ALCALDÍA MAYOR
BOGOTÁ D.C.
TRANSMILENIO S.A.

METHODOLOGICAL GUIDE TO PERFORM TESTS IN BUSES WITH ZERO OR LOW EMISSION TECHNOLOGY

TRANSMILENIO

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TRANSMILENIO BOGOTÁ HUMANA

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1 INTRODUCTION

This methodological guide to apply environmental and operational performance testing protocols on clean bus technologies comprises a series of procedures intended to measure the performance of bi-articulated, articulated, transit, *busetón, buseta* and microbus buses. The goal is to guarantee bus abilities to operate in the Integrated System of Public Transportation (SITP) so that the fleet fulfills the requirements and optimum conditions to provide public service in an integrated system.

New technologies applied to buses must undergo a detailed verification documenting the state of the art and configuration of the new bus model specifically in order to verify safety matters, structural integrity and durability, performance reliability, maintenance, noise, energy economy, brakes and emissions, if any.

This testing methodological guide for clean mobility is mandatory for the authorized dealer of the transport operation in order to enable each bus type in the SITP and it does not cover those tests required by the relevant authority to certify the vehicle, obtain the official approval and license plate either during the manufacturing stage or before the Colombian authority. All trial data are compiled in a test report included in the memory of the equipment to be validated in the SITP.

The application of test protocols herein has the following main objectives:

1. To verify vehicle compliance with requirements and standards for the integration to the system operation pursuant to the operation manual and technical standards and legal governing regulations.
2. To verify the environmental and operation performance of a test bus under normal operation conditions of Bogota's public transport system.
3. To verify the usefulness and applicability of technology in the system operation.

The application of protocols included in this guide guarantees that the bus performance complies with the objectives related to processes of fleet incorporation, operation and renewal.

Pursuant to the requirements of each protocol and any further applicable requirements, the operator or shareholder who is going to present one or more buses for testing is subject to provide the bus(es) to be tested and the time availability, (technical and specialized) staff, and (technical, human and economic) resources needed, as well as performing equipment-installation and testing activities on buses in order to comply with the protocols provided herein.

The tests included in this document may be applied to all bus typologies included in the provision of the collective and massive public transport service in the city of Bogota.

2 BUS TYPOLOGY FOR TESTING PROTOCOL

The bus typology for Bogota's SITP operation is detailed in the Operation Manual. This document is kept by TRANSMILENIO S.A. in his capacity as managing body and may be referred upon request to said institution. Some items detailed in the manual may be subject to modification depending on the conclusions determined by the tests.

The following is a list of relevant items of each typology described in the Operation Manual:

2.1 BI-ARTICULATED BUS

- It must be a trunk vehicle with three cars and two articulations.
- It must be driven by engines complying with the requirements provided by the current regulations on technologies, emissions and clean fuel standards defined by the relevant authority.
- The vehicle must have enough power, torque and transmission ratio to allow reaching a 40Km/h speed at full loading capacity in less than 22 seconds on a flat surface in the city of Bogota.
- It must have a total automatic suspension system; mixed suspensions or any other types are not accepted.
- Vehicles must have a weight detection system (with calibration options) with a sound and light signal at the driver's seat and the service doors so that both driver and passengers are notified about overloads over 2% of the bus capacity. Also, it must have a digital signal connection to the onboard logic unit in order to inform this situation to the control center online.
- It must have a speed regulation system so that the maximum speed allowed by the current National Code of Traffic in urban roads is not exceeded (60Km/h).
- The vehicle must have a radio control to control the opening and closing of the automatic door system installed at the stations, together with the opening and closing system of the vehicle's service doors. This control must be compatible with the system currently installed at trunks and with the system installed in the infrastructure of future expansion trunks of the system. The necessary wiring and electric protection must be considered for this purpose.

- The useful life must be indicated based on a technical study by the suppliers pursuant to the type of bus technology.

