PE16-009

BOWMAN AND BROOKE

10-25-2017

FOR DOW AUTOMOTIVE SYSTEMS

REQUEST NO. 7

DOW000756

ABIC *TESTING LABORATORIES, INC.*

24 Spielman Road **973-227-7060**
Fairfield, NJ 07004 **Fax: 973-227-0172**

Report to:	Dow Chemical	January 17, 2008
Sample of:	DOT 4 Motor Vehicle Brake Fluid	
Submitted by:	Dr. Jin Zhao	
Project No.:	5013-36b	
Sample No.:	2049	
Marking:	Dow Brake Fluid 460	
Sampled by:	Client	

RESULTS OF TESTS FOR CONFORMANCE WITH FEDERAL MOTOR VEHICLE SAFETY STANDARD 116 FOR DOT 4 MOTOR VEHICLE BRAKE FLUID

TESTS	REQUIREMENTS	RESULTS
Original Equilibrium Reflux		
Boiling point	min. 230°C (446°F)	275°C (528°F)
Wet Equilibrium Reflux		
Boiling point	min. 155°C (311°F)	171°C (340°F)
Viscosity		
@ -40 °C (-40 °F)	max. 1800 mm^2/s.	1031 mm^2/s.
@ 100 °C (212 °F)	min. 1.5 mm^2/s.	2.3 mm^2/s.
pH	7 - 11.5	7.7
Brake Fluid Stability		
High temperature stability Boiling point change	max. 3°C (5.4°F) + 0.05/1° that original ERBP exceeds 225 °C (437 °F)	-1°C (-1°F)

Division of ABIC INTERNATIONAL CONSULTANTS, INC.

TESTS	REQUIREMENTS	RESULTS
Chemical stability Boiling point change	max. 3.0°C (5.4 °F) + 0.05/1 that original ERBP exceeds 225°C (437°F)	-1°C (-2°F)
Corrosion		
Weight change in mg./sq. cm.		
Tinned iron	max. 0.2	0.00
Steel	max. 0.2	0.00
Aluminum	max. 0.1	0.00
Cast iron	max. 0.2	0.00
Brass	max. 0.4	0.03
Copper	max. 0.4	0.04
Pitting or etching of strips discernible without magnification	None	None
Gelling of fluid/water, mixture at 23 ± 5°C (73.4°F ± 9°F)	None	None
Crystalline deposit on glass jar walls or on metal strips	None	None
pH of water/fluid mixture	7 - 11.5	7.5
Sedimentation	max. 0.10%	None
Disintegration of rubber cup as evidenced by stickiness, blisters or sloughing	None	None
Decrease in hardness of rubber cups	max. 15 IRHD	2 IRHD
Increase in base diameter of rubber cup	max. 1.4 mm. (0.055 in)	0.05 mm (0.002 in)

TESTS	REQUIREMENTS	RESULTS
Fluidity And Appearance At Low Temperatures		
@ -40°C (-40°F)		
Stratification or sedimentation, sludging or crystallization	None	None
Time for air bubble to travel to top	max. 10 seconds	4 Seconds
Appearance of sample after warming to room temperature	Same as before testing	Same
@ -50°C (-58°F)		
Stratification or sedimentation, sludging or crystallization	None	None
Time for air bubble to travel to top	max. 35 seconds	6 Seconds
Appearance of sample after warming to room temperature	Same as before testing	Same
Water Tolerance		
@ -40°C (-40°F)		
Stratification or sedimentation, sludging or crystallization	None	None
Time for air bubble to travel to top	max. 10 seconds	1 Seconds
Appearance of sample after warming to room temperature	Shall regain original clarity and fluidity	Regains original clarity and fluidity
@ 60°C (140°F)		
Stratification	None	None
Sedimentation	max. 0.15%	None

TESTS	REQUIREMENTS	RESULTS
Compatibility		
@ -40°C (-40°F)		
Stratification or sedimentation, sludging or crystallization	None	None
@ 60°C (140°F)		
Stratification	None	None
Sedimentation	max. 0.05%	None
Resistance To Oxidation		
Pitting or roughening of metal strips discernible to naked eye	None	None
Gum deposited on metal strips	Trace	None
Weight loss in mg./sq. cm.		
Aluminum	max. 0.05	0.01
Cast iron	max. 0.3	0.03
Effect On Rubber		
@ 70°C ± 2°C (158°F ± 3.6°F)		
Hardness increase	None	None
Hardness decrease	max. 10 IRHD	5 IRHD
Base diameter increase	0.15 mm (0.006 in) to1.40mm (0.055 in)	0.43 mm (0.017 in.)
Disintegration as evidenced by stickiness, blisters or sloughing	None	None

TESTS	REQUIREMENTS	RESULTS
Effect On Rubber,continued		
@ 120°C ± 2°C (248°F ± 3.6°F)		
Hardness increase	None	None
Hardness decrease	max. 15 IRHD	3 IRHD
Base diameter increase	0.15 mm (0.006 in) to 1.40mm (0.055 in)	0.79 mm (0.031 in.)
Disintegration as evidenced by stickiness, blisters or sloughing	None	None
Simulated Service Performance 85,000 strokes, 120°C ± 5°C (248°F ± 9°F)		
Pitting or etching of metal parts discernible without magnification	None	None
Change in initial diameter of any cylinder or piston	max.0.13mm. (0.005 in.)	None
Average lip diameter inter-ference set of rubber cups	max. 65%	26 %
Average hardness decrease of rubber cups	max. 15 IRHD	5 IRHD
Number of rubber cups having a hardness decrease greater than 17 IRHD	max. 1	None
Operating conditions of rubber cups as evidenced by stickiness, blisters or sloughing	Satisfactory	Satisfactory
Fluid loss during any 24,000 stroke period	max. 36 ml.	5 ml.

TESTS	REQUIREMENTS	RESULTS
Simulated Service Performance,continued		
Freezing or malfunction of cylinder pistons	None	None
Fluid loss during 100 strokes at end of test	max. 36 ml.	5 ml.
Condition of fluid after test; evidence of gelling	None	None
Percent sediment in fluid drained from wheel cylinders and master cylinder	max. 1.5%	< 0.05%
Increase in base diameter of rubber cups		
Wheel cylinder cups	max. 0.90 mm. (0.035 in)	0.66 mm. (0.026 in)
Master cylinder cups		
Primary	max. 0.90 mm. (0.035 in)	0.41 mm. (0.016 in)
Secondary	max. 0.90 mm. (0.035 in)	0.55 mm. (0.022 in)
Deposits formed or adhering to cylinder walls that are abrasive or cannot be removed with ethanol	None	None
Color	Colorless to amber	Amber

DISCUSSION

The sample of Dow Brake Fluid 460 tested meets the requirements of the Federal Motor Vehicle Safety Standard 116 as published in the Federal Register and amended October 1, 2006 for DOT 4 Motor Vehicle Brake Fluid.

