SAE International™ SURFACE VEHICLE STANDARD

SAE J1703

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Motor Vehicle Brake Fluid

1. ***Scope***—This SAE Standard covers motor vehicle brake fluids of the nonpetroleum type 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 natural rubber (NR), styrene-butadiene rubber (SBR), or a terpolymer of ethylene, propylene, and a diene (EPDM).

2. References

2.1 Applicable Publications—The following publications form a part of this specification to the extent specified herein. Unless otherwise indicated, the latest issue of SAE publications shall apply.

2.1.1 SAE PUBLICATION—Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

SAE J527—Brazed Double Wall Low Carbon Steel Tubing

2.1.2 ASTM PUBLICATIONS—Available from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.

ASTM D 91—Test Method for Precipitation Number of Lubricating Oils
ASTM D 344—Method of Test for Relative Dry Hiding Power of Paints
ASTM D 395—Test Methods for Rubber Property—Compression Set
ASTM D 412—Test Methods for Rubber Properties in Tension
ASTM D 445—Test Method for Kinematic Viscosity of Transparent and Opaque Liquids (and the Calculation of Dynamic Viscosity)
ASTM D 664—Test Method for Neutralization Number of Potentiometric Titration
ASTM D 746—Test Method for Brittleness Temperature of Plastics and Elastomers by Impact
ASTM D 865—Test Method for Rubber—Deterioration by heating in Air (Test Tube Enclosure)
ASTM D 1120—Method of Test for Boiling Point of Engine Coolants
ASTM D 1209—Test Method for Color of Clear Liquids (Platinum-Cobalt Pigments)
ASTM D 1364—Test Method for Water in Volatile Solvents (Fischer Reagent Titration Method)
ASTM D 1415—Method of Test for International Hardness of Vulcanized Natural Rubber and Synthetic Rubbers
ASTM D 1613—Test Method for Acidity in Volatile Solvents and Chemical Intermediates Used in Paint, Varnish, Lacquer, and Related Products
ASTM D 2240—Method of Test for Indentation Hardness of Rubber and Plastics by Means of a Durometer

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ASTM D 3182—Recommended Practice for Rubber-Materials, Equipment, and Procedures for Mixing Standard Compounds and Preparing Standard Vulcanized Sheets
ASTM D 3185—Methods for Rubber-Evaluation of SBR (Styrene-Butadiene Rubber) including Mixtures with Oil
ASTM E 1—Specification for ASTM Thermometers
ASTM E 145—Specification for Gravity-Convection and Forced-Ventilation Ovens

2.2 Related Publications—The following publications are provided for information purposes only and are not a required part of this document.

2.2.1 ASTM PUBLICATIONS—Available from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.

ASTM E 260—Standard Recommended Practice for General Gas Chromatography Procedure
ASTM E 298—Evaluation of Benzoyl Peroxides

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

4. Requirements

4.1 Equilibrium Reflux Boiling Point—Brake fluid when tested by the procedure specified in 5.1 shall have an equilibrium reflux boiling point not less than 205 °C (401 °F).

4.2 Wet Boiling Point—Brake fluid, when tested by the procedure specified in 5.2.2, shall have a wet boiling point of not less than 140 °C (284 °F).

4.3 Fluid Stability

4.3.1 HIGH TEMPERATURE STABILITY—When tested by the procedure specified in 5.3.1, the equilibrium reflux boiling point of the brake fluid shall not change by more than 5 °C (9 °F) increase or decrease.

4.3.2 CHEMICAL STABILITY—When tested by the procedure specified in 5.3.2, the test fluid mixture shall show no chemical reversion as evidenced by a change in recorded temperature of more than 5 °C (9 °F) increase or decrease.

4.4 Viscosity—Brake fluid when tested by the procedure specified in 5.4 shall have the following kinematic viscosities:

4.4.1 AT –40 °C (–40 °F)—Not more than 1800 mm^2/s (1800 cSt).

4.4.2 AT 100 °C (212 °F)—Not less than 1.5 mm^2/s (1.5 cSt).

4.5 pH Value—Brake fluid, when tested by the procedure specified in 5.5, shall have a pH value not less than 7.0, not more than 11.5.

4.6 **Corrosion—**Brake fluid, when tested by the procedure specified in 5.6, shall not cause corrosion exceeding the limits shown in Table 1. The metal strips outside of the area where the strips are in contact shall neither be pitted nor roughened to an extent discernible to the naked eye, but staining or discoloration is permitted.

TABLE 1—CORROSION TEST STRIPS AND WEIGHT CHANGES (SEE ALSO APPENDIX A)

Test Strip[1]	RM No.	Max Permissible Weight Change, mg/cm^2 of Surface
Tinned Iron	6a	0.2
Steel	7	0.2
Aluminum	8	0.1
Cast Iron	9	0.2
Brass	10	0.4
Copper	11	0.4

1. Obtainable from the Society of Automotive Engineers, Inc., 400 Commonwealth Drive, Warrendale, PA 15096-0001.

The fluid-water mixtures at end of test shall show no jelling at 23 °C ± 5 °C (73 °F ± 9 °F). No crystalline type of deposit shall form and adhere to either the glass jar walls or the surface of metal strips. The fluid-water mixture shall contain no more than 0.10% sediment by volume. The fluid-water mixture shall have a pH value of not less than 7.0, not more than 11.5.

The rubber cup at end of test shall show no disintegration, as evidenced by blisters or sloughing indicated by carbon black separation on the surface of the rubber cup. The hardness of the rubber cup shall not decrease by more than 15 degrees and the base diameter shall not increase by more than 1.4 mm (0.055 in).

4.7 Fluidity and Appearance at Low Temperatures

4.7.1 AT –40 °C (–40 °F)—When brake fluid is tested by the procedure specified in 5.7.1, the fluid shall show no stratification, sedimentation, or crystallization. Upon inversion of sample bottle, the air bubble shall travel to the top of the fluid in not more than 10 s. Cloudiness is permissible, but on warming to room temperature 23 °C ± 5 °C (73 °F ± 9 °F), the fluid shall regain its original uniformity, appearance, and clarity.

4.7.2 AT –50 °C (–58 °F)—When brake fluid is tested by the procedure specified in 5.7.2, the fluid shall show no stratification, sedimentation, or crystallization. Upon inversion of sample bottle, the air bubble shall travel to the top of the fluid in not more than 35 s. Cloudiness is permissible, but on warming to room temperature 23 °C ± 5 °C (73 °F ± 9 °F), the fluid shall regain its original uniformity, appearance, and clarity.