2.2 ARTICULATED BUS

- It must be a vehicle with two cars and one articulation.
- It must be driven by engines complying with the requirements provided by the current regulations on technologies, emissions and clean fuel standards defined by the relevant authority.
- Vehicles must have a weight detection system (with calibration options) with a sound and light signal at the driver's seat and the service doors so that both driver and passengers are notified about overloads over 2% of the bus capacity. Also, it must have a digital signal connection to the onboard logic unit in order to inform this situation to the control center online.
- The vehicle must have a radio control to control the opening and closing of the automatic door system installed at the stations, together with the opening and closing system of the vehicle's service doors. This control must be compatible with the system currently installed at trunks and with the system installed in the infrastructure of future expansion trunks of the system. The necessary wiring and electric protection must be considered for this purpose
- The vehicle must have enough power, torque and transmission ratio to allow reaching a 40Km/h speed at full loading capacity in less than 22 seconds on a flat surface in the city of Bogota
- It must have a total automatic suspension system; mixed suspensions or any other types are not accepted.
- It must have a speed regulation system so that the maximum speed allowed by the current National Code of Traffic in urban roads is not exceeded (60Km/h).
- The useful life must be indicated based on a technical study by the suppliers pursuant to the type of bus technology

2.3 FEEDER AND TRANSIT BUS

- It must be a single-body bus vehicle.

- The vehicle must have enough power, torque and transmission ratio to allow reaching a 40Km/h speed at full loading capacity in less than 22 seconds on a flat surface in the city of Bogota.

- It must be driven by engines complying with the requirements provided by the current regulations on technologies, emissions and clean fuel standards defined by the relevant authority.

- All vehicles must have a weight detection system (with calibration options) with a sound and light signal at the driver's seat and the service doors so that both driver and passengers are notified about overloads over 2% of the bus capacity. Also, it must have a digital signal connection to the onboard logic unit in order to inform this situation to the control center online.

- All buses must be equipped with the elements needed to allow wheelchair user access. The feeder vehicles must comply with the accessibility standards provided by Decree 1660 from June 16, 2003, or the current standards. Either by means of low entrance buses (through ramp) or lifting ramp in case of high floor buses.

- The authorized dealer may design a special solution for the feeder system in order to serve physically, sensory and mentally challenged passengers exclusively. This solution must include, among other, accessible vehicles (for example, available spaces adequate for placing aids such as walking sticks, crutches, wheelchairs and any other device or mechanism deemed a technical aid for a handicapped person; and it must not represent any additional cost for them), call center, control center and all the required devices, so that handicapped passenger mobility is guaranteed in the services provided.

- The bus ascending capacity must be at least 20% higher than that required to climb the steepest slope in the operation area.

- It must have a speed regulation system so that the maximum speed allowed by the current National Code of Traffic in urban roads is not exceeded (60Km/h).

- The useful life must be indicated based on a technical study by the suppliers pursuant to the type of bus technology

- Buses must have fuel storage tanks that allow a minimum 260Km autonomy and quick filling up, under conditions that allow providing services continuously all day long.

- When the vehicle typology provided establishes accurate dimensions for the different vehicle features, or in case maximum and minimum ranges are set for vehicle features,

or if specific features are indicated; any modification on these features or the use of variations on these test ranges shall only be accepted provided that they are supported by technical studies fully justifying such modification.

- TRANSMILENIO S.A. may add or remove elements from the vehicle typology in order to improve the System operation due to the infrastructure's technological features or their condition.

2.4 10-TO-79 PASSENGER CONVENTIONAL BUS

Conventional buses must comply at least with the latest version of Colombian technical standard NTC-5206, and, if required, NTC 5701 or its latest equivalent version, without prejudice to the following specific technical features:

- The vehicle must be a single body bus.
- It must have enough power, torque and transmission ratio to allow reaching a 40Km/h speed at full loading capacity in less than 22 seconds on a flat surface in the city of Bogota.
- The bus ascending capacity must be at least 20% higher than that required to climb the steepest slope in the operation area.
- It must be driven by engines complying with the requirements provided by the current regulations on technologies, emissions and clean fuel standards defined by the relevant authority
- The vehicle engine and control systems must certify, have and maintain an environmental performance complying with the current standards on technologies, clean fuels, emission levels and control defined by the relevant authority.
- It must have a speed regulation system so that the maximum speed allowed by the current National Code of Traffic in urban roads is not exceeded (60Km/h)
- Buses must have fuel storage tanks that allow a minimum 260Km autonomy and quick filling up, under conditions that allow providing services continuously all day long.
- When the vehicle typology provided establishes accurate dimensions for the different vehicle features, or in case maximum and minimum ranges are set for vehicle features, or if specific features are indicated; any modification on these features or the use of variations on these test ranges shall only be accepted provided that they are supported by technical studies fully justifying such modification.

