

TP-121D-01
May 9, 1990

U.S. DEPARTMENT OF TRANSPORTATION
NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION

LABORATORY TEST PROCEDURE

FOR

FMVSS 121D

Air Brake Systems - Dynamometer



SAFETY ASSURANCE
Office of Vehicle Safety Compliance
Room 6111, NSA-30
400 Seventh Street, SW
Washington, DC 20590

OVSC LABORATORY TEST PROCEDURE NO. 121D
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1. PURPOSE AND APPLICATION

The Office of Vehicle Safety Compliance (OVSC) provides contractor laboratories with Laboratory Test Procedures as guidelines for obtaining compliance test data. The data are used to determine if a specific vehicle or item of motor vehicle equipment meets the minimum performance requirements of the subject Federal Motor Vehicle Safety Standard (FMVSS). The purpose of the OVSC Laboratory Test Procedures is to present a uniform testing and data recording format, and provide suggestions for the use of specific equipment and procedures. If any contractor views any part of an OVSC Laboratory Test Procedure to be in conflict with a Federal Motor Vehicle Safety Standard (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.

Every contractor is required to submit a detailed test procedure to the COTR before initiating the compliance test program. The procedure must include a step-by-step description of the methodology to be used. The contractor's test procedure shall contain a complete listing of test equipment with make and model number and a detailed check-off sheet. 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. The OVSC Laboratory Test Procedures 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 Laboratory Test Procedures do not constitute an endorsement or recommendation for use of any product or method. However, the application of any such testing technique or equipment is subject to prior approval of the COTR.

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

1. PURPOSE AND APPLICATION....Continued

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

This standard establishes performance and equipment requirements for braking systems on trucks, buses, and trailers equipped with air brakes. Testing to the standard requires both vehicle and dynamometer tests. A test procedure has been developed for each category. This test procedure is for testing brake assemblies on a dynamometer.

3. SECURITY

The contractor shall provide appropriate security measures to protect the OVSC test vehicles, items of motor vehicle equipment, and Government Furnished Property (GFP) such as test dummies, 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, items of motor vehicle equipment and GFP. Any security problems which arise shall be reported by telephone to the Industrial Property Manager (IPM), Office of Contracts and Procurement, within two working days after the incident. A letter containing specific details of the security problem will 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 and test dummy calibration (if applicable) before and after each vehicle or item of motor vehicle equipment test. No information concerning the vehicle or equipment item safety compliance testing program, including dummy calibration data (if applicable), shall be released to anyone except the COTR, unless specifically authorized by the COTR or the COTR's Branch or Division Chief.

NOTE: NO INDIVIDUALS, OTHER THAN CONTRACTOR PERSONNEL DIRECTLY INVOLVED IN THE COMPLIANCE TESTING PROGRAM, SHALL BE ALLOWED TO WITNESS ANY COMPLIANCE TEST UNLESS SPECIFICALLY AUTHORIZED BY THE COTR OR THE COTR'S SUPERVISOR.

4. GOOD HOUSEKEEPING

Contractors shall maintain the item of motor vehicle equipment compliance testing area, test 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 testing. Tests shall be completed as required in the contract. Scheduling shall be adjusted to permit sample motor vehicles to be tested to other FMVSS as may be required by the OVSC. All testing shall be coordinated to allow monitoring by the FMVSS 121D COTR.

6. TEST DATA DISPOSITION

The contractor shall make all vehicle and equipment item preliminary compliance test data available to the COTR on location within 4 hours after the test. Final test data, including digital printouts and computer generated plots (if applicable), shall be furnished to the COTR within 5 working days. The contractor shall analyze the preliminary test results as directed by the COTR. Backup data sheets, strip charts, recordings, plots, technician's notes, etc., shall be either sent to the COTR or destroyed at the conclusion of each delivery order, purchase order, etc.

7. GOVERNMENT FURNISHED PROPERTY (GFP)

ACCEPTANCE OF EQUIPMENT

All equipment items will be inventoried upon receipt and checked against the shipping documents. Any missing or broken parts will be reported immediately to the COTR. A running inventory list will be maintained until the complete matrix list of test samples is received.

NOTIFICATION OF COTR

The COTR must be notified within 24 hours after all brake and, if required, axle components have been delivered.

8. CALIBRATION OF TEST INSTRUMENTS

Before the contractor initiates the safety compliance test program, a test instrumentation calibration system will be implemented and maintained in accordance with established calibration practices. Guidelines for setting up and maintaining such calibration systems are described in MIL-C-45662A, "Calibration System Requirements". The calibration system shall be set up and maintained as follows:

- A. Standards for calibrating the measuring and test equipment will 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 TO EXCEED TWELVE (12) MONTHS! 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 will 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:
 - (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)
- E. Records of calibration for all test instrumentation shall be kept by the contractor in a manner which assures the maintenance of established calibration schedules. All such records shall be readily available for inspection when requested by the COTR. The calibration system will need the acceptance of the COTR before the test program commences.