4.8 Water Tolerance

4.8.1 AT –40 °C (–40 °F)—When brake fluid is tested by the procedure specified in 5.8.1, the black contrast lines on a hiding power chart shall be discernible when viewed through the fluid in the centrifuge tube. The fluid shall show no stratification or sedimentation. Upon inversion of the centrifuge tube, the air bubbles shall travel to the top of the fluid in not more than 10 s.

4.8.2 AT 60 °C (140 °F)—When brake fluid is tested by the procedure specified in 5.8.2, the fluid shall show no stratification, and sedimentation shall not exceed 0.05% by volume after centrifuging when fluid is tested for qualification, or shall not exceed 0.15% by volume for a commercial packaged fluid.

4.9 Compatibility

4.9.1 At −40 °C (−40 °F)—When brake fluid is tested by the procedure specified in 5.9.1, the black contrast lines on a hiding power chart shall be discernible when viewed through the fluid in the centrifuge tube. The fluid shall show no stratification or sedimentation.

4.9.2 At 60 °C (140 °F)—When brake fluid is tested by the procedure specified in 5.9.2, the fluid shall show no stratification, and sedimentation shall not exceed 0.05% by volume after centrifuging.

4.10 Resistance to Oxidation—Brake fluid, when tested by the procedure specified in 5.10, shall not cause the metal strips outside the areas in contact with the tinfoil to be pitted or roughened to an extent discernible to the naked eye, but staining or discoloration is permitted. No more than a trace of gum shall be deposited on the test strips outside of the areas in contact with the tinfoil. The aluminum strips shall not decrease in weight by more than 0.05 mg/cm^2 and the cast iron strips shall not decrease in weight by more than 0.3 mg/cm^2.

4.11 Effect on Rubber

4.11.1 Rubber brake cups subjected to brake fluid, as specified in 5.11.1, shall show no increase in hardness, shall not decrease in hardness by more than 10 points, and shall show no disintegration as evidenced by blisters or sloughing indicated by carbon black separation on the surface of the rubber cup. The increase in the diameter of the base of the cups shall not be less than 0.15 mm (0.006 in), nor more than 1.4 mm (0.055 in).

4.11.2 Rubber brake cups subjected to brake fluid, as specified in 5.11.2, shall show no increase in hardness, shall not decrease in hardness by more than 15 points, and shall show no disintegration as evidenced by blisters or sloughing indicated by carbon black separation on the surface of the rubber cup. The increase in the diameter of the base of the cups shall not be less than 0.15 mm (0.006 in), nor more than 1.4 mm (0.055 in).

4.11.3 Rubber slab stock subjected to brake fluid, as specified in 5.11.3, shall show no increase in hardness, shall not decrease in hardness by more than 10 points, and shall show no disintegration as evidenced by blisters or sloughing indicated by carbon black separation on the surface of the test specimens. The test specimens shall not decrease in volume and the increase in volume shall not exceed 10%.

4.11.4 Rubber slab stock subjected to brake fluid, as specified in 5.11.4, shall show no increase in hardness, shall not decrease in hardness by more than 15 points, and shall show no disintegration as evidenced by blisters or sloughing indicated by carbon separation on the surface of the test specimens. The test specimens shall not decrease in volume and the increase in volume shall not exceed 10%.

5. Test Procedures

5.1 Equilibrium Reflux Boiling Point—Determine the equilibrium reflux boiling point of the fluid by ASTM D 1120 with the following exceptions:

5.1.1 APPARATUS

5.1.1.1 4.4 Thermometer—ASTM E 1, 76 mm immersion, calibrated. Use ASTM 3C or 3F thermometer. For fluids boiling below 300 °C (572 °F), ASTM 2C or 2F thermometer may be used.

5.1.1.2 4.5 Heat Source—Use a suitable variac-controlled 100 mL heating mantle designed to fit the flask, capable of supplying the heat required to conform to the specified heating and reflux rates. (Supplier: GLAS COL Apparatus Co., Terre Haute, IN. Serial number: 135464. 230 W, 135 V[max]).

5.1.1.3 Preparation of Apparatus—6.4 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—7.1 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 min ± 2 min 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 min ± 2 min period. Maintain a timed and constant equilibrium reflux rate of 1 to 2 drop/s for an additional 2 min; record the average value of four temperature readings taken at 30 s intervals as the equilibrium reflux boiling point.

5.1.2.1 205 and 232 °C (401 and 450 °F) Fluids—Report the boiling point to the nearest degree Celsius (Fahrenheit). Duplicate runs which agree within 1 °C (2 °F) are acceptable for averaging (95% confidence level).

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).

5.1.5 288 °C (550 °F) FLUID—Report the boiling point to the nearest degree Celsius (Fahrenheit). Duplicate runs which agree within 3 °C (5 °F) are acceptable for averaging (95% confidence level).

5.1.6 REPEATABILITY (SINGLE ANALYST)—The standard deviation of results (each the average of duplicates), obtained by one analyst on different days, has been estimated to be 1.3 °C (2.38 °F) at 34 degrees of freedom. Two such values should be considered suspect (95% confidence level) if they differ by more than 4 °C (7 °F).

5.1.7 REPRODUCIBILITY (MULTILABORATORY)—The standard deviation of results (each the average of duplicates), obtained by analysts in different laboratories, has been estimated to be 3.5 °C (6.44 °F) at 15 degrees of freedom. Two such values should be considered suspect (95% confidence level) if they differ by more than 10.5 °C (19 °F).

5.2 Wet Boiling Point

5.2.1 HUMIDIFICATION PROCEDURE—Lubricate the ground-glass joint of a 250 mm (9.89 in) I.D. bowl-form desiccator having matched tubulated glass cover and fitted with a No. 8 rubber stopper. Pour 450 mL ± 10 mL (15.22 oz ± 0.34 oz) 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 ± 5 mL of the test brake fluid into the desiccator. Place a second open RM-49 corrosion test jar containing 350 mL ± 5 mL of TEGME (triethylene glycol monomethyl ether, brake fluid grade-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% ± 0.05% by weight (Karl Fischer analysis or equivalent). Replace desiccator cover and insert at once into an ASTM E 145, Type II A, forced ventilation oven set at 50 °C ± 1 °C (122 °F ± 1.8 °F).

