



SURFACE VEHICLE STANDARD

J1704™

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Superseding J1704 SEP2019

Motor Vehicle Brake Fluid Based Upon Glycols,
Glycol Ethers, and the Corresponding Borates

RATIONALE

This document has been revised to include the new reference fluid RM-66-07 and new EPDM rubber RM-69-02. Reinstated 5.11.2, Effect on rubber for EPDM. Added Appendix G for low-temperature freezer use. Revised gas chromatographic analysis method for RM-71. A new test is introduced for determining a fluid's resistance to friction-induced noise based on DIN 51834-5 using a tribometer.

1. SCOPE

This SAE Standard covers motor vehicle brake fluids of the nonpetroleum type, based upon glycols, glycol ethers, and borates of glycol ethers, and appropriate inhibitors for use in the braking system of any motor vehicle, such as a passenger car, truck, bus, or trailer. These fluids are not intended for use under arctic conditions. These fluids are designed for use in braking systems fitted with rubber cups and seals made from styrene-butadiene rubber (SBR) or a terpolymer of ethylene, propylene, and a diene (EPDM).

2. REFERENCES

2.1 Applicable Documents

The following publications form a part of this specification to the extent specified herein. Unless otherwise indicated, the latest issue of SAE, ASTM, ISO, and DIN publications shall apply.

2.1.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or +1 724-776-4970 (outside USA), www.sae.org.

SAE J75 Motor Vehicle Brake Fluid Container Compatibility

SAE J527 Brazed Double Wall Low-Carbon Steel Tubing

SAE J1703 Motor Vehicle Brake Fluid

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Documents

Document Sharing Hub

2.1.2 ASTM Publications

Available from ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959, Tel: 610-832-9585, www.astm.org.

ASTM D34-08	Standard Guide for Chemical Analysis of White Pigments
ASTM D91	Test Method for Precipitation Number of Lubricating Oils
ASTM D344	Method of Test for Relative Dry Hiding Power of Paints
ASTM D395	Test Methods for Rubber Property - Compression Set
ASTM D412	Test Methods for Rubber Properties in Tension
ASTM D445	Test Method for Kinematic Viscosity of Transparent and Opaque Liquids (and the Calculation of Dynamic Viscosity)
ASTM D664	Test Method for Neutralization Number of Potentiometric Titration
ASTM D792	Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement
ASTM D865	Test Method for Rubber - Deterioration by Heating in Air (Test Tube Enclosure)
ASTM D1120	Method of Test for Boiling Point of Engine Coolants
ASTM D1209	Test Method for Color of Clear Liquids (Platinum-Cobalt Pigments)
ASTM D1364	Test Method for Water in Volatile Solvents (Fischer Reagent Titration Method)
ASTM D1415	Method of Test for International Hardness of Vulcanized Natural Rubber and Synthetic Rubbers
ASTM D1613	Test Method for Acidity in Volatile Solvents and Chemical Intermediates Used in Paint, Varnish, Lacquer, and Related Products
ASTM D2137	Standard Test Methods for Rubber Property - Brittleness Point of Flexible Polymers and Coated Fabrics
ASTM D2240	Method of Test for Indentation Hardness of Rubber and Plastics by Means of a Durometer
ASTM D3182	Recommended Practice for Rubber - Materials, Equipment, and Procedures for Mixing Standard Compounds and Preparing Standard Vulcanized Sheets
ASTM D3185	Methods for Rubber - Evaluation of SBR (Styrene-Butadiene Rubber) Including Mixtures with Oil
ASTM E1	Specification for ASTM Thermometers
ASTM E145	Specification for Gravity-Convection and Forced-Ventilation Ovens
ASTM E260	Standard Recommended Practice for General Gas Chromatography Procedure
ASTM E298	Standard Test Methods for Assay of Organic Peroxides

2.1.3 Federal Motor Vehicle Safety Standards (FMVSS) Publications

FMVSS 116	Motor Vehicle Brake Fluids
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2.1.4 ISO Publications

Copies of these documents are available online at <https://webstore.ansi.org/>.

