TP-106-10
April 10, 2008

U.S. DEPARTMENT OF TRANSPORTATION

NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION

LABORATORY TEST PROCEDURE

FOR

FMVSS 106

Brake Hoses

ENFORCEMENT
Office of Vehicle Safety Compliance
Mail Code: NVS-220
1200 New Jersey Avenue, SE
Washington, DC 20590

OVSC LABORATORY TEST PROCEDURE NO. 106
TABLE OF CONTENTS

PAGE

REVISION CONTROL LOG

FOR OVSC LABORATORY TEST PROCEDURES

TP-106

TEST PROCEDURE		FMVSS 106		DESCRIPTION
REV. No.	DATE	AMENDMENT	EFFECTIVE DATE	
00				Original release signed by O.D.
01				
02				
03				
04				
05				
06				
07				
08	3/31/93			
09	8/26/05	69FR76298	12/20/2006	Substantive changes to incorporate several SAE Recommended Practices relating to hydraulic brake hoses, air brake hoses, vacuum brake hoses, plastic brake tubing, and end fittings.
10	3/7/2008	72FR57450	12/21/2007	Minor technical amendments and changes to adopt a standardized format for the OVSC test procedures.[1]
11				
12				

1 The Office of Vehicle Safety Compliance is updating its laboratory test procedures, to the extent practicable, with a standardized format.

1. PURPOSE AND APPLICATION

This document is a laboratory test procedure provided by the National Highway Traffic Safety Administration (NHTSA), Office of Vehicle Safety Compliance (OVSC) for the purpose of presenting guidelines for a uniform testing data and information recording format, and providing suggestions for the use of specific equipment and procedures for contracted testing laboratories. The data correspond to specific requirements of the Federal Motor Vehicle Safety Standard(s) (FMVSS). The OVSC test procedures include requirements that are general in scope to provide flexibility for contracted laboratories to perform compliance testing and are not intended to limit or restrain a contractor from developing or utilizing any testing techniques or equipment which will assist in procuring the required compliance test data. These test procedures do not constitute an endorsement or recommendation for use of any particular product or testing method.

Prior to conducting compliance testing, contracted laboratories are required to submit a detailed test procedure to the COTR to demonstrate concurrence with the OVSC laboratory test procedure and the applicable FMVSS. If any contractor views any part of an OVSC laboratory test procedure to be in conflict with a FMVSS or observes deficiencies in a laboratory test procedure, the contractor is required to advise the Contracting Officer's Technical Representative (COTR) and resolve the discrepancy prior to the start of compliance testing or as soon as practicable. The contractor's test procedure must include a step-by-step description of the methodology and detailed check-off sheets. Detailed check-off sheets shall also be provided for the testing instrumentation including a complete listing of the test equipment with make and model numbers. The list of test equipment shall include instrument accuracy and calibration dates. All equipment shall be calibrated in accordance with the manufacturer's instructions. There shall be no contradictions between the laboratory test procedure and the contractor's in-house test procedure. Written approval of the in-house test procedures shall be obtained from the COTR before initiating the compliance test program.

NOTE: The OVSC Laboratory Test Procedures, prepared for the limited purpose of use by independent laboratories under contract to conduct compliance tests for the OVSC, are not rules, regulations or NHTSA interpretations regarding the meaning of a FMVSS. The laboratory test procedures are not intended to limit the requirements of the applicable FMVSS(s). In some cases, the OVSC laboratory test procedures do not include all of the various FMVSS minimum performance requirements. Recognizing applicable test tolerances, the laboratory test procedures may specify test conditions that are less severe than the minimum requirements of the standard. In addition, the laboratory test procedures may be modified by the OVSC at any time without notice, and the COTR may direct or authorize contractors to deviate from these procedures, as long as the tests are performed in a manner consistent with the standard itself and within the scope of the contract. Laboratory test procedures may not be relied upon to create any right or benefit in any person. Therefore, compliance of a vehicle or item of motor vehicle equipment is not necessarily guaranteed if the manufacturer limits its certification tests to those described in the OVSC laboratory test procedures.

2. GENERAL REQUIREMENTS

FMVSS 106 specifies labeling and performance requirements for motor vehicle brake hose, brake hose assemblies, and brake hose end fittings.

The purpose of S106 is to reduce deaths and injuries occurring as a result of brake system failure from pressure or vacuum loss due to hose or hose assembly and plastic tubing or plastic tubing assembly rupture. The requirements apply to passenger cars, multipurpose passenger vehicles, trucks, buses, trailers, and motorcycles, and to hydraulic, air, vacuum brake hose, plastic air brake tubing, brake hose and plastic air brake tubing assemblies, and brake hose and plastic air brake tubing end fittings for use in those vehicles.

The test procedures and methods outlined herein are based upon the requirements of S106 effective on December 21, 2007.

METRIC SYSTEM OF MEASUREMENT

Section 5164 of the Omnibus Trade and Competitiveness Act (Pub. L. 100-418) establishes that the metric system of measurement is the preferred system of weights and measures for trade and commerce in the United States. Executive order 12770 directs Federal agencies to comply with the Act by converting regulatory standards to the metric system after September 30, 1992. In a final rule published on March 15, 1990 (60 FR 13639), NHTSA completed the first phase of metrication, converting English measurements in several regulatory standards to the metric system. Since then, metrication has been applied to other regulatory standards (63 FR 28912).

Accordingly, the OVSC laboratory test procedures include revisions to comply with governmental directives in using the metric system. Regulatory standards converted to metric units are required to use metric measurements in the test procedures. For any testing equipment that is not available for direct measurement in metric units, the test laboratory shall calculate the exact metric equivalent by means of a conversion factor carried out to at least five significant digits before rounding consistent with the specified metric requirement.

All final compliance test reports are required to include metric measurements for standards using metrication.

NOTE: The methodology for rounding measurement in the test reports shall be made in accordance with ASTM E29-06b, “Standard Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications.”

3. SECURITY

The contractor shall provide appropriate security measures to protect the OVSC test vehicles and Government Furnished Property (GFP) from unauthorized personnel during the entire compliance testing program. The contractor is financially responsible for any acts of theft and/or vandalism which occur during the storage of test vehicles and GFP. Any security problems which arise shall be reported by telephone to the Industrial Property Manager (IPM), Office of Acquisition Management, within two working days after the incident. A letter containing specific details of the security problem shall be sent to the IPM (with copy to the COTR) within 48 hours.

The contractor shall protect and segregate the data that evolves from compliance testing before and after each vehicle test. No information concerning the vehicle safety compliance testing program shall be released to anyone except the COTR, unless specifically authorized by the COTR or the COTR's Division Chief.

NOTE: No individuals, other than contractor personnel directly involved in the compliance testing program or OVSC personnel, shall be allowed to witness any vehicle or equipment item compliance test or test dummy calibration unless specifically authorized by the COTR.

4. GOOD HOUSEKEEPING

Contractors shall maintain the entire vehicle compliance testing area, fixtures and instrumentation in a neat, clean and painted condition with test instruments arranged in an orderly manner consistent with good test laboratory housekeeping practices.

5. TEST SCHEDULING AND MONITORING

The contractor shall submit a test schedule to the COTR prior to conducting the first compliance test. Tests shall be completed at intervals as required in the contract. If not specified, the first test shall be conducted within 6 weeks after receiving the first delivered unit. Subsequent tests shall be completed in no longer that 1 week intervals unless otherwise specified by the COTR.

Scheduling of tests shall be adjusted to permit vehicles (or equipment, whichever applies) to be tested to other FMVSSs as may be required by the OVSC. All compliance testing shall be coordinated with the COTR in order to allow monitoring by the COTR and/or other OVSC personnel if desired. The contractor shall submit a monthly test status report and a vehicle status report (if applicable) to the COTR. The vehicle status report shall be submitted until all vehicles are disposed of. The status report forms are provided in the forms section.

6. TEST DATA DISPOSITION

The Contractor shall make all preliminary compliance test data available to the COTR on location within four hours after the test. Final test data, including digital printouts and computer generated plots (if applicable), shall be available to the COTR in accordance with the contract schedule or if not specified within two working days. Additionally, the Contractor shall analyze the preliminary test results as directed by the COTR.

All backup data sheets, strip charts, recordings, plots, technicians' notes, etc., shall be retained by the contractor for a minimum of 3 years after conclusion of each delivery order, purchase order, etc. The COTR shall direct final disposition at that time.

The contractor shall protect and segregate the data that evolves from compliance testing before and after each test.

TEST DATA LOSS

A. INVALID TEST DESCRIPTION

An invalid compliance test is one, which does not conform precisely to all requirements/specifications of the OVSC Laboratory Test Procedure and Statement of Work applicable to the test.

B. INVALID TEST NOTIFICATION

The Contractor shall notify NHTSA of any test not meeting all requirements/specifications of the OVSC Laboratory Test Procedure and Statement of Work applicable to the test, by telephone, within 24 hours of the test and send written notice to the COTR within 48 hours or the test completion.

C. RETEST NOTIFICATION

The Contracting Officer of NHTSA is the only NHTSA official authorized to notify the Contractor that a retest is required. The retest shall be completed within 2 weeks after receipt of notification by the Contracting Officer that a retest is required.

D. WAIVER OF RETEST

NHTSA, in its sole discretion, reserves the right to waive the retest requirement. This provision shall not constitute a basis for dispute over the NHTSA's waiving or not waiving any requirement.

6. TEST DATA DISPOSITION….Continued

E. TEST REPORT

No test report is required for any test that is determined to be invalid unless NHTSA specifically decides, in writing, to require the Contractor to submit such report. The test data from the invalid test must be safeguarded until the data from the retest has been accepted by the COTR. The report and other required deliverables for the retest vehicle are required to be submitted to the COTR within 3 weeks after completion of the retest.

F. DEFAULT

The Contractor is subject to the default and subsequent reprocurement costs for nondelivery of valid or conforming test (pursuant to the Termination For Default clause in the contract).

G. NHTSA'S RIGHTS

None of the requirements herein stated shall diminish or modify the rights of NHTSA to determine that any test submitted by the Contractor does not conform precisely to all requirements/specifications of the OVSC Laboratory Test Procedure and Statement of Work applicable to the test.

7. GOVERNMENT FURNISHED PROPERTY (GFP) AND TEST SAMPLES

TEST SAMPLE IDENTIFICATION AND STORAGE
A test set of brake hoses shall consist of a quantity of test hoses plus a specific quantity which may be required for retest if necessary. The quantities shown below shall be used for tests unless amended by the contract.

HOSE TYPE	NO. OF TEST HOSES
Hydraulic	21
Air	15
Vacuum	10
Plastic tubing	23

Each test specimen shall be banded on one end or tagged at one end, and marked with a laboratory group number and individual sample number such as "001-2" for group 1, specimen number 2. The marking shall be suitable to withstand all tests and handling environments. Test flow and usage of the test specimens shall be as shown in Figures 1, 2, 3 and 4.

7. GFP AND TEST SAMPLES....Continued

An inventory shall be made of the number, name and condition of samples received, and then the samples shall be stored in a dry, clean, dark, and dust free area to prevent damage to them in any manner which may affect test results.

FLOW SEQUENCE FOR BRAKE HOSE COMPLIANCE TESTS

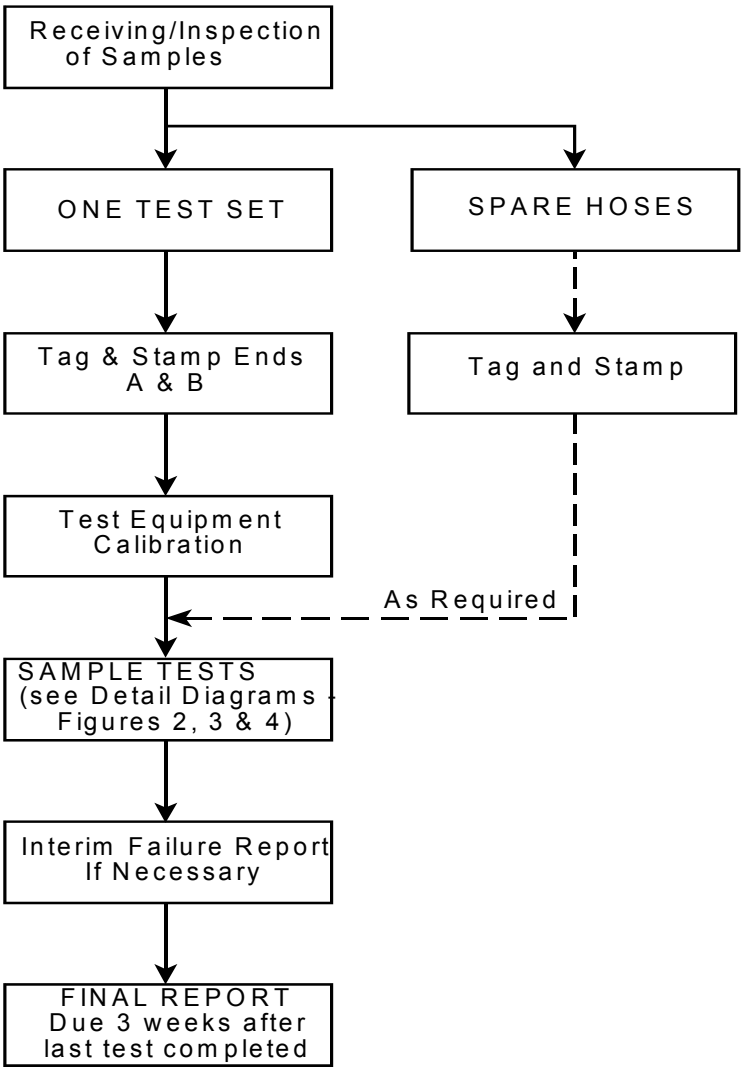


FIGURE 1

7. GFP AND TEST SAMPLES....Continued

Hydraulic Brake Hoses – Test Sequence

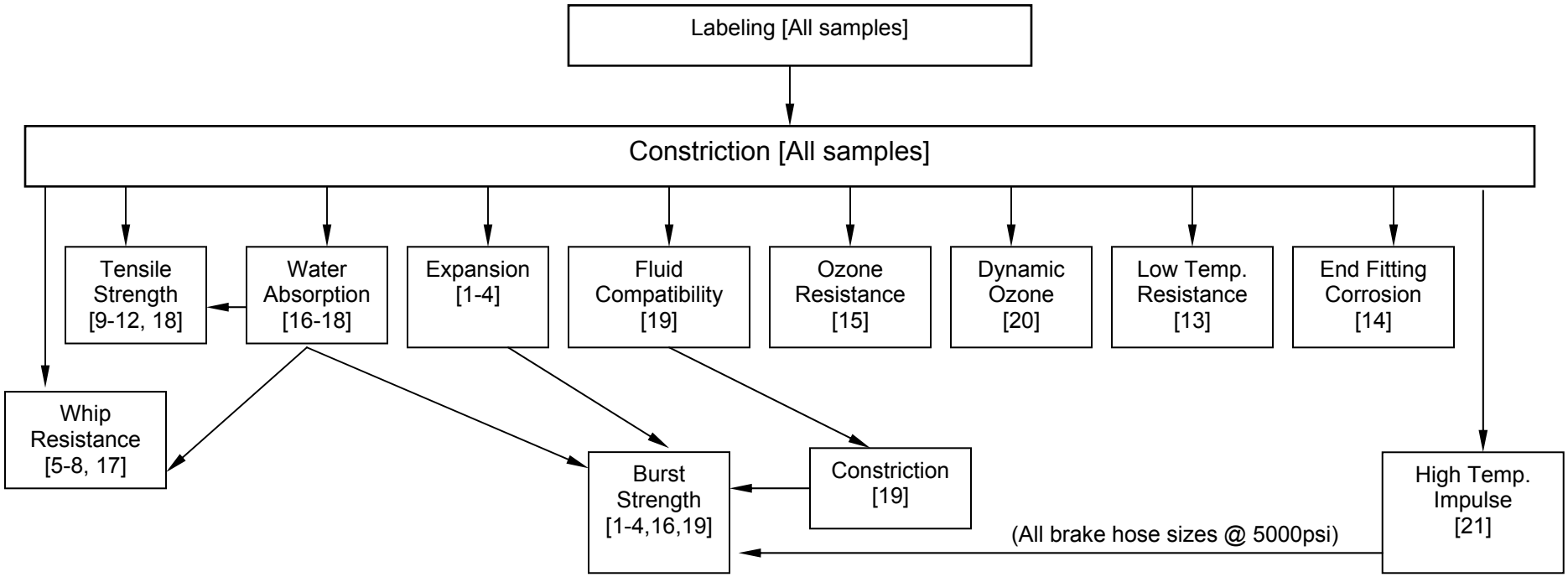


FIGURE 2

HYDRAULIC BRAKE HOSES – TEST REQUIREMENTS (FMVSS No. 106)			
Par.		Par.	
S5.3.1	Constriction	S5.3.8	Low Temperature Resistance
S5.3.2	Expansion and Burst	S5.3.9	Brake Fluid Compatibility, Constriction and Burst Strength
S5.3.3	Whip Resistance	S5.3.10	Ozone Resistance
S5.3.4	Tensile Strength	S5.3.11	Dynamic Ozone Test
S5.3.5	Water Absorption and Burst Strength	S5.3.12	High Temperature Impulse
S5.3.6	Water Absorption and Tensile Strength	S5.3.13	End Fitting Corrosion Resistance
S5.3.7	Water Absorption and Whip Resistance		

7. GFP AND TEST SAMPLES....Continued

FLOW SEQUENCE FOR AIR BRAKE HOSES

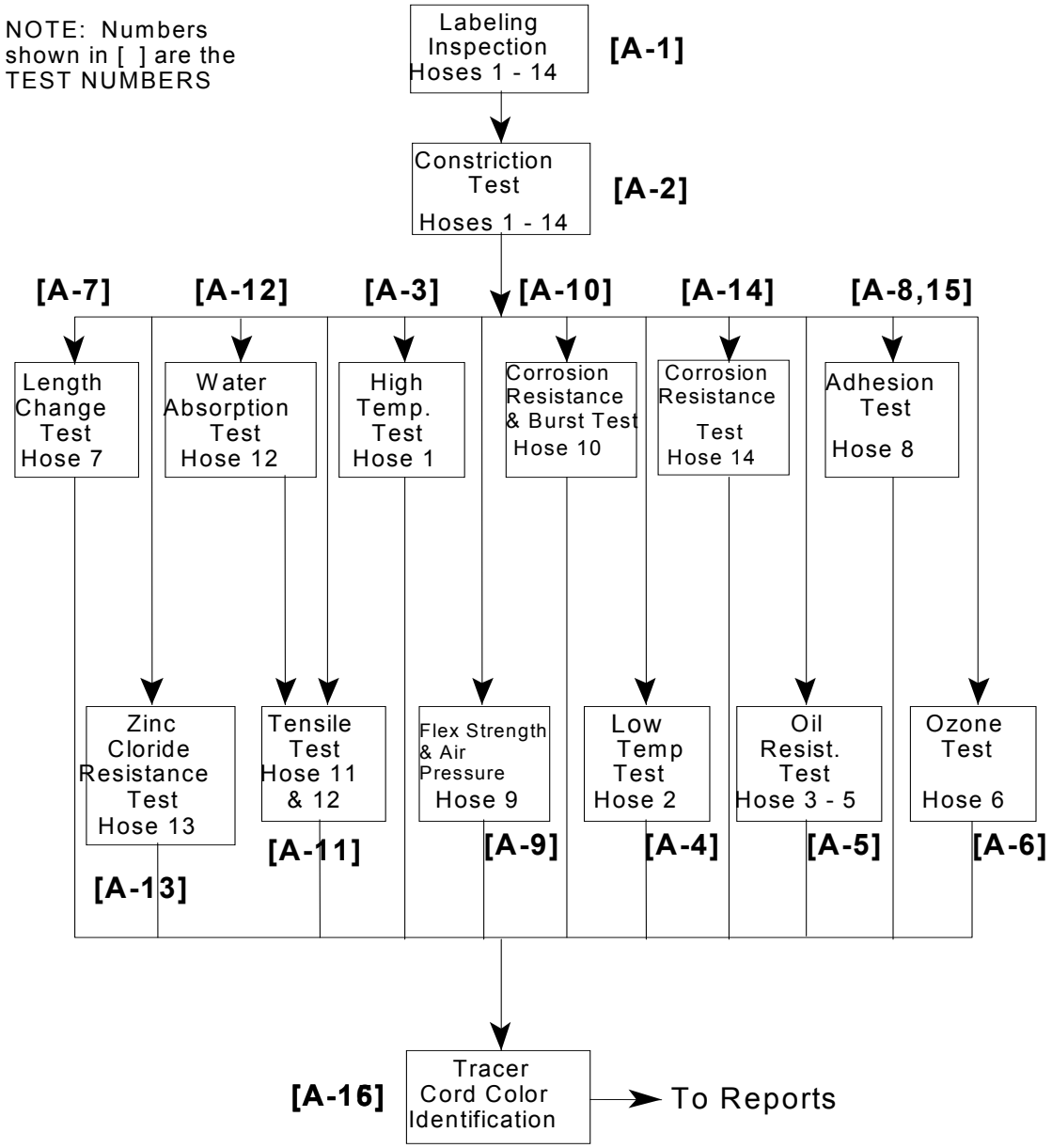


FIGURE 3

7. GFP AND TEST SAMPLES....Continued

FLOW SEQUENCE FOR VACUUM BRAKE HOSES

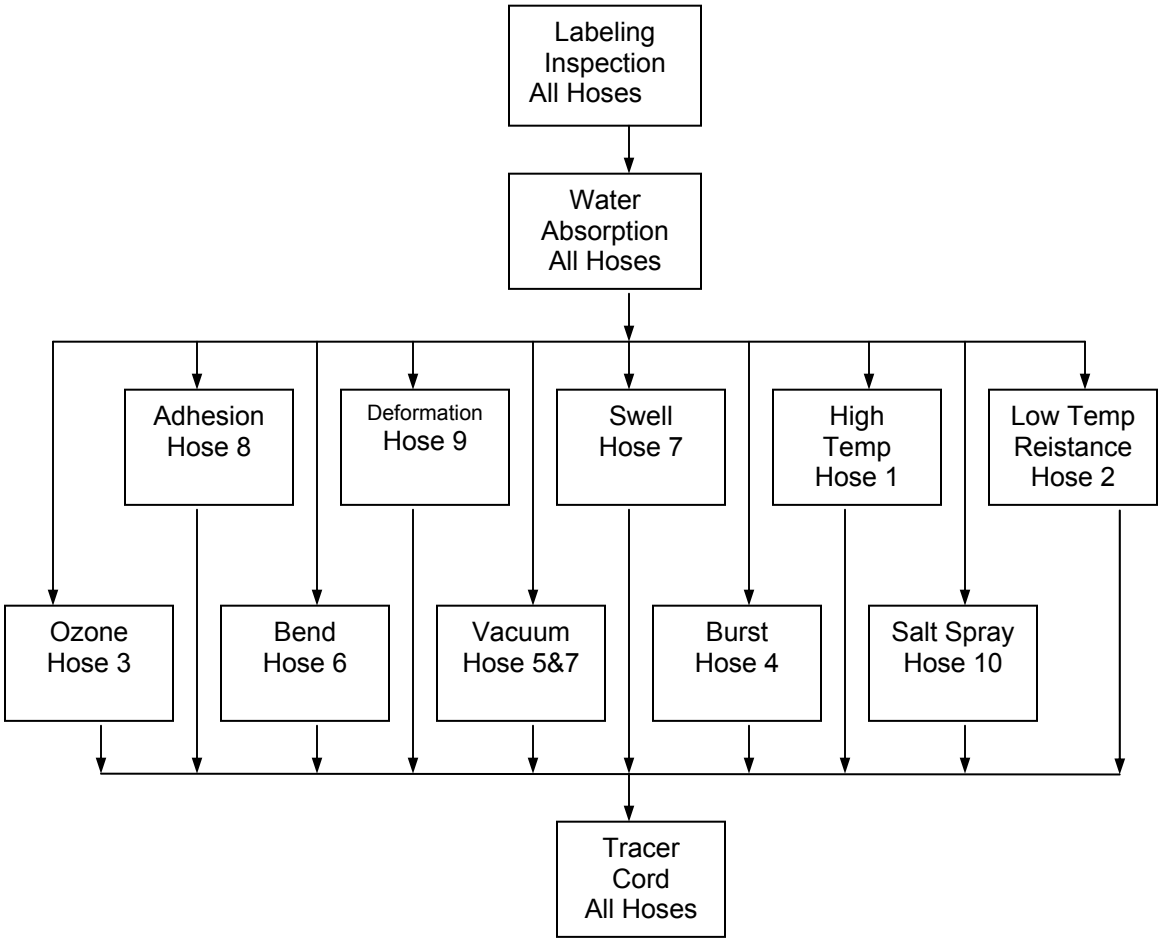


FIGURE 4

8. CALIBRATION OF TEST INSTRUMENTS

Before the Contractor initiates the vehicle safety compliance test program, a test instrumentation calibration system must be implemented and maintained in accordance with established calibration practices. The calibration system shall include the following as a minimum:

A. Standards for calibrating the measuring and test equipment shall be stored and used under appropriate environmental conditions to assure their accuracy and stability.

B. All measuring instruments and standards shall be calibrated by the Contractor, or a commercial facility, against a higher order standard at periodic intervals not exceeding 12 months for instruments and 12 months for the calibration standards except for static types of measuring devices such as rulers, weights, etc., which shall be calibrated at periodic intervals not to exceed two years. Records, showing the calibration traceability to the National Institute of Standards and Technology (NIST), shall be maintained for all measuring and test equipment.

C. All measuring and test equipment and measuring standards shall be labeled with the following information:

1. Date of calibration
2. Date of next scheduled calibration
3. Name of the technician who calibrated the equipment

D. A written calibration procedure shall be provided by the Contractor, which includes as a minimum the following information for all measurement and test equipment unless the calibration is performed by a licensed commercial facilty:

1. Type of equipment, manufacturer, model number, etc.
2. Measurement range
3. Accuracy
4. Calibration interval
5. Type of standard used to calibrate the equipment (calibration traceability of the standard must be evident).
6. The actual procedures and forms used to perform the calibrations.

E. Records of calibration for all test instrumentation shall be kept by the Contractor in a manner that assures the maintenance of established calibration schedules.

8. CALIBRATION OF TEST INSTRUMENTS….Continued

F. All such records shall be readily available for inspection when requested by the COTR. The calibration system shall need the acceptance of the COTR before vehicle safety compliance testing commences.

G. Test equipment shall receive a system functional check out using a known test input immediately before and after the test. This check shall be recorded by the test technician(s) and submitted with the final report.

H. The Contractor may be directed by NHTSA to evaluate its data acquisition system.

Further guidance is provided in the International Standard ISO 10012-1, “Quality Assurance Requirements for Measuring Equipment” and American National Standard ANSI/NCSL Z540-1, “Calibration Laboratories and Measuring and Test Equipment General Requirements.”

NOTE: In the event of a failure to meet the standard's minimum performance requirements additional calibration checks of some critically sensitive test equipment and instrumentation may be required for verification of accuracy. The necessity for the calibration will be at the COTR's discretion and shall be performed without additional cost.

9. PHOTOGRAPHIC DOCUMENTATION

Digital Photographs

The contractor shall take digital photographs of the test execution procedures. Photographs shall be taken in color and contain clear images. A tag, label or placard identifying the test item, NHTSA number (if applicable) and date shall appear in each photograph and must be legible. Each photograph shall be labeled as to the subject matter. The required resolution for digital photographs is a minimum of 1,600 x 1,200 pixels. Digital photographs are required to be created in color and in a JPG format. Glare or light from any illuminated or reflective surface should be minimized while taking photographs.

The test reports should include enough photographs to describe the testing in detailed and should be organized in a logical succession of consecutive pictures. The digital photographs should be included in the test report as 125 mm x 175 mm (5 x 7 inch) pictures. All photographs are required to be included in the test report in the event of a test failure. Any failure must be photographed at various angles to assure complete coverage.

9. PHOTOGRAPHIC DOCUMENTATION….Continued

Upon request, the photographs should be sent to the COTR on a CD or DVD and saved in a “read only” format to ensure that the digital photographs are the exact pictures taken during testing and have not been altered from the original condition.

10. DEFINITIONS

ARMOR

Protective material installed on a brake hose/plastic tubing to increase the resistance to abrasion or impact damage.

BRAKE HOSE

A flexible conduit, other than a vacuum tubing connector, manufactured for use in a brake system to transmit or contain the fluid pressure or vacuum used to apply force to a vehicle's brakes.

BRAKE HOSE ASSEMBLY

A brake hose, with or without armor, equipped with end fittings for use in a brake system, but does not include an air or vacuum assembly prepared by the owner or operator of a used vehicle, by his employee, or by a repair facility, for installation in that used vehicle.

BRAKE HOSE END FITTING

A coupler other than a clamp, designed for attachment to the end of a brake hose.