Respectfully submitted

Leonard Mackowiak
Vice President

PE16-009

BOWMAN AND BROOKE

10-25-2017

FOR DOW AUTOMOTIVE SYSTEMS

REQUEST NO. 7

DOW000762

ABIC *TESTING LABORATORIES, INC.*

24 Spielman Road **973-227-7060**
Fairfield, NJ 07004 **Fax: 973-227-0172**

Report to:	Dow Chemical	April 15, 2010
Sample of:	DOT 4 Motor Vehicle Brake Fluid	
Submitted by:	Ms. Lisa Wujkowski	
Project No.:	5013-51	
Sample No.:	2268	
Marking:	Dow Brake Fluid 460, Batch YB100195K1	
Sampled by:	Client	

RESULTS OF TESTS FOR CONFORMANCE WITH FEDERAL MOTOR VEHICLE SAFETY STANDARD 116 FOR DOT 4 MOTOR VEHICLE BRAKE FLUID

TESTS	REQUIREMENTS	RESULTS
Original Equilibrium Reflux		
Boiling point	min. 230°C (446°F)	271°C (520°F)
Wet Equilibrium Reflux		
Boiling point	min. 155°C (311°F)	171°C (340°F)
Viscosity		
@ -40 °C (-40 °F)	max. 1800 mm^2/s.	954 mm^2/s.
@ 100 °C (212 °F)	min. 1.5 mm^2/s.	2.2 mm^2/s.
pH	7 - 11.5	7.4
Brake Fluid Stability		
High temperature stability Boiling point change	max. 3°C (5.4°F) + 0.05/1° that original ERBP exceeds 225 °C (437 °F)	-1°C (-1°F)

Division of ABIC INTERNATIONAL CONSULTANTS, INC.

TESTS	REQUIREMENTS	RESULTS
Chemical stability Boiling point change	max. 3.0°C (5.4 °F) + 0.05/1 that original ERBP exceeds 225°C (437°F)	-1°C (-2°F)
Corrosion		
Weight change in mg./sq. cm.		
Tinned iron	max. 0.2	0.00
Steel	max. 0.2	0.00
Aluminum	max. 0.1	0.00
Cast iron	max. 0.2	0.00
Brass	max. 0.4	0.03
Copper	max. 0.4	0.03
Pitting or etching of strips discernible without magnification	None	None
Gelling of fluid/water, mixture at 23 ± 5°C (73.4°F ± 9°F)	None	None
Crystalline deposit on glass jar walls or on metal strips	None	None
pH of water/fluid mixture	7 - 11.5	7.3
Sedimentation	max. 0.10%	None
Disintegration of rubber cup as evidenced by stickiness, blisters or sloughing	None	None
Decrease in hardness of rubber cups	max. 15 IRHD	2 IRHD
Increase in base diameter of rubber cup	max. 1.4 mm. (0.055 in)	0.03 mm (0.001 in)

TESTS	REQUIREMENTS	RESULTS
Fluidity And Appearance At Low Temperatures		
@ -40°C (-40°F)		
Stratification or sedimentation, sludging or crystallization	None	None
Time for air bubble to travel to top	max. 10 seconds	3 Seconds
Appearance of sample after warming to room temperature	Same as before testing	Same
@ -50°C (-58°F)		
Stratification or sedimentation, sludging or crystallization	None	None
Time for air bubble to travel to top	max. 35 seconds	6 Seconds
Appearance of sample after warming to room temperature	Same as before testing	Same
Water Tolerance		
@ -40°C (-40°F)		
Stratification or sedimentation, sludging or crystallization	None	None
Time for air bubble to travel to top	max. 10 seconds	3 Seconds
Appearance of sample after warming to room temperature	Shall regain original clarity and fluidity	Regains original clarity and fluidity
@ 60°C (140°F)		
Stratification	None	None
Sedimentation	max. 0.15%	None

TESTS	REQUIREMENTS	RESULTS
Compatibility		
@ -40°C (-40°F)		
Stratification or sedimentation, sludging or crystallization	None	None
@ 60°C (140°F)		
Stratification	None	None
Sedimentation	max. 0.05%	None
Resistance To Oxidation		
Pitting or roughening of metal strips discernible to naked eye	None	None
Gum deposited on metal strips	Trace	None
Weight loss in mg./sq. cm.		
Aluminum	max. 0.05	0.00
Cast iron	max. 0.3	0.02
Effect On Rubber		
@ 70°C ± 2°C (158°F ± 3.6°F)		
Hardness increase	None	None
Hardness decrease	max. 10 IRHD	4 IRHD
Base diameter increase	0.15 mm (0.006 in) to1.40mm (0.055 in)	0.48 mm (0.019 in.)
Disintegration as evidenced by stickiness, blisters or sloughing	None	None

TESTS	REQUIREMENTS	RESULTS
Effect On Rubber,continued		
@ 120°C ± 2°C (248°F ± 3.6°F)		
Hardness increase	None	None
Hardness decrease	max. 15 IRHD	6 IRHD
Base diameter increase	0.15 mm (0.006 in) to 1.40mm (0.055 in)	0.61 mm (0.024 in.)
Disintegration as evidenced by stickiness, blisters or sloughing	None	None
Simulated Service Performance 85,000 strokes, 120°C ± 5°C (248°F ± 9°F)		
Pitting or etching of metal parts discernible without magnification	None	None
Change in initial diameter of any cylinder or piston	max.0.13mm. (0.005 in.)	None
Average lip diameter interference set of rubber cups	max. 65%	28 %
Average hardness decrease of rubber cups	max. 15 IRHD	3 IRHD
Number of rubber cups having a hardness decrease greater than 17 IRHD	max. 1	None
Operating conditions of rubber cups as evidenced by stickiness, blisters or sloughing	Satisfactory	Satisfactory
Fluid loss during any 24,000 stroke period	max. 36 ml.	5 ml.

TESTS	REQUIREMENTS	RESULTS
Simulated Service Performance,continued		
Freezing or malfunction of cylinder pistons	None	None
Fluid loss during 100 strokes at end of test	max. 36 ml.	3 ml.
Condition of fluid after test; evidence of gelling	None	None
Percent sediment in fluid drained from wheel cylinders and master cylinder	max. 1.5%	< 0.05%
Increase in base diameter of rubber cups		
Wheel cylinder cups	max. 0.90 mm. (0.035 in)	0.71 mm. (0.028 in)
Master cylinder cups		
Primary	max. 0.90 mm. (0.035 in)	0.45 mm. (0.018 in)
Secondary	max. 0.90 mm. (0.035 in)	0.58 mm. (0.023 in)
Deposits formed or adhering to cylinder walls that are abrasive or cannot be removed with ethanol	None	None
Color	Colorless to amber	Amber

DISCUSSION

The sample of Dow Brake Fluid 460, BatchYB100195K1 tested meets the requirements of the Federal Motor Vehicle Safety Standard 116 as published in the Federal Register and amended October 1, 2008 for DOT 4 Motor Vehicle Brake Fluid.

