

STATE OF WISCONSIN)
) SS.
DEPARTMENT OF TRANSPORTATION)

MVD 8

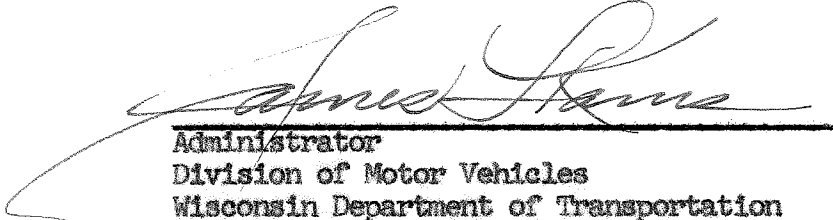
TO ALL TO WHOM THESE PRESENTS SHALL COME, GREETINGS;

I, James L. Karns, Administrator of the Division of Motor Vehicles of the State of Wisconsin Department of Transportation, and legal custodian of the official records of said division, do hereby certify that the annexed, attached created Chapter MVD 8, entitled "Trailer, Semi-Trailer Brake, Hitch & Coupling Requirements and Requirements for Safety Chains, Cables & Leveling Bars," of the published Wisconsin Administrative Code, marked "Exhibit A," has been duly approved and adopted by me as Administrator of said division, this 27th day of June, 1968.

I further certify that these newly-created rules attached to my Order as "Exhibit A" which are being filed with the offices of the Revisor of Statutes and Secretary of State, respectively, have been compared by me with the original on file in this division, and that each respective copy, including "Exhibit A," is a true and correct copy of the original Order and attached "Exhibit A" on file with this division.

IN TESTIMONY WHEREOF, I have hereunto set my hand and affixed the official seal of the Department of Transportation at the Hill Farms State Office Building in the city of Madison, Wisconsin, this 27th day of June, 1968.





Administrator
Division of Motor Vehicles
Wisconsin Department of Transportation

BEFORE THE DEPARTMENT OF TRANSPORTATION OF THE STATE OF WISCONSIN
DIVISION OF MOTOR VEHICLES

IN THE MATTER OF THE ADOPTION OF CHAPTER *
MVD 8 OF THE WISCONSIN ADMINISTRATIVE CODE; *
RULES RELATIVE TO TRAILER AND SEMI-TRAILER *
BRAKE REQUIREMENTS UNDER 347.35 (3)(b), * ORDER ADOPTING RULES
WIS. STATS., AND COUPLINGS, SAFETY CHAINS, *
LEVELING BARS OR CABLES UNDER 347.47 (4), *
WIS. STATS. *

Pursuant to authority vested in the Administrator of the Division of Motor Vehicles of the Wisconsin Department of Transportation under section 110.06, and more specifically under 347.35 (3)(b), and 347.47 (4), Wis. Stats., created by Chapter 292 of the Laws of 1967; and, after due notice and public hearing held April 15, 1968, at 11:00 a.m., in Room 256, Hill Farms State Office Building, 4802 Sheboygan Avenue, Madison, Wisconsin; and, as provided under Chapter 227, Wis. Stats.; and, after due consideration to the objections and suggestions of those persons attending such public hearing relative to the various portions of the rules, create and adopt rules thereunder as provided in "Exhibit A" attached hereto and made a part hereof;

IT IS HEREBY ORDERED, That Chapter MVD 8 of the Wisconsin Administrative Code, entitled "Trailer, Semi-Trailer Brake, Hitch & Coupling Requirements, and Requirements for Safety Chains, Cables & Leveling Bars," is hereby created as made and provided in "Exhibit A" attached hereto, adopted hereby, and made a part of this Order by reference.

Dated at Madison, Wisconsin, this 27th day of June, 1968.





Administrator
Division of Motor Vehicles
Wisconsin Department of Transportation

EXHIBIT A

TRAILER, SEMI-TRAILER BRAKE, HITCH & COUPLING REQUIREMENTS
REQUIREMENTS FOR SAFETY CHAINS, CABLES & LEVELING BARS

- 8.01 Emergency Braking
- 8.02 Brake Tubing and Hose, Adequacy
- 8.03 Brake Tubing and Hose Connections
- 8.04 Brake Lining
- 8.05 Brakes to be Operative
- 8.06 Single Valve to Operate All Brakes
- 8.07 Warning Devices & Gauges
- 8.08 Electrical Brake Connections
- 8.09 Brake Performance
- 8.10 Trailer & Mobile Home Classification &
Standard Minimum Strength Requirements
of Hitch and Coupling
- 8.11 The Minimum Strength Ratings for the
Coupling and Ball for Trailers and
Mobile Homes
- 8.12 Safety Chains or Cables for Trailers
and Mobile Homes
- 8.13 Leveling Bars

MVD 8.01 Emergency Braking

(1) Every truck or truck tractor equipped with air brakes, when used for towing other vehicles equipped with air brakes, shall be equipped with two means of activating the emergency features of the trailer brakes. One of these means shall operate automatically in the event of reduction of the towing vehicle air supply to a fixed pressure which shall not be lower than 20 pounds per square inch nor higher than 45 pounds per square inch. The other means shall be a manually controlled device readily operable by a person seated in the driving seat. Its emergency position or method of operation shall be clearly indicated. In no instance may the manual means be so arranged as to permit its use to prevent operation of the automatic means. The automatic and manual means required by this section may be, but are not required to be separate.

(2) Every truck tractor and truck when used for towing other vehicles equipped with vacuum brakes, shall have, in addition to the single control required by section MVD 8.06 to operate all brakes of the combination, a second manual control device which can be used to operate the brakes on the towed vehicles in emergencies. Such second control shall be independent of other controls, unless the braking system be so arranged that failure of the pressure on which the second control depends will cause the towed vehicle brakes to be applied automatically. The second control is not required by this rule to provide modulated or graduated braking.

(3) Air brake systems installed on towed vehicles shall be so designed, by the use of "no-bleed-back" relay emergency valves or equivalent devices, that the supply reservoir used to provide air for brakes shall be safeguarded against backflow of air to the towing vehicle upon reduction of the towing vehicle air pressure.

(4) The requirements of paragraphs (2) and (3) of this section shall not be applicable to motor vehicles in driveaway-towaway operations.

MVD 8.02 Brake Tubing and Hose, Adequacy

Brake tubing and brake hose shall be:

(1) Designed and constructed of proper material and so installed and maintained as to insure proper continued functioning;

(2) Sufficiently long and flexible as to accommodate without damage all normal motions of the parts to which they are attached;

(3) Suitably secured against chafing, kinking, or other mechanical injury; and

(4) Brake hose shall be so constructed as to insure adequate and reliable functioning and shall conform to the appropriate specification set forth in the SAE Standards for "Hydraulic Brake Hose", "Air Brake Hose", or "Vacuum Brake Hose". (See 1968 SAE Handbook, pages 260-264.)

MVD 8.03 Brake Tubing and Hose Connections

All connections for air, vacuum, or hydraulic braking systems shall:

- (1) Be adequate in material and construction to insure proper continued functioning;
- (2) Be designed, constructed, installed and maintained so as to insure, when properly connected, an attachment free of leaks, constrictions, or other defects;
- (3) Have suitable provision in every detachable connection to afford reasonable assurance against accidental disconnection;
- (4) Have the vacuum brake engine manifold connection at least three-eighths inch in diameter.

MVD 8.04 Brake Lining

The brake lining on every trailer type vehicle shall be so constructed, installed and maintained as not to be subject to excessive fading and grabbing and shall be adequate in thickness, means of attachment, and physical characteristics to provide for safe and reliable stopping of the vehicle.

MVD 8.05 Brakes to be Operative

All brakes with which trailer-type vehicles are equipped shall be operative at all times except brakes need not be operative on disabled vehicles being towed.

MVD 8.06 Single Valve to Operate All Brakes

Every motor vehicle, the date of manufacture of which is subsequent to June 30, 1953, which is equipped with power brakes, shall have the braking system so arranged that one application valve shall when applied operate all the service brakes on the motor vehicle or combination of motor vehicles. This requirement shall not be construed to prohibit motor vehicles from being equipped with an additional valve to be used to operate the brakes on a trailer or trailers. This section shall not be applicable to driveaway-towaway operations unless the brakes on such operations are designed to be operated by a single valve.

MVD 8.07 Warning Devices and Gauges

(1) Air brakes as provided in paragraph (4) of this section. Every truck and truck tractor using compressed air for the operation of its own brakes or the brakes on any towed vehicle shall be equipped with a warning signal readily audible or visible to the driver, which will give continuous warning at all pressures below a

(cont'd.)

fixed pressure not less than one-half of the compressor governor cut-out pressure. In addition, each such vehicle shall be equipped with a pressure gauge which will indicate to the driver the pressure in pounds per square inch available for braking.

(2) Vacuum brakes as provided in paragraph (4) of this section. Every truck and truck tractor using vacuum for the operation of its own brakes and vacuum for the brakes on any towed vehicle shall be equipped with a warning signal readily audible or visible to the driver, which will give continuous warning at any time the vacuum in the vehicle's supply reservoir is less than 8 inches of mercury. In addition, each such vehicle shall be equipped with a vacuum gauge which will indicate to the driver the vacuum in inches of mercury available for braking.

(3) Maintenance. The warning devices and gauges required by this section shall be maintained in operative condition.

(4) Application. This section applies to all combinations of property-carrying vehicles utilizing trailers or semi-trailers where the gross weight of the trailer or semi-trailer is 3000 pounds or more.

MVD 8.08 Electrical Brake Connections

All electrical wiring shall be mechanically and electrically adequate and free of short or open circuits. Suitable provision shall be made in every such detachable connection to afford reasonable assurance against connection in an incorrect manner or accidental disconnection. Detachable connections made by twisting together wires from the towed and towing units are prohibited. Precaution shall be taken to provide sufficient slack in the connecting wire or cable to accommodate without damage all normal motions of the parts to which they are attached.

