P	
	Sedimentation, % by volume	P	
	Disintegration of cups	P	
	pH after test	P	
	Decrease in cup hardness	P	
	Increase in cup diameter	P	
7.	Fluidity and Appearance at Low Temperature:		
	Sludging at -40°C (-40°F)	P	
	Sludging at -50°C (-58°F)	P	
	Crystallization at -40°C (-40°F)	P	
	Crystallization at -50°C (-58°F)	P	
	Sedimentation at -40°C (-40°F)	P	
	Sedimentation at -50°C (-58°F)	P	
	Air Bubble Rise Time at -40°C (-40°F)	P	
	Air Bubble Rise Time at -50°C (-58°F)	P	
	Stratification at -40°C (-40°F)	P	
	Stratification at -50°C (-58°F)	P	
	Fluid Appearance at Room Temperature		
	. After -40°C (-40°F) Test	P	
	. After -50°C (-58°F) Test	P	

B. SECTION 2 - COMPLIANCE TEST DATA SUMMARY

DATA SHEET NO. 2 OF 3

BRAKE FLUID BRAND: BMW Group DOT 4 Motor Vehicle Brake Fluid

INDICATE P - PASS OR F - FAIL	PASS	FAIL
8. Evaporation:		
Percent weight loss	NP*	
Abrasion/Gritty Precipitate	NP*	
Pour point of residue	NP*	
9. Water Tolerance:		
Sludging at -40°C (-40°F)	P	
Stratification at -40°C (-40°F)	P	
Stratification at 60°C (140°F)	P	
Sedimentation at -40°C (-40°F)	P	
% Sedimentation at 60°C (140°F)	P	
Crystallization at -40°C (-40°F)	P	
Air Bubble Rise Time at -40°C (-40°F)	P	
Appearance at Room Temperature after -40°C (-40°F) Test	P	
10. Compatibility:		
Sludging at -40°C (-40°F)	P	
Sedimentation at -40°C (-40°F)	P	
Crystallization at -40°C (-40°F)	P	
Stratification at -40°C (-40°F) (Except DOT 5)	P	
Stratification at 60°C (140°F)	P	
% Sedimentation at 60°C (140°F)	P	
11. Resistance to Oxidation:		
Weight loss, mg/cm²		
Aluminum	P	
Cast Iron	P	
Pitting and etching	P	
Gum deposit on strips	P	
12. Effect on SBR Cups:		
Hardness increase at 70°C (158°F)	P	
Hardness increase at 120°C (248°F)	P	
Hardness decrease at 70°C (158°F)	P	
Hardness decrease at 120°C (248°F)	P	
Base diameter change at 70°C (158°F)	P	
Base diameter change at 120°C (248°F)	P	
Disintegration at 70°C (158°F)	P	
Disintegration at 120°C (248°F)	P	
13. Stroking Properties	NP*	
14. Color:		
Clear to Amber (DOT 3 & 4 & 5.1)	P	
Purple (DOT 5)		

B. SECTION 2 - COMPLIANCE TEST DATA SUMMARY

DATA SHEET NO. 3 OF 3

BRAKE FLUID BRAND: BMW Group DOT 4 Motor Vehicle Brake Fluid

		INDICATE P - PASS OR F- FAIL PASS	 FAIL
15.	Container Sealing:		
	Resealable	P	
	Tamper-Proof Feature	P	
16.	Certification, Marking and Labeling:		
	Certification --		
	FMVSS 116 Statement	P	
	Marking		
	Lot I.D. Code Shown	P	
	Grade Type Shown	P	
	Grade Type Statement	P	
	Minimum Wet ERBP Shown	P	
	Complete Mailing Address	P	
	Labeling -		
	Safety Warning Statements	P	
	Removability	P	
	Legibility	P	

COMMENTS:

*NP: Not Performed

C. SECTION 3 - TEST DATA

DATA SHEET 1 OF 3

GROUP NO.: 10 LAB: Report No. 116-ABI-19-010

BRAKE FLUID BRAND: BMW Group DOT 4 Motor Vehicle Brake Fluid

Test No.	Test Description	Test Requirements	Test Results	Start Date	Completion Date
1	Boiling Point (ERBP)	Min. =230°C (446°F)*	>260°C (>500°F)	1/17/19	1/17/19
2	Wet ERBP	Min. =155°C (311°F)*	176°C (350°F)	1/16/19	1/18/19
3	Viscosity at -40°C (-40°F)	Max. = 1800 mm^2/s*	1150 mm^2/s	1/17/19	1/17/19
	Viscosity at 100°C (212°F)	Min = 1.5 mm^2/s	2.0 mm^2/s	1/17/19	1/17/19
4	pH Value	7 to 11.5	7.6	1/21/19	1/21/19
5	Fluid Stability:	Max. Change		1/21/19	1/21/19
	High Temperature	3°C (5.4°F) + Δ	>260°C (>500°F)	1/21/19	1/21/19
	Chemical	3°C (5.4°F) + Δ	1°C (2°F)	1/21/19	1/21/19
		Δ = + 0.05/° that BP is >225°C (437°F)	Δ = 2°C (3.1°F)		
6	Corrosion:				
	Weight Change, mg/cm²				
	Tinned Iron	Max. = 0.2	0.00	1/30/19	2/4/19
	Steel	Max. = 0.2	0.00		
	Aluminum	Max. = 0.1	0.00		
	Cast Iron	Max. = 0.2	0.00		
	Brass	Max. = 0.4	0.02		
	Copper	Max. = 0.4	0.03		
	Pitting/Roughening	None	None		
	Gelling of mixture	None	None		
	Crystalline deposits	None	None		
	Sedimentation, % by vol.	Max. = 0.10%	None		
	Disintegration of cups	None	None		
	pH after Test	7 to 11.5	7.4		
	Decrease in cup hardness	Max. = 15 IRHD	3		
	Increase in cup diameter	Max. =1.44 mm (0.055")	0.02 mm (0.001")		

** NA: Not Applicable

C. SECTION 3 - TEST DATA

DATA SHEET 2 OF 3

BRAKE FLUID BRAND: BMW Group DOT 4 Motor Vehicle Brake Fluid

Test No.	Test Description	Test Requirements		Test Results		Start Date	Completion Date
7	Fluidity and Appearance at Low Temperature:	-40°C (-40°F)	-50°C (-58°F)			1/21/19	1/26/19
	Stratification	None	None	None	None	1/21/19	1/26/19
	Sludging	None	None	None	None	1/21/19	1/26/19
	Sedimentation	None	None	None	None	1/21/19	1/26/19
	Crystallization	None	None	None	None	1/21/19	1/26/19
	Air Bubble Rise Time - sec.	10 max	35 max	2sec.	2 sec.	1/21/19	1/26/19
	Appearance at Room Temperature After Low Temperature Exposure	Same as before testing	Same as before testing	Same	Same	1/21/19	1/26/19
8	Evaporation:						
	% Weight Loss	Max. = 80%				NP*	NP*
	Abrasive/Gritty Precipitate	None					
	Pour Point of Residue	Max. = -5°C (23°F)					
9	Water Tolerance:	-40°C (-40°F)	60°C (140°F)			1/18/19	1/23/18
	Sludging	None	----------	None			
	Stratification	None	None	None	None		
	Sedimentation, %	None	.15 max	None	None		
	Air Bubble Rise Time - sec.	10 max	----------	2 sec.	--------		
	Crystallization	None	----------	None	--------		
	Appearance at Room Temperature After Low						
10	Compatibility:	-40°C (-40°F)	60°C (140°F)			1/21/19	1/23/18
	Stratification	None	None				
	Crystallization	None	----------	None	--------		
	Sedimentation, %	None	.05 max	None	None		
	Sludging	None	----------	None	-------		
11	Resistance to Oxidation:					1/25/19	2/4/19
	Weight Loss, mg/cm²						
	Aluminum	Max. = 0.05		0.00			
	Cast Iron	Max. = 0.30		0.01			
	Pitting/Etching	None		None			
	Gum Deposits on Strips	Trace		None			
12	Effect on SBR Cups:	70°C (158°F)	120°C (248°F)			2/1/19	2/4/19
	Hardness Increase	None	None	None	None		
	Hardness Decrease, IRHD	10 max	15 max	9	6		
	Base Diameter Change - in.	0.15 mm 1.40mm (0.006 to 0.055")	0.15mm 1.40 mm (0.006 to 0.055″)	.71 mm. (0.028in.)	.99 mm. (0.039in.)		
	Disintegration	None	None	None	None		

C. SECTION 3 - TEST DATA

DATA SHEET 3 OF 3

BRAKE FLUID BRAND: BMW Group DOT 4 Motor Vehicle Brake Fluid

Test No.	Test Description	Test Requirements	Test Results	Start Date	Complete Date
13	Stroking Properties	N/P			
14	Color:				
	DOT 3 & DOT 4 & DOT 5.1	Clear to Amber	Passes	2/1/19	2/1/19
	DOT 5	Purple		2/1/19	2/1/19
15	Container Sealing:	Resealable	Passes	2/1/19	2/1/19
		Tamper-Proof Feature	Passes	2/1/19	2/1/19
16	Certification:	S116 Statement	Passes	2/1/19	2/1/19
	Marking - Lot ID Code	Shown	Passes	2/1/19	2/1/19
	Marking - Grade Type & Grade Statement	Shown	Passes	2/1/19	2/1/19
	Marking - Min Wet ERBP	Shown	Passes	2/1/19	2/1/19
	Marking - Mailing Address	Complete	Passes	2/1/19	2/1/19
	Labeling	Safety Warning Statements	Passes	2/1/19	2/1/19
		Removability	Passes	2/1/19	2/1/19
		Legibility	Passes	2/1/19	2/1/19

