Washington Metropolitan Area Transit Authority
RFP Number: FQ18001/BTK

Date: October 21, 2017

SUBJECT: Revised RFP No. FQ18001/BTK Part 2 of 2 Technical Specification

Dear Prospective Offers:

The attached Amendment is issued to delete and replace RFP No. FQ18001/BTK Part 2 of 2 Technical Specification for 40 Foot/60 Foot Clean Diesel and 40 Foot/60 Foot Compressed Natural Gas (CNG) Bus Rapid Transit (BRT) Style Heavy Duty Transit Buses dated August 30, 2017 with a revised RFP No. FQ18001/BTK Part 2 of 2 Technical Specification dated 10/20/2017.

The Revised RFP No. FQ18001/BTK Part 2 of 2 Technical Specification dated October 20, 2017 shall replace RFP No. FQ18001/BTK Part 2 of 2 Technical Specification dated August 30, 2017 that was posted on WMATA website. This revised RFP FQ18001/BTK Part 2 of 2 Technical Specification dated October 20, 2017 supersede previous RFP FQ18001/BTK Part 2 of 2 Technical Specification dated August 30, 2017. RFP FQ18001/BTK Part 2 of 2 Technical Specification dated August 30, 2017 shall not be used by prospective proposers to response to this solicitation. All prospective proposers shall use the Revised RFP FQ18001/BTK Part 2 of 2 Technical Specification dated October 20, 2017 to response to solicitation, RFP No. FQ18001/BTK 40 Foot/60 Foot Clean Diesel and 40 Foot/60 Foot Compressed Natural Gas (CNG) Bus Rapid Transit (BRT) Style Heavy Duty Transit Buses. Changes in the revised technical specification are marked up in red.

If you have any technical, contractual, or administrative questions, please e-mail them to Benjamin Kpadeh at bkpadeh@wmata.com no later than close of business, Monday, November 13, 2017. WMATA will provide written answers by e-mail to all those who obtain the RFP and provide their e-mail addresses. If an amendment(s) is issued resulting from questions and answers, it will be posted on WMATA website.

Your proposal must be received with all required submittals as stated in the RFP, no later than 2:00PM EST, Friday, December 22, 2017 at WMATA, Office of Procurement and Materials, 600 Fifth Street, NW, Room 3C-02, Washington, DC 20001-2651.

Sincerely,

Benjamin Kpadeh
Office of Procurement and Materials

WASHINGTON METROPOLITAN AREA TRANSIT AUTHORITY
600 Fifth Street, NW, Washington, DC 20001-2651

AMENDMENT OF SOLICITATION / MODIFICATION OF CONTRACT

1. AMENDMENT/MODIFICATION	2. EFFECTIVE DATE
AM No. 04	(Same as block 17)
3. ISSUED BY PURCHASING SECTION	**4. ADMINISTERED BY (If other than block 3)**
Benjamin Kpadeh JGB – 3rd Floor 3C-02 Office of Procurement and Materials	

5. CONTRACTOR NAME AND ADDRESS

(Street, city, county, state, and Zip Code)

[Contractor Name]
Attn: [Contact Name]
[Address Line]
[Address Line 2]
[City], [State] [Zip+4]

6. FORM TYPE (Check only one)

■ AMENDMENT OF SOLICITATION NO. FQ18001/BTK

DATE 10/21/2017 (See block 7)

☐ MODIFICATION OF CONTRACT/ORDER NO. _____

DATE _____ (See block 9)

7. THIS BLOCK APPLIES ONLY TO AMENDMENTS OF SOLICITATIONS

■ The above numbered solicitation is amended as set forth in block 10. The hour and date specified for receipt of Offers ☐ is extended, ■ is not extended. Offerors must acknowledge receipt of this amendment prior to the hour and date specified in the solicitation, or as amended, by one of the following methods; (a) By signing and returning ONE (1) copy of this amendment; (b) by acknowledging receipt of this amendment on each copy of the offer submitted; or (c) by separate letter or telegram which includes a reference to the solicitation and amendment numbers. FAILURE OF YOUR ACKNOWLEDGMENT TO BE RECEIVED AT THE ISSUING OFFICE PRIOR TO THE HOUR AND DATE SPECIFIED MAY RESULT IN REJECTION OF YOUR OFFER. If, by virtue of this amendment you desire to change an offer already submitted, such change may be made by telegram or letter, provided such telegram makes reference to the solicitation and this amendment, and is received prior to the opening hour and date specified.

8. ACCOUNTING AND APPROPRIATION DATA (If required)

9. THIS BLOCK APPLIES ONLY TO MODIFICATIONS OF CONTRACTS/ORDERS

(a) ☐ This Change Order is issued pursuant to _____
The Changes set forth in block 10 are made to the above numbered contract/order.

(b) ☐ The above numbered contract/order is modified to reflect the administrative changes (such as changes in paying office, appropriation data, etc.) set forth in block 10.

(c) ☐ This Supplemental Agreement is entered into pursuant to authority of _____
It modifies the above numbered contract as set forth in block 10.

10. DESCRIPTION OF AMENDMENT/MODIFICATION

AMENDMENT NUMBER 04 (AM 04) IS FOR RFP FQ18001/BTK - 40 FOOT / 60 FOOT CLEAN DIESEL AND 40 FOOT / 60 FOOT COMPRESSED NATURAL GAS (CNG) BUS RAPID TRANSIT (BRT) STYLE HEAVY DUTY BUSES.

AMENDMENT 04 IS ISSUED TO DELET AND REPLACE RFP FQ18001/BTK PART 2 OF 2 TECHNICAL SPECIFICATION DATE 8/30/2017. THE REVISED RFP NO. FQ18001/BTK PART 2 OF 2 TECHNICAL SPECIFICATION DATED 10/20/2017 SUPERSEDES PREVIOUS RFP NO. FQ18001/BTK PART 2 OF 2 TECHNICAL SPECIFICATION DATED 8/30/2017 THAT WAS POSTED ON WMATA WEBSITE. QUESTIONS DUE DATE FOR THE REVISED TECHNICAL SPECIFICATION IS CLOSE OF BUSINESS ON MONDAY, NOVEMBER 13, 2017.

Please monitor www.wmata.com for amendments and updates.

END OF AMENDMENT 04

Except as provided herein, all terms and conditions of the document referenced in block 6, as heretofore changed, remain unchanged and in full force and effect.

11.	
■ CONTRACTOR/OFFEROR IS REQUIRED TO SIGN THIS MODIFICATION AND RETURN ONE (1) COPY TO ISSUING OFFICE.	☐ CONTRACTOR/OFFEROR IS NOT REQUIRED TO SIGN THIS DOCUMENT
12. NAME OF CONTRACTOR/OFFICE BY _____ (Signature of person authorized to sign)	15. WASHINGTON METROPOLITAN AREA TRANSIT AUTHORITY BY _____ (Signature of Contracting Officer)

13. NAME AND TITLE OF SIGNER (Type or print)	14. DATE SIGNED	16. NAME OF CONTRACTING OFFICER (Type or print)	17. DATE SIGNED
		Benjamin Kpadeh	10/21/17

Request For Proposals
(Federal)

Procurement of 40 Foot/60 Foot Clean Diesel and 40 Foot/60 Foot Compressed Natural Gas (CNG) Bus Rapid Transit B.R.T. Style Heavy Duty Transit Buses

TECHNICAL SPECIFICATION

RFP No. :FQ18001/BTK

PART 2 0F 2

Date: October 20, 2017

Washington Metropolitan Area Transit Authority
RFP Number: FQ18001/BTK

Table of Contents

Washington Metropolitan Area Transit Authority
RFP Number: FQ18001/BTK

SECTION 1: GENERAL CONDITIONS

GC 1. Definitions

The following are definitions of special terms used in this document:

Class 1 Failure (physical safety): A failure that could lead directly to passenger or operator injury and represents a severe crash situation.

Class 2 Failure (road call): A failure resulting in an en route interruption of revenue service. Service is discontinued until the bus is replaced or repaired at the point of failure.

Days: Unless otherwise stated, "days" shall mean calendar days.

Defect: Patent or latent malfunction or failure in manufacture, installation or design of any component or subsystem.

Deviation: Variance from a requirement or specification that does not alter the basis of a contract or adversely affects its performance.

Extended Warranty: A warranty available for purchase above the standard warranty.

Fatigue Failure (Corrosion Fatigue): The mechanical degradation of a material under the joint action of corrosion and cyclic loading.

Pass-Through Warranty: A warranty provided by the Contractor but administered directly with the component Supplier.

Related Defect: Damage inflicted on any component or subsystem as a direct result of a separate Defect.

Superior Warranty: A warranty still in effect after all contractually required warranties have expired. The remaining warranty is administered directly between the sub-Supplier and the Agency.

Supplier: Any manufacturer, company or Agency providing units, components or subassemblies for inclusion in the bus that is installed by the Contractor. Supplier items shall require qualification by type and acceptance tests in accordance with requirements defined in "Section 8: Quality Assurance."

Subcontractor: Any manufacturer, company or Agency providing units, components or subassemblies for inclusion in the bus that are installed by a Subcontractor. Subcontractor items shall require qualification by type and acceptance tests in accordance with requirements defined in "Section 8: Quality Assurance."

Work: Any and all labor, supervision, services, materials, machinery, equipment, tools, supplies and facilities called for by the Contract and necessary to the completion thereof.

GC 2. Materials and Workmanship

The Contractor shall be responsible for all materials and workmanship in the construction of the bus and all accessories used, whether the same are manufactured by the Contractor or purchased from a Supplier. This provision excludes any equipment leased or supplied by WMATA, except insofar as such equipment is damaged by the failure of a part or component for which the Contractor is responsible, or except insofar as the damage to such equipment is caused by the Contractor during the manufacture of the buses.

GC 3. Conformance with Specifications and Drawings

Materials furnished and Work performed by the Contractor shall conform to the requirements of the Technical Specifications and other Contract documents. Notwithstanding the provision of drawings, technical specifications or other data by WMATA, the Contractor shall have the responsibility of supplying all parts and details required to make the bus complete and ready for service even though such details may not be specifically mentioned in the drawings and specifications. Items that are installed by the Authority shall not be the responsibility of the Contractor unless they are included in this Contract.

GC 4. Inspection, Testing and Acceptance

GC 4.1 General

The pre-delivery tests and inspections shall be performed at the Contractor's plant; they shall be performed in accordance with the procedures defined in "Section 8: Quality Assurance"; and they may be witnessed by the resident inspector. When a bus passes these tests and inspections, the resident inspector shall authorize release of the bus.

Within fifteen (15) calendar days after arrival at the designated point of delivery, the bus shall undergo the WMATA tests defined in "Post-Delivery Tests." If the bus passes these tests or if WMATA does not notify the Contractor of non-acceptance within 15 calendar days after delivery, then acceptance of the bus by the WMATA occurs on the 30th day after delivery. If the bus fails these tests, it shall not be accepted until the repair procedures defined in "Repairs After no acceptance" have been carried out and the bus retested until it passes. Acceptance occurs earlier if WMATA notifies the Contractor of early acceptance or places the bus in revenue service.

> **NOTE:** Under federal requirements (49 CFR 663.37) no resident inspector is required for orders of 10 or fewer buses or 20 or fewer vehicles serving rural or urbanized areas of 200,000 people or fewer.

GC 4.2 Risk of Loss

WMATA shall assume risk of loss of the bus on delivery, as defined in "Bus Delivery." Prior to this delivery, the Contractor shall have risk of loss of the bus, including any damages sustained during the delivery regardless of the status of title or any payments related to the bus. Drivers shall keep a maintenance log in route, and it shall be delivered to WMATA with

the bus. If the bus is released back to the Contractor for any reason, the Contractor has the risk of loss upon such release.

GC 5. Title and Warranty of Title

Adequate documents for registering the bus in District of Columbia (Washington D.C.) shall be provided to WMATA not less than 10 business days before delivery to the Authority. Upon acceptance of each bus, the Contractor warrants that the title shall pass to WMATA free and clear of all encumbrances.

SECTION 2: SPECIAL TECHNICAL PROVISIONS

STP.1 Inspection, Tests and Repairs
STP.1.1 Pilot Bus

The Contractor shall produce one pilot vehicle for each type of vehicle with respect to the base order. This vehicle shall be one of the ultimate quantities of the base vehicle order. The pilot vehicle shall demonstrate that the vehicles fully meet all requirements of the Contract. The pilot vehicle shall be produced and delivered to WMATA for a minimum of sixty (60) days prior to initiation of any production activities for the remaining vehicles unless otherwise authorized in writing by WMATA**.** In the event that noncompliance is identified, the Authority shall to the extent practicable notify the Contractor of said noncompliance. No later than thirty (30) days after the end of the 45-day test, WMATA shall issue a written report to the Contractor that advises the Contractor of any noncompliance issues and/or any proposed modifications or changes required on the remaining vehicles.
In the event that the pilot vehicle does not initially comply with all performance criteria contained in the Technical Specifications, WMATA shall have the right to retain a portion of any progress payment that may have been established for the pilot vehicle. The amount to be withheld shall be based on the lack of compliance and may equal up to the entire progress payment amount for the pilot vehicle. This amount shall be withheld until compliance is demonstrated. In the event that the compliance is subsequently determined to be impossible to achieve, WMATA may require all or a portion of the progress payment for the pilot vehicle to be forfeited as a penalty for the noncompliance. The amount of the penalty shall be negotiated by the parties.

STP. 1.2 Configuration and Performance Approval

In order to assess the Contractor's compliance with the Technical Specifications, WMATA and the Contractor shall, at the Pre-Production Meeting, jointly develop a configuration and performance review document for review of the pilot vehicle. This document shall include appropriate performance standards for each test that is being required and the document shall become part of the official record of the pre-production meeting. First Article Inspection – Production

The purpose of a first article inspection is to confirm that any components, systems, subsystems, major assemblies, subassemblies, products, parts, apparatuses, articles and other materials comply with the Technical Specifications and other Contract documents.
Where required by the Contract documents or requested by the WMATA, the Contractor shall cause first article inspections to be conducted. A first article inspection may include both a physical configuration inspection and a functional demonstration. First article inspections shall be conducted at the Contractor or Subcontractor's facility. The Contractor shall furnish to the Authority prior to each first article inspection a written inspection and demonstration plan for each item for review. The Authority's inspectors will attend each first article inspection unless the Authority provides a written waiver of its right to attend any such inspection. The results of each first article inspection shall be documented by the Contractor in a format

deemed acceptable by the Authority, and all documents relating to the inspection shall be forwarded to the Authority.

STP. 1.3 Post-Delivery Tests

The Authority will conduct acceptance tests on each delivered bus. These tests shall be completed within fifteen (15) days after bus delivery and shall be conducted in accordance with written test plans. The purpose of these tests is to identify Defects that have become apparent between the time of bus release and delivery to the Authority. The post-delivery tests shall include visual inspection and bus operations. No post-delivery test shall apply criteria that are different from the criteria applied in an analogous pre-delivery test (if any). Buses that fail to pass the post-delivery tests are subject to non-acceptance. The WMATA shall record details of all Defects on the appropriate test forms and shall notify the Contractor of acceptance or non-acceptance of each bus according to "Inspection, Testing and Acceptance" after completion of the tests. The Defects detected during these tests shall be repaired according to procedures defined in "Repairs after Non-Acceptance."

STP. 1.4 Repairs after Non-Acceptance

The Contractor, or its designated representative, shall perform the repairs after non-acceptance. If the Contractor fails or refuses to begin the repairs within five (5) days, then the Work may be done by the Authority's personnel with reimbursement by the Contractor.

STP. 1.5 Repair Performance
STP. 1.5.1 Repairs by Contractor

After non-acceptance of the bus, the Contractor must begin Work within five (5) working days after receiving notification from the Authority of failure of acceptance tests. The Authority shall make the bus available to complete repairs timely with the Contractor repair schedule. The Contractor shall provide, at its own expense, all spare parts, tools and space required to complete the repairs. At the Authority's option, the Contractor may be required to remove the bus from the Authority's property while repairs are being made. If the bus is removed from the Authority's property, repair procedures must be diligently pursued by the Contractor's representatives, and the Contractor shall assume risk of loss while the bus is under its control.

Repairs by the Authority

The Authority will not take responsibility to correct Defects, except to replace defective parts as instructed by the Contractor.

1. **Parts used.** If the Authority performs the repairs after non-acceptance of the bus, it shall correct or repair the Defect and any Related Defects using Contractor-specified parts available from its own stock or those supplied by the Contractor specifically for this repair. Reports of all repairs covered by this procedure shall be submitted by the Authority to the Contractor for reimbursement or replacement of parts monthly, or at

a period to be mutually agreed upon. The Contractor shall provide forms for these reports.

2 **Contractor-supplied parts.** If the Contractor supplies parts for repairs being performed by the Authority after non-acceptance of the bus, these parts shall be shipped prepaid to the Authority.

3 **Return of defective components.** The Contractor may request that parts covered by this provision be returned to the manufacturing plant. The total costs for this action shall be paid by the Contractor.

4. **Reimbursement for labor.** The Authority shall be reimbursed by the Contractor for labor. The amount shall be determined by the Authority for a qualified mechanic at a straight time wage rate of ($62.75) per hour, which includes fringe benefits and overhead adjusted for the Authority's most recently published rate in effect at the time the Work is performed, plus the cost of towing in the bus, if such action was necessary. These wage and fringe benefits rates shall not exceed the rates in effect in the Authority's service garage at the time the Defect correction is made. (It will also increase 3.5% each year to adjust with inflation rate)

5. **Reimbursement for parts.** The Authority shall be reimbursed by the Contractor for defective parts that must be replaced to correct the Defect. The reimbursement shall include taxes where applicable and fifteen (15) percent handling costs.

STP. 2 Deliveries
STP. 2.1 Bus Delivery

Delivery of buses shall be determined by signed receipt of the WMATA's designated agent(s), at the following point(s) of delivery and may be preceded by a cursory inspection of the bus: **3433 Pennsy Drive, Landover, MD 20785**

STP. 2.2 Delivery Schedule

The buses shall be delivered at a rate not to exceed 10 buses per week. Delivery shall be completed within 52 weeks after delivery of the executed Contract documents. Hours of delivery shall be 24 hours on the following days of the week: Monday - Sunday

STP. 2.3 Contract Deliverables

Contract deliverables associated with this Contract are set forth in the table below, along with other pertinent information. Contract deliverables shall be submitted in accordance with Section 6: Technical Specifications. Due dates shown note the last acceptable date for receipt of Contract deliverables. The Authority will consider early receipt of Contract deliverables on a case-by-case basis. The reference section designates the appropriate specification section(s) where the requirement is referenced.

NOTE: Table 1 below provides a sample list of Contract deliverables. This list should be adapted by the Authority to reflect the Contract deliverables required by the Contract specifications.

Washington Metropolitan Area Transit Authority
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TABLE 1
Contract Deliverables

Deliverable		Authority Action	Reference Section	Due Date	Format	Quantity Due
1.	Bus Testing — Altoona Test Report	Review		Prior to pilot bus delivery	Hardcopy	1
2.	List of serialized units installed on each bus	Review		With each delivered bus	Electronic Media	1 per bus
3.	Copy of Manufacturers formal Quality Assurance Program	Review		Pre-award site visit	Hardcopy	1
4.	QA manufacturing certificate	Review		With each delivered bus	Hardcopy	1 per bus
5.	QA purchasing certifications acknowledging receipt of applicable specification	Review		30 days following first pre-production meeting	Hardcopy	1 per major Supplier
6.	Pre-Delivery Bus Documentation Package	Review		With each delivered bus	Hardcopy	1 per bus
7.	Motor Vehicle Pollution Requirements Certificate	Review		With each bus	Hardcopy	1
8.	Engine Emissions Certificate — NOx levels	Review		Prior to completion of pilot bus	Hardcopy	1
9.	Pre-production meeting minutes	Approval		30 days after each meeting	Hardcopy	2 originals
10.	Driver's log and incident report	Review		With each bus delivery if drive away service is used	Hardcopy	1 per bus
11.	Title documentation	Review		10 days prior to bus delivery	Hardcopy	1 per bus
12.	Performance bond	Review		30 days following execution of Contract	Hardcopy	1
13.	Insurance certificates	Approval		Before Work commences	Hardcopy	1
14.	Engineering support	Review		During pre-production meeting	Contracts	1
15.	Training instructor information	Approval		30 days prior to delivery of pilot bus	Electronic Media	
16.	Training curriculum	Approval		30 days prior to delivery of pilot bus	Electronic Media	
17.	Teaching materials	Review		During classroom instruction	Hardcopy	1
18.	Professionally prepared mechanics' "Bus Orientation" training video	Review		30 days prior to first production bus	Electronic Media	20 each
19.	Final preventative maintenance manuals	Review		90 days after Authority written approval	Hardcopy Electronic Media	15/100 buses 20

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TABLE 1
Contract Deliverables

Deliverable		Authority Action	Reference Section	Due Date	Format	Quantity Due
20.	Final diagnostic procedures manuals	Review		90 days after Authority written approval	Hardcopy Electronic Media	10/100 buses 20
21.	Final parts manuals	Approval		90 days after Authority written approval	Hardcopy Electronic Media	10/100 buses 20
22.	Component repair manuals (Authority approval/review period of 90 days from date of receipt)	Approval		90 days after Authority written approval of OEM component repair list	Hardcopy Electronic Media	2 2
23.	Draft preventative maintenance manuals (Authority approval/review period of 90 days from date of receipt)	Approval		With pilot bus	Hardcopy	10
24.	Draft diagnostic procedures manuals (Authority approval/review period of 90 days from date of receipt)	Approval		With pilot bus	Hardcopy	10
25.	Draft parts manuals. (Authority approval/review period of 90 days from date of receipt)	Approval		With pilot bus	Hardcopy	10
26.	List of OEM component repair manuals	Approval		With pilot bus	Hardcopy	10
27.	Draft operators' manuals (Authority approval/review period of 90 days from date of receipt)	Approval		With pilot bus or maximum of 30 days prior to start of production	Hardcopy	10
28.	Final operators' manuals	Review		30 days following Authority approval of draft manual	Hardcopy	1 per bus
29.	Recommended spare parts list, including bill of materials	Review		60 days prior to shipment of first bus	Hardcopy	1
30.	Part number index	Approval		60 days prior to shipment of first bus	Hardcopy Spreadsheet	1 1
31.	Current price list	Review		90 days after Authority written approval of draft parts manual	Hardcopy	20
32.	In-process drawings	Review		30 days prior to production	Scale drawings	1
33.	Complete electrical and air schematics & data logic	Review		30 days prior to production	Hardcopy	1

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TABLE 1
Contract Deliverables

Deliverable		Authority Action	Reference Section	Due Date	Format	Quantity Due
34.	As-built drawings	Review		Within 60 days after final bus delivery	Electronic Media	1
35.	Material samples	Review		By conclusion of pre-production meetings		1
36.	Undercoating and cavity protection (inside frame) system program	Approval		First pre-production meeting	Hardcopy	1
37.	Flooring certificate	Review		First pre-production meeting	Certificate/copy of purchase order	1
38.	Interior features – fire-resistance certificates	Review		Prior to pilot bus completion	Certificates	1
39.	Crashworthiness	Review		Pre-award audit	Certificate	1
40.	Technical review of electronic functionality	Approval		Prior to production	Hardcopy	1
41.	Interior & exterior security camera layout.	Approval		Prior to pilot bus completion	Copies of interior views	1 each
42.	Technical review of power plant			Prior to production		
43.	Power plant certifications	Review		Prior to pilot bus completion	Hardcopy	1 each
44.	Striping layout	Approval		Prior to production	Hardcopy	1
45.	Resolution of issues “subject to Authority approval”	Approval		Prior to production	Hardcopy	1
46	Manufacturer standard decals (interior & exterior)	Approval		Prior to production	Hardcopy	2

STP 3. Service and Parts

STP. 3.1 Contractor Service and Parts Support

The Contractor shall state on the form Contractor Service and Parts Support Data the representatives responsible for assisting the Authority, as well as the location of the nearest distribution center, which shall furnish a complete supply of parts and components for the repair and maintenance of the buses to be supplied. The Contractor also shall state below, or by separate attachment, its policy on transportation charges for parts other than those covered by warranty.

STP. 3.2 Documentation

The Contractor shall provide (Five (5) preliminary (Draft) of current maintenance manual(s), Operator's manuals, **Cross reference parts manual.** to include preventative maintenance procedures, diagnostic procedures or trouble-shooting guides and major component service manuals, current parts manual(s), and (Electronic Media) standard operator's manual(s) as part of this Contract. The Contractor also shall exert its best efforts to keep maintenance manuals, operator manuals and parts books up to date for a period of fifteen (15) years. The supplied manuals shall incorporate all equipment ordered on the buses covered by this procurement. In instances where copyright restrictions or other considerations prevent the Contractor from incorporating major components information into the bus parts and service manuals, separate manual sets as published by the subcomponent Supplier will be provided.

Cross reference parts manual shall include the following

A. Grouping by system, and special tool for stocking identification

B. Generic name, trade name, description rating, accuracy, Manufacturing part number, original equipment manufacturers (OEM's) name, OEM's part number, drawing references and correlation with parts manuals.

STP. 3.3 Parts Availability Guarantee

The Contractor hereby guarantees to provide, within reasonable periods of time, the spare parts, software and all equipment necessary to maintain and repair the buses supplied under this Contract for a period of at least twelve (12) years after the date of acceptance. Parts shall be interchangeable with the original equipment and shall be manufactured in accordance with the quality assurance provisions of this Contract. Prices shall not exceed the Contractor's then-current published catalog prices.

Where the parts ordered by the Authority are not received within two working days of the agreed-upon time and date and a bus procured under this Contract is out of service due to the lack of said ordered parts, then the Contractor shall provide the Authority, within eight (8) hours of the Authority's verbal or written request, the original Suppliers' and/or manufacturers' parts numbers, company names, addresses, telephone numbers and contact persons' names for all of the specific parts not received by the Authority.

Where the Contractor fails to honor this parts guarantee or parts ordered by the Authority are not received within thirty (30) days of the agreed-upon delivery date, then the Contractor shall provide to Authority, within seven (7) days of the Authority's verbal or written request, the design and manufacturing documentation for those parts manufactured by the Contractor and the original Suppliers' and/or manufacturers' parts numbers, company names, addresses, telephone numbers and contact persons' names for all of the specific parts not received by the Authority. The Contractor's design and manufacturing documentation provided to the Authority shall be for its sole use in regard to the buses procured under this Contract and for no other purpose.

STP. 4 Federal Motor Vehicle Safety Standards (FMVSS)

The Contractor shall submit one (1) manufacturer's FMVSS self-certification, Federal Motor Vehicles Safety Standards that the vehicle complies with relevant FMVSS or two manufacturer's certified statement that the contracted buses will not be subject to FMVSS regulations.

STP. 5 Authority-Specific Provisions

STP 5.1 SCOPE

Technical Specifications define requirements for a heavy duty, low floor, Clean Diesel and Compressed Natural Gas (CNG) powered transit bus which, by the selection of specifically identified alternative configuration, may be used for both suburban express service and general service on urban arterial streets. It shall have a minimum expected life of 12 years of 500,000 miles whichever comes first and is intended for the widest possible spectrum of passengers, including children, adults, the elderly, and persons with disabilities.

STP 5.2 DEFINITIONS

The following are definitions of special terms used in part SP

(1) Heavy Heavy-Duty Gas Engine(HHDG) Heavy-Duty gas engine have sleeved cylinder liners, are designed for multiple rebuilds, and a rated horsepower that generally exceeds 250.

(2) Operator Eye Range. The 95th percentile ellipse defined in SAE Recommended Practice J941, except that the height of the ellipse shall be determined from the seat at its reference height.

(3) Human Dimensions. The human dimensions used in Technical Specification are defined in Human scale 1/2/3, N. Diffrient, A.R. Tilley, J.C. Bardagiy, MIT Press.