MVD 8.09 Brake Performance

Every combination of vehicles, at all times and under all conditions of loading, upon application of the service brake, shall be capable of stopping from a speed of 20 miles per hour in not more than 50 feet.

MVD 8.10 Trailer and Mobile Home Classification and Standard Minimum Strength Requirements of Hitch and Coupling.

(1) Hitch Definition: The hitch is that part of the connecting mechanism, including the coupling platform and its attaching members or weldments, which is attached to the towing vehicle.

(2) Coupling Definition: The coupling is that part of the connecting mechanism, including the coupling and its attaching members or weldments, which is attached to the trailer or mobile home and by which connection is made to the hitch.

(3) . Trailer and Mobile Home Classification: Trailers and mobile homes shall be classified according to the following gross weights, which gross weight shall include the weight of the vehicle and the actual load carried.

- (a) Class A All vehicles whose gross weight does not exceed 2000 lbs.
- (b) Class B All vehicles in excess of 2000 lbs. gross weight but not exceeding 3500 lbs. gross weight.
- (c) Class C All vehicles in excess of 3500 lbs. gross weight and not exceeding 5000 lbs. gross weight.
- (d) Class D All vehicles with gross weight, in excess of 5000 lbs. but not to exceed 10,000 lbs.

(4) Strength Ratings for Trailer and Mobile Home Couplings:

- (a) The trailer or mobile home coupling shall be of such design as to conform to the minimum strength requirements set forth in subparagraph (b) of this section. Where a ball-and-socket type of coupling is used, the ball must conform to the minimum load ratings of the mating coupling.
- (b) Minimum strength ratings for the coupling used in conjunction with specific classes of trailers and mobile homes:

<u>Vehicle Classification</u>	<u>Minimum Breaking Point Requirements of Coupling</u>	
Class A	Longitudinal tension	6,000 lbs.
	Longitudinal compression	6,000 lbs.
	Transverse thrust	2,000 lbs.
	Vertical tension	2,500 lbs.
	Vertical compression	2,500 lbs.
Class B	Longitudinal tension	10,500 lbs.
	Longitudinal compression	10,500 lbs.
	Transverse thrust	3,000 lbs.
	Vertical tension	4,500 lbs.
	Vertical compression	4,500 lbs.
Class C	Longitudinal tension	15,000 lbs.
	Longitudinal compression	15,000 lbs.
	Transverse thrust	4,000 lbs.
	Vertical tension	7,000 lbs.
	Vertical compression	7,000 lbs.

- Class D
- Longitudinal tension - gross load of trailer-type vehicle in pounds x 3
 - Longitudinal compression - gross load of trailer-type vehicle in pounds x 3
 - Transverse thrust - gross load of trailer-type vehicle in pounds x 1
 - Vertical tension - gross load of trailer-type vehicle in pounds x 1.3
 - Vertical compression - gross load of trailer-type vehicle in pounds x 1.3

- (c) Strength rating of hitch and coupling for trailers over 10,000 lbs. - Each coupling system, other than safety chain or cable, shall have a minimum longitudinal strength, in both tension and compression, no less than 130% of the total gross weight towed by the coupling system but not to exceed 60,000 lbs. The coupling system shall include not only coupling devices such as tow bars, pintles, tow bar eye, but all the members, means and attachments used to fasten or secure the coupling device to the motor vehicle.
- (5) Each coupling is to be mounted to the attaching member by bolting, welding or riveting in such manner that the maximum loading required for the coupling designation shown in (4)(b) is safely and adequately transferred to that member.
- (6) Each hitch and coupling, regardless of classification, must be equipped with a manually operated mechanism so adapted as to prevent disengagement of the unit while in operation.
- (7) Strength Rating for Trailer and Mobile Home Hitches:
- (a) The hitch and its coupling platform shall be of such design and shall be so attached to the towing vehicle as to safely and adequately handle the gross load of trailer or mobile home including contents thereof.

MVD 8.11 The Minimum Strength Ratings for the Coupling and Ball for Trailers and Mobile Homes is as follows:

<u>Maximum Gross Wt.</u>	<u>Minimum Ball Diam.</u>	<u>Minimum Ball Bolt Diam.</u>
2000 lbs.	1-7/8"	5/8"
3500 lbs.	2"	11/16"
5000 lbs.	2"	3/4"
over 5000 lbs.	Ball and bolt sizes shall equal or exceed the larger of the above classification. In addition the ball and bolts shall be of sufficient size and strength to prevent collapse or shearing under the actual gross towed weight.	

MVD 8.12 Safety Chains or Cables for Trailer and Mobile Homes

(1) Number of Lengths of Chain Required: Two separate lengths of safety chain or cable shall be required on all trailers and mobile homes.

(2) Strength Ratings for Safety Chains or Cables: The strength rating for each length of safety chain or cable used in conjunction with trailers and mobile homes as classified in MVD 8.10 (3) shall be as follows:

<u>Maximum Gross Wt.</u>	<u>Minimum Chain Size</u>	<u>Minimum Cable Size</u>
2000 lbs.	3/16" proof coil steel chain or equivalent	5/32" diam. 7 x 19 preformed aircraft cable or equivalent
3500 lbs.	1/4" proof coil steel welded chain or equivalent	3/16" diam. 7 x 19 preformed aircraft cable or equivalent
5000 lbs.	5/16" proof coil steel welded chain or equivalent	7/32" diam. 7 x 19 preformed aircraft cable or equivalent
over 5000 lbs.	Strength rating of each length of safety chain or cable shall be equal in minimum break test load to the gross weight of the trailer or mobile home.	

(3) The means of attachment of safety chains shall be located equally distant from and on opposite sides of the longitudinal centerline of the towing vehicle and the trailer. Each means of attachment shall have no towing function other than the connection of safety chains and shall not be common with or utilize fasteners common with a ball, socket, ring, pintle, clevis, pin or other equivalent portion of the primary towing arrangement. No welding operation shall be performed on safety chain subsequent to its manufacture. Safety chains shall be so connected that the slack for each length of chain between the trailer and towing vehicle is the same and is not more than necessary to permit proper turning of the vehicles. Each means of attaching chain or cable shall have a longitudinal strength at least equal to the total gross towed weight.

(4) All tilt bed trailers built with a swivel pole to permit angling of pole for forward drive unloading, shall be equipped with a chain at that point where the bend is joined to the pole. Chain shall be of sufficient strength, adequately fastened, and short enough to prohibit the trailer from angling in the event the connecting pin breaks or becomes disconnected.

MVD 8.13 Leveling Bars

The strength rating of each leveling bar, or part of such unit, shall be not less than:

Longitudinal tension - gross load of trailer-type vehicle in pounds x 3

Longitudinal compression - gross load of trailer-type vehicle in pounds x 3

Transverse thrust - gross load of trailer-type vehicle in pounds x 1

Vertical tension - gross load of trailer-type vehicle in pounds x 1.3

Vertical compression - gross load of trailer-type vehicle in pounds x 1.3

NOTE: The 1968 SAE Handbook referred to in the above and foregoing rules may be obtained from Society of Automotive Engineers, Inc., 485 Lexington Avenue, New York, New York.



Technical Report Preprint

This report is scheduled to appear in the 1968 SAE Handbook.

J40c

SOCIETY OF AUTOMOTIVE ENGINEERS, INC.,
485 Lexington Avenue, New York, New York 10017

Automotive Brake Hoses - SAE J40c

SAE Standard

Report of Motorcoach and Motor Truck Division approved January 1942 and last revised by Hydraulic Brake Systems Actuating Committee January 1967.

[The specifications in this SAE Standard originated in the SAE-ASTM Technical Committee on Automotive Rubber (other than tires). They represent the correlation of the best information available from research investigation and production experience on the minimum constructional and performance characteristics essential for new brake-hose assemblies used as original or replacement equipment. They also represent the minimum quality recognized by car manufacturers and hose suppliers as essential for satisfactory and safe operation by the hose itself and other coating parts of the braking system. This SAE Standard includes hoses for hydraulic, air, and vacuum brakes.]

HYDRAULIC-BRAKE HOSE (SAE 40R1) ASSEMBLY SPECIFICATION FOR 1/8-IN. HOSE

Scope—This specification covers a grade of hose fabricated from braid and natural rubber or from braid and synthetic rubber, assembled with steel or brass end fittings for use on automotive hydraulic-brake equipment as flexible connections.

Manufacture—This hose shall consist of a rubber inner tube, two braids of cotton, viscose rayon, or polyester cord imbedded in and bonded to the rubber, and a rubber outer cover. The cover must be a black stock, free from sulfur bloom, which will not crack when subjected to long periods of weather aging. The inner tube of this hose must be a nonblooming stock which will effectively resist deterioration by nonmineral oil brake fluids approved by the original vehicle manufacturers.

End Connections—Exposed steel or brass end connections of the hose assembly shall be suitably protected against rust or corrosion.

Hose Identification—Each manufacturer of hose shall identify his product by one or more colored cords woven into the braid.

NOTE: The approved cord color designation for each brake-hose manufacturer shall be assigned by the Rubber Manufacturers Association, Inc., 444 Madison Avenue, New York 22, N. Y.

Each hose assembly must bear a distinctive designation prominently and permanently indicating the name or trade mark of the hose-assembly manufacturer.

TABLE 1 - SAMPLES REQUIRED FOR TEST^a, SAE 40R1, HOSE

	Original Test	Retest
Tensile (Dry)	4	8
Tensile (Water Immersed)	4	8
Volumetric Exp. Followed by		
Burst (Dry)	4	8
Burst (Water Immersed)	4	8
Whip (Dry)	4	8
Whipt (Water Immersed)	4	8
Cold Flux Test	1	2
Ozone Test	1	2
	26	52

^a This specification does not show any items relating to the tensile strength, elongation, and other physical characteristics of the rubber compounds and materials composing the tube, cover, and cord. The preparation of suitable test specimens for tensile strength and stretch from rubber hose of the diameter herein specified is impractical; furthermore, separate test slabs prepared from rubber compounds representing tube and cover compounds are not considered suitable.