9. PHOTOGRAPHIC DOCUMENTATION

Photographs shall be black and white, 8 x 10 inches, and legible. A tag, label or placard identifying the test vehicle model and NHTSA number shall appear in each photograph and be legible. Each photograph shall be labeled as to subject matter. As a minimum the following photographs shall be included:

- A. Thermocouple installations
- B. Dynamometer with test setup

10. DEFINITIONS

ANTI-LOCK BRAKING SYSTEM (ABS)

Portion of service brake system that automatically controls the degree of rotational wheel slip at one or more road wheels of the vehicle during braking

GROSS AXLE WEIGHT RATING (GAWR)

Value specified by vehicle manufacturer as the load-carrying capacity of a single axle system as measured at the tire-ground interfaces

INITIAL BRAKE TEMPERATURE

Average temperature of brake friction material 18 seconds before brake application

FINAL BRAKE TEMPERATURE

Temperature 0.1 seconds after brake release

PRESSURE

Force per unit area exerted by the compressed air in brake application or release mechanisms

SNUB

Braked decrease in RPM, but not to 0 RPM

10. DEFINITIONS....Continued

STATIC LOADED RADIUS (SLR)

Effective radius of tire(s) when loaded to weight born by tire(s) with axle loaded to the GAWR — obtain value from manufacturer of tires on vehicle

TEST ARTICLE

Composed of complete brake assembly, the drum or disc and hub or wheel assembly, and supporting bearings. In event that brake components such as air chambers or cam shafts are supported by weldments to the axle, it will be necessary to include one-half of the axle or axle housing assembly as well. Any air/hydraulic booster and hydraulic system necessary for proper operation must be utilized. One brake from each axle will tested.

11. PRETEST REQUIREMENTS

TEST EQUIPMENT SPECIFICATIONS

The dynamometer must have provision for the following:

- A. Inertia brake dynamometer complete with electronic console with an inertia range between 250 and 1,500 slug-feet² in minimum increments to obtain any required inertia within + 0%, - 2%.
- B. Constant pressure control with ± 1 psi from 20 to 80 psi.
- C. Constant torque control within ± 100 ft lb for pressure rate changes not in excess of 20 psi per second.
- D. Temperature control within $\pm 10^{\circ}\text{F}$.
- E. Time control within ± 1 second for repetitive cycles.
- F. Speed control within 1 mph.
- G. Pressure response time capable of reaching 60 psi from a supply pressure of 100 psi in not more than 0.25 seconds with a 50 inch³ test reservoir.

11. PRETEST REQUIREMENTS....Continued

- H. Permanent recording.
- I. Simultaneous direction of air uniformly and continuously over the brake drum or disc at a velocity of $2,200 \pm 200$ fpm.
- J. Inertia shaft drag of less than 30 ft-lb

PRETEST DATA COLLECTION

The following information is available from the COTR and should be obtained prior to starting testing:

- A. Manufacturer's manual or detailed information on:
 - (1) Plumbing, electrical, and antilock systems.
 - (2) Brake, wheel drum or disc, and axle assembly; installation removal and adjustment procedures.
 - (3) Part number identification for brake system components, axles.
- B. Static loaded radius of tires at GAWR at tire inflation pressure for GVWR.
- C. Manufacturer's brake adjustment procedure.

OPERATING TEST PROCEDURE

Before starting the test program, the contractor shall provide a written operating test procedure which includes a step-by-step description of the test methodology used in the program. Where appropriate, the test procedure will include items such as check-off lists and individual worksheets for each testing phase. The operating test procedure will need the acceptance of the COTR before testing commences. Every sheet of any document relating to a test must contain the vehicle, NHTSA number, and date. Data is to be recorded in every data blank or, if not applicable, insert NA. Corrections are to be made by drawing a line through the data, leaving it legible, and inserting the corrected entry. Corrections are to be initialed and dated.

11. PRETEST REQUIREMENTS....Continued

DYNAMOMETER TEST CONDITIONS

The ambient air temperature shall be between 75°F and 100°F. Air at ambient temperature shall be directed uniformly and continuously over the brake drum or disc at a velocity of 2200 fpm \pm 200 fpm. Increase brake temperature to a specified level by conducting one or more stops from 40 mph at a deceleration of 10.0 feet/second/second. Decrease brake temperature to a specified level by rotating the drum or disc at a constant 30 mph (equivalent RPM).