Periodically, during oven humidification, remove the rubber stopper from the desiccator and, using a long needle hypodermic syringe, quickly sample the control fluid and determine its water content. When the water content of the control fluid has reached 3.70% ± 0.05% by weight, remove the desiccator from the oven and seal the test jar promptly using a screw-cap lid (RM-63). Allow the sealed jar to cool for 60 to 90 min at 23 °C ± 5 °C (73.4 °F ± 9 °F).

5.2.2 WET BOILING POINT PROCEDURE—Humidify the fluid as described in 5.2.1 and determine the boiling point as described in 5.1.

5.3 Fluid Stability

5.3.1 HIGH TEMPERATURE STABILITY—Heat a new sample of the original test brake fluid to a temperature of 185 °C ± 2 °C (365 °F ± 3.6 °F) by the procedure specified in 5.1 and maintain at that temperature for 2 h. Then determine the boiling point of this brake fluid as specified in 5.1. The difference between this observed boiling point and that previously determined in 5.1 shall be considered as the change in boiling point of the brake fluid.

5.3.2 CHEMICAL STABILITY—Mix 30 mL of fluid with 30 mL of SAE Compatibility Fluid described in Appendix B (RM-66-05). Determine the equilibrium reflux boiling point of this fluid mixture by use of the test apparatus specified in 5.1, applying heat to the flask at such a rate that the fluid is refluxing in 10 min ± 2 min at a rate in excess of 1 drop/s. The reflux rate shall not exceed 5 drops/s. Record the maximum fluid temperature observed during the first minute after the fluid begins refluxing at a rate in excess of 1 drop/s. Over the next 15 min ± 1 min, adjust and maintain the rate of reflux to 1 to 2 drops/s. Maintain a timed and constant equilibrium reflux rate of 1 to 2 drops/s for an additional 2 min; record the average value of four temperature readings taken at 30 s intervals as the final equilibrium reflux boiling point. Chemical reversion is evidenced by the decrease in temperature between the maximum fluid temperature recorded and the final equilibrium reflux boiling point.

5.4 Viscosity—Determine the kinematic viscosity of the fluid by ASTM D 445.

5.4.1 Report the viscosity to the nearest mm^2/s (centistoke). Duplicate runs which agree within 1.2% relative are acceptable for averaging (95% confidence level).

5.4.2 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%.

5.4.3 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%.

5.5 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 ± 5 °C (73.4 °F ± 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 D 664.

5.6 Corrosion—Prepare two sets of strips from each of the metals listed in Table 1, each strip having a surface area of $25\ cm^2 \pm 5\ cm^2$ (approximately 8 cm long, 1.3 cm wide, and not more than 0.6 cm thick). Drill a hole between 4 and 5 mm in diameter and about 6 mm from one end of each strip. With the exception of the tinned iron strips, clean the strips by abrading them on all surface areas with 320A (RM-29) or P400 waterproof carborundum paper and isopropanol or ethanol until all surface scratches, cuts, and pits are removed from the strips, using a new piece of carborundum paper for each different type of metal. Wash the strips, including the tinned iron, with isopropanol or ethanol and dry the strips with a clean lint-free cloth and place strips in a desiccator containing desiccant maintained at 23 °C ± 5 °C (73.4 °F ± 9 °F) for at least 1 h. Handle the strips with clean forceps after polishing to avoid fingerprint contamination.

Weigh each strip to the nearest 0.1 mg and assemble each set of strips on an uncoated steel bolt (RM-61) in the order tinned iron, steel, aluminum, cast iron, brass, and copper, so that the strips are in electrolytic contact. Bend the strips, other than cast iron, so that there is a separation of at least 3 mm between adjacent strips for a distance of about 6 cm from the free end of the strips. Immerse strip assemblies in isopropanol or ethanol to eliminate fingerprints and then handle only with clean forceps.

Measure the base diameter of two standard SBR cups (RM-3a) described in Appendix C, using an optical comparator or micrometer to the nearest 0.02 mm (0.001 in) along the centerline of the SAE and rubber type identifications and at right angles to this centerline. Take the measurements within 0.4 mm (0.015 in) of the bottom edge and parallel to the base of the cup. Discard any cup if the two measured diameters differ by more than 0.08 mm (0.003 in). Average the two readings of each cup. Support the rubber cup on a rubber anvil or cylinder having a flat circular top surface of at least 19 mm in diameter, a thickness of at least 9 mm, and a hardness within 5 IRHD of the hardness of the rubber test cup. Determine the hardness of each cup thus supported by the procedure specified in ASTM D 1415 using the Standard Tester.

NOTE—ASTM D 2240 may be used for quality control and routine tests when a type A durometer is equipped with a fixture for keeping the plane of the pressure foot on the durometer parallel to the plane of the cup face during measurement.

Obtain two straight-sided round glass jars[1] (RM-49) having a capacity of approximately 475 mL and inner dimensions of approximately 100 mm in height and 75 mm in diameter.

To the RM-49 corrosion test jar, apply four wrappings of 3/4 in Teflon tape around the jar threads allowing a 1/8 in height above the top of the jar. Place one rubber cup with lip edge facing up, in each of the two glass jars. Use only tinned steel lids vented with a hole 0.8 mm ± 0.1 mm in diameter (RM-64).

Insert a metal strip assembly inside each cup with the bolted end in contact with the concavity of the cup and the free end extending upward in the jar. Mix 760 mL of fluid with 40 mL of distilled water.

Add 400 mL of the mixture to cover the metal strip assembly in each jar to a depth of approximately 10 mm above the tops of the strips. Tighten the lids and place the jars in an oven maintained at 100 °C ± 2 °C (212 °F ± 3.6 °F) for 120 h ± 2 h. Allow the jars to cool at 23 °C ± 5 °C (73.4 °F ± 9 °F) for 60 to 90 min. Immediately following the cooling period, remove the metal strips from the jars by use of a forceps, removing loose adhering sediment by agitation of the metal strip assembly in the fluid in jar. Examine test strips and test jars for adhering crystalline deposit, disassemble the metal strips, removing adhering fluid by flushing with water, and clean individual strips by wiping with a cloth wetted with isopropanol or ethanol. Examine the strips for evidence of corrosion and pitting. Place strips in a desiccator containing a desiccant maintained at 23 °C ± 5 °C (73.4 °F ± 9 °F) for at least 1 h. Weigh each strip to the nearest 0.1 mg. Determine the difference in weight of each metal strip and divide the difference by the total surface area of the metal strip measured in square centimeters. Average the measured quantities of the duplicates. In the event of a marginal pass on inspection, or of a failure in only one of the duplicates, another set of duplicate test samples shall be run. Both repeat samples must meet all the requirements of 4.6.

