



Technical Report Preprint

Published June 1966

J70c

SOCIETY OF AUTOMOTIVE ENGINEERS, INC.,
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HYDRAULIC BRAKE FLUID—SAE J70c

SAE Standard

Report of Nonmetallic Materials Committee approved December 1946 and last revised by Hydraulic Brake Systems Actuating Committee June 1966.

HEAVY DUTY TYPE (SAE 70R1 AND SAE 70R1 ARCTIC)

1.0 Type—These specifications cover hydraulic brake fluids of the nonpetroleum type for use in the braking system of motor vehicles such as passenger cars, trucks, buses, and trailers, except in a system designed for a hydraulic brake fluid having a boiling point greater than 150 C (302 F).

2.0 Material—The quality of the materials used shall be such that the resulting product will conform to the requirements of these specifications and insure uniformity of performance.

3.0 Requirements

3.1 Boiling Point—Brake fluid when tested by the procedure specified in Section 4.1 shall have a boiling point not less than 150 C (302 F).

3.2 Flash Point—Brake fluid when tested by the procedure specified in Section 4.2 shall have a flash point not less than 63 C (145.4 F).

3.3 Viscosity—Brake fluid when tested by the procedure specified in Section 4.3 shall have the following kinematic viscosities:

(a) At -55°C (-67°F): Not more than 1500 centistokes for arctic type fluids.

(b) At -40°C (-40°F): Not more than 1800 centistokes.

(c) At 50°C (122°F): Not less than 3.5 centistokes.

(d) At 100°C (212°F): Not less than 1.3 centistokes.

3.4 pH Value—Brake fluid when tested by the procedure specified in Section 4.4 shall have a pH value not less than 7.0, nor more than 11.5.

3.5 Stability at High Temperature—When tested by the procedure specified in Section 4.5, the boiling point of the brake fluid shall not be less than 146°C (294.8°F) and shall not change by more than 5.0°C (9.0°F).

3.6 Corrosion—Brake fluid when tested by the procedure specified in Section 4.6 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.

The fluid-water mixtures shall show no jelling at $23 \pm 5^{\circ}\text{C}$ ($73.4 \pm 9^{\circ}\text{F}$). No crystalline type 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 not less than 7.0, nor more than 11.5.

The test rubber cup shall show no disintegration, as evidenced by excessive tackiness, 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 deg and the base diameter shall not increase by more than 1.4 mm (0.055 in.).

3.7 Fluidity and Appearance at Low Temperatures

(a) At -40°C (-40°F)—When brake fluid is tested by the procedure specified in Section 4.7(a), the black contrast lines on a hiding power chart shall be clearly discernible when viewed through the fluid in the sample bottle. The fluid shall show no stratification or sedimentation, and, upon inversion of the sample bottle, the air bubble shall travel to the top of the fluid in not more than 10 sec.

(b) At -50°C (-58°F)—When brake fluid is tested by the procedure specified in Section 4.7(b), the black contrast lines on a hiding power chart shall be clearly discernible when viewed through the fluid in the sample bottle. The fluid shall show no stratification or sedimentation and upon inversion of the sample bottle, the air bubble shall travel to the top of the fluid in not more than 35 sec.

3.8 Evaporation—When brake fluid is tested by the procedure specified in Section 4.8, loss by evaporation shall not exceed 80% by weight. Residue from the brake fluid after evaporation shall contain no precipitate that remains gritty or abrasive when rubbed with the fingertip. Residue shall have a pour point below -5°C ($+23^{\circ}\text{F}$).

3.9 Water Tolerance

(a) At -40°C (-40°F)—When brake fluid is tested by the procedure specified in Section 4.9(a), the black contrast lines on a hiding power chart shall be clearly 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 bubble shall travel to the top of the fluid in not more than 10 sec.

(b) At 60°C (140°F)—When brake fluid is tested by the procedure specified in Section 4.9(b) the fluid shall show no stratification, and sedimentation shall not exceed 0.05% by volume after centrifuging.

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—SAE Technical Board Rules and Regulations

3.10 Compatibility

(a) At -40 C (-40 F)—When brake fluid is tested by the procedure specified in Section 4.10(a), the black contrast lines on a hiding power chart shall be clearly discernible when viewed through the fluid in the centrifuge tube. The fluid shall show no stratification or sedimentation.