- The useful life must be indicated based on a technical study by the suppliers pursuant to the type of bus technology

- TRANSMILENIO S.A. may add or remove elements from the vehicle typology in order to improve the System operation due to the infrastructure's technological features or their condition.

3 PROTOCOL APPLICATION PROCEDURE

The testing process comprises the following stages:

- **Short-lasting tests:** less than three months. In this stage, the protocols described herein are implemented; there will be on-route tests to be performed under simulated load conditions along a standardized journey, with at least 15 repetitions or those required statistically. Additionally, laboratory tests must be performed in a dynamometer, which must be programmed with Bogota's standard driving cycle. This tests aims at measuring the environmental performance (emissions, noise, energy efficiency) and operation performance in terms of maneuverability, autonomy and operational restrictions.

- **Long-lasting tests (Optional):** From three to six months. In this stage, the vehicle undergoes normal operation conditions of the current transport system with control and monitoring on the environmental and operation performance through a schedule defined by the managing body and the shareholder who is going to perform the tests at the beginning of this stage.

The following steps must be followed to perform the tests:

For the short-lasting test stage:

Step 1: perform the (temporary or permanent) vehicle import procedure in case it comes from abroad.

Step 2: the vehicle must have a transit license (free transit permit, (red) temporary plate or permanent plate).

Step 3: statement of interest and/or feasibility request to perform short-lasting tests: this request may be performed by authorized dealers of the system, manufacturers or bus suppliers together with the two aforementioned parties or any public or private institution who is to verify the feasibility to operate new technology in the system. This communication must include the vehicle's technical datasheet, logistic requirements for vehicle operation and the statement ensuring they have or shall obtain the resources needed to perform the tests.

Step 4: TRANSMILENIO S.A. shall respond the request of the operator or shareholder who wants to perform the tests. If the answer is affirmative, TRANSMILENIO S.A. shall communicate the procedure to follow in different stages and attach the Methodological Guide to Implement Testing Protocols for Assessing the Feasibility of New Technology Implementation in the Massive Public Transport of Bogota.

Step 5: file the commitment letter and process-start request to carry out the tests. The operator or shareholder shall file a communication before TRANSMILENIO S.A. stating that they accept the requirements and conditions to perform the process and agree to perform the short-lasting tests assuming the costs associated to their performance; and they must submit a copy of the test-process information and results as required by the managing body. Additionally, they must attach the following documents:

- Insurance: SOAT
- Technical Partner to perform specific tests if required: must indicate the registered name, certify suitability and experience of both staff involved and the institution performing this type of tests, technical infrastructure and logistics for performing tests.
- Test Schedule Proposal.
- List of Key staff involved in the test development (identification and contact data).
- List of auxiliary staff who requires permits and/or authorizations to access the system infrastructure (applies to staff external to authorized dealers).

Step 6: Upon revising the information, TRANSMILENIO S.A. shall call a coordination meeting to define jointly the schedule, type of tests, controls and monitoring to be performed on the vehicle and appoint those responsible for assistance.