(4) Head Injury Criteria. The following equation presents the definition of head injury criteria

$$[\frac{1}{t1-t2}\int_{t2}^{t1}(a)]^{2.5}(t2-t1)$$

Where:

a = the resultant acceleration at the center of gravity of the head from expressed as a multiple of g, the acceleration of gravity.

t_1 and $_2$ = any two points in time during the impact.

(5) Default Configuration Bus. The bus described by TS (Technical Specifications) if no alternatives are selected. Signing, colors, the destination sign reading list and other information must be provided by Procurement Authority in attachments to Part TS (Technical Specifications).

(6) Alternative. An Alternative specification condition to the Default configuration bus. The Procurement Authority may define alternatives to the Default

configuration to satisfy local operating condition and requirements. Alternative for the Default configuration will be clearly identified.

(7) Design Operating Profile. The operating profile for design purposes shall consist of simulated transit type service. The duty cycle is described in the figure "Transit Bus Duty Cycle" The duty cycle consist of three phases to be repeated in sequence: a central business district (CBD) phase of 2 miles with 7 stops per miles and a top speed of 20 mph and a commuted phase of 4 miles with 1 stop and a maximum speed of 55 mph and a 5 minute idle phase.

Phase	Stop/ Mile	Top Speed (mph)	Miles	Accl. Dist. (ft)	Accl. Time (s)	Cruise Dist. (ft)	Cruise Time (s)	Decel. Rate (fpsps)	Decel. Dist (ft)	Decel Time (s)	Dwell Time (s)	Cycle Time (min-s)	Total Stops
CDB	7	20	2	155	10	540	18.5	6.78	60	4.5	7	9-20	14
Idle	-	-	-	-	-	-	-	-	-	-	-	5-0	-
Arterial	2	40	2	1035	29	1350	22.5	6.78	255	9	7	4-30	4
CBD	7	20	2	155	10	510	18.5	6.78	60	4.5	7	9-20	14
Arterial	2	40	2	1035	35	1350	22.5	6.78	255	9	7	4-30	4
CBD	7	20	2	155	10	510	18.5	6.78	60	4.5	7	9-20	14
Commuter	1 stop for phase	Max or 65	4	5500	90	2 miles + 4580 ft.	188	6.78	480	12	20	5-10	1
Total			14									47-10	51
Average Speed -17.8 mph													

The bus shall be loaded to SLW and shall average approximately speed 18 mpg while operating on this duty cycle. Operation shall continue regardless of the ambient temperature or weather conditions. The passenger door shall be opened and closed at each stop, and the bus shall be knelt at each stop during the CBD phase. The braking profile shall be:

16 percent of the stops at 3ft/sec/sec
50 percent of the stops at 6ft/sec/sec
26 percent of the stops at 9ft/sec/sec
8percent of the stops at 12ft/sec/sec

These percentages of stops shall be evenly distributed over the three phases of the duty cycle. For scheduling purposes, the average deceleration rate is assumed.

High Density Urban Operating Profile. Additional requirements for Procuring Agencies with more demanding operating profiles.

A High Density Urban (HDU) Operating Profile may be applicable to transit agencies operating in a highly populated urban area in addition to the above requirements, this profile shall be taken into account during the design of subsystems such as charging, air, brakes and radiator/coolers. The HDU profile consists of mostly CBD type operating with some arterial and minimal commuter. However, the number of stops per mile and loading condition may be greater than propose specified for CBD cycle. The HDU profile is characterized by the following:

Average Speed	9 to 10 mph
Average Idle Time	50%
Percent Time at 0 to 19 mph	80% range
Percent Time at 20 mph & above	20%

Average speed is defined as the average engine hours divided by the miles traveled. Much of the "Idle" time is due to stop and go nature of the service of the HDU operation. The majority of this idle time is while the bus is in gear and stopped in traffic, or at bus stops, as well as frequent brake applications per mile due to traffic congestion and traffic signals. WMATA can provide additional operating characteristics to expand on these.

(8) Class of Failures. Classes of failures are described below.

a. Class 1: Physical Safety. A failure that could lead directly to passenger or operator injury or presents a severe crash situation.
b. Class 2: Road Call. A failure resulting in an en route interruption of revenue service. Service is discontinued until the bus is replaced or repaired at the point of failure.
c. Class 3: Bus Change. A failure that requires removal of the bus from service during its assignments. The bus is operable to
d. Class 4: Bad Order. A failure that does not require removal of the bus from service during its assignments but does degrade bus operation. The failure shall be reported by operating personnel.

(9) General Installation Requirements

a. Water intrusion control. All external ancillary components shall be installed using stainless steel machine threaded hardware and sealing methods/materials that will prevent water intrusion and damage for the design life of the vehicle.
b. Definitions
Data Network. A group of devices communicating over a shared data link of specific protocol (i.e. SAE J1939/ J1587/1708). The separation of data networks for the purposes of physical identification shall be distinct to the specific group of devices connected (i.e. CAN1, CAN2, Etc., following vehicle manufacturer conventions).

(10) Maintenance Personal Skill Levels.
Define below are maintenance personal levels used in WMATA.

a) 5M: Specialist Mechanic or Class A Mechanic Leader.
b) 4M: Journeyman or Class A Mechanic.
c) 3M: Mechanic Helper or Class B Servicer.
d) 2M: Mechanic Helper or Bus Serviser
e) 1M: Cleaner, Fueler, Oiler, Hostler, or Shifter

Note: Whenever a specific time is indicated to access components or complete a task, it is assumed the vehicle is in the location where the work is to be performed. All necessary equipment is in correct position (tools, jacks, vehicle lifts, lighting, fluid recovery system etc.) and ready for use.

STP. 6 Authority-Specific Provisions
STP 6.1 Passenger Seating:

The passenger seats shall be **American Seating Company "In-Sight" or USSC "Aries" or "Gemini"** model with vandal resistant padded seat or approved equal. WMATA will be sole determiner of what will be approved as an equal. The seat will be cantilever configuration with the two-passenger seat 35 inches wide and 24 3/16 inches overall front to back. The seats must meet all testing requirement for Padded seat as required by the APTA Standard Bus Procurement Guide lines for Transit Buses (latest version)

The bidder shall include in his proposal a Certified Test Report as evidence of compliance with the specifications and test requirements contained herein.

It shall be the option of Transit Authority Engineer to require and witness the testing of a representative transverse seat at the manufacturer's facility.

The test report shall contain a record of Test performed in accordance with the guideline requirements of APTA Standard Bus Procurement Guidelines for Transit Buses (latest revision).
The report must show the diagrams, and load results on representative seats completely assembled and fastened to a rigid fixture simulating the vehicle attachment. The test data for each test shall describe the test procedure and test equipment, the resultant deflection graphically recorded, and the permanent deformation of inspection.

All seats will be similar construction and appearance. (The seat frames and mounting brackets shall be bead blasted stainless steel.) Seat assemblies and components of identical seats shall be mechanically interchangeable. Inserts and grab handles shall be individual

and fully interchangeable. Seat shells are to be provided in one (1), two (2) and three (3) passenger constructions with common frames to minimize weight.

The one (1) and two (2) passenger configured transverse seats shall consist of either a one or two-passenger shell with separate seat and back inserts supported by a tubular steel frame. The one piece seat shell shall be securely fastened to the tubular steel frame without rivets in a manner to provide structural integrity to the seat.

The seat shell shall be fully contoured for body from comfort and occupant retention. The shell must be designed with step-down relief in seat and back areas to accept padded inserts. The relief shall be 5/16″ in depth and contoured to follow the configuration of the shell.

The seat incorporates a waterfall design on the front and leading edge of the seat insert to insure continuous leg support for the ranges of passengers, from the 5th to 95th percentile. There shall be no “pinch points” or sharp edges in the seat’s construction or installation nor surfaces which impede circulation in the legs while in the seated position. Where three (3) passengers longitudinal (aisle facing) seats are required, the seat is to have one continuous shell with three individual sittings to match the style lines and accept the same inserts as other seats in the vehicle.

The transverse seats shall have energy-absorbing, cut resistant colored textured thermoplastic grab handles capable of decelerating an occupant’s head in a vehicle collision at a velocity of 22 feet per second. The grab handle shall be readily replaceable but attached securely to provide adequate and firm support.

Separate padded seat and back inserts shall be provided for each sitting. Inserts shall be **minimum 3/4″** in thickness and shall be comprised of 20ga steel contoured base panel with 1/2″ low smoke and flammability foam padding covered with Holdsworth-fabric # 5621 6094 3267 (federal Docket 90A), Seat and back inserts shall be attached with a floating/ratcheting device which self-aligns and firmly secures to the shell eliminating rattling. The fasteners shall be capable of being cycled 25 times without diminished performance.

The rear side of the transverse seat backs shall be covered with a panel made of high impact, strength textured, thermoplastic of 1/8″ nominal thickness in #989 Blue. The back panel with the molded crash pad shall encompass the entire rearward frame structure and shall be recessed for increased passenger knee clearance. Coloring shall be consistent throughout the thickness of the material with no portion painted.

The bus shall be equipped with Q’Straint (Q-POD) Restraints. All frames and mounting brackets shall be stainless steel with a “bead blasted” finish. Each wheelchair location shall be equipped with two (2) passenger transverse flip up seat and/or two (2) or three (3) passenger longitudinal flip-up seat, locking into position thus creating an area to accommodate a wheelchair. At the rear of each w/c securement location a barrier with remote release securement belts and a passenger restrain belt (one end mounted to the vehicle wall and the other to the barrier) will provide required and safe securements. (QRT Deluxe

Securement Belts). All accessibility components must comply with the requirements of the ADA.

All frame members shall be finished with high durability powder coated finish. Each wheelchair securement location shall be equipped with two (2) passenger transverse flip-up seat and/or two (2) or three (3) passenger longitudinal flip-up seat, locking into position thus creating an area to accommodate a wheelchair. At the rear of each w/c securement location, a barrier with remote release securement belts and a passenger restraint belt (one mounted in the vehicle wall and the other to the barrier) will provide required safe securement.(QRT Deluxe Securement Belts). At the forward end of the w/c securement location a telescoping A.R.M system by American Seating Company, equipped with QRT Deluxe Securement Belts shall be provided. All accessibility components must comply with the requirement of the ADA.

STP 7. FIRE ALARM SYSTEMS.

An OEM redundant fire sensing device shall be provided with an alarm and light on the dash
to alert the operator while bus in revenue service. The bus shall be designed and manufactured in accordance with all applicable fire safety and smoke emission regulations.

STP 8. Automatic Vehicle Health Monitoring System.

2. GENERAL

The bus manufacturer shall supply a bus with an Intelligent Vehicle System (IVS). This will provide accurate, reliable and timely bus performance and fault information and improve vehicle and passenger safety and security. IVS shall be integrated with the on-board microprocessor controlled systems and with WMATA Wireless and Ethernet LAN to create a fully intelligent vehicle that will increase vehicle performance, optimize fleet utilization, and increase operational efficiency.

Note that in the following there will be references to the sections of this appendix unless otherwise specified. A reference to the technical specification will be explicitly indicated.

The IVS is primarily constituted of bus on-board system and a depot system. The bus onboard system will have the main function to collect the fault and performance data from all of the microprocessor based systems and deliver the passenger friendly functionalities described in the following.

The depot system is required to collect fault and performance data downloaded from the buses through the wireless link and to generate customizable reports (this system is not part of this procurement).

The bus builder shall supply the IVS system in accordance with the requirements outlined in this appendix. The bus builder shall develop a scope of supply, system integration and

implementation.

The Bus Manufacturer shall be responsible for proving the installation of the IVS in the bus, the functional interfaces between this equipment and the bus, and to ensure that bus systems comply with the requirements of this appendix. The supply and proper functioning of all interfaces shall be provided in accordance with the requirements of this Specification.

The configuration of the functional interfaces will be finalized during the technical evaluation process.

2. IVS ONBOARD SYSTEM

The on-board system is the key element of the IVS system and shall consist of the following components: Controller, Mounting Bracket, Bus Interface Harness, Multi-Band Roof-Mount Antenna (used for Wireless LAN, Cellular Communication and GPS), Wireless LAN Antenna Cable and GPS Antenna Cable.

Each bus shall be provided with one controller that will deliver the functions of the on board System. The main functions are listed below:

- Automatic Vehicle Monitoring
- Hard Brake and Last Stop Reporting
- GPS and Dead Reckoning
- Diesel Particulate Filter Active Regeneration Inhibit Control
- Automatic Vehicle Annunciation
- Automatic Passenger Counting
- Mobile Data Terminal

The bus Manufacturer is required to present the complete implementation of the IVS, its features and its provisions for technical compliance review.

2.1 IVS CONTROLLER HARDWARE REQUIREMENTS

There shall be one controller per bus which should have a service life equal to the design life of the bus.

The controller shall be capable to communicate with any bus subsystem capable of interfacing on a network as specified in Section 3.1 and 3.2. The controller shall include a built in audio module with an audio controller, microphone input, volume control input to allow for automatic volume control.

The controller shall be designed with a navigation system based on a combination of GPS and dead reckoning (Section 3.5).

A solid state high speed drive of a minimum storage capacity of 8GB will serve as the main

storage device for the controller's program functions, navigation information, fault and performance data, audio data and processed data. The flash storage shall not malfunction or corrupt due to any voltage fluctuation or power interruption such as "knifing the bus".

The controller shall incorporate a sleep function with automatic shut down within a configurable time after the run switch is turned to the off position. The system shall not malfunction if battery power is removed before the automatic shutdown is initiated.

2.2 IVS BUS COMMUNICATION ANTENNA

Wireless communication shall be IEEE 802.11ac,n compliant. The system shall contain a multi-band antenna with cables that will allow the controller to have GPS satellite communication, WIFI communication via IEEE 802.11ac,n and cellular communication. Cellular antenna specifications shall include the 700MHz band in addition to all currently licensed cellular bands. The antenna shall have 2, dual-band, WiFi elements for 2x2 MIMO operation in the 2.4GHz and 5GHz bands. There shall be one ITS antenna per bus and it shall be 18" or more away from any other antennas. Antenna and cable shall have a service life equal to the design life of the bus. The bus manufacturer will install the antenna and the cable in conformance to this specification.

3.1 VEHICLE MONITORING

The vehicle monitoring system shall automatically collect selected bus system's faults and operational performance data that will be transmitted simultaneously to the controller via the SAE-compliant on-board communication protocols utilized on the vehicle and in effect at the time of production. For Example, SAE CAN/J1939 Network, SAE J1708/J1587 Network, SAE J2012 and RS-232/485).

The system shall be capable of verifying active communication between all monitored systems and the system controller, and be capable of using multiple communication protocols simultaneously (SAE CAN/J1939 Network, SAE J1708/J1587 Network, SAE J2012 and RS232/485).

As system equipped vehicles come into range of the wireless LAN at the depot, all collected data (vehicle ID, all fault codes, and selected operational performance data defined in Tables 2-1 to 2-9) shall be automatically transmitted to the server and loaded into a format compatible with the depot system server. All data shall be presented in US or Metric units as the Transit Authority desires. All data shall be capable of being presented using manufacturers descriptions (by default) and SAE definitions.

Bus and sub-component manufacturers shall provide all necessary documentation/support to ensure that all points are monitored properly with the actual fault/performance data point descriptions as they appear in all respective bus/sub-component maintenance manuals. In addition to all standard SAE vehicle area network data points, all data point visualized on the operators' dashboard and in any respective bus/sub-component diagnostic software

shall be broadcast on an SAE complaint vehicle area network making it available for monitoring by the IVS system.

When a gateway or an interface is used between the controller and the on-board communication systems, the gateway shall output all data to the controller in the format that's compliant with section 3.2.

A CAN analyzer test and a data review shall be performed by the bus manufacturer to confirm all data availability. The OEM shall provide a complete list of all available data points on the vehicle area network to support this process, this includes standard and proprietary data point addresses. The test result shall be submitted to WMATA for review prior to bus configuration audit.

The following documents shall be submitted to the IVS manufacturer and a copy to WMATA for technical review.

- Technical interface document for each system vendor that is being monitored (for example, Engine, Transmission, HVAC, Multiplex, ABS, etc.)
- List of all performance points that are capable of being monitored (for example, engine temperature and climate control compressor discharge pressure).
- List of all fault codes that are capable of being monitored (for example, engine code "2963", climate control fault code "6").
- The information above should be grouped by the system that is reporting the data (for example, Engine, HVAC, Multiplex, ABS and Door Control).
- Denote how each system communicates (for example, J1939, J1708, J2012, RS232/RS485).

3.1.1 Fault Events and Performance Data

All fault events and performance data broadcasted on the bus networks (SAE J1939, J1708/J1587, J2012 or RS232/RS485) shall be monitored, reported and stored in a non-volatile flash memory drive of the controller. Fault codes shall remain available indefinitely or as on-board memory storage permits. Data will be purged on a first in first out (FIFO) basis. Fault code data shall remain available after disconnecting the 24V batteries if disconnection occurs not less than 10 seconds after turning off the master run switch.

The system shall not collect faults and performance data when the engine is not running. The system shall not collect any data when the bus master switch is in the off position. Diagnostic fault codes (DM1, BAM or PID194, Multi-Section Parameter) from each system are to be monitored and the frequency of collection shall be configurable. Utilizing proprietary or reserved PGNs, SPNs, MIDs, FMIs, and PIDs will not be accepted as they are not compliant with SAE J1587 or J1939 or the intention of this specification. Conditions or parameters for collecting fault codes based on either time delay or number of events in a time period shall be user definable. Condition or parameter changes will be made by the IVS supplier.

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Table - 1 : Vehicle Signals	
No.	**Signal Name**
1	Vehicle speed (MPH)
2	Engine Speed (RPM)
3	Brake pedal Position (Applied or Not-Applied)
4	Engine Load (%)
5	Throttle Position (%)
6	Odometer pulse (Square Wave). Must be delivered as a discrete Voltage signal to IVS
7	Front Door Open – Discrete
8	Rear Door Open – Discrete (if there is a Center door, this signal should be combined with the Rear Door)
9	Wheel Chair Deployed – Discrete
10	Stop Request – Discrete (include Wheel Chair Stop Request)
11	Reverse – Discrete (Active High)

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Table -2: Engine			
No.	**Signal Name**	**No.**	**Signal Name**
1	All Diagnostic fault codes	23	Particulate Trap Outlet Gas Temperature
2	Software Identification	24	Unit Number (Power Unit)
3	Boost Pressure	25	Trip Distance – High Resolution
4	Electrical Potential (Voltage)	26	Maximum Vehicle Speed Limit
5	Engine Average Fuel Economy	27	Intake Manifold Pressure
6	Engine Coolant Level	28	Engine Turbocharger Boost Pressure
7	Engine Coolant Temperature	29	Engine Trip Fuel – High Resolution
8	Engine Crankcase Pressure	30	Engine Total Idle Hours
9	Engine Fuel Rate – High Resolution	31	Engine Total Idle Fuel Used
10	Engine Idle Shutdown has Shutdown Engine	32	Engine Total Hours of Operation
11	Engine Intake Manifold 1 Temperature	33	Engine Total Fuel Used – High Resolution signal
12	Engine Oil Level	34	Engine Speed
13	Engine Oil Pressure	35	Component Identification (Engine Serial Number)
14	Engine Protection System has Shutdown Engine	36	Engine Exhaust Temperature
15	Engine Shutdown Override Switch	37	Catalyst Tank Temperature
16	Exhaust Gas Temp 1 = DPF Inlet Gas Temp	38	Catalyst Tank Level
17	Exhaust Gas Temp 3 = DPF Outlet Gas Temp	39	Engine Air Inlet Pressure
18	Particulate Trap Active Regeneration Inhibited Due to Inhibit Switch	40	Number of Emergency Stops
19	Particulate Trap Active Regeneration Status	41	Software Identification (Calibration Version)
20	Total Vehicle Distance	42	Road Speed PGN65265 SPN84 at a consistent 100ms broadcast rate
21	Wheel-Based Vehicle Speed	43	Calibration Information (DM19)
22	Vehicle Identification Number		

Table -3: Transmission	
No.	**Signal Name**
1	All Diagnostic fault codes
2	Software Identification
3	Battery Potential (Voltage)
4	Hydraulic Retarder Oil Temperature
5	Transmission Input Shaft Speed
6	Transmission Output Shaft Speed
7	Transmission Oil Temperature
8	Transmission Oil Level High/Low
9	Transmission Oil Life Remaining
10	Transmission Shift Position

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Table - 4: Multiplex System			
No.	**Signal Name**	**No.**	**Signal Name**
1	Exhaust Regen Off	18	Wheel Chair Stop Request
2	IVN Regen Enable	19	Passenger Stop Request (does not include Wheel Chair Stop Request) – J1939
3	IVN Status	20	Fire Suppression System Active (Deployed)
4	Reverse	21	Fire Shutdown Engine
5	Network Failure – Individual Modules	22	Software Identification (if applicable)
6	Engine Fuel Filter Clogged	23	Parking Brake Engaged
7	Engine Air Filter Clogged	24	Air Compressor Status (Duty Cycle)
8	ABS Indicator	25	Wheelchair – rate of deployment or system health (for example, amp draw of motor)
9	Alternator Charge Indicator	26	Charging System Monitor – Low Charge Indicator
10	Coolant Level: Low	27	Front Door Open Signal – J1939
11	Low Air Pressure	28	Rear Door Open Signal – J1939
12	Check Engine	29	Wheel Chair Cycle Counts
13	Stop Engine	30	Bus Battery Voltage
14	Kneeling Active	31	Seat Belt Status (if applicable)
15	Throttle Malfunction	32	Seat Alarm (Pressure switch status) – (if applicable)
16	A/C Failure	33	All Available Diagnostic Fault Codes
17	Wheel Chair Ramp Deployed – J1939	34	Door Master Switch Status

Table - 5: ABS System	
No.	**Signal Name**
1	All diagnostic fault codes
2	Road Speed
3	ABS Active
4	Software Identification
5	Wheel Speed PGN65215 SPN904 at a consistent 100ms broadcast rate

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Table-6 : Door Systems	
No.	**Signal Name**
1	Diagnostic fault codes
2	Software Identifications
3	Front Door Open
4	Front Door Close
5	Rear Door #1 Open (Bus with 2 or 3 doors only)
6	Rear Door #1 Close (Bus with 2 or 3 doors only)
7	Rear Door #2 Open (Bus with 3 doors only)
8	Rear Door #2 Close (Bus with 3 doors only)

Table -7 : Climate Control System			
No.	**Signal Name**	**No.**	**Signal Name**
1	All Diagnostic Fault Codes	9	Discharge Pressure
2	Software Identification	10	Suction Pressure
3	Ambient Air Temperature	11	Operating Mode
4	Discharge Air Temperature	12	Performance Data
5	Discharge Air #2 Temperature (if applica-ble on Artic bus)	13	Configuration File
6	Return Air Temperature	14	Compressor Clutch Cycles
7	Return Air All Zones Temperature (only apply to artic bus)	15	Compressor Hours
8	Water Inlet Temperature		

Table-8 : Artic Joint System (Applies to Artic bus only)	
No.	**Signal Name**
1	All Diagnostic Fault Codes
2	Software Identification
Table-9 : IVS	
No.	**Signal Name**
1	All Diagnostic Fault Codes
2	Software Identification

3.2 DATA FORMAT AND AVAILABILITY

The automatic vehicle monitoring controller shall send and receive messages from all bus systems actively communicating and connected to the CAN and J1708 networks. Section 3.2 sets forth the data definitions for the IVS controller and the monitored systems to assure mutual communication over the networks as applicable to each.

3.3 DATA DEFINITION

Regardless of the communication protocol used, each bus sub-system supplier shall provide an interface specification and data definition consistent with the provided interface. Manufacturers of systems to be monitored shall provide documentation for the data to be transmitted for each system, the interface protocol to be used and the data definition of the externalized data. Bus Manufacturer shall provide each system vendor with this appendix.

The bus manufacturer is responsible for monitoring bandwidth utilization to insure sufficient throughput for network traffic and must assure that there are no network collisions, frame errors, etc.

The bus manufacturer must ensure that, any bus system supplier that makes programming changes keep the existing data available. If any new faults or performance data is added during any program change it must be made available as per the J1939, J1708/J1587, and RS-232/485 requirements. If changes do occur the bus system supplier and the sub-system supplier must notify WMATA of changes in writing. The bus system supplier and the sub-system supplier shall perform any necessary campaigns to ensure consistency by implementing changes across the entire fleet.

3.4 J1939 BUS SYSTEM FAULT REPORTING AND PERFORMANCE DATA

All bus system non-diagnostic application layer messages must be formatted and transmitted in conformance with SAE J1939-71, “Vehicle Application Layer”. All performance data not made available through a broadcast must be available to the system controller via the Request PGN (59904), as described in SAE J1939-21, “Data Link Layer”.

3.4.1.1 BUS SYSTEM FAULT REPORTING (DM1 DIAGNOSTIC MESSAGES)

All diagnostic (fault) application layer messages must conform to the requirements described in SAE J1939-73 “Application Layer – Diagnostics”.

At a minimum, all active bus system faults must be formatted and transmitted in accordance with paragraph 5.7.1 (“Active Diagnostic Trouble Codes (DTC)” – Message Type DM1 [PGN 65226]). These messages are to be broadcast, but shall also be available on request using the Request Message PGN [59904]. The Request PGN is described in J1939-21, “Data Link Layer”. The response to the DM1 request must be in accordance with paragraph 5.7.1 with regard to the formatting of DM1 messages. See “Transport Protocol”, below for

details regarding the transmission of multiple packets (containing DTCs) using the Broadcast Announce Message (BAM).

The DM1 message involves the use of Suspect Parameter Numbers (SPNs) to identify a particular element, component or parameter associated with a J1939 network device Diagnostic Trouble Code (DTC). Where possible, bus systems shall use SPNs defined in the SAE J1939 specification when reporting faults. If there is no correlation to an existing SPN, values in the proprietary range must be used. These are the SPN values which span from 520192 (7F000 hex) to 524287 (7FFFF hex), inclusive.

3.4.1.2 TRANSPORT PROTOCOL - BROADCAST ANNOUNCE MESSAGE (BAM)

In all cases where a response or broadcast message will require greater than 8 data bytes, the capabilities of the Transport Protocol must be employed.
Specifically, the Broadcast Announce Message Transport Protocol, as described in SAE J1939-21, “Data Link Layer”, paragraph 5.10; provides for the transmission of messages which encompass multiple packets of data. An example of such a transmission would be a DM1 message with more than one Diagnostic Trouble Code (DTC) being reported.

3.5 J1587 PERFORMANCE DATA AND FAULT REPORTING

3.5.1.1 J1587 PERFORMANCE DATA

All non-diagnostic or fault application layer status messages must be formatted and transmitted in conformance with SAE J1587, “Electronic Data Interchange Between Microcomputer Systems in Heavy Duty Vehicle Applications” and SAE J1708, “Serial Data Communications Between Microcomputer Systems in Heavy Duty Vehicle Applications”. All performance data are expected to be available via appropriate Message ID (MID), Parameter ID (PID), SID, Fault ID (FMI), assignments in accordance with these specifications. Utilizing proprietary or reserved FMIs, MIDs, and PIDs are will not be accepted as they are not compliant with SAE J1587 or the intention of this specification.

3.5.1.2 J1587 FAULT REPORTING

All diagnostic (fault) application layer messages must be formatted and transmitted in conformance with SAE J1587, “Electronic Data Interchange Between Microcomputer Systems in Heavy Duty Vehicle Applications” and SAE J1708, “Serial Data Communications Between Microcomputer Systems in Heavy Duty Vehicle Applications”. Specific attention shall be devoted to the use of PID 194 (Transmitter System Diagnostic Occurrence Count Table) to report the diagnostic condition of a device on the network. All fault reporting data are expected to be available via appropriate Message ID (MID), Parameter ID (PID), SID, Fault ID (FMI), assignments in accordance with these specifications.

3.5.1.3 J1587 MULTI-SECTION PARAMETER

PID 192 (Multi-section Parameter) is used to transmit parameters that are longer than what is limited by SAE J1708. A specified parameter can be broken into sections with each section being transmitted in a different message. This shall be used as appropriate.