(b) At 60 C (140 F)—When brake fluid is tested by the procedure specified in Section 4.10(b), the fluid shall show no stratification, and sedimentation shall not exceed 0.05% by volume after centrifuging.

3.11 Resistance to Oxidation—Brake fluid, when tested by the procedure specified in Section 4.11, 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/sq cm and the cast iron strips shall not decrease in weight by more than 0.3 mg/sq cm.

3.12 Effect on Rubber—Rubber brake cups subjected to brake fluid, as specified in Section 4.12 shall show no increase in hardness, shall not decrease in hardness by more than 10 deg, and shall show no disintegration as evidenced by excessive tackiness, 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.).

3.13 Simulated Service Performance—Brake fluid, when tested by the procedure specified in Section 4.13, shall meet the following performance requirements:

(a) Metal parts shall not show corrosion as evidenced by pitting to an extent discernible to the naked eye, but staining or discoloration shall be permitted.

(b) The initial diameter of any cylinder or piston shall not change by more than 0.13 mm (0.005 in.) during test.

(c) Rubber cups shall not decrease in hardness by more than 10 deg and shall not be in an unsatisfactory operating condition as evidenced by excessive amounts of tackiness, scoring, scuffing, blistering, cracking, chipping (heel abrasion), or change in shape from original appearance.

(d) The base diameter of the rubber cups shall not increase by more than 0.9 mm (0.035 in.).

(e) The average lip diameter interference set of the rubber cups shall not be greater than 65%.

(f) During any period of 24,000 strokes, the volume loss of fluid shall be not more than 36 ml.

(g) The cylinder pistons shall not freeze nor function improperly throughout the test.

(h) The volume loss of fluid during the 100 strokes at the end of the test shall not be more than 36 ml.

(i) The fluid at the end of the test shall not be in an unsatisfactory operating condition as evidenced by sludging, jelling, or abrasive grittiness, and sedimentation shall not exceed 1.0% by volume after centrifuging.

(j) No more than a trace of gum shall be deposited on brake cylinder walls or other metal parts. No deposits shall form or adhere to brake cylinder walls that are abrasive or cannot be removed when rubbed with a cloth wetted with ethanol.

4.0 Test Procedures

4.1 Boiling Point—Determine the boiling point of the fluid by ASTM D 1120-53, Method of Test for Boiling Point of Engine Antifreezes.¹

4.2 Flash Point—Determine the flash point of the fluid by ASTM D 92-57, Method of Test for Flash and Fire Points by Cleveland Open Cup.¹

4.3 Viscosity—Determine the kinematic viscosity of the fluid by ASTM D 445-64, Method of Test for Kinematic Viscosity.¹

4.4 pH Value—Mix the fluid with an equal volume of an 80% ethanol-20% distilled water mixture neutralized to a pH of 7.0. Deter-

mine the pH of the resulting solution electrometrically at 23 ± 5 C (73.4 ± 9 F), using a pH meter equipped with a calibrated glass electrode and a calomel reference electrode.

4.5 Stability at High Temperature—Determine the brake fluid boiling point by the procedure specified in Section 4.1. Cool the fluid to a temperature of 145 ± 2 C (293 ± 3.6 F) and maintain at that temperature for 2 hr. Boil the fluid sample once more and determine the boiling point again by the procedure specified in Section 4.1. Calculate the difference between the two observed boiling points.

4.6 Corrosion

Prepare three sets of strips from each of the metals listed in Table 1, each strip having a surface area of 25 ± 5 sq cm (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 320 A waterproof carborundum paper and stoddard solvent 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. With the exception of the tinned iron strips, polish the strips with 00 grade steel wool. Wash the strips, including the tinned iron, with 95% ethanol and dry the strips with a clean lint-free cloth and place strips in a desiccator containing a desiccant maintained at 23 ± 5 C (73.4 ± 9 F) for at least 1 hr. Handle the strips with clean forceps after polishing to avoid finger print contamination.

Weigh each strip to the nearest 0.1 mg and assemble each set of strips on an uncoated steel cotter pin or bolt 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 95% ethanol containing 5% by volume of distilled water to eliminate fingerprints and then handle only with clean forceps.