ISO 37	Rubber, vulcanized or thermoplastic - Determination of tensile stress-strain properties
ISO 48-4	Rubber, vulcanized or thermoplastic - Determination of hardness - Part 4: Indentation hardness by durometer method (Shore hardness)
ISO 2081	Metallic and other inorganic coatings - Electroplated coatings of zinc with supplementary treatments on iron or steel
ISO 3574	Cold-reduced carbon steel sheet of commercial and drawing qualities
ISO 4520	Chromate conversion coatings on electroplated zinc and cadmium coatings
ISO 4926	Road vehicles - Hydraulic braking systems - Non-petroleum-based reference fluid
ISO 1183-1	Plastics - Methods for determining the density of non-cellular plastics - Part 1: Immersion method, liquid pycnometer method and titration method
ISO 7619-2	Rubber, vulcanized or thermoplastic - Determination of indentation hardness - Part 2: IRHD pocket meter method

2.1.5 DIN Publications

Copies of these documents are available online at www.din.de/en/.

DIN 51834-5	Testing of lubricants - Tribological test in the translatory oscillation apparatus - Part 5: Quantification of the friction-induced noise development of brake fluids in EPDM-steel contacts
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3. MATERIALS

The quality of the materials used shall be such that the resulting product will conform to the requirements of this standard and ensure uniformity of performance.

4. REQUIREMENTS

Requirements are given in Table 1 using the test procedures according to Section 5.

Table 1 - SAE J1704 test procedures and requirements

Test Procedure Section	Test Description	Unit	Requirements	
			Standard	Low Viscosity
5.1	Equilibrium Reflux Boiling Point (ERBP)	°C	≥230	≥250
5.2	Wet Equilibrium Reflux Boiling Point (WERBP)	°C	≥155	≥165
5.3	Viscosity		≤1500	≤750
5.3.1	at -40 °C	mm²/s	≥1.5	
5.3.2	at 100 °C	mm²/s		
5.4	pH Value	--	7.0 to 11.5	
5.5	Fluid Stability			
5.5.1	High-Temperature Stability	°C	±5	
5.5.2	Chemical Stability	°C	±5	
5.6	Metal Corrosion		Maximum	
5.6.1	Wet Fluid Corrosion Metal Strip Characteristics, After Test Weight Change of Metal Strips			
	Tinned Iron	mg/cm²	±0.2	
	Steel	mg/cm²	±0.2	
	Aluminum	mg/cm²	±0.1	
	Cast Iron	mg/cm²	±0.2	
	Brass	mg/cm²	±0.4	
	Copper	mg/cm²	±0.4	
	Zinc-Plated Steel	mg/cm²	±0.4	
	Appearance	--	No pitting or roughness outside contact area	
	Staining and Discoloration	--	Permitted	
	Liquid Characteristics, After Test			
	Appearance	--	No gelling or crystalline deposit	
	pH Value	--	7.0 to 11.5	
	Sediment	%	≤0.1	
	Rubber Characteristics, After Test			
	SBR (RM-03a)			
	Blisters or Sloughing	--	None	
	Hardness Decrease, Maximum	IRHD	15	
	Base Diameter Increase, Maximum	mm	1.4	
	EPDM (RM-69-02)			
	Blisters or Sloughing	--	None	
	Hardness Decrease, Maximum	IRHD	10	
	Volume Increase	%	≤10	
5.6.2	Dry Fluid Corrosion (Fluid As Received) - Metal Strip Characteristics, After Test Weight Change of Metal Strips		Maximum	
	Tinned Iron	mg/cm²		
	Steel	mg/cm²	±0.2	
	Aluminum	mg/cm²	±0.1	
	Cast Iron	mg/cm²	±0.2	
	Brass	mg/cm²	±0.4	
	Copper	mg/cm²	±0.4	
	Zinc-Plated Steel	mg/cm²	±0.4	
	Appearance	--	No pitting or roughness outside contact area	
	Staining and Discoloration	--	Permitted	