3.5.1.4 J1939 COMPLIANT DEVICES DATA DEFINITION

All bus systems shall externalize all data including fault codes and performance data in a standard, non-proprietary J1939 format. All systems shall be assigned with a Source Address on the J1939 network. Specific detail for all Parameter Group Numbers (PGNs) supported (down to the individual parameters supported within the PGN) shall be provided to IVS supplier.

Details for each fault the device is capable of generating (using the DM1 message) shall include the Source Address (SA), Suspect Parameter Number (SPN), Fault ID (FMI), OEM Description and OEM Flash Code or Fault Code, if it exists. All bus systems shall also broadcast its software identification level to the system
Controller.

3.5.1.5 J1587 COMPLIANT DEVICES

All bus systems shall externalize all data including fault codes and performance data in a standard, non-proprietary J1587 format. MID on the J1587 (J1708) network and specific detail for all PIDs shall be provided to the automatic vehicle monitoring controller. Details for each fault the device is capable of generating (using the PID 194 message) shall include the MID, PID/SID, Fault ID (FMI), OEM Description and OEM Flash Code or Fault Code, if it exists. All bus systems shall also broadcast its software identification level to the automatic vehicle monitoring controller.

3.6 MULTIPLEX SYSTEM MONITORING

Multiplex systems shall be monitored via J1708/J1939 and/or RS232/485 and must be equipped with all necessary gateways and programming required to externalize data in a manner compatible with the automatic vehicle monitoring controller. Multiplex system sleep mode time shall be set to fifteen (15) minutes by the bus manufacturer.
The J1939 compliant multiplexer system shall interface with the IVS controller and transmit diagnostic fault codes (DM1, BAM or PID194, Multi-Section Parameter) available on the network .Interfacing may require a J1939 multiplexer gateway if a gateway is required it shall be provided by the contracted bus builder. Performance data to be supplied by the bus manufacturer shall consist of but is not limited to current draw, electrical arcing, system shutdown alerts and input and output status.

STP 9. Front Pedestrian Warning System
STP 9.1 Location

A Front Light shall be mounted (Location shall be approved by WMATA). Forward-facing, centered on forward roof area of the bus. Light orientation is horizontal and mounting position is perpendicular to road surface. The mounting position shall provide unobstructed visability of all light segments at no less than three feet from the forward edge of the front bumper when measured at a height of no more than four feet from the level road surface. Light assembly, and any required attaching structure(s) shall be attached using permanently installed stainless steel threaded inserts and machine screws, sealed to prevent water intrusion for the design life of the vehicle.

STP 9.2. Type, Function and operation.

- Type: Whelen D800800 Dominator or approved equal
- LED Color: All segments Amber
- Lens Color: Clear
- Programmed pattern: Back and Forth Chase.
- Function: During Driving:
- Master Run Switch in Day or Night Run
- Propulsion in forward range.
- Brake interlock released.
- During exterior light test.

STP 10. Rear Safety Light.
STP 10.1. Location

Rear light mounts centered on upper section of engine door (Location shall be approved by WMATA). Light shall be installed in such a manner that it is visually unobstructed and meets the same visibility requirements for stop and turn signal lights. Light shall be mounted in a position lower than the horizontal plane occupied by the high mounted (3rd) brake light(s). Light installation shall not impede opening of the engine door or contact any portion of the bus in an open position of the engine door. Light assembly, and any required attaching structure(s) shall be attached using permanently installed stainless steel threaded inserts and machine screws, sealed to prevent water intrusion for the design life of the vehicle

STP 10.2. Type, function and operation.

- Type: Whelen RSA03ZCR (or approved equal)

During deceleration:

- Master Run Switch in Day Run or Night Run.
- Vehicle speed above 10 MPH.
- Zero throttle angle.
- Turn signals not active

- Above true for >2 seconds.

While servicing a passenger stop:

- Master Run Switch in Day Run or Night Run.
- Propulsion in forward range.
- Front or rear doors not closed.

When Bus is backing:

- Master Run Switch in Day or Night Run.
- Propulsion in reverse range.

During exterior light test.

STP 11. Body.

The roof exterior shall have anti-skid material installed to afford safety and aid in performing service and maintenance on roof mounted equipment.

STP 11.1. Fasteners.

The Contractor shall procure and deliver fasteners made in the United States for use in the coach manufacturing process. The steel shall be of high quality and for use in general and critical applications. At a minimum, Grade 5 bolts shall be used in all areas where 1/4-inch or larger bolts are required. Grade 8 bolts, nuts, flat and lock washers shall be used as recommended by SAE for critical applications such as: steering, brakes, suspension, etc. The bus manufacturer shall make available a list of locations where Grade 8 bolts are used. All items covered by this specification shall conform to applicable S.A.E., U.S.S., or Metric standards and shall be of U.S. manufacture. No counterfeit fasteners will be permitted.

Should WMATA find the Contractor or its suppliers providing counterfeit fasteners of any type, the Contractor may be declared in default and the contract may be terminated or be required to replace all fasteners at its expense.

WMATA has the option of random testing of all fasteners prior to coach assembly. This testing may be done by WMATA or its agent at any time during the terms of the contract. A variety of at least 10 fasteners will be collected from various stations in the assembly line by a WMATA employee or authorized consultant. These fasteners will be randomly taken from the stock to be used in the manufacturing of this procurement. These fasteners will be mechanically analyzed by an independent testing laboratory to determine continued compliance with the applicable standards. Additional sample tests may be taken if there is a variance from the Specification.

Cost for testing will be paid for by the Contractor if the samples fail. WMATA will accept the cost for testing all samples which are found to be compliant. In order to comply with Federal

Regulations, all shipments must be fully traceable for lab testing, heat treatment, and steel requirements. A code shall be assigned and marked on each package which will trace the purchase order. Certifications and testing conducted should be germane to specific products ordered.

The Contractor shall, upon request by WMATA, produce the manufacturer's test, traceability requirements, and certifications for the following:

a) Process and lay-out inspection.
b) Heat treatment lot number.
c) Plating thickness.
d) Plating baking per Federal Specification Q-Z-325.
e) Gauging of threads.
f) Material chemistry.
g) Tensile strength, wedge angle.
h) Surface/core hardness.
I) Proof load (nuts).

STP 11.2. Materials.

Exterior panels shall be constructed of metal or reinforced molded fiberglass. Chromium-plated trim pieces are not acceptable. Any bright metal exterior trim shall be stainless steel or anodized aluminum.

Use of wood shall be limited to flooring and platforms.

All interior/exterior applied parts and panels shall be vandal resistant. Examples of vandal resistant provisions are locating or shielding components to provide protection from abuse; minimizing use of plastics and rough surfaced materials; use of easily cleanable materials; eliminating carpeting; use of mar/scratch resistant materials; use of vandal resistant fabric seats; reinforcing louvers, mounting provisions and barriers; allowing removal of components only with the use of tools; and securing compartments and access doors in passenger area with latches/fasteners which cannot be opened without the use of tools but not with a standard slotted screwdriver.

STP 11.3. Corrosion.

WMATA places a high priority on the vehicle being made of non-corrosive materials or being corrosion proofed. The OEM shall provide details of materials and anti-corrosion provisions. The operating environment consists of a wide variety of climatic conditions including heavy rains, snow and high humidity. Road salts are very heavily used. All components at or near floor and platform levels such as fasteners, floor ducts, trim strips, heaters, etc. shall be stainless steel. Items below floor level must be corrosion resistant. Underneath portion of the under frame, flooring and stepwells, wheel housings and all exposed underfloor surfaces shall be undercoated. Fasteners less the 1/4" used for frequently serviced

items below floor level such as mud flaps must be stainless. Anti-seize compound shall be used in service areas where appropriate.

The Bus main structure shall be inherently corrosion resistant. The bus main structure shall be made of (304) grade stainless steel **(Option)**

STP 12. Exterior Panels and Finishes
STP 12.1. Access Doors.

Access Doors (with locks): The locks shall be corrosion resistant and preferably flush mounted and standardized as defined by WMATA so that only one tool is required to open all major access doors on the bus.

Exterior access doors for accessing the Radiator, Air Dryer and Engine, etc., shall be equipped with gas props with safety tubes. The Surge Tank access door shall be retained by a over-center spring in lieu of a Square Key Lock.

STP 12.2. Bumpers.

The front and rear bumpers shall have bumper extensions installed.

The front bumper shall be designed to accommodate a mounted bicycle rack capable of transporting up to two (2) bicycles. All necessary hardware **(to include bracketry) necessary** for mounting the Sportswork (Apex 2) or BykRak bicycle rack to the front bumper shall be provided by the bus manufacturer. The bicycle mounting bracket shall be easily removable to permit front end lift or flat towing without having to disassemble and/or remove any part(s) and/or section(s) of the front bumper assembly utilizing the “quick release” system.

STP 12.3. Finish and Colors.

The exterior paint and graphics are comprised of base coat clear coat process and vinyl decals. Primarily the forward half of the bus is painted DuPont Silver Metallic 841 I44EGG and DuPont Clear coat 8420S. The rear half of the bus is painted DuPont Red 830650EG and DuPont Clear coat 842OSVMATA. The two paint colors are joined by a reverse .5fl “swooshing blue and white decal extending from the bottom of the bus to the top of the roof. WMATA will provide a sample of the exterior paint and graphics layout. WMATA may reject any bus that does not comply with the approved exterior graphics scheme drawings. Upon inspection of the Pilot Bus, WMATA may direct the Contractor to make minor changes in the paint/graphics placement and color scheme consistent with the approved color scheme drawings, at no additional cost to WMATA.

The exterior and interior graphics shall be supplied by an Authority approved Graphics Vendor. All striping, decals, coach numbers, signage. Monograms and appliqués will be provided by The Authority approved Vendor.

The selected contractor will furnish the Authority approved Graphics Vendor an electronic file showing the elevation drawings of the proposed bus and all interior and exterior graphics locations. In return, the Authority approved Graphics Vendor will furnish the successful bidder and WMATA complete engineering drawings with material specifications. This final layout will be provided within 3 weeks of receipt of the electronic file. The Authority approved Graphics Vendor will oversee installation of the entire graphics package to assure that all recommended 3M procedures are followed. Alt exterior graphics shall be manufactured from 3M 680C reflective vinyl material. Interior decals and signage material specifications shall be determined by WMATA.

STP 12.4. Numbering and Signing.

The placement, size, appearance, content and fabrication of all decals, numbering, and signage shall be submitted for WMATA's approval based on existing WMATA buses and operational requirements. WMATA will supply samples of these items upon request from the Contractor.

The bus unit number series for this contract shall be provided after the bid award. Unit numbers shall run consecutively in the same order as the bus serial numbers starting with the lowest serial number.

Detailed minimum requirements for the quantities, placement, size, appearance, content, and fabrication of signage are given in the following sections. The Contractor may propose additional signage for WMATA's approval to enhance customer service, safety, or other benefits.

STP 12.5. Exterior Decals.

WMATA will provide a layout of the exterior decaling for the bus.

STP 12.6. Fleet Numbers.

The bus shall have six sets of four-digit, 4-inches in high unit numbers installed. There shall also be one set of four-digit, 24-inch high unit numbers installed on the roof. The exact location for installation will be approved by WMATA.

STP 12.6. Other Exterior Decals/Graphics

WMATA will provide a complete set of sample exterior decals/graphics and installation locations to the successful proposer.

STP 12.6.1. Interior Signage

WMATA will provide a complete set of sample interior decals/graphics and installation locations to the successful proposer.

STP 12.6.2. Interior Panels and Finish

A) Additional requirements for anti-graffiti/vandalism treatments for interior surfaces, if any, will be provided by WMATA after contract award.

B) Rear interior bulkhead shall be Arborite P-891-S Grit Blue or thermoplastic material installed flushed with trim strips where appropriate.

C) Lower interior side wall panels and modesty panels shall be Arborite P-891-S Grit Blue or Authority approved substitution. Upper side wall panels shall be Arborite P608/suede SilveEftervescence or thermo plastic material in Authority approved color.

STP 12.6.3. Modesty Panel

The curbside Modesty Panels fore and aft of the rear exit door, shall have a clear Lexan section on top. Specific dimensions to be approved by WMATA.

STP 12.6.4. Floor Covering

Shall be Ahro Capri TFCR 2760 (2.7mm/0. II “thick) for aisle and tinder passenger seals. Flooring in each wheelchair securement (Q-Pod) location shall have in laid markings denoting the specific wheelchair “parking” location.

The floor covering at the rear exit door area shall be yellow with “PLEASE NO STANDEES INTHIS AREA”.

STP 12.6.5. Headlining

Ceiling panels shall be melamine Pionite SW-806-WInte. Headlining shall be supported to prevent buckling, drumming, or flexing and shall be secured without loose edges. The headlining material shall be treated or insulated to prevent marks due to condensation where panels are in contact with metal members. Moldings & trim strips shall be stainless steel, aluminum or plastic and colored to compliment the ceiling material. Headlining panels covering operational equipment that is mounted above the ceiling shall be on hinges for ease of service but retained to prevent inadvertent opening.

STP 13. Passenger Interior Lighting

Two (2) additional LED stepwell lights shall be installed in the rear stepwell and one (I) LED illuminated “Watch Your Step” siwi shall be installed in the ceiling above the rear stepwell.

STP 13.1. Passenger Interior Lighting

Two (2) additional LED stepwell lights shall be installed in the rear stepwell and one (I) LED

illuminated “Watch Your Step” sign shall be installed in the ceiling above the rear stepwell.

STP 13.2. Fare Collection:

Fare Collection Interfaces. The contractor shall provide physical, electrical, and data provisions to support fare collection equipment installation. The exact model of farebox and physical installation requirements will be provided at time of award. The following table lists electrical and data requirements, cable termination points and manner of presentation.

Interface	Source Point	Voltage	Cabling	Presentation
Farebox battery power	Nearest distribution panel. Dedicated circuit breaker	24 Volt 15 Amps	16AWG minimum	3 cavity sealed bulkhead connector of appropriate size and rating mounted to bus floor within farebox base.
Farebox Power Chassis Ground	Grounding bus bar in close proximity to power source listed in cell above.	Ground	16AWG minimum	
Farebox Power Ignition Signal	Multiplexed signal capable of supporting a 1 amp load. Shall have no detectable voltage present in off state. Programming TBD	24 Volt	16AWG	
SAE J1708 RS422 RS485	Ancillary equipment closet, terminated in ring connectors attached to dedicated adjacent positions of provided terminal strip	+/- 6VDC	One single shielded harness meeting SAE J1708 physical layer specifications shall be provided to support any listed data protocol	These six circuits shall be wired to a single sealed bulkhead connector of appropriate application for data circuits and mounted to the bus floor within the farebox base.
SAE J1939	Chassis J1939 backbone.	Per SAE Specification	J1939-11 compliant 20AWG Cabling	
Ethernet	Ancillary equipment closet. RJ45 strain-relieved molded termination capped and sealed with 4’ minimum working length inside cabinet	Per Ethernet Specification	Category 6 Ethernet cable with Red jacket	RJ45 Strain-Relieved termination capped and sealed with 3’ minimum working length above bus floor, secured within farebox base adapter.

STP 14. Electrification of CNG and Clean Diesel Buses

ALTERNATIVE.
THE CONTRACTOR SHALL PRESENT A PROPOSAL AND PRICE FOR FULLY ELECTRIFICATION OF BUSES. INCLUDING POWER STEERING, HVAC, DOORS. PROPOSAL SHALL BE FOR BOTH VANNER AND BAE SYSTEM FOR WMATA EVALUATION.

STP 15 Anti Idling Provisions:

Contractor shall configure vehicle to prevent excessive engine idling during secured vehicle operation. Under the following conditions, engine operation shall cease after a period of fifteen (15) minutes:

- Master run switch in Day Run or Night Run.
- Parking Brakes applied.
- Propulsion system in Neutral.
- Engine ignition select switch in Front Run

Idle shutdown time shall reset on exception of any above listed condition.

a. **Instrumentation.** When the above conditions are met, an incremental visual indication system shall be provided on the instrument panel to inform the operator of the fifteen minute time allotment. This system shall indicate, at a minimum, the following conditions:

- Idle Shutdown in 15 minutes.
- Idle Shutdown in 10 minutes.
- Idle Shutdown in 5 minutes,
- Idle shutdown in 2 minutes.
- Idle time exceeded, engine shut down.

b. **Exceptions.** The anti-idling protection shall not operate if the Silent Alarm toggle switch is active or the Engine Run Switch is placed in the Rear Run position.

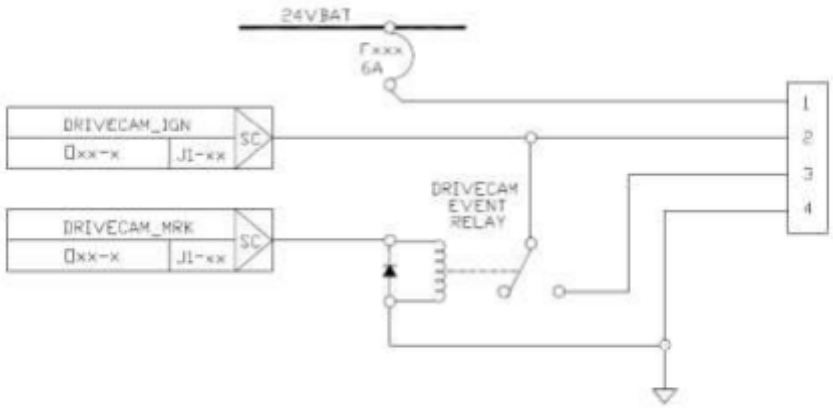
c. **Load Shedding.** Upon engine shutdown at fifteen minutes of secured idle time, a measured period of five (5) minutes shall commence. When this additional five minute period has expired, battery management system shall be enabled and the following electrical systems shall be automatically shut down:

- All propulsion and support systems
  - Transmission

- Hybrid Drive
- CNG Fuel system
- Charging system(S)

- Climate Control and Auxiliary heating.

STP 16. Emergency Alarm Provision:



Deutsch DT06-4S	
Cavity	**Function**
1	24v Battery
2	24v Ignition
3	Event Mark
4	Chassis Ground

Connector Legend

Wiring connector to be located in center of destination sign cabinet, secured to existing harnessing.

SECTION 3: FEDERAL REQUIREMENTS

FR 1. Testing of New Bus Models

The Contractor agrees to comply with 49 USC A 5323(c) and FTA's implementing regulation at 49 CFR Part 665 and shall perform the following:

1. A manufacturer of a new bus model or a bus produced with a major change in components or configuration shall provide a copy of the final test report to the recipient at a point in the procurement process specified by the recipient, which will be prior to the recipient's final acceptance of the first vehicle.

2. A manufacturer who releases a report under Paragraph 1 above shall provide notice to the operator of the testing facility that the report is available to the public.

3. If the manufacturer represents that the vehicle was previously tested, the vehicle being sold should have the identical configuration and major components as the vehicle in the test report, which must be provided to the recipient prior to recipient's final acceptance of the first vehicle. If the configuration or components are not identical, the manufacturer shall provide a description of the change and the manufacturer's basis for concluding that it is not a major change requiring additional testing.

4. If the manufacturer represents that the vehicle is "grandfathered" (has been used in mass transit service in the United States before October 1, 1988, and is currently being produced without a major change in configuration or components), the manufacturer shall provide the name and address of the recipient of such a vehicle and the details of that vehicle's configuration and major components.

FR 2. Pre-Award and Post-Delivery Audits

The Contractor agrees to comply with 49 USC § 5323(l) and FTA's implementing regulation at 49 CFR Part 663 and to submit the following certifications:

1. **Buy America requirements:** The Contractor shall complete and submit a declaration certifying either compliance or noncompliance with Buy America. If the recommended Bidder/Proposer certifies compliance with Buy America, it shall submit documentation that lists (1) component and subcomponent parts of the rolling stock to be purchased identified by manufacturer of the parts, their country of origin and costs; and (2) the location of the final assembly point for the rolling stock, including a description of the activities that will take place at the final assembly point and the cost of final assembly.

2. **Solicitation specification requirements:** The Contractor shall submit evidence that it will be capable of meeting the bid specifications.
3. **Federal Motor Vehicle Safety Standards (FMVSS):** The Contractor shall submit (1) manufacturer's FMVSS self-certification, Federal Motor Vehicle Safety Standards, that the vehicle complies with relevant FMVSS or (2) manufacturer's certified statement that the contracted buses will not be subject to FMVSS regulations.

FR 3. Cargo Preference

The Contractor agrees to the following:

- To use privately owned U.S.-flag commercial vessels to ship at least fifty (50) percent of the gross tonnage (computed separately for dry bulk carriers, dry cargo liners and tankers) involved, whenever shipping any equipment, material or commodities pursuant to the underlying Contract to the extent such vessels are available at fair and reasonable rates for U.S.-flag commercial vessels;

- To furnish within twenty (20) working days following the date of loading for shipments originating within the United States or within thirty (30) working days following the date of leading for shipments originating outside the United States, a legible copy of a rated, "on-board" commercial ocean bill of lading in English for each shipment of cargo described in the preceding paragraph to the Division of National Cargo, Office of Market Development, Maritime Administration, Washington, DC 20590 and to the FTA recipient (through the Contractor in the case of a Subcontractor's bill-of-lading.)

- To include these requirements in all subcontracts issued pursuant to this Contract when the subcontract may involve the transport of equipment, material or commodities by ocean vessel.

SECTION 4: TECHNICAL SPECIFICATIONS

GENERAL

TS 1. Scope

Technical specifications define requirements for heavy-duty low floor, Compress Natural Gas (CNG) powered transit buses, which, by the selection of specifically identified alternative configurations, may be used for both suburban express service and general service on urban arterial streets. Buses shall have a minimum expected life of twelve (12) years or 500,000 miles, whichever comes first, and are intended for the widest possible spectrum of passengers, including children, adults, the elderly and people with disabilities.

TS 2. Definitions

Alternative. An alternative specification condition to the default bus configuration. The Authority may define alternatives to the default configuration to satisfy local operating requirements. Alternatives for the default configuration will be clearly identified.

Ambient Temperature. The temperature of the surrounding air. For testing purposes, ambient temperature must be between 16 °C (50 °F) and 38 °C (100 °F).

Analog Signals. A continuously variable signal that is solely dependent upon magnitude to express information content.

NOTE: Analog signals are used to represent the state of variable devices such as rheostats, potentiometers, temperature probes, etc.

Audible Discrete Frequency: An audible discrete frequency is determined to exist if the sound power level in any 1/3-octave band exceeds the average of the sound power levels of the two adjacent 1/3-octave bands by 4 decibels (dB) or more.

Battery Compartment. Low-voltage energy storage, i.e. 12/24 VDC batteries.

Battery Management System (BMS). Monitors energy, as well as temperature, cell or module voltages, and total pack voltage. The BMS adjusts the control strategy algorithms to maintain the batteries at uniform state of charge and optimal temperatures.

Burst Pressure. The highest pressure reached in a container during a burst test.

Capacity (fuel container). The water volume of a container in gallons (liters).

Cells. Individual components (i.e., battery or capacitor cells).

Code. A legal requirement.

Combination Gas Relief Device. A relief device that is activated by a combination of high pressures or high temperatures, acting either independently or together.

Composite Container for CNG. A container fabricated of two or more materials that interact to facilitate the container design criteria.

Compressed Natural Gas (CNG). Mixtures of hydrocarbon gases and vapors consisting principally of methane in gaseous form that has been compressed for use as a vehicular fuel.

Container. A pressure vessel, cylinder, or cylinders permanently manifold together used to store CNG.

Container Appurtenances. Devices connected to container openings for safety, control or operating purposes.

Container Valve. A valve connected directly to a container outlet.

Curb Weight. Weight of vehicle, including maximum fuel, oil and coolant; and all equipment required for operation and required by this Specification, but without passengers or driver.

DBA. Decibels with reference to 0.0002 microbar as measured on the “A” scale.
DC to DC Converter. A module which converts a source of direct current (DC) from one voltage level to another.

Default Configuration Bus. The bus described if no alternatives are selected. Signing, colors, the destination sign reading list and other information must be provided by the WMATA.

Defueling. The process of removing fuel from a tank.

Defueling Port. Device which allows for vehicle defueling, or the point at which this occurs.

Destroyed. Physically made permanently unusable.

Discrete Signal. A signal that can take only pre-defined values, usually of a binary 0 or 1 nature where 0 is battery ground potential and 1 is a defined battery positive potential.

DPF. Diesel particulate filter.

Driver's Eye Range. The 95th-percentile ellipse defined in SAE Recommended Practice J941, except that the height of the ellipse shall be determined from the seat at its reference height.

Fill Pressure for CNG. The pressure attained at the actual time of filling. Fill pressure varies according to the gas temperatures in the container, which are dependent on the charging parameters and the ambient conditions. The maximum dispensed pressure shall not exceed 125 percent of service pressure.

Flow Capacity. For natural gas flow, this is the capacity in volume per unit time (normal cubic meters/minute or standard cubic feet per minute) discharged at the required flow rating pressure.

Fuel Line. The pipe, tubing or hose on a vehicle, including all related fittings, through which natural gas passes.

Fusible Material. A metal, alloy or other material capable of being melted by heat.

Fire Resistant. Materials that have a flame spread index less than 150 as measured in a radiant panel flame test per ASTM-E 162-90.

Fireproof. Materials that will not burn or melt at temperatures less than 2000 °F.

Free Floor Space: Floor area available to standees, excluding the area under seats, area occupied by feet of seated passengers, the vestibule area forward of the standee line, and any floor space indicated by manufacturer as non-standee areas such as, the floor space “swept” by passenger doors during operation. Floor area of 1.5 sq ft shall be allocated for the feet of each seated passenger that protrudes into the standee area.

Fuel Management System. Natural gas fuel system components that control or contribute to engine air fuel mixing and metering, and the ignition and combustion of a given air-fuel mixture. The fuel management system would include, but is not limited to, reducer/regulator valves, fuel metering equipment (e.g. carburetor, injectors), sensors (e.g., main throttle, waste gate).

GAWR (Gross Axle Weight Rated). The maximum total weight as determined by the axle manufacturer, at which the axle can be safely and reliably operated for its intended purpose.

Gross Load. 150 lbs for every designed passenger seating position, for the driver, and for each 1.5 square feet of free floor space.

GVW (Gross Vehicle Weight). Curb weight plus gross load.

GVWR (Gross Vehicle Weight Rated): The maximum total weight as determined by the vehicle manufacturer, at which the vehicle can be safely and reliably operated for its intended purpose.

High Pressure. Those portions of the CNG fuel system that see full container or cylinder pressure.

High Voltage (HV). Greater than 50 volts (AC and DC).

Hose: Flexible line.

Intermediate Pressure. The portion of a CNG system after the first pressure regulator, but before the engine pressure regulator. Intermediate pressure on a CNG vehicle is generally from 3.5 to 0.5 MPa (510 to 70 psi).

Inverter. A module that converts DC to and from AC.

Labeled. Equipment or materials to which has been attached a label, symbol or other identifying mark of an organization, which is acceptable to the authority having jurisdiction and concerned with product evaluation, which maintains periodic inspection of production labeled equipment or materials, and by whose labeling the manufacturer indicates compliance with appropriate standards or performance in a specified manner.

Leakage. Release of contents through a Defect or crack. See *Rupture*.

Line: All tubes, flexible and hard, that carry fluids.

Liner. Inner gas-tight container or gas container to which the overwrap is applied.

Local Regulations. Regulations below the state level.

Low-Floor Bus. A bus that, between at least the front (entrance) and rear (exit) doors, has a floor sufficiently low and level so as to remove the need for steps in the aisle between the doors and in the vicinity of these doors.

Low Voltage (LV). 50 volts or less (AC and DC).

Lower Explosive Limit. The lowest concentration of gas where, given an ignition source, combustion is possible.

Maximum Service Temperature. The maximum temperature to which a container/cylinder will be subjected in normal service.

Metallic Hose. A hose whose strength depends primarily on the strength of its metallic parts; it can have metallic liners or covers, or both.

Metering Valve. A valve intended to control the rate of flow of natural gas.