DIMENSIONAL DESCRIPTIONS

For hose, a dimensional description such as "1/4-inch hose" refers to the Nominal Inside Diameter (I.D.).

For tubing, a dimensional description such as "1/4-inch tubing" refers to the Nominal Outside Diameter (O.D.).

FREE LENGTH

The linear measurement of hose exposed between the end fittings of a hose assembly in a straight position.

10. DEFINITIONS….Continued

PERMANENTLY ATTACHED END FITTING

An end fitting that is attached by deformation of the fitting about the hose by crimping or swaging, or an end fitting that is attached by use of a sacrificial sleeve or ferrule that requires replacement each time a hose assembly is rebuilt.

PREFORMED

A brake hose that is manufactured with permanent bends and is shaped to fit a specific vehicle without further bending.

RUPTURE

Any failure that results in separation of a brake hose from its end fitting or in leakage.

VACUUM TUBING CONNECTOR

A flexible conduit of vacuum that –

- Connects metal tubing to metal tubing in a brake system
- Is attached without end fittings
- When installed, has an unsupported length less than the total length of those portions that cover the metal tubing

11. PRETEST REQUIREMENTS

IN-HOUSE TEST PROCEDURE

Prior to conducting any compliance test, contractors are required to submit a detailed in-house compliance test procedure to the COTR which includes a step-by-step description of the methodology to be used. Written approval must be obtained from the COTR before initiating the compliance test program so that all parties are in agreement.

The test methods and procedures shall be based on the requirements of the following non-NHTSA documents wherein S106 shall take precedence followed by this Laboratory Test Procedure in case of conflict.

Society of Automotive Engineers (SAE) - -

SAE RM–66–04, Compatibility Fluid

11. PRETEST REQUIREMENTS….Continued

SAE Standard J1703, Motor Vehicle Brake Fluid

American Society for Testing of Materials (ASTM) - -

ASTM E4–03, Standard Practices for Force Verification of Testing Machines

ASTM B117–03, Standard Practice for Operating Salt Spray (Fog) Apparatus

ASTM D471–98, Standard Test Method for Rubber Property—Effect of Liquids

ASTM G154–00 Standard Practice for Operating Fluorescent Light Apparatus for UV Exposure of Nonmetallic Materials

ASTM G151–97, Standard Practice for Exposing Nonmetallic Materials in Accelerated Test Devices that Use Laboratory Light Sources

ASTM D4329–99, Standard Practice for Fluorescent UV Exposure of Plastics

Military Specifications (MIL) - -

C-45662A, Calibration System Requirements

The procedure shall contain instructions for the following:

A. Sample tagging or marking
B. Sample stowage
C. Testing setup
D. Testing procedure (step-by-step)
E. Data recording
F. Setup photographs
G. Photographs of sample failure(s) illustrating point(s) of failure (include photographs of samples before testing)
H. Description of failure(s)

11. PRETEST REQUIREMENTS....Continued

TEST DATA LOSS

A compliance test is not to be conducted unless all of the various test conditions specified in the applicable OVSC Laboratory Test Procedure have been met. Failure of a contractor to obtain the required test data and to maintain acceptable limits on test parameters in the manner outlined in the applicable OVSC Laboratory Test Procedure may require a retest at the expense of the contractor. The retest costs will include the cost of the replacement item of motor vehicle equipment and all costs associated with conducting the retest. The original test specimen used for the invalid test shall remain the property of OVSC, and the retest specimen shall remain the property of the contractor. If there is a test failure, the contractor shall retain the retest specimen for a period not exceeding 2 years. If there is no test failure, the Contractor may dispose of the test specimen upon notification from the COTR that the final test report has been accepted.

The Contracting Officer of NHTSA is the only NHTSA official authorized to notify the contractor that a retest is required. The retest shall be completed within two (2) weeks after receipt of notification by the Contracting Officer that a retest is required. If a retest is conducted, no test report is required for the original test.

TEST CONDITIONS

Unless otherwise specified, all tests and measurements shall be conducted under the following environmental conditions:

A.	Temperature	75ºF ± 5ºF
B.	Relative Humidity	50% ± 10%
C.	Atmospheric Pressure	

Continuous recording of environmental temperature and relative humidity of the testing area shall be available during all tests. Test samples, unless otherwise specified, shall be stabilized at test room conditions for a period of at least 24 hours immediately prior to testing.

TEST PERSONNEL PERFORMANCE

Personnel supervising and/or performing the compliance test program shall be thoroughly familiar with the requirements, test conditions, equipment for the test to be conducted, and safety requirements.

11. PRETEST REQUIREMENTS....Continued

RECORDING OF TEST DATA

Environmental data and test data shall be recorded on permanent strip charts, circular recording charts, or other acceptable media. Where permanent trace recording is not required, data will be recorded on standard report forms. Changes or corrections shall be made by drawing a line through the original entry, which must still remain legible, and adding the change alongside.

Test data will be submitted on the standard form Test Data Sheets specified for use in the final test report and shown in Section 15. Data will be typed before the sheets are submitted.

All test areas will require permanent trace recordings, where applicable, and before/after photographs where feasible. This is required to document that test conditions have been maintained as specified and that test criteria have been applied properly and uniformly throughout the test program. The test laboratory will submit for the approval of the contracting officer technical representative the type of permanent data history the laboratory proposes to use, based on test equipment and conditions applicable to each test.

When a sample failure does occur (sample WILL NOT be subjected to further testing), all of the charts and/or recordings for the failed sample or copies thereof shall be retained by the contractor along with the failed specimen unless otherwise directed by the COTR. This shall include a copy of the original operators hand written data as recorded during the test failure.

REPORTING FORMS

The attached forms will be used for submission of data to the COTR. These forms will be reproduced on the Test Laboratory's stationary. One set of the data sheets will be used for each test set of brake hose assemblies. The final report data sheet information shall be typed. One set of data sheets shall consist of the following:

Data Sheets H-1 through H-12 for HYDRAULIC BRAKE HOSES

Data Sheets A-1 through A-15 for AIR BRAKE HOSES

Data Sheets V-1 through V-13 for VACUUM BRAKE HOSES

Data Sheets P-1 through P-13 for AIR BRAKE TUBING

11. PRETEST REQUIREMENTS....Continued

TEST DATA REPORTING SHEETS

In addition to the instrument recording data (which may be in analog form), all test data shall be recorded, in standard engineering units, on forms specifically prepared for this purpose such as those shown as the data sheet for each test. Changes or corrections of data sheets shall be made by drawing a line through the original entry, which must still remain legible, and adding the change alongside. The initials of the changer shall appear alongside the change.

Data sheets presented in a final form must be typewritten, signed, and include the date of test and date of sign-off. **The Report Number must appear at the top of each Data Sheet**.

SAMPLE INFORMATION AND SUMMARY OF RESULTS

Preceding the test data sheets in the Final Report, there will be test specimen information and a summary of test results. These sheets will describe the articles tested, list the various tests performed, and indicate the result as either Pass (P) or Fail (F) as supported by the information tabulated on the test data sheets.

PARTS DATA AND SUMMARY OF TEST RESULTS

A. On parts data section of the reporting forms, each space shall be filled out. Where data is not present, write "NONE."

B. Where a trademark is present, provide a recognizable sketch.

C. Where the hose assemblies are not in a container, but certification statement is provided, write the statement. Where no certification is provided, write "NONE."

D. Sketch the data-bearing portion of the band on the bottom of the report form if a band is present.

E. A hose, which fails one test phase, shall be subjected to NO FURTHER TESTING unless so directed by the COTR.

12. COMPLIANCE TEST EXECUTION

12.A. TEST REQUIREMENTS - HYDRAULIC BRAKE HOSES

12.A.1. - LABELING INSPECTION - (See Data Sheets H-1A, B & C)

All hydraulic test specimens shall be subjected to labeling inspection and any markings, if present, are to be recorded.

All hydraulic test specimens, which are represented by a vehicle manufacturer to be used on a specific motor vehicle, need **NOT** have any marking and therefore are **NOT** subjected to any labeling PASS/FAIL criteria.

The data sheets contain a selection matrix allowing designation of the test specimens as being the following:

- **Vehicle Specific Assemblies**
- **Aftermarket Assemblies (NON-OEM)**
- **Special Test Assemblies**

Vehicle Specific Assemblies are those designated by a vehicle manufacturer as being assemblies used on specific vehicle models and generally will be sold and shipped directly to the test contractor by the vehicle manufacturer or those sold by an authorized vehicle dealer and shipped to the test contractor by the dealer or OVSC.

Aftermarket Assemblies are **NON-OEM** hose assemblies, and, whereas the assembly manufacturer may sell the assemblies as replacement assemblies for specific vehicles, the vehicle manufacturer accepts NO responsibility for their performance.

Special Test Assemblies are those that a vehicle manufacturer may provide as surrogate assemblies for particular tests such as may be necessary to fit a particular test machine (generally these will be shorter assemblies that will fit a tensile test machine or a whip test machine). Markings are NOT required on the **Special Test Assemblies**.

HOSE MATERIAL MARKING

The following hydraulic hose information may be present on the hose material of the assemblies to be tested and shall be recorded although the specimens are NOT subject to the PASS/FAIL criteria in all applications. The stripes described in (A) below are NOT required on Vehicle Specific Assemblies. Markings (B) through (F) are NOT required on the brake hose material in any assembly.

12. COMPLIANCE TEST EXECUTION....Continued

(A) Two torque stripes parallel to the longitudinal axes of the hose and placed on opposite sides of the hose. One of the stripes may be interrupted by the information listed in (B) through (F), and the second by any other information that the manufacturer may provide. The two torque stripes are NOT required if the end fittings are such as to prevent the assembly from being installed in a twisted orientation in the vehicle.

(B) The letters "DOT"

(C) Hose Manufacturer's Identification

(D) Date of Manufacturer (Month, Day and Year OR Month and Year expressed in numerals).

(E) Nominal Inside Hose Diameter (I.D. in inches or mm)

(F) Expansion Characteristics (HR or HL)

END FITTINGS

End fittings are NOT required to be marked EXCEPT if the assembly does not contain a band. In that case, except for Vehicle Specific Assemblies, at least one of the fittings shall be etched, stamped or embossed with the assembly manufacturer's identification.

HOSE ASSEMBLIES

Except for Vehicle Specific Assemblies, each hydraulic brake hose assembly shall be labeled with a band (unless the option for end fitting marking has been selected) which shall be etched, stamped or embossed with the following.

(A) The letters "DOT"

(B) Manufacturer's Identification

12.A.2. – CONSTRICTION TEST – (See Data Sheet H-2)

All test specimens shall be subjected to this test. This is basically a "go" or "no go" test in which a plug gage, an extended plug gage, or a drop ball is inserted in the upper end of a hose assembly, which is held vertically, and allowed to drop by gravity through the hose. The hose is acceptable if the gage passes through the hose and can be seen at the lower fitting. Failure to appear at the lower fitting shall be considered a test failure.

12. COMPLIANCE TEST EXECUTION....Continued

The constriction gage shall have a minimum diameter as follows (same diameter ball or rod is permissible):

. 0.079" for 1/8" I.D. hose (2.048 mm for 3.2 mm I.D.)

0.119" for 3/16" I.D. hose (3.072 mm for 4.8 mm I.D.)

. 0.159" for 1/4" I.D. hose (4.032 mm for 6.3 mm I.D.)

The gage plug diameter used by the test laboratory shall be shown under "REMARKS" on the Data Sheet.

If a constriction does exist, establish the approximate location of the constriction. Insert drill rods into the end coupling to determine the maximum size that can be inserted without force. Note size and location on the Data Sheet. Drill rod sizes can be found in the Machinist's Handbook.

The brake hose constriction test requirements shall be met using at least one of the methods specified below.

PLUG GAUGE

(A) Utilize a plug gauge as shown in Figure 5. Diameter ‘A’ is equal to 64 percent of the nominal inside diameter of the hydraulic brake hose being tested.

(B) Brake hose assemblies that are to be used for additional testing have constriction testing only at each end fitting. Other brake hose assemblies may be cut into three inch lengths to permit constriction testing of the entire assembly. Hose assemblies with end fittings that do not permit entry of the gauge (e.g., restrictive orifice or banjo fitting) are cut three inches from the point at which the hose terminates in the end fitting and then tested from the cut end.

(C) Hold the brake hose in a straight position and vertical orientation.

(D) Place the spherical end of the plug gauge just inside the hose or end fitting. If the spherical end will not enter the hose or end fitting using no more force than gravity acting on the plug gauge, this constitutes failure of the constriction test.

12. COMPLIANCE TEST EXECUTION....Continued

(E) Release the plug gauge. Within three seconds, the plug gauge shall fall under the force of gravity alone up to the handle of the gauge. If the plug gauge does not fully enter the hose up to the handle of the gauge within three seconds, this constitutes failure of the constriction test.

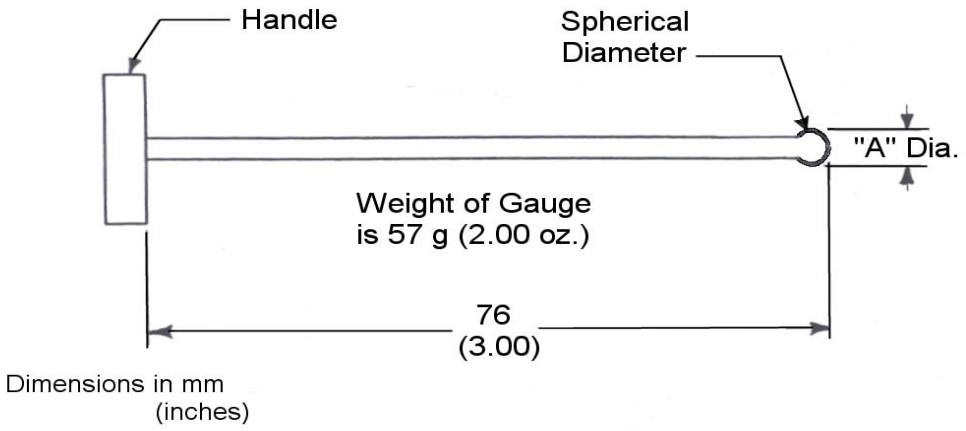


FIGURE 5. CONSTRICTION TEST PLUG GAUGE

EXTENDED PLUG GAUGE

(A) The test in S6.12.1 may be conducted with an extended plug gauge to enable testing of the entire brake hose from one end fitting, without cutting the brake hose. The extended plug gauge weight and spherical diameter specifications are as shown in Figure 5, but the handle portion of the gauge may be deleted and the gauge length may be greater than 3 inches.

(C) The required performance of the extended plug gauge in paragraph S6.12.1(e) is that after the plug gauge is released, the extended plug gauge shall fall under the force of gravity alone at an average rate of 1 inch per second until the spherical diameter of the extended gauge passes through all portions of the brake hose assembly containing hose. If the extended plug gauge does not pass through all portions of the brake hose assembly containing hose at an average rate of 1 inch per second, this constitutes failure of the constriction test.

DROP BALL TEST

(A) Utilize a rigid spherical ball with a diameter equal to 64 percent of the nominal inside diameter of the hydraulic brake hose being tested. The weight of the spherical ball shall not exceed 2 ounces (57 grams).

12. COMPLIANCE TEST EXECUTION....Continued

(B) Hold the brake hose in a straight position and vertical orientation.

(C) Hold the ball just above the end fitting.

(D) Release the ball. The ball shall fall under the force of gravity alone completely through all portions of the brake hose assembly containing hose, at an average rate of 1 inch per second. Failure of the ball to pass completely through all portions of the brake hose assembly containing hose, at an average rate of 1 inch per second, constitutes failure of the constriction test.

12.A.3. - EXPANSION TEST - (See Data Sheet H-3)

GENERAL -

Hoses numbered 1 thru 4 shall be subjected to this test. All portions of the test setup exposed to high pressure shall be made of stainless steel tubing to eliminate any measurable expansion except for that due to the hose being tested.

The test fluid shall consist of distilled water and be free of air or gases. If at any time during the test an air bubble flows out of the hose, repeat the test allowing at least 5 minutes without pressure for the hose to contract to its original size when NOT pressurized.

Compression rings may be used for unconventional ends which have long metal tubes attached to the final end fitting. In these cases, the laboratory shall take adequate precaution to remove all trapped air.

REQUIREMENTS –

The maximum expansion of a hydraulic brake hose assembly shall not exceed the values specified in the table below.

PREPARATION

Measure the free length of the hose assembly and mount the brake hose assembly so that it is in a vertical straight position without tension while under pressure (See Figure 1 of FMVSS No. 106). Allow the test fluid to flow through the brake hose and the burette to bleed all gases from the system.

12. COMPLIANCE TEST EXECUTION....Continued

Close the valve to the burette and apply 15,000 psig for 10 seconds. Check the system for leaks. Release the pressure.

PROCEDURE

Adjust the fluid level in the burette to zero. Close the valve to the burette. Apply a hydrostatic pressure of 1,000 psig at the rate of 1,500 psig/minute and hold this pressure for three seconds.

Close the lower valve and open the upper valve for 10 seconds to allow the fluid level in the burette to rise. This should be accomplished 3 times yielding 3 hose expansions. **Do not remove the hose between expansions.** The burette reading divided by 3 will give the actual hose expansion.

Repeat the Preparation and Procedure above for 1,500 psig and 2,900 psig.

This actual hose expansion must then be compared to the Maximum Allowable cc/ft. from the table below by dividing the Actual by the hose free length in ft. to determine the "PASS" or "FAIL" for each hose.

Pressure vs. Time shall be permanently recorded.

TABLE
MAXIMUM EXPANSION OF FREE LENGTH BRAKE HOSE (cc/ft)

I.D.	Test Pressure					
	1,000 psi		1,500 psi		2,900 psi	
	Regular expansion hose	Low expansion hose	Regular expansion hose	Low expansion hose	Regular expansion hose	Low expansion hose
1/8 in (or 3mm) or less	0.66	0.33	0.79	0.42	1.21	0.61
>1/8in (or 3mm) to 3/16in (or 5mm)	0.86	0.55	1.02	0.72	1.67	0.91
>3/16in(or 5mm)	1.04	0.82	1.30	1.17	Not applicable	Not applicable

12.A.4. - BURST STRENGTH TEST - (See Data Sheet H-4)

Hoses listed below shall be subjected to this test after completion of the Burst Strength test:

12. COMPLIANCE TEST EXECUTION....Continued

HOSE NO(S).	PRIOR TEST
1 - 4	Volumetric Expansion Test (H-3)
16	Water Absorption Test (H-10)
19	Brake Fluid Compatibility and Constriction Test (H-11)

Hoses subjected to the burst test need not be burst.

Connect the brake hose to a pressure system and fill it completely with water, allowing all gases to escape.

(a) Brake hose larger than 1/8 inch or 3 mm diameter:
Apply water pressure of 4,000 psi at a rate of 15,000 psi per minute, hold for 2 minutes at 4000 psi, and increase the pressure at the rate of 15,000 psi per minute until the pressure exceeds 5,000 psi.

(b) Brake hose of 1/8 inch, 3 mm, or smaller diameter:
Apply water pressure of 4,000 psi at a rate of 15,000 psi per minute, hold for 2 minutes at 4000 psi, and increase the pressure at the rate of 15,000 psi per minute until the pressure exceeds 7,000 psi.

Hydrostatic Pressure vs. Time shall be permanently recorded.

12.A.5. - WHIP TEST - (See Data Sheet H-5)

GENERAL -

Hoses numbered 5 thru 8 shall be subjected to this test and Hose #17 shall also be subjected after completion of the Water Absorption Test (H-10).

The whip machine shall be similar to that indicated in SAE J1401 and shall be dynamically balanced without hoses, and suitably mounted to avoid sympathetic vibrations. Hose couplings shall be mounted perpendicularly to the hose-mounting surfaces of the whip machine (movable and stationary headers with no twist in the hose). If at any time during the test, a hose fails due to a machine malfunction, **ALL** of the hoses in the test set shall be replaced by extra hoses from the group under test and the test will be repeated. The extra hoses must undergo the Constriction Test (H-2) prior to the Whip Test.

12. COMPLIANCE TEST EXECUTION....Continued

PREPARATION FOR TEST -

The free length of the hoses to be whip tested shall be measured to within a tolerance of 0.015" with the hose assembly in a straight position using a vernier caliper scale or equivalent. When measuring the free length, the lengths of the end fittings are not included; only the length of the exposed rubber outer cover is measured. Hoses with a free length of less than 8" or more than 24" are not required to be tested.

All external appendages such as chafing collars, removable mounting brackets, date bands and spring guards shall be removed from the brake hose assembly prior to testing on the whip machine. The removed pieces shall be retained for regrouping with each sample until disposal.

The hoses shall be installed on the whip test machine with the slack settings in the table below.

If a whip test failure occurs, prior to removal of the hose from the whip test machine, two photographs, one from above, and one from the side, shall be taken to show that the hose is not twisted. The torque stripe on the hose will be used as an indicator. The photographs shall be kept on file with the chart recordings. Remove failed hose, replace all hose assemblies with new untested hoses, and repeat the test.

TEST -

Apply the 220 to 235 psig water pressure and bleed all hoses and passages to eliminate air pockets and bubbles.

TABLE - HOSE LENGTHS

Free Length Between End Fittings, inches	**SLACK**	
	1/8" hose (3 mm) or less	**More than 1/8" hose (3 mm)**
8 to 15½, inclusive	1.750"	No Test
Over 15½ to 19, inclusive	1.250"	No Test
Over 19 to 24, inclusive	0.750"	No Test
10 to 15½, inclusive		1.000"

12. COMPLIANCE TEST EXECUTION....Continued

The time duration for the whip test shall be 35 hours at a machine speed of 780 to 800 rpm.

Pressure and RPM vs. Time shall be permanently recorded for this test.

12.A.6. - TENSILE STRENGTH TEST - (See Data Sheet H-6)

Hoses numbered 9 thru 12 shall be subjected to this test and Hose #18 shall also be subjected after completion of the Water Absorption Test (H-10).

The tension test consists of subjecting the hose assembly to increasing tensile load in a suitable testing machine until failure occurs, either by -

(A) Separation of the specimen from the end fittings, OR

(B) Failure of the hose structure

A tensile testing machine, which conforms to the requirements of ASTM Methods, E4-03, "Standard Practice for Force Verification of Testing Machines," and provided with a recording device to measure the force applied throughout the slow and fast pull tests. A machine of 1,000 lbs. capacity is sufficient. After removal of any hose armor or date bands, etc., the hose assembly fittings shall be attached to the machine by suitable fixtures so that the hose and fittings shall have a straight center line parallel to the direction of the machine pull.

(A) Conduct the slow pull test by applying tension at a rate of 1" per minute. The assemblies shall withstand a minimum pull of 325 lbs.

(B) Conduct the fast pull test by applying tension at a rate of 2" per minute. The assemblies shall withstand a minimum pull of 370 lbs.

Load vs. displacement will be permanently recorded.

12.A.7. – LOW TEMPERATURE RESISTANCE TEST - (See Data Sheet H-7)

Hose #13 shall be subjected to this test. After removal of any hose armor, date bands, etc., the hose shall be placed in the cold box on a low conductivity material such as wood. A wood mandrel of the size noted below shall be conditioned with the test hose:

12. COMPLIANCE TEST EXECUTION....Continued

HOSE I.D.	MANDREL DIAMETER (+ 0.03", -0")
Less than 1/8"	2.50"
1/8"	3.00"
3/16" and 1/4"	3.50"
Greater than 1/4"	4.00"

The 70 hour test period shall begin when the box recorded temperature stabilizes between -49ºF and -54ºF. The hoses are to be conditioned in the cold box in a straight position and after 70 hours are to be bent around the mandrel favoring any natural curvature already in the hose. The bending operation shall occur in the cold box.

The hose assembly shall be wrapped around the mandrel 180º by hand at a steady rate in 3 to 5 seconds, using suitable gloves, and holding the hose rather than grasping the end couplings.

After bending and removal from the cold box, inspect the outer rubber cover for cracks. Cut the hose lengthwise to expose the inner liner for its inspection for cracks. An external fabric braid may have to be removed to expose the outer rubber cover for inspection.

The Cold Box Temperature vs. Time shall be permanently recorded.

12.A.8. – END FITTING CORROSION TEST - (See Data Sheet H-8)

Hose #14 shall be subjected to this test. Utilize the apparatus described in ASTM B117-03, "Standard Practice for Operating Salt Spray (Fog) Apparatus."

CONSTRUCTION -

Construct the salt spray chamber so that:

(A) The construction material does not affect the corrosiveness of the fog.

12. COMPLIANCE TEST EXECUTION....Continued

(B) The hose assembly is supported or suspended 30º from the vertical and parallel to the principal direction of the horizontal flow of fog through the chamber.

(C) The hose assembly does not contact any metallic material or any material capable of acting as a wick.

(D) Condensation which falls from the assembly does not return to the solution reservoir for respraying.

(E) Condensation from any source does not fall on the brake hose assemblies or the solution collectors.

(F) Spray from the nozzles is NOT directed directly onto the hose assembly.

PREPARATION -

(A) Plug each end of the hose assembly.

(B) Mix a salt solution five parts by weight of sodium chloride to 95 parts of distilled water, using sodium chloride substantially free of nickel and copper, and containing on a dry basis not more than 0.1 percent of sodium iodide and not more than 0.3 percent total impurities.

Insure that the solution is free of suspended solids before the solution is atomized.

(C) After atomization at 95ºF (-2º F, +0º F) ensure that the collected solution is in the PH range of 6.5 to 7.2. Make the PH measurements at 77ºF.

(D) Maintain a compressed air supply to the nozzle or nozzles free of oil and dirt and between 10 and 25 psi.

OPERATION –

Subject the brake hose assembly to the salt spray continuously for 24 hours.

12. COMPLIANCE TEST EXECUTION....Continued

(A) Regulate the mixture so that each collector will collect from 1 to 2 ml. of solution per hour for each 80 square centimeters of horizontal collecting area.

(B) Maintain exposure zone temperature at 95ºF (-2º F, +0º F).

(C) Upon completion, remove the salt deposit from the surface of the hoses by washing gently or dipping in clean running water not warmer than 100º F (-2º F, +0º F) and then drying immediately.

(D) Chamber Temperature and Concentrations vs. Time must be permanently recorded.

INSPECTION –

A brake hose end fitting shall show no base metal corrosion on the end fitting surface except where crimping or the application of labeling information has caused displacement of the protective coating. Salt spray corrosion shall be noted as presence of red rust in the case of coated ferrous couplings or pitting in the case of brass couplings.

12.A.9. - OZONE RESISTANCE TEST - (See Data Sheet H-9)

PREPARATION -

Hose #15 shall be subjected to this test.

Remove all hose armor, date bands, etc., and utilizing a cylinder with a diameter eight times the nominal outside diameter of the brake hose, bind the brake hose 360º around the cylinder. In the case of hose shorter than the circumference of the cylinder, bend the hose so that as much of its length as possible is in contact.

EXPOSURE TO OZONE -

(A) Condition the hose on the cylinder in air at room temperature for 24 hours minimum.

(B) Immediately thereafter, condition the hose on the cylinder for 70 hours in an exposure chamber having an ambient air temperature of 104º F (-2º F, +0º F) during the test and containing air mixed with ozone in the proportion of 100 parts of ozone per 100 million parts of air by volume.

12. COMPLIANCE TEST EXECUTION....Continued

(C) Examine the hose for cracks under 7-power magnification, ignoring areas immediately adjacent to or within the area covered by binding. An external fabric braid may have to be removed to expose the outer rubber cover for inspection.

(D) Chamber Temperature and Concentrations vs. Time must be permanently recorded.

12.A.10. - WATER ABSORPTION TEST - (See Data Sheets H-10A, H-10B, H-10C)

Hoses numbered 16 thru 18 shall be subjected to this test.

PREPARATION -

Prepare three (3) hose assemblies and measure the free length of each hose assembly.

IMMERSION AND SEQUENCE TESTING -

Immerse the hose assemblies in distilled water at 185º F (-2º F, +0º F) for 70 hours. Within 30 minutes after removal from the water, the following tests shall be started:

Hose #16 - BURST STRENGTH TEST (Paragraph 12.A.4)

Hose #17 - WHIP TEST (Paragraph 12.A.5)

Hose #18 - TENSILE STRENGTH TEST (Paragraph 12.A.6)

12.A.11. - BRAKE FLUID COMPATIBILITY TEST - (See Data Sheet H-11)

Hose #19 shall be subjected to this test.

PREPARATION -

(A) Attach a hose assembly below a 1-pint reservoir filled with 100 ml of SAE RM-66-05 Compatibility Fluid.

(B) Fill the hose assembly with the compatibility fluid, seal the lower end, and place the test assembly in an oven in a vertical position.

12. COMPLIANCE TEST EXECUTION....Continued

OVEN TREATMENT -

(A) Condition the hose assembly at 248ºF (-2º F, +0º F) for 70 hours. Temperature vs. Time shall be permanently recorded.