Measure the base diameter of three standard natural rubber cups, described in Appendix A, 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. Determine the hardness of all test cups by the procedure specified in ASTM D 1415-62¹, Method of Test for International Hardness of Vulcanized Natural and Synthetic Rubbers or ASTM D 2240-64¹, Method of Test for Indentation Hardness of Rubber and Plastics by Means of a Durometer¹, supporting the cup on the inner face by means of a rubber anvil having a flat circular top surface at least 19 mm in diameter, a thickness of about 25 mm, and a hardness within 5 deg of the hardness of the rubber test cup. When a durometer is used to measure hardness, use a fixture to locate the anvil and to keep the base of the diameter parallel to the plane of the cup face during measurement. Place one rubber cup with lip edge facing up, in each of 3 straight sided round glass jars²

TABLE 1—CORROSION TEST STRIPS AND WEIGHT CHANGES

Test Strips	Max Permissible Weight Change, mg/sq cm of Surface
Tinned Iron: Federal Specification QQ-T-425, Type I, Grade 1, Class A-2	0.2
Steel: SAE 1010	0.2
Aluminum: SAE AA2024	0.1
Cast Iron: SAE G3000 or strips from housing of wheel brake cylinder, smooth machined surfaces	0.2
Brass: SAE CA268	0.4
Copper: SAE CA114	0.4

¹Test strips may be obtained from Society of Automotive Engineers, Inc., 485 Lexington Ave., New York, N. Y. 10017.

¹Published by the American Society for Testing and Materials, 1916 Race Street, Philadelphia, Penna. 19103.

²Suitable corrosion test jars and tinned steel lids may be obtained from the Society of Automotive Engineers, Inc., 485 Lexington Ave., New York, N. Y. 10017.

having a capacity of approximately 515 ml and inner dimensions of approximately 115 mm in height and 75 mm in diameter. Use only tinned steel lids vented with a hole 0.8 ± 0.1 mm in diameter. Insert a metal strip assembly inside each cup with the pinned end in contact with the concavity of the cup and the free end extending upward in the jar. Mix 1140 ml of fluid with 60 ml of distilled water.

Add a sufficient amount of the mixture (but not less than 375 ml) to cover the metal strip assembly in each jar to a depth of at least 10 mm above the tops of the strips. Tighten the lids and place the jars in an oven maintained at 100 ± 2 C (212 ± 3.6 F) for 120 ± 2 hr. 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, remove adhering fluid by flushing with water and clean individual strips by wiping with a cloth wetted with 95% ethanol. Examine the strips for evidence of corrosion and pitting. Place strips in a desiccator containing a desiccant maintained at 23 ± 5 C (73.4 ± 9 F) for at least an hour. 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 results for the three strips of each type of metal.

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 the jar. Rinse cups in 95% ethanol and air-dry cups. Examine the cups for evidence of sloughing, tackiness, blisters, and other forms of disintegration. Determine the hardness and base diameter in accordance with the method described above.

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 coneshaped centrifuge tube and determine percent sediment as described in paragraph 5(b) of ASTM D 91-61, Method of Test for Precipitation Number of Lubricating Oils.¹

Measure the pH value of the corrosion test fluid by the procedure specified in Section 4.4.

4.7 Fluidity and Appearance at Low Temperatures

(a) At -40 C (-40 F)—Place 100 ml of fluid in a 125 ml oil sample bottle, about 3.5 cm in diameter and 15 cm in length. Stopper the bottle with a cork and place in a cold bath maintained at -40 ± 2 C (-40 ± 3.6 F) for 144 ± 4 hr. Remove the bottle from the bath, quickly wipe the bottle with a clean lint-free cloth saturated with ethanol or acetone, determine the transparency of the fluid by placing the bottle against a hiding power test chart², 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 bottle and determine the number of seconds required for the air bubble to travel to the top of the fluid.

(b) At -50 C (-58 F)—Place 100 ml of fluid in a 125 ml oil sample bottle, about 3.5 cm in diameter and 15 cm in length. Stopper the bottle with a cork and place in a cold bath maintained at -50 ± 2 C (-58 ± 3.6 F) for 6 ± 0.2 hr. Remove the bottle from the bath, quickly wipe the bottle with a clean lint-free cloth saturated with ethanol or acetone, determine the transparency of the fluid by placing the bottle against a hiding power test chart² and observing the clarity of the contrast lines on the chart when viewed through the fluid. Examine the fluid for evidence of stratification or sedimentation. Invert the bottle and determine the number of seconds required for the air bubble to travel to the top of the fluid.