Module. Assembly of individual components

Motor (Electric). A device that converts electrical energy into mechanical energy.

Operating Pressure. The varying pressure developed in a container during service.

Physical Layer. The first layer of the seven-layer International Standards Organization (ISO) Open Systems Interconnect (OSI) reference model. This provides the mechanical, electrical, functional and procedural characteristics required to gain access to the transmission medium (e.g., cable) and is responsible for transporting binary information between computerized systems.

Pipe: Nonflexible line.

Pressure Relief Device (PRD). A pressure and/or temperature activated device used to vent the container/cylinder contents and thereby prevent rupture of a NGV fuel container/cylinder, when subjected to a standard fire test as required by fuel container/cylinder standards.

> **NOTE:** Since this is a pressure-activated device, it may not protect against rupture of the container when the application of heat weakens the container to the point where its rupture pressure is less than the rated burst pressure of the relief device, particularly if the container is partially full.

Power. Work or energy divided by time

Power Density. Power divided by mass, volume or area.

Propulsion System. System that provides propulsion for the vehicle proportional to operator commands. Includes, as applicable, the HDS, energy storage system and the hybrid system controller.

Real-Time Clock (RTC). Computer clock that keeps track of the current time.

Regenerative Braking. Deceleration of the bus by switching motors to act as generators, which return vehicle kinetic energy to the energy storage system.

Rejectable Damage. In terms of NGV fuel containers/cylinders, this is damage as outlined in CGA C-6.4, “Methods for External Visual Inspection of Natural Gas Vehicle

Fuel Containers and Their Installations," and in agreement with the manufacturer's recommendations.

Retarder. Device used to augment or replace some of the functions of primary friction based braking systems of the bus.

Rupture. Sudden and unstable damage propagation in the structural components of the container resulting in a loss of contents. See *Leakage*.

Seated Load. 175 lbs for every designed passenger seating position and for the driver.

SLW (Seated Load Weight). Curb weight plus seated load.

Serial Data Signals. A current loop based representation of ASCII or alphanumeric data used for transferring information between devices by transmitting a sequence of individual bits in a prearranged order of significance.

NOTE: An example is the communication that takes place between two or more electronic components with the ability to process and store information.

Service Pressure. The settled pressure at a uniform gas temperature of 21 °C (70 °F) and full gas content. It is the pressure for which the equipment has been constructed, under normal conditions. Also referred to as the nominal service pressure or working pressure.

Settled Pressure. The gas pressure when a given settled temperature, usually 21 °C (70 °F), is reached.

Settled Temperature. The uniform gas temperature after any change in temperature caused by filling has dissipated.

Solid State Alternator. A module that converts high-voltage DC to low-voltage DC (typically 12/24 volt systems).

Sources of Ignition. Devices or equipment that because of their modes of use or operation, are capable of providing sufficient thermal energy to ignite flammable compressed natural gas-air mixtures when introduced into such a mixture, or when such a mixture comes into contact with them

Special Tools. Tools not normally stocked by the Authority.

Specification. A particular or detailed statement, account, or listing of the various elements, materials, dimensions, etc. involved in the manufacturing and construction of a product.

Standard. A firm guideline from a consensus group.

Standards. Standards referenced in "Part 5: Technical Specifications" are the latest revisions unless otherwise stated.

Standee Line. A line marked across the bus aisle to designate the forward area that passengers may not occupy when the bus is moving.

Stress Loops. The "pig-tails" commonly used to absorb flexing in piping.

Structure. The structure shall be defined as the basic body, including floor deck material and installation, load bearing external panels, structural components, axle mounting provisions and suspension beams and attachment points.

Thermally Activated Gas Relief Device. A relief device that is activated by high temperatures and generally contains a fusible material.

NOTE: Since this is a thermally activated device, it does not protect against over-pressure from improper charging practices.

Wheelchair. A mobility aid belonging to any class of three- or four-wheeled devices, usable indoors, designed for and used by individuals with mobility impairments, whether operated manually or powered. A "common wheelchair" is such a device that does not exceed 30 in. in width and 48 in. in length measured 2 in. above the ground, and does not weigh more than 600 lbs when occupied.

TS 3. Referenced Publications

The documents or portions thereof referenced within this specification shall be considered part of the requirements of the specification. The edition indicated for each referenced document is the current edition, as of the date of the APTA issuance of this specification.

TS 4. Legal Requirements

The Contractor shall comply with all applicable federal, state and local regulations. These shall include but not be limited to ADA, as well as state and local accessibility, safety and security requirements. Local regulations are defined as those below the state level.

Buses shall meet all applicable FMVSS and shall accommodate all applicable FMCSR regulations in effect at location of the WMATA and the date of manufacture.

In the event of any conflict between the requirements of these specifications and any applicable legal requirement, the legal requirement shall prevail. Technical requirements that exceed the legal requirements are not considered to conflict.

TS 5. Overall Requirements

The Contractor shall ensure that the application and installation of major bus subcomponents and systems are compliant with all such subcomponent vendors' requirements and

recommendations. Contractor and WMATA shall identify subcomponent vendors that shall submit installation/application approval documents with the completion of a pilot or lead bus. Components used in the vehicle shall be of heavy-duty design and proven in transit service. A list of all major subcomponents shall be supplied to the WMATA.

TS 5.1 Weight

It shall be a design goal to construct each bus as light in weight as possible without degradation of safety, appearance, comfort, traction or performance.

Buses at a capacity load shall not exceed the tire factor limits, brake test criteria or structural design criteria.

TS 5.2 Capacity

The vehicle shall be designed to carry the gross vehicle weight, which shall not exceed the bus GVWR.

TS 5.3 Service Life

The minimum useful design life of the bus in transit service shall be at least twelve (12) years or 500,000 miles. It shall be capable of operating at least 40,000 miles per year, including the 12th year.

TS 5.4. Maintenance and Inspection

Scheduled maintenance tasks shall be related and shall be, in accordance with the manufacturer's recommended preventative maintenance schedule (along with routine daily service performed during the fueling operations).

Test ports, as required, shall be provided for commonly checked functions on the bus, such as air intake, exhaust, hydraulic, pneumatic, charge-air and engine cooling systems.

The coach manufacturer shall give prime consideration to the routine problems of maintaining the vehicle. All coach components and systems, both mechanical and electrical, which will require periodic physical Work or inspection processes, shall be installed so that a minimum of time is consumed in gaining access to the critical repair areas. It shall not be necessary to disassemble portions of the coach structure and/or equipment such as seats and flooring under seats in order to gain access to these areas. Each coach shall be designed to facilitate the disassembly, reassembly, servicing or maintenance, using tools and equipment that are normally available as standard commercial items.

Requirements for the use of unique specialized tools will be minimized. The body and structure of the coach shall be designed for ease of maintenance and repair. Individual panels or other equipment which may be damaged in normal service shall be repairable or replaceable. Ease of repair shall be related to the vulnerability of the item to damage in service.

Contractor shall provide a list of all special tools and pricing required for maintaining this equipment. Said list shall be submitted as a supplement to the Pricing Schedule.

> **NOTE:** Tools such as compartment door keys, bellows gauges and other tools that are required for daily maintenance and inspections shall not be included in the special tool list and shall be furnished for each coach.

TS 5.5 Interchangeability

Unless otherwise agreed, all units and components procured under this Contract, whether provided by Suppliers or manufactured by the Contractor, shall be duplicates in design, manufacture and installation to ensure interchangeability among buses in each order group in this procurement. This interchangeability shall extend to the individual components as well as to their locations in the buses. These components shall include, but are not limited to, passenger window hardware, interior trim, lamps, lamp lenses and seat assemblies. Components with non-identical functions shall not be, or appear to be, interchangeable.

Any one component or unit used in the construction of these buses shall be an exact duplicate in design, manufacture and assembly for each bus in each order group in this Contract. **The Authority shall be notified of any changes made to components, units and/or design used in the construction of these buses having an impact on interchangeability between each order group of buses under this contract. Any changes shall be mutually agreed upon.** Contractor shall identify and secure approval for any changes in components or unit construction provided within a Contract.

In the event that the Contractor is unable to comply with the interchangeability requirement, the Contractor must notify the WMATA and obtain the WMATA's prior written approval, including any changing in pricing.

WMATA shall review proposed product changes on a case-by-case basis and shall have the right to require extended warranties to ensure that product changes perform as least as well as the originally supplied products.

TS 5.6 Training

The Contractor shall have at least one qualified instructor who shall be available at the WMATA's property between the hours of 7.00 AM and 4:30 PM after, acceptance of the first bus. Operator Training requires the following non-copyrighted course materials to be delivered by the vendor, according to the following specifications.

The program shall provide for formal classroom instructions and a period of time to perform maintenance function an on – bus and shop environments.

The authority's Training Instructions and Supervisory staff student shall be exposed to the depth of detail that is oriented to the performance of preventive (schedule) and corrective (unscheduled) maintenance operations. The student shall allotted adequate time for performing the more complex maintenance operations on the bus and in the

shops, in addition to troubleshooting "buggee" system using the subsystem test devices.

The Training Program shall provide System Subsystem maintenance for the Authority's Training Instructors and supervisory staff at the Authority's facilities. System and Subsystem Maintenance Training shall include but not be limited to: Body, front and rear axles, brakes, cooling system, electrical system, engine, fuel system steering, suspension, CNG system, HVAC and special equipment to include wheelchair ramp and electronic destination signs, CNG and engine controls where applicable.

The Authority's Maintenance Instructors shall have approximately one week of instruction on "how to teach the course", familiarization with training aids, etc., prior to teaching each formal Maintenance Course. Following this Formal Maintenance Training Course, they shall have approximately one week of instruction on any subjects the Contractor deems appropriate.

The depth of the Maintenance Training Program shall include details in the performance of heavy repair and rebuilding of selected components. Examples include replacement of engine and CNG assemblies.

Training Plan containing the data is necessary to begin scheduling instruction. The plan must be submitted to TTRNG ten days after NTP. The plan must address for approval a proposed time line that all deliverables are approved and training is presented before the equipment is placed into service.

A. List of courses and their duration.

B. Recommended class size

C. Student qualification prerequisites. For the purpose of course development and presentation, vendors should assume all WMATA students are high school graduates (or equivalent), and that maintenance personal will possess the ability to use hand tools and electronic test equipment.

D. Inspector qualifications: A description of instructor qualifications, a resume, curriculum vital, or other description should document a thorough knowledge of the subject equipment, an understanding of the adult learning process, and demonstrated experience in vocational instruction.

E. In progress reviews will be scheduled prior to the development of material, during the development and review process, and prior to and during the delivery of instruction.

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Training Schedule:

All courses shall be completed by a mutually agreed to time by the Authority's training/safety department and the contractors training departments.

Maintenance Course shall have a length commensurate with material required for in-depth presentation. Class shall be scheduled a 40 hour work week basis, 8 hours per day, 5 work days per week. The Authority's shall be observed. Class instruction periods shall be normally be 50 minutes in duration with ten minute break between periods of instruction. Length of practical application periods is not fixed.

The following is a recommended list identifying course disciplines. Class topics are not limited to the listed. Four classes are indicated for each subsystem taught. **Training schedule is based on actual training requires for each annual delivery of 100 buses.**

WMATA'S REFERENCE SHALL BE WEB BASED TRAINING AND SHALL HAVE ACCESS TO THE ENTIRE VIDEO LIBRARY AND HAVE THE ABILITY TO CREATE UNLIMITED CUSTOM CONTENT AT NO ADDITIONAL COST.

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PROPOSED TRAINING SCHEDULE

PHASE I (40 FT. Low Floor Bus) - TRAINING WILL COMMENCE WITH THE FIRST BUS DELIVERED AND CONTINUE AS DEEMED NECESSARY BY THE APPROPRIATE REPRESENTATIVE OF THE WMATA'S TRAINING DEPARTMENT

TRAINING COURSE					TOTALS	
Item	Title	Course Description	Min Hours per course (1 Session)	Avg Class Size	No. of Training Sessions	Hours of Training
1	Bus Familiarization (over and above the initial per delivery location requirement)	Bus overview, identification, location and operation of all systems and sub-systems (primarily for Bus Operators)	1	15	10	10
2	Engine Running Repairs	Routine maintenance and minor repairs. Fault diagnosis and use of specialized test equipment	16	10	6	96
3	Transmission Running Repairs	Routine maintenance and minor repairs. Fault diagnosis and use of specialized test equipment	16	10	6	96
4	Steering System Running Repairs	Routine maintenance, diagnosis and minor repairs of steering boxes, shafts, transfer boxes, steering columns and linkage, power steering pumps, etc.	8	10	4	32
5	Air System Running Repairs	Routine maintenance, diagnosis and minor repairs of air compressors, dryers, governors, valves, etc.	8	10	4	32
6	Hydraulic System Running Repairs	Routine maintenance, diagnosis and minor repair of hydraulic motors, pumps, valves, etc.	8	10	4	32
7	Electrical System Running Repairs	Routine maintenance, diagnosis and minor repair of generators, regulators, motors, electronics	8	10	4	32
8	Brake System Running Repairs	Routine maintenance, diagnosis and running repairs of brake air system, mechanical components and brake reline, ABS and electrical components, etc.	16	10	6	96
9	Door System Running Repairs	Routine maintenance, diagnosis and minor repair of door controls, interlocks, linkages, hinges and motor components, etc.	8	10	4	32
10	Heat/Vent/Air Conditioning System Running Repairs	Routine maintenance, diagnosis and minor repair of all Heat/Vent/Air Conditioning controls and components including A/C compressor, A/C Evaporator/condenser unit and diesel fired engine coolant heater, etc.	16	10	4	64
11	Axles/Suspension System Running Repairs	Routine maintenance, diagnosis and minor repair of axles, leveling valves, shocks and struts, air springs, radius and lateral rods, kneeling systems, etc.	8	10	4	32
12	Special Options Running Repairs	Routine maintenance, diagnosis and minor repair of special options (e.g. operator seat, power mirrors, electronics	8	10	4	32
13	Body	Damage repair process of exterior and interior body parts and structural evaluation as needed	8	10	4	32

PHASE I (40 FT. Low Floor Bus) - TRAINING WILL COMMENCE WITH THE FIRST BUS DELIVERED AND CONTINUE AS DEEMED NECESSARY BY THE APPROPRIATE REPRESENTATIVE OF THE WMATA'S TRAINING DEPARTMENT

Item	Title	Course Description	Min Hours per course (1 Session)	Avg Class Size	No. of Training Sessions	Hours of Training
14	Kneeling Chassis, Suspension and Frame	Routine maintenance and minor repairs. Fault diagnosis and use of specialized test equipment	8	20	4	32
15	Towing and Emergency Service Procedures	In depth instruction and procedures for towing and maintenance personnel	8	10	4	32
16	Ramp Familiarization and maintenance	In depth instruction and procedures	4	40	8	32
17	Ramp Rebuild	Routine maintenance and minor repairs. Fault diagnosis and use of specialized test equipment	4	20	4	16
18	Theory of Electrical Basic Wiring	Routine maintenance and minor repairs. Fault diagnosis and use of specialized test equipment	40	20	2	80
19	Destination Signs/Electronics	Routine maintenance and minor repairs. Fault diagnosis and use of specialized test equipment	8	10	2	16
20	Fuel and Cooling Systems	In-depth instruction, overhaul and major repairs. Component failure analysis and use of specialized test equipment	8	20	2	16

Note: Manuals and/or necessary training literature aids and equipment shall be provided by the contractor for use during each course. During first session, content and format of each course shall be subject to review and alteration by WMATA Training Section Personnel

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TRAINING AIDS

Training aids for both the Operator and Maintenance classes shall consist of:

1. Operation Manual and Maintenance Manuals and Preventive Maintenance Manuals, Service Manuals and Inspection Cards.
2. Multimedia presentations including 3-D illustrations. This media shall illustrate subassemblies showing component locations, component cutaways, schematics and wiring diagrams. Clear and concise graphics depicting hydraulic, pneumatic and air conditioning system shall include direction of flow for particular medium as shown by animation.
3. Glossary and definition for all components used in schematics and wiring diagrams incorporated in operating and maintenance manuals.
4. SCORM compliant and compatible with WMATA,s Learning Management System Computer Based Training modules appropriate for refresher training on the following topics:

- Axles & Brake & Air Systems.
- Kneeling Chassis, Suspension & Frame.
- Steering
- CNG/Diesel electrical system
- Ramp maintenance

5. Troubleshooting and systems diagnostics on CD Rom.
6. Multimedia Projector
7. Laptop Computer

All presentation materials, including illustrations drawings, diagrams, charts and tables shall be developed for use in a classroom approximately 20 X 30 feet.

The Contractor shall make corrections and improvements to all training aids during the conduct of the course when examinations, tests, or instructor observations indicate that a majority of students fail to attain the learning objectives.

Test points shall be incorporated on all simulated panels together with all hardware necessary for maintenance operations.

All training materials, to include schematics, diagrams, mock-ups (to include models actual “training units” such as Electrical PLC Training boards, Air System Training Boards, etc), cutaways, and lesson plans shall become the property of WMATA at the completion of the training programs. The contractor shall be responsible for the condition of these materials for the duration of the training program, and shall replace all damage materials unless the damage resulted from neglect by the Authority. Lesson plans shall be updated as required during the course instruction.

CLASSROOM INSTRUCTION

Instructors shall have qualification themselves fully for their presentation. Qualifications will be considered to be adequate

(l) When the designer of the system is the Instructor and has the desire and ability to communicate the facts about the system to others in understandable terms; or

(2) When the instructors have been trained in teaching methods and have familiarized themselves

fully with the subject matter. In all cases, lesson plans shall be prepared and submitted to the BMTC at least thirty days prior to the class being scheduled. These lesson plans shall include an outline of the material to be presented and copies of the pass-out material and other training aids to be used.

Training aids shall include actual samples of manually operable devices and working samples of devices, the functions of which can be displayed without dismantling the device. Training aids should be Components such as:

1. Front and Rear Door mock-up with controllers,
2. Brake, ABS/ ATC, pneumatic system training board,
3. Multiplex/PLC control system training board,
4. Digital manometer,
5. fuel tank pressure tester,
6. Cummins fuel pressure gauge (0-300 PSI)
7. Cummins vacuum gauge (0-30 HG) ST (434),
8. Cummins engine Tune-Up T-handle No 3376592 and socket ST 669-13, tachometer (Digital) '3377462,
9. Operational Engine mock-up with all necessary gauges and dash lights to Match vehicle,
10. Front/rear axle assemblies,
11. front/rear axle service tool sets
12. HVAC service tools,
13. Any other specialty tools and/or items mutually agreed to.

The working of other significant components shall be illustrated with diagrams, cutaway views, etc., displayed with sufficient scale and clarity to permit all to see clearly.
Wiring diagrams, when used as training aids and reference material, shall be divided to facilitate comprehension. There shall be single-line functional diagrams of systems and schematic diagrams of each component in the systems. Where parts are identified by initials or reference numbers, there shall be a legend
to permit precise identification on the same sheet. (All training aids shall be up-to-date and precisely reflect the systems and subsystems on the buses delivered under this contract.)

Classroom instruction shall include not only the anatomy and functioning of the parts under discussion but the essentials of their routine care including lubrication schedules, materials, Contactor's recommendations for test frequency, tolerance limits and methods for testing, including instruments required, when applicable.
When methods of access, removal, dismantling, or application are not self-evident to a reasonably intelligent individual, the instruction shall cover these matters. Overhaul procedures are to be taught in separate classes.

INSTRUCTOR'S GUIDE

The Instructor's guide is to contain all the information and direction necessary for the instructor to make an effective presentation. It shall include adequate guidelines to con-

duct a comprehensive training program. Individual lessons within the course will be organized as separate blocks (or modules) which may be taught as a unit. In some instances, the same standard operating procedures could be used for bus operators, transportation supervisors and central control supervisors. The instructor's Guide contain, at a minimum:

Program Overview:

1. A statement of overall program goals.
2. Lesson plans (a session by session outline) containing the following:
    - Student learning objectives, stated in measurable terms.
    - Overview on each lesson
    - Suggested instructional methods/learning activities.
    - Required equipment and/or resources
    - Required time for each topic, lesson and course
3) Evaluation Device(S) (written and practical tests) designed to measure the extent to which student have met the learning objectives with an answer key for each of the test developed .Test should use a multiple choice format, and have been validated in a pilot course or by some other means agreed to by WMATA. Each written test shall be accompanied by a pool of questions based on the learning objectives. Fifty to one-hundred questions are required per objective depending on the complexity of the objective. Whenever possible, a practical hands-on test shall be developed to demonstrate the transference of operational and mechanical skill.

STUDENT MANUAL.

The Student Manual is to include all materials for the student to interact in the learning situation.

It shall contain:

a) Program overview/introduction
b) Statement of overall program goals
c) Learning objectives, stated in measurable terms that specifically describe desired behaviors or knowledge to be gained.
d) Prose treatment (not outline format) fully developed content presentation, developed in same modular format as the Instructor's Guide.
e) Illustrations, charts, graphics and duplication of each visual aid used during course presentation in order to enhance content presentation and provide a course reference.
f) Problem/questions related to lesson content, as appropriate.

WMATA TRAINING DEPARTMENT DELIVERABLES

Audio-visual aids (handouts, DVD's, and interactive computer presentations)

Visual aids are required for each circuit or wiring diagram and all activities not demonstrable in the classroom. All materials become the property of WMATA.

Supplemental Materials.

A functional mock up or a functional representation is required of any equipment which requires theoretical discussion. This may be a form of animated schematic, a model of the equipment, an actual device, an interactive video training device, or a TRNG-approved substitute. All materials described above the property of WMATA.

Number of copies required for WMATA Training Department.

The Vendor shall deliver final copies to WMATA Training as follows:

a) Two complete set of training materials that are specific electronic format or camera ready copy.
b) Five copies of all students and instructor materials, to be used for archival purpose in the WMATA Technical Document Center (TDC)
c) A set of complete student materials for each participant enrolled in training classes.
d) WMATA shall have right to make copies as needed basis for all software, CDs.

FIELD INSTRUCTION

The extend of instruction in the Contractor's and subcontractor's shop shall be at the discretion of the Authority. The Authority may request access to these shops for limited numbers of supervisory and technical personal to familiarize them with assembly methods: and the Contractor shall make a reasonable effort to comply with such a request, but not to the detriment of production. Similarly, the Authority's operating supervision shall be granted access to all equipment for the purpose of familiarization.

Field instruction involving use of a bus shall be presented by instructors having thorough experience in maintenance service or operation, as the case may require. They shall have their subjects' properly organized prior commencement of the class. Instruction in

operation shall follow a logical progression involving the anatomy of the bus, the manipulation of all control and actual operation.

The Authority will make available, upon proper notice, and advance design bus at accessible Shop locations for instructional purpose: and will arrange for road operation as well as furnishing power, dispatching, and operational supervision as necessary. There will be no charge for the cooperation.

DELIVERY OF INSTRUCTION

All instruction will be presented in accordance with approved training materials as specified under deliverables.

All training will be coordinated through **OPER TRNG**.

Courses will be attended and monitored by OPER. Unsatisfactory performance may result in suspension of the training until such time as specified discrepancies are corrected.

When multiple presentations of the same class are schedule, there will be a minimum of a five day period between the first presentation and the remainder of the presentations to facilitate possible corrections.

No courses will be permitted to start without approved training materials on hand in sufficient quantities to conduct instruction.

Penalties for non-compliance will be in accordance with the penalty provisions of the contract or purchase.

SAFETY TRAINING (CNG)

This session shall provide all operations personal with knowledge and understanding of CNG system locations, inspection and servicing, and emergency shut-offs. Sessions specific to maintenance and safety personal will include comprehensive CNG system training.

FIRST RESPONDER TRAINING

Contractor will provide training material and training to procuring Authority to support first responder training. Contractor is not responsible, unless otherwise requested, to provide direct first responder training.

Technical/Service Representatives

The Contractor shall, at its own expense, have one or more competent technical service representatives available on request to assist the Washington Metropolitan Area Transit Authority in the solution of engineering or design problems within the scope of the

specifications that may arise during the warranty period. This does not relieve the Contractor of responsibilities under the provisions of "Section 7: Warranty Requirements."

TS 5.7 Operating Environments

The bus shall achieve normal operation in ambient temperature ranges of 10 ºF to 115 ºF, at relative humidity between 5 percent and 100 percent, and at altitudes up to 3000 feet above sea level. Degradation of performance due to atmospheric conditions shall be minimized at temperatures below 10 °F, above 115 °F or at altitudes above 3000 feet. Altitude requirements above 3000 feet will need separate discussions with the engine manufacturer to ensure that performance requirements are not compromised. Speed, gradability and acceleration performance requirements shall be met at, or corrected to, 77 °F, 29.31 in. Hg, dry air per SAE J1995.

TS 5.8 Noise

WMATA prefer that each bus have the lowest level of interior/exterior noise achievable. Instrumentation and other requirements shall conform to SAE J366, except that two-(2) dBA tolerance is not allowed. If noise level contains an audible discrete frequency, a penalty of (5) dBA shall be added to the sound level. The contractor shall develop a test plan for validating the noise levels based on the following criteria. This plan shall be presented to WMATA for review and approval. The tests shall be configured to be conducted with the bus loaded to SLW.

Interior Noise

The combination of inner and outer panels and any material used between them shall provide sufficient sound insulation so that a sound source with a level of 77 dBA measured at the outside skin of the bus shall have a sound level of 65 dBA or less at any point inside the bus. These conditions shall prevail with all openings, including doors and windows, closed and with the engine and accessories switched off.

The bus-generated noise level experienced by a passenger at any seat location in the bus shall not exceed 77 dBA. The driver area shall not experience a noise level of more than 74 dBA under the following test conditions. The bus shall be empty for test personal, not to exceed 4 persons, and the test equipment. All openings shall be closed and accessories shall be operating during the test. The bus shall accelerate at full throttle from stand still to 35 mph on level commercial asphalt or concrete pavement in an area free of large reflecting surfaces within 50 feet of the bus path. During the test, the ambient noise level in the test area shall be at least 10 dBA lower than the bus under test. Instrumentation and other general requirements shall confirm to SAE J366.

An exception shall be made for the turntable area (on Articulated Bus), which shall be considered a separate environment.

Exterior Noise

Airborne noise generated by the bus and measured from either side shall not exceed 76 dBA under full power acceleration when operated 0 to 35 mph at curb weight. The maximum noise level generated by the bus pulling away from a stop at full power shall not exceed 76 dBA. The bus-generated noise at curb idle shall not exceed 60 dBA. If the noise contains an audible discrete frequency, a penalty of 5 dBA shall be added to the sound level measured. All noise reading shall be taken 50 feet and perpendicular to the centerline of the bus with all accessories operating. The Contractor shall comply with the exterior noise requirements defined in local laws and ordinances identified by the Authority and SAE J366. The pull away test shall begin with the front bumper even with the microphone. The curb idle test shall be conducted with the rear bumper even with the microphone.

In addition, the Contractor shall comply with the exterior noise requirements defined in local laws and ordinances identified by WMATA.

TS 5.9. FIRE SENSING AND SUPPRESSION SYSTEMS (FSS)

(INCLUDE METHANE DETECTION FOR CNG BUSES)

An Automatic Fire Suppression System (AFSS) shall be provided. The AFSS shall be arranged as to detect and direct the application of suppressant agent to specific defined locations/zones. The AFSS detection shall consist of two (2) zones as defined by APTA-BTS-RP-003-08.

1. Engine/Driveline Compartment

2. Emission Module Compartment

Each zone shall be protected through either separate or manifold ported delivery systems at a minimum of 25 lbs. of suppressant per zone.

The AFSS shall be arranged as to provide basic passenger protection. The system will detect, control, suppress and limit vehicle damage. A manual discharge switch shall be located within reach of the driver from a seated position. The switch shall require three (3) separate actions in order to manually activate the AFSS.