TEST PREPARATION

- A. Verify the accuracy of the instrumentation used to indicate and record RPM, torque, applied air pressure, and brake temperature.
- B. Install a thermocouple at the center of the most heavily loaded shoe or pad as shown on the next page. The thermocouple shall be installed 0.5" to 1.0" from any edge or any center groove of a segmented lining. A second thermocouple shall be installed within 0.5" of the first at a depth of 0.060" to be used only if the first malfunctions.
- C. Obtain the following brake components intact from the vehicle for the test.
 - (1) Drum or disc and hub wheel assemblies.
 - (2) Bearings
 - (3) Brake assembly including slack adjusters and air chambers. Prior to removal of brake assembly, measure (\pm 0.001") distance from friction material surface to the axle centerline at 4 points along the shoe circumference 0.05" to 1.0" in from each edge with shoes secured to prevent movement with metal banding material. Use care while banding not to damage linings or distort shoes by tightening to tightly. Padding may be used provided it does not permit banding to loosen prior to installation on the dynamometer. Record readings for use at that time.
 - (4) One-half of the axle or axle housing assembly if brake spider, air chamber bracket, or camshaft bracket are welded to the axle assembly.

11. PRETEST REQUIREMENTS....Continued

- D. Replace all brake and axle components parts damaged during the test. Use only identical replacement parts with exact parts numbers as specified by vehicle manufacturer or component part manufacturer.
- E. Attach the brake and drum to the dynamometer using fixtures and/or axle components to properly simulate as nearly as practical the actual mounting configuration on the vehicle. The drum and hub on the wheel must be installed on the bearings removed from the vehicle. Brake lining measurements must be within plus or minus 0.005" of those taken on the vehicle.
- F. Equivalent RPM is calculated from the formula:

$$R = (168.07 \times M) / \text{SLR}, \text{ where --}$$

$$R = \text{Rate of drum or disc rotation on the dynamometer in RPM}$$

$$168.07 = \text{Constant of proportionality.}$$

$$M = \text{Equivalent vehicle speed in miles per hour}$$

$$\text{SLR} = \text{Static Loaded Radius of tire used on vehicle in inches}$$
- G. Adjust dynamometer controls for the proper RPM(s).
- H. Determine the dynamometer inertia equivalent to the GAWR for the applicable vehicle axle. Inertia is calculated from the formula:

$$I = (W \times \text{SLR}^2) / 2G, \text{ where --}$$

$$I = \text{Moment of inertia of dynamometer fly-wheel in slug ft}^2$$

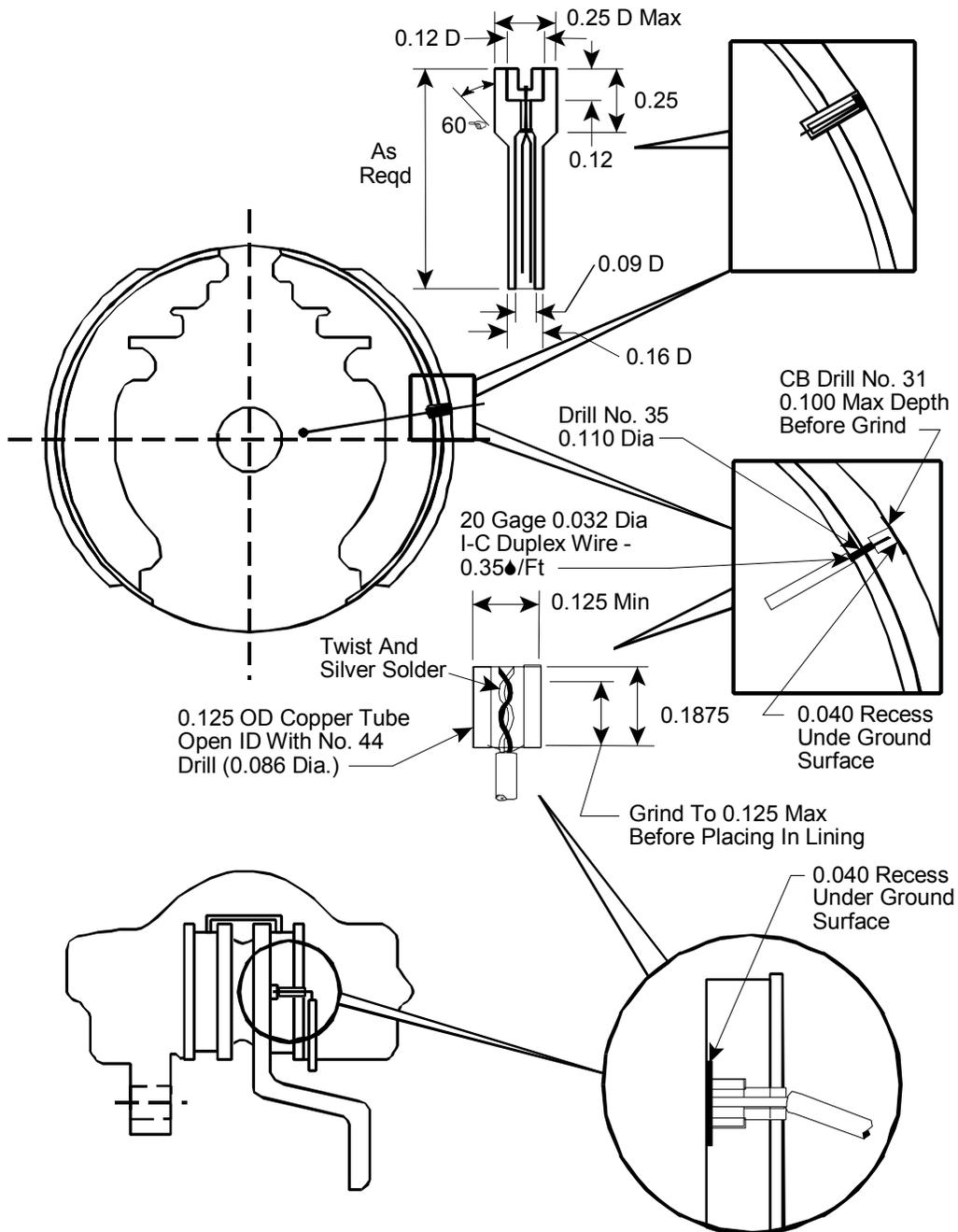
$$W = \text{GAWR rating in pounds}$$

$$\text{SLR} = \text{Static loaded radius in feet}$$

$$G = \text{Gravity (32.2 f/s/s)}$$
- Select a test inertia (I_t) that is within +0% and -2% of the calculated value (I). Attach the appropriate flywheels to the dynamometer inertia shaft.

11. PRETEST REQUIREMENTS....Continued

TYPICAL PLUG TYPE THERMOCOUPLE INSTALLATION



11. PRETEST REQUIREMENTS....Continued

- I. Determine the torque required to achieve the appropriate deceleration rates. The torque is calculated from the formula:

$$T = (I_a \times D)/SLR, \text{ where --}$$

T = Torque in foot pounds

I_a = Actual inertia used

D = Deceleration rate (ft/s/s)

SLR = Static loaded radius in feet

Adjust the dynamometer controls for the calculated torque(s).

- J. Make final adjustment to provide appropriate deceleration. If the air chamber incorporates a spring brake application mechanism fully cage the spring with the tool provided in accordance with the manufacturer's instructions.

Alternative: Supply 90 psi minimum to spring brake air port.

- K. Record initial settings of controls for RPM, torque, air pressure, temperature, time, ramp rate and any other parameter affecting the test. Indicate changes made during the test on the appropriate data sheet.
- L. Complete test parameters on specification data sheet.

12. COMPLIANCE TEST EXECUTION

BURNISH (Paragraph S6.2.6)

Brakes are burnished before testing as follows:

Place the brake assembly on an inertia dynamometer and adjust the brake as recommended by the brake manufacturer. Make 200 stops from 40 mph at a deceleration of 10 ft/s/s, with an initial brake temperature on each stop of not less than 315°F and not more than 385°F. Make 200 additional stops from 40 mph at a deceleration of 10 ft/s/s, with an initial brake temperature on each stop of not less than 450°F and not more than 550°F. The brakes may be adjusted up to 3 times during the burnish procedure at intervals specified by the vehicle manufacturer, and may be adjusted at the conclusion of the burnishing in accordance with the vehicle manufacturer's recommendation.

12. COMPLIANCE TEST EXECUTION....Continued

PROCEDURE:

- A. Adjust brakes per brake manufacturer's instructions. Attach a copy of manufacturer's instruction manual.
- B. Warm brake to test temperature (315°F to 385°F) by making stops from the RPM equivalent to 40 mph at a deceleration rate of 10 ft/s/s plus or minus 0.15 ft/s/s at a time interval not less than 90 seconds, unless necessary to achieve the test temperature.
- C. Make 200 stops from 40 mph equivalent RPM at 10 ft/s/s from an initial brake temperature of 315°F to 385°F. For each stop, record RPM, initial brake temperature, air pressure, torque, and stop time for the first and every twentieth stop.
- D. Cool brake by rotating the drum at 30 mph equivalent RPM until the brake cools to 90°F to 100°F, before adjusting of brakes if necessary.
- E.. Repeat item B to achieve test temperature of 450°F to 550°F with an interval of not less than 60 seconds, unless necessary to achieve temperature.
- F. Repeat item C for an initial brake temperature of 450°F to 550°F.
- G. Repeat item D.
- H. Observe brake pads and record percent lining contact.

NOTE: Brakes with automatic adjuster will not need adjustment.