(B) Cool the hose assembly at room temperature for 30 minutes minimum.

(C) Drain the fluid from the brake hose and perform the Constriction Test in accordance with Paragraph 12.A.2.

(D) Immediately following the test above, perform a Burst Strength Test in accordance with Paragraph 12.A.4 (except after the 2-minute hold increase the pressure to 5000 psi for all hose sizes).

12.A.12. - HIGH TEMPERATURE IMPULSE TEST - (See Data Sheet H-12)

APPARATUS –

(A) A pressure cycling machine to which one end of the brake hose assembly can be attached, with the entire hose assembly installed vertically inside of a circulating air oven. The machine shall be capable of increasing the pressure in the hose from zero psi to 1600 psi, and decreasing the pressure in the hose from 1600 psi to zero psi, within 2 seconds.

(B) A circulating air oven that can reach a temperature of 295 degrees Fahrenheit within 30 minutes and can maintain 295º F (-2º F, +0º F) thereafter, with the brake hose assembly inside of the oven and attached to the pressure cycling machine.

(C) A burst test apparatus to conduct testing specified in S6.2.

PREPARATION -

(A) Connect one end of the hose assembly to the pressure cycling machine and plug the other end of the hose. Fill the pressure cycling machine and hose assembly with SAE RM-66-05 Compatibility Fluid, as described in Appendix B of SAE Standard J1703 JAN 1995 “Motor Vehicle Brake Fluid,” and bleed all gases from the system.

12. COMPLIANCE TEST EXECUTION....Continued

(B) Place the brake hose assembly inside of the circulating air oven in a vertical position. Increase the oven temperature to 295º F and maintain this temperature (-2º F, +0º F) throughout the pressure cycling test.

(C) During each pressure cycle, the pressure in the hose is increased from zero psi to 1600 psi and held constant for 1 minute, then the pressure is decreased from 1600 psi to zero psi and held constant for 1 minute. Perform 150 pressure cycles on the brake hose assembly.

(D) Remove the brake hose assembly from the oven, disconnect it from the pressure cycling machine, and drain the fluid from the hose. Cool the brake hose assembly at room temperature for 45 minutes.

(E) Wipe the brake hose using acetone to remove residual Compatibility Fluid. Conduct the burst strength test in S6.2, except all sizes of hose are tested at 5,000 psi.

12.A.13. - DYNAMIC OZONE TEST (See Data Sheet H-13)

Apparatus - Utilize a test apparatus shown in Figure 6 which is constructed so that:

(A) It has a fixed pin with a vertical orientation over which one end of the brake hose is installed.

(B) It has a movable pin that is oriented 30 degrees from vertical, with the top of the movable pin angled towards the fixed pin. The moveable pin maintains its orientation to the fixed pin throughout its travel in the horizontal plane. The other end of the brake hose is installed on the movable pin.

PREPARATION -

(A) Precondition the hose assembly by laying it on a flat surface in an unstressed condition, at room temperature, for 24 hours.

(B) Cut the brake hose assembly to a length of 8.6 inches (218 mm), such that no end fittings remain on the cut hose.

12. COMPLIANCE TEST EXECUTION....Continued

(C) Mount the brake hose onto the test fixture by fully inserting the fixture pins into each end of the hose. Secure the hose to the fixture pins using a band clamp at each end of the hose.

(D) Place the test fixture into an ozone chamber.

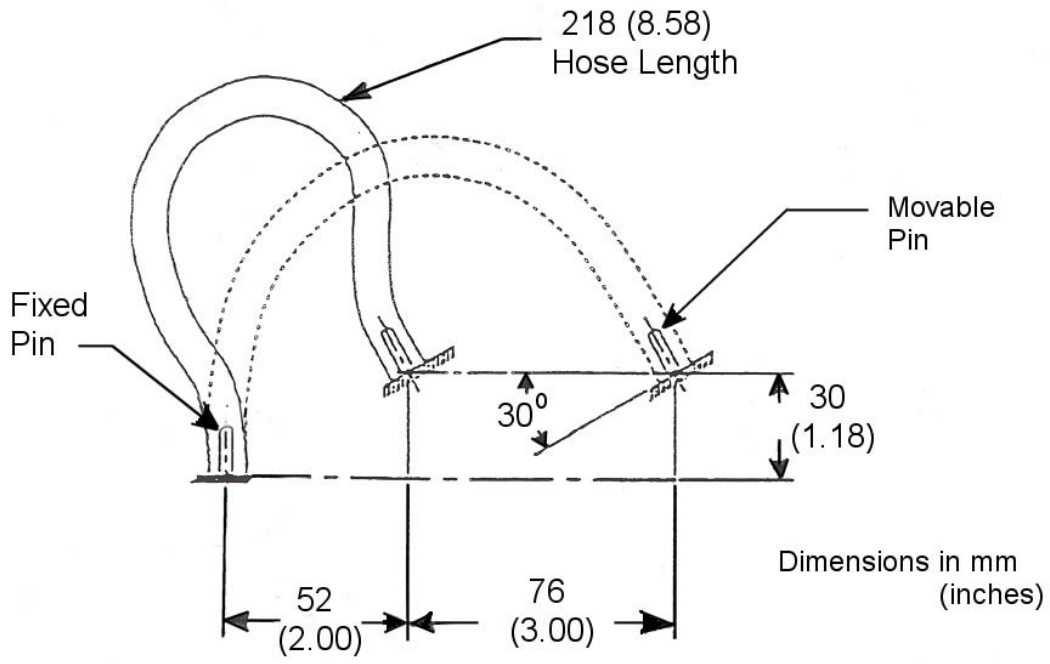
(E) Stabilize the atmosphere in the ozone chamber so that the ambient temperature is 104º F (-2º F, +0º F) and the air mixture contains air mixed with ozone in the proportion of 100 parts of ozone per 100 million parts of air by volume. This atmosphere is to remain stable throughout the remainder of the test.

(F) Begin cycling the movable pin at a rate of 0.3 Hz. Continue the cycling for 48 hours.

(G) At the completion of 48 hours of cycling, remove the test fixture from the ozone chamber. Without removing the hose from the test fixture, visually examine the hose for cracks without magnification, ignoring areas immediately adjacent to or within the area covered by the band clamps. Examine the hose with the movable pin at any point along its travel.

12. COMPLIANCE TEST EXECUTION....Continued

Figure 6. Dynamic Ozone Test Apparatus



12.A.14. - TRACER CORD IDENTIFICATION - (See Data Sheet H-14)

This paragraph is provided for information only to aid in further hose identification, if required, particularly in the event of illegible hose/fitting identification.

All hoses within the group with the exception of the "FAILED" sample shall be subjected to this test. To determine the tracer cord color, carefully

remove one section of the outer rubber cover (approximately 2 inches long and one-half way around the hose) to expose the outer ply of the braid, and identify the color of the tracer cord. Where no tracer cord is present in the outer braid, expose the surface of the inner braid.

12. COMPLIANCE TEST EXECUTION....Continued

State the color or colors found and refer to the R.M.A. Code Assignments, "Colored Yarn Manufacturers Identification," to add the name of the hose manufacturer. If no identification is present in either braid, write "NONE" in the space on the data sheet. The R.M.A. Code Assignments may be obtained from the Rubber Manufacturers Association, Inc., 1400 K Street, NW, Washington, DC 20005 (Attention Mr. Stephen Butcher, Telephone Number 202-682-4818).

12.B. TEST REQUIREMENTS - AIR BRAKE HOSES

12.B.1. - LABELING INSPECTION - (See Data Sheets A-1A, B & C)

All air hose test specimens shall be subjected to labeling inspection and any markings, if present, are to be recorded.
The data sheets contain a selection matrix allowing designation of the test specimens as being the following:

- **Vehicle Specific Assemblies**
- **Aftermarket Assemblies (NON-OEM)**
- **Special Test Assemblies**

Vehicle Specific Assemblies are those designated by a vehicle manufacturer as being assemblies used on specific vehicle models and generally will be sold and shipped directly to the test contractor by the vehicle manufacturer or those sold by an authorized vehicle dealer and shipped to the test contractor by the dealer or OVSC.

Aftermarket Assemblies are **NON-OEM** hose assemblies, and, whereas the assembly manufacturer may sell the assemblies as replacement assemblies for specific vehicles, the vehicle manufacturer accepts NO responsibility for their performance.

Special Test Assemblies are those that a vehicle manufacturer may provide as surrogate assemblies for particular tests such as may be necessary to fit a particular test machine (generally these will be shorter assemblies that will fit a tensile test machine). Markings are NOT required on the **Special Test Assemblies**.

HOSE MATERIAL MARKING

Although NOT required on hose material of assemblies to be tested, the following hose information shall be recorded if present.

12. COMPLIANCE TEST EXECUTION....Continued

(A) The letters "DOT"

(B) Hose Manufacturer's Identification

(C) Date of Manufacturer (Month, Day and Year OR Month and Year expressed in numerals).

(D) Nominal Inside Hose Diameter (I.D. in inches or mm) or the Nominal Outside Diameter (O.D.) of plastic tubing followed by the letters "OD"

(E) The letters A, AI or AII

END FITTINGS (NON-CRIMPED OR SWAGED TYPE)

At least one component of any non-crimped or swaged type end fitting shall be marked with the following information.

(A) The letters "DOT"

(B) Manufacturer's Identification

(C) The letters A, AI or AII

(D) Nominal Inside Hose Diameter (I.D. in inches or mm) or the Nominal Outside Diameter (O.D.) of plastic tubing following by the letters "OD"

HOSE ASSEMBLIES (CRIMPED OR SWAGED TYPE END FITTINGS)

Hose assemblies with fittings attached by crimping or swaging have two (2) options for marking.

OPTION 1: Marking shall be on a band and shall consist of the following:

(A) The letters "DOT"

(B) Manufacturer's identification

OPTION 2: The manufacturer's Identification shall be marked on at least one end fitting hose assemblies with fittings other than crimped or swaged have NO assembly labeling requirements.

12. COMPLIANCE TEST EXECUTION....Continued

12.B.2. - CONSTRICTION TEST - (See Data Sheet A-2)

All test specimens shall be subjected to this test. This shall be conducted following the same procedure and with the same plug gages as specified previously. The constriction gage shall have a plug maximum diameter as follows: (Same diameter ball or rod is permissible)

0.0820" to 0.0823"	for 1/8" hose	(3.2 mm)
0.1230" to 0.1234"	for 3/16" hose	(4.8 mm)
0.1641" to 0.1646"	for 1/4" hose	(6.3 mm)
0.2051" to 0.2057"	for 5/16" hose	(7.9 mm)
0.2461" to 0.2469"	for 3/8" hose	(9.5 mm)
0.2666" to 0.2674"	for 13/32" hose	(10.3 mm)
0.2870" to 0.2879"	for 7/16" hose	(11.1 mm)
0.3281" to 0.3291"	for 1/2" hose	(12.7 mm)
0.4104" to 0.4115"	for 5/8" hose	(15.9 mm)

NOTE: Hose marked as 3/8 O.D. shall be considered as a 1/4 inch Nominal Inside Diameter (I.D.).

The gage plug maximum diameter used by the test laboratory shall be shown to the nearest ten thousandth of an inch, under "REMARKS" on the Data Sheet.

If a constriction does exist, establish the approximate location of the constriction. Insert drill rods into the end coupling to determine the maximum size that can be inserted without force. Note size and location on the Data Sheet. Drill rod sizes can be found in the Machinist's Handbook.

The brake hose constriction test requirements shall be met using at least one of the methods specified below.

Plug gauge

(A) Utilize a plug gauge as shown in Figure 5. Diameter ‘A’ is equal to 66 percent of the nominal inside diameter of the hydraulic brake hose being tested.

(B) Brake hose assemblies that are to be used for additional testing have constriction testing only at each end fitting. Other brake hose assemblies may be cut into three inch lengths to permit constriction testing of the entire assembly. Hose assemblies with end fittings that do not permit entry of the gauge (e.g., restrictive orifice or banjo fitting) are cut three

12. COMPLIANCE TEST EXECUTION....Continued

inches from the point at which the hose terminates in the end fitting and then tested from the cut end.

(C) Hold the brake hose in a straight position and vertical orientation.

(D) Place the spherical end of the plug gauge just inside the hose or end fitting. If the spherical end will not enter the hose or end fitting using no more force than gravity acting on the plug gauge, this constitutes failure of the constriction test.

(E) Release the plug gauge. Within three seconds, the plug gauge shall fall under the force of gravity alone up to the handle of the gauge. If the plug gauge does not fully enter the hose up to the handle of the gauge within three seconds, this constitutes failure of the constriction test.

EXTENDED PLUG GAUGE

(A) The test in S6.12.1 may be conducted with an extended plug gauge to enable testing of the entire brake hose from one end fitting, without cutting the brake hose. The extended plug gauge weight and spherical diameter specifications are as shown in Figure 5, but the handle portion of the gauge may be deleted and the gauge length may be greater than 3 inches.

12. COMPLIANCE TEST EXECUTION....Continued

(B) The required performance of the extended plug gauge in paragraph S6.12.1(e) is that after the plug gauge is released, the extended plug gauge shall fall under the force of gravity alone at an average rate of 1 inch per second until the spherical diameter of the extended gauge passes through all portions of the brake hose assembly containing hose. If the extended plug gauge does not pass through all portions of the brake hose assembly containing hose at an average rate of 1 inch per second, this constitutes failure of the constriction test.

DROP BALL TEST

(A) Utilize a rigid spherical ball with a diameter equal to 66 percent of the nominal inside diameter of the hydraulic brake hose being tested. The weight of the spherical ball shall not exceed 2 ounces (57 grams).

(B) Hold the brake hose in a straight position and vertical orientation.

(C) Hold the ball just above the end fitting.

(D) Release the ball. The ball shall fall under the force of gravity alone completely through all portions of the brake hose assembly containing hose, at an average rate of 1 inch per second. Failure of the ball to pass completely through all portions of the brake hose assembly containing hose, at an average rate of 1 inch per second, constitutes failure of the constriction test.

12.B.3. - HIGH TEMPERATURE TEST - (See Data Sheet A-3)

Hose #1 shall be subjected to this test. Use a cylinder of the diameter noted on the table below for the specific hose diameter being tested.

Secure the test hose around the cylinder and place the assembly in an air oven for 70 hours. Maintain the temperature at 212º F (-2º F, +0º F).

Temperature vs. Time shall be permanently recorded.

Remove the hose and cylinder from the oven and allow to cool to room temperature. Hand straighten the hose and inspect for external cracks, charring or disintegration. Cut the hose lengthwise and inspect internally for any test damage.

12. COMPLIANCE TEST EXECUTION....Continued

HOSE NOMINAL I.D. (mm)	TEST CYLINDER RADIUS
3/16" (4,5)	1" (25)
1/4" (6)	1½" (38)
5/16" (8)	1¾"
3/8" (-)	1¾"
13/32" (10)	1 ⅞"
7/16", 1/2" (12)	2"
5/8"	2½"

12.B.4. – LOW TEMPERATURE RESISTANCE TEST - (See Data Sheet A-4)

Hose #2 shall be subjected to this test.

After removal of any hose armor, date bands, etc., the hose shall be placed in the cold box on a low conductivity material such as wood. A wood mandrel of the size noted in the table below shall be conditioned with the test hose.

The cold box 70 hour test period shall begin when the box recorded temperature stabilizes at -40º F (-0º F, +2º F). The hose is to be conditioned in the cold box in a straight position and after 70 hours is to be bent around the mandrel favoring any natural curvature already in the hose. The bending operation shall occur in the cold box at -40º F (-0º F, +2º F).

12. COMPLIANCE TEST EXECUTION....Continued

HOSE NOMINAL I.D. (mm)	TEST CYLINDER RADIUS
3/16" (4,5)	2" (51)
1/4" (6)	2½" (64)
5/16" (8)	3" (76)
3/8" (-)	3½" (89)
13/32" (10)	3½" (89)
7/16", 1/2" (12)	4" (102)
5/8"	4½" (114)

The hose assembly shall be wrapped 180º around the mandrel by hand at a steady rate in a period of 3 to 5 seconds, using suitable gloves, and holding the hose rather than grasping the end couplings. After bending and removal from the cold box, inspect the outer rubber cover for cracks without magnification.

Allow the hose to warm at room temperature for two hours. Cut away the end fittings and cut through one wall of the hose lengthwise to expose the inner liner for its inspection for cracks. An external fabric braid may have to be removed to expose the outer rubber cover for inspection.

The Cold Box Temperature vs. Time shall be permanently recorded.

12.B.5. - OIL RESISTANCE TEST - (See Data Sheet A-5)

Hoses numbered 3 thru 5 shall be subjected to this test.

NOTE: A minimum of three (3) hoses must be used for this test.

PREPARATION -

Fabricate the three test specimens by cutting blocks 2 inches long and 3/8 of an inch in width, having a thickness of not more than one-sixteenth inch, from the brake hose inner tube and buff the specimens on both faces to ensure smooth surfaces.

12. COMPLIANCE TEST EXECUTION....Continued

MEASUREMENT -

(A) Weigh each specimen to the nearest milligram in air (WI) and in distilled water (W2) at room temperature. If wetting is necessary to remove air bubbles, dip the specimen in acetone and thoroughly rinse it with distilled water.

(B) Immerse each specimen in ASTM IRM 903 oil for 70 hours at 212ºF (-2º F, +0º F) and then cool in ASTM IRM 903 oil at room temperature for 30 to 60 minutes.

(C) Dip the specimen in acetone and blot it lightly with filter paper.

(D) Weigh each specimen in a tared weighing bottle (W3) and in distilled water (W4) within 5 minutes of removal from the cooling liquid.

(E) Calculate the percentage increase in volume as follows:

$$\text{Percent of Increase} = \frac{(W_3 - W_4) - (W_1 - W_2)}{(W_1 - W_2)} \times 100$$

(F) Enter the data on Data Sheet A-5 and average the three results.

12.B.6. - OZONE TEST - (See Data Sheet A-6)

Hose #6 shall be subjected to this test.

PREPARATION -

Remove all hose armor, date bands, etc., and utilizing a cylinder in accordance with the table below, bind the brake hose 360º around the cylinder. In the case of hose shorter than the circumference of the cylinder, bend the hose so that as much of its length as possible is in contact.

12. COMPLIANCE TEST EXECUTION....Continued

TABLE I

HOSE NOMINAL I.D. (mm)	TEST CYLINDER RADIUS
3/16" (4,5)	2" (51)
1/4" (6)	2½" (64)
5/16" (8)	3" (76)
3/8" (-)	3½" (89)
13/32" (10)	3½" (89)
7/16", 1/2" (12)	4" (102)
5/8"	4½" (114)

EXPOSURE TO OZONE -

(A) Condition the hose on the cylinder in air at room temperature for 24 hours minimum.

(B) Immediately thereafter, condition the hose on the cylinder for 70 hours in an exposure chamber having an ambient air temperature of 104º F (-2º F, +0º F) during the test and containing air mixed with ozone in the proportion of 100 parts of ozone per 100 million parts of air by volume.

(C) Examine the hose for cracks under 7-power magnification, ignoring areas immediately adjacent to or within the area covered by binding.

An external fabric braid may have to be removed to expose the outer rubber cover for inspection.

(D) Chamber Temperature and Concentrations vs. Time must be permanently recorded.

12.B.7. - LENGTH CHANGE TEST - (See Data Sheet A-7)

Hose #7 shall be subjected to this test.

12. COMPLIANCE TEST EXECUTION....Continued

(A) Position a test hose in a straight, horizontal position, and apply air pressure of 9.5 to 10 psig.

(B) Measure the hose to determine original free length.

(C) Without releasing the 10 psi, raise the air pressure to the test hose to 195 to 200 psi.

(D) Measure the hose under 200 psi to determine final free length. An elongation or contraction is an increase or decrease, respectively, in the final free length from the original free length of the hose.

12.B.8. - ADHESION TEST (HOSE NOT REINFORCED BY WIRE) - (See Data Sheet A-8)

NOTE: This test shall not be performed on hose stock with internal steel cord.

Hose #8 shall be subjected to this test.

APPARATUS -

Utilize a power-driven apparatus of the inclination balance or pendulum type which is constructed so that:

(A) The recording head includes a freely rotating form with an Outside Diameter (O.D.) substantially the same as Inside Diameter (I.D.) of the hose specimen to be placed on it.

(B) The freely rotating form is mounted so that its axis of rotation is in the plane of the ply being separated from the specimen and so that the applied force is perpendicular to the tangent of the specimen circumference at the line of separation.

(C) The rate of travel of the power-actuated grip is a uniform 1 inch per minute and the capacity of the load cell is such that the maximum applied tension during the test is not more than 85 percent nor less than 15 percent of the load cell's rated capacity.

(D) The machine operates with no device for maintaining maximum load indication, and in a pendulum type machine, the weight lever swings as a free pendulum without engagement of pawls.

12. COMPLIANCE TEST EXECUTION....Continued

(E) The machine produces a chart with inches of separation as one coordinate and applied tension as the other.

PREPARATION -

(A) Cut a test specimen of 1 inch or more in length from the hose to be tested and cut the layer to be tested of that test specimen longitudinally along its entire length to the level of contact with the adjacent layer. Record specimen length on data sheet.

(B) Peel the layer to be tested from the adjacent layer to create a flap large enough to permit attachment of the power-actuated clamp of the apparatus.

(C) Mount the test specimen on the freely rotating form with the separated layer attached to the power-actuated clamp.

CALCULATIONS -

(A) The adhesion value shall be the minimum force recorded on the chart excluding that portion of the chart which corresponds to the initial and final 20 percent portion along the displacement axis.

(B) Express the force in pounds per inch of length.

12.B.9. - FLEX STRENGTH AND AIR PRESSURE TEST - (See Data Sheet A-9)

Hose #9 shall be subjected to this test.

Apparatus

A flex testing machine with a fixed hose assembly attachment point and a movable hose assembly attachment point, which meets the dimensional requirements of Figure 7 for the size of hose being tested. The attachment points connect to the end fittings on the hose assembly without leakage and, after the hose assembly has been installed for the flex test, are restrained from rotation. The movable end has a linear travel of 6 inches and a cycle rate of 100 cycles per minute. The machine is capable of increasing the air pressure in the hose assembly from zero to

12. COMPLIANCE TEST EXECUTION....Continued

150 psi within 2 seconds, and decreasing the air pressure in the hose assembly from 150 to zero psi within 2 seconds.

Preparation.

(A) Lay the hose material on a flat surface in an unstressed condition. Apply a permanent marking line along the centerline of the hose on the uppermost surface.

(B) Prepare the hose assembly with a free length as shown in the table accompanying Figure 7. The end fittings shall be attached according to the end fitting manufacturer's instructions.

(C) Plug the ends of the hose assembly and conduct the salt spray test in S6.11 using an air brake hose assembly. Remove the plugs from the end fittings.

(D) Within 168 hours of completion of the salt spray test, expose the hose assembly to an air temperature of 212^0 F (-2º F, +0º F) for 70 hours, with the hose in a straight position. Remove the hose and cool it at room temperature for 2 hours. Within 166 hours, subject the hose to the flexure test in (e).

(E) Install the hose assembly on the flex testing machine as follows. With the movable hose attachment point at the mid point of its travel, attach one end of the hose to the movable attachment point with the marked line on the hose in the uppermost position. Attach the other end of the hose to the fixed attachment point allowing the hose to follow its natural curvature.

(F) Cycle the air pressure in the hose by increasing the pressure in the hose from zero psi to 150 psi and holding constant for one minute, then decreasing the pressure from 150 psi to zero psi and holding constant for one minute. Continue the pressure cycling for the duration of the flex testing. Begin the flex testing by cycling the movable attachment point through 6 inches of travel at a rate of 100 cycles per minute. Stop the flex testing and pressure cycling after 1 million flex cycles have been completed.

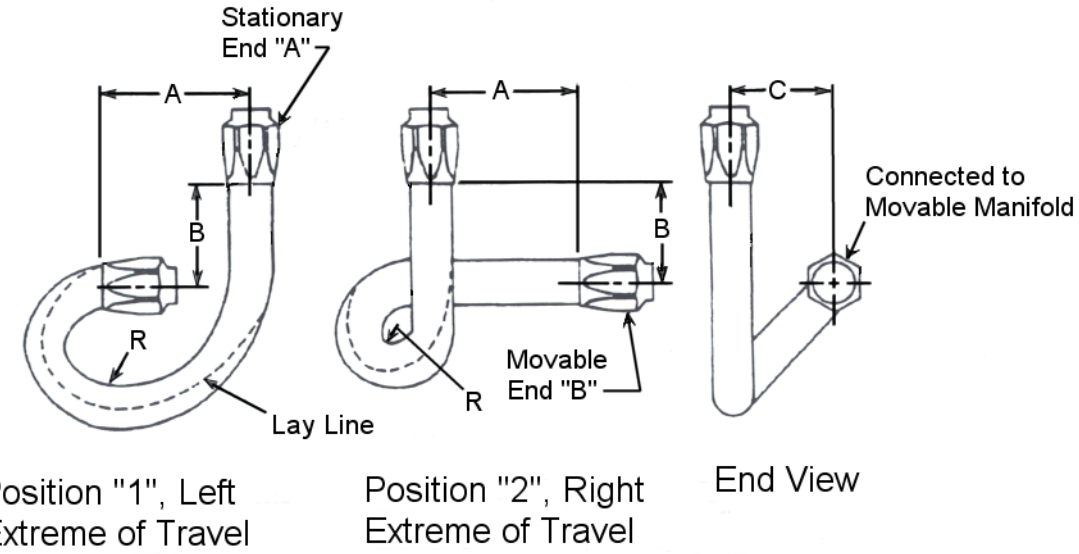
(G) Install an orifice with a hole diameter of 0.0625 inches and a thickness of 0.032 inches in the air pressure supply line to the hose assembly. Provide a gage or other means to measure air pressure

12. COMPLIANCE TEST EXECUTION....Continued

in the hose assembly. Regulate the supply air pressure to the orifice to 150 psi.

(H) Apply 150 psi air pressure to the orifice. After 2 minutes have elapsed, measure the air pressure in the brake hose assembly, while pressurized air continues to be supplied through the orifice.

Figure 7. Flex Test Apparatus



Free Hose Length	Nominal Hose Inside Diameter	Dimensions							
		Position "1"				Position "2"			
		A	B	C	R(1)	A	B	C	R(1)
10.00 (254)	3/16, 1/4	3.00 (76)	2.75 (70)	3.75 (95)	1.40 (34)	3.00 (76)	2.75 (70)	3.75 (95)	1.20 (30)
11.00 (279)	5/16, 3/8, 13/32	3.00 (76)	3.50 (89)	4.50 (114)	1.70 (43)	3.00 (76)	3.50 (89)	4.50 (114)	1.30 (33)
14.00 (355)	7/16, ½, 5/8	3.00 (76)	4.00 (102)	5.00 (127)	2.20 (56)	3.00 (76)	4.00 (102)	5.00 (127)	1.80 (46)

Note (1) This is an approximate average radius.

Pressure vs. Time shall be permanently recorded.

12.B.10. - CORROSION RESISTANCE AND BURST STRENGTH TEST - (See Data Sheet A-10)

Hose #10 shall be subjected to this test. Conduct the test specified in Paragraph 12.A.8 using an air brake hose assembly.

12. COMPLIANCE TEST EXECUTION....Continued

Remove the plugs from the ends of the hose assembly.

Fill the hose assembly with water, allowing all gases to escape. Apply water pressure at a uniform rate of increase of approximately 1,000 psi per minute until the hose ruptures.

Pressure vs. Time shall be permanently recorded.

12.B.11. - TENSILE STRENGTH TEST - (See Data Sheet A-11)

Hose #11 shall be subjected to this test and Hose #12 shall also be subjected after completion of the Water Absorption Test (A-12).

The tension test consists of subjecting the hose assembly to increasing tensile load in a suitable testing machine until failure occurs, either by -

(A) Separation of the specimen from the end fittings, OR
(B) Failure of the hose structure

A tensile testing machine, which conforms to the requirements of ASTM Methods, E4, "Verification of Testing Machines," shall be used. A machine of 1,000 lbs. capacity is sufficient. After removal of any hose armor or date bands, etc., the hose assembly fittings shall be attached to the machine by suitable fixtures so that the hose and fittings shall have a straight center line parallel to the direction of the machine pull. Tensile pull shall be applied at the rate of 1" ± 0.1" per minute. The allowable tensile strengths in pounds are shown in the table below.

The tensile machine shall be provided with a recording device such as an X-Y Plotter, to give the total pull (pounds) at the conclusion of the test.