Immediately following the cooling period, remove the rubber cups from the jars by use of a forceps, removing loose adhering sediment by agitation of the cup in the fluid in jar. Rinse cups in isopropanol or ethanol and air dry cups. Examine the cups for evidence of sloughing, blisters, and other forms of disintegration. Measure the base diameter and hardness of each cup within 15 min after removal from the fluid.

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[1] Obtainable from the Society of Automotive Engineers, Inc., 400 Commonwealth Drive, Warrendale, PA 15096-0001.

Examine the fluid-water mixture in the jars for jelling. Agitate the fluid in jars to suspend and uniformly disperse sediment and transfer a 100 mL portion of this fluid to an ASTM cone-shaped centrifuge tube and determine percent sediment as described in 5.2 of ASTM D 91. Measure the pH value of the corrosion test fluid by the procedure specified in 5.5.

5.7 Fluidity and Appearance at Low Temperature

5.7.1 AT –40 °C (–40 °F)—Place 100 mL of the test fluid in a glass sample bottle[2] (RM-59a) having a capacity of approximately 125 mL, an outside diameter of 37 mm ± 0.5 mm, and an overall height of 165 mm ± 3 mm. Stopper or cap the bottle tightly and place in a cold bath maintained at –40 °C ± 2 °C (–40 °F ± 3.6 °F) for 144 h ± 4 h. Remove the bottle from the bath, quickly wipe the bottle with a clean lint-free cloth saturated with isopropanol or ethanol, and examine the fluid for evidence of stratification, sediment, or crystals. Invert the bottle and determine the number of seconds required for the air bubble to travel to the top of the fluid. Allow the fluid to warm to room temperature 23 °C ± 5 °C (73 °F ± 9 °F); if necessary, allow to stand for as long as 4 h. Examine the fluid for clarity and appearance by comparing it to an original sample of the test fluid in an identical container.

5.7.2 AT –50 °C (–58 °F)—Place 100 mL of fluid in a glass sample bottle (same as in –40 °C test above). Stopper or cap the bottle tightly and place in a cold bath maintained at –50 °C ± 2 °C (–58 °F ± 3.6 °F) for 6 h ± 0.2 h. Remove the bottle from the bath, quickly wipe the bottle with a clean lint-free cloth saturated with isopropanol or ethanol, and examine the fluid for evidence of stratification, sediment, or crystals. Invert the bottle and determine the number of seconds required for the air bubble to travel to the top of the fluid. Allow the fluid to warm to room temperature 23 °C ± 5 °C (73 °F ± 9 °F); if necessary, allow to stand for as long as 4 h. Examine the fluid for clarity and appearance by comparing it to a sample of the original test fluid in an identical container.

5.8 Water Tolerance

5.8.1 AT –40 °C (–40 °F)—Pour 100 mL of fluid which has been humidified according to 5.2.1 into an ASTM coneshaped centrifuge tube described in 3(a) in ASTM D 91. Stopper the tube with a cork and place in a cold bath maintained at –40 °C ± 2 °C (–40 °F ± 3.6 °F) for 22 h ± 2 h. Remove the centrifuge tube from the bath, quickly wipe the tube with a clean lint-free cloth saturated with isopropanol or ethanol, determine the transparency of the fluid by placing the tube against a hiding power test chart[3] (RM-28) and observing the clarity of the contrast lines on the chart when viewed through the fluid. Examine the fluid for evidence of stratification and sedimentation. Invert the tube and determine the number of seconds required for the air bubble to travel to the top of the fluid. (The air bubble shall be considered to have reached the top of the fluid when the top of the bubble reaches the 2 mL graduation of the centrifuge tube.)

5.8.2 AT 60 °C (140 °F)—Place the centrifuge tube from 5.9.1 in an oven maintained at 60 °C ± 2 °C (140 °F ± 3.6 °F) for 22 h ± 2 h. Remove the tube from the oven and immediately examine the contents for evidence of stratification. Determine percent sediment by volume as described in 5.2 of ASTM D 91.

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[2] Obtainable from the Society of Automotive Engineers, Inc., 400 Commonwealth Drive, Warrendale, PA 15096-0001.

[3] A suitable hiding power chart as described in ASTM D 344, Method of Test for Relative Dry Hiding Power of Paints, published by the American Society for Testing and Materials, or in Method 4112 of Federal Test Method Standard No. 141, is obtainable from the Society of Automotive Engineers, Inc., 400 Commonwealth Drive, Warrendale, PA 15096-0001.

5.9 Compatibility

5.9.1 At –40 °C (–40 °F)—Mix 50 mL of fluid with 50 mL of SAE Compatibility Fluid described in Appendix B (RM-66-05) and pour this mixture into an ASTM cone-shaped centrifuge tube described in 3(a) in ASTM D 91 and stopper with a cork. Place centrifuge tube for 22 h ± 2 h in a bath maintained at –40 °C ± 2 °C (–40 °F ± 3.6 °F). Remove the centrifuge tube from the bath, quickly wipe the tube with a clean lint-free cloth saturated with isopropanol or ethanol, determine the transparency of the fluid by placing the tube against a hiding power test chart[3] (RM-28) and observing the clarity of the contrast lines on the chart when viewed through the fluid. Examine the fluid for stratification and sedimentation.

5.9.2 At 60 °C (140 °F)—Place the centrifuge tube from 5.8.1 in an oven at 60 °C ± 2 °C (140 °F ± 3.6 °F) for 22 h ± 2 h. Remove the tube from the oven and immediately examine the contents for evidence of stratification. Determine percent sediment by volume as described in 5.2 of ASTM D 91.

5.10 Resistance to Oxidation—Prepare two sets of aluminum and cast iron test strips (as listed in Table 1) by the procedure specified in 5.6. Weigh each strip to the nearest 0.1 mg and assemble a strip of each metal on an uncoated steel bolt (RM-62), separating the strips at each end with a piece of tinfoil[4] (RM-27) (99.5% tin, 0.5% lead, max) approximately 12 mm square and between 0.02 and 0.06 mm in thickness.

Place 30 mL ± 1 mL of fluid in a small glass bottle approximately 120 mL in capacity. Add 60 mg ± 2 mg of reagent grade benzoyl peroxide and 1.5 mL ± 0.05 mL distilled water to bottle. Stopper the bottle and shake the contents, avoiding getting the solution on the stopper. Place bottle in an oven at 70 °C ± 2 °C (158 °F ± 3.6 °F) for 120 min ± 10 min, shaking every 15 min to effect solution of the peroxide. Remove the bottle from the oven, do not disturb the stopper, and cool in air at room temperature, 23 °C ± 5 °C (73 °F ± 9 °F).