1. Break Seal

2. Lift Cover

3. Push Button

The vehicle shall be equipped with a Kidde or approved equal ABC dry chemical pre-engineered fire suppression system designed for vehicle applications. The automatic

actuation system shall provide 24 hour fire detection of the engine compartment. The system shall include the following features:

A minimum 25 pound capacity agent cylinder of the stored pressure type shall be furnished; be constructed of welded steel and must conform to DOT specification 4BW and be rated for 12 year minimum hydrostatic retest. The cylinder shall be outfitted with a gauge that can be visually inspected for pressure condition and a forged brass valve assembly. The system shall have a minimum capacity of 20 pounds of BC or ABC dry chemical agent. The engine compartment Fire Suppression System must be tested and certified to the P-Mark Standards

Dual Spectrum System with low cylinder pressure detection system – low cylinder detection system must have independent pressure switch from pressure gauge. Armored Linear Thermal Detection wire technologies only, to include exhaust chimney coverage – the use of thermal spot sensors is not acceptable. The use of Optical Sensors shall be permitted for direct visual coverage of the turbocharger and each side of the engine compartment.

A Control Panel shall be provided to electrically supervise the automatic fire suppression system following wiring circuits: POWER, HEAT DETECTION, and SYSTEM ACTUATION. The monitor shall provide a display indicating NORMAL, FIRE or FAULT conditions, and the panel will shut the engine and HVAC System down within 15 seconds or less of detecting a fire. An engine shutdown reset button on panel will be included. Data logging capabilities must be incorporated to independently monitor and record any problems associated with each component within the Fire Suppression / Gas Detection Systems.

An inspection door will be provided by the OEM on the bus body allowing for visual site inspection of the agent cylinder gauge.

A Battery backup system will be provided to ensure uninterrupted power to the Fire Suppression System. Battery backup shall provide monitoring and deployment readiness in the absence of vehicle power for a period of not less than 720 hours (30 days)

The bus OEM (contractor) shall provide a written sign off (from the suppression manufacturer) that all installation requirements have been met on the pilot buses system(s).

A Fire Sensing and Suppression System (FSS) shall be provided to monitor the engine compartment and (optional) auxiliary area(s) where a significant fire hazard exists. Upon detection, the system will alert the operator with visual and audible signals and initiate automatic engine shutdown, fuel shut-off and extinguisher discharge sequences.

The vehicle shall be equipped with a Kidde or approved equal ABC dry chemical pre-engineered fire suppression system designed for vehicle applications, Model V25 or a WMATA approved equal. The system shall be approved and listed for use at – 65 degrees F to 150 degrees F by Factory Mutual Research Corporation. The automatic actuation system

shall provide 24 hour fire detection of the engine compartment. The system shall include the following features:

A minimum 25 pound capacity agent cylinder of the stored pressure type shall be furnished; be constructed of welded steel and must conform to DOT specification 4BW and be rated for 12 year minimum hydrostatic retest. The cylinder shall be outfitted with a gauge that can be visually inspected for pressure condition and a forged brass valve assembly. The system shall have a minimum capacity of 20 pounds of BC or ABC dry chemical agent. System cylinder shall have a minimum service pressure of 350 psi and be DOT rated. Nozzles and distribution shall be installed in accordance with the installation manual. Stored pressure type extinguishing units shall be provided with a gauge that can be visually inspected for pressure condition.

Three (3) temperature sensitive weather proof miniature thermostats, constructed of stainless steel material, shall be located in the engine compartment. Detectors shall be approved for use by Factory Mutual Research Corporation as heat actuated fire detectors. The detectors shall be normally open and shall be capable of carrying sufficient amperage for the purposes of firing the electric actuator. The electric control head shall also be activated manually by depressing an electric switch (button w/pull pin, labeled “fire”) mounted in the driver’s dash area.

A Control Panel shall be provided to electrically supervise the automatic fire suppression system following wiring circuits: POWER, HEAT DETECTION, and SYSTEM ACTUATION. The monitor shall provide a display indicating NORMAL, FIRE or FAULT conditions, and the panel will shut the engine down within 15 seconds or less of detecting a fire. An engine shutdown reset button on panel will be included.

A minimum of four (4) brass nozzles shall be located in the engine compartment and one (1) brass nozzle located in the catalytic converter compartment/area fitted with dust caps that, upon actuation, are displaced to allow full ABC chemical flow.

The bus OEM (contractor) shall provide a written sign off (from the suppression manufacturer) that all installation requirements have been met on the pilot buses system(s).

An inspection door will be provided by the OEM on the bus body allowing for visual site inspection of the agent cylinder gauge.

Dual Spectrum System with low cylinder pressure detection system – low cylinder detection system must have independent pressure switch from pressure gauge. Linear Thermal Detection wire technologies only, to include exhaust chimney coverage – the use of thermal spot sensors are not permitted. The use of Optical Sensors shall be permitted for direct visual coverage of the turbocharger and each side of the engine compartment.

THE BUS SHALL BE DESIGNED AND MANUFACTURED IN ACCORDANCE WITH ALL APPLICABLE FIRE SAFETY AND SMOKE EMISSION REGULATIONS. THESE PROVISIONS SHALL INCLUDE THE USE OF

FIRE-RETARDANT/LOW-SMOKE MATERIALS, FIRE DETECTION SYSTEMS, BULKHEADS AND FACILITATION OF PASSENGER EVACUATION.

ALL MATERIALS USED IN THE CONSTRUCTION OF THE PASSENGER COMPARTMENT OF THE BUS SHALL BE IN ACCORDANCE WITH THE RECOMMENDED FIRE SAFETY PRACTICES DEFINED IN DOCKET 90, DATED OCTOBER 20, 1993. MATERIALS ENTIRELY ENCLOSED FROM THE PASSENGER COMPARTMENT, SUCH AS INSULATION WITHIN THE SIDEWALLS AND SUB-FLOOR, NEED NOT COMPLY. IN ADDITION, SMALLER COMPONENTS AND ITEMS, SUCH AS SEAT GRAB RAILS, SWITCH KNOBS AND SMALL LIGHT LENSES, AND SHALL BE EXEMPT FROM THIS REQUIREMENT.

TS 5.9.1. Fire Detection

All sensing elements shall have a twenty (20) year service life. No cleaning, calibration or inspection shall be required.

A service mechanism shall be provided to allow the use of hot tooling and maintenance within the detection zones without the hazard of a discharge. The service mechanism shall be simple to engage and shall automatically reset or prevent a system discharge.

TS 5.9.2. Thermal Fire Detection

Linear fire detectors shall be designed for use in engine compartments. The armored linear thermal detector should be a twin conductor cable with a heat – sensitive covering protected by an armored metallic outer sheath. In the event of a fire, the heat sensitive covering inside the armor sheathing melts, causing the conductors to short, which alarms the system. Minimum operating temperature -350 F – Approximate Alarm Temperature 400F

TS 5.9.3. Optical Fire Detection

Optical fire detectors shall sense infrared radiation emitted from a fire (three-dimensional detection) and be designed for use in engine compartments. Optical fire detectors must be able to view a fire in order to detect and must be mounted per the installation instructions. The optical detector shall have at least a 90 degree conical field-of-view. The optical fire detector shall have a response time of less than one half of one second to a fire. The optical detection system in the engine compartment will be comprised of at least two each infrared optical fire detectors.

TS 5.9.4. System Action.

The Fire Suppression System, both independent zones A& B, in automatic mode shall operate as follows:

1. Cease operation of HVAC compressor and all forced ventilation.

2. Cease operation of all auxiliary cooling fans and electrically driven coolant and hydraulic pumps.

3. Flash “FIRE – STOP VEHICLE” on operators’ display.

4. Sound an audible alarm from the instrument panel.

5. The operators’ display shall also read “ENGINE SHUTOWN –XX SECONDS” where XX is replaced with a countdown timer from 15 to 00. The display timer shall count down and the audible alarm frequency shall simultaneously increase until the timer reaches 0 seconds, at which time the propulsion system(s) shall shutdown.

Engine shutdown timer may be reset to 15 seconds by depressing the Overrule Switch.

TS 5.9.5. Alarm Indication.

Upon detection of a fire, the system will provide a visual and audible fire alarm to the operator.

TS 5.9.6. System Status and Trouble Indication.

The FSS shall provide an active visual indication of the system status. An immediate visual Trouble indication will be provided if a fault occurs in any portion of the FSS circuit. An indicator Test function shall be provided at the panel.

TS 5.9.7. Automatic Engine Shut-Down.

TS 5.9.8. Engine shutdown with operator override.

After a fire is detected, the FSS shall cause the fuel flow to cease, and the engine to shut down. An operator override feature shall be provided. The air conditioning blower motors should shut off during the engine shut down.

TS 5.9.9. Automatic engine shutdown with delay.

An automatic delay between the fire alarm and engine shutdown shall not exceed 15 seconds.

TS 5.9.10. Manual override.

A manual override shall be provided, which when constantly depressed, will allow the driver to delay the engine shutdown, but not the FSS System Activation and alarm system.

TS 5.9.11. Extinguisher Discharge.

The system shall provide a means for manually discharging the extinguisher with the control located in the driver's area. The installation shall be certified by the manufacturer of the suppression system.

TS 5.9.12. Operator Over-Ride of Automatic Engine Shut-Down and Extinguisher Discharge.

When the system is configured so that the Engine Shut-down and Extinguisher Discharge occur after a pre-set delay following the Fire Alarm, the FSS shall offer provision for the operator to over-ride the automatic action of the system. The over-ride will prevent the engine shutdown from occurring. The over-ride delay shall require active input from the operator.

TS 5.9.13. Battery Back-Up.

The FSS shall have provision to operate with a back-up power source, other than the vehicle battery. The back-up power source shall be capable of automatically actuating the FSS for a period of 24 hours in the event of loss of the vehicle electrical power source. The back-up battery shall be self-recharging when vehicle electric power is restored with a design life no less than 3.5 years.

TS 5.9.14. System Reset.

After a fire alarm and complete system sequence, the FSS shall have provision to be reset after the system is reconfigured per the instructions provided by the manufacturer.

TS 5.9.15. Redundant Fire Alarm System.

An independent redundant fire detection and alarm system shall also be installed in the bus. The system shall have sensors in required location with an independent audible and visible alarm in the driver's compartment.

TS 5.9.16 Passive Monitoring.

The AFSS shall employ an integrated method of system event logging. Deployments and system exceptions, together with time and date of occurrence shall be saved for future retrieval. The following conditions shall be captured:

1. Sensor faults. The system shall log the location of specific sensor experiencing out of range or inoperative conditions.

2. Sensor wiring failures. Open and short circuit failures shall be determined and logged independently of sensor faults.

3. Deployments. The system shall log the time and date of all automatic system deployments and provide association to button or sensor(s) causing each deployment.

4. Supply voltage anomalies. Out of range supply voltages, both from vehicle supply and backup battery system(s) shall be captured independently, together with the specific voltages observed at time voltage event is captured.

5. Test mode activations. Activation of built-in test modes shall be captured and logged.

TS 5.9.17 Communication with External Systems.

The AFSS system shall communicate with external monitoring systems via SAE J1939 messaging. At minimum, all conditions listed in Passive Monitoring section (above) shall be communicated in real time over the required data connection.

TS 5.10 Respect for the Environment

In the design and manufacture of the bus, the Contractor shall make every effort to reduce the amount of potentially hazardous waste. In accordance with Section 6002 of the Resource Conservation and Recovery Act, the Contractor shall use, whenever possible and allowed by the specifications, recycled materials in the manufacture of the bus.

TS 5.11. Accessibility

All systems or components subject to periodic maintenance or that are subject to periodic failures shall be readily accessible for service and inspection. To the extent practicable, removal or physical movement of components unrelated to the specific maintenance and/or repair tasks involved shall be unnecessary. As a goal, relative accessibility of components, measured in time required to gain access, shall be inversely proportional to frequency of maintenance and repair of the components. Specific maintainability requirements are defined in other sections of Part 5: Technical Specifications.

TS 5.12 Interchangeability

Components with identical functions shall be interchangeable to the extent practicable. These components shall include, but not limited to passenger windows and their hardware, interior trim, interior and exterior lamps, lamp lenses, and seat assemblies. Components with non-identical functions shall not be, or appear to be, interchangeable. A component shall not be used in an application for which it was neither designed nor intended.

Any one component or unit used in the construction of these buses shall be an exact duplicate in design, manufacture, and assembly for each bus in each order group in this Contract. **The Authority shall be notified of any changes made to components, units**

and/or design used in the construction of these buses having an impact on interchangeability between each order group of buses under this contract. Any changes shall be mutually agreed upon.

TS 5.13 Safety

The buses electrical system shall be designed so that no casual contact with electrical components, devices or equipment that has sufficient voltage potential (emf) to cause bodily injury shall be possible. There shall be no high voltage wiring, components or devices within the passenger compartment. High voltage cables and wires shall be installed in dedicated harnesses, conduits or raceways so as they do not interfere with any low voltage, radio communication or emergency systems and shall be permanently identified, color-coded and numbered, in accordance with SAE J1673.

TS 5.14 Fire Safety

The bus shall be designed and manufactured in accordance with all applicable fire safety and smoke emission regulations. These provisions shall include the use of fire-retardant/low-smoke materials, fire detection systems, firewalls, and facilitation of passenger evacuation. In addition, an independent redundant fire alarm system must be installed.

All materials used in the construction of the Passenger Compartment of the bus shall be in accordance with the Recommended Fire Safety Practices defined in FTA Docket 90, dated October 20, 1993. Materials entirely enclosed from the passenger compartment, such as insulation within the sidewalls, need not comply. In addition, smaller components and items, such as seat grab rails, switch knobs and small light lenses shall be exempt from this requirement.

Fire sensing and suppression systems shall be provided.

TS 5.15 Fire Safety Equipment.

The Contractor shall furnish and install a 5-lb., dry chemical type extinguisher with a twenty (20) inch hose assembly.
A safety triangular reflector kit is to be provided on each bus for use in emergency situations when bus breaks down in service. The kit shall be contained in a compartment near the driver's area.

DIMENSION

TS 6. Physical Size

With exceptions such as exterior mirrors, marker and signal lights, bumpers, fender skirts, washers, wipers, ad frames, cameras, object detection systems, bicycle racks, feelers and rub rails, the bus shall have the following overall dimensions as shown in Figure 1 at static conditions and design height.

Baseline: Use for 40-42 Foot length bus.

(1) Body Length: 40 Feet (+2 feet 6 inches, –3 inches).
(2) Body Width: 102 Inches (+0, -1 inch).
(3) Maximum Overall Height: 135 Inches, includes all rigid roof mounted items such A/C. & exhaust

.

TS 6.1 Bus Lengths

For ease of use, the following tolerances will be allowable for each given bus length. Bus length is determined as the measurement from bumper to bumper.

- **42-ft bus: 42 ft. (-0, +3 inches)**
- **62-ft bus: 62 ft. (-0, + 3 inches)**

TS 6.2 Bus Widths

102-IN. WIDTH BUS
Body width shall be 102 in. (+0, -1 in.).

TS 6.3 Bus Heights

Maximum Overall Height
Maximum overall height shall be 135 in., including all rigid, roof-mounted items such as A/C, exhaust, fuel system and cover, etc.

TS 6.4 Step Heights

The step height shall not exceed 15.5 in. at either doorway without kneeling and shall not exceed 15.5 in. at the step. A maximum of two steps is allowed to accommodate a raised aisle floor in the rear of the bus.

TS 6.5 Underbody Clearances

The bus shall maintain the minimum clearance dimensions as shown in Figure 2 and defined in SAE Standard J689, regardless of load up to the gross vehicle weight rating.

TS 6.6 Ramp Clearances

The approach angle is the angle measured between a line tangent to the front tire static loaded radius arc and the initial point of structural interference forward of the front tire to the ground.

The departure angle is the angle measured between a line tangent to the rear tire static loaded radius arc and the initial point of structural interference rearward of the rear tire to the ground.

The break over angle is the angle measured between two lines tangent to the front and rear tire static loaded radius and intersecting at a point on the underside of the vehicle that defines the largest ramp over which the vehicle can roll.

TABLE 2
Break over Angle

Angle	**40-ft Bus**	**60-ft Bus**
Approach	9 degrees (min.)	9 degrees (min.)
Front break over	8 degrees (min.)	10.2 degrees (min.)
Rear break over (articulated only)	n/a	8.7 degrees (min.)
Departure	9 degrees (min.)	9 degrees (min.)

TS 6.7 Ground Clearances

Ground clearance shall be no less than 10 in., (8 in. at jacking pad) except within the axle zone and wheel area.

Axle zone clearance, which is the projected area between tires and wheels on the same axial centerline, shall be no less than 6.0 in.

Wheel area clearance shall be no less than 8 in. for parts fixed to the bus body and 8 in. for parts that move vertically with the axles.

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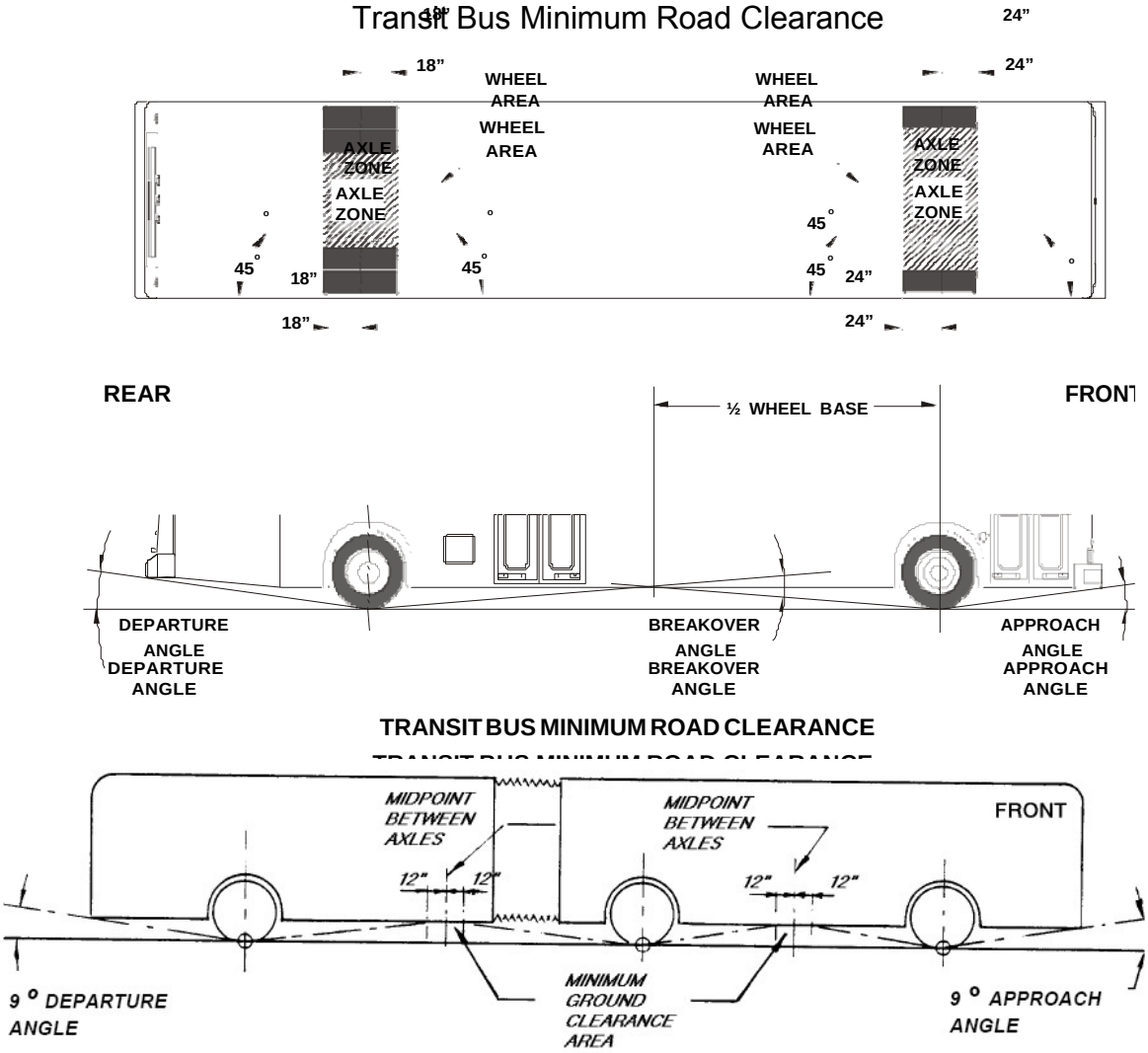
FIGURE 2
Transit Bus Minimum Road Clearance



TS 6.8 Floor Height.

Height of the step above the street shall be no more than 15.5″ in. measured at the centerline of the front and rear doorway. The floor may be inclined along the longitudinal axis of the bus, and the incline shall not exceed 3.5º (degree) off the horizontal except locally at the doors where 2 º (degree) slopes toward the door is allowed. All floor measurements shall be with the bus at the design running height and on a level surface and with the standard installed tires. A maximum of two steps is allowed to accommodate a raised aisle floor in the rear of the bus.

TS 6.9 Interior Headroom

Headroom above the aisle and at the centerline of the aisle seats shall be no less than 78″ in. in the forward half of the bus tapering to no less than 74″ in. forward of the rear settee. At the centerline of the window seats, headroom shall be no lower than 65″ in., except for parcel racks and reading lights, if specified. Headroom at the back of the rear bench seat may be

reduced to a minimum of 54″ in., but it shall increase to the ceiling height at the front of the seat cushion. In any area of the bus directly over the head of a seated passenger and positioned where a passenger entering or leaving the seat is prone to strike his or her head, padding shall be provided on the overhead paneling.

TS 6.10 Aisle Width

The minimum clear aisle width between pairs of Cantilever seats with all attached hardware shall be at least 22″ in.

The aisle width between the front wheelhouses shall be at least 35.5″ in., and the entire area between the front wheelhouses shall be available for passengers and mobility aid devices.

TS 6.11 Weight

Curb weight of the bus, shall not exceed 33,000 pounds for a 40ft bus and 47,500 pounds for a 60ft articulated bus.

TS 6.12 Capacity

The vehicle shall be designed to carry the Gross Vehicle Weight. The vehicle interior shall be designed to maximize the number of seated passengers.

VEHICLE PERFORMANCE

TS 7 Power Requirements

The propulsion system shall be sized to provide sufficient power to enable the bus to meet the defined acceleration, top speed, and gradability requirements, and operate all propulsion-driven accessories. Power requirements are based on heavy, heavy-duty gas (HHDG) engines certified for use in all 50 state using actual road test results and computerized vehicle performance data.

TS 7.1 Top Speed

The bus shall be capable of achieving a top speed of 65 mph on a straight, level road at GVWR with all accessories operating. The bus shall be capable of safely maintaining the vehicle speed according to the recommendations by the tire manufacturer.

NOTE: Values are assumed to be sustained. Manufacturer shall supply Authority with data if there is a variance between peak performance and sustained vehicle performance.

TS 7.2. Gradability

Gradability requirements shall be met on grades with a dry commercial asphalt or concrete pavement at GVWR with all accessories operating.

The propulsion system and drive train shall enable the bus to achieve and maintain a speed of 40 mph on a 2½ percent ascending grade and 15 mph on a 10 percent ascending grade continuous.

NOTE: Values are assumed to be sustained. Manufacturer shall supply WMATA with data if there is a variance between peak performance and sustained vehicle performance.

TS 7.3 Acceleration

The acceleration shall meet the requirements below and shall be sufficiently gradual and smooth to prevent throwing standing passengers off-balance. Acceleration measurement shall commence when the accelerator is depressed.

TABLE 3
Maximum Start Acceleration Times on a Level Surface[1]

Speed (mph)	Maximum time (seconds)
10	5
20	10
30	18.0
40	30.0
50	60
Top speed	65

1. Vehicle weight = GVWR

THE SYSTEM SHALL BE PROGRAMMABLE TO ALLOW OPTIMIZATION OF ACCELERATION AND DECELERATION RATE. PERFORMANCE MAY BE AFFECTED WHEN REPROGRAMMING. THE MANUFACTURER SHALL SUPPLY THE NEW PERFORMANCE DATA.

TS 7.4 Operating Range

The operating range of the coach shall be designed to meet the operating profile as stated in the “Design Operating Profile” section.

THE OPERATING RANGE OF THE COACH WHEN RUN ON THE DESIGN OPERATING PROFILE “DESIGN OPERATING PROFILE” SHALL BE AT LEAST 350 MI ON A FULL TANK OF FUEL.(CNG AND DIESEL)

TS 8. Fuel Economy

Test results from the Altoona fuel economy tests or other applicable test procedures shall be provided to WMATA. Results shall include vehicle configuration and test environment information. Fuel economy data shall be provided for each design operating profile. The

design operating profile is assumed to be defined by the Altoona fuel duty cycle. WMATA will provide a percentage of each duty cycle that is representative of WMATA's service.

POWERPLANT

TS 9. Engine

The engine shall meet all regulatory requirements when operating on fuel equal to CARB Specifications for Compressed Natural Gas #2292.5. The four predominant characteristics that must be met are Methane, Ethane, Butane, and Propane.

The engine shall meet or exceed all appropriate emission standards for use in transit service as require by the Environmental Protection Authority (EPA) according to date of delivery, including any special circumstances requiring alternative regulatory compliance and/or testing. Complete vehicle or system certification documentation shall be provided to WMATA as required by EPA or state/local regulatory Authority. This documentation will specify the role and regulatory responsibilities of the bus manufacturer and subsystem manufacturers. Any requirements must be approved by WMATA. Responsibility for all emissions and useful life requirements shall be sole responsibilities by the bus manufacturer and subsystem manufacturer(s) unless specifically detailed in the compliance plan and approved by WMATA.

Automatic Engine Protection/Shutdown Override Feature
A guarded momentary toggle switch shall be provided within reach of the seated operator that will override automatic shutdown of the engine for a period of 15 seconds. This period shall be repeatable indefinitely. This override shall prevail over shutdown from any system; Engine, fire suppression, and/or gas detection. Override action shall be recorded. This data shall be retrievable by the WMATA.

TS 9.1 Engine (CNG)

The HHDG Engine shall be designed to operate for not less than 300,000 miles without major failure or significant deterioration. The engine shall comply with applicable local, state, and/or federal emissions and useful life requirements. Components of the fuel management and/or control system shall have a design life of not less than 150,000 miles without replacement or major service. The lifetime estimate is based on the design operating profile.

The engine shall have on-board diagnostic capabilities, able to monitor vital functions, store out-of-parameter conditions in memory, and communicate faults and vital conditions to service personnel. Diagnostic reader device connector ports, suitably protected against dirt and moisture, shall be provided in operator's area and near or inside engine compartment. The on-board diagnostic system shall inform the operator via visual and/or audible alarms when out-of-parameter conditions exist for vital engine functions.

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THE PREFERRED ENGINES FOR THIS PROCUREMENT ARE THE CUMMINGS ISL ENGINE AS REQUIRED BY EMISSION STANDARD OF THE YEAR OF DELIVERY.

FOR CNG AND CLEAN DIESEL BUSES WMATA PREFERENCE IS 39MT GEAR-REDUCTION STARTER FOR REDUCE CURRENT DRAW AND HIGHER CRANKING TORQUE

NO AUXILIARY HEATER REQUIRED FOR CNG BUSES UNLESS ENGINE MANUFACTURER MANDATE FOR PROPER PERFORMANCE.

The engine control system shall be protect the engine and propulsion system against progressive damage and shall be met by operation on either of the commercially available CNG.

The system shall monitor conditions critical for safe operation and automatically derate power and/or speed and initiate engine shutdown as needed.

The engine shall be equipped with an electronically controlled management system, compatible with either 12- or 24-volt power distribution. The engine control system shall be capable of transmitting and receiving electronic inputs+ and data from other drive train components and broadcasting that data to other vehicle systems. Communication between electronic drive train components and other vehicle systems shall be made using the communications networks. The engine's electronic management system shall monitor operating conditions and provide instantaneous adjustments to optimize both engine and bus performance. The system shall be programmable to allow optimization of programmable features.

The engine must be capable of starting after an ambient cold soak as low as -10º F for eight hours. The engine starter shall be Delco Remy model 39MT, or equivalent gear reduction 24 volt heavy duty starting motor with over-crank protection to prevent thermal damage.