Vehicle Application	**ALLOWABLE TENSILE STRENGTH**			
	I.D. ≤ ¼ "	**I.D.> ¼ "**	**¼" <I.D. ≤ ½"**	**I.D.<½"**
Between frame and axle	250 lbs	325 lbs	-	-
Other	50 lbs	-	150 lbs	325 lbs

12. COMPLIANCE TEST EXECUTION....Continued

12.B.12. - WATER ABSORPTION TEST - (See Data Sheet A-12)

Hose #12 shall be subjected to this test. Immerse the hose in distilled water at room temperature for 70 hours. Within 30 minutes after removal from the water, conduct the Tensile Strength Test in accordance with Paragraph 12.B.11.

12.B.13. - ZINC CHLORIDE RESISTANCE TEST - (See Data Sheet A-13)

Hose #13 shall be subjected to this test.

Immerse the hose in a 50 percent zinc chloride aqueous solution at room temperature for 200 hours. Remove it from the solution and examine it

under 7-power magnification for cracks. An external fabric braid may have to be removed to expose the outer rubber cover for inspection.

12.B.14. - SALT SPRAY TEST - (See Data Sheet A-14)

Hose #14 shall be subjected to this test. Perform the test in accordance with Paragraph 12.A.8.

12.B.15. - ADHESION TEST (HOSE REINFORCED BY WIRE) - (See Data Sheet A-15)

(A) Place a steel ball with a diameter equal to 73 percent of the nominal inside diameter of the hose being tested inside of the hose. Plug one end of the hose. Attach the other end of the hose to a source of vacuum.

(B) Subject the hose to a vacuum of 25 inches of Hg for five minutes. With the vacuum still applied to the hose, bend the hose 180 degrees around a large test cylinder with a radius specified in Table I (Par. 12.B.4) for the size of hose tested. At the location of this bend, bend the hose 180 degrees around the test cylinder in the opposite direction.

(C) With the vacuum still applied to the hose, return the hose to a straight position. Attempt to roll the ball inside the hose using gravity from one end of the hose to the other end.

12. COMPLIANCE TEST EXECUTION....Continued

12.B.16. - TRACER CORD IDENTIFICATION - (See Data Sheet A-15)

Perform the identification in accordance with Paragraph 12.A.12.

12.C. TEST Requirements - VACUUM BRAKE HOSES

12.C.1. - LABELING INSPECTION - (See Data Sheets V-1A, B & C)

All vacuum hose test specimens shall be subjected to labeling inspection and any markings, if present, are to be recorded.

The data sheets contain a selection matrix allowing designation of the test specimens as being as follows:

Vehicle Specific Assemblies
Aftermarket Assemblies
Special Test Assemblies

Vehicle Specific Assemblies are those designated by a vehicle manufacturer as being assemblies used on specific vehicle models and generally will be sold and shipped directly to the test contractor by the vehicle manufacturer or those sold by an authorized vehicle dealer and shipped to the test contractor by the dealer or OVSC.

Aftermarket Assemblies are **NON-OEM** hose assemblies, and, whereas the assembly manufacturer may sell the assemblies as replacement assemblies for specific vehicles, the vehicle manufacturer accepts NO responsibility for their performance.

Special Test Assemblies are those that a vehicle manufacturer may provide as surrogate assemblies for particular tests such as may be necessary to fit a particular test machine (generally these will be shorter assemblies that will fit a tensile test machine). Markings are NOT required on the **Special Test Assemblies**.

HOSE MATERIAL MARKING

Although NOT required on hose material of assemblies to be tested, the following hose information shall be recorded if present.

(A) The letters "DOT"

(B) Hose Manufacturer's Identification

12. COMPLIANCE TEST EXECUTION....Continued

(C) Date of Manufacturer (Month, Day and Year OR Month and Year expressed in numerals).

(D) Nominal Inside Hose Diameter (I.D. in inches or mm) or the Nominal Outside Diameter (O.D.) of plastic tubing followed by the letters "OD"

(E) The letters VL or VH

END FITTINGS (Reusable fittings only)

Except for an end fitting that is attached by heat shrinking or by interference fit with plastic vacuum hose or that is attached by deformation of the fitting about a hose by crimping or swaging, at least one component of any end fitting shall be marked with the following information.

(A) The letters "DOT"

(B) Manufacturer's Identification

(C) The letters VL or VH

(D) Nominal Inside Hose Diameter (I.D. in inches or mm) or the Nominal Outside Diameter (O.D.) of plastic tubing following by the letters "OD"

HOSE ASSEMBLIES (Nonreusable end fittings only)

Hose assemblies with nonreusable end fittings have two (2) options for marking.

OPTION 1: Marking shall be on a band and shall consist of the following:

(A) The letters "DOT"

(B) Manufacturer's identification

OPTION 2: The manufacturer's Identification shall be marked on at least one end fitting

Hose assemblies with reusable end fittings have NO assembly labeling requirements.

12.C.2. - CONSTRICTION TEST - (See Data Sheet V-2)

12. COMPLIANCE TEST EXECUTION....Continued

All test specimens shall be subjected to this test. This is basically a "go" or "no go" test in which a plug gage, an extended plug gage, or a drop ball is inserted in the upper end of a hose assembly, which is held vertically, and allowed to drop by gravity through the hose. The hose is acceptable if the gage passes through the hose and can be seen at the lower fitting. Failure to appear at the lower fitting shall be considered a test failure.

The gage plug maximum diameter used by the test laboratory shall be shown under "REMARKS" on the Data Sheet.

If a constriction does exist, establish the approximate location of the constriction. Insert drill rods into the end coupling to determine the maximum size that can be inserted without force. Note size and location on the Data Sheet. Drill rod sizes can be found in the Machinist's Handbook.

The brake hose constriction test requirements shall be met using at least one of the methods specified below.

PLUG GAUGE

(A) Utilize a plug gauge as shown in Figure 5. Diameter ‘A’ is equal to 75 percent of the nominal inside diameter of the vacuum brake hose if it is heavy duty, or 70 percent of the nominal inside diameter of the vacuum brake hose if it is light duty.

(B) Brake hose assemblies that are to be used for additional testing have constriction testing only at each end fitting. Other brake hose assemblies may be cut into three inch lengths to permit constriction testing of the entire assembly. Hose assemblies with end fittings that do not permit entry of the gauge (e.g., restrictive orifice or banjo fitting) are cut three inches from the point at which the hose terminates in the end fitting and then tested from the cut end.

(C) Hold the brake hose in a straight position and vertical orientation.

(D) Place the spherical end of the plug gauge just inside the hose or end fitting. If the spherical end will not enter the hose or end fitting using no more force than gravity acting on the plug gauge, this constitutes failure of the constriction test.

(E) Release the plug gauge. Within three seconds, the plug gauge shall fall under the force of gravity alone up to the handle of the gauge. If the plug gauge does not fully enter the hose up to the handle of the gauge within three seconds, this constitutes failure of the constriction test.

12. COMPLIANCE TEST EXECUTION....Continued

EXTENDED PLUG GAUGE

(A) The test in S6.12.1 may be conducted with an extended plug gauge to enable testing of the entire brake hose from one end fitting, without cutting the brake hose. The extended plug gauge weight and spherical diameter specifications are as shown in Figure 5, but the handle portion of the gauge may be deleted and the gauge length may be greater than 3 inches.

(B) The required performance of the extended plug gauge in paragraph S6.12.1(e) is that after the plug gauge is released, the extended plug gauge shall fall under the force of gravity alone at an average rate of 1 inch per second until the spherical diameter of the extended gauge passes through all portions of the brake hose assembly containing hose. If the extended plug gauge does not pass through all portions of the brake hose assembly containing hose at an average rate of 1 inch per second, this constitutes failure of the constriction test.

DROP BALL TEST

(A) Utilize a rigid spherical ball with a diameter equal to 75 percent of the nominal inside diameter of the vacuum brake hose if it is heavy duty, or 70 percent of the nominal inside diameter of the vacuum brake hose if it is light duty. The weight of the spherical ball shall not exceed 2 ounces (57 grams).

(B) Hold the brake hose in a straight position and vertical orientation.

12. COMPLIANCE TEST EXECUTION....Continued

(C) Hold the ball just above the end fitting.

(D) Release the ball. The ball shall fall under the force of gravity alone completely through all portions of the brake hose assembly containing hose, at an average rate of 1 inch per second. Failure of the ball to pass completely through all portions of the brake hose assembly containing hose, at an average rate of 1 inch per second, constitutes failure of the constriction test.

12.C.3. - HIGH TEMPERATURE RESISTANCE TEST - (See Data Sheet V-3)

(A) Measure the initial outside diameter of the hose.

(B) Subject the hose to an internal vacuum of 26 inches of Hg at an ambient temperature of 257^0 F (-2º F, +0º F) for a period of 96 hours. Remove the hose to room temperature and atmospheric pressure.

(C) Within 5 minutes of completion of the conditioning in (b), measure the outside diameter at the point of greatest collapse and calculate the percentage collapse based on the initial outside diameter.

(D) Cool the hose at room temperature for 5 hours. Bend the hose around a mandrel with a diameter equal to five times the initial outside diameter of the hose. Examine the exterior of the hose for cracks, charring, or disintegration visible without magnification. Remove the hose from the mandrel.

(E) Fill the hose assembly with water, allowing all gases to escape. Apply water pressure in the hose of 175 psi within 10 seconds. Maintain an internal hydrostatic pressure of 175 psi for one minute and examine the hose for visible leakage.

12.C.4. - LOW TEMPERATURE RESISTANCE TEST - (See Data Sheet V-4)

Hose #2 shall be subjected to this test.

(A) Conduct the test specified in S8.2 (a) through (c) using vacuum brake hose and with the cylinder radius specified in Table II (Par. 12.C.8) for the size of hose tested.

(B) Remove the hose from the test cylinder, warm the hose at room temperature for 5 hours, and conduct the hydrostatic pressure test in 10.1(e).

12. COMPLIANCE TEST EXECUTION....Continued

12.C.5. - OZONE TEST - (See Data Sheet V-5)

Hose #3 shall be subjected to this test. Perform this test in accordance with Paragraph 12.A.9.

12.C.6. - BURST STRENGTH TEST - (See Data Sheet V-6)

Hose #4 shall be subjected to this test. Perform the test in accordance with Paragraph 12.A.4 except that the minimum allowable burst strength shall be 350 psig.

12.C.7. - VACUUM TEST - (See Data Sheet V-7)

Hose #5 shall be subjected to this test, and Hose #7 shall also be subjected after completion of the Swell Test (V-9), utilizing a 12-inch long vacuum brake hose assembly sealed at one end, as follows:

(A) Measure the hose Outside Diameter (O.D.).
(B) Attach the hose to a source of vacuum and subject it to a vacuum of 25 to 26 inches of Hg for 5 minutes.
(C) Measure the hose to determine the minimum outside diameter while the hose is still subject to vacuum.

12.C.8. - BEND TEST - (See Data Sheet V-8)

Hose #6 shall be subjected to this test.

(A) Bend a vacuum brake hose, of the length prescribed in Table II (shown below), in the direction of its normal curvature until the ends just touch as shown in Figure 6 of FMVSS 106.

(B) Measure the outside diameter of the specimen at point A before and after bending.

(C) The difference between the two measurements is the collapse of the hose Outside Diameter on bending. The allowable maximum collapse is shown in the table below.

12. COMPLIANCE TEST EXECUTION....Continued

TABLE II - VACUUM BRAKE HOSE TEST REQUIREMENTS

Hose Inside Dia. (I.D.)	High Temperature Resistance		High Temperature Resistance		Bend		Deformation-Collapsed Inside Dia. (Dimen. D)
	Hose Length	Dia. of Cylinder (+.03,-0)	Hose Length	Dia. of Cylinder (+.03,-0)	Hose Length	Max. Collapse of Outside Dia. (O.D.)	
7/32"	8"	3"	17.5"	6"	7"	11/64"	3/64"
1/4"	9"	3"	17.5"	6"	8"	3/32"	1/16"
9/32"	9"	3.5"	19"	7"	9"	12/64"	4/64"
11/32"	9"	3.5"	19"	7"	11"	13/64"	5/64"
3/8"	10"	3.5"	19"	7"	12"	5/32"	3/32"
15/32"	11"	4"	20.5"	8"	14"	17/64"	5/64"
1/2"	11"	4"	20.5"	8"	16"	7/32"	1/8"
5/8"	12"	4.5"	22"	9"	22"	7/32"	5/32"
3/4"	14"	5"	24"	10"	28"	7/32"	3/16"
1"	16"	6.5"	28.5"	13"	36"	9/32"	1/4"

12.C.9. - SWELL AND ADHESION TEST - (See Data Sheet V-10)

Hose #8 shall be subjected to this test.

(A) Fill a specimen of vacuum brake hose 12 inches long with ASTM Reference Fuel B as described in ASTM D471-98e[1] Standard Test Method for Rubber Property - Effect of Liquids.

(B) Maintain reference fuel in the hose under atmospheric pressure at room temperature for 48 hours.

(C) Remove fuel and conduct the constriction test in S10.11.

(D) Attach the hose to a source of vacuum and subject it to a vacuum of 26 inches of Hg for 10 minutes. Remove the hose from the vacuum source.

12. COMPLIANCE TEST EXECUTION....Continued

(E) For a vacuum brake hose constructed of two or more layers, conduct the test specified in S8.6 using the vacuum brake hose.

12.C.11. - DEFORMATION TEST - (See Data Sheet V-11)

Hose #9 shall be subjected to this test. The vacuum brake hose shall return to 90 percent of its original outside diameter within 60 seconds after five applications of force as specified herein. In the case of heavy-duty hose the first application of force shall not exceed a peak value of 70 pounds, and the fifth application of force shall reach a peak value of at least 40 pounds. In the case of light-duty hose the first application of force shall not exceed a peak value of 50 pounds, and the fifth application of force shall reach a peak value of at least 20 pounds. The table below specifies the test specimen dimensions.

APPARATUS -

Utilize a compression device, equipped to measure force of at least 100 pounds, and feeler gages of sufficient length to be passed completely through the test specimens.

OPERATION -

(A) Position the test specimen longitudinally in the compression device with the fabric laps not in the line of the applied pressure.

(B) Apply gradually increasing force to the test specimen to compress its Inside Diameter to that specified in the table below (dimension D of Figure 8) for the size of hose tested.

(C) After 5 seconds release the force and record the peak load applied.

(D) Repeat the procedure four times permitting a 10-second recovery period between load applications.

12. COMPLIANCE TEST EXECUTION....Continued

FIGURE. 8 - DEFORMED SPECIMEN OF VACUUM BRAKE HOSE

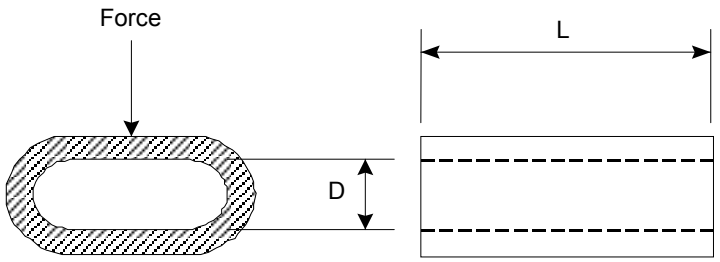


TABLE - DIMENSIONS OF TEST SPECIMEN AND FEELER GAGE FOR DEFORMATION TEST

Inside Dia. (I.D.) Of Hose	Specimen Dimensions (see Figure 8)		Feeler Gage Dimensions	
	"D" Dimension	"L" Dimension	Width	Thickness
7/32"	3/64"	1"	1/8"	3/64"
1/4"	1/16"	1"	1/8"	1/16"
9/32"	1/16"	1"	1/8"	1/16"
11/32"	5/64"	1"	3/16"	5/64"
3/8"	3/32"	1"	3/16"	3/32"
15/32"	5/64"	1"	1/4"	5/64"
1/2"	1/8"	1"	1/4"	1/8"
5/8"	5/32"	1"	1/4"	5/32"
3/4"	3/16"	1"	1/4"	3/16"
1.0"	1/4"	1"	1/4"	1/4"

12. COMPLIANCE TEST EXECUTION....Continued

12.C.12. - SALT SPRAY TEST - (See Data Sheet V-12)

Hose #10 shall be subjected to this test. Perform the test in accordance with Paragraph 12.A.8.

12.C.13. - TRACER CORD IDENTIFICATION - (See Data Sheet V-13)

Perform the identification in accordance with Paragraph 12.A.12.

12.D. TEST REQUIREMENTS – PLASTIC AIR BRAKE TUBING

12.D.1. - LABELING INSPECTION - (See Data Sheets A-1A, B & C)

All air brake tubing test specimens shall be subjected to labeling inspection and any markings, if present, are to be recorded.
The data sheets contain a selection matrix allowing designation of the test specimens as being the following:

- **Vehicle Specific Assemblies**
- **Aftermarket Assemblies (NON-OEM)**
- **Special Test Assemblies**

Vehicle Specific Assemblies are those designated by a vehicle manufacturer as being assemblies used on specific vehicle models and generally will be sold and shipped directly to the test contractor by the vehicle manufacturer or those sold by an authorized vehicle dealer and shipped to the test contractor by the dealer or OVSC.

Aftermarket Assemblies are **NON-OEM** hose assemblies, and, whereas the assembly manufacturer may sell the assemblies as replacement assemblies for specific vehicles, the vehicle manufacturer accepts NO responsibility for their performance.

Special Test Assemblies are those that a vehicle manufacturer may provide as surrogate assemblies for particular tests such as may be necessary to fit a particular test machine (generally these will be shorter assemblies that will fit a tensile test machine). Markings are NOT required on the **Special Test Assemblies**.

AIR BRAKE TUBING MATERIAL MARKING

Although NOT required on tubing material of assemblies to be tested, the following hose information shall be recorded if present.

12. COMPLIANCE TEST EXECUTION....Continued

(A) The letters "DOT"

(B) Hose Manufacturer's Identification

(C) Date of Manufacturer (Month, Day and Year OR Month and Year expressed in numerals).

(D) Nominal Outside Hose Diameter (O.D. in inches or mm) of plastic tubing followed by the letters "OD"

(E) The letter “A”

END FITTINGS (Non-crimped or Swaged type)

At least one component of any non-crimped or swaged type end fitting shall be marked with the following information.

(A) The letters "DOT"

(B) Manufacturer's Identification

(C) The letter “A”

(D) Nominal Outside Diameter (O.D. in inches or mm) of plastic tubing following by the letters "OD"

HOSE ASSEMBLIES (Crimped or swaged type end fittings)

Air brake tubing assemblies with fittings attached by crimping or swaging have two (2) options for marking.

OPTION 1: Marking shall be on a band and shall consist of the following:

(A) The letters "DOT"

(B) Manufacturer's identification

OPTION 2: The manufacturer's Identification shall be marked on at least one end fitting

Air brake tubing assemblies with fittings other than crimped or swaged have NO assembly labeling requirements.

12. COMPLIANCE TEST EXECUTION....Continued

12.D.2. – CONSTRICTION TEST – (See Data Sheet P-2)

All test specimens shall be subjected to this test. This is basically a "go" or "no go" test in which a plug gage, an extended plug gage, or a drop ball is inserted in the upper end of an air brake tubing assembly, which is held vertically, and allowed to drop by gravity through the tubing. The air brake tubing is acceptable if the gage passes through the tubing and can be seen at the lower fitting. Failure to appear at the lower fitting shall be considered a test failure.

The constriction gage shall have a minimum diameter as follows (same diameter ball or rod is permissible):

- 0.079" for 1/8" I.D. hose (2.048 mm for 3.2 mm I.D.)

- 0.119" for 3/16" I.D. hose (3.072 mm for 4.8 mm I.D.)

- 0.159" for 1/4" I.D. hose (4.032 mm for 6.3 mm I.D.)

The gage plug maximum diameter used by the test laboratory shall be shown under "REMARKS" on the Data Sheet.

If a constriction does exist, establish the approximate location of the constriction. Insert drill rods into the end coupling to determine the maximum size that can be inserted without force. Note size and location on the Data Sheet. Drill rod sizes can be found in the Machinist's Handbook.

The brake tubing constriction test requirements shall be met using at least one of the methods specified below.

Plug gauge

(A) Utilize a plug gauge as shown in Figure 5. Diameter ‘A’ is equal to tested.

(B) Brake tubing assemblies that are to be used for additional testing have constriction testing only at each end fitting. Other brake tubing assemblies may be cut into three inch lengths to permit constriction testing of the entire assembly. Air brake tubing assemblies with end fittings that do not permit entry of the gauge (e.g., restrictive orifice or banjo fitting) are cut three inches from the

12. COMPLIANCE TEST EXECUTION....Continued

point at which the tubing terminates in the end fitting and then tested from the cut end.

(C) Hold the brake tubing in a vertical orientation.

(D) Place the spherical end of the plug gauge just inside the tubing or end fitting. If the spherical end will not enter the air brake tubing or end fitting using no more force than gravity acting on the plug gauge, this constitutes failure of the constriction test.

(E) Release the plug gauge. Within three seconds, the plug gauge shall fall under the force of gravity alone up to the handle of the gauge. If the plug gauge does not fully enter the air brake tubing up to the handle of the gauge within three seconds, this constitutes failure of the constriction test.

EXTENDED PLUG GAUGE

(A) The constriction test may be conducted with an extended plug gauge to enable testing of the entire brake air brake tubing from one end fitting, without cutting the brake tubing. The extended plug gauge weight and spherical diameter specifications are as shown in Figure 5, but the handle portion of the gauge may be deleted and the gauge length may be greater than 3 inches.

(B) The required performance of the extended plug gauge in paragraph S6.12.1(e) is that after the plug gauge is released, the extended plug gauge shall fall under the force of gravity alone at an average rate of 1 inch per

12. COMPLIANCE TEST EXECUTION....Continued

second until the spherical diameter of the extended gauge passes through all portions of the brake tubing assembly containing plastic tubing. If the extended plug gauge does not pass through all portions of the brake tubing assembly containing plastic tubing at an average rate of 1 inch per second, this constitutes failure of the constriction test.

DROP BALL TEST

(A) Utilize a rigid spherical ball with a diameter equal to 66 percent of the nominal inside diameter of the hydraulic brake tubing being tested. The weight of the spherical ball shall not exceed 2 ounces (57 grams).

(B) Hold the brake tubing in a vertical orientation.

(C) Hold the ball just above the end fitting.

(D) Release the ball. The ball shall fall under the force of gravity alone completely through all portions of the brake tubing assembly containing plastic tubing, at an average rate of 1 inch per second. Failure of the ball to pass completely through all portions of the brake tubing assembly containing tubing, at an average rate of 1 inch per second, constitutes failure of the constriction test.

12.D.3. - HIGH TEMPERATURE CONDITIONING AND DIMENSIONAL STABILITY TEST - (See Data Sheet P- 3)

(A) Condition the tubing at 230º F (-2º F, +0º F) for 4 hours in an air oven.

(B) Remove the tubing from the oven and allow to cool at room temperature for 30 minutes.

(C) Measure the tubing dimensions including wall thickness, inside diameter and outside diameter, using appropriate metrology apparatus such as micrometers, dial indicators and gauges, or optical comparators. To account for slight out-of-round conditions, diameter measurements may be calculated using the average of the major and minor diameters.

12.D.4. – BOILING WATER CONDITIONING AND DIMENSIONAL STABILITY TEST - (See Data Sheet P- 4)

(A) Utilize a container constructed of a non-reactive material, large enough so that the tubing to be tested does not touch any surface of the container. Fill container with distilled water.

(B) Slip the tubing over a stainless steel wire for positioning it in the container.

12. COMPLIANCE TEST EXECUTION....Continued

(D) Bring the water to a boil. Place the tubing in the water and position it so that it does not touch the container. Boil the tubing for two hours. Replenish the water as necessary, adding it slowly so that the water in the container boils continuously.

(D) Remove the tubing from the water and allow to cool at room temperature for 30 minutes. Wipe off any water that remains on the tubing.

(E) Measure the tubing dimensions including wall thickness, inside diameter, and outside diameter, using appropriate metrology apparatus such as micrometers, dial indicators and gauges, or optical comparators. To account for slight out-of-round conditions, diameter measurements may be calculated using the average of the major and minor diameters.

12.D.5. – BURST STRENGTH TEST - (See Data Sheet P- 5)

(A) Utilize an air brake tubing assembly or prepare a 12 inch length of tubing and install end fittings according to the end fitting manufacturer's instructions.

(B) Plug one end of the assembly, fill it with water, and connect the other end to a source of water pressure. Bleed any air from the assembly and water pressure system.

(C) Increase the water pressure inside the tubing assembly at a rate of 3,000 psi per minute to the burst strength pressure for the size of tubing being tested as specified in Table III.

12.D.6. – MOISTURE ABSORPTION AND BURST STRENGTH TEST - (See Data Sheet P-6)

(A) Prepare a sample of tubing twelve inches in length.

(B) Condition the tubing at 230º F (-2º F, +0º F) for 24 hours in an air oven. Remove the tubing from the oven and within 30 seconds, weigh it to establish the initial weight. The weight shall be measured with a resolution of 0.01 gram; if the scale has a higher resolution, then values of 0.005 gram and above shall be rounded to the nearest 0.01 gram and values below 0.005 gram shall be truncated.

(C) Place the tubing in an environmental chamber and condition it for 100 hours at 100% relative humidity and a temperature of 75^0 F (-2º F, +0º F).

(D) Remove the tubing from the chamber and within a period of 5 minutes, remove all surface moisture from the tubing using cloth and weigh the

12. COMPLIANCE TEST EXECUTION....Continued

tubing to establish the conditioned weight. Weight shall be measured to the nearest 0.01 gram as in (b) above.

(E) Calculate percentage of moisture absorption as follows:
[Conditioned Weight - Initial Weight]. [Initial Weight] x 100

(F) Install end fittings according to the end fitting manufacturers instructions.

(G) Conduct the burst strength test in 12.5 except use 80 percent of the burst strength pressure for the size of tubing being tested as specified in Table III.

12.D.7. – UV LIGHT RESISTANCE TEST - (See Data Sheet P- 7)

(A) Apparatus. An accelerated weathering test machine for ultraviolet light conditioning of plastic air brake tubing. The machine shall be equipped with fluorescent UVA-340 light bulbs and automatic irradiance control. Also utilize an impact test apparatus as shown in Figure 9.

(B) Test Standards. The testing is in accordance with American Society for Testing and Materials (ASTM) G154-00 Standard Practice for Operating Light Apparatus for UV Exposure of Nonmetallic Materials; ASTM G151-00 Standard Practice for Exposing Nonmetallic Materials in Accelerated Test Devices that Use Laboratory Light Sources, and; ASTM D4329-99 Standard Practice for Fluorescent UV Exposure of Plastics.

(C) Preparation.

(i) Utilize a 12-inch length of plastic air brake tubing. Mask 1 inch of each end of the tubing where end fittings will be attached using opaque tape.

(ii) Attach the tubing to the test racks of the machine, securing it at the ends along the masked sections. Wipe the outside surface of the tubing with acetone to remove any surface contaminants. Place the tubing and racks in the accelerated weathering test machine so that the center of the tubing assembly is approximately in the center of the UV light exposure area of the test machine. (If multiple plastic brake tubing assemblies are tested, then their position in the machine should be rotated according to ASTM D4329-99 S7.4.1, except the rotation shall be each 96 hours instead of weekly.) The distance from the light bulb to the tubing shall be approximately 2 inches. Set the UV irradiance to 0.85 watts per square meter @ 340 nanometers and maintain this level during the testing. Maintain a temperature in the test chamber of 113º F (-2º F, +0º F), and use

12. COMPLIANCE TEST EXECUTION....Continued

only atmospheric humidity. Expose the tubing at this UV irradiance level for 300 hours continuously. Remove the tubing from the test chamber.

(iii) Place the tubing inside the impact test apparatus, and drop the impacter onto the tubing from a height of 12 inches.

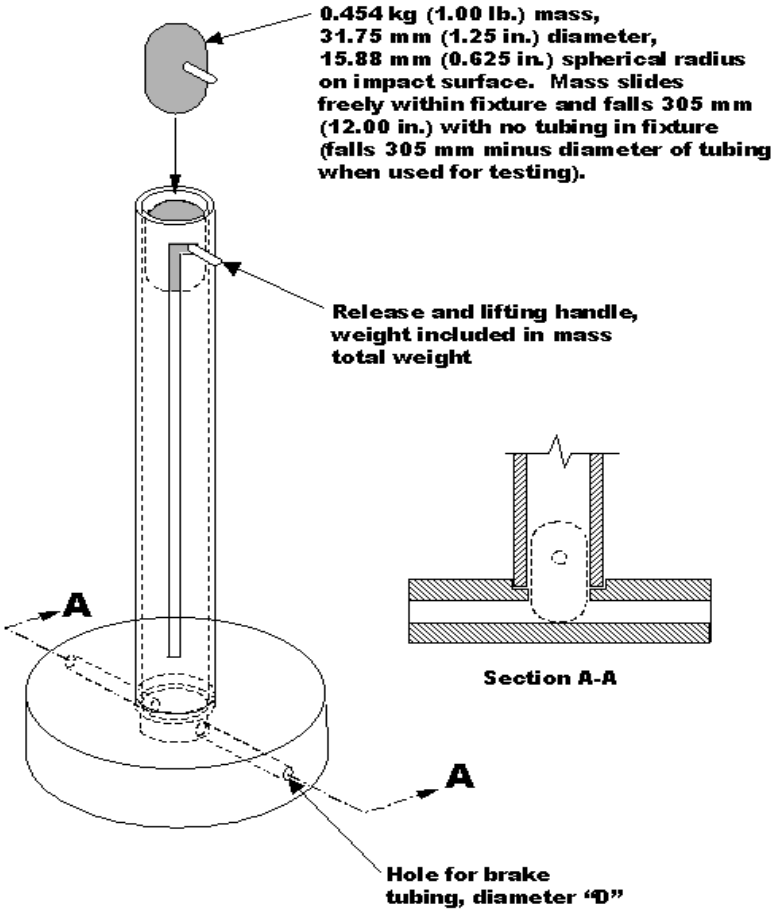
(iv) Remove the masking material from the ends of the tubing. Install end fittings according to the end fitting manufacturer's instructions. Conduct the burst strength test in S12.5 except use 80 percent of the burst strength pressure for the size of tubing being tested as specified in the table below.