Place approximately 1/8 section of a standard SBR cup described in Appendix C (RM-3a) in the bottom of each of two test tubes about 22 mm in diameter and 175 mm in length. Add 10 mL of prepared test fluid to each test tube. Place a metal-strip assembly in each tube with the end of the strips resting on the rubber, the solution covering about one-half the length of the strips, and the bolted end remaining out of the solution. Stopper the tubes with corks and store upright for 22 h ± 2 h at 23 °C ± 5 °C (73.4 °F ± 9 °F). Loosen the stoppers and place the tubes for 168 h ± 2 h in an oven maintained at 70 °C ± 2 °C (158 °F ± 3.6 °F). After the heating period, remove and disassemble the metal strips. Examine the strips for gum deposits. Wipe the strips with a cloth wet with isopropanol or ethanol and examine for pitting or roughening of surface. Place strips in desiccator containing a desiccant maintained at 23 °C ± 5 °C (73.4 °F ± 9 °F) for at least 1 h. Weigh each strip to the nearest 0.1 mg.

Determine corrosion loss by dividing the difference in weight of each metal strip by the total surface area of each metal strip measured in square centimeters. Average the measured quantities of the duplicates. In the event of a marginal pass on inspection, or of a failure in only one of the duplicates, another set of duplicate test samples shall be run. Both repeat samples must meet all the requirements of 4.10.

5.11 Effect on Rubber—For test procedures 5.11.1 and 5.11.2, use standard SBR cups described in Appendix C (RM-3a). Measure the base diameter of all cups and hardness of all specimens as described in 5.6, discarding any cups whose diameters differ by more than 0.08 mm (0.003 in).

For test procedures 5.11.3 and 5.11.4, cut 25.4 mm x 25.4 mm (1 in x 1 in) test specimens from standard EPDM slab stock, as described in Appendix D (RM-69). Determine the volume of each specimen in the following manner:

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[4] Obtainable from the Society of Automotive Engineers, Inc., 400 Commonwealth Drive, Warrendale, PA 15096-0001.

Weigh the specimen in air (M_1) to the nearest milligram and then weigh the specimens immersed in room temperature distilled water (M_2) containing no more than 0.2% of a suitable wetting agent. Pluronic L-61 (BASF Wyandotte) or equivalent has been found to be acceptable.

5.11.1 TEST AT 70 °C (158 °F)—Place two standard SBR cups in a straight-sided round glass jar[5] (RM-51), having a capacity of approximately 250 mL and inner dimensions of approximately 125 mm in height and 50 mm in diameter, and a tinned steel lid (RM-52a). Add 75 mL of fluid to the jar and heat for 70 h ± 2 h at 70 °C ± 2 °C (158 °F ± 3.6 °F). Allow the jar to cool at 23 °C ± 5 °C (73.4 °F ± 9 °F) for 60 to 90 min. Remove the cups from the jar, wash quickly with isopropanol or ethanol, and air dry cups. Examine the cups for disintegration as evidenced by blisters or sloughing. Measure the base diameter and hardness of each cup within 15 min after removal from the fluid.

5.11.2 TEST AT 120 °C (248 °F)—Place two standard SBR cups (RM-3a) in a straight-sided round glass jar[1] (RM-51), having a capacity of approximately 250 mL and inner dimensions of approximately 125 mm in height and 50 mm in diameter, and a tinned steel lid (RM-52a). Add 75 mL of fluid to the jar and heat for 70 h ± 2 h at 120 °C ± 2 °C (248 °F ± 3.6 °F). Allow the jar to cool at 23 °C ± 5 °C (73.4 °F ± 9 °F) for 60 to 90 min. Remove the cups from the jar, wash quickly with isopropanol or ethanol, and air dry cups. Examine the cups for disintegration as evidenced by blisters or sloughing. Measure the base diameter and hardness of each cup within 15 min after removal from the fluid.

5.11.3 TEST AT 70 °C (158 °F)—Place two 25.4 mm x 25.4 mm (1 in x 1 in) standard test specimens (RM-69) in a straight-sided round glass jar[6] having a capacity of approximately 250 mL and inner dimensions of approximately 125 mm in height and 50 mm in diameter, and a tinned steel lid (RM-52a). Add 75 mL of fluid to the jar and heat for 70 h ± 2 h at 70 °C ± 2 °C (158 °F ± 3.6 °F). Allow the jar to cool to 23 °C ± 5 °C (73.4 °F ± 9 °F) for 60 to 90 min. Remove the specimens from the jar, wash quickly with isopropanol or ethanol, and air dry. Examine the specimens for disintegration as evidenced by blisters or sloughing. Weigh each specimen in air (M_3), again to the nearest milligram, then reweigh immersed in room temperature distilled water (M_4), to determine the volume after hot fluid immersion. Measure the hardness of each specimen. All weighings must be completed within 60 min after removal from the test fluid. Volume changes shall be reported as a percentage of the original volume, calculated as follows:

$$\text{Percent Volume Change} = \frac{(M_3 - M_4) - (M_1 - M_2) \times 100}{(M_1 - M_2)} \qquad \text{(Eq. 1)}$$

where:

M_1 = Initial mass in air
M_2 = Initial mass in water
M_3 = Final mass in air
M_4 = Final mass in water

5.11.4 TEST AT 120 °C (248 °F)—Place two 25.4 mm x 25.4 mm (1 in x 1 in) standard test specimens (RM-69) in a straight-sided round glass jar[6], having a capacity of approximately 250 mL and inner dimensions of approximately 125 mm in height and 50 mm in diameter, and tinned steel lid (RM-52a). Add 75 mL of fluid to the jar and heat for 70 h ± 2 h at 120 °C ± 2 °C (248 °F ± 3.6 °F). Allow the jar to cool to 23 °C ± 5 °C (73.4 °F ± 9 °F) for 60 to 90 min. Remove the specimens from the jar, wash quickly with isopropanol or ethanol, and air dry. Examine the specimens for disintegration as evidenced by blisters or sloughing. Determine the volume change as in 5.11.3. Measure the hardness of each specimen.

5.11.5 Report the rubber swell to the nearest 0.03 mm (0.001 in). Duplicate results which agree within 0.10 mm (0.004 in) are acceptable for averaging (95% confidence level).