Test Procedure Section	Test Description	Unit	Requirements
	Liquid Characteristics, After Test		
	Appearance	--	No gelling or crystalline deposit
	pH Value	--	7.0 to 11.5
	Sediment	%	≤0.1
	Rubber Characteristics, After Test		
	SBR (RM-03a)		
	Blister		None
	Sloughing		None
	EPDM (RM-69-02)		
	Blister		None
	Sloughing		None
5.7	Fluidity and Appearance at Low Temperatures		
5.7.1	At -40 °C		
	Stratification	--	None
	Sedimentation/Crystallization	--	None
	Bubble Inversion Time	s	≤10
	Appearance at Room Temperature	--	As original
5.7.2	At -50 °C		
	Stratification	--	None
	Sedimentation/Crystallization	--	None
	Bubble Inversion Time	s	≤35
	Appearance at Room Temperature	--	As original
5.8	Water Tolerance		
5.8.1	At -40 °C		
	Stratification	--	None
	Sedimentation/Crystallization	--	None
	Appearance	--	Contrast lines on hiding power chart to be discernible when viewed through fluid.
	Bubble Inversion Time	s	≤10
5.8.2	At 60 °C		
	Stratification	--	None
	Sedimentation	% vol	≤0.05
	Sediment in Commercial Packaged Fluid	% vol	≤0.15
5.9	Compatibility		
5.9.1	At -40 °C		
	Stratification	--	None
	Sedimentation/Crystallization	--	None
	Appearance	--	Contrast lines on hiding power chart to be discernible when viewed through fluid.
5.9.2	60 °C		
	Stratification	--	None
	Sedimentation	% vol	≤0.05
5.10	Resistance to Oxidation		
	Metal Appearance	--	No pitting or roughness outside contact area. No more than trace of gum.
	Staining/Discoloration	--	Permitted
	Weight Loss of Aluminum	mg/cm ²	≤0.05
	Weight Loss of Cast Iron	mg/cm ²	≤0.3
5.11	Effect on Rubber		
5.11.1	Styrene Butadiene Rubber (SBR) RM-03a		
	At 120 °C		
	Hardness Decrease	IRHD	



Test Procedure Section	Test Description	Unit	Requirements
	Base Diameter Increase	mm	0.15 to 1.4
	Blisters	--	None
	Sloughing	--	None
5.11.2	Ethylene Propylene Diene Monomer (EPDM) RM-69-02		
	At 120 °C		
	Hardness Decrease	IRHD	0 to 15
	Volume Increase	%	0 to 10
	Blisters	--	None
	Sloughing	--	None
5.12	Resistance to Friction-Induced Noise		
	Stick-slip oscillations, sigma		<0.005
	Static friction coefficient, SFC		Report

5. TEST PROCEDURES

5.1 Equilibrium Reflux Boiling Point

Determine the equilibrium reflux boiling point of the brake fluid by ASTM D1120 with the following exceptions:

5.1.1 Apparatus

5.1.1.1 Thermometer

ASTM E1, 76 mm immersion, calibrated. Use ASTM 3C or 3F thermometer. For fluids boiling below 300 °C (572 °F), ASTM 2C or 2F thermometer or other suitable non-mercury containing temperature measuring device, such as a thermocouple, capable of operating in the same temperature range and having equal or better accuracy may be used.

5.1.1.2 Heat Source

Heat source, variable autotransformer-controlled heating mantle designed to fit the flask, or an electric heater with rheostat heat control.

5.1.1.3 Boiling Point Stones RM-75

Silicon carbide boiling stones #8.

5.1.1.4 Preparation of Apparatus

Thoroughly clean and dry all glassware before use. Attach the flask to the condenser. Place the mantle under the flask and support it with a suitable ring clamp and laboratory type stand, holding the whole assembly in place by a clamp.

NOTE: Place the whole assembly in an area free from drafts or other types of sudden temperature changes.