TABLE ACCOMPANYING FIGURE 9

Nominal Tubing Outside Diameter	Hole Diameter "D"	
	mm	Inches
1/8 inch	3.96	0.156
5/32 inch	4.75	0.187
3/16 inch	5.54	0.218
1/4 inch	7.14	0.281
5/16 inch	8.71	0.343
3/8 inch	10.31	0.406
1/2 inch	13.49	0.531
5/8 inch	16.66	0.656
3/4 inch	20.32	0.800
6 mm	6.80	0.268
8 mm	8.80	0.346
10 mm	10.80	0.425
12 mm	12.80	0.504
16 mm	16.80	0.661

12. COMPLIANCE TEST EXECUTION....Continued

Figure 9. Impact Test Apparatus



12. COMPLIANCE TEST EXECUTION....Continued

12.D.8. – LOW TEMPERATURE FLEXIBILITY TEST - (See Data Sheet P- 8)

(A) Utilize a cylinder having a radius of six times the nominal outside diameter of the tubing.

(B) Condition the tubing in an air oven at 230º F (-2º F, +0º F) for 24 hours. Remove from the oven and cool at room temperature for 30 minutes.

(C) Condition the cylinder and the tubing in an environmental chamber at minus 40º F (-0º F, +2º F) for four hours.

(D) With the tubing and test cylinder at minus 40º F (-0º F, +2º F), bend the tubing 180 degrees around the cylinder at a steady rate in a period of 4 to 8 seconds.

12.D.9. – HIGH TEMPERATURE FLEXIBILITY TEST - (See Data Sheet P- 9)

(A) Utilize a cylinder having a radius equal to the supported bend radius in Table III for the size of tubing being tested.

(B) Bend the tubing 180 degrees around the cylinder and hold in place with a clamp or other suitable support, applying only enough force on the tubing to hold it in position.

(C) Condition the tubing and cylinder in an air oven at 230º F (-2º F, +0º F) for 72 hours. Remove the tubing and cylinder from the oven and cool at room temperature for two hours.

(D) Remove the clamps or supports from the tubing and straighten the tubing at a steady rate in a period of 4 to 8 seconds.

(E) Rebend the tubing 180 degrees around the cylinder, at the same point but in the opposite direction of the bending in (b) above, at a steady rate in a period of 4 to 8 seconds.

(F) Conduct the burst strength test in S12.5 except use 80 percent of the burst strength pressure for the size of tubing being tested as specified in Table III.

12.D.10. – HIGH TEMPERATURE RESISTANCE TEST - (See Data Sheet P- 10)

Condition the tubing in an air oven at 230º F (-2º F, +0º F) for 72 hours. Remove the tubing and allow to cool at room temperature for 30 minutes. Conduct the burst strength test in S12.5 except use 80 percent of the

12. COMPLIANCE TEST EXECUTION....Continued

burst strength pressure for the size of tubing being tested as specified in Table III.

12.D.11. – HIGH TEMPERATURE CONDITIONING, LOW TEMPERATURE IMPACT RESISTANCE TEST - (See Data Sheet P- 11)

(A) Utilize an impact test apparatus as shown in Figure 9.

(B) Condition the tubing in an air oven at 230º F (-2º F, +0º F) for 72 hours. Remove the tubing and allow to cool at room temperature for 30 minutes.

(C) Condition the tubing and the impact test apparatus in an environmental chamber at minus 40º F (-0º F, +2º F)) for 4 hours.

(D) With the tubing and impact test apparatus at minus 40º F (-0º F, +2º F), place the tubing inside the apparatus and drop the impacter onto the tubing from a height of 12 inches. Remove the tubing from the chamber and allow to warm at room temperature for one hour.

(E) Conduct the burst strength test in S12.5 except use 80 percent of the burst strength pressure for the size of tubing being tested as specified in Table III

12.D.12. – BOILING WATER CONDITIONING, LOW TEMPERATURE IMPACT RESISTANCE TEST - (See Data Sheet P- 12)

(A) Utilize an impact test apparatus as shown in Figure 9.

(B) Condition the tubing in boiling water using the test in S12.4 (a) through (d), except that the length of tubing shall be 12 inches.

(C) Condition the tubing and the impact test apparatus in an environmental chamber at minus 40º F (-0º F, +2º F) for 4 hours.

(D) With the tubing and impact test apparatus at minus 40º F (-0º F, +2º F), place the tubing inside the apparatus and drop the impacter onto the tubing from a height of 12 inches. Remove the tubing from the chamber and allow to warm at room temperature for one hour.

(E) Conduct the burst strength test in S12.5 except use 80 percent of the burst strength pressure for the size of tubing being tested as specified in Table III.

12. COMPLIANCE TEST EXECUTION....Continued

12.D.13. – ZINC CHLORIDE RESISTANCE TEST - (See Data Sheet P- 13)

(A) Utilize a cylinder having a radius equal to the supported bend radius in Table III for the size of tubing being tested. The cylinder is constructed of a non-reactive material or coated to prevent chemical reaction with zinc chloride. The length of the tubing sample is long enough so that its ends will not be submerged during the immersion in zinc chloride, or the ends of the tubing are plugged to keep the zinc chloride from entering the tubing.

(B) Bend the tubing 180 degrees around the cylinder and hold in place with a clamp or other suitable support constructed of non-reactive materials, applying only enough force on the tubing to hold it in position.

(C) Immerse the tubing and cylinder in a 50 percent zinc chloride aqueous solution at room temperature for 200 hours.

(D) Remove the tubing and cylinder from the solution. While still on the test cylinder, inspect the tubing under 7-power magnification for cracks.

12.D.14. – METHYL ALCOHOL RESISTANCE TEST - (See Data Sheet P- 14)

(A) Utilize a cylinder having a radius equal to the supported bend radius in the table below for the size of tubing being tested. The cylinder is constructed of a non-reactive material or coated to prevent chemical reaction with methyl alcohol.

(B) Bend the tubing 180 degrees around the cylinder and hold in place with a clamp or other suitable support constructed of non-reactive materials, applying only enough force on the tubing to hold it in position. The ends of the tubing may be shortened so that they will be fully submerged in the methyl alcohol.

(C) Immerse the tubing and cylinder in a 95 percent methyl alcohol aqueous solution at room temperature for 200 hours.

(D) Remove the tubing and cylinder from the solution. While still on the test cylinder, inspect the tubing under 7-power magnification for cracks.

12. COMPLIANCE TEST EXECUTION....Continued

TABLE III - PLASTIC AIR BRAKE TUBING MECHANICAL PROPERTIES

Nominal Tubing OD	Burst Strength Pressure		Supported Bend Radius[1]		Unsupported Bend Radius[2]		Conditioned Tensile Load	
	kPa	Psi	mm	inches	mm	inches	N	lbf
1/8 inch	6900	1000	9.4	0.37	9.4	0.37	156	35
5/32 inch	8300	1200	12.7	0.50	12.7	0.50	178	40
3/16 inch	8300	1200	19.1	0.75	19.1	0.75	222	50
1/4 inch	8300	1200	25.4	1.00	25.4	1.00	222	50
5/16 inch	6900	1000	31.8	1.25	38.1	1.50	334	75
3/8 inch	9700	1400	38.1	1.50	38.1	1.50	667	150
1/2 inch	6600	950	50.8	2.00	63.5	2.50	890	200
5/8 inch	6200	900	63.5	2.50	76.2	3.00	1446	325
3/4 inch	5500	800	76.2	3.00	88.9	3.50	1557	350
6 mm	7600	1100	20.0	0.75	25.4	1.00	222	50
8 mm	6200	900	31.8	1.25	38.1	1.50	334	75
10 mm	8200	1200	38.1	1.50	38.1	1.50	667	150
12 mm	6900	1000	44.5	1.75	63.5	2.50	890	200
16 mm	6000	875	69.9	2.75	76.2	3.00	1446	325

Notes: (1) Supported bend radius for tests specifying cylinders around which the tubing is bent.
(2)Unsupported bend radius for the collapse resistance test in which the tubing is not supported by a cylinder during bending.

12.D.15. – HIGH TEMPERATURE CONDITIONING AND COLLAPSE RESISTANCE TEST - (See Data Sheet P- 15)

(A) APPARATUS

A holding device consisting of two vertical pins affixed to a flat, horizontal plate. Each pin projects 1 inch above the top surface of the plate. The diameter of each pin is approximately equal to the inside diameter of the tubing being tested. Using the unsupported bend radius for the size of tubing being tested from Table III, the distance between the pin centerlines is equal to:
[2 x unsupported bend radius] + [nominal OD of tubing]

(B) PREPARATION

(i) Use the unsupported bend radius for the size of tubing being tested from Table III and cut the tubing to the following length:

12. COMPLIANCE TEST EXECUTION....Continued

[3.14 x [unsupported bend radius]] + [10 x [nominal tubing OD]] + 2 inches
or [3.14 x [unsupported bend radius]] + [10 x [nominal tubing OD]] + 50 mm

(ii) Place a reference mark at the center of the sample. At this mark, measure the initial outside diameter of the tubing. If the tubing is slightly out-of-round, use the elliptical minor diameter as the initial outside diameter.

(iii) Install the tubing completely over the pins of the holding device so that the tubing is bent 180 degrees. If the tubing has a natural curvature, the tubing shall be bent in the direction of the natural curvature.

(iv) Condition the holding device and tubing in an air oven at 230º F (-2º F, +0º F) for 24 hours. Remove the holding device and tubing and allow to cool at room temperature for thirty minutes.

(v) With the tubing still mounted to the holding device, measure the elliptical minor diameter of the tubing at the reference mark to determine the final outside diameter.

(C) CALCULATION

Calculate the percentage collapse of the outside diameter of the tubing as follows:

[[Initial Outside Diameter - Final Outside Diameter] / [Initial Outside Diameter]] x 100

12.D.16. - OZONE RESISTANCE TEST - (See Data Sheet P- 16)

PREPARATION -

Remove all armor, date bands, etc., and utilizing a cylinder with a diameter eight times the nominal outside diameter of the brake tubing, bind the brake tubing 360º around the cylinder. In the case of tubing shorter than the circumference of the cylinder, bend the tubing so that as much of its length as possible is in contact.

EXPOSURE TO OZONE -

(A) Condition the tubing on the cylinder in air at room temperature for 24 hours minimum.

12. COMPLIANCE TEST EXECUTION....Continued

(B) Immediately thereafter, condition the tubing on the cylinder for 70 hours in an exposure chamber having an ambient air temperature of 104ºF (-2º F, +0º F) during the test and containing air mixed with ozone in the proportion of 100 parts of ozone per 100 million parts of air by volume.

(C) Examine the tubing for cracks under 7-power magnification, ignoring areas immediately adjacent to or within the area covered by binding. An external fabric braid may have to be removed to expose the outer rubber cover for inspection.

(D) Chamber Temperature and Concentrations vs. Time must be permanently recorded.

12.D.17. – OIL RESISTANCE TEST - (See Data Sheet P- 17)

(A) Utilize a plastic air brake tubing assembly or prepare a 12 inch length of tubing and install end fittings according to the end fitting manufacturer's instructions.

(B) Immerse the tubing assembly in ASTM 903 oil at 200º F (-2º F, +0º F) for 70 hours. Remove and allow to cool at room temperature for 30 minutes. Wipe any excess oil from the tubing assembly.

(C) Conduct the burst strength test in S12.5 except use 80 percent of the burst strength pressure for the size of tubing being tested as specified in Table III and, at the manufacturer's option, oil may be used as the test medium instead of water.

12.D.18. - TENSILE STRENGTH TEST - (See Data Sheet P- 18)

Air brake tubing numbered 9 thru 12 shall be subjected to this test and Air brake tubing #18 shall also be subjected after completion of the Water Absorption Test (H-10).

The tension test consists of subjecting the tubing assembly to increasing tensile load in a suitable testing machine until failure occurs, either by -

(A) Separation of the specimen from the end fittings, OR

(B) Failure of the air brake tubing structure

A tensile testing machine, which conforms to the requirements of ASTM Methods, E4-03, "Standard Practice for Force Verification of Testing Machines," and provided with a recording device to measure the force applied throughout the

12. COMPLIANCE TEST EXECUTION....Continued

slow and fast pull tests. A machine of 1,000 lbs. capacity is sufficient. After removal of any air brake tubing armor or date bands, etc., the air brake tubing assembly fittings shall be attached to the machine by suitable fixtures so that the tubing and fittings shall have a straight center line parallel to the direction of the machine pull.

(A) Conduct the slow pull test by applying tension at a rate of 1" per minute. The assemblies shall withstand a minimum pull of 325 lbs.

(B) Conduct the fast pull test by applying tension at a rate of 2" per minute. The assemblies shall withstand a minimum pull of 370 lbs.

Load vs. displacement will be permanently recorded.

12.D.19. – BOILING WATER CONDITIONING AND TENSILE STRENGTH TEST - (See Data Sheet P- 19)

(A) Apparatus

Use a tension testing machine as specified in S8.9. The lower attachment point of the machine is equipped with a heated, open-top container that is water tight. The inside of the container (lower attachment point) and upper attachment point of the machine have provisions to quickly attach a brake hose assembly for tensile testing.

(B) Preparation.

Prepare an air brake tubing assembly with a free length of 6 inches (six inches of exposed tubing between the end fittings), with the end fittings installed in accordance with the end fitting manufacturer's instructions. If necessary install adapters on the end fittings to permit quick attachment to the machine, to keep water from entering the tubing assembly, and to ensure that the tubing assembly is in a straight position when installed on the machine. Fill the container with distilled water such that the lower 4 inches of exposed tubing will be submerged when the brake tubing assembly is installed on the machine. Heat the water until it boils. Then quickly install the plastic air brake tubing assembly on the machine with the lower end of the tubing assembly in the boiling water. After the water has boiled continuously for 5 minutes, apply tension to the tubing assembly at a rate of 1 inch per minute travel of the moving head until either the conditioned tensile load in Table III for the size of tubing being tested is reached or the free length of the tubing assembly reaches 9 inches, whichever occurs first.

12. COMPLIANCE TEST EXECUTION....Continued

12.D.20. – THERMAL CONDITIONING AND TENSILE STRENGTH TEST - (See Data Sheet P- 20)

(A) Apparatus

Use a tension testing machine as specified in S8.9.

(B) Preparation.

Prepare an air brake tubing assembly with a free length of 6 inches (six inches of exposed tubing between the end fittings), with the end fittings installed in accordance with the end fitting manufacturer's instructions. If necessary install adapters on the end fittings to permit attachment to the machine, to keep water from entering the tubing assembly, and/or to ensure that the tubing assembly is in a straight position when installed on the machine. Subject the tubing assembly to four complete cycles of the following sequence:

(i) Condition the tubing assembly in an environmental chamber at minus 40º F (-0º F, +2º F) for 30 minutes. Remove from the chamber and allow to warm at room temperature for 30 minutes.

(ii) Condition the tubing assembly by submerging it in boiling water for 15 minutes. Remove and allow to cool at room temperature for 30 minutes.

Install the tubing assembly on the tension testing machine and apply tension to the tubing assembly at a rate of 1 inch per minute travel of the moving head until either the conditioned tensile load in Table III for the size of tubing being tested is reached or the free length of the tubing assembly reaches 9 inches, whichever occurs first.

12.D.21. – VIBRATION RESISTANCE TEST - (See Data Sheet P- 21)

(A) Apparatus

A vibration testing machine that supports a brake tubing assembly by its end fittings in approximately a straight line and includes the following features:

(i) One tubing assembly attachment point is fixed and the other moves in a plane perpendicular to a line projected between

12. COMPLIANCE TEST EXECUTION....Continued

the attachment points. The movable attachment point moves in a linear direction and travels 1/2 inch total and at its midpoint of travel falls on a line projected between the attachment points. The movable attachment point has a cycle rate of 600 cycles per minute.

(ii) The distance between the attachment points is adjustable to compensate for varying lengths of brake tubing assemblies.

(iii) The actuating mechanism for the movable attachment point is balanced to prevent introduction of machine vibration into the brake tubing assembly.

(iv) The machine has a compressed air supply system that pressurizes the air brake tubing assembly through one fitting while the other fitting is plugged. The machine's compressed air supply system includes a pressure gauge or monitoring system and an air flow meter.

(v) The machine is constructed so that an air brake tubing assembly mounted on it can be conditioned in an environmental test chamber.

(B) Preparation

(i) Prepare an air brake tubing assembly with a free length of 18 inches (18 inches of exposed tubing between the end fittings), with the end fittings installed in accordance with the end fitting manufacturer's instructions. Record the initial tightening torque for an end fitting that uses a threaded retaining nut.

(ii) Install the air brake tubing assembly on the vibration testing machine and, with the movable attachment point at the midpoint of its travel, adjust the distance between the attachment points so that they are 1/2 inch closer together than the distance at which the tubing assembly is taut.

(iii) With the tubing assembly inside the environmental chamber, apply compressed air to the tubing assembly at a regulated pressure of 120 psi and maintain the supply of air to the tubing assembly for the duration of the test. Set the temperature of the environmental chamber to 220º F (-2º F, +0º F) and initiate cycling of the movable attachment point. After 250,000 cycles, set the temperature of the environmental chamber to minus 40º F (-0º F, +2º F). After 500,000 cycles, set the temperature of the environmental

12. COMPLIANCE TEST EXECUTION....Continued

chamber to 220º F (-2º F, +0º F)). After 750,000 cycles, set the temperature of the environmental chamber to minus 40 ^{0}F (-0º F, +2º F). Measure the air flow rate just prior to 1,000,000 cycles and if the compressed air flow rate supplied to the air brake tubing assembly exceeds 50 cm^3 per minute this constitutes failure of the test. Stop the cycling at 1,000,000 cycles and set the environmental chamber temperature to 75º F (-2º F, +0º F), while air pressure is still supplied to the air brake tubing assembly. After 1 hour, measure the compressed air flow rate supplied to the air brake tubing assembly and if the rate exceeds 25 cm^3 per minute this constitutes failure of the test.

(iv) For end fittings that use a threaded retaining nut, apply 20 percent of the original tightening torque as recorded in S12.21(b)(i). If the retention nut visibly moves, this constitutes a failure of the test.

12.D.22. – END FITTING RETENTION TEST - (See Data Sheet P- 22)

(A) Utilize an air brake tubing assembly or prepare a 12 inch length of tubing and install end fittings according to the end fitting manufacturer's instructions.

(B) Plug one end of the assembly, fill it with water, and connect the other end to a source of water pressure. Bleed any air from the assembly and water pressure system.

(C) Increase the pressure inside the tubing assembly at a rate of 3,000 psi per minute to 50 percent of the burst strength pressure for the size of tubing being tested as specified in Table III. Hold the pressure constant for 30 seconds.

(D) Increase the pressure inside the tubing assembly at a rate of 3,000 psi per minute to the burst strength pressure for the size of tubing being tested as specified in Table III.

12.D.23. – THERMAL CONDITIONING AND END FITTING RETENTION TEST - (See Data Sheet P- 23)

(A) Apparatus

A source of hydraulic pressure that includes a pressure gauge or monitoring system, uses ASTM IRM 903 oil, and is constructed so that an air brake tubing assembly mounted to it can be conditioned in an environmental test chamber.

12. COMPLIANCE TEST EXECUTION....Continued

(B) Preparation

Utilize an air brake tubing assembly or prepare a 12 inch length of tubing and install end fittings according to the end fitting manufacturer's instructions. Attach one end of the assembly to the hydraulic pressure supply and plug the other end of the assembly, fill the assembly with ASTM IRM 903 oil and bleed any air from the assembly, and place the tubing assembly inside an environmental chamber. Conduct the following tests:

(i) With atmospheric pressure applied to the oil inside the tubing assembly, set the environmental chamber temperature to 200º F (-2º F, +0º F) and condition the tubing assembly for 24 hours.

(ii) With the temperature maintained at 200º F (-2º F, +0º F), increase the oil pressure inside the tubing assembly at a rate of 3,000 psi per minute to 450 psi, and hold this pressure for 5 minutes.

(iii) Decrease the oil pressure inside the tubing assembly at a rate of 3,000 psi per minute to atmospheric pressure and set the temperature of the environmental chamber to 75º F (-2º F, +0º F). Condition the tubing assembly at this temperature for 1 hour.

(iv) Set the temperature of the environmental chamber to minus 40º F (-0º F, +2º F) and condition the tubing assembly for 24 hours.

(v) With the temperature maintained at minus 40º F (-0º F, +2º F), increase the hydraulic pressure inside the tubing assembly at a rate of 3,000 psi per minute to 450 psi, and hold this pressure for 5 minutes.

12.D.24. –END FITTING RETENTION SERVICEABILITY TEST - (See Data Sheet P-24)

(A) Apparatus

A source of air pressure that includes a pressure gauge or monitoring system and is equipped with a mass air flow meter.

(B) Preparation.

12. COMPLIANCE TEST EXECUTION....Continued

Prepare a 12-inch length of tubing and plug one end. Assemble the end fitting with the threaded retention nut on the other end of the tubing according to the end fitting manufacturer's instructions, then disassemble the fitting. Repeat the assembly and disassembly sequence three more times, and then reassemble the end fitting (five total assembly steps).

(C) Attach the end fitting with the threaded retention nut to the source of air pressure. Pressurize the tubing at a rate of 3,000 psi per minute to a pressure of 120 psi. If the end fitting leaks, measure and record the leakage rate using the mass air flow meter.

12.D.25. – END FITTING CORROSION TEST - (See Data Sheet P- 25)

Air brake tubing #14 shall be subjected to this test. Utilize the apparatus described in ASTM B117-03, "Standard Practice for Operating Salt Spray (Fog) Apparatus."

CONSTRUCTION -

Construct the salt spray chamber so that:

(A) The construction material does not affect the corrosiveness of the fog.

(B) The air brake tubing assembly is supported or suspended 30º from the vertical and parallel to the principal direction of the horizontal flow of fog through the chamber.

(C) The air brake tubing assembly does not contact any metallic material or any material capable of acting as a wick.

(D) Condensation which falls from the assembly does not return to the solution reservoir for respraying.

(E) Condensation from any source does not fall on the brake tubing assemblies or the solution collectors.

(F) Spray from the nozzles is NOT directed directly onto the tubing assembly.

PREPARATION -

(A) Plug each end of the air brake tubing assembly.

(B) Mix a salt solution five parts by weight of sodium chloride to 95 parts of distilled water, using sodium chloride substantially free of nickel and copper, and containing on a dry basis not more than 0.1 percent of sodium iodide and not more than 0.3 percent total impurities.

12. COMPLIANCE TEST EXECUTION....Continued

Insure that the solution is free of suspended solids before the solution is atomized.

(C) After atomization at 95º F (-2º F, +0º F) ensure that the collected solution is in the PH range of 6.5 to 7.2. Make the PH measurements at 77º F.

(D) Maintain a compressed air supply to the nozzle or nozzles free of oil and dirt and between 10 and 25 psi.

OPERATION –

Subject the brake tubing assembly to the salt spray continuously for 24 hours.

(A) Regulate the mixture so that each collector will collect from 1 to 2 ml. of solution per hour for each 80 square centimeters of horizontal collecting area.

(B) Maintain exposure zone temperature at 95º F (-2º F, +0º F).

(C) Upon completion, remove the salt deposit from the surface of the air brake tubing by washing gently or dipping in clean running water not warmer than 100º F (-2º F, +0º F) and then drying immediately.

(D) Chamber Temperature and Concentrations vs. Time must be permanently recorded.

INSPECTION –

A brake tubing end fitting shall show no base metal corrosion on the end fitting surface except where crimping or the application of labeling information has caused displacement of the protective coating. Salt spray corrosion shall be noted as presence of red rust in the case of coated ferrous couplings or pitting in the case of brass couplings.

13. POST TEST REQUIREMENTS

The contractor shall re-verify all instrumentation and check data sheets and photographs. Make sure that data is recorded in all applicable data blocks on every Data Sheet.

14. REPORTS

14.1 MONTHLY STATUS REPORTS

The contractor shall submit a monthly Test Status Report and an Equipment Status Report to the COTR. The Equipment Status Report shall be submitted until all final

14. REPORTS....Continued

reports are accepted. Samples of the required Monthly Status Reports are contained in the report forms section.

14.2 APPARENT TEST FAILURE

Any indication of a test failure shall be communicated by telephone to the COTR within 1 working day with written notification mailed within 2 working days. A Notice of Test Failure (see report forms section) with a copy of the particular compliance test data sheet(s) shall be included.

In the event of a test failure, a post test calibration check of some critically sensitive test equipment and instrumentation may be required for verification of accuracy. The necessity for the calibration shall be at the COTR's discretion and shall be performed without additional costs to the OVSC.

14.3 FINAL TEST REPORTS

14.3.1 COPIES

In the case of a test failure, **SEVEN** copies of the Final Test Report shall be submitted to the COTR for acceptance within three weeks of test completion. The Final Test Report format to be used by all contractors can be found in the attachment.

Where there has been no indication of a test failure, **FOUR** copies of each Final Test Report shall be submitted to the COTR within three weeks of test completion. Payment of contractor's invoices for completed compliance tests may be withheld until the Final Test Report is accepted by the COTR. Contractors are requested to NOT submit invoices before the COTR is provided copies of the Final Test Report.

Contractors are required to submit the first Final Test Report in typed draft form within two weeks after the compliance test is conducted. The contractor and the COTR will then be able to discuss the details of both test conduct and report content early in the compliance test program.

Contractors are required to PROOF READ all Final Test Reports before submittal to the COTR. The OVSC will not act as a report quality control office for contractors. Reports containing a significant number of errors will be returned to the contractor for correction, and a "hold" will be placed on invoice payment for the particular test.

14.3.2 REQUIREMENTS

The Final Test Report, associated documentation (including photographs) are relied upon as the chronicle of the compliance test. The Final Test Report will be released to the public domain after review and acceptance by the COTR. For these reasons, each final report must be a complete document capable of standing by itself.

14. REPORTS....Continued

The contractor should use **detailed** descriptions of all compliance test events. Any events that are not directly associated with the standard but are of technical interest should also be included. The contractor should include as much **detail** as possible in the report.

Instructions for the preparation of the first three pages of the final test report are provided below for the purpose of standardization.

14.3.3 FIRST THREE PAGES

A. FRONT COVER

A heavy paperback cover (or transparency) shall be provided for the protection of the final report. The information required on the cover is as follows:

(1) Final Report Number such as 106-ABC-XX-001

where —
106 is the FMVSS tested
ABC are the initials for the laboratory
XX is the Fiscal Year of the test program
001 is the Group Number (001 for the 1st brand, 002 for the 2nd brand, etc.)

(2) Final Report Title And Subtitle such as

SAFETY COMPLIANCE TESTING FOR FMVSS 106
Brake Hoses
* * * * * * * * * * * * * * * *
ACE Manufacturing
Sure-Safe Type 21 Air Brake Hose

(3) Contractor's Name and Address such as

COMPLIANCE TESTING LABORATORIES, INC.
4335 West Dearborn Street
Detroit, Michigan 48090-1234

14. REPORTS....Continued

NOTE: DOT SYMBOL WILL BE PLACED BETWEEN ITEMS (3) AND (4)

(4) Date of Final Report completion

(5) The words "FINAL REPORT"

(6) The sponsoring agency's name and address as follows

U. S. DEPARTMENT OF TRANSPORTATION
National Highway Traffic Safety Administration
Enforcement
Office of Vehicle Safety Compliance
Mail Code: NVS-220
1200 New Jersey Ave., SE
Washington, DC 20590

14. REPORTS....Continued

B. FIRST PAGE AFTER FRONT COVER

When a contract test laboratory is reporting, a disclaimer statement and an acceptance signature block for the COTR shall be provided as follows:

> This publication is distributed by the National Highway Traffic Safety Administration in the interest of information exchange. Opinions, findings and conclusions expressed in this publication are those of the author(s) and not necessarily those of the Department of Transportation or the National Highway Traffic Safety Administration. The United States Government assumes no liability for its contents or use thereof.
>
> If trade or manufacturers' names or products are mentioned, it is only because they are considered essential to the object of the publication and should not be construed as an endorsement.