Step 7: Test Start: the following minimum tests shall be performed on this stage pursuant to the schedule submitted by the authorized dealer or requestor:

TEST TYPE	ID	TESTS
OPERATIVE	1	typology revision
	2	braking (include fifth wheel or manufacturer's confirmation certificate)

TEST TYPE	ID	TESTS
	3	turning radius, maneuverability and perception
	4	Acceleration and ascending capacity (include the capacity to reach certain speeds)
ENVIRONMENTAL PERFORMANCE	5	Energy Efficiency and Performance on route
	6	Energy Efficiency and Performance on dynamometer (upon request from the managing body)
	7	emission factors on route
	8	Emission factors on dynamometer (upon request from the managing body)
	9	Noise and thermal comfort
	10	emissions inside the vehicle
TECHNIQUES	11	Autonomy
	12	Usefulness factor (upon request from the managing body)
	13	Regeneration on route (upon request from the managing body)

Step 8: Test termination and complete documentation by those involved in it. Submit the final report and additional information required to the managing body.

Step 9: Meeting to close and define the need and/or feasibility to continue long-lasting tests: TRANSMILENIO and the requestor shall agree a date and time for the closing meeting. A joint analysis of test results and conclusions shall be performed in this meeting.

Long-lasting test stage:

Upon completing the short-lasting test stage, the following additional steps must be performed to perform the long-lasting tests:

Step 1: Perform the (temporary or permanent) import renewal procedure if necessary.

Step 2: Perform the vehicle's official approval before the Ministry of Transport.

Step 3: RUNT Registration before the Ministry of Transport.

Step 4: Verify and/ or perform the procedure to have an operating Partner and Technical Partner to carry out the tests if required.

Step 5: request the operation card before the *Secretaría Distrital de Movilidad*

Step 6: in case requestor is not an authorized dealer of the system, he may look for an operating partner to carry out the long-lasting tests through prior consent from the managing body.

Step 7: file the commitment letter and process-start request in order to carry out the long-lasting tests: operator and other participants will file a communication before TRANSMILENIO S.A. stating that they accept the requirements and conditions to perform the process and agree to perform the long-lasting tests assuming the costs associated to their performance; and they must submit a copy of the test-process information and results as required by the managing body. Additionally, they must attach the following documents:

- Insurance: SOAT, Contractual insurance and extra-contractual insurance.
- Technical Partner to perform specific tests if required: must indicate the registered name, certify suitability and experience of both staff involved and the institution performing this type of tests, technical infrastructure and logistics for performing tests.
- Test Schedule Proposal and/or definition of routs and services where the service is going to operate. TRANSMILENIO reserves the right to make specific requirements on tests, routes and additional services.
- List of Key staff involved in the test development (identification and contact data).

- List of auxiliary staff who requires permits and/or authorizations to access the system infrastructure (applies to staff external to authorized dealers).

Step 8: TRANSMILENIO S.A. shall present the vehicle being test to the Secretaria Distrital de Movilidad to make possible the request of the Vehicle's operation card and SIM registration within the new-technology testing program of the system.

Step 9: TRANSMILENIO S.A. shall send to the authorized dealer or shareholder a copy of the presentation letter filed at the Secretaría Distrital de Movilidad.

Step 10: Requesting the Operation Card and SIM Registration: the authorized dealer or shareholder who is to perform the tests shall perform this procedure before the Secretaría Distrital de Movilidad, attaching the relevant documentation based on the communication sent by TRANSMILENIO S.A.

Step 11: perform the vehicle's incorporation process into regular operation before TRANSMILENIO S.A.

Step 12: coordination meeting to start the tests: upon incorporating the vehicle, TRANSMILENIO S.A. shall call a coordination meeting to define jointly the schedule, type of tests, controls and monitoring to be performed on the vehicle in order to assess the environmental and operational performance under normal operation conditions of the system. The test start-date shall be defined and those responsible for assistance and periodic vehicle-performance report generation shall be appointed.

Step 13: perform controls and specific performance tests pursuant to the schedule and make periodic reports which are to be submitted to TRANSMILENIO S.A. on the dates previously agreed.

Step 14: test termination and full documentation by those involved therein. Submit final reports and additional information required to the managing body.

Step 15: Meeting to close and define the need and/or feasibility to continue testing: TRANSMILENIO and the requestor shall agree a date and time for the closing meeting. A joint analysis of test results and conclusions shall be performed in this meeting.