26 sample hose assemblies from each lot are required to run a complete test in accordance with this specification. In the interest of safety any assemblies remaining intact after these tests must be destroyed, by cutting through at the center of the length.

Retests and Rejections—In the event of the failure of one sample of the 26 selected at random from a lot to meet any of the following requirements, additional samples, as shown under Retest in Table 1, shall be submitted to the same test and the failure of any one of these shall be cause for rejection of the entire lot.

The temperature of the testing room shall be between 70 and 90 F (21 and 32 C). The samples to be tested shall be stabilized at room temperature previous to testing.

NOTE: The above does not apply to the samples for the cold test.

Test Requirements—The assemblies for test shall be new and unused and shall be at least 24 hr old.

All tests must be made in accordance with the latest ASTM D 571, Methods of Testing Automotive Hydraulic Brake Hose.

Constriction—The constriction of the hose assemblies shall be measured with a gage plug whose "A" dimensions shall be 0.080 in. minimum in diameter. The time required for the gage plug to drop of its own weight a distance of 3 in. into the hose assembly shall not exceed 5 sec.

Expansion—The maximum expansion of any of the hose assemblies so tested shall not exceed values in Table 2.

Bursting Strength—When tested under hydraulic pressure, each sample of hose shall withstand a pressure of 4000 psi minimum for 2 min. The pressure shall then be increased at a rate of 25,000 (plus or minus 10,000) psi per min until burst occurs. The minimum bursting strength for any sample shall be 5000 psi.

Whip Test—The minimum life of any one of the sample hose assemblies with free lengths ranging from 8 to 24 in. run continuously on the flexing machine shall be 35 hr.

Tensile Test—The hose assembly is fixed in the testing machine and pulled at a speed of approximately 1 in. per min. All hose assemblies so tested shall withstand a minimum pull of 325 lb without the end fittings pulling off or rupture of the hose.

Water Absorption Test—Coupled assemblies after 70 hr in water at room temperature, shall pass all burst, whip, and tensile requirements. Coupled assemblies shall have the cover removed 1/2 in. to 3/8 in. from either side of the center (total 1 in. to 1/4 in. cover re-

TABLE 2 - MAXIMUM EXPANSION CC PER FOOT OF
FREE LENGTH OF HOSE, SAE 40R1

	1000 psi		1500 psi	
	Reg. Exp. Hose	Low Exp. Hose	Reg. Exp. Hose	Low Exp. Hose
1/8 in. Hose	0.66	0.33	0.79	0.42
3/16 in. Hose	0.86	0.55	1.02	0.72
1/4 in. Hose	1.04	(a)	1.30	(a)

(a) At present there is no 1/4 in. low expansion hose available.

moved) so that the outer braid is exposed. Care must be taken during removal of the cover that the outer yarn is not injured, nor shall the hose be elongated during the removal. The assembly with the portion of cover removed shall be immersed in water at room temperature for a period of 70 to 72 hr. Within 10 minutes of removal from the water, all tests, except whip test, shall be made. The whip test shall be started within 30 minutes after removal from the water.

Cold Test—The hose assembly shall be conditioned in a cold box in straight position at -65 to -70 F for 72 hr. After conditioning and without removal from the cold box, the hose shall be bent around a mandrel having a diameter of 3 in. The hose shall not crack or break.

Ozone Test* - The outer cover of the hose shall show no cracking when tested in accordance with ASTM D622.

Salt-Spray Test—The hose assembly end connections shall withstand 24-hr exposure to salt spray when tested in accordance with ASTM B 117.

100% Pressure Test—Before shipment by the vendor, each complete hose assembly shall be given a pressure test, using air or water as the pressure medium. The test pressure shall be 1500 psi minimum for air or gas and 3000 psi minimum for liquid. Special care should be taken in case air is used, as under the pressure specified, air is explosive if a failure should occur in the hose or hose assembly. The pressure shall be held for not less than 10, nor more than 25, sec. Hose assemblies showing leaks under this test shall be rejected and destroyed.

ASSEMBLY SPECIFICATION FOR 3/16- AND 1/4-IN. HOSE

Scope—This specification covers a grade of two sizes of hose fabricated from braid and natural rubber or from braid and synthetic rubber, assembled with steel or brass end fittings for use on automotive hydraulic-brake equipment as flexible connections where standard 1/8-in. hose does not provide sufficient fluid displacement.

Manufacture—This hose shall consist of a rubber inner tube, two braids of cotton, viscose rayon, or polyester cord imbedded in and bonded to the rubber, and a rubber outer cover. The cover must be a black stock, free from sulfur bloom, which will not crack when subjected to long periods of weather aging. The inner tube of this hose must be nonblooming stock which will effectively resist deterioration by nonmineral oil brake fluids approved by the original vehicle manufacturers.

End Connections—Exposed steel or brass end connections of the hose assembly shall be suitably protected against rust or corrosion.

Hose Identification—Each manufacturer of hose shall identify his product by one or more colored cords woven into the braid.

NOTE: The approved cord color designation for each brake-hose manufacturer shall be assigned by the Rubber Manufacturers Association, Inc., 444 Madison Avenue, New York 22, N. Y.

Each hose assembly must bear a distinctive designation prominently and permanently indicating the name or trade mark of the hose-assembly manufacturer.

26 sample hose assemblies from each lot are required to run a complete test in accordance with this specification. In the interest of safety, any assemblies remaining intact after these tests must be destroyed by cutting through at the center of the length.

Retests and Rejection—In the event of the failure of one sample of the 26 selected at random from a lot to meet any of the following requirements, additional samples, as shown under Retest in Table 1, shall be submitted to the same test and the failure of any one of these shall be cause for rejection of the entire lot.

The temperature of the testing room shall be between 70 and 90 F (21 and 32 C). The samples to be tested shall be stabilized at room temperature previous to testing.

(The above does not apply to the samples for the cold test.)

Test Requirements—The assemblies for test shall be new and unused and shall be at least 24 hr old. All tests must be made in accordance with the latest ASTM D 571, Methods of Testing Automotive Hydraulic Brake Hose.

Constriction—The constriction of the hose assemblies shall be measured with a gage plug whose "A" dimensions shall be 0.120 in. minimum in diameter for the 3/16 inside diameter hose and 0.165 in. minimum in diameter for the 1/4 inside diameter hose. The time required for the gage plug to drop of its own weight a distance of 3 in. into the hose assembly shall not exceed 5 sec.

*Conformance to MIL-H-13719 is acceptable in lieu of ASTM D622.

Expansion—The maximum expansion of any of the hose assemblies so tested shall not exceed values in Table 2.

Bursting Strength—When tested under hydraulic pressure, each sample of hose shall withstand a pressure of 3000 psi minimum for 2 min. The pressure shall then be increased at a rate of 25,000 (plus or minus 10,000) psi per min until burst occurs. The minimum bursting strength for any sample shall be 4500 psi.

Whip Test—The minimum life of any one of the sample hose assemblies with free lengths ranging from 8 to 15 1/2 in. run continuously on the flexing machine shall be 35 hr.

Tensile Test—The hose assembly is fixed in the testing machine and pulled at a speed of approximately 1 in. per min. All hose assemblies so tested shall withstand a minimum pull of 325 lb without the end fittings pulling off or rupture of the hose.

Water Absorption Test—Coupled assemblies after 70 hr in water at room temperature, shall pass all burst, whip, and tensile requirements. Coupled assemblies shall have the cover removed 1/2 in. to 3/4 in. from either side of the center (total 1 in. to 1 1/4 in. cover removed) so that the outer braid is exposed. Care must be taken during removal of the cover that the outer yarn is not injured, nor shall the hose be elongated during the removal. The assembly with the portion of cover removed shall be immersed in water at room temperature for a period of 70 to 72 hr. Within 10 minutes of removal from the water, all tests, except whip test, shall be made. The whip test shall be started within 30 minutes after removal from the water.

Cold Test—The hose assembly shall be conditioned in a cold box in straight position at -65 to -70 F for 72 hr. After conditioning and without removal from the cold box, the hose shall be bent around a mandrel having a diameter of 3 1/2 in. The hose shall not crack or break.

Ozone Test* - The outer cover of the hose shall show no cracking when tested in accordance with ASTM D622.

Salt-Spray Test—The hose assembly end connections shall withstand 24-hr exposure to salt spray when tested in accordance with ASTM B 117.

100% Pressure Test—Before shipment by the vendor, every complete hose assembly shall be given a pressure test, using air or water as the pressure medium. The test pressure shall be 1500 psi minimum for air or gas and 3000 psi minimum for liquid. Special care should be taken in case air is used, as under the pressure specified, air is explosive if a failure should occur in the hose or hose assembly. The pressure shall be held for not less than 10, nor more than 25, sec. Hose assemblies showing leaks under this test shall be rejected and destroyed.

AIR-BRAKE HOSE (SAE 40R2)

Scope—This specification covers five types of air hose intended for use in automotive air brake systems. The system includes all air actuated equipment leading from the air brake line. These types of hose are not to be used from the air compressor to air reservoir if air temperature is in excess of 250 F. The types of hose are as follows:

Type A—Hose shall be mandrel built having a tube and friction of oil resisting rubber, reinforced with cotton or synthetic cord or duck plies or a combination of both, and a cover of oil resisting compounds utilizing polymerized chloroprene as the basic material. Assemble with reusable or permanent type metal end fittings.