Prepared By: _____

Approved By: _____*

Approval Date: _____*

FINAL REPORT ACCEPTANCE BY OVSC:*

Accepted By: _____

Acceptance Date: _____

* These lines not required when OVSC staff writes the Test Report

14. REPORTS....Continued

C. SECOND PAGE AFTER FRONT COVER

A completed Technical Report Documentation Page (Form DOT F1700.7) shall be completed for those items that are applicable with the other spaces left blank. Sample data for the applicable block numbers of the title page follows.

Block 1 — REPORT NUMBER

106-ABC-XX-001

Block 2 — GOVERNMENT ACCESSION NUMBER

Leave blank

Block 3 — RECIPIENT'S CATALOG NUMBER

Leave blank

Block 4 — TITLE AND SUBTITLE

Final Report of FMVSS 106 Compliance Testing of Sure-Safe Type 21 Air Brake Hose, Part No. 8456782

Block 5 — REPORT DATE

Month Day, 20XX

Block 6 — PERFORMING ORGANIZATION CODE

ABC

Block 7 — AUTHOR(S)

John Smith, Project Manager
Bill Doe, Project Engineer

Block 8 — PERFORMING ORGANIZATION REPORT NUMBER

ABC-DOT-XXX-001

Block 9 — PERFORMING ORGANIZATION NAME AND ADDRESS

ABC Laboratories
405 Main Street
Detroit, MI 48070-1234

14. REPORTS....Continued

Block 10 — WORK UNIT NUMBER

Leave blank

Block 11 — CONTRACT OR GRANT NUMBER

DTNH22-XX-D-12345

Block 12 — SPONSORING AGENCY NAME AND ADDRESS

US Department of Transportation
National Highway Traffic Safety Administration
Enforcement
Office of Vehicle Safety Compliance (NVS-222)
1200 New Jersey Ave. SE, Room W45-334
Washington, DC 20590

Block 13 — TYPE OF REPORT AND PERIOD COVERED

Final Test Report
Month Day, to Month Day, 20XX (Start Date to Completion Date)

Block 14 — SPONSORING AGENCY CODE

NVS-220

Block 15 — SUPPLEMENTARY NOTES

Leave blank

Block 16 — ABSTRACT

Compliance tests were conducted on Sure-Safe Type 21 Air Brake Hoses in accordance with the specifications of the Office of Vehicle Safety Compliance Test Procedure No. TP-106-XX. Test failures identified were as follows:

None

NOTE: Above wording must be shown with appropriate changes made for a particular compliance test. Any questions should be resolved with the COTR.

14. REPORTS....Continued

Block 17 — KEY WORDS

Compliance Testing
Safety Engineering
FMVSS 106

Block 18 — DISTRIBUTION STATEMENT

Copies of this report are available from--

National Highway Traffic Safety Administration
Technical Information Services Division
Room E12-100 (NPO-411)
1200 New Jersey Ave., SE
Washington, DC 20590
Email: tis@nhtsa.dot.gov
Fax: 202-493-2833

Block 19 — SECURITY CLASSIFICATION OF REPORT

Unclassified

Block 20 — SECURITY CLASSIFICATION OF PAGE

Unclassified

Block 21 — NUMBER OF PAGES

Add appropriate number

Block 22 — PRICE

Leave blank

14. REPORTS....Continued

14.3.4 TABLE OF CONTENTS

Final test report Table of Contents shall include the following:

A. Section 1 — Purpose of Compliance Test

B. Section 2 — Compliance Test Data Summary

C. Section 3 — Test Data

D. Section 4 — Test Failure Details (if applicable)

E. Appendix A — Interpretations or Deviations From FMVSS 106

F. Appendix B — Test Equipment List and Calibration Information

G. Appendix C — Photographs

15. DATA SHEETS

SUMMARY OF HYDRAULIC BRAKE HOSE TESTING RESULTS

GRP NO.: ___ ; NOM. HOSE ID: ___"; VEH MFR: _____; PART NO.: _____

HOSE ASSY. MFR.: _____ PART NO.: _____

HOSE STOCK MFR.: _____

TYPE OF HOSE ASSYS.: _____-Veh. Specific*; _____-Aftermarket

* These types of assemblies are NOT SUBJECT to Label Inspection PASS/FAIL criteria.

SUMMARY: (INDICATE P - PASS, F - FAIL, N/A - NOT APPLICABLE)

		HOSE NUMBER																			
Test No.	**TEST**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**.**	**.**	**.**	**21**	**Spare**
1	LABEL INSPECTION																				
2	CONSTRIC. TEST																				
3	EXPANSION TEST																				
4	BURST TEST																				
5	WHIP TEST																				
6	TENSILE TEST																				
7	COLD BOX TEST																				
8	SALTSPRAY TEST																				
9	END FITTING CORROSION																				
9	OZONE TEST																				
10	WATER ABSORP.																				
11	BRK.FLUID COMPAT.																				
12	HIGH TEMP. IMPULSE																				
13	DYNAMIC OZONE																				
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	Spare

RECORDED BY: _____ ; DATE: _____

APPROVED BY: _____

15. DATA SHEETS....Continued

DATA SHEET H-1A

HYDRAULIC BRAKE HOSE LABELING INSPECTION - HOSE

GROUP NO.: _____ TEST DATE: _____

TYPE OF HOSE ASSYS.: ___-Veh. Specific; ___-Aftermarket

MARKINGS ON HOSE: DOT LINE- _____
OTHER LINE-

TORQUE STRIPES* (2) ON HOSE: ___-Yes; ___-No
*Required on AFTERMARKET ASSYS only

PASS	FAIL	N/A

DATE CODE ON HOSES			
HOSE NO.	**DATE CODE**	**HOSE NO.**	**DATE CODE**
1		11	
2		12	
3		13	
4		14	
5		15	
6		.	
7		.	
8		.	
9		21	
10		Spare	

RECORDED BY: _____ ; DATE: _____
APPROVED BY: _____

15. DATA SHEETS....Continued

DATA SHEET H-1B

HYDRAULIC BRAKE HOSE LABELING INSPECTION - ASSEMBLY

GROUP NO.: _____ TEST DATE: _____

TYPE HOSE ASSYS.: ___-Veh. Specific; ___-Aftermarket

MARKINGS ON BAND*:
_____
(Metal Band unless otherwise noted)
If band is NOT present, check Data Sheet H-1C Option Selection for PASS/FAIL judgement for AFTERMARKET ASSEMBLIES

PASS	FAIL	N/A

* If marking on any hose assembly band is different than recorded above, copy the marking and identify by hose number in the space below.

REMARKS:

RECORDED BY: _____ ; DATE: _____

APPROVED BY: _____

15. DATA SHEETS....Continued

DATA SHEET H-1C

HYDRAULIC BRAKE HOSE LABELING INSPECTION - END FITTINGS

GROUP NO.: _____ TEST DATE: _____

TYPE OF HOSE ASSYS.: _____-Vehicle Specific; _____-Aftermarket
TYPE OF END FITTING: _____-Permanent; _____-Crimp/Swag; _____-Sleeve/Ferrule
MARKINGS ON END FITTINGS*: (Each hose assy end must be marked with an "A" or "B" by lab)
* If Band is NOT present, one fitting on Aftermarket Assys must have manufacturer's identification

HOSE NO.	"A" END _____	"B" END _____	PASS, FAIL, N/A
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
.			
.			
.			
21			
SPARE			

RECORDED BY: _____ ; DATE: _____

APPROVED BY: _____

15. DATA SHEETS....Continued

DATA SHEET H-2

HYDRAULIC BRAKE HOSE CONSTRICTION TEST

GROUP NO.: _____; TEST DATE: _____; HOSE NOMINAL I.D.: _____"

AMB. TEMP.: ____ºF; PLUG SIZE USED: _____" PLUG GAGE __ EXT. PLUG GAGE __ BALL GAGE __
Each end of the hose assembly must be marked with an "A" or "B" by the laboratory.
The constriction of the bore was measured at both ends using the size gage plug as shown above.

HOSE NO.	END	PASS	FAIL*	MAX. DRILL SIZE
1	A B	----------	----------	----------
2	A B	----------	----------	----------
3	A B	----------	----------	----------
4	A B	----------	----------	----------
5	A B	----------	----------	----------
6	A B	----------	----------	----------
7	A B	----------	----------	----------
8	A B	----------	----------	----------
9	A B	----------	----------	----------
10	A B	----------	----------	----------
11	A B	----------	----------	----------
12	A B	----------	----------	----------
13	A B	----------	----------	----------
14	A B	----------	----------	----------
15	A B	----------	----------	----------
16	A B	----------	----------	----------
.	A B	----------	----------	----------
.	A B	----------	----------	----------
21	A B	----------	----------	----------
SPARE	A B	----------	----------	----------

*Approximate location of obstruction ___in. from A__ B___

RECORDED BY: _____ ; DATE: _____
APPROVED BY: _____

15. DATA SHEETS....Continued

DATA SHEET H-3

HYDRAULIC BRAKE HOSE EXPANSION TEST

GROUP NO.: _____ ; HOSE TYPE: _____ ; TEST DATE: _____

HOSE NOMINAL I.D.: _____"; EXPANSION AMBIENT TEMPERATURE: _____ºF

DO NOT MOVE THE HOSE BETWEEN THE THREE (3) EXPANSIONS

Expansion @ 1000 psig: (____ cc/ft allowed)		**HOSE #1**	**HOSE #2**	**HOSE #3**	**HOSE #4**
Hose Free Length (FL), INCHES	FL				
Hose Free Length (FL), FEET	FL				
Expansions @ 1000 psig	#1				
	#2				
	#3				
TOTAL OF THREE EXPANSIONS	T				
AVERAGE = TOTAL/3	A				
EXPANSION (ACTUAL/FL (feet)	E				
Expansion @ 1500 psig: (____ cc/ft allowed)		**HOSE #1**	**HOSE #2**	**HOSE #3**	**HOSE #4**
Expansions @ 1500 psig	#1				
	#2				
	#3				
TOTAL OF THREE EXPANSIONS	T				
AVERAGE = TOTAL/3	A				
EXPANSION (ACTUAL/FL (feet)	E				
Expansion @ 2900 psig: (____ cc/ft allowed)		**HOSE #1**	**HOSE #2**	**HOSE #3**	**HOSE #4**
Expansions @ 2900 psig	#1				
	#2				
	#3				
TOTAL OF THREE EXPANSIONS	T				
AVERAGE = TOTAL/3	A				
EXPANSION (ACTUAL/FL (feet)	E				
PASS					
FAIL					

RECORDED BY: _____ ; DATE: _____

APPROVED BY: _____

15. DATA SHEETS....Continued

DATA SHEET H-4

HYDRAULIC BRAKE HOSE BURST STRENGTH TEST

GROUP NO.: _____ ; HOSE TYPE: _____ ; TEST DATE: _____

AMBIENT TEMPERATURE: _____ ºF

HOSE NUMBER	ACTUAL PRESSURE ATTAINED, psig	PASS	FAIL
1			
2			
3			
4			
16			
19			

REMARKS:

I.D.	MINIMUM ALLOWABLE BURST STRENGTH
larger than 1/8 inch or 3 mm	5,000 psi
1/8 inch, 3 mm, or smaller	7,000 psi

RECORDED BY: _____ DATE: _____

APPROVED BY: _____

15. DATA SHEETS....Continued

DATA SHEET H-5
HYDRAULIC BRAKE HOSE WHIP TEST

GROUP NO.: _____ ; AMBIENT TEMPERATURE: _____ ºF

	TIME	**DATE**
START OF TEST		
END OF TEST		
TOTAL ELAPSED TEST TIME (hours) =		

The free length of each specimen was measured to within a tolerance of 0.015" between the end fittings while hanging in a straight position.

Water pressure of 220 to 235 psig was applied, and the hose and passages bled to eliminate air pockets or bubbles. The machine speed was 780 to 800 rpm, and total whip running time was a minimum of 40 hours. See TP Table 2 for "Slack" requirements.

Inspect condition of the hoses after 35 hours and 40 hours of whip test running time. PASS/FAIL shall be based upon the condition at the 35 hour inspection.

Inspect condition of the hoses after 35 hours and 40 hours of whip test running time. PASS/FAIL shall be based upon the condition at the 35 hour inspection. **NOTE: Measurements in thousands of an inch.**		**HOSE #5**	**HOSE #6**	**HOSE #7**	**HOSE #8**
Hose Free Length	FL				
Slack Setting	SS				
Machine Setup Length (FL - SS)	MSL				
Line Pressure (220 to 235 psig)	LP				
Whip Test Running Time, hours (Minimum = 40 hours)	ET				

HOSE CONDITION AT 35 HOURS AND AT 40 HOURS

HOSE NO.	**AT 35 HOURS**	**AT 40 HOURS**	**DETERMINED @ 35 HRS**	
			PASS	**FAIL**
5				
6				
7				
8				

RECORDED BY: _____ ; DATE:
APPROVED BY: _____

15. DATA SHEETS....Continued

DATA SHEET H-6

HYDRAULIC BRAKE HOSE TENSILE TEST

GROUP NO._____; TEST DATE: _____ ; AMBIENT TEMP.: _____ ºF

The hose assemblies were mounted in the tensile machine so that the hose and end fittings had a straight centerline corresponding to the direction of the machine pull.

The hose assembly was pulled at a rate of 1 inch/minute until failing as follows:

A. Hose pulled out of the end fitting
B. Hose ruptured

TABLE H6-1 - Slow Pull Test (1" per minute)

HOSE NO.	ACTUAL TOTAL LOAD AT TIME OF FAILURE (lbs)	TYPE OF FAILURE "A" or "B"	MIN. ALLOW. TENSILE STRENGTH (lbs)	PASS	FAIL
9A			325		
10A			325		
11A			325		
12A			325		

TABLE H6-1 - Fast Pull Test (2" per minute)

HOSE NO.	ACTUAL TOTAL LOAD AT TIME OF FAILURE (lbs)	TYPE OF FAILURE "A" or "B"	MIN. ALLOW. TENSILE STRENGTH (lbs)	PASS	FAIL
9B			370		
10B			370		
11B			370		
12B			370		

REMARKS:

RECORDED BY: _____ ; DATE: _____

APPROVED BY: _____

15. DATA SHEETS....Continued

DATA SHEET H-7

HYDRAULIC BRAKE HOSE LOW TEMPERATURE RESISTANCE TEST

GROUP NO.: _____ ; HOSE DIAMETER: _____ inches

The hose assembly was conditioned in the cold box in a straight position or natural position at -40ºF to -54ºF for 70 hours.

After the conditioning period and while still at this temperature, the hose assembly was bent around a wood mandrel of the diameter noted in the "REMARKS" section.

All cracks and breaks are noted below.

HOSE #13	DATE	TIME	BOX TEMPERATURE (ºF)	EVIDENCE OF CRACKS OR BREAKS
IN BOX				
OUT BOX				
TOTAL EXPOSURE TIME =				

TEST RESULTS:

PASS	FAIL

Wood Mandrel diameter used = _____ inches

HOSE NOMINAL I.D.	TEST CYLINDER DIAMETER(+ 0.03, - 0)
LESS THAN 1/8"	2.50"
1/8"	3.00"
3/16" AND 1/4"	3.50"
GREATER THAN 1/4"	4.00"

REMARKS:
External Inspection -
Internal Inspection -

RECORDED BY: _____ ; DATE: _____

APPROVED BY: _____

15. DATA SHEETS....Continued

DATA SHEET H-8

HYDRAULIC BRAKE HOSE END FITTING CORROSION TEST

GROUP NO.: _____

The hose assembly was subjected to a Salt Spray test for 24 hours in accordance with the testing method of Salt Spray (Fog) Testing ASTM B117-03.

The temperature in the salt chamber and the air supply (psig) were continuously recorded.

HOSE #14	DATE	TIME	SALT SOLUTION PROP.		EVIDENCE OF RUST OR CORROSION
			Sp.Gr.@95±2ºF	Ph	
IN Cabinet					
OUT Cabinet					

TEST RESULTS:

PASS	FAIL

REMARKS: (Note all interruptions in test, cause, and length of time)

RECORDED BY: _____ ; DATE: _____

APPROVED BY: _____

15. DATA SHEETS....Continued

DATA SHEET H-9

HYDRAULIC BRAKE HOSE OZONE RESISTANCE TEST

GROUP NO.: _____ ; AMBIENT TEMPERATURE: _____ ºF

HOSE NO.: __15__ ; HOSE NOMINAL O.D.: _____ inches

CYLINDER DIAMETER = 8 x HOSE NOMINAL O.D. = _____ inches

	TIME	**DATE**
START OF TEST		
END OF TEST		
TOTAL EXPOSURE TIME (hours) =		

The brake hose was bound around a cylinder with a diameter of _____ inches and conditioned at room temperature for 24 hours.

The brake hose and cylinder were then exposed to an ozone concentration of 100 parts per 100 million by volume for 70 hours at a temperature of 104ºF.

Examination of the hose under 7-power magnification yielded the following results -

TEST RESULTS:

PASS	**FAIL**

REMARKS:

RECORDED BY: _____ ; DATE: _____

APPROVED BY: _____

15. DATA SHEETS....Continued

DATA SHEET H-10A

HYDRAULIC BRAKE HOSE WATER ABSORPTION - BURST TEST

GROUP NO.: _____ ; AMBIENT TEMPERATURE: _____ ºF

HOSE FREE LENGTH: _____ inches ; HOSE NOMINAL I.D.: _____ inches

	TIME	**DATE**
START OF IMMERSION TIME		
END OF IMMERSION TIME		
TOTAL IMMERSION TIME (hours) =		

The hose was prepared and immersed in distilled water at 185 F for 70 hours. Within 30 minutes after removal from the water, the Burst Strength Test was conducted in accordance with TP Paragraph 12.A.4.

HOSE NUMBER	**ACTUAL PRESSURE ATTAINED, psig**	**PASS**	**FAIL**
16			

I.D.	**MINIMUM ALLOWABLE BURST STRENGTH**
larger than 1/8 inch or 3 mm	5,000 psi
1/8 inch, 3 mm, or smaller	7,000 psi

REMARKS:

RECORDED BY: _____ ; DATE: _____

APPROVED BY: _____

15. DATA SHEETS....Continued

DATA SHEET H-10B

HYDRAULIC BRAKE HOSE WATER ABSORPTION - WHIP TEST

GROUP NO.: _____ ; AMBIENT TEMPERATURE: _____ ºF

HOSE FREE LENGTH: _____ inches ; HOSE NOMINAL I.D.: _____ inches

	TIME	**DATE**
START OF IMMERSION TIME		
END OF IMMERSION TIME		
TOTAL IMMERSION TIME (hours) =		

The hose was prepared and immersed in distilled water at room temperature for 70 hours. Within 30 minutes after removal from the water, the Whip (Fatigue) Test was started in accordance with TP Paragraph 12.A.5.

Ambient Temperature = _____ ºF.	**TIME**	**DATE**
START OF WHIP TEST		
END OF WHIP TEST		
TOTAL WHIP TEST TIME (hours) =		

NOTE: Measurements in thousands of an inch.		**HOSE #17**
Hose Free Length	FL	
Slack Setting	SS	
Machine Setup Length (FL - SS)	MSL	
Line Pressure (220 to 235 psig)	LP	
Whip Test Running Time, hours (Min. = 40 hrs)	ET	

HOSE CONDITION AT 35 HOURS AND AT 40 HOURS				
HOSE NO.	**AT 35 HOURS**	**AT 40 HOURS**	**DETERMINED @ 35 HRS**	
			PASS	**FAIL**
17				

RECORDED BY: _____ ; DATE: _____

APPROVED BY: _____

15. DATA SHEETS....Continued

DATA SHEET H-10C

HYDRAULIC BRAKE HOSE WATER ABSORPTION - TENSILE TEST

GROUP NO.: _____ ; AMBIENT TEMPERATURE: _____ ºF

HOSE FREE LENGTH: _____ inches ; HOSE NOMINAL I.D.: _____ inches

	TIME	DATE
START OF IMMERSION TIME		
END OF IMMERSION TIME		
TOTAL IMMERSION TIME (hours) =		

The hose was prepared and immersed in distilled water at room temperature for 70 hours. Within 30 minutes after removal from the water, the Tensile Strength Test was started in accordance with TP Paragraph 12.A.6.

The hose assemblies were mounted in the tensile machine so that the hose and end fittings had a straight centerline corresponding to the direction of the machine pull.

The hose assembly was pulled failure as follows:

A. Hose pulled out of the end fitting
B. Hose ruptured

TABLE H6-1 - Slow Pull Test (1" per minute)

HOSE NO.	ACTUAL TOTAL LOAD AT TIME OF FAILURE (lbs)	TYPE OF FAILURE "A" or "B"	MIN. ALLOW. TENSILE STRENGTH (lbs)	PASS	FAIL
18			325		

TABLE H6-1 - Fast Pull Test (2" per minute)

HOSE NO.	ACTUAL TOTAL LOAD AT TIME OF FAILURE (lbs)	TYPE OF FAILURE "A" or "B"	MIN. ALLOW. TENSILE STRENGTH (lbs)	PASS	FAIL
18			370		

RECORDED BY: _____ ; DATE: _____
APPROVED BY: _____

15. DATA SHEETS....Continued

DATA SHEET H-11

HYDRAULIC BRAKE HOSE BRAKE FLUID COMPATIBILITY TEST

GROUP NO.: _____ ; HOSE NUMBER: _____

	TIME	**DATE**
START OF TEST TIME		
END OF TEST TIME		
TOTAL IMMERSION TIME (hours) =		

The hose was attached to a 1 pint reservoir of Compatibility fluid and placed vertically in an oven at 195 to 200ºF for 70 hours. After removal, the hose was cooled for 30 minutes.

Cool Period: Start Time - _____ End Time - _____

TOTAL Cool Time - _____

The Constriction Test was performed in accordance with the TP Paragraph 12.A.2.

HOSE NUMBER	**END**	**PASS**	**FAIL**
19	A		
	B		

The Burst Strength Test was performed in accordance with the TP Paragraph 12.A.4.

I.D.	**MINIMUM ALLOWABLE BURST STRENGTH**
larger than 1/8 inch or 3 mm	5,000 psi
1/8 inch, 3 mm, or smaller	,000 psi

HOSE NUMBER	**ACTUAL PRESSURE ATTAINED, psig**	**PASS**	**FAIL**
19			

REMARKS:

RECORDED BY: _____ ; DATE: _____

APPROVED BY: _____

15. DATA SHEETS....Continued

DATA SHEET H-12

HYDRAULIC BRAKE HOSE HIGH TEMPERATURE IMPULSE TEST

GROUP NO.: _____ ; AMBIENT TEMPERATURE: _____ ºF

HOSE NO.: _____ ; HOSE NOMINAL O.D.: _____ inches

One end of hose assembly was connected to a pressure cycling machine. The other end of the hose assembly was plugged. The pressure cycling machine and hose assembly were filled with SAE RM-66-05 Compatibility Fluid.

The brake hose assembly was placed inside of a circulating air oven in a vertical position. With the oven temperature at 295 degrees F (146 degrees Celsius) the pressure inside the hose was cycled (from zero psi to 1600 psi and held constant for 1 minute, then the pressure is decreased from 1600 psi to zero psi and held constant for 1 minute) for 150 cycles.

	TIME	**DATE**
START OF 150 CYCLES		
END OF 150 CYCLES		
TOTAL CYCLE TIME (hours) =		

The brake hose was removed from the oven, disconnected from the pressure cycling machine, and allowed to cool at room temperature for 45 minutes.

The burst strength test was conducted (all sizes of hose tested at 5,000 psi).

HOSE NUMBER	**ACTUAL PRESSURE ATTAINED, psig**	**PASS**	**FAIL**

REMARKS:

RECORDED BY: _____ ; DATE: _____

APPROVED BY: _____

15. DATA SHEETS....Continued

DATA SHEET H-13

HYDRAULIC BRAKE HOSE DYNAMIC OZONE TEST

GROUP NO.: _____ ; AMBIENT TEMPERATURE: _____ ºF

HOSE NO.: _____ ; HOSE NOMINAL O.D.: _____ inches

The brake hose was conditioned at room temperature for 24 hours, then cut and mounted on the test fixture (Par. 12.A.13, Figure 3).

The test fixture with the cut portion of the brake hose mounted on it were exposed to an ozone concentration of 100 parts per 100 million by volume for 48 hours at a temperature of 104ºF. The movable pin of the test fixture was cycled at 0.3 Hz for the full 48 hours of ozone exposure.

	TIME	**DATE**
START OF EXPOSURE		
END OF EXPOSURE		
TOTAL EXPOSURE TIME (hours) =		

Examination of the hose without magnification yielded the following results -

TEST RESULTS:

PASS	**FAIL**

REMARKS:

RECORDED BY: _____ ; DATE: _____

APPROVED BY: _____

15. DATA SHEETS....Continued

DATA SHEET H-14
HYDRAULIC BRAKE HOSE TRACER CORD COLOR IDENTIFICATION TEST

GROUP NO.: _____ ; TEST DATE: _____

After completion of all tests, remove a portion of the hose outer cover in all NONFAILING samples to determine the color of the tracer cord woven into the outre braid; tracer cord may be woven into inner braid on some hose assemblies.

SPECIMEN NO.	CORD COLOR	R.M.A. IDENTIFICATION
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		
17		
18		
19		
SPARE		

RECORDED BY: _____ ; DATE: _____

APPROVED BY: _____

15. DATA SHEETS....Continued

SUMMARY OF AIR BRAKE HOSE TESTING RESULTS

GROUP NO.: _____ ; NOMINAL HOSE I.D.: _____ inches

VEHICLE MFR: _____; PART NO.: _____

HOSE ASSY MFR: _____; PART NO.: _____

HOSE STOCK MFR: _____

TYPE OF HOSE ASSYS.: _____-Veh. Specific*; _____-Aftermarket
* These types of assys are NOT subject to Label Inspection PASS/FAIL criteria.

TYPE OF END FITTING: ____-Permanent; ____-Reusable; ____-Renewable

SUMMARY: (P = PASSED, F = FAILED, N/A = NOT APPLICABLE)

		HOSE NUMBER													
TEST NAME		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	.	.	.	**15**
01	Label Inspection														
02	Constriction Test														
03	High Temperature Test														
04	Cold Box Test														
05	Oil Resistance Test														
06	Ozone Test														
07	Length Change Test														
08	Adhesion (Not Reinforced) Test														
09	Flex & Air Pressure Test														
10	Corrosion & Burst Test														
11	Tensile Test														
12	Water Absorption														
13	Zinc Chloride Test														
14	Salt Spray Test														
15	Adhesion (Reinforced) Test														
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**.**	**.**	**.**	**15**

RECORDED BY: _____ ; DATE: _____

APPROVED BY: _____

15. DATA SHEETS....Continued

DATA SHEET A-1A

AIR BRAKE HOSE LABELING INSPECTION - HOSE

GROUP NO.: _____ ; TEST DATE: _____

TYPE ASSY: ____-Veh Specific*; ____-Aftermarket
* These types of assys are NOT subject to Label Inspection PASS/FAIL criteria.

MARKINGS ON HOSE: DOT Line-
_____
Other Line-

HOSE NUMBER	DATE CODE ON HOSE
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
.	
.	
.	
15	
SPARE	

REMARKS:

RECORDED BY: _____ ; DATE: _____

APPROVED BY: _____

15. DATA SHEETS....Continued

DATA SHEET A-1B

AIR BRAKE HOSE LABELING INSPECTION - ASSEMBLY

GROUP NO.: _____; AFTERMARKET ASSY: __-Yes/__-No; TEST DATE: _____

MARKINGS ON BAND:
(Metal band unless otherwise noted)

MARKING OPTION SELECTED: ____-Yes; ____-No
(If YES, see Data Sheet A-1C for PASS/FAIL judgment)

HOSE NO.	DOT MARK	MANUFACTURER'S MARK	PASS, FAIL or N/A
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			

REMARKS:

RECORDED BY: _____ ; DATE: _____

APPROVED BY: _____

15. DATA SHEETS....Continued

DATA SHEET A-1C

AIR BRAKE HOSE LABELING INSPECTION - END FITTINGS

GROUP NO.: _____ ; TEST DATE: _____

TYPE OF END FITTINGS: ____-Permanent*; ____-Reusable; ____-Renewable
* NOT subject to Label Inspection PASS/FAIL criteria.