The engine starting system shall be protected by an interlock that prevents its engagement when the engine is running. Special equipment or procedures may be employed to start the bus when exposed to temperatures less than 30 °F for a minimum of four hours without the engine in operation. All cold weather starting aids, engine heating devices and procedures shall be of the type recommended by the engine manufacturer and approved by the WMATA. The integration of all systems on the vehicle relative to engine idle speed shall be the responsibility of the vehicle manufacturer to meet the requirements of the transit property.

Propulsion System Service

The propulsion system shall be arranged so that accessibility for all routine maintenance is assured. No special tools, other than dollies and hoists, shall be required to remove the propulsion system or any subsystems. The exhaust system, (without band clamps), air cleaner, air compressor, starter (if used), alternator, radiator, all engine accessories, and any other component requiring service or

replacement shall be easily removable. Contractor shall provide all specialty tools and diagnostic equipment required for maintaining the Propulsion System in accordance with Special Tools List.

The PPU shall be equipped with an electronically controlled management system, compatible with multiplex wiring systems and either 12- or 24-volt electrical systems.

The engine shall have on-board diagnostic capabilities, able to monitor vital functions, store out-of parameter conditions in memory, and communicate faults and vital conditions to service personnel. Diagnostic reader device connector ports, suitably protected against dirt and moisture, shall be provided in operator's area and near or inside engine compartment. The on-board diagnostic system shall inform the operator via visual and/or audible alarms when out-of-parameter conditions exist for vital engine functions.

The engine starting system shall be protected by an interlock that prevents its engagement when the engine is running and when fuel door open or the parking brake is released. Special equipment or procedures may be employed to start the engine when exposed to temperatures less than 30° F for a minimum of four hours without the engine in operation. All cold weather starting aids, engine heating devices and procedures shall be of the type recommended by the engine manufacturer and approved by the Authority.

TS 9.2 Engine (Clean Diesel)

Propulsion System Description (for conventional (non-hybrid) powered 40' bus. The bus shall be powered by a clean diesel propulsion system. Function and operation of the bus shall be transparent to the Bus Operator and passengers. The OEM shall assure that the bus structure can successfully accept the installation of the propulsion system and be operated on the stated duty-cycle for a period of 12 years without a structural failure. At a minimum, propulsion system shall comply with applicable local, state, and/or federal emissions and useful life requirements. The propulsion system shall comply with local, state, and federal (maintenance) and other applicable sections. The diesel engine shall be rated for the BUS GVWR or greater.

Electronic Controls

The electronic controls shall be compatible with multiplex wiring systems, capable of receiving inputs from the throttle, shift selector and engine. Communication between the electronically controlled vehicle systems shall be made using the SAE J1939 Recommended Practice communication link. Electronic controls shall be compatible with either 12 or 24 volt systems, and compensate for changing conditions such as variations in vehicle weight and engine

power. A nominal brake pedal application of 15 to 20 psi shall be required by the operator to engage forward or reverse range from the neutral position.

Propulsion System Service

The propulsion system shall be arranged so that accessibility for all routine maintenance is assured. No special tools, other than dollies and hoists, shall be required to remove the propulsion system or any subsystems. However, WMATA shall recognize that properly rated test equipment and safe electrical work practices are essential. The exhaust system, air cleaner, air compressor, starter (if used), alternator, radiator, all engine accessories, and any other component requiring service or replacement shall be easily removable. Contractor shall provide all specialty tools and diagnostic equipment required for maintaining the Propulsion System in accordance with Special Tools List.

THE PREFERRED DIESEL & CNG ENGINE (40' & 60' BUSES ONLY) FOR THIS PROCUREMENT IS CUMMINS ISL ENGINE AS REQUIRED BY EMISSION STANDARD OF THE YEAR OF DELIVERY.

Engine shall be equipped with WMATA approved hinged engine belt guard for safety.

TS 10.Cooling Systems

The cooling systems shall be of sufficient size to maintain all engine and transmission fluids and engine intake air at safe, continuous operating temperatures within manufacturers specifications for all cooled equipment and during the most severe operations possible and in accordance with engine and transmission manufacturers' cooling system requirements. The cooling system fan controls should sense the temperatures of the operating fluids and the intake air, and if either is above safe operating conditions the cooling fan should be engaged. The fan control system shall be designed with a fail-safe mode of "fan on." The cooling system shall meet the requirements stated in the WMATA Transit operating environment. The cooling system in new condition shall have an ambient capacity of at least 110º F with water as coolant and sea level operation.

TS 10.1 Engine Cooling System

The engine shall be cooled by water-based, pressure type, cooling system that does not permit boiling or coolant loss during the operations described above. Engine thermostats shall be easily accessible for replacement. Shutoff valves shall allow filter replacement without coolant loss. Valves shall be installed to provide individual isolation of heating and defroster units, and water booster pumps. The water booster pump shall be magnetically coupled, brushless design. All low points in the water based cooling system shall be equipped with drain plugs. Air vent shall be fitted at high points in the cooling system unless it can be demonstrated that system is self – purging. No heat producing components shall be mounted between the engine cooling air intake aperture and the radiator. The radiator and charge air cooler shall be designed to withstand thermal fatigue and vibration associated with the installed configuration.

A sight glass to determine satisfactory of each isolated coolant circulation system (Engine and cabin may be isolated). Engine coolant level shall be provided and shall be accessible by opening one of the engine compartment access doors. A spring- loaded, push button type valve to safely release pressure or vacuum in the cooling system shall be provided with both it and water filler no more than 60 inches above the ground and both shall be accessible through the same access door. Provide a test port for pressure testing of cooling system at surge tank. The serge tank shall have an automotive style fill cap in addition to the standard/traditional pressure relief cap. An overflow bottle with high and low marking for both tank with dual cooling system. Cabin coolant overflow must be return to serge tank.

Fully electric radiator charge air and hydraulic system shall be of durable, corrosion-resistant construction with independently replaceable heat exchanger elements. The system must have a design life of at least equal to that of the vehicle. The cooling fan shall be temperature controlled, allowing the engine to reach operating temperature quickly. The temperature controlled fan shall not be driven when the coolant temperature falls below the minimum level recommended by the engine manufacturer expect as required to maintain the engine compartment temperature within the WMATA gradient.

Screen in Radiator Door
The radiator input shall be protected by an easily cleanable screen designed to collect large debris. Radiators with a fin density greater than 12 fins per in. or a louvered slit design shall not be used. No heat-producing components or climate control system components shall be mounted between the engine cooling air intake aperture and the radiator. The radiator and charge air cooler shall be designed to withstand thermal fatigue and vibration associated with the installed configuration. The radiator and charge air cooler cores shall be easily cleaned (to include engine side core surface) with standard pressure-washing equipment.

Standard Requirement for Coolant Filtration
The engine cooling system shall be equipped with a properly sized water filter with a spin-on element and an automatic system for releasing supplemental coolant additives as needed to replenish and maintain protection properties. When replacing the water filter, only the water in the filter will be lost.

Standard Mounting Design
Mounting location of radiator and charge air cooler shall be the Contractor's standard bolted design.

Cooling Fan Controls
The cooling fan shall be temperature controlled, allowing the engine to reach operating temperature quickly. Temperature measurements shall be obtain via J1939 connection.

TS 10.2 Charge Air Cooling

The charge air cooling system also referred to as after-coolers or inter-coolers shall provide maximum air intake temperature reduction with minimal pressure loss. The charge air radiator shall be sized and positioned to meet engine manufacturer's requirements. The charge air radiator shall not be stacked ahead of or behind the engine radiator and shall be positioned as close to the engine as possible unless integrated with the radiator. Air ducting and fittings shall be protected against heat sources and shall be configured to minimize restrictions and maintain sealing integrity.

TS 10.3 Transmission Cooling

The transmission shall be cooled by a dedicated heat exchanger sized to maintain operating fluid within the transmission manufacturer's recommended parameters of flow, pressure and temperature. The transmission cooling system shall be matched to retarder and engine cooling systems to ensure that all operating fluids remain within recommended temperature limits established by each component manufacturer. The engine cooling system should provide coolant bypass flow to the transmission cooling system with the engine thermostats closed. The transmission shall be equipped with the transmission manufacturer's approved and supplied appropriately sized transmission cooler designed to have removable end caps. The transmission cooler shall be included in the 5 year/300,000 mile transmission warranty, including collateral damage between the transmission and transmission cooler.

TS 11.Transmission (Conventional Power train)

The transmission shall be multiple speeds, automatic shift with torque converter, retarder and electronic controls. Gross input power, gross input torque and rated input speed shall be compatible with the engine. The transmission shall be designed to operate for not less than 300,000 miles on the design operating profile without replacement or major service. The transmission should be easily removable without disturbing the engine and accessible for service by a 3M mechanic with optional assistance, shall be able to remove and replace the transmission assembly for service in less than 16 hours total combined man hours.

The electronic controls shall be capable of transmitting and receiving electronic inputs and data from other drive train components and broadcasting that data to other vehicle systems. Communication between electronic drive train components and other vehicle systems shall be made using the communications networks. Electronic controls shall be compatible with either 12- or 24-volt power distribution, provide consistent shift quality and compensate for changing conditions such as variations in vehicle weight and engine power.

The electronically controlled transmission shall have on-board diagnostic capabilities, be able to monitor functions, store and time stamp out-of-parameter conditions in memory, and communicate faults and vital conditions to service personnel. The transmission shall contain built-in protection software to guard against severe damage. A diagnostic reader device connector port, suitably protect against dirt and moisture, shall be provided in the operator's area. The on-board diagnostic system shall trigger a visual alarm to the driver when the electronic control unit detects a malfunction.

An electronic transmission fluid level monitoring and protection system shall be provided. (Transmission fluid usage see Section SP 14 Oil & Lubricant requirements).

A BRAKE PEDAL APPLICATION OF 15 PSI (NOMINAL) SHALL BE REQUIRED BY THE DRIVER TO ENGAGE FORWARD OR REVERSE RANGE FROM THE NEUTRAL POSITION TO PREVENT UNINTENDED MOVEMENT OF THE BUS FROM A PARKED POSITION.

AUTOMATIC NEUTRAL FUNCTION WITH MANUAL RE-ENGAGEMENT

The transmission shall automatically shift to neutral whenever the door brake interlock is applied for five minutes. The driver shall be required to apply the service brake to re-engage forward range.

AUTOMATIC NEUTRAL FUNCTION WITH AUTOMATIC RE-ENGAGEMENT

The transmission, when in forward direction, shall automatically shift the transmission to neutral when the vehicle registers zero road speed, engine is idle and service brakes are applied. This system shall also automatically shift the transmission to “Neutral”, after a 5 minutes delay, whenever the exit door brake interlock is applied.

TS 12.Retarder

The Transmission shall be equipped with a retarder designed to extend brake lining service life. The application of the retarder shall cause a smooth blending of both retarder and service brake function and shall not activate the brake lights

Actuation of ABS and/or automatic traction control (ATC) shall override the operation of the brake retarder. Brake lights shall illuminate when the retarder is activated.

Standard Requirement for Retarder Activation

The retarder shall be adjustable within the limits of the powertrain and activated proportionally to a service brake application. WMATA will work with the OEM/drive system manufacturer to determine retarder performance settings.

Throttle Pedal Activation of the Retarder

The retarder shall become partially engaged (approximately one-quarter (1/4) to one-third (1/3) of its total application, with a resulting deceleration of no greater than 0.03g) when the throttle pedal is completely released (e.g., zero throttle). Maximum retarder shall be achieved when brake pedal is depressed prior to engagement of service brakes, with a maximum resulting deceleration of approximately 0.13g. The resulting decelerations specified include the effects of engine braking, wind resistance and rolling resistance.

RETARDER DISABLE SWITCH

If required by the transmission manufacturer, a momentary action toggle switch shall be provided that when actuated and released will de-activate the retarder for the current ignition cycle only. Location will be determined by WMATA. An appropriate dashboard indicator will illuminate whenever the retarder is manually de-activated.

DISABLING RETARDER SHALL BE RECORDED FOR AUTHORITY DATA COLLECTION.

JERK, THE RATE OF CHANGE OF ACCELERATION MEASURE AT THE CENTERLINE, FLOOR LEVEL OF THE BUS SHALL BE MINIMIZED THROUGHOUT THE SHIFTING OF EACH TRANSMISSION RANGE AND RETARDER APPLICATION AND SHALL BE NO GREATER THAN

0.3 g/sec, for duration of a (¼) quarter-second or more.

TS 13.Mounting

The power plant shall be mounted in a compartment in the rear of the bus. All power plants shall be mechanically isolated to minimize transfer of vibration to the body structure and provide a minimum clearance of 0.75 in. Mounts shall control the movement of the power plant so as not to affect performance of belt-driven accessories or cause strain in piping and wiring connections to the power plant.

TS 13.1 Service

The propulsion system shall be arranged for ease of access and maintenance. The Contractor shall list all special tools, fixtures or facility requirements recommended for servicing. Two 3M mechanics shall be able to remove and replace the engine and transmission assembly in less than 12 total combined man-hours. The muffler, exhaust system, air cleaner, air compressor, starter, alternator, radiator, all accessories and any other component requiring service or replacement shall be easily removable and independent of the engine and transmission removal. A **CAN COMMUNICATOR GAUGE** shall be provided in the engine compartment. The gauge shall be easily read during service and mounted in an area where, shall not be damaged during minor or major repairs.

ENGINE OIL AND THE RADIATOR FILLER CAPS SHALL BE HINGED TO THE FILLER NECK AND CLOSED WITH SPRING PRESSURE OR POSITIVE LOCKS TO PREVENT LEAKAGE. ALL FLUID FILL LOCATIONS SHALL BE PROPERLY LABELED WITH METAL TAGS TO HELP ENSURE THAT CORRECT FLUID IS ADDED. ALL FILLERS SHALL BE EASILY ACCESSIBLE WITH STANDARD FUNNELS, POUR SPOUTS AND AUTOMATIC DISPENSING EQUIPMENT. ALL LUBRICANT SUMPS SHALL BE FITTED WITH FUMOTO (PART # F-104) VALVE.

UNIQUE FLUID (LUBRICANT) FILLERS

The engine, transmission and hydraulic reservoir shall each incorporate a unique lubricant fill fitting to prevent cross-contamination of lubricant types. Fitting types shall be specified by the WMATA.

The engine and transmission shall be equipped with sufficient heavy-duty fuel and oil filters for efficient operation and to protect the engine and transmission between scheduled filter changes. To the extent practicable, the filters shall be of the spin-on, disposable type or integral with the engine and transmission. All filters shall be easily accessible and the filter bases shall be plumbed to ensure correct reinstallation.

A CAN COMMUNICATOR GAUGE SHALL BE PROVIDED IN THE ENGINE COMPARTMENT. AN INTERACTIVE LCD PANEL CAPABLE OF DISPLAYING DATA FROM ENGINE, TRANSMISSION AND ALL ENGINE COMPARTMENT ACCESSORIES AS WELL AS TO PROVIDE ACCESS TO REQUIRED ENGINE COMPARTMENT FUNCTIONS INCLUDING FRONT/REAR ENGINE RUN, ENGINE COMPARTMENT LIGHTS, FAST IDLE DISABLE SHALL BE PROVIDED.

ENGINE AIR CLEANER

An air cleaner with a dry filter element and a graduated air filter restriction indicator shall be provided. The filter shall be removable by a 3M mechanic in 10 minutes or less. The location of the air intake system shall be designed to minimize the entry of dust and debris and to maximize the life of the air filter. The engine air duct shall be designed to minimize the entry of water into the air intake system. Drainage provisions shall be included to allow any water/moisture to drain prior to entry into air filter.

TS 13.2 Accessories

Engine-driven accessories shall be mounted for quick removal and repair. Accessory drive systems shall operate without unscheduled adjustment for not less than 50,000 miles on the design operating profile. These accessories shall have driven speeds sufficient to assure adequate system performance during extended periods of idle operation and low route speed portion of the design operating profile. Belt guard shall be provided as required for safety and shall be sturdy in design and installation and readily removable. Belt guard design shall be approved by WMATA.

TS 14. Hydraulic Systems

If used, the hydraulic system shall demonstrate a mean time between repairs in excess of 50,000 miles. Hydraulic system service tasks shall be minimized and scheduled no more frequently than those of other major coach systems. All elements of the hydraulic system shall be easily accessible for service or unit replacement. Critical points in the hydraulic system shall be fitted with service ports so that portable diagnostic equipment may be connected or sensors for an off-board diagnostic system permanently attached to monitor system operation. High pressure hydraulic lines shall be as short as practicable and shall be

routed or shielded so that failure of the fittings or line shall not allow the contents to spray or drain onto any component operable above the auto –ignition temperature of the fluid. All hydraulic lines shall meet the noise limits defined in Section TS 14.1 A tamper-proof priority system shall prevent the loss of power steering during operation of the bus if other devices are also powered by the hydraulic system. All elements of the hydraulic system shall meet the accessibility loading requirement of section TS 79.

The hydraulic system shall operate within the allowable temperature range as specified by the lubricant manufacturer.

Sensors in the hydraulic system shall indicate, via AVM, conditions of low hydraulic fluid level.

HYDRAULIC SYSTEM SENSORS

Sensors in the main hydraulic system, excluding those in the power steering system, shall indicate on the driver's on-board diagnostic panel conditions of low hydraulic fluid level.

TS 14.1 Fluid Lines

All lines shall be rigidly supported to prevent chafing damage, Fatigue Failures, degradation and tension strain. Lines should be sufficiently flexible to minimize mechanical loads on the components. Lines passing through a panel, frame or bulkhead shall be protected by grommets (or similar devices) that fit snugly to both the line and the perimeter of the hole that the line passes through to prevent chafing and wear. **Pipes and fluid hoses shall not be bundled with or used to support electrical wire harnesses, not rubbing on any metal.**

Lines shall be as short as practicable and shall be routed or shielded so that failure of a line shall not allow the contents to spray or drain onto any component operable above the auto-ignition temperature of the fluid.

All hoses, pipes, lines and fittings shall be specified and installed as per SAE standard and WMATA's requirement.

TS 14.2 Fittings and Clamps

All clamps shall maintain a constant tension at all times, expanding and contracting with the line in response to temperature changes and aging of the line material. The lines shall be designed for use in the environment where they are installed. For example, high-temperature resistant in the engine compartment, resistant to road salts near the road surface, and so on. **All hoses shall be clamped every 12 inches.**

Compression fittings shall be standardized to prevent the intermixing of components. Compression fitting components from more than one manufacturer shall not be mixed, even if the components are known to be interchangeable.

TS 14.3 Charge Air Piping

Charge air piping and fittings shall be designed to minimize air restrictions and leaks. Piping shall be as short as possible, and the number of bends shall be minimized. Bend radii shall be maximized to meet the pressure drop and temperature rise requirements of the engine manufacturer. The cross-section of all charge air piping shall not be less than the cross-section of the intake manifold inlet. Any changes in pipe diameter shall be gradual to ensure a smooth passage of air and to minimize restrictions. Piping shall be routed away from heat sources and shielded as required to meet the temperature rise requirements of the engine manufacturer.

Charge air piping shall be constructed of stainless steel, aluminized steel or anodized aluminum, except between the air filter and turbocharger inlet, where piping may be constructed of fiberglass. Connections between all charge air piping sections shall be sealed with a short section of reinforced hose and secured with stainless steel constant tension clamps that provide a complete 360-degree seal.

TS 15. Radiator

Radiator piping shall be stainless steel or brass tubing, and if practicable, hoses shall be eliminated. Necessary hoses shall be impervious to all bus fluids. All hoses shall be secured with stainless steel clamps that provide a complete 360-degree seal. The clamps shall maintain a constant tension at all times, expanding and contracting with the hose in response to temperature changes and aging of the hose material.

TS 16. Oil and Hydraulic Lines

Oil and hydraulic lines shall be compatible with the substances they carry. The lines shall be designed and intended for use in the environment which they are installed. For example, high–temperature resistant in the engine compartment, resistant to road salts near the road surface, and so on. Lines shall be capable to withstand maximum system pressures. Lines within the engine compartment shall be **stainless steel** tubing where practicable, except in locations where flexible lines are required.

Hydraulic lines of the same size and with the same fittings as those on other piping systems of the bus, but not interchangeable, shall be tagged or marked for use on the hydraulic system only.

TS 17.Fuel

TS 17.1Fuel Lines

Fuel lines shall be securely mounted, braced and supported as designed by the bus manufacturer to minimize vibration and chafing and shall be protected against damage, corrosion or breakage due to strain or wear.

Manifolds connecting fuel containers shall be designed and fabricated to minimize vibration and shall be installed in protected locations to prevent line or manifold damage from unsecured objects or road debris.

Fuel hose and hose connections, where permitted, shall be made from materials resistant to corrosion and fuel and protected from fretting and high heat. Fuel hoses shall be accessible for ease of serviceability.

TS 17.2 Fuel Lines, CNG

Fuel lines shall comply with NFPA-52. All tubing shall be a minimum of seamless Type 304 stainless steel (ASTM A269 or equivalent). Fuel lines and fittings shall not be fabricated from cast iron, galvanized pipe, aluminum, plastic, or copper alloy with content exceeding 70 percent copper. Pipe fittings and hoses shall be clear and free from cuttings, burrs or scale. Pipe thread joining material that is impervious to CNG shall be utilized as required. Fuel lines shall be identifiable as fuel lines only.

High-pressure CNG lines shall be pressure tested to a minimum of 125 percent of system working pressure prior to fueling. CNG, nitrogen or clean, dry air shall be used to pressure test the lines/assembly. The bus manufacturer shall have a documented procedure for testing the high pressure line assembly.

Fuel lines shall be securely mounted braced and supported using "split-block" type or stainless steel P clamps; all mounting clamps shall be mounted to a rigid structure to minimize vibration and shall be protected against damage, corrosion or breakage due to strain, rubbing, or wear. "Floating clamps" (not mounted to a rigid structure) shall not be permitted. Fuel lines shall not be used to secure other components (wires, air lines, etc).

Manifolds connecting fuel containers shall be designed and fabricated to minimize vibration and shall be installed in protected location(s) to prevent line or manifold damage from unsecured objects or road debris.

Fuel hose connections, where permitted, shall be less than 48 in. in length, made from materials resistant to corrosion and action of natural gas, and protected from fretting and high heat and shall be supported approximately every 12 in.

TS 17.2.1 Fuel Capacity, CNG/CLEAN DIESEL

Shall be sufficient for the operating range of the coach when run on the WMATA duty cycle at least 350 miles.

For CNG with an initial gas settle pressure of 3,600 psi (US) at 70º F (21º C) without exceeding the estimated curb weight of this bus configuration/Specification.

Design and Construction

TS 17. 2.2 Design and Construction CNG

Fuel Tank(s)

CNG fuel containers/cylinder must be designed, constructed, manufacturer, and tested in accordance with at least one of the following:

THE CNG TANKS MUST BE CERTIFIED FOR 20 YEARS LIFE.

U.S. Applications:

- NFPA 52-Standard for Compressed Natural Gas (CNG) Vehicular Fuel Systems
- FMVSS 304
- Any local standard(s) specifically intended for CNG fuel containers

The design and construction of the fuel system supplied by the OEM shall comply with federal and local regulations.

TS 17.2.2.1 Diesel Fuel Tank(S)

Provide diesel fuel tank(s) with a capacity of 125 US gallons using pressure fill system.

The fuel tank(s) shall be securely mounted to the bus to prevent movement during bus maneuvers, but shall be capable of being removed and reinstalled by a 2M mechanic for cleaning or replacement in 1.5 hours or less.

The capacity, date of manufacture, manufacturer name, location of manufacture, and certification of compliance to Federal Motor Carrier Safety Regulation shall be permanently marked on the fuel tank(s). The markings shall be readily visible and shall not be covered with an undercoating material.

TS 17.2.2.2 Installation

Fuel cylinders shall be installed in accordance with ANSI/IAS - 1998, Basic Requirements for Compressed Natural Gas Vehicles (NGV) Fuel Containers and NFPA 52, Compressed Natural Gas (CNG) Vehicular Fuel Systems Code, 1998 edition Section 303. The placement of tanks shall be limited to the roof of the vehicle.

Fuel cylinders, attached valves, pressure relief devices, and mounting brackets should be installed and protected so that their operation is not affected by bus washers and environmental agents such as rain, snow, ice or mud. These components should be protected from significant damage caused by road debris or collision.

The roof and above the engine mounted tanks shall be contained within a skeletal structure resembling a roll cage and contained within an enclosure. The enclosure shall incorporate a

hinged clamshell type access. The access panels shall be designed to offer protection from weather and to be sacrificial as a means of providing an escape path to atmosphere upon rapid enclosure pressure rise. The latching method shall utilize quick release captive hardware that can be demonstrated to last the life of the bus. Additional shielding shall be provided surrounding end fittings and valves as needed. Shields shall be attached to the bus structure hinged in a manner that permits one mechanic to unlatch and swing the shield open for routine inspections. As practical, electrical components shall not be located within the roof enclosure and if unavoidable, they shall be intrinsically safe.

CNG fueled buses shall be equipped with an active automatic gas detection system which shall annunciate unsafe levels of methane. The automatic gas detection system shall be integrated with an onboard fire suppression system.

The materials used in mounting shall withstand the adverse effects of road salts, fuel oils, and accumulation of ice and snow for the life of the bus.

TS 17.2.2.3 Labeling
The capacity, date of manufacture, manufacturer name, location of manufacture, and certification of compliance to Federal Motor Carrier Safety Regulation and NFPA 52 Compressed Natural Gas (CNG) shall be permanently marked on the fuel tank(s). The markings shall be readily visible.

TS 17.2.2.3.Fuel Containers/Cylinders
CNG fuel containers/cylinders must be designed, constructed, manufactured, and tested in accordance with at least one of the following:

TS 17.2.2.3.1 Diesel Tank(s)
The fuel tank(s) shall be securely mounted to the bus to prevent movement during bus maneuvers.

The fuel tank(s) shall be equipped with an external, hex head, drain plug. It shall be at least a standard ⅜ in. size and shall be located at the lowest point of the tank(s). The fuel tank(s) shall have an inspection plate or easily removable filler neck to permit cleaning and inspection of the tank(s) without removal from the bus. The tank(s) shall be baffled internally to prevent fuel-sloshing regardless of fill level. The baffles or fuel pickup location shall assure continuous full power operation on a 6 percent upgrade for 15 minutes starting with no more than 25 gal of fuel over the unusable amount in the tank(s). The bus shall operate at idle on a 6 percent downgrade for 30 minutes starting with no more than 10 gal of fuel over the unusable amount in the tank(s).

The materials used in mounting shall withstand the adverse effects of road salts, fuel oils, and accumulation of ice and snow for the life of the bus.

THE ACCESS PANELS SHALL ALSO BE INTERLOCKED VIA PROXIMITY SENSORS, SUCH THAT, IF OTHER THAN IN THEIR FULLY CLOSED/LOCKED POSITION, AN INTERLOCK WILL

PREVENT ENGINE STARTER ENGAGEMENT, PREVENT SELECTION OF FORWARD OR REVERSE TRANSMISSION AND SHALL APPLY THE BRAKE INTERLOCK AT SPEEDS LESS THAN 3 MPH. WMATA WILL REVISE THE LOGIC FOR FUEL DOOR AS REQUIRED.

TS 17.2.2.4 Pressure Relief Devices (PRDs)

PRDs must be designed, constructed, manufactured and tested in accordance with ANIS/IAS PRD1 - 1998, "Pressure Relief Devices for Natural Gas Vehicle (NGV) Fuel Containers" and ANSI/IAS NGV2-1998, "Basic Requirements for Compressed Natural Gas Vehicle (NGV) Fuel Containers." All natural gas fuel system piping, including the PRD vent line shall be stainless steel. All PRDs must be vented to outside.

TS 17.2.2.5.Valves

Valves must be installed in accordance with ANIS/NGV 1 - 1998, "Basic Requirements for Compressed Natural Gas Vehicle (NGV) Fuel Containers" and NFPA 52, "Standard for Compressed Natural Gas (CNG) Vehicular Fuel Systems."