4 OPERATING TESTS

The operating test group shall comprise 4 tests. A protocol model for those tests is shown below. This protocol may be adjusted by the authorized dealer or shareholder who is to perform the test, subject to revision and approval by TRANSMILENIO S.A.

TEST TYPE	TESTS
OPERATIVE	typology revision
	braking (include fifth wheel or manufacturer's confirmation certificate)
	turning radius, maneuverability and perception
	Acceleration and ascending capacity (include the capacity to reach certain speeds)

4.1 TYPOLOGY VERIFICATION TEST

4.1.1 General Description

Test Type	TYPOLOGY VERIFICATION
Tested Vehicle	
Creation date	
Responsible	
General objective of the test	To verify the vehicle typology pursuant to the SITP Operation Manual, Standard NTC 4901-3 (Vehicles for Urban Transport of Passengers, Part 3: Conventional buses (First Update)) and Standard NTC 4901-2 (Vehicles for Urban Transport of Passengers, Part 2: Testing Methods (First Update)).

INSERT IMAGE

Figura 1. TEST BUS

4.1.2 Test Description.

4.1.2.1 Place, Date and Time of execution

Place	
Date	
Time	

4.1.2.2 Test Duration

4.1.3 Participants

Name	Institution/Company	Role

4.1.4 Reference Documents

- Operation Manual- Integrated System of Public Transport
- COLOMBIAN TECHNICAL STANDARD NTC 4901-3 (First Update).

- COLOMBIAN TECHNICAL STANDARD NTC 4901-2 (First Update).
- Decree 1660 from 2003
- Graphic Standards Manual (SITP)-Volume II Vehicle information
- Technical Documentation and/or Technical Specifications of the bus.

4.1.5 Detailed Test Procedure

4.1.5.1 Objective

The purpose of this test is to verify the typology fulfillment of the tested bus by revising the different specifications and/or by measuring directly on the prototype vehicle versus the specifications and/or requirements provided by Bogota's SITP Operation Manual and Colombian Technical Standard NTC 4901-3.

4.1.5.1.1 Equipment to be used in the test: (Measuring elements required).

4.1.5.1.2 Items to Review

4.1.5.1.2.1 General Features

- Single-body vehicle:

Approved	YES	NO

Remarks:
_____
_____
_____

- Enough power, torque and transmission ratio to allow reaching a 40Km/h speed at full loading capacity in less than 22 seconds on a flat surface in the city of Bogota (Pursuant to Testing method from Number 4.1.6 of Standard NTC 4901-2 (First Update)).

Approved	YES	NO

Remarks:
_____

_____
_____

- Capacity (80 to 120 sitting and standing passengers).

Approved	YES	NO

Remarks:
_____
_____
_____

4.1.5.1.2.2 Specific Design Feature

- Both driver and passengers seats (Minimum number required, Preferential-use seats, Distribution, Dimensions):

Approved	YES	NO

Remarks:
_____
_____
_____

- Covering and internal finishing:

Approved	YES	NO

Remarks:
_____
_____
_____

- Handrail, grip-handles and/or grip-bars:

Approved	YES	NO

Remarks:
_____

_____
_____

- Service doors (Number, Dimensions, Opening time, other):

Approved	YES	NO

Remarks:
_____
_____
_____

- Internal lighting:

Approved	YES	NO

Remarks:
_____
_____
_____

- Internal dimensions (Minimum and Maximum Ranges):

Approved	YES	NO

Remarks:
_____
_____
_____

4.1.5.1.2.3 Technical Body Features

- Body type (Bodied, integral or self-supporting Chassis,): Dimensions):

Approved	YES	NO

Remarks:
_____
_____
_____

- Body Structure (Regulation No.66 by the United Nations, Static load on the rood, Joints):

Approved	YES	NO

Remarks:
_____
_____
_____

- Thermal Isolation:

Approved	YES	NO

Remarks:
_____
_____
_____

- Acoustic Isolation:

Approved	YES	NO

Remarks:
_____
_____
_____

- (Frontal , Lateral and Rear) Destination Indicators:

Approved	YES	NO

Remarks:
_____
_____
_____

4.1.5.1.2.4 Vehicle Weight

- Vehicle Weight (Maximum Loads Allowed per axis):