Respectfully submitted

Leonard Mackowiak
Vice President

PE16-009

BOWMAN AND BROOKE

10-25-2017

FOR DOW AUTOMOTIVE SYSTEMS

REQUEST NO. 7

DOW000768

ABIC *TESTING LABORATORIES, INC.*

24 Spielman Road **973-227-7060**
Fairfield, NJ 07004 **Fax: 973-227-0172**

Report to:	Dow Chemical	June 15, 2010
Sample of:	DOT 4 Motor Vehicle Brake Fluid	
Submitted by:	Ms. Lisa Wujkowski	
Project No.:	5013-51	
Sample No.:	2288	
Marking:	Dow Brake Fluid 460, Batch YE1701EGMA	
Sampled by:	Client	

RESULTS OF TESTS FOR CONFORMANCE WITH FEDERAL MOTOR SAFETY STANDARD 116 FOR DOT MOTOR VEHICLE BRAKE FLUID

TESTS	REQUIREMENTS	RESULTS
Simulated Service Performance 85,000 strokes, 120 ±5°C (248 ± 9°F)		
Pitting or etching of metal parts discernible without magnification	None	None
Change in initial diameter of any cylinder or piston	max.0.13mm. (0.005 in.)	0.05 mm (0.002 in.)
Average lip diameter interference set of rubber cups	max. 65%	28 %
Average hardness decrease of rubber cups	max. 15 IRHD	3 IRHD
Number of rubber cups having a hardness decrease greater than 17 IRHD	max. 1	None
Operating conditions of rubber cups as evidenced by stickiness, blisters, scuffing, cracking, chipping or change in shape	Satisfactory	Satisfactory

Fluid loss during any 24,000 stroke period	max. 36 ml.	6 ml.
Freezing or malfunction of cylinder pistons	None	None
Fluid loss during 100 strokes at end of test	max. 36 ml.	3 ml.
Condition of fluid after test; evidence of gelling	None	None
Percent sediment in fluid drained from wheel cylinders and master cylinder	max. 1.5%	< 0.05%
Increase in base diameter of rubber cups		
Wheel cylinder cups	max. 0.90 mm. (0.035 in)	0.66 mm. (0.026 in.)
Master cylinder cups		
Primary	max. 0.90 mm. (0.035 in)	0.53 mm. (0.021 in.)
Secondary	max. 0.90 mm. (0.035 in)	0.50 mm. (0.020 in.)
Deposits formed or adhering to cylinder walls that are abrasive or cannot be removed with ethanol	None	None

DISCUSSION

The sample of Dow Brake Fluid 460, Batch YE1701EGMA tested meets the Simulated Service Performance requirements of the Federal Motor Vehicle Safety Standard 116 as published in the Federal Register and amended October 1, 2008 for DOT 4 Motor Vehicle Brake Fluid.

Respectfully submitted,

Leonard Mackowiak
Vice President

PE16-009

BOWMAN AND BROOKE

10-25-2017

FOR DOW AUTOMOTIVE SYSTEMS

REQUEST NO. 7

DOW000770

ABIC *TESTING LABORATORIES, INC.*

24 Spielman Road **973-227-7060**
Fairfield, NJ 07004 **Fax: 973-227-0172**

Report to:	Dow Chemical	July 11, 2011
Sample of:	DOT 4 Motor Vehicle Brake Fluid	
Submitted by:	Ms. Lisa Wujkowski	
Project No.:	5013-54a	
Sample No.:	2464	
Marking:	Dow Brake Fluid 460, Batch 201100656-44-3	
Sampled by:	Client	

RESULTS OF TESTS FOR CONFORMANCE WITH FEDERAL MOTOR VEHICLE SAFETY STANDARD 116 FOR DOT 4 MOTOR VEHICLE BRAKE FLUID

TESTS	REQUIREMENTS	RESULTS
Original Equilibrium Reflux		
Boiling point	min. 230°C (446°F)	271°C (520°F)
Wet Equilibrium Reflux		
Boiling point	min. 155°C (311°F)	170°C (337°F)
Viscosity		
@ -40 °C (-40 °F)	max. 1800 mm^2/s.	1008 mm^2/s.
@ 100 °C (212 °F)	min. 1.5 mm^2/s.	2.3 mm^2/s.
pH	7 - 11.5	7.4
Brake Fluid Stability		
High temperature stability Boiling point change	max. 3°C (5.4°F) + 0.05/1° that original ERBP exceeds 225 °C (437 °F)	-1°C (-1°F)

Division of ABIC INTERNATIONAL CONSULTANTS, INC.

TESTS	REQUIREMENTS	RESULTS
Chemical stability Boiling point change	max. 3.0°C (5.4 °F) + 0.05/1 that original ERBP exceeds 225°C (437°F)	-1°C (-2°F)
Corrosion		
Weight change in mg./sq. cm.		
Tinned iron	max. 0.2	0.00
Steel	max. 0.2	0.01
Aluminum	max. 0.1	0.00
Cast iron	max. 0.2	0.00
Brass	max. 0.4	0.04
Copper	max. 0.4	0.03
Pitting or etching of strips discernible without magnification	None	None
Gelling of fluid/water, mixture at 23 ± 5°C (73.4°F ± 9°F)	None	None
Crystalline deposit on glass jar walls or on metal strips	None	None
pH of water/fluid mixture	7 - 11.5	7.3
Sedimentation	max. 0.10%	None
Disintegration of rubber cup as evidenced by stickiness, blisters or sloughing	None	None
Decrease in hardness of rubber cups	max. 15 IRHD	2 IRHD
Increase in base diameter of rubber cup	max. 1.4 mm. (0.055 in)	0.03 mm (0.001 in)

TESTS	REQUIREMENTS	RESULTS
Fluidity And Appearance At Low Temperatures		
@ -40°C (-40°F)		
Stratification or sedimentation, sludging or crystallization	None	None
Time for air bubble to travel to top	max. 10 seconds	3 Seconds
Appearance of sample after warming to room temperature	Same as before testing	Same
@ -50°C (-58°F)		
Stratification or sedimentation, sludging or crystallization	None	None
Time for air bubble to travel to top	max. 35 seconds	7 Seconds
Appearance of sample after warming to room temperature	Same as before testing	Same
Water Tolerance		
@ -40°C (-40°F)		
Stratification or sedimentation, sludging or crystallization	None	None
Time for air bubble to travel to top	max. 10 seconds	3 Seconds
Appearance of sample after warming to room temperature	Shall regain original clarity and fluidity	Regains original clarity and fluidity
@ 60°C (140°F)		
Stratification	None	None
Sedimentation	max. 0.15%	None

TESTS	REQUIREMENTS	RESULTS
Compatibility		
@ -40°C (-40°F)		
Stratification or sedimentation, sludging or crystallization	None	None
@ 60°C (140°F)		
Stratification	None	None
Sedimentation	max. 0.05%	None
Resistance To Oxidation		
Pitting or roughening of metal strips discernible to naked eye	None	None
Gum deposited on metal strips	Trace	None
Weight loss in mg./sq. cm.		
Aluminum	max. 0.05	0.01
Cast iron	max. 0.3	0.02
Effect On Rubber		
@ 70°C ± 2°C (158°F ± 3.6°F)		
Hardness increase	None	None
Hardness decrease	max. 10 IRHD	6 IRHD
Base diameter increase	0.15 mm (0.006 in) to1.40mm (0.055 in)	0.41 mm (0.016 in.)
Disintegration as evidenced by stickiness, blisters or sloughing	None	None

TESTS	REQUIREMENTS	RESULTS
Effect On Rubber,continued		
@ 120°C ± 2°C (248°F ± 3.6°F)		
Hardness increase	None	None
Hardness decrease	max. 15 IRHD	7 IRHD
Base diameter increase	0.15 mm (0.006 in) to 1.40mm (0.055 in)	0.53 mm (0.021 in.)
Disintegration as evidenced by stickiness, blisters or sloughing	None	None
Simulated Service Performance 85,000 strokes, 120°C ± 5°C (248°F ± 9°F)		
Pitting or etching of metal parts discernible without magnification	None	None
Change in initial diameter of any cylinder or piston	max.0.13mm. (0.005 in.)	None
Average lip diameter interference set of rubber cups	max. 65%	26 %
Average hardness decrease of rubber cups	max. 15 IRHD	5 IRHD
Number of rubber cups having a hardness decrease greater than 17 IRHD	max. 1	None
Operating conditions of rubber cups as evidenced by stickiness, blisters or sloughing	Satisfactory	Satisfactory
Fluid loss during any 24,000 stroke period	max. 36 ml.	6 ml.