* Values shown are values for DOT-4 Brake Fluid ONLY. Values for DOT-3, DOT-5 and DOT-5.1 Brake Fluid are shown below:

	DOT-3	**DOT-5**	**DOT-5.1**
TEST 1	205ºC (401F)	260 ºC (500ºF)	260 ºC (500ºF)
TEST 2	140 ºC (284ºF)	180 ºC (356ºF)	180 ºC (356ºF)
TEST 3	1500 mm^2/s	900 mm^2/s	900 mm^2/s

REMARKS:

RECORDED BY: Leonard Mackowiak DATE: 2/21/19

APPROVED BY: Leonard Mackowiak

D. SECTION 4

NONE

E. APPENDIX A

INTERPRETATION OR DEVIATIONS FROM FMVSS 116

NONE

`F. APPENDIX B

EQUIPMENT LIST AND CALIBRATION RECORDS

Test Usage No.	Equipment Manufacturer Type or Model/Serial No.	Accuracy Limits	Frequency of Calibration	Expiration Date of Calibration
13,14	Thermometer Brooklyn Thermometer Co. ASTM 6F/89660	-112°F to +70°F ± 1.0°F	12 Months	2/20/19
1,3,7,8	Thermometer Brooklyn Thermometer Co ASTM 2F/38707	20°F to 580°F ± 1.0°F	12 Months	2/20/19
5	Thermometer Brooklyn Thermometer Co ASTM 30F/48332	207.5° to 212.5°F ± 0.05°F	12 Months	2/20/19
4	Thermometer Brooklyn Thermometer Co ASTM 73F/49394	-42.5°F to -37.5°F ± 0.2°F	12 Months	2/20/19
5	Constant Temperature Oil Bath (212°F) Fisher Scientific Co. Inc. ASTM D-445/10BC-3	Ambient To 250°F ± 0.2°F	Daily	Daily
4	Constant Low Temperature Bath (-40°F) Neslab Instruments Inc. ASTM D-445/88NM	-80F to Ambient	Daily	Daily
5	Viscosity Cannon Instruments Co. Cannon Fenske ASTM D-445 K5 and K22	1.6 to 8 cSt. ± 0.02 cSt	12 Months	9/20/19
4	Viscosity Cannon Instruments Co Ubbelohde ASTM D-445 3B/C196 and 3B/C194	1000 to 5000 cSt. ± 0.04 cSt.	12 Months	9/20/19

F. APPENDIX B (continued)

EQUIPMENT LIST AND CALIBRATION RECORDS

Test Usage No.	Equipment Manufacturer Type or Model/Serial No.	Accuracy Limits	Frequency of Calibration	Expiration Date of Calibration
13,14	Temperature Recorder Taylor Instruments Chart / 76JR131	30 to 230°F ± 1°F	12 Months	2/20/19
13,14	Temperature Recorder Partlow Co. Chart / 86L5666	0 to 200°C ± 1°C	12 Months	2/20/19
12,15,	Low Temperature Storage Chamber (-40°F ,-58°F) So-Low Instruments PR100-3	-18°C to -73°C ± 2°C	12 Months	2/20/19
6,9	pH Meter Orion Research Inc. 920A/002618	0 to 14 to 0.05 units	Daily	Daily
6,18, 19	Durometer PTC Instruments Inc. 26882	0 to 100	Daily	Daily
6,12	Laser Micrometer Keyence LS-3100.	.032 to 2.6 ± 0.00001 inches	Daily	Daily
9,15, 21	Centrifuge International Equipment Type K/39839P	0 to 900RCF	Daily	Daily
13,14	Mettler Balance Mettler Instruments Corp., PC2000	0 to 2000 Grams ± 0.1Grams	6 Months	7/22/19
9,17	Mettler Balance Mettler Instruments Corp., H-10/322096	0 to 160 Grams ± 0.0000 Grams	12 Months	7/22/19

G. APPENDIX C

PHOTOGRAPHS

BRAKE FLUID SAMPLE TESTED

BMW Group DOT 4 Motor Vehicle Brake Fluid

Front View

ABIC International Consultants, Inc.
Report No: 116-ABI-19-010
Brake Fluid Sample Tested

BMW Group DOT 4 Motor Vehicle Brake Fluid

Back View

ABIC International Consultants, Inc.
Report No: 116-ABI-19-010
Brake Fluid Sample Tested

BMW Group DOT 4 Motor Vehicle

Picture of Lot Code