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[5] Obtainable from the Society of Automotive Engineers, Inc., 400 Commonwealth Drive, Warrendale, PA 15096-0001.
[6] Obtainable from the Society of Automotive Engineers, Inc., 400 Commonwealth Drive, Warrendale, PA 15096-0001.

5.11.6 REPEATABILITY (SINGLE ANALYST)—The standard deviation of results (each the average of duplicate determinations) obtained by the same analyst on different days has been estimated to be 0.05 mm (0.002 in) at 46 degrees of freedom. Two such values should be considered suspect (95% confidence level) if they differ by more than 0.13 mm (0.005 in).

5.11.7 REPRODUCIBILITY (MULTILABORATORY)—The standard deviation of results (each the average of duplicates) obtained by analysts in different laboratories has been estimated to be 0.08 mm (0.003 in) at 7 degrees of freedom. Two such values should be considered suspect (95% confidence level) if they differ by more than 0.20 mm (0.008 in).

6. Notes

6.1 Marginal Indicia—The change bar (l) located in the left margin is for the convenience of the user in locating areas where technical revisions have been made to the previous issue of the report. An (R) symbol to the left of the document title indicates a complete revision of the report.

PREPARED BY THE SAE BRAKE FLUIDS STANDARDS COMMITTEE

APPENDIX A

STANDARD CORROSION TEST STRIPS[7]

A.1 See Table A1.

TABLE A1—STANDARD CORROSION TEST STRIPS

Corrosion Test Strip	Material Specification	General Material Data	Dimensions	Surface Requirements
Tinned iron RM-6a	ASTM A 624, Federal Specification QQ-T-425A	SR tin plate electrolytic, bright: No. 25, type MR Temper 3, base weight 85 lb Ferrostand and DOS oil	Approx. 8 cm long; 1.3 cm wide Thickness: As purchased Surface area: 25 cm^2 ± 5 cm^2	As sheared. Clean and uniform tinning.
Steel RM-7	SAE 1018	Low carbon sheet Cold rolled Hardness: 40 to 72 RB	Approx. 8 cm long; 1.3 cm wide Thickness: Approx. 0.2 cm Surface area: 25 cm^2 ± 5 cm^2	Edges machined to remove shearing marks. Clean uniform surfaces.
Aluminum RM-8	SAE AA2024	Wrought aluminum alloy Temper T3 Hardness: 75 RB typical	Approx. 8 cm long; 1.3 cm wide Thickness: Approx. 0.2 cm Surface area: 25 cm^2 ± 5 cm^2	Edges machined to removed shearing marks. Clean uniform surfaces.
Cast iron RM-9	SAE G3000	Soft automotive cast iron. Must be free from shrinkage cavities, porosity, or any other defects detrimental to specification use of the material. Hardness: 86 to 98 RB	Approx. 8 cm long; 1.3 cm wide Thickness: Approx. 0.4 cm Surface area: 25 cm^2 ± 5 cm^2	Surface grind 4 sides to dimension using a well-dressed No. 80 Alundum wheel. Clean uniform surfaces.
Brass RM-10	SAE CA260	Wrought alloy—yellow brass Rolled sheet or strip; half hard temper Hardness: 57 to 74 RB	Approx. 8 cm long; 1.3 cm wide Thickness: Approx. 0.2 cm Surface area: 25 cm^2 ± 5 cm^2	Edges machined to remove shearing marks. Clean uniform surfaces.
Copper RM-11	SAE CA114	Cold rolled copper sheet or strip Half-hard temper Hardness: 35 to 56 RB	Approx. 8 cm long; 1.3 cm wide Thickness: Approx. 0.2 cm Surface area: 25 cm^2 ± 5 cm^2	Edges machined to remove shearing marks. Clean uniform surfaces.

NOTE—Drill hole between 4 and 5 mm in a diameter and approximately 6 mm from one end of each strip. Holes to be clean and free from burrs. Hardness ranges are commercially for the designated metals. Hardness is not specified for the tinned iron because it is not considered a practical requirement.

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[7] Obtainable from the Society of Automotive Engineers, Inc., 400 Commonwealth Drive, Warrendale, PA 15096-0001.

APPENDIX B

SAE RM-66-05 COMPATIBILITY FLUID[8]

B.1 This fluid is a blend of six proprietary polyglycol brake fluids of fixed composition, in equal parts by volume. The six fluids selected comprise five factory-fill and one aftermarket fluid, as follows:

a. Clariant Safebrake 9 M (DOT 4)
b. Delco Supreme 11
c. DOW 1000
d. Dow HD 50-4
e. Toyota BF2500H
f. Wagner 21 B

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[8] Obtainable from the Society of Automotive Engineers, Inc., 400 Commonwealth Drive, Warrendale, PA 15096-0001.

APPENDIX C

STANDARD STYRENE-BUTADIENE RUBBER (SBR) BRAKE CUPS FOR TESTING SAE MOTOR VEHICLE BRAKE FLUIDS

C.1 Formulation of Rubber Compound—(See Table C1.)

TABLE C1—FORMULATION OF RUBBER COMPOUND

Ingredient	Parts by Weight
SBR type 1503[(1)]	100
Oil furnace black (NBS 378)	40
Zinc oxide (NBS 370)	5
Sulfur (NBS 371)	0.25
Stearic acid (NBS 372)	1
n-tertiary butyl-2-benzothiazole sulfenamide (NBS 384)	1
Symmetrical-dibetanophthyl-p-phenylene diamine	1.5
Dicumyl peroxide (40% on precipitated $CaCO_3$)[(2)]	4.5
Total	153.25

NOTE—The ingredients labeled (NBS) must have properties identical with those supplied by the National Institute of Standards and Technology.

1. Philprene 1503 has been found suitable.
2. Use only within 90 d of manufacture and store at temperature below 27 °C (80 °F)

C.2 Procedure for Mixing Rubber Compound—The rubber compound shall be mixed in accordance with the procedure given in ASTM D 3185 for Formula 2B.