TESTS	REQUIREMENTS	RESULTS
Simulated Service Performance,continued		
Freezing or malfunction of cylinder pistons	None	None
Fluid loss during 100 strokes at end of test	max. 36 ml.	3 ml.
Condition of fluid after test; evidence of gelling	None	None
Percent sediment in fluid drained from wheel cylinders and master cylinder	max. 1.5%	< 0.05%
Increase in base diameter of rubber cups		
Wheel cylinder cups	max. 0.90 mm. (0.035 in)	0.66 mm. (0.026 in)
Master cylinder cups		
Primary	max. 0.90 mm. (0.035 in)	0.38 mm. (0.015 in)
Secondary	max. 0.90 mm. (0.035 in)	0.53 mm. (0.021 in)
Deposits formed or adhering to cylinder walls that are abrasive or cannot be removed with ethanol	None	None
Color	Colorless to amber	Amber

DISCUSSION

The sample of Dow Brake Fluid 460, Batch 201100656-44-3 tested meets the requirements of the Federal Motor Vehicle Safety Standard 116 as published in the Federal Register and amended October 1, 2008 for DOT 4 Motor Vehicle Brake Fluid.

Respectfully submitted

Leonard Mackowiak
Vice President

PE16-009

BOWMAN AND BROOKE

10-25-2017

FOR DOW AUTOMOTIVE SYSTEMS

REQUEST NO. 7

DOW000776

ABIC *TESTING LABORATORIES, INC.*

24 Spielman Road **973-227-7060**
Fairfield, NJ 07004 **Fax: 973-227-0172**

Report to:	Dow Chemical	May 10, 2013
Sample of:	DOT 4 Motor Vehicle Brake Fluid	
Submitted by:	Ms. Lisa Wujkowski	
Project No.:	5013-59	
Sample No.:	2727	
Marking:	Dow Brake Fluid 460, Batch 2B200195K1	
Sampled by:	Client	

RESULTS OF TESTS FOR CONFORMANCE WITH FEDERAL MOTOR VEHICLE SAFETY STANDARD 116 FOR DOT 4 MOTOR VEHICLE BRAKE FLUID

TESTS	REQUIREMENTS	RESULTS
Original Equilibrium Reflux		
Boiling point	min. 230°C (446°F)	276°C (528°F)
Wet Equilibrium Reflux		
Boiling point	min. 155°C (311°F)	174°C (345°F)
Viscosity		
@ -40 °C (-40 °F)	max. 1800 mm^2/s.	1028 mm^2/s.
@ 100 °C (212 °F)	min. 1.5 mm^2/s.	2.4 mm^2/s.
pH	7 - 11.5	7.5
Brake Fluid Stability		
High temperature stability Boiling point change	max. 3°C (5.4°F) + 0.05/1° that original ERBP exceeds 225 °C (437 °F)	-1°C (-1°F)

Division of ABIC INTERNATIONAL CONSULTANTS, INC.

TESTS	REQUIREMENTS	RESULTS
Chemical stability Boiling point change	max. 3.0°C (5.4 °F) + 0.05/1 that original ERBP exceeds 225°C (437°F)	-1°C (-2°F)
Corrosion		
Weight change in mg./sq. cm.		
Tinned iron	max. 0.2	0.00
Steel	max. 0.2	0.00
Aluminum	max. 0.1	0.00
Cast iron	max. 0.2	0.00
Brass	max. 0.4	0.03
Copper	max. 0.4	0.05
Pitting or etching of strips discernible without magnification	None	None
Gelling of fluid/water, mixture at 23 ± 5°C (73.4°F ± 9°F)	None	None
Crystalline deposit on glass jar walls or on metal strips	None	None
pH of water/fluid mixture	7 - 11.5	7.5
Sedimentation	max. 0.10%	None
Disintegration of rubber cup as evidenced by stickiness, blisters or sloughing	None	None
Decrease in hardness of rubber cups	max. 15 IRHD	2 IRHD
Increase in base diameter of rubber cup	max. 1.4 mm. (0.055 in)	0.02 mm (0.001 in)

TESTS	REQUIREMENTS	RESULTS
Fluidity And Appearance At Low Temperatures		
@ -40°C (-40°F)		
Stratification or sedimentation, sludging or crystallization	None	None
Time for air bubble to travel to top	max. 10 seconds	3 Seconds
Appearance of sample after warming to room temperature	Same as before testing	Same
@ -50°C (-58°□F)		
Stratification or sedimentation, sludging or crystallization	None	None
Time for air bubble to travel to top	max. 35 seconds	5 Seconds
Appearance of sample after warming to room temperature	Same as before testing	Same
Water Tolerance		
@ -40°C (-40°F)		
Stratification or sedimentation, sludging or crystallization	None	None
Time for air bubble to travel to top	max. 10 seconds	2 Seconds
Appearance of sample after warming to room temperature	Shall regain original clarity and fluidity	Regains original clarity and fluidity
@ 60°C (140°F)		
Stratification	None	None
Sedimentation	max. 0.15%	None

TESTS	REQUIREMENTS	RESULTS
Compatibility		
@ -40°C (-40°F)		
Stratification or sedimentation, sludging or crystallization	None	None
@ 60°C (140°F)		
Stratification	None	None
Sedimentation	max. 0.05%	None
Resistance To Oxidation		
Pitting or roughening of metal strips discernible to naked eye	None	None
Gum deposited on metal strips	Trace	None
Weight loss in mg./sq. cm.		
Aluminum	max. 0.05	0.00
Cast iron	max. 0.3	0.01
Effect On Rubber		
@ 70°C ± 2°C (158°F ± 3.6°F)		
Hardness increase	None	None
Hardness decrease	max. 10 IRHD	8 IRHD
Base diameter increase	0.15 mm (0.006 in) to1.40mm (0.055 in)	0.50 mm (0.020 in.)
Disintegration as evidenced by stickiness, blisters or sloughing	None	None

TESTS	REQUIREMENTS	RESULTS
Effect On Rubber,continued		
@ 120°C ± 2°C (248°F ± 3.6°F)		
Hardness increase	None	None
Hardness decrease	max. 15 IRHD	8 IRHD
Base diameter increase	0.15 mm (0.006 in) to 1.40mm (0.055 in)	0.76 mm (0.030 in.)
Disintegration as evidenced by stickiness, blisters or sloughing	None	None
Simulated Service Performance 85,000 strokes, 120°C ± 5°C (248°F ± 9°F)		
Pitting or etching of metal parts discernible without magnification	None	None
Change in initial diameter of any cylinder or piston	max.0.13mm. (0.005 in.)	None
Average lip diameter interference set of rubber cups	max. 65%	33 %
Average hardness decrease of rubber cups	max. 15 IRHD	8 IRHD
Number of rubber cups having a hardness decrease greater than 17 IRHD	max. 1	None
Operating conditions of rubber cups as evidenced by stickiness, blisters or sloughing	Satisfactory	Satisfactory
Fluid loss during any 24,000 stroke period	max. 36 ml.	6 ml.