BRAKE RETARDATION FORCE (Paragraphs S5.4.1 & S5.4.1.1)

Paragraph S5.4.1 — The sum of the retardation forces exerted by the brakes on each vehicle designed to be towed by another vehicle equipped with air brakes shall be such that the quotient

$$\frac{(\text{Sum of Brake Retardation Forces})}{(\text{Sum of GAWR's})}$$

relative to brake chamber air pressure, shall have values not less than those shown in Column 1 of Table III. Retardation force shall be determined as follows:

12. COMPLIANCE TEST EXECUTION....Continued

TABLE III
BRAKE RETARDATION FORCE

Brake Retardation Force/GAWR	Brake Chamber Pressure (psi)
Column 1	Column 2
0.05	20
0.12	30
0.18	40
0.25	50
0.31	60
0.37	70
0.41	80

Paragraph S5.4.1.1 — After burnishing the brake pursuant to §6.2.6, retain the brake assembly on the inertia dynamometer. With an initial brake temperature between 125°F and 200°F, conduct a stop from 50 mph maintaining brake chamber air pressure at a constant 20 psi. Measure the average torque exerted by the brake from the time the specified air pressure is reached until the brake stops and divide by the static loaded tire radius specified by tire manufacturer to determine the retardation force. Repeat the procedure 6 times, increasing the brake chamber air pressure by 10 psi. After each stop, rotate the brake drum or disc until the temperature of the brake falls to between 125°F and 200°F.

PROCEDURE:

- A. Warm the brake to a temperature of 125°F to 200°F or cool the brake by rotating drum or disc at 30 mph (equivalent RPM) until cooled to 125°F to 200°F.

12. COMPLIANCE TEST EXECUTION....Continued

- B. With an initial brake temperature between 125°F to 200°F make a stop from 50 mph (equivalent RPM) with a constant 20 psi air pressure. Measure the average torque from the time the air pressure reached 20 psi until the drum or disc stops. Divide this value by the static loaded radius to obtain the brake retardation force and by the load (GAWR)/2 to obtain the ratio. Record the RPM, initial brake temperature, air pressure, torque and stop time.
- C. After cooling at 30 mph equivalent RPM, repeat item B at 10 psi increments up to and including 80 psi.
- D. Cool brake by rotating drum or disc at 30 mph (equivalent RPM).

BRAKE POWER (Paragraph S5.4.2)

Paragraph S5.4.2 — When mounted on an inertia dynamometer, each brake shall be capable of making 10 consecutive decelerations at an average rate of 9 ft/s/s from 50 mph to 15 mph, at equal intervals of 72 seconds, and shall be capable of decelerating to stop from 20 mph at an average deceleration rate of 14 ft/s/s one minute after the 10th deceleration. The series of decelerations shall be conducted as follows:

Paragraph S5.4.2.1 — With an Initial brake temperature between 150°F and 200°F for the first brake application, and the drum or disc rotating at a speed equivalent to 50 mph, apply the brake and decelerate at an average deceleration rate of 9 ft/s/s to 15 mph. Upon reaching 15 mph, accelerate to 50 mph and apply the brake for a second time 72 seconds after the start of the first application. Repeat the cycle until 10 decelerations have been made. The service line air pressure shall not exceed 100 psi during any deceleration.

Paragraph S5.4.2.2 — One minute after the end of the last deceleration required by Paragraph S5.4.2.1 and with the drum or disc rotating at a speed of 20 mph, decelerate to a stop at an average deceleration rate of 14 ft/s/s.

12. COMPLIANCE TEST EXECUTION....Continued

BRAKE RECOVERY (Paragraph S5.4.3)

Starting 2 minutes after completing tests required by Paragraph S5.4.2, (the brake of a vehicle other than either front axle brake of a truck tractor), shall be capable of making 20 consecutive stops from 30 mph at an average deceleration rate of 12 ft/s/s, at equal intervals of 1 minute measured from the start of each brake application. The service line air pressure needed to attain a rate of 12 ft/s/s shall be not more than 85 lb/in², and not less than 20 lb/in² for a brake not subject to the control of an antilock braking system, or 12 lb/in² for a brake subject to the control of an antilock system.

NOTE: Front axle brakes on a truck-tractor are not subject to the requirements set forth in S5.4.3 Front axle brakes on a bus or truck are not subject to the minimum pressure requirements.

DEFINITION:

Average Deceleration Rate: The change in velocity divided by the deceleration time measured from the onset of deceleration. (For purposes of the requirements of Paragraphs S5.4.2 and S5.4.3)

NOTE: Timed sequence must be followed exactly. Tolerance on time intervals: - 0 to +1 seconds. Tolerance on deceleration rates are as follows:

+0 to -1 ft/s/s, except for 12 ft/s/s: ± 0.5 ft/s/s.

- A. Set maximum supply pressure to 100 psi.
- B. Warm the brake as in the burnish procedure to a temperature between 150°F to 200°F or cool the brake by rotating the drum or disc at 30 mph equivalent RPM.
- C. Subject the brake to 10 consecutive decelerations at an average rate of 9 ft/s/s from 50 mph equivalent RPM to 15 mph equivalent RPM at 72 second intervals with an initial brake temperature between 150°F and 200°F for the first deceleration only. Record RPM, brake temperature, air pressure, torque and stop time.