TS 17.2.2.6.Fuel Filler

The fuel filler shall be located 7 to 38 feet (on a 30-, 35- and 40-foot coach) behind the centerline of the front door on a side determined by the Authority. The filler cap shall be retained to prevent loss and shall be recessed into the body.

The fill and vent receptacles shall be located within an enclosure on the right side of the bus. The access door shall be sized to allow full viewing of gauges, ease of hookups and maneuver of fuel nozzle.

Fuel system shall be capable of being filled (for 350 mile range) from 500 psi to a settled pressure of 3,600 psi (US) in a maximum of five minutes.

Electrically operated tank valves shall be controlled by individual multiplex outputs, one for each valve; each output shall have current monitoring and open circuit detection enabled. Electrical faults, such as current draw above or below tank valve manufacturers operating specifications or open circuit conditions in any of the tank valve circuits shall be logged by the multiplex system and identified to the specific fault that has occurred with the specific valve, these faults shall also be available to maintenance personnel via specified Automatic Vehicle Health Monitoring (AVM) solution. Installation of an external tank valve fault detection system that does not meet these requirements will not be accepted.

The fuel fill receptacle and vent receptacle attachment shall be robust and capable of routine fueling connects/disconnects without deflection or metal fatigue, and capable of withstanding mechanical loads induced by a fueling drive away incident without attachment failure.

THE ACCESS DOOR INTERLOCK SHALL ALSO POWER "ON" THE FUEL LEVEL GAUGES/ILLUMINATION WHEN IN THE OPEN POSITION.

A STATIC GROUND PLUG SHALL BE INSTALLED NEAR THE FUELING RECEPTACLE FOR GROUNDING DURING REFUELING OPERATIONS.

TS 17.2.2.7 Fueling System

The CNG fueling port receptacle shall be an ANSI/AGA NGV1 or NGV2 certified receptacle as designated by the Authority. The coach shall be capable of being fueled by a nozzle determined by the Authority. The fueling port receptacle location shall be such that connection by fueling personnel can be performed without physical strain or interference. A dust cap shall be permanently "tethered" to the fueling port receptacle. The fueling port receptacle access door shall be equipped with an interlock sensor that disables the engine starting system when the access door is open, to prevent drive-away. The interlock shall be of the type such that if the sensor fails, the coach will not start.

Fueling site characteristics such as pressure, flow rate, and temperature shall be provided by WMATA.

TS 17.2.2.8 Defueling System

The CNG defueling port shall be an NGV-3.1/CGA-12.3 certified receptacle. The CNG defueling port shall be located on the curbside of the coach, in a location that is compatible with the WMATA's defueling station operation. The de-fueling system shall incorporate the following characteristics:

- Dust cap permanently "tethered" to the defueling port.
- Device(s) to prevent inadvertent defueling. Specifications to be provided by WMATA.
- Components compatible with WMATA defueling operation.
- The piping and fittings onboard the bus shall be sized to allow the fueling station to meet the following operating parameters:

FUEL SYSTEM SIZED TO ALLOW A BUS WITH 20,000 SCF ON BOARD TO DEFUEL WITHIN 2.5 HOURS

LOCATION/METHOD OF ATTACHING CNG FUEL SYSTEM TO EARTH GROUND.

TS 18 Emissions and Exhaust

TS 18.1Exhaust Emissions

The engine and related systems shall meet all applicable emission and engine design guidelines and standards.

TS 18.2Exhaust System

Exhaust gases and waste heat shall be discharged from the roadside rear corner of the roof. The exhaust pipe shall be of sufficient height to prevent exhaust gases and waste heat from discoloring or causing heat deformation to the bus. The entire exhaust system shall be

adequately shielded to prevent heat damage to any bus component, including the exhaust after-treatment compartment area. The exhaust outlet shall be designed to minimize rain, snow or water generated from high-pressure washing systems from entering into the exhaust pipe and causing damage to the after-treatment.

TS 18.3Exhaust After treatment

An exhaust after treatment system will be provided to ensure compliance to all applicable EPA regulations in effect.

TS 18.4 Particulate After treatment

If required by the engine manufacturer to meet particulate level requirements specified by EPA, a particulate trap will be provided. The particulate trap shall regenerate itself automatically if it senses clogging. Regeneration cycles and conditions will be defined by the engine manufacturer.

STRUCTURE

TS 19.General

TS 19.1Design

The structure of the bus shall be designed to withstand the transit service conditions typical of an urban duty cycle throughout its service life. The vehicle structural frame shall be designed to operate with minimal maintenance throughout the 12-year design operating profile. The design operating profile specified by the WMATA shall be considered for this purpose.

TS 20. Altoona Testing

Prior to acceptance of first bus, the vehicle must have completed any FTA-required Altoona testing. Any items that required repeated repairs or replacement must undergo the corrective action with supporting test and analysis. A report clearly describing and explaining the failures and corrective actions taken to ensure any and all such failures will not occur shall be submitted to the WMATA.

ALTOONA TEST REPORT PROVIDED TO WMATA PRIOR TO START OF BUS PRODUCTION

Prior to the start of any bus manufacturing or assembly processes, the structure of the proposed bus model shall have undergone appropriate structural testing and/or analysis, including the complete regimen of FTA required Altoona tests. Prior to assembly of the first bus, the OEM shall provide the WMATA with a completed report of Altoona testing for the proposed bus model along with a plan of corrective action to address deficiencies, breakdowns and other issues identified during Altoona testing. The bus model tested shall match the bus model proposed for procurement, including structure, axles and drive-train. Base model and partial Altoona test reports are acceptable when the combination of these tests adequately represents the proposed bus model.

TS 20.1 Structural Validations

BASELINE STRUCTURAL ANALYSIS

The structure of the bus shall have undergone appropriate structural testing and/or analysis. At minimum, appropriate structural testing and analysis shall include Altoona testing or Finite Element Analysis (FEA).

DETAILED STRUCTURAL ANALYSIS

The structure of the proposed bus model shall have undergone structural testing prior to assembly of the first bus. The OEM shall provide the WMATA with completed reports of other structural tests as specified by the Authority.

TS 21.Distortion

The bus, loaded to GVWR and under static conditions, shall not exhibit deflection or deformation that impairs the operation of the steering mechanism, doors, windows, passenger escape mechanisms or service doors. Static conditions shall include the vehicle at rest with any one wheel or dual set of wheels on a 6 in. curb or in a 6 in. deep hole.

TS 22. Resonance and Vibration

All structure, body and panel-bending mode frequencies, including vertical, lateral and torsion modes, shall be sufficiently removed from all primary excitation frequencies to minimize audible, visible or sensible resonant vibrations during normal service.

TS 22.1 Engine Compartment Bulkheads

The passenger and engine compartment shall be separated by fire-resistant bulkheads. The engine compartment shall include areas where the engine and exhaust system are housed. This bulkhead shall preclude or retard propagation of an engine compartment fire into the passenger compartment and shall be in accordance with the Recommended Fire Safety Practices defined in FTA Docket 90A, dated October20, 1993. Only necessary openings shall be allowed in the bulkhead, and these shall be fire-resistant. Any passageways for the climate control system air shall be separated from the engine compartment by fire-resistant material. Piping through the bulkhead shall have fire-resistant fittings sealed at the bulkhead. Wiring may pass through the bulkhead only if connectors or other means are provided to prevent or retard fire propagation through the bulkhead. Engine access panels in the bulkhead shall be fabricated of fire-resistant material and secured with fire-resistant fasteners. These panels, their fasteners and the bulkhead shall be constructed and reinforced to minimize warping of the panels during a fire that will compromise the integrity of the bulkhead.

TS 22.2. Crashworthiness

The bus body and roof structure shall withstand a static load equal to 150 percent of the curb weight evenly distributed on the roof with no more than a 6 in. reduction in any interior dimension. Windows shall remain in place and shall not open under such a load. These requirements must be met without the roof-mounted equipment installed.

The bus shall withstand a 25 mph impact by a 4000-pound automobile at any side, excluding doorways, along either side of the bus with no more than 3 in. of permanent structural deformation at seated passenger hip height. This impact shall not result in sharp edges or protrusions in the bus interior.

Exterior panels below 35 in. from ground level shall withstand a static load of 2000 lbs applied perpendicular to the bus by a pad no larger than 5 sq in. This load shall not result in deformation that prevents installation of new exterior panels to restore the original appearance of the bus.

TS 23. Corrosion

The bus flooring, sides, roof, understructure and axle suspension components shall be designed to resist corrosion or deterioration from atmospheric conditions and de-icing materials for a period of 12 years or 500,000 miles, whichever comes first. It shall maintain structural integrity and nearly maintain original appearance throughout its service life, with the WMATA use of proper cleaning and neutralizing agents.

All materials that are not inherently corrosion resistant shall be protected with corrosion-resistant coatings. All joints and connections of dissimilar metals shall be corrosion resistant and shall be protected from galvanic corrosion. Representative samples of all materials and connections shall withstand a two-week (336-hour) salt spray test in accordance with ASTM Procedure B-117 with no structural detrimental effects to normally visible surfaces and no weight loss of over 1 percent.

CORROSION-RESISTANCE REQUIREMENTS FOR EXPOSED AND INTERIOR SURFACES OF TUBING BELOW LOWER WINDOW LEVEL

All exposed surfaces and the interior surfaces of tubing and other enclosed members below lower window line shall be corrosion resistant through application of a corrosion protection system.

TS 24. Towing

Each towing device shall withstand, without permanent deformation, tension loads up to 1.2 times the curb weight of the bus within 20 degrees of the longitudinal axis of the bus. If applicable, the rear towing device(s) shall not provide a toehold for unauthorized riders. The method of attaching the towing device shall not require the removal, or disconnection, of front suspension or steering components. Removal of the bike rack is permitted for attachment of towing devices.

A plug connector **(Cole-Hersee)** permanently mounted at the front of the bus shall provide for bus tail lamp, marker, stop and turn signal lamp operation as controlled from the towing vehicle. The connector shall include a spring-loaded dust- and water-resistant cap. **Two shop air connectors** shall be provided (one should be provided air to the bus, a second should be provided air to brakes) at the front and one rear of the bus and shall be capable of supplying all pneumatic systems of the bus with externally sourced compressed air. The

location of these shop air connectors shall facilitate towing operations. All air connections must be labeled with plate (white/red) affixed to chassis.

LIFTED (UNSUPPORTED) FRONT AXLE AND FLAT TOWING CAPABILITY

The front towing devices shall allow attachment of adapters for a rigid tow bar and shall permit the lifting and towing of the bus, at curb weight, while the front wheels are clear off the ground. These devices shall also permit common flat towing.

Two rear recovery devices/tie downs shall permit lifting and towing of the bus for a short distance, such as in cases of an emergency, to allow access to provisions for front towing of bus. The method of attaching the tow bar or adapter shall require the specific approval of WMATA. Each towing device shall accommodate a under- lift with a minimum 1 in. throat.

TS 25. Jacking

It shall be possible to safely jack up the bus, at curb weight, with a common 10-ton floor jack with or without special adapter, when a tire or dual set is completely flat and the bus is on a level, hard surface, without crawling under any portion of the bus. Jacking from a single point shall permit raising the bus sufficiently high to remove and reinstall a wheel and tire assembly. Jacking pads located on the axle or suspension near the wheels shall permit easy and safe jacking with the flat tire or dual set on a 6 in. high run-up block not wider than a single tire. Jacking and changing any one tire shall be completed by a 2M mechanic helper in less than 30 minutes from the time the bus ia approached. The bus shall withstand such jacking at any one or any combination of wheel locations without permanent deformation or damage.

YELLOW PADS

Jacking pads shall be painted safety yellow or orange.

TS 26. Hoisting

The bus axles or jacking plates shall accommodate the lifting pads of a two-post (or three-post if 60 ft articulated bus) hoist system. Jacking plates, if used as hoisting pads, shall be designed to prevent the bus from falling off the hoist. Other pads or the bus structure shall support the bus on jack stands independent of the hoist. All jacking points/plates shall be identified and approved by WMATA.

TS 27. Floor

TS 27.1 Design

The floor shall be essentially a continuous plane, except at the wheel housings and platforms. Where the floor meets the walls of the bus, as well as other vertical surfaces such as platform risers, the surface edges shall be blended with a circular section of radius **not less than ¼ in**. or installed in a fully sealed butt joint. Similarly, a molding or cover shall prevent debris accumulation between the floor and wheel housings. The vehicle floor in the area of the

entrance and exit doors shall have a lateral slope not exceeding 2 degrees to allow for drainage.

BI-LEVEL FLOOR DESIGN

The floor design shall consist of two levels (bi-level construction). Aft of the rear door extending to the rear settee riser, the floor height may be raised to a height no more than 21 in. above the lower level, with equally spaced steps. An increase slope shall be allowed on the upper level, not to exceed 3.5 degrees off the horizontal.

SLOPED FLOOR DESIGN

The floor of the bus shall be of a sloped low floor design. Aft of the rear door extending to the rear settee riser, the floor may be sloped but shall not exceed 5.5 degrees off the horizontal.

FLOOR DRAIN

A floor drain of noncorrosive materials shall be provided on the bus behind the front, curbside wheelhouse near the wall to help drain any water that may accumulate due to ice, snow, rain, etc. The drain pipe shall be approximately 1½ in. in diameter and shall extend no more than 5 in. below the floor. The drain pipe shall be fitted with a rubber drain spout to minimize or prevent air drafts to the interior of the bus. The strainer shall be firmly retained but also removable to allow flushing of any accumulated debris.

TS 27.2 Strength

The floor deck may be integral with the basic structure or mounted on the structure securely to prevent chafing or horizontal movement and designed to last the life of the bus. Sheet metal screws shall not be used to retain the floor, and all floor fasteners shall be serviceable from one side only. Any adhesives, bolts or screws used to secure the floor to the structure shall last and remain effective throughout the life of the coach. Tapping plates, if used for the floor fasteners, shall be no less than the same thickness as a standard nut, and all floor fasteners shall be secured and protected from corrosion for the service life of the bus.

The floor deck shall be reinforced as needed to support passenger loads. At GVWR, the floor shall have an elastic deflection of no more than 0.60 in. from the normal plane. The floor shall withstand the application of 2.5 times gross load weight without permanent detrimental deformation. The floor, with coverings applied, shall withstand a static load of at least 150 lbs applied through the flat end of a ½ in. diameter rod, with 1/32-inch radius, without permanent visible deformation.

TS 27.3 Construction

The floor shall consist of the subfloor and the floor covering that will last the life of the bus. The floor as assembled, including the sealer, attachments and covering shall be waterproof, non-hygroscopic and resistant to mold growth. The subfloor shall be resistant to the effects of moisture, including decay (dry rot). It shall be impervious to wood-destroying insects such as termites.

Pressure-Preserved Plywood Panel
Plywood shall be certified at the time of manufacturing by an industry-approved third-party inspection Authority such as APA – The Engineered Wood Association (formerly the American Plywood Association). Plywood shall be of a thickness adequate to support design loads, manufactured with exterior grade glue, satisfy the requirements of a Group I Western panel as defined in PS 1-95 (Voluntary Product Standard PS 1-95, "Construction and Industrial Plywood") and be of a grade that is manufactured with a solid face and back. Plywood shall be installed with the highest-grade, veneer side up. Plywood shall be pressure-treated with a preservative chemical and process such as alkaline copper quaternary (ACQ) that prevents decay and damage by insects. Preservative treatments shall utilize no EPA-listed hazardous chemicals. The concentration of preservative chemicals shall be equal to or greater than required for an above ground level application. Treated plywood will be certified for preservative penetration and retention by a third party inspection Authority. Pressure-preservative treated plywood shall have moisture content at or below 15 percent. A barrier shall be installed to prevent contact by road salt with the plywood panels.

COMPOSITE FLOORING.
Flooring material with noise-reduction characteristics (Similar to Antiphon).

TS 28. Platforms

TS 28.1 Driver's Area

Platform heights shall not exceed **17.5 inches.** Covering of platform surfaces and risers, except where otherwise indicated, shall be the same material as specified for floor covering. Trim shall be provided along top edges of platforms unless integral nosing is provided. Other raised areas such as for providing space for under-floor installation of components shall be limited. Such raiser areas shall be constructed in accordance to these specifications.

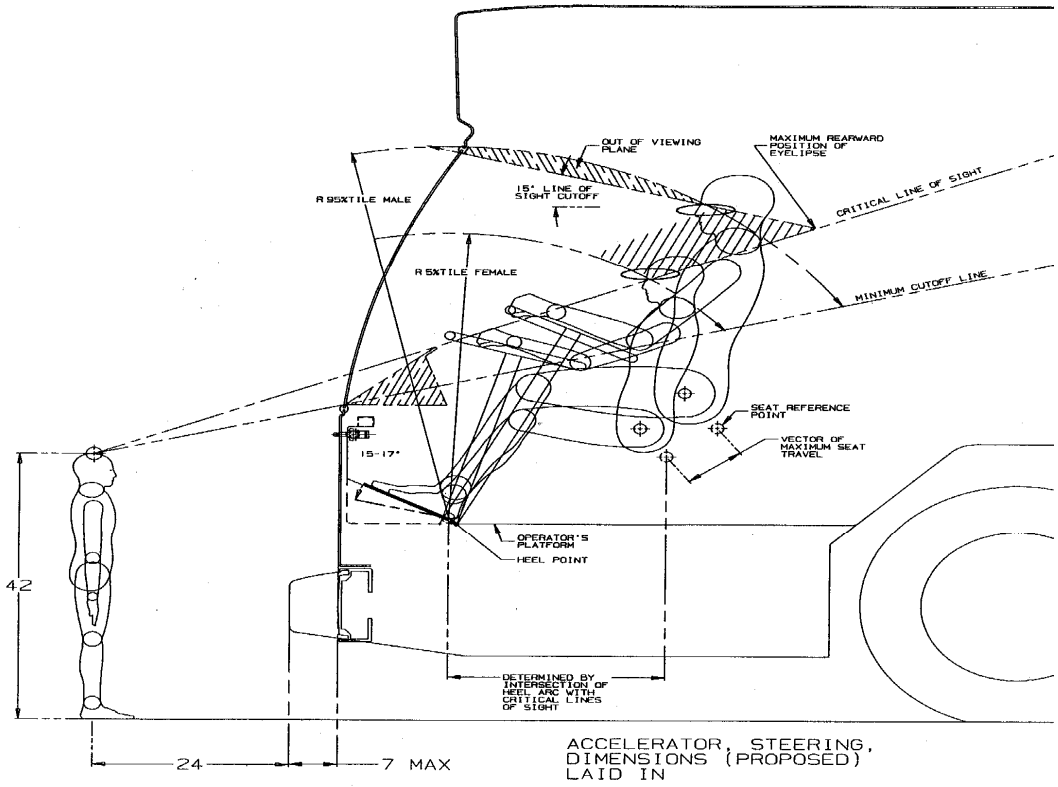
ALL TRIMS AND FASTENERS SHALL BE STAINLESS STEEL.

TS 28.2Driver's Platform

The driver's platform shall be of a height such that, in a seated position, the driver can see an object located at an elevation of 42 in. above the road surface, 24 in. from the leading edge of the bumper. Notwithstanding this requirement, the platform height shall not position the driver such that the driver's vertical upward view is less than 15 degrees. A warning decal or sign shall be provided to alert the driver to the change in floor level. Figure 3 illustrates a means by which the platform height can be determined, using the critical line of sight.

Washington Metropolitan Area Transit Authority
RFP Number: FQ18001/BTK

FIGURE 3
Determining Platform Height



TS 28.3Farebox

Farebox placement should minimize impact to passenger access and minimize interference with the driver's line of sight.

DRIVER INTERFACE REQUIRED; PLATFORM NEEDED TO BRING HEIGHT TO DRIVER ACCESS

If the driver's platform is higher than 12 in., then the farebox is to be mounted on a platform of suitable height to provide accessibility for the driver without compromising passengers' access.

STANCHIONS

Stanchions shall be located around the fare box.

TS 28.4 Rear Step Area to Rear Area

If the vehicle is of a bi-level floor design, a rear step area shall be provided along the center aisle of the bus to facilitate passenger traffic between the upper and lower floor levels. This step area shall be cut into the rear platform and shall be approximately the aisle width, a

minimum 20 in. deep and approximately half the height of the upper level relative to the lower level. The horizontal surface of this platform shall be covered with skid-resistant material with a visually contrasting nosing and shall be sloped slightly for drainage. A warning decal or sign shall be provided at the immediate platform area to alert passengers to the change in floor level.

TS 29.Wheel Housing

TS 29.1Design and Construction

Sufficient clearance and air circulation shall be provided around the tires, wheels and brakes to preclude overheating when the bus is operating on the design operating profile. Wheel housings shall be constructed of corrosion-resistant and fire-resistant material.

Interference between the tires and any portion of the bus shall not be possible in maneuvers up to the limit of tire adhesion with weights from curb weight to GVWR. Wheel housings shall be adequately reinforced where seat pedestals are installed. Wheel housings shall have sufficient sound insulation to minimize tire and road noise and meet all noise requirements of this specification TS 5.8.

Design and construction of front wheel housings shall allow for the installation of a radio or electronic equipment storage compartment on the interior top surface, or its use as a luggage rack.

The finish of the front wheel housings shall be scratch-resistant and complement interior finishes of the bus to minimize the visual impact of the wheel housing. If fiberglass wheel housings are provided, then they shall be color-impregnated to match interior finishes. The lower portion extending to approximately 10 to 12 in. above floor shall be equipped with scuff-resistant coating or stainless steel trim.

Wheel housings, as installed and trimmed, shall withstand impacts of a 2 in. steel ball with at least 200 ft-lbs of energy without penetration.

Wheel housings not equipped with seats or equipment enclosure shall have a horizontal assist mounted on the top portion of the housing no more than 4 in. higher than the wheel well housing.

ABILITY TO CHAIN BUSES.

TS 29.2 Articulated Joint

Buses shall be equipped with a turntable that permanently joins the lead unit and trailing unit sections, allows relative motion between the sections about the pitch and yaw axes, and allows a small amount of relative roll between the sections without damage. A rotating turntable connection shall be provided between the lead unit and trailing unit to serve as a floor and allow passenger access between the sections of the bus under all operating conditions. The turntable design shall provide for all

horizontal and vertical turns that the bus is capable of making without introducing discontinuities between the turntable and adjacent vehicle floors.

The structures and finishes in the interconnecting section shall be designed to prevent passenger injury under all conditions. The turntable floor cover plate shall be supported so that there will be no honing of the floor plate, making it sharp at the outer edge. The gap between the floor and the turntable shall be minimized in order to prevent a tripping hazard. It shall be designed for ease of access for inspection and repairs of all devices that are part of it or devices that pass through the turntable area. Under-floor turntable components shall be easily accessible. Floor plates must be easily lifted and secured in the open position by one person for inspection and repairs. Turntable seats shall be quickly and easily removable by one person. The under-floor turntable area shall be completely enclosed by the bellows and bulkheads on the lead and trailing units to prevent drafts into the passenger compartment. The area between the turntable floor and the bellows shall be closed to prevent collection of trash in the bottom of the bellows. Closeouts shall be attached with removable fasteners. An access hatch shall be provided for routine maintenance (i.e., greasing, adjusting potentiometer, maintenance items).

An anti-jackknife joint shall be provided. This joint — by sensing vehicle speed, relative angle between the lead and trailing sections, throttle and braking actions, and any other necessary inputs — will control the degree of stiffness in the joint to ensure that the bus does not jackknife or operate in a dangerous or unsafe condition. The Authority shall approve the anti-jackknife joint. The interconnecting structure shall be designed to prevent separation of the lead and trailing units as a result of a road accident with a commercial or private vehicle. A means shall be provided so that the driver can override the control or recover from the situation. The bus shall be equipped with a reverse speed governor that shall apply the brake and accelerator interlocks when bus speed in reverse gear exceeds 1.5 mph, but the bus shall have sufficient power in reverse to back out of wheel locator depressions at a floor hoist. The proposed configuration of these devices and the reverse speed requirements shall be submitted for approval of the WMATA.

Easy access shall be provided to overhead lines (electric, air, hydraulic, refrigerant) passing through the turntable. Hydraulic fittings shall be suitable for the given application and must be compatible with other fittings throughout the vehicle.

In order to prevent damage to the structure and electrical, air, hydraulic and refrigerant lines when the vertical or horizontal bending capabilities of the hinge are exceeded, the bus shall be provided with appropriate warning devices, brake interlocks and positive mechanical stops. These devices shall operate when the maximum bend angle is being approached in either plane.

TS 29.3 Raceway

A raceway shall be provided through the turntable area to accommodate to maximum deflection of the turntable. The raceway shall prevent chafing, binding, rubbing, crimping or leakage of all hydraulic, air, fuel and system support lines, as well as all electrical and electronic cabling through or to the turntable area. Lines shall be secured, separated and labeled at the lead and trailing unit bulkheads. Separation shall be maintained on the flexible portion of all lines through the use of a raceway. All electrical terminations and hose fittings shall be easily visible and easily tightened or removed without removing any other component. Lines, routing, securement and labeling shall be approved by the WMATA.

TS 29.4 Bellows

Replacement fabric type bellows with draft-free, no-sag bottom closure and water drains shall be provided between the lead and trailing sections to seal the bus interior and keep it free of water, dirt and drafts. Bellows hardware shall be corrosion resistant, and the under-floor area of the bellows shall be easy to clean when necessary. The passageway between the lead unit and trailing unit shall have an inside cross section that is as nearly equal as possible to the inside cross section of the bus bodies, with no tripping or pinching hazards created by the turntable cross section or closeouts. The bellows shall be durable, and it's supporting structure and stiffeners shall support the bellows material in a neat, sag-free manner. The Contractor shall supply information on the actual service life achieved by the type of bellows being proposed. A sample of the bellows and attaching hardware may be requested for evaluation at the Authority's option. Bellows shall be approved by the WMATA.

BELOW-LINER

CHASSIS

TS 30. Suspension

TS 30.1General Requirements

The front, rear and mid (if articulated) suspensions shall be pneumatic type. The basic suspension system shall last the service life of the bus without major overhaul or replacement. Normal replacement items such as one suspension bushing, shock absorbers, or air spring shall be replaceable by a 3M mechanic in 30 minutes or less. Adjustment points shall be minimized and shall not be subject to a loss of adjustment in service. Routine adjustments shall be easily accomplished by limiting the removal or disconnecting the components.

TS 30.2 Alignment

All axles should be properly aligned so the vehicle tracks accurately within the size and geometry of the vehicle.

TS 30.3. Springs and Shock Absorbers

TS 30.3.1 Suspension Travel

The suspension system shall permit a minimum wheel travel of 3.00 in. jounce-upward travel of a wheel when the bus hits a bump (higher than street surface), and 3.00 in. rebound-downward travel when the bus comes off a bump and the wheels fall relative to the body. Elastomeric bumpers shall be provided at the limit of jounce travel. Rebound travel may be limited by elastomeric bumpers or hydraulically within the shock absorbers. Suspensions shall incorporate appropriate devices for automatic height control so that regardless of load the bus height relative to the centerline of the wheels does not change more than ½ in. at any point from the height required. The safe operation of a bus cannot be impacted by ride height up to 1 in. from design normal ride height.

TS 30.3.2Damping

Vertical damping of the suspension system shall be accomplished by hydraulic shock absorbers mounted to the suspension arms or axles and attached to an appropriate location on the chassis. Damping shall be sufficient to control coach motion to three cycles or less after hitting road perturbations. Shock absorbers shall maintain their effectiveness for at least 50,000 miles of the service life of the bus. Each unit shall be replaceable by a 2M mechanic in less than 15 minutes. The shock absorber bushing shall be made of elastomeric material that will last the life of the shock absorber. The damper shall incorporate a secondary hydraulic rebound stop.