TESTS	REQUIREMENTS	RESULTS
Simulated Service Performance,continued		
Freezing or malfunction of cylinder pistons	None	None
Fluid loss during 100 strokes at end of test	max. 36 ml.	4 ml.
Condition of fluid after test; evidence of gelling	None	None
Percent sediment in fluid drained from wheel cylinders and master cylinder	max. 1.5%	< 0.05%
Increase in base diameter of rubber cups		
Wheel cylinder cups	max. 0.90 mm. (0.035 in)	0.76 mm. (0.030 in)
Master cylinder cups		
Primary	max. 0.90 mm. (0.035 in)	0.53 mm. (0.021 in)
Secondary	max. 0.90 mm. (0.035 in)	0.63 mm. (0.025 in)
Deposits formed or adhering to cylinder walls that are abrasive or cannot be removed with ethanol	None	None
Color	Colorless to amber	Amber

DISCUSSION

The sample of Dow Brake Fluid 460, Batch 2B200195K1 tested meets the requirements of the Federal Motor Vehicle Safety Standard 116 as published in the Federal Register and amended October 1, 2010 for DOT 4 Motor Vehicle Brake Fluid.

Respectfully submitted

Leonard Mackowiak
Vice President

PE16-009

BOWMAN AND BROOKE

10-25-2017

FOR DOW AUTOMOTIVE SYSTEMS

REQUEST NO. 7

DOW000782

ABIC *TESTING LABORATORIES, INC.*

24 Spielman Road **973-227-7060**
Fairfield, NJ 07004 **Fax: 973-227-0172**

Report to:	Dow Chemical	June 4, 2014
Sample of:	DOT 4 Motor Vehicle Brake Fluid	
Submitted by:	Ms. Lisa Wujkowski	
Project No.:	5013-62	
Sample No.:	2810	
Marking:	Dow Brake Fluid 460, Batch 301001EGMA: IRAM Certification No. 399321	
Sampled by:	Client	

RESULTS OF TESTS FOR CONFORMANCE WITH FEDERAL MOTOR VEHICLE SAFETY STANDARD 116 FOR DOT 4 MOTOR VEHICLE BRAKE FLUID

TESTS	REQUIREMENTS	RESULTS
Original Equilibrium Reflux		
Boiling point	min. 230°C (446°F)	275°C (526°F)
Wet Equilibrium Reflux		
Boiling point	min. 155°C (311°F)	172°C (342°F)
Viscosity		
@ -40 °C (-40 °F)	max. 1800 mm^2/s.	954 mm^2/s.
@ 100 °C (212 °F)	min. 1.5 mm^2/s.	2.7 mm^2/s.
pH	7 - 11.5	7.7
Brake Fluid Stability		
High temperature stability Boiling point change	max. 3°C (5.4°F) + 0.05/1° that original ERBP exceeds 225 °C (437 °F)	-1°C (-1°F)

Division of ABIC INTERNATIONAL CONSULTANTS, INC.

TESTS	REQUIREMENTS	RESULTS
Chemical stability Boiling point change	max. 3.0°C (5.4 °F) + 0.05/1 that original ERBP exceeds 225°C (437°F)	-1°C (-2°F)
Corrosion		
Weight change in mg./sq. cm.		
Tinned iron	max. 0.2	0.00
Steel	max. 0.2	0.00
Aluminum	max. 0.1	0.00
Cast iron	max. 0.2	0.01
Brass	max. 0.4	0.04
Copper	max. 0.4	0.05
Pitting or etching of strips discernible without magnification	None	None
Gelling of fluid/water, mixture at 23 ± 5°C (73.4°F ± 9°F)	None	None
Crystalline deposit on glass jar walls or on metal strips	None	None
pH of water/fluid mixture	7 - 11.5	7.7
Sedimentation	max. 0.10%	None
Disintegration of rubber cup as evidenced by stickiness, blisters or sloughing	None	None
Decrease in hardness of rubber cups	max. 15 IRHD	4 IRHD
Increase in base diameter of rubber cup	max. 1.4 mm. (0.055 in)	0.02 mm (0.001 in)

TESTS	REQUIREMENTS	RESULTS
Fluidity And Appearance At Low Temperatures		
@ -40°C (-40°F)		
Stratification or sedimentation, sludging or crystallization	None	None
Time for air bubble to travel to top	max. 10 seconds	3 Seconds
Appearance of sample after warming to room temperature	Same as before testing	Same
@ -50°C (-58°□F)		
Stratification or sedimentation, sludging or crystallization	None	None
Time for air bubble to travel to top	max. 35 seconds	6 Seconds
Appearance of sample after warming to room temperature	Same as before testing	Same
Water Tolerance		
@ -40°C (-40°F)		
Stratification or sedimentation, sludging or crystallization	None	None
Time for air bubble to travel to top	max. 10 seconds	2 Seconds
Appearance of sample after warming to room temperature	Shall regain original clarity and fluidity	Regains original clarity and fluidity
@ 60°C (140°F)		
Stratification	None	None
Sedimentation	max. 0.15%	None

TESTS	REQUIREMENTS	RESULTS
Compatibility		
@ -40°C (-40°F)		
Stratification or sedimentation, sludging or crystallization	None	None
@ 60°C (140°F)		
Stratification	None	None
Sedimentation	max. 0.05%	None
Resistance To Oxidation		
Pitting or roughening of metal strips discernible to naked eye	None	None
Gum deposited on metal strips	Trace	None
Weight loss in mg./sq. cm.		
Aluminum	max. 0.05	0.00
Cast iron	max. 0.3	0.02
Effect On Rubber		
@ 70°C ± 2°C (158°F ± 3.6°F)		
Hardness increase	None	None
Hardness decrease	max. 10 IRHD	8 IRHD
Base diameter increase	0.15 mm (0.006 in) to1.40mm (0.055 in)	0.50 mm (0.020 in.)
Disintegration as evidenced by stickiness, blisters or sloughing	None	None

TESTS	REQUIREMENTS	RESULTS
Effect On Rubber,continued		
@ 120°C ± 2°C (248°F ± 3.6°F)		
Hardness increase	None	None
Hardness decrease	max. 15 IRHD	8 IRHD
Base diameter increase	0.15 mm (0.006 in) to 1.40mm (0.055 in)	0.78 mm (0.031 in.)
Disintegration as evidenced by stickiness, blisters or sloughing	None	None
Simulated Service Performance 85,000 strokes, 120°C ± 5°C (248°F ± 9°F)		
Pitting or etching of metal parts discernible without magnification	None	None
Change in initial diameter of any cylinder or piston	max.0.13mm. (0.005 in.)	None
Average lip diameter interference set of rubber cups	max. 65%	38 %
Average hardness decrease of rubber cups	max. 15 IRHD	9 IRHD
Number of rubber cups having a hardness decrease greater than 17 IRHD	max. 1	None
Operating conditions of rubber cups as evidenced by stickiness, blisters or sloughing	Satisfactory	Satisfactory
Fluid loss during any 24,000 stroke period	max. 36 ml.	5 ml.