C.3 Properties of Rubber Compound—Vulcanizates cured for 12 min at 180 °C (356 °F) by the procedure described in ASTM D 3182 shall meet the requirements in Table C2:

TABLE C2—PROPERTIES OF RUBBER COMPOUND

Property	Requirement	ASTM Method
Hardness	63 ± 3	D 1415 or D 2240
Tensile strength	17.5 MPa (2500 lbf/in^2, min)	D 412
Ultimate elongation	350%, min	D 412
Tensile strength after 70 h at 125 °C (257 °F)	30% decrease, max	D 865
Ultimate elongation after 70 h at 125 °C (257 °F)	50% decrease, max	D 865
Hardness after 70 h at 125 °C (257 °F)	0 to 10 increase	D 865
Compression set after 22 h at 125 °C (257 °F)	15 to 20%	D 395 (Method B)
Brittleness temperature	–40 °C (–40 °F), max	D 746

C.4 Brake Cups Prepared From Rubber Compound—Brake cups[9] shall be prepared from the rubber compound by vulcanization under the conditions required to obtain the properties given in Section C.3. The dimensions of the cups shall be suitable for the brake cylinders used to determine stroking test procedure in 5.12. Cups may be used for testing brake fluids within 60 months from date of manufacture when stored at temperatures under 23 °C (73 °F), out of sunlight (storage in dark preferred), and adequately protected from contaminants. Rubber cups should not be stored under any strain and different parts should be stored separately to avoid migration of constitutents. Lastly, rubber cups should be stored away from sources of ozone.

After removal of cups from storage, they shall be conditioned base down on a flat surface for at least 12 h at room temperature in order to allow cups to reach their true configuration before measurement.

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[9] Obtainable from the Society of Automotive Engineers, Inc., 400 Commonwealth Drive, Warrendale, PA 15096-0001.

APPENDIX D

STANDARD ETHYLENE, PROPYLENE, AND DIENE (EPDM) TERPOLYMER RUBBER SLABSTOCK (RM-69)

D.1 Formulation of Rubber Compound—(See Table D1.)

TABLE D1—FORMULATION OF RUBBER COMPOUND

Ingredient		Parts by Weight
EPDM type (Nordel 1320) (1)		100
Zinc oxide (NBS 370)		5
Oil furnace black (NBS 378)		43
Polymerized 1,2-dihydro-2,2,4-trimethylquinoline		2
Dicumyl peroxide (40% on precipitated $CaCO_3$) (2)		10
	Total	160

NOTE—The ingredients labeled (NBS) must have properties identical with those supplied by the National Institute of Standards and Technology.

1. E.I. DuPont Nordel EPDM 1320.
2. Use only within 90 d of manufacture and store at a temperature below 27 °C (80 °F).

D.2 Procedure for Mixing Rubber Compound—The rubber compound shall be mixed in accordance with the procedures given in ASTM D 3182.

D.3 Properties of Rubber Compound—Vulcanizates cured for 25 min at 175 °C (347 °F) by the procedure described in ASTM D 3182 shall meet the requirements as in Table D2:

TABLE D2—PROPERTIES OF RUBBER COMPOUND

Property	Requirement	ASTM Method
Hardness, IRHD	70 ± 3	D 1415
Tensile strength, min	13.8 MPa (2000 lbf/in^2)	D 412
Ultimate elongation, min	225%	D 412
Tensile strength, decrease after 22 h at 175 °C (347 °F), max	15%	D 865
Ultimate elongation, decrease after 22 h at 175 °C (347 °F), max	30%	D 865
Hardness, increase after 22 h at 175 °C (347 °F)	0 to 10	D 865
Compression set after 22 h at 175 °C (347 °F)	20% max	D 395 (Method B)
Brittleness temperature, max	–65 °F	D 746

D.4 Slabstock Prepared from Rubber Compound—Test slabs approximately 150 mm x 150 mm x 1.9 mm (6 in x 6 in x 0.075 in) shall be prepared from the rubber compound by vulcanization under the conditions stated in Section D.3. These slabs may be used in testing brake fluids within 36 months from their date of manufacture, when stored in the dark at ambient temperatures not exceeding 38 °C (100 °F) and adequately protected from atmospheric or other contaminants.

When stored at other than 23 °C ± 5 °C (73.4 °F ± 9 °F), the material shall be allowed to stabilize at laboratory temperature prior to measurements.

APPENDIX E

TRIETHYLENE GLYCOL MONOMETHYL ETHER (TEGME) BRAKE FLUID GRADE[10] (RM-71)[11]

TABLE E1—TRIETHYLENE GLYCOL MONOMETHYL ETHER (TEGME) BRAKE FLUID GRADE (RM71)

Property	Requirement	Method
Assay	94 area %, min Further, neither the material preceding nor that following TEGME through the column shall exceed 4 area %	Gas Chromatographic (GC) analysis (see blow)
Water content	0.3% by weight, max	ASTM D 1364
Acidity	0.02% by weight, max, as acetic acid	ASTM D 1613
Suspended matter	Substantially free	—
Appearance	Clear liquid; 100 APHA units, max	ASTM D 1209
ERBP	240 °C (464 °F), min	Paragraph 5.1 of SAE Standard J1703

E.1 Gas Chromatographic Analysis—Analyze a representative sample using a Bendix Model 2200 dual column, programmed temperature gas chromatograph, or equivalent instrument, with a thermal conductivity detector and two 10 ft x 1/8 in Type 304 stainless steel columns packed with 10% CARBOWAX 20M-terephthalic acid on Chromosorb T, 40 to 60 mesh, as follows:

E.1.1 Column Preparation—Use precleaned tubing or obtain two 10 ft lengths of 1/8 in 304 stainless steel tubing (0.02 in wall thickness) and clean as follows:

a. Rinse the tubing with 30 mL of concentrated nitric acid.
CAUTION—NITRIC ACID CAUSES SEVERE BURNS IF IT COMES IN CONTACT WITH ANY PART OF THE BODY.
b. Drain and rinse the tubing with distilled water; drain and rinse with acetone; dry with nitrogen.

E.1.1.1 Weigh 5 g of CARBOWAX 20M-terephthalic acid into a 400 mL beaker. Add 200 mL of methylene chloride and stir with a magnetic stirrer until dissolved. Approximately 30 min will be required.

E.1.1.2 Weigh 45 g of Chromosorb T, 40 to 60 mesh into a tared beaker and transfer to a 500 mL rotary evaporating flask.

E.1.1.3 Add the CARBOWAX 20M-TPA solution to the flask and mix by gently swirling. If necessary, add additional methylene chloride to form a set slurry.

E.1.1.4 Allow the slurry to stand for 10 min.

E.1.1.5 Attach the flask to a rotary evaporator and apply vacuum slowly while degassing. Set the pressure at approximately 100 mm Hg. Use dry ice-acetone traps to protect the vacuum source.

E.1.1.6 Rotate the flask at 10 rpm.