Type B—Hose shall be nonmandrel built having a tube and friction of oil resisting rubber, reinforced with cotton or synthetic cord or duck plies or a combination of both, and a cover of oil resisting compounds utilizing polymerized chloroprene as the basic material. Assemble with reusable or permanent type metal end fittings.

Type C—Hose shall be mandrel built having a tube of oil resisting rubber, reinforced with one braid of high tensile steel wire and a cover of oil resisting compounds utilizing polymerized chloroprene as the basic material. A cotton braid or other suitable material may be used to anchor the cover to the hose. Assemble with permanent type metal end fittings only.

Type D—Hose shall be mandrel built having a tube of oil resisting rubber, reinforced with two cotton braids separated by a high tensile steel wire braid. All braids are to be impregnated with an oil and age resisting compound. This hose is not to be used on any line where abrasion of the outer cover will be encountered in service. Assemble with reusable type metal end fittings only.

Type E—Hose shall be mandrel built having a tube of oil resisting rubber, reinforced with two cotton or synthetic braids separated by a wire braid. All braids are to be impregnated with an oil and age resist-

TABLE 3—AIR-BRAKE HOSE DIAMETER, SAE 40R2

Size, in.	Inside Diameter Tolerance, in.				Types A and B OD, in.		Type C OD, in.		Type D OD, in.		Type E OD, in.	
	Type A	Type B	Type C	Types D and E	Min	Max	Min	Max	Min	Max	Min	Max
3/16*	±1/64	±3/128	—	+0.016 -0.005	1/2	9/16	—	—	0.500	0.539	0.472	0.510
1/4	±1/64	±3/128	±1/64	+0.020 -0.008	19/32	21/32	19/32	21/32	0.562	0.602	0.535	0.573
5/16	±1/64	±3/128	—	+0.023 -0.008	21/32	23/32	—	—	0.656	0.695	0.598	0.636
3/8	±1/64	±3/128	±1/64	—	23/32	25/32	3/4	13/16	—	—	—	—
13/32	—	—	—	+0.023 -0.008	—	—	—	—	0.742	0.789	0.714	0.760
7/16	±1/64	±1/32	—	—	25/32	27/32	—	—	—	—	—	—
1/2	±1/64	±1/32	±3/128	+0.023 -0.008	27/32	29/32	7/8	15/16	0.898	0.945	0.808	0.854
5/8	+1/64	+1/32	—	+0.023 -0.008	1-3/32	1-1/32	—	—	1.054	1.101	0.933	0.979
5/8 Special	±1/64	±1/32	—	—	1-11/32	1-13/32	—	—	—	—	—	—

*3/16 in. size Types A and B may be single-ply reinforcement.

ing compound. This hose is not to be used on any line where abrasion of the outer cover will be encountered in its service. Assemble with reusable type metal end fittings only.

Manufacture—The construction of hose for this service embodies a smooth bore tube of oil resisting material reinforced as described for the types of hose and having a cover of abrasive oil and age resistant compound, except on Type D where the cover will be an impregnated cotton cover. The hose shall be so manufactured as to comply with the test requirements set forth in this SAE Standard.

Reusable End Fittings—Reusable end fittings shall consist of a nipple inserted into the bore of the hose and an outer sleeve (socket, body, or shell) engaging the nipple. The wall of the hose shall be compressed between the nipple and sleeve. Reusable end fittings on Types A and B shall be of such design and construction that they may be used on all constructions of both types of hose.

Dichromate Dip—All zinc plated end fittings are to be dichromate dipped.

Salt Spray Test—Hose assembly end connections shall withstand 24 hr exposure to salt spray when tested in accordance with ASTM B 117 Method of Salt Spray (Fog) Testing. Conformance to this requirement shall be determined by observation of the exterior of the fitting.

Hose Identification—The type of hose, the name or trademark of the hose manufacturer, and/or the hose assembler shall appear on the outer cover of the hose at intervals not greater than 15 in. apart. The color of the branding shall be red for Types A, B, C, D, and E hose.

Retests and Rejections—Any hose which fails in one or more tests may be resampled and retested for which purpose two additional samples shall be selected from the hose for the test that failed to meet the requirements. Failure of either of the retested samples shall be cause for final rejection.

Sizes—The hose shall conform to the dimensional requirements given in Table 3.

Type C Wire, Outside Diameter—The outside diameter over the wire reinforcement of Type C shall conform to the following:

TYPE C, OD OVER WIRE

ID, in.	Wire OD, in.
1/4	7/16 ± 3/128
3/8	19/32 ± 3/128
1/2	23/32 ± 1/32

Samples for Tests—A representative sample of hose approximately 6 ft in length shall be selected from each lot to be tested. If a single length of 6 ft is not available, several sections, each of sufficient length to provide the required test specimens, may be taken.

Test Requirements—All measurements and tests necessary for determining the conformity of the hose with these specifications shall be made in accordance with ASTM D 622, Methods of Testing Automotive Air Brake and Vacuum Brake Hose.

To qualify hose under this specification, all of the requirements shown under Qualification Tests and Inspection Tests must be met. Production shipments or lots of the qualified hose shall meet the

requirements shown under Inspection Tests, but the user may in addition, if he so desires, test hose from any or all such production shipments or lots to the requirements under the Qualification Tests.

Qualification Tests

Aging Test—The hose shall show no cracks, charring, or disintegration externally or internally when straightened after being bent over a form having the radius given in Table 4 after a period of 70 hr in an oven at 100 ± 1 C (212 ± 1.8 F).

Cold Test—After being subjected to this test, the hose shall show no signs of cracking or breaking.

Length Change—Types A, C, D and E hose shall not contract in length more than 3% nor elongate more than 5% when tested under a pressure of 200 psi.

Type B hose shall not contract in length more than 7% when tested under a pressure of 200 psi. Under the same test the hose shall not elongate.

Ozone Test—The outer cover of the hose shall show no cracking when examined under 7 power magnification after a period of 70 hr in the ozone cabinet at 50 parts of ozone per 100 million of air by volume at 104 F.

Inspection Tests—The hose shall conform to the following test requirements:

Adhesion—The minimum load required by the machine method to separate the tube from the plies, the plies, and the cover from the plies shall be 8 lb. This test is to be made only on the original unaged specimens.

Air-Pressure Test—The hose and couplings shall show no leakage under air pressure of 200 psi for 5 min.

Burst Test—The minimum bursting strength of Types A and B hose shall be 900 psi when tested with hydrostatic pressure.

The minimum bursting strength of Types C and D hose when tested with hydrostatic pressure shall be as follows:

3/16 and 1/4 in.	10,000 psi
5/16 in.	9,000 psi
3/8 and 13/32 in.	8,000 psi
1/2 in.	7,000 psi
5/8 in.	6,000 psi

The minimum bursting strength of Type E hose when tested with hydrostatic pressure shall be as follows:

3/16 in. and 1/4 in.	6,000 psi
5/16 in. and 13/32	4,000 psi
1/2 in.	3,500 psi
5/8 in.	3,000 psi

TABLE 4—AIR-BRAKE HOSE AGING TEST, SAE 40R2

	Hose Size, Inside Diameters, in.						
	1/4	5/16	3/8	7/16	1/2	5/8	5/8 Special
Length of specimen, in.	9	10	10	11	11	12	14
Radius of form	1-1/2	1-3/4	1-3/4	2	2	2-1/4	2-1/2

¹The manufacturers of vacuum-brake hose shall obtain the date code from the Rubber Manufacturers Association, Inc., 444 Madison Avenue, New York 22, N. Y.

TABLE 6—HEAVY-DUTY VACUUM-BRAKE HOSE TEST REQUIREMENTS SAE 40R3H

Hose ID, in.	Tests						
	Aging		Bend		Deformation	Burst	Swell
	Specimen Length, in.	Radius of Form, in.	Specimen Length, in.	Maximum Collapse of OD, in.	Collapsed ID (Dimension D), in.	Psi	Diameter of Ball, in.
1/4	9	1-1/2	8	3/32	1/16	1200	3/16
3/8	10	1-3/4	12	5/32	3/32	1200	3/16
1/2	11	2	16	7/32	1/8	1000	13/32
5/8	12	2-1/4	22	7/32	5/32	1000	17/32
3/4	14	2-1/2	28	7/32	3/16	800	5/8
1	16	3-1/4	36	9/32	1/4	800	7/8

TABLE 7—LIGHT-DUTY VACUUM-BRAKE HOSE DIAMETERS, SAE 40R3L

	Hose Size		
	7/32	11/32	15/32
Inside diameter, in.....	7/32	11/32	15/32
Tolerance (plus.....)	0.028	0.028	0.028
(minus.....)	0.032	0.032	0.032
Outside diameter, in.....	7/16	11/16	13/16
Tolerance (plus.....)	0.032	0.032	0.032
(minus.....)	0.032	0.032	0.032

PART II—LIGHT-DUTY TYPE (SAE 40R3L)

Scope—This specification covers a light-duty vacuum-brake hose which is intended for use only in conjunction with the power-braking system on passenger cars and light-duty trucks.

Manufacture—The construction shall conform to that given under General Requirements except that the cover shall also be oil resistant.

Hose Identification—In addition to the marking specified under the General Requirements, the letters LD shall appear on the outer cover at intervals not greater than 36 in. apart.

Sizes—The hose shall conform to the dimensional requirements given in Table 7.

Test Requirements—The hose shall conform to all of the requirements of Table 8 and the applicable requirements in the section on General Requirements.

Deformation Test—The load required in the first compression shall be less than 50 lb, and in the fifth compression it shall be greater than 20 lb.

Swell Test—The actual inside diameter of the hose specimen shall be measured before filling with isoctane, and the ball used shall have a diameter equal to the actual inside diameter measurement minus the ball-diameter factor in Table 8. In all other respects the swell test will conform to that given in the General Requirements.