TESTS	REQUIREMENTS	RESULTS
Simulated Service Performance,continued		
Freezing or malfunction of cylinder pistons	None	None
Fluid loss during 100 strokes at end of test	max. 36 ml.	3 ml.
Condition of fluid after test; evidence of gelling	None	None
Percent sediment in fluid drained from wheel cylinders and master cylinder	max. 1.5%	< 0.05%
Increase in base diameter of rubber cups		
Wheel cylinder cups	max. 0.90 mm. (0.035 in)	0.80 mm. (0.032 in)
Master cylinder cups		
Primary	max. 0.90 mm. (0.035 in)	0.58 mm. (0.023 in)
Secondary	max. 0.90 mm. (0.035 in)	0.63 mm. (0.025 in)
Deposits formed or adhering to cylinder walls that are abrasive or cannot be removed with ethanol	None	None
Color	Colorless to amber	Amber

DISCUSSION

The sample of Dow Brake Fluid 460, Batch 301001EGMA: IRAM Certificate No. 399321 tested meets the requirements of the Federal Motor Vehicle Safety Standard 116 as published in the Federal Register and amended January 17, 2014 for DOT 4 Motor Vehicle Brake Fluid.

Respectfully submitted

Leonard Mackowiak
Vice President

PE16-009

BOWMAN AND BROOKE

10-25-2017

FOR DOW AUTOMOTIVE SYSTEMS

REQUEST NO. 7

DOW000788

ABIC *TESTING LABORATORIES, INC.*

24 Spielman Road **973-227-7060**
Fairfield, NJ 07004 **Fax: 973-227-0172**

Report to:	Dow Chemical	August 17, 2015
Sample of:	DOT 4 Motor Vehicle Brake Fluid	
Submitted by:	Ms. Lisa Wujkowski	
Project No.:	5013-64	
Sample No.:	2895	
Marking:	Dow Brake Fluid 460, Batch YY00F6BBICA	
Sampled by:	Client	

RESULTS OF TESTS FOR CONFORMANCE WITH FEDERAL MOTOR VEHICLE SAFETY STANDARD 116 FOR DOT 4 MOTOR VEHICLE BRAKE FLUID

TESTS	REQUIREMENTS	RESULTS
Original Equilibrium Reflux		
Boiling point	min. 230°C (446°F)	272°C (522°F)
Wet Equilibrium Reflux		
Boiling point	min. 155°C (311°F)	172°C (341°F)
Viscosity		
@ -40 °C (-40 °F)	max. 1800 mm^2/s.	948 mm^2/s.
@ 100 °C (212 °F)	min. 1.5 mm^2/s.	2.3 mm^2/s.
pH	7 - 11.5	7.6
Brake Fluid Stability		
High temperature stability Boiling point change	max. 3°C (5.4°F) + 0.05/1° that original ERBP exceeds 225 °C (437 °F)	-1°C (-1°F)

Division of ABIC INTERNATIONAL CONSULTANTS, INC.

TESTS	REQUIREMENTS	RESULTS
Chemical stability Boiling point change	max. 3.0°C (5.4 °F) + 0.05/1 that original ERBP exceeds 225°C (437°F)	-1°C (-2°F)
Corrosion		
Weight change in mg./sq. cm.		
Tinned iron	max. 0.2	0.00
Steel	max. 0.2	0.00
Aluminum	max. 0.1	0.00
Cast iron	max. 0.2	0.00
Brass	max. 0.4	0.04
Copper	max. 0.4	0.04
Pitting or etching of strips discernible without magnification	None	None
Gelling of fluid/water, mixture at 23 ± 5°C (73.4°F ± 9°F)	None	None
Crystalline deposit on glass jar walls or on metal strips	None	None
pH of water/fluid mixture	7 - 11.5	7.7
Sedimentation	max. 0.10%	None
Disintegration of rubber cup as evidenced by stickiness, blisters or sloughing	None	None
Decrease in hardness of rubber cups	max. 15 IRHD	4 IRHD
Increase in base diameter of rubber cup	max. 1.4 mm. (0.055 in)	0.05 mm (0.002 in)

TESTS	REQUIREMENTS	RESULTS
Fluidity And Appearance At Low Temperatures		
@ -40°C (-40°F)		
Stratification or sedimentation, sludging or crystallization	None	None
Time for air bubble to travel to top	max. 10 seconds	2 Seconds
Appearance of sample after warming to room temperature	Same as before testing	Same
@ -50°C (-58°F)		
Stratification or sedimentation, sludging or crystallization	None	None
Time for air bubble to travel to top	max. 35 seconds	4 Seconds
Appearance of sample after warming to room temperature	Same as before testing	Same
Water Tolerance		
@ -40°C (-40°F)		
Stratification or sedimentation, sludging or crystallization	None	None
Time for air bubble to travel to top	max. 10 seconds	2 Seconds
Appearance of sample after warming to room temperature	Shall regain original clarity and fluidity	Regains original clarity and fluidity
@ 60°C (140°F)		
Stratification	None	None
Sedimentation	max. 0.15%	None

TESTS	REQUIREMENTS	RESULTS
Compatibility		
@ -40°C (-40°F)		
Stratification or sedimentation, sludging or crystallization	None	None
@ 60°C (140°F)		
Stratification	None	None
Sedimentation	max. 0.05%	None
Resistance To Oxidation		
Pitting or roughening of metal strips discernible to naked eye	None	None
Gum deposited on metal strips	Trace	None
Weight loss in mg./sq. cm.		
Aluminum	max. 0.05	0.01
Cast iron	max. 0.3	0.03
Effect On Rubber		
@ 70°C ± 2°C (158°F ± 3.6°F)		
Hardness increase	None	None
Hardness decrease	max. 10 IRHD	4 IRHD
Base diameter increase	0.15 mm (0.006 in) to1.40mm (0.055 in)	0.48 mm (0.019 in.)
Disintegration as evidenced by stickiness, blisters or sloughing	None	None

TESTS	REQUIREMENTS	RESULTS
Effect On Rubber,continued		
@ 120°C ± 2°C (248°F ± 3.6°F)		
Hardness increase	None	None
Hardness decrease	max. 15 IRHD	6 IRHD
Base diameter increase	0.15 mm (0.006 in) to 1.40mm (0.055 in)	0.73 mm (0.029 in.)
Disintegration as evidenced by stickiness, blisters or sloughing	None	None
Simulated Service Performance 85,000 strokes, 120°C ± 5°C (248°F ± 9°F)		
Pitting or etching of metal parts discernible without magnification	None	None
Change in initial diameter of any cylinder or piston	max.0.13mm. (0.005 in.)	None
Average lip diameter interference set of rubber cups	max. 65%	41 %
Average hardness decrease of rubber cups	max. 15 IRHD	6 IRHD
Number of rubber cups having a hardness decrease greater than 17 IRHD	max. 1	None
Operating conditions of rubber cups as evidenced by stickiness, blisters or sloughing	Satisfactory	Satisfactory
Fluid loss during any 24,000 stroke period	max. 36 ml.	4 ml.