MARKINGS ON END FITTINGS:
(Each hose assy end must be marked with an "A" or "B" by the lab)

HOSE#	"A" END	"B" END	P,F,N*
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
SPARE			

- P = PASS, F = FAIL, N = NOT APPLICABLE

REMARKS:

RECORDED BY: _____ ; DATE: _____

APPROVED BY: _____

15. DATA SHEETS....Continued

DATA SHEET A-2

AIR BRAKE HOSE CONSTRICTION TEST

GROUP NO.: _____; TEST DATE: _____; HOSE NOMINAL I.D.: _____"

AMB.TEMP.: ___ºF; PLUG SIZE USED*: _____" (NOTE: _____" Max Dia. for _____" ID hose)
* See TP Paragraph 12.B.2 for proper plug size

Each end of the hose assembly must be marked with an "A" or "B" by the lab. The constriction of the bore was measured at both ends using the size gage plug as shown above.

HOSE NO.	END	PASS	FAIL	MAX. DRILL SIZE
1	A B	_____	_____	_____
2	A B	_____	_____	_____
3	A B	_____	_____	_____
4	A B	_____	_____	_____
5	A B	_____	_____	_____
6	A B	_____	_____	_____
7	A B	_____	_____	_____
8	A B	_____	_____	_____
9	A B	_____	_____	_____
10	A B	_____	_____	_____
11	A B	_____	_____	_____
12	A B	_____	_____	_____
13	A B	_____	_____	_____
14	A B	_____	_____	_____
15	A B	_____	_____	_____
SPARE	A B	_____	_____	_____

REMARKS:

RECORDED BY: _____ ; DATE: _____

APPROVED BY: _____

15. DATA SHEETS....Continued

DATA SHEET A-3

AIR BRAKE HOSE HIGH TEMPERATURE TEST

GROUP NO.: _____ ; HOSE NOMINAL I.D.: _____ inches

	TIME	DATE
START OF HIGH TEMPERATURE TEST		
END OF HIGH TEMPERATURE TEST		
TOTAL TEST TIME (hours) =		

Hose 1 was secured around a cylinder with a diameter of _____ inches and placed in an air oven for 70 hours at 212ºF. After removal and cooling, the hose was hand straightened and inspected.

TEST RESULTS:

PASS	FAIL

External Inspection - _____

Internal Inspection - _____

HOSE NOMINAL I.D. (mm)	TEST CYLINDER DIAMETER (mm)
3/16" (4,5)	1" (25)
1/4" (6)	1½" (38)
5/16" (8)	1¾" (45)
3/8" (-)	1¾" (45)
13/32" (10)	1 ⅞" (48)
7/16", 1/2" (12)	2" (51)
5/8"	2½" (64)

REMARKS:

RECORDED BY: _____ ; DATE: _____

APPROVED BY: _____

15. DATA SHEETS....Continued

DATA SHEET A-4

LOW TEMPERATURE RESISTANCE TEST

GROUP NO.: _____ ; HOSE NOMINAL I.D.: _____ inches

The hose assembly was conditioned in the cold box in a straight position or natural position at -40ºF for 70 hours.

After the conditioning period and while still at this temperature, the hose assembly was bent around a test cylinder.

All cracks and breaks are noted below.

HOSE #2	DATE	TIME	BOX TEMPERATURE (ºF)	EVIDENCE OF CRACKS OR BREAKS
IN BOX				
OUT BOX				
TOTAL EXPOSURE TIME =				

TEST RESULTS:

PASS	FAIL

Test cylinder diameter used = _____ inches

HOSE NOMINAL I.D. (mm)	TEST CYLINDER DIAMETER (mm)
3/16" (4,5)	1" (25)
1/4" (6)	1½" (38)
5/16" (8)	1¾" (45)
3/8" (-)	1¾" (45)
13/32" (10)	1 ⅞" (48)
7/16", 1/2" (12)	2" (51)
5/8"	2½" (64)

RECORDED BY: _____ ; DATE: _____

APPROVED BY: _____

15. DATA SHEETS....Continued

DATA SHEET A-5
AIR BRAKE HOSE OIL RESISTANCE TEST

GROUP NO.: _____

Specimens were prepared from Hose Numbers 3, 4 and 5 in accordance with the TP Paragraph 12.B.5 and weighed to the nearest milligram in air (W_1) and in distilled water (W_2).

Each specimen was immersed in ASTM No. 3 oil for 70 hours at 207ºF to 212ºF and then cooled for 30 to 60 minutes. Specimens were each weighed in a tared weighing bottle (W_3) and in distilled water (W_4) within 5 minutes after removal from the cooling liquid.

The percent increase in volume was calculated as follows:

$$\text{Percent of Increase} = \frac{(W_3 - W_4) - (W_1 - W_2)}{(W_1 - W_2)} \times 100$$

	DATE	TIME	TEMPERATURE (ºF)
OVEN TEST START			
OVEN TEST END			
COOL PERIOD END			

	HOSE #3	HOSE #4	HOSE #5
Wt. in air (W_1) mg			
Wt. in water (W_2) mg			
Wt. in bottle (W_3) mg			
Wt. in water (W_4) mg			
Percent Increase			
PASS			
FAIL			

The average percent increase in volume = _____ %. (100% max.)

RECORDED BY: _____ ; DATE: _____

APPROVED BY: _____

15. DATA SHEETS....Continued

DATA SHEET A-6

AIR BRAKE HOSE OZONE TEST - 70 HOURS

GROUP NO.: _____ ; AMBIENT TEMPERATURE: _____ ºF

HOSE NO.: 6 ; HOSE NOMINAL O.D.: _____ inches

CYLINDER DIAMETER = 8 x HOSE NOMINAL O.D. = _____ inches

	TIME	DATE
START OF TEST		
END OF TEST		
TOTAL EXPOSURE TIME (hours) =		

The brake hose was bound around a cylinder with a diameter of _____ inches and conditioned at room temperature for 24 hours.

The brake hose and cylinder were then exposed to an ozone concentration of 100 parts per 100 million by volume for 70 hours at a temperature of 104ºF.

Examination of the hose under 7 power magnification yielded the following results -

TEST RESULTS:

PASS	FAIL

REMARKS:

RECORDED BY: _____ ; DATE: _____

APPROVED BY: _____

15. DATA SHEETS....Continued

DATA SHEET A-7

AIR BRAKE HOSE LENGTH CHANGE TEST

GROUP NO.: _____ ; AMBIENT TEMPERATURE: _____ ºF

TEST DATE: _____ ; HOSE NOMINAL I.D.: _____ inches

The hose was positioned in a straight horizontal position and pressurized to 10 psig, and the free length measured. Pressure was increased to 200 psig and the free length re-measured.

	@ 10 psig	@ 200 psig	PASS	FAIL
Hose Free Length (in.)				

The Free Length Change = _____ %. (-7%)

REMARKS:

RECORDED BY: _____ ; DATE: _____

APPROVED BY: _____

15. DATA SHEETS....Continued

DATA SHEET A-8

AIR BRAKE HOSE ADHESION TEST

GROUP NO.: _____ ; AMBIENT TEMPERATURE:_____ ºF

TEST DATE: _____ ; SAMPLE LENGTH: _____ inches

Hose #8 was prepared in accordance with the TP Paragraph 12.B.2 and installed in the Adhesion Test Device. The moving head travel was 1.0 inch per minute with a permanent recording of Tension vs. Displacement.

Minimum Force Recorded (lbs.)	Adhesion Value (lbs./in.)	Minimum Allowable (lbs./in.)	PASS	FAIL
		8		

Record data for all layers.

REMARKS:

RECORDED BY: _____ ; DATE: _____

APPROVED BY: _____

15. DATA SHEETS....Continued

DATA SHEET A-9

AIR BRAKE HOSE FLEX STRENGTH AND AIR PRESSURE TEST

GROUP NO.: _____ ; AMBIENT TEMPERATURE:_____ ºF

TEST DATE: _____ ; HOSE NO.: ____9

The hose assembly was marked along the centerline.

HOSE FREE LENGTH.:

The hose assembly was subjected to a Salt Spray test for 24 hours in accordance with the testing method of Salt Spray (Fog) Testing ASTM B117-03.

The temperature in the salt chamber, air supply (psig), and were continuously recorded.

HOSE #14	DATE	TIME	SALT SOLUTION PROP.		EVIDENCE OF RUST OR CORROSION
			Sp.Gr.@95±2ºF	Ph	
IN Cabinet					
OUT Cabinet					

DATE/TIME END OF CORROSION TEST:
DATE/TIME START EXPOSURE TO 212F DATE/TIME END EXPOSURE TO 212F
DATE/TIME START FLEX TEST TO 212F

The hose was pressurized to 150 psig. After a 2 minute hold, the final pressure was recorded.

Initial Pressure (psig)	Final Pressure (psig)	Pressure Decay During 5 Min. Hold (psig)	PASS	FAIL

Free Hose Length	Nominal Hose Inside Diameter	Dimensions							
		Position "1"				Position "2"			
		A	B	C	R(1)	A	B	C	R(1)
10.00 (254)	3/16, 1/4	3.00 (76)	2.75 (70)	3.75 (95)	1.40 (34)	3.00 (76)	2.75 (70)	3.75 (95)	1.20 (30)
11.00 (279)	5/16, 3/8, 13/32	3.00 (76)	3.50 (89)	4.50 (114)	1.70 (43)	3.00 (76)	3.50 (89)	4.50 (114)	1.30 (33)
14.00 (355)	7/16, ½, 5/8	3.00 (76)	4.00 (102)	5.00 (127)	2.20 (56)	3.00 (76)	4.00 (102)	5.00 (127)	1.80 (46)

REMARKS:

RECORDED BY: _____ ; DATE: _____

APPROVED BY: _____

15. DATA SHEETS....Continued

DATA SHEET A-10

AIR BRAKE CORROSION RESISTANCE AND BURST STRENGTH TEST

GROUP NO.: _____ ; TEST DATE:

The hose assembly was subjected to a Salt Spray test for 24 hours in accordance with the testing method of Salt Spray (Fog) Testing ASTM B117-03.

The temperature in the salt chamber, air supply (psig), and were continuously recorded.

(Note all interruptions in test, cause, and length of time)

HOSE #14	DATE	TIME	SALT SOLUTION PROP.		EVIDENCE OF RUST OR CORROSION
			Sp.Gr.@95±2ºF	Ph	
IN Cabinet					
OUT Cabinet					

The hose was connected to the pressure source and completely filled with water.

After all air was eliminated in the hose, the relief valve was closed and pressure applied at the rate of 1,000 psi per minute until the specimen bursts.

HOSE NUMBER	ACTUAL PRESSURE ATTAINED, psig	MINIMUM ALLOWABLE BURST STRENGTH	PASS	FAIL
10		900 psig		

REMARKS:

RECORDED BY: _____ ; DATE: _____

APPROVED BY: _____

15. DATA SHEETS....Continued

DATA SHEET A-11

AIR BRAKE HOSE TENSILE TEST

GROUP NO.: _____ ; TEST DATE:

HOSE SIZE: _____ inches AMBIENT TEMP.: _____ ºF

VEHICLE APPLICATION: _____
(Relative motion unless otherwise noted)

The hose assembly was mounted in the tensile machine so that the hose and end fittings had a straight centerline corresponding to the direction of the machine pull.

The hose assembly was pulled at a rate of 1 inch per minute until failing as follows:

A. Hose pulled out of the end fitting
B. Hose ruptured

HOSE NO.	ACTUAL TOTAL LOAD AT TIME OF FAILURE (lbs)	TYPE OF FAILURE	MIN. ALLOWABLE TENSILE STRENGTH	PASS	FAIL
11					

Vehicle Application	ALLOWABLE TENSILE STRENGTH			
	I.D. ≤ ¼ "	I.D.> ¼ "	¼" <I.D. ≤ ½"	I.D.<½"
Between frame and axle	250 lbs	325 lbs	-	-
Other	50 lbs	-	150 lbs	325 lbs

REMARKS:

RECORDED BY: _____ ; DATE: _____

APPROVED BY: _____

15. DATA SHEETS....Continued

DATA SHEET A-12

AIR BRAKE HOSE WATER ABSORPTION - TENSILE TEST

GROUP NO.: _____ ; AMBIENT TEMPERATURE: _____ ºF

HOSE FREE LENGTH: _____ inches ; HOSE NOMINAL I.D.: _____ inches

	TIME	DATE
START OF IMMERSION TIME		
END OF IMMERSION TIME		
TOTAL IMMERSION TIME (hours) =		

The hose was prepared and immersed in distilled water at room temperature for 70 hours. Within 30 minutes after removal from the water, the Tensile Strength Test was started in accordance with TP Paragraph 12.A.11.

HOSE NO.	ACTUAL TOTAL LOAD AT TIME OF FAILURE (lbs)	TYPE OF FAILURE (A or B)	MIN. ALLOWABLE TENSILE STRENGTH	PASS	FAIL
12					

FAILURE TYPES: A = Hose pulled out of end fitting
B = Hose ruptured

Vehicle Application	ALLOWABLE TENSILE STRENGTH			
	I.D. ≤ ¼ "	I.D.> ¼ "		
Between frame and axle	250 lbs	325 lbs	-	-

REMARKS:

RECORDED BY: _____ ; DATE: _____

APPROVED BY: _____

15. DATA SHEETS....Continued

DATA SHEET A-13

AIR BRAKE HOSE ZINC CHLORIDE RESISTANCE TEST

GROUP NO.: _____ ; AMBIENT TEMPERATURE: _____ ºF

	TIME	DATE
START OF IMMERSION TIME		
END OF IMMERSION TIME		
TOTAL IMMERSION TIME (hours) =		

Hose #13 shall be immersed in a 50 percent zinc chloride aqueous solution at room temperature for 200 hours. After that time, the hose was removed from the solution and examined under 7-power magnification. Inspection of the hose yielded the following:

TEST RESULTS:

PASS	FAIL

REMARKS:

RECORDED BY: _____ ; DATE: _____

APPROVED BY: _____

15. DATA SHEETS....Continued

DATA SHEET A-14

AIR BRAKE HOSE SALT SPRAY TEST - 24 HOURS

GROUP NO.:

The hose assembly was subjected to a Salt Spray test for 24 hours in accordance with the testing method of Salt Spray (Fog) Testing ASTM B117-03.

The temperature in the salt chamber, air supply (psig), and were continuously recorded.

HOSE #14	DATE	TIME	SALT SOLUTION PROP.		EVIDENCE OF RUST OR CORROSION
			Sp.Gr.@95±2ºF	Ph	
IN Cabinet					
OUT Cabinet					

TEST RESULTS:

PASS	FAIL

REMARKS: (Note all interruptions in test, cause, and length of time)

RECORDED BY: _____ ; DATE: _____

APPROVED BY: _____

15. DATA SHEETS....Continued

DATA SHEET A-15

AIR BRAKE HOSE ADHESION TEST (REINFORCED BY WIRE)

GROUP NO.: _____ ; AMBIENT TEMPERATURE:_____ ºF

TEST DATE: _____ ; BRAKE HOSE ID: _____ inches

Plug one end of the brake hose. Place a steel ball with a diameter equal to 73% of the nominal I.D. of the brake hose inside the hose.

STEEL BALL ID: _____

Attach the other end of the brake hose to a source of vacuum and subject the hose to 25 mm of Hg for 5 minutes. While applying vacuum, bend the hose around the test cylinder. At the location of the bend, bend the hose in the opposite direction.

TEST CYLINDER ID: _____

With the vacuum still applied return the hose to a straight position and attempt to roll the ball inside the hose from one end to the other end using gravity.

PASS CRITERION: The ball should roll from one each end of the brake hose to the other

REMARKS:

RECORDED BY: _____ ; DATE: _____

APPROVED BY: _____

15. DATA SHEETS....Continued

DATA SHEET A-16

AIR BRAKE HOSE TRACER CORD COLOR IDENTIFICATION TEST

GROUP NO.: _____ ; TEST DATE:

After completion of all tests, remove a portion of the hose outer cover in all NONFAILING samples to determine the color of the tracer cord woven into the outer braid; tracer cord may be woven into inner braid on some hose assemblies.

SPECIMEN NO.	CORD COLOR	R.M.A. IDENTIFICATION
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		

REMARKS:

RECORDED BY: _____ ; DATE: _____

APPROVED BY: _____

15. DATA SHEETS....Continued

SUMMARY OF VACUUM BRAKE HOSE TESTING RESULTS

GROUP NO.: _____ ; NOMINAL HOSE I.D.: _____ inches

VEHICLE MFR: _____ ; PART NO.: _____

HOSE ASSY MFR: _____ ; PART NO.: _____

HOSE STOCK MFR.: _____

TYPE OF HOSE ASSYS.: _____-Veh. Specific*; _____-Aftermarket
* NOT subject to Label Inspection PASS/FAIL criteria.

TYPE OF END FITTING: ____-Permanent; ____-Reusable; ____-Renewable

SUMMARY: (P = PASSED, F = FAILED, N/A = NOT APPLICABLE)

		HOSE NUMBER									
TEST NAME		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
01	Label Inspection										
02	Constriction Test										
03	High Temperature Test										
04	Cold Box Test										
05	Ozone Test										
06	Burst Test										
07	Vacuum Test										
08	Bend Test										
09	Swell Test										
10	Adhesion Test										
11	Deformation Test										
12	Salt Spray Test										
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**

REMARKS:

RECORDED BY: _____ ; DATE: _____
APPROVED BY: _____

15. DATA SHEETS....Continued

DATA SHEET V-1A

VACUUM BRAKE HOSE LABELING INSPECTION - HOSE

GROUP NO.: _____ ; TEST DATE: _____

TYPE OF ASSY: ___-Veh Specific*; ___-Aftermarket
* Labeling NOT subject to PASS/FAIL criteria.

MARKINGS ON HOSE: DOT Line- _____
Other Line-

HOSE NUMBER	DATE CODE ON HOSE
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
SPARE	

REMARKS:

RECORDED BY: _____ ; DATE: _____

APPROVED BY: _____

15. DATA SHEETS....Continued

DATA SHEET V-1B

VACUUM BRAKE HOSE LABELING INSPECTION - ASSEMBLY

GROUP NO.: _____ ; TEST DATE: _____

AFTERMARKET ASSY: ____-Yes; ____-No

MARKINGS ON BAND:
(Metal band unless otherwise noted)

MARKING OPTION SELECTED: ____-Yes; ____-No
(If YES, see Data Sheet V-1C for PASS/FAIL judgment)

HOSE NO.	DOT MARK	MANUFACTURER'S MARK	PASS, FAIL or N/A
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
SPARE			

REMARKS:

RECORDED BY: _____ ; DATE: _____
APPROVED BY: _____

15. DATA SHEETS....Continued

DATA SHEET V-1C

VACUUM BRAKE HOSE LABELING INSPECTION - END FITTINGS

GROUP NO.: _____ ; TEST DATE: _____

TYPE OF END FITTINGS: ____-Permanent*; ____-Reusable; ____-Renewable*
* NOT subject to Label Inspection PASS/FAIL criteria.

MARKINGS ON END FITTINGS:
(Each end of hose assembly must be marked with an "A" or "B" by the laboratory)

HOSE #	"A" END _____	"B" END _____	P,F,N*
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
SPARE			

* P = PASS, F = FAIL, N/A = NOT APPLICABLE

REMARKS:

RECORDED BY: _____ ; DATE: _____
APPROVED BY: _____

15. DATA SHEETS....Continued

DATA SHEET V-2

VACUUM BRAKE HOSE CONSTRICTION TEST

GROUP NO.: _____; TEST DATE: _____

AMBIENT TEMP.: _____ºF; HOSE NOMINAL I.D.: _____"

PLUG SIZE USED*: _____" (NOTE: _____" Maximum Diameter for _____" I.D. hose)
* Plug size not less than 75% nominal I.D. for heavy duty, or 70% nominal I.D. for light duty

Each end of the hose assembly must be marked with an "A" or "B" by the laboratory.

The constriction of the bore was measured at both ends using the size gage plug indicated above.

HOSE NO.	END	PASS	FAIL	MAX. DRILL SIZE
1	A B	_____	_____	_____
2	A B	_____	_____	_____
3	A B	_____	_____	_____
4	A B	_____	_____	_____
5	A B	_____	_____	_____
6	A B	_____	_____	_____
7	A B	_____	_____	_____
8	A B	_____	_____	_____
9	A B	_____	_____	_____
10	A B	_____	_____	_____
Spare	A B	_____	_____	_____

REMARKS:

RECORDED BY: _____ ; DATE: _____
APPROVED BY: _____

15. DATA SHEETS....Continued

DATA SHEET V-3

VACUUM BRAKE HOSE HIGH TEMPERATURE TEST

GROUP NO.: _____ ; HOSE NOMINAL O.D.: _____ inches

Hose was subjected to vacuum of 26 inches of Hg.

	TIME	DATE
START TEMPERATURE CONDITIONING		
END TEMPERATURE CONDITIONING		
TOTAL CONDITIONING TIME (hours) =		

HOSE O.D. (within 5 minutes of conditioning to 257F: _____ inches

After keeping hose at ambient temperature for 5 hours, the hose was bent around a mandrel with a diameter of _____ inches. The hose was inspected.

Inspection _____

Applied water pressure of 175 psi for one minute.

Inspection _____

REMARKS:

PASS	FAIL

RECORDED BY: _____ ; DATE: _____

APPROVED BY: _____

15. DATA SHEETS....Continued

DATA SHEET V-4

VACUUM BRAKE LOW TEMPERATURE RESISTANCE TEST

GROUP NO.: _____ ; HOSE NOMINAL I.D.: _____ inches

The hose assembly and the large test cylinder was conditioned in the cold box in a straight position or natural position at -40ºF for 70 hours.

After the conditioning period and while still at this temperature, the hose assembly was bent around a wood mandrel of the diameter noted in the "REMARKS" section.

All cracks and breaks are noted below.

HOSE #2	DATE	TIME	BOX TEMPERATURE (ºF)	EVIDENCE OF CRACKS OR BREAKS
IN BOX				
OUT BOX				
TOTAL EXPOSURE TIME =				

TEST RESULTS:

PASS	FAIL

Wood Mandrel diameter used = _____ inches

Table IV B Air Brake Hose Diameters and Test Cylinder Radii

Nominal hose inside diameter, inches[1]	3/16	1/4	5/16	3/8	13/32	7/16, 1/2	5/8
Nominal hose inside diameter, millimeters[1]	4, 5	6	8	…	10	12	16
Small test cylinder, radius in inches (millimeters) [2]	1 (25)	1 1/2 (38)	1 3/4 (45)	1 3/4 (45)	1 7/8 (48)	2 (51)	2 1/2 (64)
Large test cylinder, radius in inches (millimeters) [3]	2 (51)	2 1/2 (64)	3 (76)	3 1/2 (89)	3 1/2 (89)	4 (102)	4 1/2 (114)

Notes:
(1) These sizes are listed to provide test cylinder radii for brake hoses manufactured in these sizes. They do not represent conversions.
(2) Small test cylinders are used for the high temperature resistance test.
(3) Large test cylinders are used for the low temperature resistance, ozone resistance, and adhesion of wire-reinforced hose tests.

RECORDED BY: _____ ; DATE: _____
APPROVED BY: _____

15. DATA SHEETS....Continued

DATA SHEET V-5

VACUUM BRAKE HOSE OZONE TEST - 70 HOURS

GROUP NO.: _____ ; AMBIENT TEMPERATURE: _____ ºF

HOSE NO.: 3 ; HOSE NOMINAL O.D.: _____ inches

CYLINDER DIAMETER = 8 x HOSE NOMINAL O.D. = _____ inches

	TIME	DATE
START OF TEST		
END OF TEST		
TOTAL EXPOSURE TIME (hours) =		

The brake hose was bound around a cylinder with a diameter of _____ inches and conditioned at room temperature for 24 hours.

The brake hose and cylinder were then exposed to an ozone concentration of 50 parts per 100 million by volume for 70 hours at a temperature of 98 to 104ºF.

Examination of the hose under 7-power magnification yielded the following results -

TEST RESULTS:

PASS	FAIL

REMARKS:

RECORDED BY: _____ ; DATE: _____

APPROVED BY: _____

15. DATA SHEETS....Continued

DATA SHEET V-6

VACUUM BRAKE HOSE BURST STRENGTH TEST

GROUP NO.: _____ ; TEST DATE: _____

AMBIENT TEMPERATURE: _____ ºF.

The hose was connected to the pressure source and completely filled with water.

After all air was eliminated in the hose, the relief valve was closed and pressure applied at the rate of 800 to 1,000 psi per minute until the specimen burst or reached 350 psi minimum.

HOSE NUMBER	ACTUAL PRESSURE ATTAINED, psig	MINIMUM ALLOWABLE BURST STRENGTH	PASS	FAIL
4		350 psig		

REMARKS:

RECORDED BY: _____ ; DATE: _____

APPROVED BY: _____

15. DATA SHEETS....Continued

DATA SHEET V-7

VACUUM BRAKE HOSE VACUUM TEST

GROUP NO.: _____ ; TEST DATE: _____

AMBIENT TEMPERATURE: _____ ºF.

The Outside Diameter (O.D.) of Hose #5 was measured and the hose was subjected to an internal vacuum of 25 to 26 inches of mercury for 5 minutes and the O.D. re-measured while the hose was still under vacuum. The O.D. shall not contract in excess of 1/16 inches.

Vacuum = _____ inches of Hg.

	PRETEST O.D. (in.)	AT VACUUM O.D. (in.)	CHANGE (in.)	ALLOWABLE (in.)	PASS	FAIL
Hose #5						

REMARKS:

RECORDED BY: _____ ; DATE: _____

APPROVED BY: _____

15. DATA SHEETS....Continued

DATA SHEET V-8

VACUUM BRAKE HOSE BEND TEST

GROUP NO.: _____ ; TEST DATE: _____

AMBIENT TEMP.: _____ ºF. NOMINAL HOSE ID: _____ inches

Hose #6 was cut to the length below and bent in its direction of normal curvature until the ends touched. The hose Outside Diameter (O.D.) was measured before and after bending. The allowable differences in diameters (collapse) are shown in Table 3 of the TP.

Hose Length = _____ inches

	O.D. PRIOR TO BEND (in.)	O.D. AT BEND (in.)	CHANGE (in.)	ALLOWABLE (in.)	PASS	FAIL
Hose #6						

REMARKS:

RECORDED BY: _____ ; DATE: _____

APPROVED BY: _____

15. DATA SHEETS....Continued

DATA SHEET V-9

VACUUM BRAKE HOSE SWELL TEST

GROUP NO.: _____ ; AMBIENT TEMP.: _____ ºF

HOSE TYPE: _____-VL; _____-VH; HOSE NOMINAL I.D.: _____ inches

Hose #7 was cut into a 12-inch length and filled with Reference Fuel A in accordance with ASTM D471-64. The hose was maintained at ambient temperature and pressurized for 48 hours.

	TIME	DATE
START OF TEST		
END OF TEST		
TOTAL TEST TIME (hours) =		

The **CONSTRICTION TEST** was performed in accordance with TP Paragraph 12.C.6.

HOSE NO.	HOSE END	PASS	FAIL
7	A		
	B		

The **VACUUM TEST** was performed in accordance with TP Paragraph 12.C.8.

Vacuum = _____ inches of mercury (Hg)

TEST RESULTS:

PASS	FAIL

RECORDED BY: _____ ; DATE: _____

APPROVED BY: _____

15. DATA SHEETS....Continued

DATA SHEET V-10

VACUUM BRAKE HOSE ADHESION TEST

GROUP NO.: _____ ; AMBIENT TEMPERATURE: _____ ºF

TEST DATE: _____ ; SAMPLE LENGTH: _____ inches

Hose #8 was prepared in accordance with the TP Paragraph 12.B.2 and installed in the Adhesion Test Device. The moving head travel was 1.0 in./minute with a permanent recording of tension vs. displacement.

Minimum Force Recorded (lbs.)	Adhesion Value (lbs./in.)	Minimum Allowable (lbs./in.)	PASS	FAIL
		8		

REMARKS:

RECORDED BY: _____ ; DATE: _____

APPROVED BY: _____

15. DATA SHEETS....Continued

DATA SHEET V-11

VACUUM BRAKE HOSE DEFORMATION TEST

GROUP NO.: _____ ; AMBIENT TEMPERATURE: _____ ºF

TEST DATE: _____ ; HOSE NOMINAL I.D.: _____ inches

HOSE TYPE: _____-VL; _____-VH

Hose #9 was positioned longitudinally in the compression device with the fabric laps not in the line of the applied force and a gradually increasing force was applied to the test specimen to compress its Inside Diameter (I.D.) to the dimension "D" for the size of the hose tested. After 5 seconds the force was released and the peak load recorded. The procedure was repeated 4 times permitting a 10-second recovery period between load applications.

FORCE APPLICATION		FORCE (lbs.)
1	less than 70 lbs for HD hose	
	less than 50 lbs for LD hose	
2		
3		
4		
5	more than 40 lbs for HD hose	
	more than 20 lbs for LD hose	

Hose Original O.D. = _____ inches

Compression Dimension (D) = _____ inches (from Table 4 of Paragraph 12.C.11)

Post Load O.D. = _____ inches

% of Original O.D. = _____ % (Allowable = 90%; Wire Reinforced Allowable = 85%)

PASS	FAIL

RECORDED BY: _____ ; DATE: _____

APPROVED BY: _____

15. DATA SHEETS....Continued

DATA SHEET V-12

VACUUM BRAKE HOSE SALT SPRAY TEST - 24 HOURS

GROUP NO.: _____

The hose assembly was subjected to a Salt Spray test for 24 hours in accordance with the testing method of Salt Spray (Fog) Testing ASTM B117-64.