4.8 Evaporation—Obtain the tare weight of four covered Petri dishes of approximately 100 mm in diameter and 15 mm high, weighing with cover in place to the nearest 0.01 gr. Place approximately 25 ml of fluid in each of the four tared Petri dishes, replace proper covers and reweigh to the nearest 0.01 gr. Determine the weight of fluid from the difference in weights of filled and empty dishes.

Place the dishes inside the inverted covers in a draft free oven at 23 ± 5 C (73.4 ± 9 F) and raise the oven temperature gradually over a period of 6 hr to 100 ± 2 C (212 ± 3.6 F) and maintain this temperature for 46 ± 2 hr.

Remove the dishes from the oven, allow to cool to 23 ± 5 C (73.4 ± 9 F) and weigh each dish. Return all dishes to oven for an additional 22 ± 2 hr. Continue this procedure either until equilibrium is reached, as evidenced by an incremental weight loss of less than 0.25 gr in 22 hr on all individual dishes or for a maximum of 7 days. Calculate the percentage of fluid evaporated from each dish. Average the percentage evaporated from all four dishes to determine the loss by evaporation.

Examine the residue in the dishes at the end of 1 hr at 23 ± 5 C (73.4 ± 9 F). Rub any sediment with the fingertip to determine grittiness or abrasiveness.

Combine the residues from all four dishes and determine the pour point by ASTM D 97-57, Method of Test for Cloud and Pour Points,¹ except for reduced size of sample.

4.9 Water Tolerance

(a) At -40 C (-40 F)—Mix 3.5 ml of distilled water with 100 ml of fluid and pour the mixture into an ASTM coneshaped centrifuge tube described in paragraph 3(a) in ASTM D 91-61, Method of Test for Precipitation Number of Lubricating Oils.¹ Stopper the tube with a cork and place in a cold bath maintained at -40 ± 2 C (-40 ± 3.6 F) for 22 ± 2 hr. Remove the centrifuge tube from the bath, quickly wipe the tube with a clean lint-free cloth saturated with ethanol or acetone, determine the transparency of the fluid by placing the tube against a hiding power test chart² 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.)

(b) At 60 C (140 F)—Place the centrifuge tube from Section 4.9(a) in an oven maintained at 60 ± 2 C (140 ± 3.6 F) for 22 ± 2 hr. Remove the tube from the oven and immediately examine the contents for evidence of stratification. Determine percent sediment by volume as described in paragraph 5(b) of ASTM D91-61.

4.10 Compatibility

(a) At -40 C (-40 F)—Mix 50 ml of fluid with 50 ml of SAE Standard Compatibility Test Brake Fluid described in Appendix B, and pour this mixture into an ASTM coneshaped centrifuge tube described in paragraph 3(a) of ASTM D 91-61¹ and stopper with a cork. Place centrifuge tube for 22 ± 2 hr in a bath maintained at -40 ± 2 C (-40 ± 3.6 F). Remove the centrifuge tube from the bath, quickly wipe the tube with a clean lint-free cloth saturated with ethanol or acetone, determine the transparency of the fluid by placing the tube against a hiding power test chart² and observing the clarity of the contrast lines on the chart when viewed through the fluid. Examine the fluid for stratification and sedimentation.

(b) At 60 C (140 F)—Place the centrifuge tube from Section 4.10(a) in an oven maintained at 60 ± 2 C (140 ± 3.6 F) for 22 ± 2 hr. Remove the tube from the oven and immediately examine the contents for evidence of stratification. Determine percent sediment by volume as described in paragraph 5(b) of ASTM D91-61.

4.11 Resistance to Oxidation—Prepare three sets of aluminum and cast iron test strips (as listed in Table 1) by the procedure specified in Section 4.6. Weigh each strip to the nearest 0.1 mg and assemble a strip of each metal on an uncoated steel cotter pin, separating the strips at each end with a piece of tinfoil³ (99.9% tin, 0.025% lead, max) approximately 12 mm sq and between 0.02 and 0.06 mm in thickness.

Place 50 ml of fluid in a small glass bottle approximately 120 ml in capacity. Add 100 ± 2 mg of reagent grade benzoyl peroxide and 2.5 ± 0.1 ml of distilled water to bottle. Stopper the bottle and shake contents, avoiding getting solution on stopper. Place bottle in an oven at 70 ± 2 C (158 ± 3.6 F) for 120 ± 10 minutes, shaking every 15 minutes to effect solution of the peroxide. Remove bottle from oven and maintain at 23 ± 5 C (73.4 ± 9 F) for 22 ± 2 hr.