TESTS	REQUIREMENTS	RESULTS
Simulated Service Performance,continued		
Freezing or malfunction of cylinder pistons	None	None
Fluid loss during 100 strokes at end of test	max. 36 ml.	3 ml.
Condition of fluid after test; evidence of gelling	None	None
Percent sediment in fluid drained from wheel cylinders and master cylinder	max. 1.5%	< 0.05%
Increase in base diameter of rubber cups		
Wheel cylinder cups	max. 0.90 mm. (0.035 in)	0.83 mm. (0.033 in)
Master cylinder cups		
Primary	max. 0.90 mm. (0.035 in)	0.63 mm. (0.025 in)
Secondary	max. 0.90 mm. (0.035 in)	0.65 mm. (0.026 in)
Deposits formed or adhering to cylinder walls that are abrasive or cannot be removed with ethanol	None	None
Color	Colorless to amber	Amber

DISCUSSION

The sample of Dow Brake Fluid 460, Batch YY00F6BBIGA tested meets the requirements of the Federal Motor Vehicle Safety Standard 116 as published in the Federal Register and amended January 17, 2014 for DOT 4 Motor Vehicle Brake Fluid.

Respectfully submitted

Leonard Mackowiak
Vice President

PE16-009

BOWMAN AND BROOKE

10-25-2017

FOR DOW AUTOMOTIVE SYSTEMS

REQUEST NO. 7

DOW000794

ABIC *TESTING LABORATORIES, INC.*

24 Spielman Road **973-227-7060**
Fairfield, NJ 07004 **Fax: 973-227-0172**

Report to:	Dow Chemical	June 9, 2016
Sample of:	DOT 4 Motor Vehicle Brake Fluid	
Submitted by:	Ms. Lisa Wujkowski	
Project No.:	5013-66	
Sample No.:	2987	
Marking:	Dow Brake Fluid 460, Batch YY00G47BKA	
Sampled by:	Client	

RESULTS OF TESTS FOR CONFORMANCE WITH FEDERAL MOTOR VEHICLE SAFETY STANDARD 116 FOR DOT 4 MOTOR VEHICLE BRAKE FLUID

TESTS	REQUIREMENTS	RESULTS
Original Equilibrium Reflux		
Boiling point	min. 230°C (446°F)	274°C (526°F)
Wet Equilibrium Reflux		
Boiling point	min. 155°C (311°F)	172°C (342°F)
Viscosity		
@ -40 °C (-40 °F)	max. 1800 mm^2/s.	978 mm^2/s.
@ 100 °C (212 °F)	min. 1.5 mm^2/s.	2.3 mm^2/s.
pH	7 - 11.5	7.7
Brake Fluid Stability		
High temperature stability Boiling point change	max. 3°C (5.4°F) + 0.05/1° that original ERBP exceeds 225 °C (437 °F)	-1°C (-1°F)

Division of ABIC INTERNATIONAL CONSULTANTS, INC.

TESTS	REQUIREMENTS	RESULTS
Chemical stability Boiling point change	max. 3.0°C (5.4 °F) + 0.05/1 that original ERBP exceeds 225°C (437°F)	-1°C (-2°F)
Corrosion		
Weight change in mg./sq. cm.		
Tinned iron	max. 0.2	0.00
Steel	max. 0.2	0.01
Aluminum	max. 0.1	0.00
Cast iron	max. 0.2	0.00
Brass	max. 0.4	0.03
Copper	max. 0.4	0.04
Pitting or etching of strips discernible without magnification	None	None
Gelling of fluid/water, mixture at 23 ± 5°C (73.4°F ± 9°F)	None	None
Crystalline deposit on glass jar walls or on metal strips	None	None
pH of water/fluid mixture	7 - 11.5	7.7
Sedimentation	max. 0.10%	None
Disintegration of rubber cup as evidenced by stickiness, blisters or sloughing	None	None
Decrease in hardness of IRHD rubber cups	max. 15 IRHD	2
Increase in base diameter of rubber cup	max. 1.4 mm. (0.055 in)	0.12 mm (0.005 in)

TESTS	REQUIREMENTS	RESULTS
Fluidity And Appearance At Low Temperatures		
@ -40°C (-40°F)		
Stratification or sedimentation, sludging or crystallization	None	None
Time for air bubble to travel to top	max. 10 seconds	2 Seconds
Appearance of sample after warming to room temperature	Same as before testing	Same
@ -50°C (-58°F)		
Stratification or sedimentation, sludging or crystallization	None	None
Time for air bubble to travel to top	max. 35 seconds	5 Seconds
Appearance of sample after warming to room temperature	Same as before testing	Same
Water Tolerance		
@ -40°C (-40°F)		
Stratification or sedimentation, sludging or crystallization	None	None
Time for air bubble to travel to top	max. 10 seconds	2 Seconds
Appearance of sample after warming to room temperature	Shall regain original clarity and fluidity	Regains original clarity and fluidity
@ 60°C (140°F)		
Stratification	None	None
Sedimentation	max. 0.15%	None

TESTS	REQUIREMENTS	RESULTS
Compatibility		
@ -40°C (-40°F)		
Stratification or sedimentation, sludging or crystallization	None	None
@ 60°C (140°F)		
Stratification	None	None
Sedimentation	max. 0.05%	None
Resistance To Oxidation		
Pitting or roughening of metal strips discernible to naked eye	None	None
Gum deposited on metal strips	Trace	None
Weight loss in mg./sq. cm.		
Aluminum	max. 0.05	0.01
Cast iron	max. 0.3	0.02
Effect On Rubber		
@ 70°C ± 2°C (158°F ± 3.6°F)		
Hardness increase	None	None
Hardness decrease	max. 10 IRHD	2 IRHD
Base diameter increase	0.15 mm (0.006 in) to1.40mm (0.055 in)	0.45 mm (0.018 in.)
Disintegration as evidenced by stickiness, blisters or sloughing	None	None

TESTS	REQUIREMENTS	RESULTS
Effect On Rubber,continued		
@ 120°C ± 2°C (248°F ± 3.6°F)		
Hardness increase	None	None
Hardness decrease	max. 15 IRHD	6 IRHD
Base diameter increase	0.15 mm (0.006 in) to 1.40mm (0.055 in)	0.73 mm (0.029 in.)
Disintegration as evidenced by stickiness, blisters or sloughing	None	None
Simulated Service Performance 85,000 strokes, 120°C ± 5°C (248°F ± 9°F)		
Pitting or etching of metal parts discernible without magnification	None	None
Change in initial diameter of any cylinder or piston	max.0.13mm. (0.005 in.)	None
Average lip diameter interference set of rubber cups	max. 65%	46 %
Average hardness decrease of rubber cups	max. 15 IRHD	5 IRHD
Number of rubber cups having a hardness decrease greater than 17 IRHD	max. 1	None
Operating conditions of rubber cups as evidenced by stickiness, blisters or sloughing	Satisfactory	Satisfactory
Fluid loss during any 24,000 stroke period	max. 36 ml.	8 ml.

TESTS	REQUIREMENTS	RESULTS
Simulated Service Performance, continued		
Freezing or malfunction of cylinder pistons	None	None
Fluid loss during 100 strokes at end of test	max. 36 ml.	3 ml.
Condition of fluid after test; evidence of gelling	None	None
Percent sediment in fluid drained from wheel cylinders and master cylinder	max. 1.5%	< 0.05%
Increase in base diameter of rubber cups		
Wheel cylinder cups	max. 0.90 mm. (0.035 in)	0.86 mm. (0.034 in)
Master cylinder cups		
Primary	max. 0.90 mm. (0.035 in)	0.68 mm. (0.027 in)
Secondary	max. 0.90 mm. (0.035 in)	0.71 mm. (0.028 in)
Deposits formed or adhering to cylinder walls that are abrasive or cannot be removed with ethanol	None	None
Color	Colorless to amber	Amber

DISCUSSION

The sample of Dow Brake Fluid 460, Batch YY00G47BKA tested meets the requirements of the Federal Motor Vehicle Safety Standard 116 as published in the Federal Register and amended September 21, 2015 for DOT 4 Motor Vehicle Brake Fluid.