12. COMPLIANCE TEST EXECUTION....Continued

- D. One minute after the last deceleration in item B, energize brake while rotating at a speed equivalent to 20 mph (equivalent RPM) at a deceleration rate of 14 ft/s/s. Record RPM, brake temperature, air pressure and torque.
- E. Two minutes after the deceleration of item C, subject the brake to a series of 20 consecutive stops from 30 mph (equivalent RPM) at 12 ft/s/s at one minute intervals measured from the start of each stop. Record RPM, brake temperature, air pressure and torque.
- F. Cool the brake by rotating drum or disc at 30 mph (equivalent RPM) until the brake cools to 90°F to 100°F. Remove brake, components and fixtures from dynamometer and examine brake for evidence of visual defects.

13. POST TEST REQUIREMENTS

Remove fixture and brake assembly from the dynamometer. Mark brake assembly components with NHTSA identification number.

14. REPORTS

14.1 MONTHLY STATUS REPORTS

The contractor shall submit a monthly Test Status Report to the COTR. A sample of the required report is found in the report forms section.

14.2 APPARENT TEST FAILURE

Any indication of an test failure shall be communicated by telephone to the COTR within 24 hours with written notification mailed within 48 hours (Saturday and Sunday hours excluded). A Notice of Test Failure (see report forms section) with a copy of the particular compliance test data sheet(s) and preliminary data plot(s) shall be included. If possible repeat that portion of the test where the failure was noted to ensure that there is a test failure. 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. REPORTS....Continued

14.3 FINAL TEST REPORTS

14.3.1 COPIES

In the case of an apparent 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 "Report Section".

Where there has been no indication of an apparent noncompliance, three copies of each Final Test Report shall be submitted to the COTR for acceptance within three weeks of test completion. No payment of contractor's invoices for conducting compliance tests will be made prior to the Final Test Report acceptance by the COTR. Contractors are requested to NOT submit invoices before the COTR is provided with copies of the Final Test Report.

Contractors are required to submit the first Final Test Report in draft form within one week 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.

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 for standardization.

14. REPORTS....Continued

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 121D-ABC-0X-001, where --

121D is the FMVSS tested (121-Dynamometer)
 ABC are the initials for the test laboratory (contractor)
 0X is the Fiscal Year of the test program (after year 1999)
 001 is the Group Number (001 for the 1st test,
 002 for the 2nd test, etc.)

- (2) Final Report Title And Subtitle such as

SAFETY COMPLIANCE TESTING FOR FMVSS 121D
 Air Brake Systems — Dynamometer

Name of Vehicle Manufacturer
 Model Year, Make and Model of Vehicle
 Axle Manufacturer and Part Number
 NHTSA No. for Test Vehicle (if available)

- (3) Contractor's Name and Address such as

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

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

- (4) Date of Final Report completion

- (5) The words "FINAL REPORT"

14. REPORTS....Continued

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

U. S. DEPARTMENT OF TRANSPORTATION
National Highway Traffic Safety Administration
Safety Assurance
Office of Vehicle Safety Compliance
400 Seventh Street, SW
Room 6111 (NSA-30)
Washington, DC 20590

14. REPORTS....Continued

B. FIRST PAGE AFTER FRONT COVER

A disclaimer statement and an acceptance signature block for the COTR shall be provided as follows

This publication is distributed by the U. S. Department of Transportation, National Highway Traffic Safety Administration, in the interest of information exchange. The 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. The United States Government does not endorse products or manufacturers.

Prepared By: _____

Approved By: _____

Approval Date: _____

FINAL REPORT ACCEPTANCE BY OVSC:

Accepted By: _____

Acceptance Date: _____

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

121D-ABC-0X-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 121D Compliance Testing of 200X Ace Truck, Madewell Axle No. XXXX, NHTSA No. CX0701

Block 5 — REPORT DATE

March 1, 200X

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

14. REPORTS....Continued

Block 9 — PERFORMING ORGANIZATION NAME AND ADDRESS

ABC Laboratories
405 Main Street
Detroit, MI 48070

Block 10 — WORK UNIT NUMBER

Leave blank

Block 11 — CONTRACT OR GRANT NUMBER

DTNH22-0X-D-12345

Block 12 — SPONSORING AGENCY NAME AND ADDRESS

US Department of Transportation
National Highway Traffic Safety Administration
Safety Assurance
Office of Vehicle Safety Compliance
400 Seventh Street, SW
Mail Code: NSA-30, Room 6111
Washington, DC 20590

Block 13 — TYPE OF REPORT AND PERIOD COVERED

Final Test Report
Feb. 15 to Mar. 15, 200X

Block 14 — SPONSORING AGENCY CODE

NSA-30

Block 15 — SUPPLEMENTARY NOTES

Leave blank

14. REPORTS....Continued

Block 16 — ABSTRACT

Compliance tests were conducted on the subject axle assembly in accordance with the specifications of the Office of Vehicle Safety Compliance Test Procedure No. TP-121D-0X for the determination of FMVSS 121D compliance. 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.