Approved	YES	NO

Remarks:
_____
_____
_____

4.1.5.1.2.5 External Dimensions

- Vehicle Dimensions (Height, Length, Width):

Approved	YES	NO

Remarks:
_____
_____
_____

- Overhangs (Height, Length, Width):

Approved	YES	NO

Remarks:
_____
_____
_____

- Height from the ground to the lowest body point:

Approved	YES	NO

Remarks:
_____
_____
_____

4.1.5.1.2.6 Emergency and Security Systems

- Sign post elements (Pursuant to Decree 1660 from 2003):

Approved	YES	NO

Remarks:
_____
_____
_____

- Emergency Exits (At least 9):

Approved	YES	NO

Remarks:
_____
_____
_____

- Windows (Windshield, Side and Emergency windows):

Approved	YES	NO

Remarks:
_____
_____
_____

GENERAL OBJECTIVES:

_____
_____
_____

PARTICIPANTS:

TRANSMILENIO S.A.:

Name: Signature:

_____ _____

_____ _____

_____ _____

Operator or Shareholder who is to Perform the Test:

Name: Signature:

_____ _____

_____ _____

_____ _____

OTHER:

Name: Signature:

_____ _____

_____ _____

_____ _____

4.2 TURNING RADIUS TEST

4.2.1 General Description

Test Type	**TURNING RADIUS VERIFICATION**
Tested Vehicle	
Creation date	
Responsible	
General objective of the test	Verification of the vehicle turning radius pursuant to the SITP Operation Manual, Standard NTC 4901-3 (Vehicles for Urban Transport of Passengers, Part 3: Conventional buses (First Update)) and Standard NTC 4901-2 (Vehicles for Urban Transport of Passengers, Part 2: Testing Methods (First Update)).

INSERT IMAGE

Figura 2. TEST BUS

4.2.2 Test Description

4.2.2.1 Place, Date and Time of execution

Place	
Date	
Time	

4.2.2.2 Test Duration

4.2.3 Participants

Name	Institution/Company	Role

4.2.4 Reference Documents

- Operation Manual- Integrated System of Public Transport
- COLOMBIAN TECHNICAL STANDARD NTC 4901-3 (First Update).
- COLOMBIAN TECHNICAL STANDARD NTC 4901-2 (First Update).
- Technical Documentation and/or Technical Specifications of the bus.

4.2.5 Detailed Test Procedure

4.2.5.1 Objective

The purpose of this test is to verify the vehicle compliance with both internal and external turning radius considering the following conditions and in comparison to the specifications and/or requirements provided by Bogota's SITP Operation Manual and Colombian Technical Standards NTC 4901-3 and NTC 4901-2.

4.2.5.2 Procedure

The verification of the 90 and 180 degree turning radius must be performed pursuant to the provisions from Number 4.1.8.3. In letters (a) and (b) of COLOMBIAN TECHNICAL STANDARD NTC 4901-2 (First Update).

1. The vehicle is aligned in parallel to a reference line.
2. The steering is turned completely.
3. The vehicle is moved per meters and the trajectory of each external wheel is marked on the floor while the vehicle is turning.
4. Each position is recorded.
5. A graphic is made and the turning radius is obtained.

Note: we recommend performing 3 measurements on a flat, regular and dry surface, as well as 2 full turns before the measurement.

4.2.5.3 Equipment to be used in the test: (Measuring elements required)

4.2.5.4 Items to Review

4.2.5.4.1 Annulus of the Vehicle Turn

- (Internal and external) Turning radius:

Approved	YES	NO

GENERAL OBJECTIVES:

_____
_____
_____

PARTICIPANTS:

TRANSMILENIO S.A.:

Name:	Signature:
_____	_____
_____	_____
_____	_____

Operator or Shareholder who is to Perform the Test:

Name:	Signature:
_____	_____
_____	_____
_____	_____

OTHER:

Name:	Signature:
_____	_____
_____	_____
_____	_____

4.3 BRAKING DISTANCE TEST

4.3.1 General Description

Test Type	**VERIFICATION OF BRAKING DISTANCES**

Tested Vehicle	
Creation date	
Responsible	
General objective of the test	Verification of the vehicle braking distances pursuant to the SITP Operation Manual, Standard NTC 4901-3 (Vehicles for Urban Transport of Passengers, Part 3: Conventional buses (First Update)) and Standard NTC 4901-2 (Vehicles for Urban Transport of Passengers, Part 2: Testing Methods (First Update)). The reference distances are those provided by Federal Safety Standard MVSS 121.