Cover Tensile—The cover stock shall have a minimum tensile of 800 psi.

Cover Elongation—The cover stock shall have a minimum elongation at break of 200% (2 to 6 in.).

Cover Volume Increase—A specimen prepared from the cover of the hose shall show a volume increase when measured within 5 min after removal from isoctane, in which it has been immersed for 24 hr at room temperature, of not more than 50%.

Tube Tensile—The tube stock shall have a minimum tensile of 700 psi.

Tube Elongation—The tube stock shall have a minimum elongation at break of 175%.

All technical reports, including standards approved and practices recommended, are advisory only. Their use by anyone engaged in industry or trade is entirely voluntary. There is no agreement to adhere to any SAE Standard or SAE Recommended Practice, and no commitment to conform to or be guided by any technical report.

TABLE 8—LIGHT-DUTY VACUUM-BRAKE HOSE TEST REQUIREMENTS SAE 40R3L

Hose ID, in.	Tests						
	Aging		Bend		Deformation	Burst	Swell
	Specimen Length, in.	Radius of Form, in.	Specimen Length, in.	Maximum Collapse of OD, in.	Collapsed ID (Dimension D), in.	Psi	Ball-Diameter Factor
7/32	8	1-1/2	7	11/64	3/64	350	1/16
11/32	9	1-3/4	11	13/64	5/64	350	3/32
15/32	11	2	14	17/64	5/64	350	3/32

PART III—OIL RESISTING HEAVY-DUTY TYPE (SAE 40R3M)

Scope—This specification covers a heavy-duty type vacuum brake hose which is intended for use as manifold connections, but also may be used for all services described under the scope of Part I-Heavy-Duty Type.

Manufacture—The construction shall conform to that given under General Requirements, except that the tube shall also be oil resistant.

Hose Identification—In addition to the marketing specified under the General Requirements, the letter M shall appear on the outer cover at intervals not greater than 36 in. apart.

Sizes—The hose shall conform to the dimensional requirements given in Table 5.

Test Requirements—The hose shall conform to all the requirements of Table 6, the applicable requirements in the section on General Requirements, and the requirements specified under Part I-Heavy Duty Type (SAE 40R3H).

Tube Volume Increase—A specimen prepared from the inner tube of the hose shall show a volume increase, when measured after removal from ASTM No. 3 Oil in which it has been immersed for 70 hr at 212 F, of not more than 100%.

COLOR ASSIGNMENTS TO BRAKE-HOSE MANUFACTURERS

[This listing is not considered a part of this SAE Standard]

As of 1964 the Rubber Manufacturers Association, 444 Madison Ave., New York 22, N. Y., has assigned brake-hose identification colors to the hose manufacturers as follows:

Yellow	B. F. Goodrich Co.	Yellow and Brown	Bowling Green Rubber Co.
Green	Goodyear Tire and Rubber Co.	Red and Black	Dominion Rubber Co., Ltd.
Red	United States Rubber Co.	Red and Blue	Goodall Rubber Co.
Black	Inland Div., General Motors Corp.	Red and Brown	Continental Rubber Works
Blue	Raybestos-Manhattan Inc.	Black and Blue	Electric Hose and Rubber Co.
Brown	Republic Rubber Div., Aeroquip Corp.	Black and Brown	Boston Woven Hose and Rubber Co.
Violet	Firestone Tire and Rubber Co.	Blue and Brown	Societe Francaise de Freins Hydrauliques Lockheed
Orange	Dayco Corp.	Green, Yellow, Red	Acme-Hamilton Manufacturing Co.
Green and Yellow	Renault (France)	Green, Yellow, Black	Polymer Corp. of Pennsylvania
Green and Red	Thermoid Div., H. K. Porter Co.	Blue, Brown, Brown	Pirelli S. p. A. (Italy)
Green and Black	Gates Rubber Co.	Blue, Blue, Brown	Mundener Gummiwarenfabrik (Germany)
Green and Blue	Crown Products Co.	Yellow and Blue	Hewlett-Robins, Inc.
Green and Brown	Nagoya Rubber Co. of Japan		
Yellow and Red	Swan Rubber Co.		
Yellow and Black	Continental Gummi-Werke A. G. (Germany)		

In formulating and approving technical reports, the Technical Board, its Councils and Committees will not investigate or consider patents which may apply to the subject matter. Prospective users of the report are responsible for protecting themselves against liability for infringement of patents.

—SAE Technical Board Rules and Regulations

AUTOMOTIVE BRAKE HOSES—SAE J40d

SAE Standard

Report of Motorcoach and Motor Truck Division approved January 1942 and last revised by Hydraulic Brake Systems Actuating Committee January 1967 and by Nonmetallic Materials Committee March 1967.

[The specifications in this SAE Standard originated in the SAE-ASTM Technical Committee on Automotive Rubber (other than tires). They represent the correlation of the best information available from research investigation and production experience on the minimum constructional and performance characteristics essential for new brake-hose assemblies used as original or replacement equipment. They also represent the minimum quality recognized by car manufacturers and hose suppliers as essential for satisfactory and safe operation by the hose itself and other coating parts of the braking system. This SAE Standard includes hoses for hydraulic, air, and vacuum brakes.]

HYDRAULIC-BRAKE HOSE (SAE 40R1) ASSEMBLY SPECIFICATION FOR 1/8-IN. HOSE

Scope—This specification covers a grade of hose fabricated from braid and natural rubber or from braid and synthetic rubber, assembled with steel or brass end fittings for use on automotive hydraulic-brake equipment as flexible connections.

Manufacture—This hose shall consist of a rubber inner tube, two braids of cotton, viscose rayon, or polyester cord imbedded in and bonded to the rubber, and a rubber outer cover. The cover must be a black stock, free from sulfur bloom, which will not crack when subjected to long periods of weather aging. The inner tube of this hose must be a nonblooming stock which will effectively resist deterioration by nonmineral oil brake fluids approved by the original vehicle manufacturers.

End Connections—Exposed steel or brass end connections of the hose assembly shall be suitably protected against rust or corrosion.

Hose Identification—Each manufacturer of hose shall identify his product by one or more colored cords woven into the braid.

NOTE: The approved cord color designation for each brake-hose manufacturer shall be assigned by the Rubber Manufacturers Association, Inc., 444 Madison Avenue, New York, N.Y. 10022.

Each hose assembly must bear a distinctive designation prominently and permanently indicating the name or trade mark of the hose-assembly manufacturer.

Twenty-six sample hose assemblies from each lot are required to run a complete test in accordance with this specification. In the interest of safety any assemblies remaining intact after these tests must be destroyed by cutting through at the center of the length.

Retests and Rejections—In the event of the failure of one sample of the 26 selected at random from a lot to meet any of the following requirements, additional samples, as shown under Retest in Table 1, shall be submitted to the same test and the failure of any one of these shall be cause for rejection of the entire lot.

The temperature of the testing room shall be between 70 and 90 F (21 and 32 C). The samples to be tested shall be stabilized at room temperature previous to testing.

NOTE: The above does not apply to the samples for the cold test.

TABLE 1—SAMPLES REQUIRED FOR TEST^a, SAE 40R1, HOSE

	Original Test	Retest
Tensile (dry).....	4	8
Tensile (water immersed).....	4	8
Volumetric expansion, Followed by Burst (dry).....	4	8
Burst (water immersed).....	4	8
Whip (dry).....	4	8
Whip (water immersed).....	4	8
Cold Flux Test.....	1	2
Ozone Test.....	1	2
	26	52

^a This specification does not show any items relating to the tensile strength, elongation, and other physical characteristics of the rubber compounds and materials composing the tube, cover, and cord. The preparation of suitable test specimens for tensile strength and stretch from rubber hose of the diameter herein specified is impractical; furthermore, separate test slabs prepared from rubber compounds representing tube and cover compounds are not considered suitable.

Test Requirements—The assemblies for test shall be new and unused and shall be at least 24 hr old.

All tests must be in accordance with the latest ASTM D 571, Methods of Testing Automotive Hydraulic Brake Hose.

Constriction—The constriction of the hose assemblies shall be measured with a gage plug whose "A" dimensions shall be 0.080 in. minimum in diameter. The time required for the gage plug to drop of its own weight a distance of 3 in. into the hose assembly shall not exceed 5 sec.

Expansion—The maximum expansion of any of the hose assemblies so tested shall not exceed values in Table 2.

TABLE 2—MAXIMUM EXPANSION OF FREE LENGTH HOSE, SAE 40R1 (cc/h)

Hose, in.	1000 psi		1500 psi	
	Reg. Exp. Hose	Low Exp. Hose	Reg. Exp. Hose	Low Exp. Hose
1/8	0.66	0.33	0.79	0.42
3/16	0.86	0.55	1.02	0.72
1/4	1.04	^a	1.30	^a

^a At present there is no 1/4 in. low expansion hose available.

Bursting Strength—When tested under hydraulic pressure, each sample of hose shall withstand a pressure of 4000 psi minimum for 2 min. The pressure shall then be increased at a rate of 25,000 (± 10,000) psi per min until burst occurs. The minimum bursting strength for any sample shall be 5000 psi.

Whip Test—The minimum life of any one of the sample hose assemblies with free lengths ranging from 8 to 24 in. run continuously on the flexing machine shall be 35 hr.

Tensile Test—The hose assembly is fixed in the testing machine and pulled at a speed of approximately 1 in. per min. All hose assemblies so tested shall withstand a minimum pull of 325 lb without the end fittings pulling off or rupture of the hose.

Water Absorption Test—Coupled assemblies after 70 hr in water at room temperature, shall pass all burst, whip, and tensile requirements. Coupled assemblies shall have the cover removed 1/2 in. to 5/8 in. from either side of the center (total 1 in. to 1 1/4 in. cover removed) so that the outer braid is exposed. Care must be taken during removal of the cover that the outer yarn is not injured, nor shall the hose be elongated during the removal. The assembly with the portion of cover removed shall be immersed in water at room temperature for a period of 70 to 72 hr. Within 10 minutes of removal from the water, all tests, except whip test, shall be made. The whip test shall be started within 30 minutes after removal from the water.