Block 17 — KEY WORDS

Compliance Testing
FMVSS 121D

Block 18 — DISTRIBUTION STATEMENT

Copies of this report are available from —

NHTSA Technical Information Services (TIS)
Mail Code: NAD-40, Room 5108
400 Seventh Street, SW
Washington, DC 20590
Telephone No.: 202-366-4946

Block 19 — SECURITY CLASSIFICATION OF REPORT

Unclassified

Block 20 — SECURITY CLASSIFICATION OF PAGE

Unclassified

Block 21 — NUMBER OF PAGES

Add appropriate number

14. REPORTS....Continued

Block 22 — PRICE

Leave blank

14.4. TABLE OF CONTENTS

Final test report Table of Contents shall include the following:

Section 1 — Purpose of Compliance Test

Section 2 — Test Data Summary

Section 3 — Test Data

Section 4 — Test Equipment List and Calibration Information

Section 5 — Photographs

Section 6 — Notice of Test Failure (if applicable)

15. DATA SHEETS

DYNAMOMETER TEST SUMMARY

S5.4.1.1 - BRAKE RETARDATION FORCE RATIO

REQUIRED		ACTUAL		PASS/ FAIL
AIR PRESSURE	RETARDATION FORCE RATIO (Min)	AIR PRESSURE (psi)	RETARDATION FORCE RATIO	
20 psi	0.05			
30 psi	0.12			
40 psi	0.18			
50 psi	0.25			
60 psi	0.31			
70 psi	0.37			
80 psi	0.41			

S5.4.2.1 - BRAKE POWER PHASE — Reqmt: Max Pressure During Stops 100 psi

SNU B	AIR PRESSURE (psi)	PASS/FAIL	REMARKS
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

15. DATA SHEETS....Continued

S5.4.2.1 - 20 MPH STOP

STOP	AIR PRESSURE (psi)	PASS/FAIL	REMARKS
11			

S5.4.3 - BRAKE RECOVERY — Requirement: Air Pressure (psi)

	MIN	MAX
w/o antilock	20	85
w/ antilock	12	85

STOP	AIR PRESSURE (psi)		PASS/FAIL	REMARKS
	MINIMUM	MAXIMUM		
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				

Continued on next page

15. DATA SHEETS....Continued

STOP	AIR PRESSURE (psi)		PASS/ FAIL	REMARKS
	MINIMUM	MAXIMUM		
13				
14				
15				
16				
17				
18				
19				
20				

REMARKS:

15. DATA SHEETS....Continued

SPECIFICATIONS

TEST NO.: _____ ; DATE: _____

VEHICLE:

MODEL YEAR/MAKE/MODEL: _____

NHTSA NO: _____ ; VIN: _____

AXLE: _____

BRAKE ASSEMBLY:

BRAKE TYPE: _____

MANUFACTURER: _____ ; P/N: _____

DRUM SIZE: _____

MANUFACTURER: _____ ; P/N: _____

FRICTION MATERIAL: _____

MANUFACTURER: _____ ; P/N: _____

SLACK ADJUSTER: _____

MANUFACTURER: _____ ; P/N: _____

AIR CHAMBER: _____

MANUFACTURER: _____ ; P/N: _____

15. DATA SHEETS....Continued

TEST PARAMETERS:

TEST START: _____ ; DYNAMOMETER: _____

TEST COMPLETE: _____ ; FIXTURE: _____

REQUIRED WHEEL LOAD (lb): _____ ; ROLLING RADIUS: _____

ACTUAL WHEEL LOAD (lb): _____ ; ROTATION: _____

REQUIRED INERTIA (slug ft²): _____ ; COOLING AIR TEMP: _____ °FACTUAL INERTIA (slug ft²): _____ ; COOLING AIR VELOCITY: _____

REMARKS:

15. DATA SHEETS....Continued

BRAKE ADJUSTMENT S6.2.6

VEHICLE MY/MAKE/MODEL: _____

VEHICLE NHTSA NO.: _____ ; DATE OF TEST: _____

SCHEDULE:

PERFORMANCE REQUIREMENT:

Brakes may be adjusted up to 3 times during the burnish procedure at intervals specified by vehicle manufacturer, and may be adjusted at the conclusion of the burnishing in accordance with the vehicle manufacturer's recommendation.