INSERT IMAGE

Figura 1. TEST BUS

4.3.2 Test Description

4.3.2.1 Place, Date and Time of execution

Place	
Date	
Time	

4.3.2.2 Test Duration

4.3.3 Participants

Name	Institution/Company	Role

4.3.4 Reference Documents:

- Operation Manual- Integrated System of Public Transport
- COLOMBIAN TECHNICAL STANDARD NTC 4901-3 (First Update).
- COLOMBIAN TECHNICAL STANDARD NTC 4901-2 (First Update).
- FEDERAL SAFETY STANDARD MVSS 121(Braking curves).
- COLOMBIAN TECHNICAL STANDARD NTC 3964.
- Technical Documentation and/or Technical Specifications of the bus.

4.3.5 Detailed Test Procedure

4.3.5.1 Objective

The purpose of this test is to verify the vehicle braking distances considering the following conditions and in comparison to the specifications and/or requirements provided by Bogota's SITP Operation Manual and Colombian Technical Standards NTC 4901-3 and NTC 4901-2 (Number 4.1.7.).

4.3.5.2 Procedure

The verification of the vehicle braking distances must be performed pursuant to the provisions from Number 4.1.7 of COLOMBIAN TECHNICAL STANDARD NTC 4901-2 (First Update), plus the different loading and speed conditions suggested by TRANSMILENIO S.A.

1. Normal operating conditions of the vehicle specified by the manufacturer.
2. Check system leaks.
3. Check the tire pressure is the maximum pressure specified by the manufacturer.
4. Load the vehicle to have testing conditions as empty, medium load and full load.
5. Perform different distance measurements based on the vehicle speed between 30 and 60 Km/h in stops each 5 Km/h (that is to say every 30, 35, 40, 45, 50, 55, 60Km/h)

Note 1: it is recommended to perform 3 measurements and make an average.
Note 2: the test must be performed on a dry, straight, paved, flat and safe road.

4.3.5.3 Equipment to be used in the test

- Data acquisition equipment with speed, distance, time and acceleration sensors (Fifth wheel) installed under the recommendations of the instrument manufacturer.
- Braking-start indicator device (brake-pedal movement sensor that detects the movement on the first 3.2mm of pedal trajectory).

4.3.5.4 Items to Review

- Braking Distances for different load and speed conditions:

Approved	YES	NO

Remarks:
_____
_____
_____

NOTA: See attached record charts.

GENERAL OBJECTIVES:

_____
_____
_____

PARTICIPANTS:

TRANSMILENIO S.A.:

Name: Signature:

_____ _____

_____ _____

_____ _____

Operator or Shareholder who is to Perform the Test:

Name: Signature:

_____ _____

_____ _____

_____ _____

OTHER:

Name: Signature:

_____ _____

_____ _____

_____ _____

4.4 ASCENDING CAPACITY TEST

4.4.1 General Description

Test Type	**VERIFICATION OF THE ASCENDING CAPACITY**
Tested Vehicle	
Creation date	
Responsible	

General objective of the test	Verify the vehicle ascending capacity pursuant to the SITP Operation Manual, Standard NTC 4901-3 (Vehicles for Urban Transport of Passengers, Part 3: Conventional buses (First Update)) and Standard NTC 4901-2 (Vehicles for Urban Transport of Passengers, Part 2: Testing Methods (First Update)).