Place approximately $\frac{1}{8}$ section of a standard natural rubber cup, described in Appendix A, in the bottom of each of three 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 end having the cotter pin remaining out of the solution. Stopper the tubes with corks and store upright for 70 ± 2 hr at 23 ± 5 C (73.4 ± 9 F). Loosen the stoppers and place the tubes for 16 ± 1 hr in an oven maintained at

²A suitable hiding power chart as described in ASTM D 344-39, 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, may be obtained from Society of Automotive Engineers, Inc., 485 Lexington Ave., New York, N. Y. 10017.

³Tinfoil may be obtained from Society of Automotive Engineers, Inc., 485 Lexington Ave., New York, N. Y. 10017.

70 $\pm$ 2 C (158 $\pm$ 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 95% ethanol and examine for pitting or roughening of surface. Place strips in a desiccator containing a desiccant maintained at 23 $\pm$ 5 C (73.4 $\pm$ 9 F) for at least an hour. 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 results for the three strips of each type of metal to determine the corrosion loss.

4.12 Effect on Rubber—Use standard natural rubber and standard SBR cups described in Appendices A and C, respectively. Measure the base diameter and hardness of all cups as described in Section 4.6, discarding any cup whose diameters differ by more than 0.08 mm (0.003 in.).

Place two standard natural rubber cups in a straight sided round glass jar,⁵ 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. Add 75 ml of fluid to the jar. Repeat the above procedure with a second glass jar using two standard SBR cups. Heat both prepared glass jars for 120 $\pm$ 2 hr at 70 $\pm$ 2 C (158 $\pm$ 3.6 F). Allow the jars to cool at 23 $\pm$ 5 C (73.4 $\pm$ 9 F) for 60 to 90 minutes. Remove the cups from the jars, wash quickly with 95% ethanol and air-dry cups. Examine the cups for disintegration as evidenced by tackiness, blisters, or sloughing. Measure the base diameter and hardness of each cup within 15 minutes after removal from the fluid.

4.13 Simulated Service Performance—Use the following procedure to evaluate the lubricating quality of the brake fluid.

4.13.1 Test Apparatus and Materials⁶—Use an apparatus consisting of the following components arranged as shown in Fig. 1.

(a) Master Cylinder Assembly—One cast iron housing hydraulic brake system cylinder having a diameter of approximately 28 mm (1 1/8 in.) and fitted with an uncoated steel stand pipe.

(b) Brake Assemblies—Four cast iron housing straight bore hydraulic brake wheel cylinder assemblies having diameters of approximately 28 mm (1 1/8 in.), including four forward brake shoes and four reverse brake shoes with linings and four front wheel brake drum assemblies with necessary assembly component parts.

⁵Suitable effect on rubber test jars and tinned steel lids can be obtained from Society of Automotive Engineers, Inc., 485 Lexington Ave., New York, N. Y. 10017.

⁶Test apparatus components may be obtained from Society of Automotive Engineers, Inc., 485 Lexington Ave., New York, N. Y. 10017.

(c) Braking Pressure Actuating Mechanism—A suitable actuating mechanism for applying a force to the master cylinder push rod without sidethrust.

The amount of force applied by the actuating mechanism shall be adjustable and capable of applying sufficient thrust to the master cylinder to create a pressure of at least 70 kg/sq cm (1000 psi) in the simulated brake system. A hydraulic gage or pressure recorder, having a range of at least 0 to 70 kg/sq cm (0 to 1000 psi), shall be installed between the master cylinder and the brake assemblies and shall be provided with a shut-off valve and with a bleeding valve for removing air from the connecting tubing.

The actuating mechanism shall be designed to permit adjustable stroking rates of approximately 1000 strokes per hour. A mechanical or electrical counter shall be used to record the total number of strokes.

(d) Heated Air Bath Cabinet—An insulated cabinet or oven having sufficient capacity to house the four mounted wheel assemblies, master cylinder, and necessary connections. A suitable thermostatically controlled heating system is required to maintain a temperature of 70 $\pm$ 5 C and 120 $\pm$ 5 C (158 $\pm$ 9 F and 248 $\pm$ 9 F). Heaters shall be shielded to prevent direct radiation to wheel or master cylinders.