Respectfully submitted

Leonard Mackowiak
Vice President

PE16-009

BOWMAN AND BROOKE

10-25-2017

FOR DOW AUTOMOTIVE SYSTEMS

REQUEST NO. 7

DOW000800

ABIC *TESTING LABORATORIES, INC.*

24 Spielman Road **973-227-7060**
Fairfield, NJ 07004 **Fax: 973-227-0172**

Report to:	Dow Chemical	September 14, 2017
Sample of:	DOT 4 Motor Vehicle Brake Fluid	
Submitted by:	Ms. Lisa Wujkowski	
Project No.:	5013-70	
Sample No.:	3131	
Marking:	Dow Brake Fluid 460, Batch 1408890	
Sampled by:	Client	

RESULTS OF TESTS FOR CONFORMANCE WITH FEDERAL MOTOR VEHICLE SAFETY STANDARD 116 FOR DOT 4 MOTOR VEHICLE BRAKE FLUID

TESTS	REQUIREMENTS	RESULTS
Original Equilibrium Reflux		
Boiling point	min. 230°C (446°F)	277°C (530°F)
Wet Equilibrium Reflux		
Boiling point	min. 155°C (311°F)	174°C (346°F)
Viscosity		
@ -40 °C (-40 °F)	max. 1800 mm^2/s.	970 mm^2/s.
@ 100 °C (212 °F)	min. 1.5 mm^2/s.	2.3 mm^2/s.
pH	7 - 11.5	7.5
Brake Fluid Stability		
High temperature stability Boiling point change	max. 3°C (5.4°F) + 0.05/1° that original ERBP exceeds 225 °C (437 °F)	-1°C (-1°F)

Division of ABIC INTERNATIONAL CONSULTANTS, INC.

TESTS	REQUIREMENTS	RESULTS
Chemical stability Boiling point change	max. 3.0°C (5.4 °F) + 0.05/1 that original ERBP exceeds 225°C (437°F)	-1°C (-2°F)
Corrosion		
Weight change in mg./sq. cm.		
Tinned iron	max. 0.2	0.00
Steel	max. 0.2	0.00
Aluminum	max. 0.1	0.00
Cast iron	max. 0.2	0.00
Brass	max. 0.4	0.03
Copper	max. 0.4	0.05
Pitting or etching of strips discernible without magnification	None	None
Gelling of fluid/water, mixture at 23 ± 5°C (73.4°F ± 9°F)	None	None
Crystalline deposit on glass jar walls or on metal strips	None	None
pH of water/fluid mixture	7 - 11.5	7.5
Sedimentation	max. 0.10%	None
Disintegration of rubber cup as evidenced by stickiness, blisters or sloughing	None	None
Decrease in hardness of IRHD rubber cups	max. 15 IRHD	2
Increase in base diameter of rubber cup	max. 1.4 mm. (0.055 in)	0.07 mm (0.003 in)

TESTS	REQUIREMENTS	RESULTS
Fluidity And Appearance At Low Temperatures		
@ -40°C (-40°F)		
Stratification or sedimentation, sludging or crystallization	None	None
Time for air bubble to travel to top	max. 10 seconds	2 Seconds
Appearance of sample after warming to room temperature	Same as before testing	Same
@ -50°C (-58°F)		
Stratification or sedimentation, sludging or crystallization	None	None
Time for air bubble to travel to top	max. 35 seconds	5 Seconds
Appearance of sample after warming to room temperature	Same as before testing	Same
Water Tolerance		
@ -40°C (-40°F)		
Stratification or sedimentation, sludging or crystallization	None	None
Time for air bubble to travel to top	max. 10 seconds	2 Seconds
Appearance of sample after warming to room temperature	Shall regain original clarity and fluidity	Regains original clarity and fluidity
@ 60°C (140°F)		
Stratification	None	None
Sedimentation	max. 0.15%	None

TESTS	REQUIREMENTS	RESULTS
Compatibility		
@ -40°C (-40°F)		
Stratification or sedimentation, sludging or crystallization	None	None
@ 60°C (140°F)		
Stratification	None	None
Sedimentation	max. 0.05%	None
Resistance To Oxidation		
Pitting or roughening of metal strips discernible to naked eye	None	None
Gum deposited on metal strips	Trace	None
Weight loss in mg./sq. cm.		
Aluminum	max. 0.05	0.00
Cast iron	max. 0.3	0.02
Effect On Rubber		
@ 70°C ± 2°C (158°F ± 3.6°F)		
Hardness increase	None	None
Hardness decrease	max. 10 IRHD	4 IRHD
Base diameter increase	0.15 mm (0.006 in) to1.40mm (0.055 in)	0.40 mm (0.016 in.)
Disintegration as evidenced by stickiness, blisters or sloughing	None	None

TESTS	REQUIREMENTS	RESULTS
Effect On Rubber,continued		
@ 120°C ± 2°C (248°F ± 3.6°F)		
Hardness increase	None	None
Hardness decrease	max. 15 IRHD	5 IRHD
Base diameter increase	0.15 mm (0.006 in) to 1.40mm (0.055 in)	0.63 mm (0.025 in.)
Disintegration as evidenced by stickiness, blisters or sloughing	None	None
Simulated Service Performance 85,000 strokes, 120°C ± 5°C (248°F ± 9°F)		
Pitting or etching of metal parts discernible without magnification	None	None
Change in initial diameter of any cylinder or piston	max.0.13mm. (0.005 in.)	None
Average lip diameter interference set of rubber cups	max. 65%	37 %
Average hardness decrease of rubber cups	max. 15 IRHD	6 IRHD
Number of rubber cups having a hardness decrease greater than 17 IRHD	max. 1	None
Operating conditions of rubber cups as evidenced by stickiness, blisters or sloughing	Satisfactory	Satisfactory
Fluid loss during any 24,000 stroke period	max. 36 ml.	8 ml.

TESTS	REQUIREMENTS	RESULTS
Simulated Service Performance, continued		
Freezing or malfunction of cylinder pistons	None	None
Fluid loss during 100 strokes at end of test	max. 36 ml.	7 ml.
Condition of fluid after test; evidence of gelling	None	None
Percent sediment in fluid drained from wheel cylinders and master cylinder	max. 1.5%	< 0.05%
Increase in base diameter of rubber cups		
Wheel cylinder cups	max. 0.90 mm. (0.035 in)	0.73 mm. (0.029 in)
Master cylinder cups		
Primary	max. 0.90 mm. (0.035 in)	0.63 mm. (0.025 in)
Secondary	max. 0.90 mm. (0.035 in)	0.61 mm. (0.024 in)
Deposits formed or adhering to cylinder walls that are abrasive or cannot be removed with ethanol	None	None
Color	Colorless to amber	Amber

DISCUSSION

The sample of Dow Brake Fluid 460, Batch 1408890 tested meets the requirements of the Federal Motor Vehicle Safety Standard 116 as published in the Federal Register and amended September 21, 2015 for DOT 4 Motor Vehicle Brake Fluid.

Respectfully submitted

Leonard Mackowiak
Vice President