Cold Test—The hose assembly shall be conditioned in a cold box in straight position at -65 to -70 F for 72 hr. After conditioning and without removal from the cold box, the hose shall be bent around a mandrel having a diameter of 3 in. The hose shall not crack or break.

Ozone Test—The outer cover of the hose shall show no cracking when tested in accordance with ASTM D622.

Salt-Spray Test—The hose assembly end connections shall withstand 24-hr exposure to salt spray when tested in accordance with ASTM B 117.

100% Pressure Test—Before shipment by the vendor, each complete hose assembly shall be given a pressure test, using air or water as the pressure medium. The test pressure shall be 1500 psi minimum for air or gas and 3000 psi minimum for liquid. Special care should be taken in case air is used, as under the pressure specified, air is explosive if a failure should occur in the hose or hose assembly. The pressure shall be held for not less than 10, nor more than 25, sec. Hose assemblies showing leaks under this test shall be rejected and destroyed.

ASSEMBLY SPECIFICATION FOR 3/16- AND 1/4-IN. HOSE

Scope—This specification covers a grade of two sizes of hose fabricated from braid and natural rubber or from braid and synthetic rubber, assembled with steel or brass end fittings for use on automotive hydraulic-brake equipment as flexible connections where standard 1/8-in. hose does not provide sufficient fluid displacement.

¹Conformance to MIL-H-13719 is acceptable in lieu of ASTM D622.

Manufacture—This hose shall consist of a rubber inner tube, two braids of cotton, viscose rayon, or polyester cord imbedded in and bonded to the rubber, and a rubber outer cover. The cover must be a black stock, free from sulfur bloom, which will not crack when subjected to long periods of weather aging. The inner tube of this hose must be a nonblooming stock which will effectively resist deterioration by nonmineral oil brake fluids approved by the original vehicle manufacturers.

End Connections—Exposed steel or brass end connections of the hose assembly and shall be suitably protected against rust or corrosion.

Hose Identification—Each manufacturer of hose shall identify his product by one or more colored cords woven into the braid.

NOTE: The approved cord color designation for each brake-hose manufacturer shall be assigned by the Rubber Manufacturers Association, Inc., 444 Madison Avenue, New York, N.Y. 10022.

Each hose assembly must bear a distinctive designation prominently and permanently indicating the name or trade mark of the hose-assembly manufacturer.

Twenty-six sample hose assemblies from each lot are required to run a complete test in accordance with this specification. In the interest of safety, any assemblies remaining intact after these tests must be destroyed by cutting through at the center of the length.

Retests and Rejection—In the event of the failure of one sample of the 26 selected at random from a lot to meet any of the following requirements, additional samples, as shown under Retest in Table 1, shall be submitted to the same test and the failure of any one of these shall be cause for rejection of the entire lot.

The temperature of the testing room shall be between 70 and 90 F (21 and 32 C). The samples to be tested shall be stabilized at room temperature previous to testing.

(The above does not apply to the samples for the cold test.)

Test Requirements—The assemblies for test shall be new and unused and shall be at least 24 hr old. All tests must be made in accordance with the latest ASTM D 571, Methods of Testing Automotive Hydraulic Brake Hose.

Constriction—The constriction of the hose assemblies shall be measured with a gage plug whose "A" dimensions shall be 0.120 in. minimum in diameter for the $\frac{3}{16}$ inside diameter hose and 0.165 in. minimum in diameter for the $\frac{1}{4}$ inside diameter hose. The time required for the gage plug to drop of its own weight a distance of 3 in. into the hose assembly shall not exceed 5 sec.

Expansion—The maximum expansion of any of the hose assemblies so tested shall not exceed values in Table 2.

Bursting Strength—When tested under hydraulic pressure, each sample of hose shall withstand a pressure of 3000 psi minimum for 2 min. The pressure shall then be increased at a rate of 25,000 ($\pm 10,000$) psi per min until burst occurs. The minimum bursting strength for any sample shall be 4500 psi.

Whip Test—The minimum life of any one of the sample hose assemblies with free lengths ranging from 8 to 15½ in. run continuously on the flexing machine shall be 35 hr.

Tensile Test—The hose assembly is fixed in the testing machine and pulled at a speed of approximately 1 in. per min. All hose assemblies so tested shall withstand a minimum pull of 325 lb without the end fittings pulling off or rupture of the hose.

Water Absorption Test—Coupled assemblies after 70 hr in water at room temperature, shall pass all burst, whip, and tensile requirements. Coupled assemblies shall have the cover removed $\frac{1}{2}$ in. to $\frac{5}{8}$ in. from either side of the center (total 1 in. to 1¼ in. cover removed) so that the outer braid is exposed. Care must be taken during removal of the cover that the outer yarn is not injured, nor shall the hose be elongated during the removal. The assembly with the portion of cover removed shall be immersed in water at room temperature for a period of 70 to 72 hr. Within 10 minutes of removal from the water, all tests, except whip test, shall be made. The whip test shall be started within 30 minutes after removal from the water.

Cold Test—The hose assembly shall be conditioned in a cold box in straight position at -65 to -70 F for 72 hr. After conditioning and without removal from the cold box, the hose shall be bent around a mandrel having a diameter of 3½ in. The hose shall not crack or break.

Ozone Test—The outer cover of the hose shall show no cracking when tested in accordance with ASTM D622.

Salt-Spray Test—The hose assembly end connections shall withstand 24-hr exposure to salt spray when tested in accordance with ASTM B 117.

100% Pressure Test—Before shipment by the vendor, every complete hose assembly shall be given a pressure test, using air or water as

the pressure medium. The test pressure shall be 1500 psi minimum for air or gas and 3000 psi minimum for liquid. Special care should be taken in case air is used, as under the pressure specified, air is explosive if a failure should occur in the hose or hose assembly. The pressure shall be held for not less than 10, nor more than 25, sec. Hose assemblies showing leaks under this test shall be rejected and destroyed.

AIR-BRAKE HOSE (SAE 40R2)

Scope—This specification covers five types of air hose intended for use in automotive air brake systems. The system includes all air actuated equipment leading from the air brake line. These types of hose are not to be used from the air compressor to air reservoir if air temperature is in excess of 250 F. The types of hose are as follows:

Type A—Hose shall be mandrel built having a tube and friction of oil resisting rubber, reinforced with cotton or synthetic cord or duck plies or a combination of both, and a cover of oil resisting compounds utilizing polymerized chloroprene as the basic material. Assemble with reusable or permanent type metal end fittings.

Type B—Hose shall be nonmandrel built having a tube and friction of oil resisting rubber, reinforced with cotton or synthetic cord or duck plies or a combination of both, and a cover of oil resisting compounds utilizing polymerized chloroprene as the basic material. Assemble with reusable or permanent type metal end fittings.

Type C—Hose shall be mandrel built having a tube of oil resisting rubber, reinforced with one braid of high tensile steel wire and a cover of oil resisting compounds utilizing polymerized chloroprene as the basic material. A cotton braid or other suitable material may be used to anchor the cover to the hose. Assemble with permanent type metal end fittings only.

Type D—Hose shall be mandrel built having a tube of oil resisting rubber, reinforced with two cotton braids separated by a high tensile steel wire braid. All braids are to be impregnated with an oil and age resisting compound. This hose is not to be used on any line where abrasion of the outer cover will be encountered in service. Assemble with reusable type metal end fittings only.

Type E—Hose shall be mandrel built having a tube of oil resisting rubber, reinforced with two cotton or synthetic braids separated by a wire braid. All braids are to be impregnated with an oil and age resisting compound. This hose is not to be used on any line where abrasion of the outer cover will be encountered in its service. Assemble with reusable type metal end fittings only.

Type F—Hose shall be mandrel built having a tube of oil resisting rubber, reinforced with one 300 Series stainless steel braid and one fabric braid separated by an insulation layer of oil resisting rubber. The fabric braid is to be impregnated with an oil and age resistant compound. Assembled with reusable or permanent type metal end fittings.

Manufacture—The construction of hose for this service embodies a smooth bore tube of oil resisting material reinforced as described for the types of hose and having a cover of abrasive oil and age resistant compound, except on Types D, E, and F where the cover will be an impregnated cotton cover. The hose shall be so manufactured as to comply with the test requirements set forth in this SAE Standard.

Reusable End Fittings—Reusable end fittings shall consist of a nipple inserted into the bore of the hose and an outer sleeve (socket, body, or shell) engaging the nipple. The wall of the hose shall be compressed between the nipple and sleeve. Reusable end fittings on Types A and B shall be of such design and construction that they may be used on all constructions of both types of hose.

Dichromate Dip—All zinc plated end fittings are to be dichromate dipped.

Salt Spray Test—Hose assembly end connections shall withstand 24 hr exposure to salt spray when tested in accordance with ASTM B 117 Method of Salt Spray (Fog) Testing. Conformance to this requirement shall be determined by observation of the exterior of the fitting.

Hose Identification—The type of hose, the name or trademark of the hose manufacturer, and/or the hose assembler shall appear on the outer cover of the hose at intervals not greater than 15 in. apart. The color of the branding shall be red for Types A, B, C, D, E, and F hose.

Retests and Rejections—Any hose which fails in one or more tests may be resampled and retested for which purpose two additional samples shall be selected from the hose for the test that failed to meet the requirements. Failure of either of the retested samples shall be cause for final rejection.

Sizes—The hose shall conform to the dimensional requirements given in Table 3.