The temperature in the salt chamber was continuously recorded.

HOSE #14	DATE	TIME	SALT SOLUTION PROP.		EVIDENCE OF RUST OR CORROSION
			Sp.Gr.@95±2ºF	Ph	
IN Cabinet					
OUT Cabinet					

TEST RESULTS:

PASS	FAIL

REMARKS: (Note all interruptions in test, cause, and length of time)

RECORDED BY: _____ ; DATE: _____

APPROVED BY: _____

15. DATA SHEETS....Continued

DATA SHEET V-13

VACUUM BRAKE HOSE TRACER CORD COLOR IDENTIFICATION TEST

GROUP NO.: _____ ; TEST DATE: _____

After completion of all tests, remove a portion of the hose outer cover in all NONFAILING samples to determine the color of the tracer cord woven into the outer braid; tracer cord may be woven into inner braid on some hose assemblies.

SPECIMEN NO.	CORD COLOR	R.M.A. IDENTIFICATION
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

REMARKS:

RECORDED BY: _____ ; DATE: _____

APPROVED BY: _____

15. DATA SHEETS....Continued

DATA SHEET P-1A

AIR BRAKE TUBING LABELING INSPECTION - HOSE

GROUP NO.: _____ ; TEST DATE: _____

TYPE ASSY: ____-Veh Specific*; ____-Aftermarket
* These types of assys are NOT subject to Label Inspection PASS/FAIL criteria.

MARKINGS ON TUBING: DOT Line-
_____
Other Line-

SAMPLE NUMBER	DATE CODE ON TUBING
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
.	
.	
23	
SPARE	

REMARKS:

RECORDED BY: _____ ; DATE: _____

APPROVED BY: _____

15. DATA SHEETS....Continued

DATA SHEET P-1B

AIR BRAKE TUBING LABELING INSPECTION - ASSEMBLY

GROUP NO.: _____; AFTERMARKET ASSY: __-Yes/__-No; TEST DATE: _____

MARKINGS ON BAND:
(Metal band unless otherwise noted)

MARKING OPTION SELECTED: ____-Yes; ____-No
(If YES, see Data Sheet A-1C for PASS/FAIL judgment)

SAMPLE NO.	DOT MARK	MANUFACTURER'S MARK	PASS, FAIL or N/A
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
.			
.			
23			

REMARKS:

RECORDED BY: _____ ; DATE: _____

APPROVED BY: _____

15. DATA SHEETS....Continued

DATA SHEET P-1C

AIR BRAKE TUBING LABELING INSPECTION - END FITTINGS

GROUP NO.: _____ ; TEST DATE: _____

TYPE OF END FITTINGS: ____Permanent*; ____Reusable
* NOT subject to Label Inspection PASS/FAIL criteria.

MARKINGS ON END FITTINGS:
(Each tubing assy end must be marked with an "A" or "B" by the lab)

SAMPLE#	"A" END	"B" END	P,F,N*
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
.			
.			
23			
SPARE			

- P = PASS, F = FAIL, N = NOT APPLICABLE

REMARKS:

RECORDED BY: _____ ; DATE: _____

APPROVED BY: _____

15. DATA SHEETS....Continued

DATA SHEET P-2

AIR BRAKE TUBING CONSTRICTION TEST

TEST DATE: _____; TUBING O.D.: _____"

AMB.TEMP.: ___ºF; PLUG SIZE USED*: _____" (NOTE: _____" Max Dia. for _____" ID hose)
* See TP Paragraph 12.B.2 for proper plug size

Each end of the tubing assembly must be marked with an "A" or "B" by the lab. The constriction of the bore was measured at both ends using the size gage plug as shown above.

SAMPLE NO.	END	PASS	FAIL	MAX. DRILL SIZE
1	A B	_____	_____	_____
2	A B	_____	_____	_____
3	A B	_____	_____	_____
4	A B	_____	_____	_____
5	A B	_____	_____	_____
6	A B	_____	_____	_____
7	A B	_____	_____	_____
8	A B	_____	_____	_____
9	A B	_____	_____	_____
10	A B	_____	_____	_____
11	A B	_____	_____	_____
.	A B	_____	_____	_____
.	A B	_____	_____	_____
23	A B	_____	_____	_____
SPARE	A B	_____	_____	_____

REMARKS:

RECORDED BY: _____ ; DATE: _____

APPROVED BY: _____

15. DATA SHEETS....Continued

DATA SHEET P-3

AIR BRAKE TUBING HIGH TEMPERATURE CONDITIONING AND DIMENSIONAL STABILITY TEST

GROUP NO.: _____ AMBIENT TEMPERATURE: _____ºF

TUBING O.D (OD) _____ inches

TUBING INSIDE DIAMETER (ID) _____ inches

TUBING THICKNESS _____ inches

Conditioned the tubing at 230 F for 4 hours.

230 F	TIME	DATE
START OF EXPOSURE		
END OF EXPOSURE		

Allowed to cool at room temperature for 30 minutes and measured the dimensions.

TUBING O.D (OD) _____ inches

TUBING INSIDE DIAMETER (ID) _____ inches

TUBING THICKNESS _____ inches

REMARKS:

RECORDED BY: _____ ; DATE: _____
APPROVED BY: _____

15. DATA SHEETS....Continued

DATA SHEET P-4

AIR BRAKE TUBING BOILING WATER CONDITIONING AND DIMENSIONAL STABILITY TEST

GROUP NO.: _____ AMBIENT TEMPERATURE: _____ºF

TUBING O.D (OD) _____ inches

TUBING INSIDE DIAMETER (ID) _____ inches

TUBING THICKNESS _____ inches

Conditioned the tubing in water at 212 F for 2 hours.

WATER @ 212 F	TIME	DATE
START OF EXPOSURE		
END OF EXPOSURE		

Allowed to cool at room temperature for 30 minutes and measured the dimensions.

TUBING O.D (OD) _____ inches

TUBING INSIDE DIAMETER (ID) _____ inches

TUBING THICKNESS _____ inches

REMARKS:

RECORDED BY: _____ ; DATE: _____
APPROVED BY: _____

15. DATA SHEETS....Continued

DATA SHEET P-5

AIR BRAKE TUBING BURST STRENGTH TEST

GROUP NO.: _____ ; HOSE TYPE: _____ ; TEST DATE: _____

AMBIENT TEMPERATURE: _____ ºF

ACTUAL PRESSURE ATTAINED, psig	PASS	FAIL

REMARKS:

RECORDED BY: _____ DATE: _____

APPROVED BY: _____

15. DATA SHEETS....Continued

DATA SHEET P-6

AIR BRAKE TUBING MOISTURE ABSORPTION AND BURST TEST

GROUP NO.: _____ AMBIENT TEMPERATURE: _____ºF

TUBING O.D (OD) _____ inches

Conditioned the tubing at 230 F for 24 hours.

230 F	TIME	DATE
START OF EXPOSURE		
END OF EXPOSURE		

Within 30 seconds after conditioning weighed the sample.

INTIAL WEIGHT: _____ grams

Placed the sample in an environmental chamber at 75 F and 100% relative humidity for 100 hours.

75 F	TIME	DATE
START OF EXPOSURE		
END OF EXPOSURE		

Within 5 minutes after conditioning weighed the sample.

CONDITIONED WEIGHT: _____ grams

Calculated percentage of moisture absorption.

Moisture Absorption = 100(Conditioned Weight – Initial Weight)/Initial Weight = _____%

Installed the end fittings and conducted the burst test.

	REQUIREMENT FROM TABLE BELOW	ACTUAL PRESSURE ATTAINED, psig	PASS	FAIL
80% Burst Pressure				

:

RECORDED BY: _____ ; DATE: _____
APPROVED BY: _____

15. DATA SHEETS....Continued

DATA SHEET P-7

AIR BRAKE TUBING ULTRAVIOLET LIGHT RESISTANCE TEST

GROUP NO.: _____ AMBIENT TEMPERATURE: _____ºF

TUBING O.D (OD) _____ inches

The sample was exposed to an irradiance level of 0.85 watts per square meter at 340 nm for 300 hours, while keeping the temperature in the chamber at 113 F at ambient humidity.

113 F	TIME	DATE
START OF EXPOSURE		
END OF EXPOSURE		

The sample was placed inside the impact test apparatus and drop the impacter into the tubing from a height of 12 inches.

Installed the end fittings and conducted the burst test.

	REQUIREMENT FROM TABLE BELOW	ACTUAL PRESSURE ATTAINED, psig	PASS	FAIL
80% Burst Pressure				

:

:

RECORDED BY: _____ ; DATE: _____
APPROVED BY: _____

15. DATA SHEETS....Continued

DATA SHEET P-8

AIR BRAKE TUBING LOW TEMPERATURE FLEXIBILITY TEST

GROUP NO.: _____ AMBIENT TEMPERATURE: _____ºF

TUBING O.D (OD) _____ inches

Conditioned the tubing at 230 F for 24 hours.

230 F	TIME	DATE
START OF EXPOSURE		
END OF EXPOSURE		

Allowed to cool at ambient for 30 minutes.

Placed the sample and the cylinder in an environmental chamber at -40 F for 4 hours.

-40 F	TIME	DATE
START OF EXPOSURE		
END OF EXPOSURE		

Bent the sample around the cylinder while at –40 F.

PASS	FAIL

REMARKS:

RECORDED BY: _____ ; DATE: _____
APPROVED BY: _____

15. DATA SHEETS....Continued

DATA SHEET P-9

AIR BRAKE TUBING HIGH TEMPERATURE FLEXIBILITY TEST

GROUP NO.: _____ AMBIENT TEMPERATURE: _____ºF

TUBING O.D (OD) _____ inches

CYLINDER RADIUS _____ inches

Bent the sample 180 degrees around the cylinder and held it in place.

Conditioned the tubing and the cylinder in an oven at 230 F for 72 hours.

230 F	TIME	DATE
START OF EXPOSURE		
END OF EXPOSURE		

Allowed to cool at ambient for 30 minutes.

Removed the clamps and straighten the tubing.

Rebent the sample 180 degrees around the cylinder (same point but opposite direction).

Conducted the burst test.

	REQUIREMENT FROM TABLE BELOW	ACTUAL PRESSURE ATTAINED, psig	PASS	FAIL
80% Burst Pressure				

:

:

RECORDED BY: _____ ; DATE: _____
APPROVED BY: _____

15. DATA SHEETS....Continued

DATA SHEET P-10

AIR BRAKE TUBING HIGH TEMPERATURE RESISTANCE TEST

GROUP NO.: _____ AMBIENT TEMPERATURE: _____ºF

TUBING O.D (OD) _____ inches

Conditioned the tubing at 230 F for 72 hours.

230 F	TIME	DATE
START OF EXPOSURE		
END OF EXPOSURE		

Allowed to cool at room temperature for 30 minutes and conducted the burst test.

	REQUIREMENT FROM TABLE BELOW	ACTUAL PRESSURE ATTAINED, psig	PASS	FAIL
80% Burst Pressure				

REMARKS:

RECORDED BY: _____ ; DATE: _____
APPROVED BY: _____

15. DATA SHEETS....Continued

DATA SHEET P-11

AIR BRAKE TUBING HIGH TEMPERATURE CONDITIONING, LOW TEMPERATURE IMPACT RESISTANCE TEST

GROUP NO.: _____ ; AMBIENT TEMPERATURE: _____ºF

TUBING O.D.: _____ inches FREE LENGTH: _____inches

230 F	TIME	DATE
START OF EXPOSURE		
END OF EXPOSURE		

Conditioned the tubing in an air oven at 230 F for 72 hours.

-40 F	TIME	DATE
START OF EXPOSURE		
END OF EXPOSURE		

Conditioned the tubing and the impact test at apparatus in an environmental chamber at –40 F for 4 hours.

After dropping the impacter remove the tubing from the chamber and allow to warm for 1 hour at ambient temperature.

AMBIENT TEMPERATURE	TIME	DATE
START OF EXPOSURE		
END OF EXPOSURE		

Plot Pressure (psig) vs. time (minutes)

	REQUIREMENT FROM TABLE BELOW	ACTUAL PRESSURE ATTAINED, psig	PASS	FAIL
80% Burst Pressure				

REMARKS:
RECORDED BY: _____ ; DATE: _____
APPROVED BY: _____

15. DATA SHEETS....Continued

DATA SHEET P-12

AIR BRAKE TUBING BOILING WATER CONDITIONING, LOW TEMPERATURE IMPACT RESISTANCE TEST

GROUP NO.: _____ ; AMBIENT TEMPERATURE: _____ºF

TUBING O.D.: _____ inches FREE LENGTH: _____inches

WATER @ 212 F	TIME	DATE
START OF EXPOSURE		
END OF EXPOSURE		

Condition the tubing and the impact test at apparatus in an environmental chamber at –40 F for 4 hours.

-40 F	TIME	DATE
START OF EXPOSURE		
END OF EXPOSURE		

After dropping the impacter remove the tubing from the chamber and allow to warm for 1 hour at ambient temperature.

AMBIENT TEMPERATURE	TIME	DATE
START OF EXPOSURE		
END OF EXPOSURE		

Plot Pressure (psig) vs. time (minutes)

	REQUIREMENT FROM TABLE BELOW	ACTUAL PRESSURE ATTAINED, psig	PASS	FAIL
80% Burst Pressure				

REMARKS:

RECORDED BY: _____ ; DATE: _____
APPROVED BY: _____

15. DATA SHEETS....Continued

DATA SHEET P-13

AIR BRAKE TUBING ZINC CHLORIDE RESISTANCE TEST

GROUP NO.: _____ AMBIENT TEMPERATURE: _____ ºF

TUBING NOMINAL O.D. _____ inches

	TIME	DATE
START OF IMMERSION TIME		
END OF IMMERSION TIME		
TOTAL IMMERSION TIME (hours) =		

The brake hose was bound around a cylinder having radius equal to the unsupported bend radius in Table VIII of S106.

CYLINDER RADIUS _____ inches

The tubing and cylinder were then exposed to a 50 percent zinc chloride aqueous solution at room temperature for 200 hours.

The hose was removed from the solution and examined under 7-power magnification.

Examination of the hose under 7-power magnification yielded the following results -

TEST RESULTS:

PASS	FAIL

REMARKS:

RECORDED BY: _____ ; DATE: _____
APPROVED BY: _____

15. DATA SHEETS....Continued

DATA SHEET P-14

AIR BRAKE TUBING METHYL ALCOHOL RESISTANCE TEST

GROUP NO.: _____ ; AMBIENT TEMPERATURE: _____ ºF

HOSE NO.: ____ ; TUBING NOMINAL O.D.: _____ inches

CYLINDER RADIUS: _____ inches

	TIME	DATE
START OF EXPOSURE		
END OF EXPOSURE		
TOTAL EXPOSURE TIME (hours) =		

The tubing and cylinder were then exposed to an aqueous solution of 95% methyl alcohol.

Examination of the hose under 7 power magnification yielded the following results.

TEST RESULTS:

PASS	FAIL

REMARKS:

RECORDED BY: _____ ; DATE: _____

APPROVED BY: _____

15. DATA SHEETS....Continued

DATA SHEET P-15

AIR BRAKE TUBING HIGH TEMPERATURE CONDITIONING AND COLLAPSE RESISTANCE TEST

GROUP NO.: _____ AMBIENT TEMPERATURE: _____ºF

TUBING O.D (OD)	
UNSUPORTED BEND RADIUS (UBR)	
DISTANCE BETWEEN PINS (DP)	
TUBING LENGTH (TL)	
Note: PC=2(BR)+OD TL= 3.14(BR) + 10(OD) + 2	

After placing a permanent mark at the center of the sample, record the initial OD.

INITIAL OD _____ inches

Install the tubing over the pins of the holding device and condition the device with the tubing at 200 F for 24 hours.

200 F	TIME	DATE
START OF EXPOSURE		
END OF EXPOSURE		

After exposure measure and record the final OD.

FINAL OD _____ inches

Calculate Percent Collapse.

%Collapse = 100(Initial OD – Final OD)/Initial OD

%Collapse: _____

REMARKS:

RECORDED BY: _____ ; DATE: _____
APPROVED BY: _____

15. DATA SHEETS....Continued

DATA SHEET P-16

AIR BRAKE TUBING OZONE RESISTANCE TEST

GROUP NO.: _____ ; AMBIENT TEMPERATURE: _____ ºF

HOSE NO.: 15 ; HOSE NOMINAL O.D.: _____ inches

CYLINDER DIAMETER = 8 x HOSE NOMINAL O.D. = _____ inches

	TIME	**DATE**
START OF TEST		
END OF TEST		
TOTAL EXPOSURE TIME (hours) =		

The brake hose was bound around a cylinder with a diameter of _____ inches and conditioned at room temperature for 24 hours.

The brake hose and cylinder were then exposed to an ozone concentration of 100 parts per 100 million by volume for 70 hours at a temperature of 104ºF.

Examination of the hose under 7-power magnification yielded the following results -

TEST RESULTS:

PASS	**FAIL**

REMARKS:

RECORDED BY: _____ ; DATE: _____

APPROVED BY: _____

15. DATA SHEETS....Continued

DATA SHEET P-17

AIR BRAKE TUBING OIL RESISTANCE TEST

GROUP NO.: _____ ; HOSE TYPE: _____ ; TEST DATE: _____

AMBIENT TEMPERATURE: _____ ºF

The sample was immersed in ASTM IRM 903 oil at 212 F for 70 hours.

ASTM IRM 903 OIL @ 212 F	TIME	DATE
START OF TEST		
END OF TEST		
TOTAL EXPOSURE TIME (hours) =		

The sample was removed and allowed to cool at ambient temperature for 30 minutes. The burst test was conducted.

	REQUIREMENT FROM TABLE BELOW	ACTUAL PRESSURE ATTAINED, psig	PASS	FAIL
80% Burst Pressure				

REMARKS:

RECORDED BY: _____ DATE: _____

APPROVED BY: _____

15. DATA SHEETS....Continued

DATA SHEET P-18

AIR BRAKE TUBING TENSILE TEST

GROUP NO._____; TEST DATE: _____ ; AMBIENT TEMP.: _____ ºF

The sample was mounted in the tensile machine so that the hose and end fittings had a straight centerline corresponding to the direction of the machine pull.

The sample was pulled at a rate of 1 inch/minute until failing as follows:

A. Hose pulled out of the end fitting
B. Hose ruptured

TABLE H6-1 - Slow Pull Test (1" per minute)

HOSE NO.	ACTUAL TOTAL LOAD AT TIME OF FAILURE (lbs)	TYPE OF FAILURE "A" or "B"	MIN. ALLOW. TENSILE STRENGTH (lbs)	PASS	FAIL
9A			325		
10A			325		
11A			325		
12A			325		

TABLE H6-1 - Fast Pull Test (2" per minute)

HOSE NO.	ACTUAL TOTAL LOAD AT TIME OF FAILURE (lbs)	TYPE OF FAILURE "A" or "B"	MIN. ALLOW. TENSILE STRENGTH (lbs)	PASS	FAIL
9B			370		
10B			370		
11B			370		
12B			370		

REMARKS:

RECORDED BY: _____ ; DATE: _____
APPROVED BY: _____

15. DATA SHEETS....Continued

DATA SHEET P-19

AIR BRAKE TUBING BOILING WATER CONDITIONING AND TENSILE TEST

GROUP NO.: _____ ; AMBIENT TEMPERATURE: _____ºF

TUBING O.D.: _____ inches FREE LENGTH: _____inches

WATER @ 212 F	TIME	DATE
START OF EXPOSURE		
END OF EXPOSURE		

The hose assemblies were mounted in the tensile machine so that the hose and end fittings had a straight centerline corresponding to the direction of the machine pull.
Record when either the required load or a free length of 9” is achieved.

Tensile Test (1" per minute)

ACTUAL LOAD (lbs)	REQUIRED LOAD	PASS	FAIL
OR			
ACTUAL FREE LENGTH	**REQUIRED FREE LENGTH**		
	9”		

RECORDED BY: _____ ; DATE: _____
APPROVED BY: _____

15. DATA SHEETS....Continued

DATA SHEET P-20

AIR BRAKE TUBING THERMAL CONDITIONING AND TENSILE TEST

GROUP NO.: _____ ; AMBIENT TEMPERATURE: _____ ºF
TUBING O.D.: _____ inches

-40 F	TIME	DATE
START OF EXPOSURE		
END OF EXPOSURE		
AMBIENT TEMPERATURE		
START OF EXPOSURE		
END OF EXPOSURE		
WATER @ 212 F		
START OF EXPOSURE		
END OF EXPOSURE		
AMBIENT TEMPERATURE		
START OF EXPOSURE		
END OF EXPOSURE		

The hose assemblies were mounted in the tensile machine so that the hose and end fittings had a straight centerline corresponding to the direction of the machine pull.
Record when either the required load or a free length of 9” is achieved.

Tensile Test (1" per minute)

ACTUAL LOAD (lbs)	REQUIRED LOAD	PASS	FAIL
OR			
ACTUAL FREE LENGTH	**REQUIRED FREE LENGTH**		
	9”		

RECORDED BY: _____ ; DATE: _____
APPROVED BY: _____

15. DATA SHEETS....Continued

DATA SHEET P-21
AIR BRAKE TUBING VIBRATION RESISTANCE TEST

GROUP NO.: _____ ; AMBIENT TEMPERATURE: _____ ºF

FREE LENGTH: _____

INITIAL TIGHTENING TORQUE: _____

Plot:

Up to 1,000,000 cycles

Chamber Temperature vs. Cycles (up to 1,000,000 cycles)
Camber Temperature vs. Time (up to one hour after 1,000,000 cycles)

For the last 100 cycles

Flow rate (cm^3/min) vs. cycles

After 1,000,000 cycles

Flow rate (cm^3/min) vs. time
Temperature vs. time

One hour after reaching 1,000,000 cycles – 20% Initial Tightening Torque: _____

TEST RESULTS:

PASS	FAIL

REMARKS:

RECORDED BY: _____ ; DATE:

APPROVED BY: _____

15. DATA SHEETS....Continued

DATA SHEET P-22

AIR BRAKE TUBING END FITTING RETENTION TEST

GROUP NO.: _____ ; TEST DATE: _____ AMBIENT TEMPERATURE: _____ ºF

Plot Pressure (psig) vs. time (minutes)

	REQUIREMENT FROM TABLE BELOW	ACTUAL PRESSURE ATTAINED, psig	PASS	FAIL
50% Burst Pressure				
Burst Pressure				

REMARKS:

RECORDED BY: _____ DATE: _____

APPROVED BY: _____

15. DATA SHEETS....Continued

DATA SHEET P-23

AIR BRAKE TUBING THERMAL CONDITIONING AND END FITTING RETENTION TEST

GROUP NO.: _____ ; AMBIENT TEMPERATURE: _____ºF

TUBING O.D.: _____ inches

Fill the sample with ASTM IRM 903 oil, connect to a source of hydraulic pressure. Insert in an environmental chamber apply atmospheric pressure. Set the temperature in the chamber to 200 F. Condition the tubing for 24 hours.

200 F	TIME	DATE
START OF EXPOSURE		
END OF EXPOSURE		

Increase the pressure at a rate of 3000 psi/min to 450 psi and hold for 5 minutes. Decrease the pressure to atmospheric and condition the tubing the environmental chamber at 75 F for 1 hours.

75 F	TIME	DATE
START OF EXPOSURE		
END OF EXPOSURE		

Condition the sample in the environmental chamber at -40 F for 24 hours.

AMBIENT TEMPERATURE	TIME	DATE
START OF EXPOSURE		
END OF EXPOSURE		

Increase the pressure at a rate of 3000 psi/min to 450 psi and hold for 5 minutes.

Plot Pressure (psig) vs. time (minutes)

REMARKS:

RECORDED BY: _____ ; DATE: _____
APPROVED BY: _____

15. DATA SHEETS....Continued

DATA SHEET P-24

AIR BRAKE TUBING END FITTING SERVICEABILITY TEST

GROUP NO.: _____ ; TEST DATE: _____ AMBIENT TEMPERATURE:_____ ºF

After assembly/disassembly sequence, pressurize the test item to 120 psig and hold for 20 seconds.

Plot Pressure (psig) vs. time (seconds)

Flow rate (cm^3/min) vs. time

TEST RESULTS:

Leakage Present: NO ____ Yes _____ Leakage rate: _____

PASS	FAIL

REMARKS:

RECORDED BY: _____ DATE: _____

APPROVED BY: _____

15. DATA SHEETS....Continued

DATA SHEET P-25

AIR BRAKE TUBING END FITTING CORROSION TEST

GROUP NO.: _____

The sample was subjected to a Salt Spray test for 24 hours in accordance with the testing method of Salt Spray (Fog) Testing ASTM B117-03.

The temperature in the salt chamber and the air supply (psig) were continuously recorded.

HOSE #14	DATE	TIME	SALT SOLUTION PROP.		EVIDENCE OF RUST OR CORROSION
			Sp.Gr.@95±2ºF	Ph	
IN Cabinet					
OUT Cabinet					

TEST RESULTS:

PASS	FAIL

REMARKS: (Note all interruptions in test, cause, and length of time)

RECORDED BY: _____ ; DATE: _____
APPROVED BY: _____

16. FORMS

LABORATORY NOTICE OF TEST FAILURE TO OVSC

FMVSS 106 TEST DATE: _____

LABORATORY: _____

CONTRACT NO.: _____; DELV. ORDER NO.: _____

LABORATORY PROJECT ENGINEER'S NAME: _____

TEST SPECIMEN DESCRIPTION - -

MANUFACTURER: _____

MODEL: _____

_____

PART NO.: _____

TEST FAILURE DESCRIPTION: _____

_____

_____

FMVSS REQUIREMENT, PARAGRAPH §____ : _____

_____

_____

_____

NOTIFICATION TO NHTSA (COTR): _____

DATE: _____ BY: _____

REMARKS:

16. FORMS....Continued

MONTHLY INVENTORY STATUS REPORT

FMVSS 106

DATE OF REPORT:

GROUP NO.	MANUFACTURER'S NAME	MODEL	NUMBER OF SPECIMENS RECEIVED	CONDITION OF SAMPLE	DATE RECEIVED
001					
002					
003					
004					
005					
006					
007					
008					
009					
010					
011					
012					
013					
014					
015					
016					
017					
018					
019					
020					

REMARKS:

16. FORMS....Continued

MONTHLY TEST STATUS REPORT

FMVSS 106

DATE OF REPORT:

GROUP NO.	VEHICLE MANUFACTURER AND MODEL	TEST START DATE	TEST COMPLETE DATE	PASS / FAIL	DATE FINAL REPORT SUBMITTED
001					
002					
003					
004					
005					
006					
007					
008					
009					
010					
011					
012					
013					
014					
015					
016					
017					
018					
019					
020					

REMARKS:

APPENDIX A

INTERPRETATIONS OR DEVIATIONS FROM FMVSS 106

This Test Procedure (TP) is written in coordination with FMVSS 106 and is in no way intended to conflict with the requirements set forth in the standard and must be followed by the laboratory while conducting minimum performance compliance tests to FMVSS 106 for the Office of Vehicle Safety Compliance (OVSC), National Highway Traffic Safety Administration (NHTSA). If the testing laboratory interprets any part of this procedure to be in conflict with FMVSS 106, it will advise the Contracting Officer's Technical Representative (COTR) and resolve the discrepancy prior to testing to FMVSS 106.

Interpretations and/or deviations from this TP shall be shown in Appendix A of the Final Test Report.

APPENDIX B

EQUIPMENT LIST AND CALIBRATION SCHEDULES

TEST GROUP NO.: _____ ; INSP. DATE:_____

TESTING LABORATORY: _____

NOTE: Information to be included for each item of test instrumentation is as follows:

EQUIPMENT DESCRIPTION: _____

EQUIPMENT MANUFACTURER: _____

TYPE AND/OR MODEL: _____

SERIAL NUMBER: _____

LIMITS: _____

ACCURACY: _____

FREQUENCY OF CALIBRATION: _____

EXPIRATION OF CALIBRATION: _____

USED ON TEST NUMBER: _____

REMARKS:

RECORDED BY: _____ ; DATE:_____

APPROVED BY: _____

APPENDIX C

PHOTOGRAPHS

The test setup and equipment used therein are to be photographed for the record and the photographs inserted in this Appendices or a part of the Final Test Report. Normally one photograph of the test setup and equipment will suffice unless the setup is complicated and/or spread out thereby requiring two or more photographs. The equipment in the photos must agree with those items noted in Appendix B. Each photo must be accompanied by a suitable caption.