4.13.2 Preparation of Test Apparatus

(a) Wheel Cylinder Assemblies—Use new wheel cylinder assemblies having pistons made from unanodized SAE AA2024 aluminum alloy. Disassemble cylinders and discard rubber cups. Clean all metal parts with ethanol and dry with clean compressed air. Inspect the working surfaces of all metal parts for scoring, galling, or pitting and cylinder bore roughness, and discard all defective parts. Remove any stains on cylinder walls with crocus cloth and ethanol. If stains cannot be removed, discard the cylinder.

Measure the internal diameter of each cylinder at locations approximately 19 mm (0.75 in.) from each end of the cylinder bore, taking measurements in line with the hydraulic inlet opening and at right angles to this centerline. Discard the cylinder if any of these four readings exceed maximum or minimum limits of 28.66-28.60 mm (1.1285-1.126 in.). Measure the outside diameter of each piston at two points approximately 90 deg apart. Discard any piston if either reading exceeds maximum or minimum limits of 28.55-28.52 mm (1.124-1.123 in.). Select parts to insure that the clearance between each piston and mating cylinder is within 0.08-0.13 mm (0.003-0.005 in.).

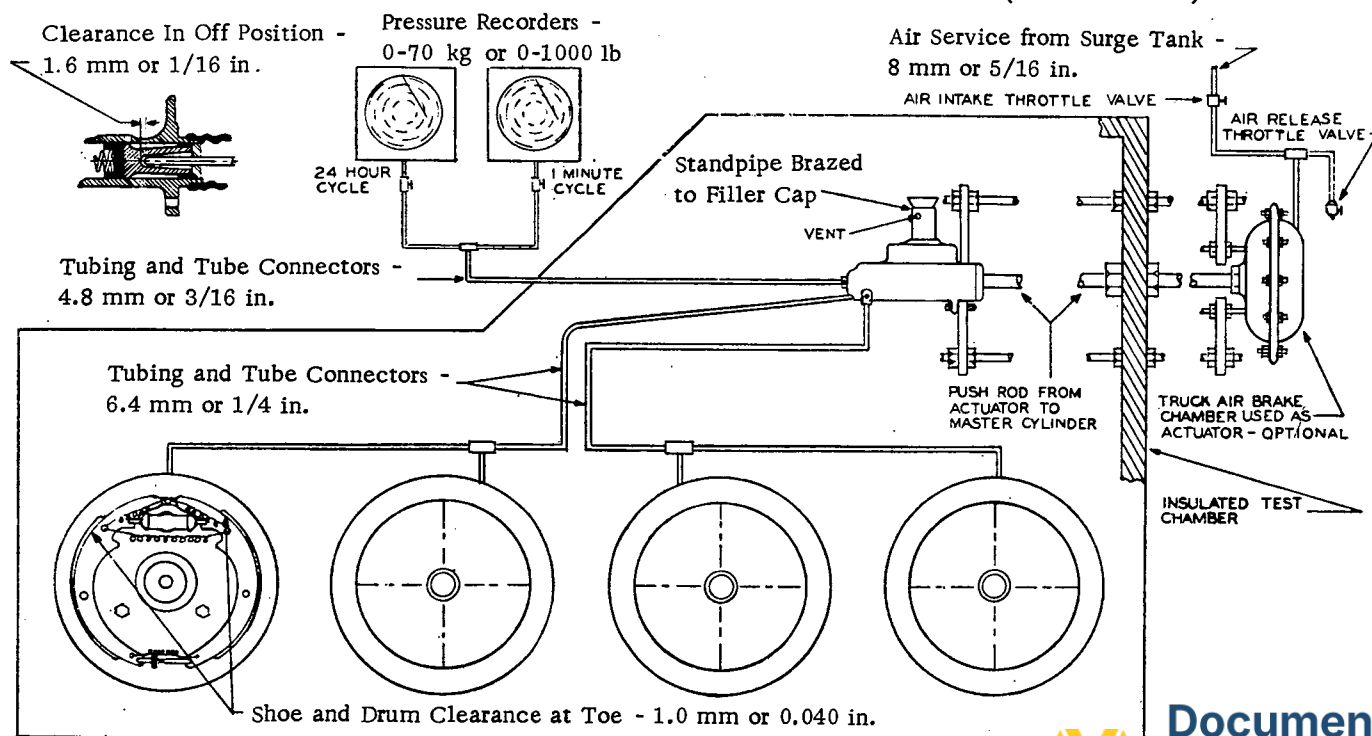


FIG. 1—STROKING TEST APPARATUS