TABLE 3—AIR-BRAKE HOSE DIAMETER, SAE 40R2

Size, in.	Inside Diameter Tolerance, in.				Types A and B OD, in.		Type C OD, in.		Type D OD, in.		Type E OD, in.		Type F OD, in.	
	Type A	Type B	Type C	Types D, E and F	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
3/16*	±1/64	±3/128	—	+0.016 +0.005	1/2	9/16	—	—	0.500	0.539	0.472	0.510	0.468	0.507
1/4	±1/64	±3/128	±1/64	+0.020 -0.008	19/32	21/32	19/32	21/32	0.562	0.602	0.535	0.573	—	—
5/16	±1/64	±3/128	—	+0.023 -0.008	21/32	23/32	—	—	0.656	0.695	0.598	0.636	0.593	0.632
3/8	±1/64	±3/128	±1/64	—	21/32	23/32	3/4	13/16	—	—	—	—	—	—
13/32	—	—	—	+0.023 -0.008	—	—	—	—	0.742	0.789	0.714	0.760	0.742	0.788
7/16	±1/64	±1/32	—	—	25/32	27/32	—	—	—	—	—	—	—	—
1/2	±1/64	±1/32	±3/128	+0.023 -0.008	27/32	29/32	7/8	15/16	0.898	0.945	0.808	0.854	0.837	0.883
5/8	±1/64	±1/32	—	+0.023 -0.008	1-3/32	1-1/32	—	—	1.054	1.101	0.933	0.979	0.953	1.015
5/8 Special	±1/64	±1/32	—	—	1-11/32	1-13/32	—	—	—	—	—	—	—	—

* 3/16 in. size Types A and B may be single-ply reinforcement.

Type C Wire, Outside Diameter—The outside diameter over the wire reinforcement of Type C shall conform to the following:

TYPE C, OD OVER WIRE

ID, in.	Wire OD, in.
1/4	7/16 ± 3/128
3/8	19/32 ± 3/128
1/2	23/32 ± 1/32

Samples for Tests—A representative sample of hose approximately 6 ft in length shall be selected from each lot to be tested. If a single length of 6 ft is not available, several sections, each of sufficient length to provide the required test specimens, may be taken.

Test Requirements—All measurements and tests necessary for determining the conformity of the hose with these specifications shall be made in accordance with ASTM D 622, Methods of Testing Automotive Air Brake and Vacuum Brake Hose.

To qualify hose under this specification, all of the requirements shown under Qualification Tests and Inspection Tests must be met. Production shipments or lots of the qualified hose shall meet the requirements shown under Inspection Tests, but the user may in addition, if he so desires, test hose from any or all such production shipments or lots to the requirements under the Qualification Tests.

Qualification Tests

Aging Test—The hose shall show no cracks, charring, or disintegration externally or internally when straightened after being bent over a form having the radius given in Table 4 after a period of 70 hr in an oven at 100 ± 1 C (212 ± 1.8 F).

TABLE 4—AIR-BRAKE HOSE AGING TEST, SAE 40R2

	Hose Size, Inside Diameters, in.						
	1/4	5/16	3/8	7/16	1/2	5/8	5/8 Special
Types A-E: Length of Specimen, in. Radius of form	9 1-1/2	10 1-3/4	10 1-3/4	11 2	11 2	12 2-1/4	14 2-1/2
Type F: Length of Specimen, in. Radius of form	3/16	5/16	13/32	1/2	5/8		
	9 1-1/2	11 2	12 2-5/16	15 2-3/4	19 3-1/4		

Cold Test—After being subjected to this test, the hose shall show no signs of cracking or breaking.

Length Change—Types A, C, D and E hose shall not contract in

*The manufacturers of vacuum-brake hose shall obtain the date code from the Rubber Manufacturers Association, Inc., 444 Madison Avenue, New York, N. Y. 10022.

length more than 3% nor elongate more than 5% when tested under a pressure of 200 psi.

Types B and F hose shall not contract in length more than 7% when tested under a pressure of 200 psi. Under the same test the hose shall not elongate.

Ozone Test—The outer cover of the hose shall show no cracking when examined under 7 power magnification after a period of 70 hr in the ozone cabinet at 50 parts of ozone per 100 million of air by volume at 104 F.

Inspection Tests—The hose shall conform to the following test requirements:

Adhesion—The minimum load required by the machine method to separate the tube from the plies, the plies, and the cover from the plies shall be 8 lb. This test is to be made only on the original unaged specimens.

Air-Pressure Test—The hose and couplings shall show no leakage under air pressure of 200 psi for 5 min.

Burst Test—The minimum bursting strength of Types A and B hose shall be 900 psi when tested with hydrostatic pressure. The minimum bursting strength of Type F hose shall be 1000 psig when tested with hydrostatic pressure.

The minimum bursting strength of Types C and D hose when tested with hydrostatic pressure shall be as follows:

3/16 and 1/4 in.	10,000 psi
5/16 in.	9,000 psi
3/8 and 13/32 in.	8,000 psi
1/2 in.	7,000 psi
5/8 in.	6,000 psi

The minimum bursting strength of Type E hose when tested with hydrostatic pressure shall be as follows:

3/16 in. and 1/4 in.	6,000 psi
5/16 in. and 13/32	4,000 psi
1/2 in.	3,500 psi
5/8 in.	3,000 psi

Tensile Test—The hose assembly complete with coupling shall withstand a minimum pull of 325 lb without separation from the couplings or rupture of the hose structure, except that 3/16 and 1/4 in. sizes of Types A and B shall withstand minimum pull of 250 lb without separation from the coupling or rupture of the hose structure.

Volume Increase of Tube in Types A, B, C, D, and E, and Cover Types, A, B, and C—A specimen prepared from the inner tube and from the cover of the hose shall show a volume increase when measured after removal from the ASTM No. 3 Oil, in which it has been immersed for 70 hr at 212 F of not more than 100%.

VACUUM-BRAKE HOSE (SAE 40R3)
GENERAL REQUIREMENTS

For the purposes of clearly identifying the scopes and simplification of the specification, the vacuum-brake hose specification is divided into three parts as follows:

Part I (SAE 40R3H)—Heavy-Duty Type—for service on trucks, truck-

trailer combinations, and so forth.

Part II (SAE 40R3L)—Light-Duty Type—for service in conjunction with the power-braking system on passenger cars and light trucks.

Part III (SAE 40R3M)—Oil Resisting Heavy Duty Type—for specific use as manifold connections, but also may be used for all services specified for Heavy Duty Type SAE 40R3H.

Manufacture—The construction of hose for this service embodies a smoothbore tube of flexible material, reinforced with cord or duck plies, or a combination of both, together with an abrasive-, weather-, and sunlight-resistant cover. The hose shall be so manufactured as to comply with the test requirements set forth in this SAE Standard.

End Connections—All zinc plated end connections are to be dichromate dipped.

Salt Spray Test—Hose assembly end connections shall withstand 24 hr exposure to salt spray when tested in accordance with ASTM B 117. Conformance to this requirement shall be determined by observation of the exterior of the fitting.

Hose Identification—The name or trademark and date code shall appear on the outer cover of the hose at intervals not greater than 36 in. apart.²

Retests and Rejections—Any hose which fails in one or more tests shall be resampled and retested, for which purpose two additional samples shall be selected from the lot for the test that failed to meet the requirements. Failure of either of the retested samples shall be cause for final rejection of the lot.

Samples for Test—A representative sample of hose approximately 15 ft in length shall be selected from each lot to be tested. If a single length of 15 ft is not available, several sections, each of sufficient length to provide the required test specimens, may be taken. The samples shall be not less than 7 nor more than 120 days old.

Test Requirements—All measurements and tests necessary for determining the conformity of the hose with these specifications shall be made in accordance with ASTM D 622, Methods of Testing Automotive Air Brake and Vacuum Brake Hose.

To qualify hose under this specification, all of the requirements shown under Qualification Tests and Inspection Tests must be met. Production shipments or lots of the qualified hose shall meet the requirements shown under Inspection Tests, but the user may in addition, if he so desires, test hose from any or all such production shipments or lots to the requirements under Qualification Tests.

Tube Tensile—The tube tensile shall be as specified in Parts I, II, and III.

Tube Elongation—The tube elongation shall be as specified in Parts I, II, and III.

Tube Volume Increase—The tube volume increase shall be as specified.

Qualification Tests

Aging Test—The hose shall show no cracks, charring, or disintegration externally or internally when straightened after being bent over a form having the radius given in Table 6 for Heavy-Duty Type and Table 8 for Light-Duty Type, after a period of 70 hr in an air oven at 100 ± 1 C (212 ± 1.8 F).

Cold Test—After being subjected to this test, the hose shall show no signs of cracking or breaking.

Ozone Test—The outer cover of the hose shall show no cracking when examined under 7 power magnification after a period of 70 hr in the ozone cabinet at 50 parts of ozone per 100 million of air by volume at 104 F.

Inspection Tests

Burst Test—The hose shall not burst, leak, or show signs of failure at a hydrostatic pressure lower than specified in Table 6 for Heavy-Duty Type and Table 8 for Light-Duty Type.

Vacuum Test—The collapse of the outside diameter of the hose under internal vacuum of 26 in. of Hg for 5 min shall not exceed 1/16 in.

Bend Test—The collapse of the outside diameter of the hose at the middle point of the test length when bent until the ends touch shall not exceed the values given in Table 6 for Heavy-Duty Type and Table 8 for Light-Duty Type.

Deformation Test—A specimen 1 in. long shall be compressed five times to a collapsed inside diameter (dimension D) in Table 6 for Heavy-Duty Type and Table 8 for Light-Duty Type. The load required in the first compression and in the fifth compression shall be as specified in the detailed sections for Heavy-Duty and Light-Duty Hose. After the test, the specimen shall immediately return to at least 90% of the original outside diameter.