5.1.2 Procedure

When everything is in readiness, turn on the condenser water and apply heat to the flask at such a rate that the fluid is refluxing in 10 minutes $\pm$ 2 minutes at a rate in excess of 1 drop/s.

Immediately adjust heat input to obtain a specified equilibrium reflux rate of 1 to 2 drop/s over the next 5 minutes $\pm$ 2 minutes. Maintain a timed and constant equilibrium reflux rate of 1 to 2 drop/s for an additional 2 minutes; record the average value of four temperature readings taken at 30-second intervals as the equilibrium reflux boiling point.

5.1.3 Repeatability (Single Analyst)

The standard deviation of results (each the average of duplicates), obtained by the same analyst on different days, has been estimated to be 0.4 °C (0.88 °F) at 72 degrees of freedom. Two such values should be considered suspect (95% confidence level) if they differ by more than 1.5 °C (2.5 °F).

5.1.4 Reproducibility (Multilaboratory)

The standard deviation of results (each the average of duplicates), obtained by analysts in different laboratories, has been estimated to be 1.8 °C (3.02 °F) at 17 degrees of freedom. Two such values should be considered suspect (95% confidence level) if they differ by more than 5 °C (9 °F).

5.2 Wet Equilibrium Reflux Boiling Point

5.2.1 Humidification Procedure

Lubricate the ground-glass joint of a 250 mm (9.89 inches) ID bowl-form desiccator having matched tubulated glass cover and fitted with a No. 8 rubber stopper. Pour 450 mL $\pm$ 10 mL of distilled water into the desiccator and insert a perforated porcelain plate (Coors No. 60456 or equivalent). Immediately place one open RM-49 corrosion test jar containing 350 mL $\pm$ 5 mL of the test brake fluid into the desiccator. Place a second open RM-49 corrosion test jar containing 350 mL $\pm$ 5 mL of TEGME (triethylene glycol monomethyl ether, brake fluid grade; see Appendix E) (RM-71) into the same desiccator. The water content of the TEGME control fluid at the start of exposure shall have been adjusted to 0.50% $\pm$ 0.05% by weight (Karl Fischer analysis or equivalent). Replace desiccator cover and insert at once into an ASTM E145, Type II A, forced ventilation oven set at 50 °C $\pm$ 1 °C (122 °F $\pm$ 1.8 °F).

Periodically, during oven humidification, determine water content of the control fluid. When the water content of the control fluid has reached 3.70% $\pm$ 0.05% by weight, remove the desiccator from the oven and seal the test sample. Allow the sealed jar to cool for 60 to 90 minutes at 23 °C $\pm$ 5 °C (73.4 °F $\pm$ 9 °F).

5.2.2 Wet Equilibrium Reflux Boiling Point

Humidify the brake fluid as described in 5.2.1 and determine the boiling point of the humidified brake fluid as described in 5.1.

5.3 Viscosity

Determine the kinematic viscosity of the fluid by ASTM D445.

5.3.1 Report the viscosity to the nearest mm²/s (centistokes). Duplicate runs which agree within 1.2% relative to test result are acceptable for averaging (95% confidence level).

5.3.2 Repeatability (Single Analyst)

The coefficient of variation of results (each the average of duplicates), obtained by the same analyst on different days, has been estimated to be 0.4% at 47 degrees of freedom. Two such values should be considered suspect (95% confidence level) if they differ by more than 1.2%.

5.3.3 Reproducibility (Multilaboratory)

The coefficient of variation of results (each the average of duplicates), obtained by analysts in different laboratories, has been estimated to be 1% at 15 degrees of freedom. Two such values should be considered suspect (95% confidence level) if they differ by more than 3%.

5.4 pH Value

Mix the fluid with an equal volume of a mixture of 50% ethanol and 50% distilled water neutralized to a pH of 7.0. Determine the pH of the resulting solution electrometrically at 23 °C $\pm$ 5 °C (73.4 °F $\pm$ 9 °F) using a pH meter equipped with a calibrated full range (0 to 14) glass electrode and a calomel reference electrode, as specified in ASTM D664.