INSERT IMAGE

4.4.2 Test Description.

4.4.2.1 Place, Date and Time of execution

Place	
Date	
Time	

4.4.2.2 Test Duration

4.4.3 Participants

Name	**Institution/Company**	**Role**

4.4.4 Reference Documents

- Operation Manual- Integrated System of Public Transport
- COLOMBIAN TECHNICAL STANDARD NTC 4901-3 (First Update).
- COLOMBIAN TECHNICAL STANDARD NTC 4901-2 (First Update).
- Technical Documentation and/or Technical Specifications of the bus.

4.4.5 Detailed Test Procedure

4.4.5.1 Objective

The purpose of this test is to verify the vehicle ascending capacity considering the specifications and/or requirements provided by Bogota's SITP Operation Manual and Colombian Technical Standards NTC 4901-3 and NTC 4901-2 (Number 4.1.6).

4.4.5.2 Procedure:

The reference to verify the vehicle ascending capacity shall be the different routes with steepest slopes where the vehicle is going to operate, and the verification must be performed pursuant to Number 4.1.6 of COLOMBIAN TECHNICAL STANDARD NTC 4901-2 (First Update), plus the different loading and speed conditions suggested by TRANSMILENIO S.A.

1. Normal operating conditions of the vehicle specified by the manufacturer.
2. Check the tire pressure is the maximum pressure specified by the manufacturer.
3. Load the vehicle with full-load conditions.

Note 1: It is recommended to perform 3 starts and make an average of speed and acceleration conditions.

Note 2: the test must be performed on a dry, paved and safe road.

4.4.5.3 Equipment to be used in the test:

- Data acquisition equipment with speed, distance, time and acceleration sensors (Fifth wheel) installed under the recommendations of the instrument manufacturer.
- Braking-start indicator device (brake-pedal movement sensor that detects the movement on the first 3.2mm of pedal trajectory).

4.4.5.4 Items to Review:

- Verify the ascending capacity in the steepest slope to be tested in the road.

Approved	YES	NO

Remarks:

_____
_____
_____

NOTA: See attached record charts.

GENERAL OBJECTIVES:

_____
_____
_____

PARTICIPANTS:

TRANSMILENIO S.A.:

Name: Signature:

_____ _____

_____ _____

_____ _____

Operator or Shareholder who is to Perform the Test:

Name: Signature:

_____ _____

_____ _____

_____ _____

OTHER:

Name: Signature:

_____ _____

_____ _____

_____ _____

5 ENVIRONMENTAL PERFORMANCE TEST

The environmental performance test group comprises 6 tests which include an attached document (See annex 1). This document can be used as reference to perform the tests. It might be adjusted by the authorized dealer or shareholder who is to perform the tests, subject to revision and approval by TRANSMILENIO S.A. with assistance from the Secretaría Distrital de Ambiente.

TEST TYPE	TESTS
ENVIRONMENTAL PERFORMANCE	Energy Efficiency and Performance on route
	Energy Efficiency and Performance on dynamometer (upon request from the managing body)
	emission factors on route
	Emission factors on dynamometer (upon request from the managing body)

TEST TYPE	TESTS
	Noise and thermal comfort
	emissions inside the vehicle

In order to perform the tests inside the vehicle (noise, thermal comfort and emissions), the authorized dealer or shareholder who is to perform said tests must submit the protocols for revisions and approval by the Managing body.

6 TECHNICAL TESTS

The Technical Test group comprises 3 tests which are listed below. In order to perform these tests, the authorized dealer or shareholder who is to perform the tests must submit the protocols for revisions and approval by the Managing body

TEST TYPE	TESTS
TECHNIQUES	Autonomy
	Usefulness factor (upon request from the managing body)
	Regeneration on route (upon request from the managing body)

7 TEST TERMINATION

When the tests terminate, the continuous improvement criteria of this process, recommendations and conclusions are defined in the joint meeting, because this testing guide document (version zero) is the reference to carry out said tests and, during the development of the tests, this methodology may be subject to remarks and modifications that allow providing feedback for test processes.

ANNEX 1

PROTOCOL TO MEASURE GAS EMISSIONS, PARTICULATE MATTER AND DETERMINE THE ENERGY EFFICIENCY IN SITP VEHICLES OF BOGOTA D.C.