Swell Test—The hose shall be filled with Reference Fuel A and held 48 hr at room temperature, after which the Reference Fuel A shall be

removed, and immediately a steel ball of the diameter given in Table 6 for Heavy-Duty Type and Table 8 for Light-Duty Type shall pass through the hose freely. The sample shall then show no leakage in vacuum test under 26 in. of Hg for 10 min, after which there shall be no separation of the inner tube from the fabric reinforcement of the hose.

NOTE: For light-duty hose, the ball diameter is calculated as specified under Part II, Swell Test.

Adhesion Test—The minimum load required to separate the tube from plies, the plies, and the cover from the plies shall be 8 lb. This test is to be made only on original, not aged, specimens.

Cover Tensile—The cover tensile shall be as specified in Part I and Part II.

Cover Elongation—The cover elongation shall be as specified in Part I and Part II.

Cover Volume Increase—The cover volume increase shall be as specified.

Applicable Requirements—All applicable requirements in this section on General Requirements shall be part of the Heavy-Duty Type (SAE 40R3H), Light-Duty Type (SAE 40R3L) specifications, and Oil Resisting Heavy-Duty Type (SAE 40R3M).

PART I—HEAVY-DUTY TYPE (SAE 40R3H)

Scope—This specification covers vacuum hose intended for use in the braking systems of single vehicles or as connecting or transmission lines in combination of vehicles or systems thereof.

Sizes—The hose shall conform to the dimensional requirements given in Table 5.

Test Requirements—The hose shall conform to all of the requirements of Table 6 and the applicable requirements in the section on General Requirements.

Deformation Test—The load required in the first compression shall be less than 70 lb, and in the fifth compression it shall be greater than 40 lb.

Cover Tensile—The cover stock shall have a minimum tensile of 1200 psi.

Cover Elongation—The cover stock shall have a minimum elongation at break of 200% (2 to 6 in.).

Tube Tensile—The tube stock shall have a minimum tensile of 1000 psi.

Tube Elongation—The tube stock shall have a minimum elongation at break of 175%.

TABLE 5—HEAVY-DUTY VACUUM-BRAKE HOSE DIAMETERS, SAE 40R3H

Inside diameter, in.....	Hose Size					
	1/4	3/8	1/2	5/8	3/4	1
Tolerance { plus.....	0.008	0.008	0.008	0.008	0.008	0.010
minus.....	0.020	0.020	0.020	0.020	0.020	0.022
Outside diameter, in.....	9/16	13/16	15/16	1-1/16	1-3/16	1-15/32
Tolerance { plus.....	1/32	1/32	1/32	1/32	1/32	1/32
minus.....	1/32	1/32	1/32	1/32	1/32	1/32

TABLE 6—HEAVY-DUTY VACUUM-BRAKE HOSE TEST REQUIREMENTS SAE 40R3H

Hose ID, in.	Tests						
	Aging		Bend		Deformation	Burst	Swell
	Specimen Length, in.	Radius of Form, in.	Specimen Length, in.	Maximum Collapse of OD, in.	Collapsed ID (Dimension D), in.	Psi	Diameter of Ball, in.
1/4	9	1-1/2	8	3/32	1/16	1200	3/16
3/8	10	1-3/4	12	5/32	3/32	1200	5/16
1/2	11	2	16	7/32	1/8	1000	13/32
5/8 3/4	12	2-1/4	22	7/32	5/32	1000	17/32
	14	2-1/2	28	7/32	3/16	800	5/8
	16	3-1/4	36	9/32	1/4	800	7/8

PART II—LIGHT-DUTY TYPE (SAE 40R3L)

Scope—This specification covers a light-duty vacuum-brake hose which is intended for use only in conjunction with the power-braking system on passenger cars and light-duty trucks.

Manufacture—The construction shall conform to that given under General Requirements except that the cover shall also be oil resistant.

Hose Identification—In addition to the marking specified under the

TABLE 7—LIGHT-DUTY VACUUM-BRAKE HOSE DIAMETERS, SAE 40R3L

	Hose Size		
	7/32	11/32	15/32
Inside diameter, in.....	7/32	11/32	15/32
Tolerance { plus.....	0.028	0.028	0.028
{ minus.....	0.032	0.032	0.032
Outside diameter, in.....	7/16	11/16	13/16
Tolerance { plus.....	0.032	0.032	0.032
{ minus.....	0.032	0.032	0.032

General Requirements, the letters LD shall appear on the outer cover at intervals not greater than 36 in. apart.

Sizes—The hose shall conform to the dimensional requirements given in Table 7.

Test Requirements—The hose shall conform to all of the requirements of Table 8 and the applicable requirements in the section on General Requirements.

Deformation Test—The load required in the first compression shall be less than 50 lb, and in the fifth compression it shall be greater than 20 lb.

Swell Test—The actual inside diameter of the hose specimen shall be measured before filling with isooctane, and the ball used shall have a diameter equal to the actual inside diameter measurement minus the ball-diameter factor in Table 8. In all other respects the swell test will conform to that given in the General Requirements.

Cover Tensile—The cover stock shall have a minimum tensile of 800 psi.

Cover Elongation—The cover stock shall have a minimum elongation at break of 200% (2 to 6 in.).

Cover Volume Increase—A specimen prepared from the cover of the hose shall show a volume increase when measured within 5 min after removal from isooctane, in which it has been immersed for 24 hr at room temperature, of not more than 50%.

Tube Tensile—The tube stock shall have a minimum tensile of 700 psi.

Tube Elongation—The tube stock shall have a minimum elongation at break of 175%.

PART III—OIL RESISTING HEAVY-DUTY TYPE (SAE 40R3M)

Scope—This specification covers a heavy-duty type vacuum brake hose which is intended for use as manifold connections, but also may be used for all services described under the scope of Part I-Heavy-Duty Type.

Manufacture—The construction shall conform to that given under General Requirements, except that the tube shall also be oil resistant.

Hose Identification—In addition to the marketing specified under the General Requirements, the letter M shall appear on the outer cover at intervals not greater than 36 in. apart.

Sizes—The hose shall conform to the dimensional requirements given

TABLE 8—LIGHT-DUTY VACUUM-BRAKE HOSE TEST REQUIREMENTS SAE 40R3L

Hose ID, in.	Tests						
	Aging		Bend		Deformation	Burst	Swell
	Specimen Length, in.	Radius of Form, in.	Specimen Length, in.	Maximum Collapse of OD, in.	Collapsed ID (Dimension D), in.	Psi	Ball-Diameter Factor
7/32	8	1-1/2	7	11/64	3/64	350	1/16
11/32	9	1-3/4	11	13/64	5/64	350	3/32
15/32	11	2	14	17/64	5/64	350	3/32

in Table 5.

Test Requirements—The hose shall conform to all the requirements of Table 6, the applicable requirements in the section on General Requirements, and the requirements specified under Part I-Heavy Duty Type (SAE 40R3H).

Tube Volume Increase—A specimen prepared from the inner tube of the hose shall show a volume increase, when measured after removal from ASTM No. 3 Oil in which it has been immersed for 70 hr at 212 F, of not more than 100%.

COLOR ASSIGNMENTS TO BRAKE-HOSE MANUFACTURERS

[This listing is not considered a part of this SAE Standard]

As of 1964 the Rubber Manufacturers Association, 444 Madison Ave., New York, N.Y. 10022, has assigned brake-hose identification colors to the hose manufacturers as follows:

Yellow Green	B. F. Goodrich Co. Goodyear Tire and Rubber Co.	Yellow and Brown Bowling Green Rubber Co.
Red Black	United States Rubber Co. Inland Div., General Motors Corp.	Red and Black Dominion Rubber Co., Ltd.
Blue	Raybestos-Manhattan Inc.	Red and Blue Goodall Rubber Co.
Brown	Republic Rubber Div., Aeroquip Corp.	Red and Brown Continental Rubber Works
Violet	Firestone Tire and Rubber Co.	Black and Blue Electric Hose and Rubber Co.
Orange	Dayco Corp.	Black and Brown Boston Woven Hose and Rubber Co.
Green and Yellow	Renault (France)	Blue and Brown Societe Francaise de Freins Hydrauliques Lockheed
Green and Red	Thermoid Div., H. K. Porter Co.	Green, Yellow, Red Acme-Hamilton Manufacturing Co.
Green and Black	Gates Rubber Co.	Green, Yellow, Black Polymer Corp. of Pennsylvania
Green and Blue	Crown Products Co.	Blue, Brown, Brown Pirelli S. p. A. (Italy)
Green and Brown	Nagoya Rubber Co. of Japan	Blue, Blue, Brown Mündener Gummiwaren-fabrik (Germany)
Yellow and Red	Swan Rubber Co.	
Yellow and Black	Continental Gummi-Werke A. G. (Germany)	
Yellow and Blue	Hawitt-Robins, Inc.	

WINDSHIELD WIPER HOSE—SAE J50a

SAE Standard

Report of Nonmetallic Materials Division approved January 1945 and last revised by Nonmetallic Materials Committee July 1964.

[This SAE Standard was formulated by SAE-ASTM Technical Committee on Automotive Rubber.]

Construction—The hose shall consist of an inner tube of flexible material, reinforced with one or more plies of wrapped fabric or braided cord, or a combination of both, and a cover of flexible material. The tube and cover shall be smooth and uniform in thickness in accordance with good manufacturing practice.

The hose shall be so manufactured as to comply with the test requirements set forth below. Where not specifically designated, the materials and construction shall be suitable for the purpose intended.

Sizes and Tolerances—The inside diameter shall be $\frac{5}{32}$, $\frac{7}{32}$ in.; outside diameter shall be $\frac{11}{32}$, $\frac{13}{32}$ in. The inside diameter shall be subject to a tolerance of plus or minus $\frac{1}{64}$ in. and the outside diameter to a tolerance of plus $\frac{3}{64}$ in., minus $\frac{1}{64}$ in.