RECORDED BY: _____

DATE: _____

APPROVED BY: _____

15. DATA SHEETS....Continued

BURNISH TEST DATA S6.2.6

VEHICLE NHTSA NO.: _____ ; DATE OF TEST: _____

SCHEDULE:

200 stops from 40 MPH (___ RPM) @

10 ft/s/s, IBT 315-385°F each stop

200 stops from 40 MPH (___ RPM) @

10 ft/s/s, IBT 450-550°F each stop

Stop time: 5.78-5.96 seconds

PERFORMANCE REQUIREMENT:

None

STOP	RPM	F/M TEMP. (315-385°F)	TORQUE (lb-ft)	STOP TIME (5.78-5.96 sec)	AVERAGE AIR PRESSURE	REMARKS
1						
20						
40						
60						
80						
100						
101						
120						
140						
160						
180						
200						
		(450-550°F)				
201						
220						
240						
260						
280						
300						

Continued on next page

15. DATA SHEETS....Continued

STOP	RPM	F/M TEMP. (315-385°F)	TORQUE (lb-ft)	STOP TIME (5.78-5.96 sec)	AVERAGE AIR PRESSURE	REMARKS
301						
320						
340						
360						
380						
400						
						Percent Shoe Contact

REMARKS:

15. DATA SHEETS....Continued

BRAKE RETARDATION FORCE S5.4.1, S5.4.1.1

VEHICLE NHTSA NO.: _____ ; DATE OF TEST: _____

SCHEDULE:

Decelerate from 50 MPH at pressures below
of 20, 30, 40, 50, 60, 70, 80 psi
IBT 125-200°F each stop
Measure torque starting coincident with
required pressure

PERFORMANCE REQUIREMENT:

Retardation ratio as in table

AIR PRESSURE APPLIED (psi)	RPM	F/M TEMPERATURE (°F)	TORQUE (lb-ft)	STOP TIME (seconds)
20				
30				
40				
50				
60				
70				
80				

AIR PRESSURE APPLIED (psi)	TORQUE DIVIDED BY STATIC RAD _____ feet	FORCE DIVIDED BY LOAD _____ lbs	REQD RETARDATION FORCE QUOTIENT	PASS/ FAIL	REMARKS
20			0.05		
30			0.12		
40			0.18		
50			0.25		
60			0.31		
70			0.37		
80			0.41		

DATA INDICATES - ___ PASS ___ FAIL

15. DATA SHEETS....Continued

BRAKE POWER S5.4.2, S5.4.2.1, S5.4.2.2

VEHICLE MY/MAKE/MODEL: _____

VEHICLE NHTSA NO.: _____ ; DATE OF TEST: _____

SCHEDULE:

PERFORMANCE REQUIREMENT:

Initial Brake Temperature 150-200°F
 Speed 50-15 MPH (___ RPM)-(___ RPM)
 Deceleration 9 ft/s/s for 72 sec intervals
 Speed from 20 MPH (___ RPM) Stop No. 11
 Deceleration at 14 ft/s/s
 Snub times stops 1-10, 5.70-6.42 seconds
 Snub time stop 11, 2.09-2.26 seconds

Maximum pressure during Snubs
 100 psi

SNUB OR STOP	RPM	FM TEMP. (°F)	TORQUE (lb-ft)	AIR PRESSURE (psi)	STOP TIME (sec)	PASS/ FAIL
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
	RPM (1 Minute After Snub 10)					
11						

DATA INDICATES – ___ PASS ___ FAIL

15. DATA SHEETS....Continued

BRAKE RECOVERY S5.4.3

VEHICLE NHTSA NO.: _____ ; DATE OF TEST: _____

SCHEDULE:

Speed 30 MPH (___ RPM)
 Deceleration at 12 ft/s/s
 @ 1 minute intervals
 Stop time = 3.52-3.83 seconds

PERFORMANCE REQUIREMENT:

	Min.	Max.
w/o Antilock	20 psi	85 psi
w/ Antilock	12 psi	85 psi

Does vehicle have anti-lock: Yes ___ ; No ___

STOP No.	RPM	F/M TEMP. (°F)	TORQUE (lb-ft)	AIR PRESSURE (psi)		STOP TIME (sec)	PASS/ FAIL
				MINIMUM	MAXIMUM		
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							

DATA INDICATES - ___ PASS ___ FAIL

16. FORMS

LABORATORY NOTICE OF TEST FAILURE TO OVSC

FMVSS NO.: 121D TEST DATE: _____

LABORATORY: _____

CONTRACT NO.: _____; DELV. ORDER NO.: _____

LABORATORY PROJECT ENGINEER'S NAME: _____

TEST SPECIMEN DESCRIPTION: _____

VEHICLE NHTSA NO.: _____; VIN: _____

PART NO.: _____ MFR: _____

TEST FAILURE DESCRIPTION: _____

FMVSS REQUIREMENT, PARAGRAPH S___ :

NOTIFICATION TO NHTSA (COTR): _____

DATE: _____ BY: _____

REMARKS:

16. FORMS....Continued

MONTHLY TEST STATUS REPORT
 FMVSS 121D
 DATE OF REPORT: _____

NO.	VEHICLE AND AXLE IDENTIFICATION	COMPLIANCE TEST DATE	PASS/ FAIL	DATE REPORT SUBMITTED	DATE INVOICE SUBMITTED	INVOICE PAYMENT DATE
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						