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[10] Stabilized by addition of 1/4% by weight of 4.4' isopropylidene diphenol.

[11] Obtainable from the Society of Automotive Engineers, Inc., 400 Commonwealth Drive, Warrendale, PA 15096-0001.

E.1.1.7 Protect the contents of the flask from extreme cold or heat by means of a hot air gun (hair dryer at 50 to 60 °C).

E.1.1.8 When all of the solvent has been removed, stop the evaporator and allow the contents of the flask to return to room temperature.

NOTE—If a rotary evaporator is not available, satisfactory packing may be prepared using the evaporating dish technique.

E.1.1.9 Transfer the dried packing to a bottle having a volume about twice the volume of the packing.

E.1.1.10 Add 0.5% by weight of powdered graphite and mix thoroughly until the mixture flows freely.

E.1.1.11 Sieve the mixture using a combination of 30- and 60-mesh screens. Retain the portion that passes through the 30-mesh and is retained on the 60-mesh screen.

E.1.1.12 Using a funnel, pack the columns with approximately 7 g of packing by gently tapping the side of the column with a suitable metal rod. Do not add large quantities of packing to the funnel at one time.

E.1.1.13 Condition the columns by programming from ambient temperature to 200 °C at 2 °C/min and hold at 200 °C for at least 4 h. Repeatedly inject a sample until a good baseline is obtained.

E.1.2 Operating Parameters

a. Recorder: 1 mV
b. Chart speed: 0.5 in/min
c. Temperatures column: 150 to 225 °C programmed at 6 °C/min; hold at 225 °C for 30 min
d. Detector: 260 °C
e. Injection port: 230 °C
f. Carrier gas: Helium at 20 cc/min
g. Sample size: 1 mL
h. Total elution time: 45 min

E.1.3 Procedure—Inject the sample into the chromatograph and obtain the chromatogram using the parameters outlined in E.1.2.

E.1.3.1 Measure the areas of all component peaks using an electronic integrator or a planimeter.

E.1.3.2 Calculate and report the area percent of TEGME. The TEGME elutes at about 15 min.

E.1.3.3 CALCULATION

$$\frac{AT \times 100}{D} = \text{Area Percent TEGME} \qquad \text{(Eq. E1)}$$

where:

A = Peak area for TEGME
D = Total area, sum of all areas corrected for attenuation
T = Attenuation for component peak

Rationale—The changes to this document include:

Stroking Test: The stroking test is withdrawn for a period of 3 years to allow time for development of a test method that will represent current components. If the committee has not developed a replacement in 3 years, a ballot will be submitted to reevaluate if it is valid to delete the stroking test permanently.

The stroking test was originally developed to evaluate the lubrication- and swell quality of brake fluids. The present test includes components that have been out of OEM production for over 35 years. The hardware sources used for the stroking test are Aftermarket. It is getting difficult to obtain such parts, as they are practically obsolete. The set up of the test has no relationship to a modern braking system and provides limited information on how a brake fluid behaves in a field situation.

Using the present test set up utilizing a single master cylinder with SBR vs. EPDM cups, totally different seal construction and a single system, does not provide viable test results related to current systems, e.g. dual systems required by NHTSA and used since the 60's.

The stroking test no longer reflects current technology and therefore the committee members voted to cancel the stroking test.

However, since this excludes a way to evaluate brake fluids for lubricity. This is an important performance parameter and there is a clear need for the development of a new method in line with the present brake practice.

A recommendation for a test that will provide the testing of current components and materials is needed. A replacement test must be developed as a high priority. This new test should reflect the design practice and material trends in brake systems that specify the fluid.

pH-Value: This revision is in order to increase the repeatability and reproducibility value (% R & R) of the pH-Value

Corrosion: The European equivalent of the US carborundum paper grade 320A is P400.

In order to cover US and Eropean standard requirements it necessary to add the abrasive paper grade P400 to the standard SAE J1703 in the section 5.6.

Replacement of RM 66-04 by RM 66-05: The reference brake fluid RM 66-04 has been replaced by RM 66-05. In order to keep the standard SAE J1703 up to date it is necessary to substitute RM 66-04 by RM 66-05.

Relationship of SAE Standard to ISO Standard—Similar to ISO 4925.

Application—This SAE Standard covers motor vehicle brake fluids of the nonpetroleum type 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 natural rubber (NR), styrene-butadiene rubber (SBR), or a terpolymer of ethylene, propylene, and a diene (EPDM).

Reference Section

SAE J527—Brazed Double Wall Low Carbon Steel Tubing

ASTM D 91—Test Method for Precipitation Number of Lubricating Oils

ASTM D 344—Method of Test for Relative Dry Hiding Power of Paints

ASTM D 395—Test Methods for Rubber Property—Compression Set

ASTM D 412—Test Methods for Rubber Properties in Tension

ASTM D 445—Test Method for Kinematic Viscosity of Transparent and Opaque Liquids (and the Calculation of Dynamic Viscosity)

ASTM D 664—Test Method for Neutralization Number of Potentiometric Titration

ASTM D 746—Test Method for Brittleness Temperature of Plastics and Elastomers by Impact

ASTM D 865—Test Method for Rubber—Deterioration by heating in Air (Test Tube Enclosure)

ASTM D 1120—Method of Test for Boiling Point of Engine Coolants

ASTM D 1209—Test Method for Color of Clear Liquids (Platinum-Cobalt Pigments)

ASTM D 1364—Test Method for Water in Volatile Solvents (Fischer Reagent Titration Method)

ASTM D 1415—Method of Test for International Hardness of Vulcanized Natural Rubber and Synthetic Rubbers

ASTM D 1613—Test Method for Acidity in Volatile Solvents and Chemical Intermediates Used in Paint, Varnish, Lacquer, and Related Products

ASTM D 2240—Method of Test for Indentation Hardness of Rubber and Plastics by Means of a Durometer

ASTM D 3182—Recommended Practice for Rubber-Materials, Equipment, and Procedures for Mixing Standard Compounds and Preparing Standard Vulcanized Sheets

ASTM D 3185—Methods for Rubber-Evaluation of SBR (Styrene-Butadiene Rubber) including Mixtures with Oil

ASTM E 1—Specification for ASTM Thermometers

ASTM E 145—Specification for Gravity-Convection and Forced-Ventilation Ovens

ASTM E 260—Standard Recommended Practice for General Gas Chromatography Procedure

ASTM E 298—Evaluation of Benzoyl Peroxides

Developed by the SAE Motor Vehicle Brake Fluids Standards Committee