TS 30.3.3 Lubrication

STANDARD GREASE FITTINGS

All elements of steering, suspension and drive systems requiring scheduled lubrication shall be provided with grease fittings conforming to SAE Standard J534. These fittings shall be located for ease of inspection and shall be accessible with a standard grease gun from a pit or with the bus on a hoist. Each element requiring lubrication shall have its own grease fitting with a relief path. The lubricant specified shall be standard for all elements on the bus serviced by standard fittings and shall be required no less than every 6000 miles.

REMOTE GREASE MANIFOLD.

TS 30.3.4 Kneeling

A KNEELING SYSTEM SHALL LOWER THE ENTRANCE(S) OF THE BUS A MINIMUM OF 3.50 IN. DURING LOADING OR UNLOADING OPERATIONS REGARDLESS OF LOAD UP TO GVWR, MEASURED AT THE LONGITUDINAL CENTERLINE OF THE ENTRANCE DOOR(S) BY THE DRIVER. THE KNEELING CONTROL SHALL PROVIDE THE FOLLOWING FUNCTIONS:

- Downward control must be held to allow downward kneeling movement.
- Release of the control during downward movement must completely stop the lowering motion and hold the height of the bus at that position.

• Upward control actuation must allow the bus to return to normal floor height without the driver having to hold the control.

The brake and throttle interlock shall prevent movement when the bus is kneeled. The kneeling control shall be disabled when the bus is in motion. The bus shall kneel at a maximum rate of 1.25 in. per second at essentially a constant rate. After kneeling, the bus shall rise within 2 seconds to a height permitting the bus to resume service and shall rise to the correct operating height within 7 seconds regardless of load up to GVWR. During the lowering and raising operation, the maximum vertical acceleration shall not exceed 0.2g, and the jerk shall not exceed 0.3g/second.

An indicator visible to the driver shall be illuminated until the bus is raised to a height adequate for safe street travel. An audible warning alarm will sound simultaneously with the operation of the kneeler to alert passengers and bystanders. A warning light mounted near the curbside of the front door, a minimum 2.5 in. diameter amber lens, shall be provided that will blink when the kneel feature is activated. Kneeling shall not be operational while the wheelchair ramp is deployed or in operation.

FULL RIGHT-SIDE KNEEL CAPABILITIES.

TS 31. Wheels and Tires

TS 31.1 Wheels

All wheels shall be interchangeable and shall be removable without a puller. Wheels shall be compatible with tires in size and load-carrying capacity. Front wheels and tires shall be balanced as an assembly per SAE J1986.Wheel and rims shall be hub-piloted, polished aluminum with Dura Bright or approved equal coating on both sides and shall resist rim flange wear. Wheel shall be compatible with tires in size and load carrying capacity.

TWO-SIDED POLISHED ALUMINUM RIMS.

TS31.2 Tires

Tires shall be suitable for the conditions of transit service and sustained operation at the maximum speed capability of the bus. Load on any tire at GVWR shall not exceed the tire Supplier's rating. The tires shall be provided under a lease agreement between WMATA and tire suppliers.

Use for low profile 305/70R 22.5 tires

The buses shall be equipped with low profile (305/70R 22.5) tires. Load range "L" as appropriate for the bus design.

TS 32. Steering

HYDRAULICALLY ASSISTED POWER STEERING SHALL BE PROVIDED. THE STEERING GEAR SHALL BE AN INTEGRAL TYPE WITH THE NUMBER AND LENGTH OF FLEXIBLE LINES MINIMIZED OR ELIMINATED. ENGINE DRIVEN HYDRAULIC PUMP SHALL BE PROVIDED FOR POWER STEERING. WITH THE BUS ON DRY, LEVEL, COMMERCIAL ASPHALT PAVEMENT, AND WITH TIRE INFLATED TO RECOMMENDED PRESSURE AND THE FRONT WHEELS POSITIONED STRAIGHT AHEAD, THE TORQUE REQUIRED TO TURN THE STEERING WHEEL 10 DEGREES SHALL BE NO LESS THAN 5 FOOT POUNDS AND NO MORE THAN 10 FOOT POUNDS. STEERING TORQUE MAY INCREASE TO 70 FOOT POUNDS WHEN THE WHEELS ARE APPROACHING TO STEERING STOPS, AS THE RELIEF VALVE ACTIVATES. STEERING EFFORT SHALL BE MEASURE WITH THE BUS AT GVWR, STOPPED WITH THE BRAKES RELEASED AND THE ENGINE AT NORMAL IDLING SPEED ON CLEAN, DRY, LEVEL, COMMERCIAL ASPHALT PAVEMENT AND THE TIRE INFLATED TO RECOMMENDED PRESSURE. POWER STEERING FAILURE SHALL NOT RESULT IN LOSS OF STEERING CONTROL. WITH THE BUS IN OPERATION THE STEERING EFFORT SHALL NOT EXCEED 55 POUNDS AT THE STEERING WHEEL RIM AND PERCEIVED FREE PLAY IN THE STEERING SYSTEM SHALL NOT MATERIALLY INCREASE AS A RESULT OF POWER ASSIST FAILURE. GEARING SHALL REQUIRE NO MORE THAN SEVEN TURNS OF THE STEERING WHEELS TO LOCK TO LOCK.

Caster angle shall be selected to provide a tendency for the return of the front wheels to the straight position with minimal assistance from the driver.
ELECTRICALLY ASSISTED STEERING SYSTEM

TS 32.1 Steering Axle

SOLID BEAM AXLE AND GREASE-TYPE FRONT BEARINGS AND SEALS

The front axle shall be solid beam, non-driving with a load rating sufficient for the bus loaded to GVWR and shall be equipped with grease type front wheel bearings and seals.

All friction points on the front axle shall be equipped with replaceable bushings or inserts and, if needed, lubrication fittings easily accessible from a pit or hoist.

The steering geometry of the outside (front lock) wheel shall be within 2 degrees of true Ackerman up to 50 percent lock measured at the inside (back lock) wheel. The steering geometry shall be within 3 degrees of true Ackerman for the remaining 100 percent lock measured at the inside (back lock) wheel.

TS 32.2. Steering Wheel

TS 32.2.1 Turning Effort

Steering effort shall be measured with the bus at GVWR, stopped with the brakes released and the engine at normal idling speed on clean, dry, level, commercial asphalt pavement and the tires inflated to recommended pressure.

Under these conditions, the torque required turning the steering wheel 10 degrees shall be no less than 5 ft-lbs and no more than 10 ft-lbs. steering torque may increase to 70 ft-lbs when the wheels are approaching the steering stops, as the relief valve activates.

Power steering failure shall not result in loss of steering control. With the bus in operation, the steering effort shall not exceed 55 lbs at the steering wheel rim, and perceived free play in the steering system shall not materially increase as a result of power assist failure. Gearing shall require no more than seven turns of the steering wheel lock-to-lock.

Caster angle shall be selected to provide a tendency for the return of the front wheels to the straight position with minimal assistance from the driver.

TS 32.2.2 Steering Wheel, General

The steering wheel diameter shall be approximately 20 inches. The rim diameter shall be ⅞ in. to 1¼ in. and shaped for firm grip with comfort for long periods of time. The Steering Wheel shall be WMATA approved Butyrate type.

Steering wheel shall be 3 spokes and wheel thickness shall ensure visibility of the dashboard so that vital instrumentation is clearly visible at center neutral position (within the range of a 95th-percentile male, as described in SAE 1050a, Sections 4.2.2 and 4.2.3). Placement of steering column must be as far forward as possible, but either in line with or behind the instrument cluster.

TS 32.2.3 Steering Column Tilt

The steering column shall have full tilt capability with an adjustment range of no less than 40 degrees from the vertical and easily adjustable by the driver.

TS 32.2.4 Steering Wheel Telescopic Adjustment

The steering wheel shall have full telescoping capability and have a maximum height of 5 in. and a minimum low-end adjustment of 29 in., measured from the top of the steering wheel rim in the horizontal position to the cab floor at the heel point.

Column1	Thigh Clearance	Resting Elbow Height
5 Percentile Female	**19.1"**	**22.1"**
95 Percentile Male	**25.6"**	**30.4"**

Steering Wheel Height (Measure from Bottom Portion Closest to Driver Relative to Angle of Slope)

At Minimum Telescopic Height Adjustment (29 in.)		At Maximum Telescopic Height Adjustment (5 in.)	
Angle of Slope	**Height**	**Angle of Slope**	**Height**
0 degrees	**29 in.**	0 degrees	**35 in.**
15 degrees	**26.2 in**.	15 degrees	**30.2 in.**
25 degrees	**24.6 in.**	25 degrees	**28.6 in.**
35 degrees	**22.5 in.**	35 degrees	**26.5 in.**

TS 33. Drive Axle

The bus shall be driven by a heavy-duty axle with a load rating sufficient for the bus loaded to GVWR. The drive axle shall have a design life to operate for not less than 300,000 miles on the design operating profile without replacement or major repairs. The lubricant drain plug shall be magnetic type. If a planetary gear design is employed, the oil level in the planetary gears shall be easily checked through the plug or sight gauge. The axle and driveshaft components shall be rated for both propulsion and retardation modes with respect to duty cycle.

NOTE: The retardation duty cycle can be more aggressive than propulsion.

The drive shaft shall be guarded to prevent hitting any critical systems, including brake lines, coach floor or the ground, in the event of a tube or universal joint failure.

TS 33.1 Non-Drive Axle (Articulated Bus)

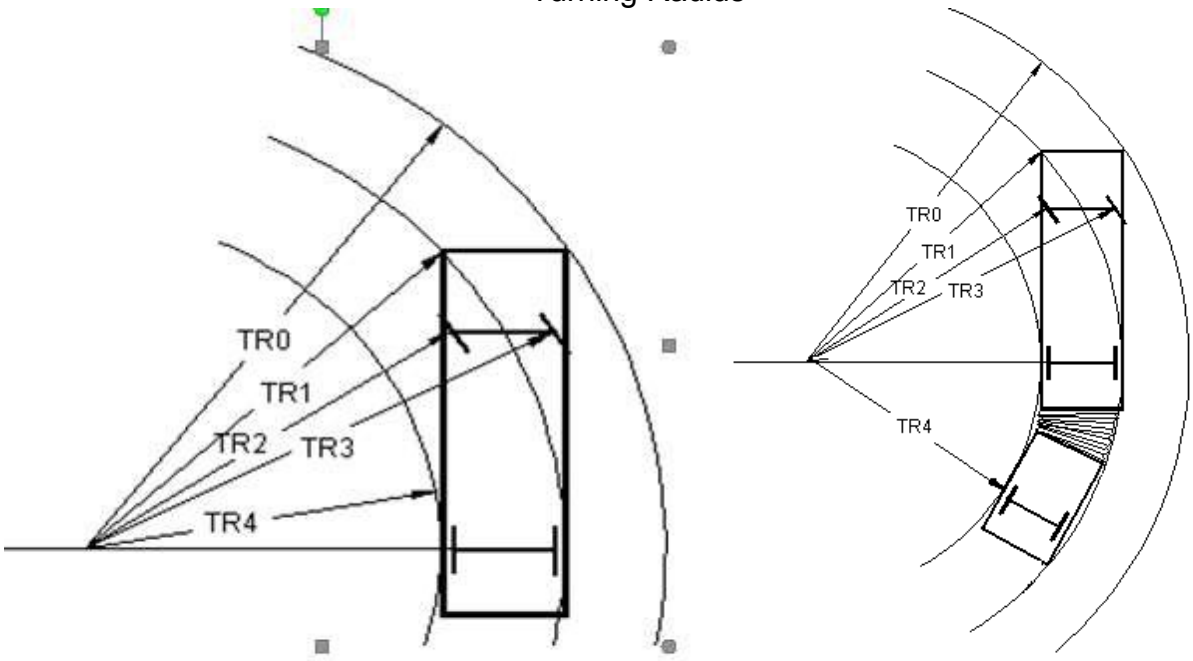
The non-drive axle is the drive axle without the drive gear with a load rating sufficient for the load to GVWR.

TS 34 Turning Radius

TABLE 4
Maximum Turning Radius

Bus Length (approximate)	Maximum Turning Radius (see Figure 4)	Authority Requirement
35 ft	39 ft (TR0)	
40 ft	44 ft (TR0)	
60 ft	43 ft (outside front axle, TR0) 17 ft (inside rearmost axle, TR4)	

FIGURE 4
Turning Radius



TS 35 Brakes

TS 35.1 Service Brake

The bus shall be equipped with disc brakes on all axles and a brake performance monitoring system featuring the E-stroke brake stroke monitor at each brake location. Brake chambers shall be warranted for a minimum of 3 years from the time the bus is placed into service. The brake system shall have provisions to monitor a “brake dragging” condition

Brakes shall be self-adjusting. Brake wear indicators (visible brake sensors) shall be provided.

VISIBLE STROKE INDICATORS MAY BE COMBINED WITH ELECTRONIC BRAKE MONITORING SYSTEM AND VEHICLE BRAKE WARNING SYSTEM TO NOTIFY DRIVER AND MAINTENANCE OF UNSAFE BRAKE CONDITIONS**.**

TS 35.2 Actuation

Air-Actuated Brakes
Service brakes shall be controlled and actuated by a compressed air system. Force to activate the brake pedal control shall be an essentially linear function of the bus deceleration rate and shall not exceed 70 lbs at a point 7 in. above the heel point of the pedal to achieve maximum braking. The heel point is the location of the driver's heel when his or her foot is rested flat on the pedal and the heel is touching the floor or heel pad of the pedal. The ECU for the ABS system shall be protected, yet in an accessible location to allow for ease of service.

TS 35.3 Anti-lock Braking (ABS) and Automatic Traction Control (ATC)

An electronically controlled Anti-Lock Braking System (ABS) shall be provided. The electronic control unit (ECU) for the ABS shall be in a protected yet accessible location to allow for ease of service.
Microprocessor controlled Automatic Traction Control (ATC) shall be provided.
ABS and ATC control and diagnostic functionality along with any other brake-related control and/or diagnostic functionality may be combined into a single Electronic Brake Controller (EBC) that is mounted in a protected yet accessible location allowing ease of service.

The operation of the retarder or regenerative braking (as applicable) shall in no way negatively affect the functionality or effectiveness of the ABS and/or ATC system, under any circumstances

Manufacturer shall demonstrate compliance by providing a copy of a thermodynamic brake balance test upon request.

Automatic Traction Control
Automatic traction control (ATC) shall be provided.

TS 35.5 Friction Materials

The entire service brake system, including friction material, shall have a minimum overhaul or replacement life of 60,000 miles on design operating profile. Brakes shall be self-adjusting throughout this period. Visible stroke indicators shall be provided to allow service personnel to easily identify when the brakes are not in correct adjustment. The brake linings shall be made of non-asbestos material. In order to aid maintenance personnel in determining extent of wear, a provision such as a scribe line or chamfer indicating the thickness at which replacement becomes necessary, shall be provided on each brake lining. Preference: An electronic brake stroke/wear indicating system shall be provided. This system shall broadcast

diagnostic and operating parameters through the J1939 communication data link to the vehicle automatic monitoring system. Critical brake stroke/wear conditions shall cause "Brake Alert" indicating light on dash to illuminate. Brake shoe surfaces shall be protected to prevent corrosion and subsequent damage to brake linings.
Contractor shall optimize braking system and related components, such as retarder/regenerative braking, to provide the maximum possible average brake life.

TS 35.6 Disk Brake System

Disc Brakes on All Axles
The bus shall be equipped with disc brakes on all axles, and the brake discs shall allow machining of each side of the disc to obtain smooth surfaces per manufacturer's specifications.

The brake system material and design shall be selected to absorb and dissipate heat quickly so that the heat generated during braking operation does not glaze brake linings.

TS 35.7 Parking/Emergency Brake

Air Brakes
The parking brake shall be a spring-operated system, actuated by a valve that exhausts compressed air to apply the brakes. The parking brake may be manually enabled when the air pressure is at the operating level per FMVSS 121. Parking brake knob must be aluminum (WMATA will provide a sample)

EMERGENCY BRAKE
An emergency brake release shall be provided to release the brakes in the event of automatic emergency brake application. The driver shall be able to manually depress and hold down the emergency brake release valve to release the brakes and maneuver the bus to safety. Once the driver releases the emergency brake release valve, the brakes shall engage to hold the bus in place.

TS 35.8 Bearing, Seals and Rotors

Replaceable wheel bearing seals shall run on replaceable wear surfaces or be of an integral wear surface sealed design. Wheel bearing and hub seals shall not leak or weep lubricant for 100,000 miles when run-ning on the design operating profile.

The brake system material and design shall be selected to absorb and dissipate heat quickly so the heat generated during braking operation does not glaze brake linings. The heat generated shall not increase the temperature of tire beads and wheel contact area to more than that allowed by the tire manufacturer.

TS 35.9 Instrumentation

Minimally indicator lights in direct line of sight of the driver, on the dashboard, shall include:

- Parking Brakes Applied (positive setting of the brakes indicated, not movement of the control)
- Service Brakes Applied (may be common with parking brake indicator)
- Brake Fault (over-stroke of any brake actuator or failure of any actuator to fully retract)

The following SAE J1939 CAN messages shall be supported:
- EBC1 (PGN 61441) “Brake Pedal Position” (SPN 521)

TS 36. Interlocks

TS 36.1Passenger Door Interlocks

To prevent opening rear passenger doors while the bus is in motion, a speed sensor shall be integrated with the door controls to prevent the rear doors from being enabled or opened unless the bus speed is less than 2 mph.

To preclude movement of the bus, an accelerator interlock shall lock the accelerator in the closed position, and a brake interlock shall engage the service brake system to stop movement of the bus when the driver’s door control is moved to a rear door enable or open position, or a rear door panel is opened more than 3 in. from the fully closed position (as measured at the leading edge of the door panel). The interlock engagement shall bring the bus to a smooth stop and shall be capable of holding a fully loaded bus on a 6 percent grade, with the engine at idle and the transmission in gear, until the interlocks are released. These interlock functions shall be active whenever the vehicle Master Run Switch is in any run position.

All door systems employing brake and accelerator interlocks shall be supplied with supporting failure mode effects analysis (FEMA) documentation, which demonstrates that failure modes are of a failsafe type, thereby never allowing the possibility of release of interlock while an interlocked door is in and unsecured condition, unless the door master switch has been actuated to intentionally release the interlocks.

NON-ADJUSTABLE BRAKE INTERLOCK REGULATOR.

REQUIRING ACCELERATOR INTERLOCK WHENEVER FRONT DOORS ARE OPEN

An accelerator interlock shall lock the accelerator in the closed position, and a brake interlock shall engage the service brake system to stop movement of the bus whenever front doors are open at 6% grade in any direction. (HILL HOLD FUNCTION)

TS 37. Pneumatic System

TS 37.1 General

The bus air system shall operate the air-powered accessories and the braking system with reserve capacity. New buses shall not leak down more than 5 psi over a 15-minute period of time as indicated on the dash gauge.

Provision shall be made to apply shop air to the bus air systems. A quick disconnect fitting (Female) shall be easily accessible and located in the engine compartment and near the front bumper area for towing. Air for the air compressor shall be filtered through the main engine air cleaner system. The air system shall be protected by a pressure relief valve set at 150 psi and shall be equipped with check valve. Retained caps shall be installed to protect fitting against dirt and moisture when not in use. Air for the compressor shall be filtered. The air system shall be protected per FMVSS 121.

TS 37.2 Air Compressor

THE ENGINE-DRIVEN AIR COMPRESSOR SHALL BE SIZED TO CHARGE THE AIR SYSTEM FROM 40 PSI TO THE GOVERNOR CUT-OFF PRESSURE IN LESS THAN 4 MINUTES WHILE NOT EXCEEDING THE FAST IDLE SPEED SETTING OF THE ENGINE.

TS 37.3 Air Lines and Fittings

Air lines, except necessary flexible lines, shall conform to the installation and material requirements of SAE Standard J1149 for copper tubing with standard, brass, flared or ball sleeve fittings, or SAE Standard J844 for nylon tubing if not subject to temperatures over 200^{o} F. The air on the delivery side of the compressor where it enters nylon housing shall not be above the maximum limits as stated in SAE J844. Nylon tubing shall be installed in accordance with the following color-coding standards:

- **Green:** Indicates primary brakes and supply.
- **Red:** Indicates secondary brakes.
- **Brown:** Indicates parking brake
- **Yellow:** Indicates compressor governor signal.
- **Black:** Indicates accessories.
- **Orange :** Fuel
- **Blue:** Suspension

Line supports shall prevent movement, flexing, tension, strain and vibration. Copper lines shall be supported to prevent the lines from touching one another or any component of the bus. To the extent practicable and before installation, the lines shall be pre-bent on a fixture that prevents tube flattening or excessive local strain. Copper lines shall be bent only once at any point, including pre-bending and installation. Rigid lines shall be supported at no more than 5-ft intervals. Nylon lines may be grouped and shall be supported at 24 in. intervals or less.

The compressor discharge line between power plant and body-mounted equipment shall be flexible convoluted copper or stainless steel line, or may be flexible Teflon hose with a braided stainless steel jacket. Other lines necessary to maintain system reliability shall be flexible Teflon hose with a braided stainless steel jacket. End fittings shall be standard SAE or JIC brass or steel, flanged, swivel-type fittings. Flexible hoses shall be as short as practicable and individually supported. They shall not touch one another or any part of the bus except for the supporting grommets. Flexible lines shall be supported at 2-ft intervals or less.

Air lines shall be clean before installation and shall be installed to minimize air leaks. All air lines shall be routed to prevent water traps to the extent possible. Grommets or insulated clamps shall protect the air lines at all points where they pass through understructure components.

TS 37.4 Air Reservoirs

All air reservoirs shall meet the requirements of FMVSS Standard 121 and SAE Standard J10 and shall be equipped with drain plugs and guarded or flush type drain valves. **Remote mounted drain valves are acceptable.** Major structural members shall protect these valves and any automatic moisture ejector valves from road hazards. Reservoirs shall be sloped toward the drain valve. All air reservoirs shall have drain valves that discharge below floor level with lines routed to eliminate the possibility of water traps and/or freezing in the drain line.

TS 37.5 Air System Dryer

An air dryer **(SKF or approved equal**) shall prevent accumulation of moisture and oil in the air system. The air dryer system shall include one or more replaceable desiccant cartridges, electrically heated drain, and activation device. A 2m/3M mechanic shall replace the desiccant in less than 15 minutes.

REQUIREMENT FOR ADDITIONAL OIL SEPARATOR PROVISION

A provision shall be included to collect/remove oil from the air system to prevent affecting function and/or damaging pneumatic system components.

THE AIR SYSTEM SHALL BE EQUIPPED WITH AN AIR DRYER LOCATED BEFORE THE NO. 1 AIR TANK AND AS FAR FROM THE COMPRESSOR AS POSSIBLE TO ALLOW AIR TO COOL PRIOR TO ENTERING THE AIR DRYER.

ELECTRICAL, ELECTRONIC AND DATA COMMUNICATION SYSTEMS

TS 38. Overview

The electrical system will consist of vehicle battery systems and components that generate distribute and store power throughout the vehicle. (e.g. generator, voltage regulator, wiring, relays, and connectors).

Electronic devices are individual systems and components that process and store data, integrate electronic information or perform other specific functions.

The data communication system consists of the bi-directional communications networks that electronic devices use to share data with other electronic devices and systems. Communication networks are essential to integrating electronic functions, both onboard the vehicle and off.

Information level systems that require vehicle information for their operations or provide information shall adhere to J1939 data standard, as required by specific application(s).Details to be finalized during pre-production meeting.

Data communications systems are divided into three levels to reflect the use of multiple data networks:

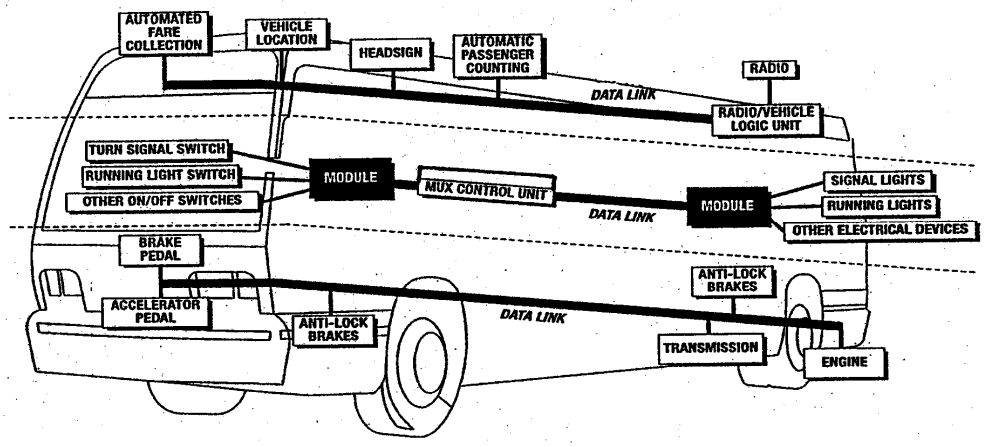
- **Drivetrain level:** Components related to the drive train including the propulsion system components (engine, transmission, hybrid units and CNG system), and anti-lock braking system (ABS), which may include traction control.
- **Information level:** Components whose primary function is the collection, control or display of data that is not necessary to the safe drivability of the vehicle (i.e., the vehicle will continue to operate when those functions are inoperable). These components typically consist of those required for automatic vehicle location (AVL) systems, destination signs, fare boxes, passenger counters, radio systems, automated voice and signage systems, video surveillance and similar components.
- **Multiplex level:** Electrical or electronic devices controlled through input/output signals such as discrete, analog and serial data information (i.e., on/off switch inputs, relay or relay control outputs). Multiplexing is used to control components not typically found on the drive train or information levels, such as lights; wheelchair lifts; doors; heating, ventilation and air conditioning (HVAC) systems; and gateway devices.

FIGURE 5
Data Communications Systems Levels

Information level

Multiplex level

Drivetrain level



TS 38.1 Modular Design

Design of the electrical, electronic and data communication systems shall be modular so that each electronic device, apparatus panel, or wiring bundle is easily separable from its interconnect by means of connectors.

Each module, except the main body wiring harness, shall be removable and replaceable in less than 1 hour by a 3 M mechanic. Power plant wiring shall be an independent wiring harness. Replacement of the engine compartment wiring harness (es) shall not require pulling wires through any bulkhead or removing any terminals from the wires.

TS 39. Environmental and Mounting Requirements

The electrical system and its electronic components shall be capable of operating in the area of the vehicle in which they will be installed, as recommended in SAE J1455. All interior electrical components shall be protected by a shield or gutter. WMATA shall approve the design.

Electrical and electronic equipment shall not be located in an environment that will reduce the performance or shorten the life of the component or electrical system when operating within the design operating profile. As a recommendation, no vehicle component shall generate, or be affected by, electromagnetic interference or radio frequency interference (EMI/RFI) that can disturb the performance of electrical/electronic equipment as defined in SAE J1113 and UNECE Council Directive 95/54 (R 10).

WMATA shall follow recommendations from bus manufacturers and subsystem Suppliers regarding methods to prevent damage from voltage spikes generated from welding, jump starts, shorts, etc.

TS 39.1 Hardware Mounting

The mounting of the hardware shall not be used to provide the sole source ground, and all hardware shall be isolated from potential EMI/RFI, as referenced in SAE J1113.

All electrical/electronic hardware mounted in the interior of the vehicle shall be inaccessible to passengers and hidden from view unless intended to be viewed. The hardware shall be mounted in such a manner as to protect it from splash or spray.

All electrical/electronic hardware mounted on the exterior of the vehicle that is not designed to be installed in an exposed environment shall be mounted in a sealed enclosure.

All electrical/electronic hardware and its mounting shall comply with the shock and vibration requirements of SAE J1455.

TS 40. General Electrical Requirements

Batteries

a. Battery shall be Absorbed Glass Mat (AGM) configuration, non-spillable and non-hazardous as defined by US DOT and IATA (International Air Transport Association).
b. Battery lead grids and oxide lead should be pure-lead of 99.99% minimum purity, no alloys to achieve long service
c. Battery must be "Dual-Purpose" rated as both a cranking rating and with deep-cycle capability rated at 400 cycles to 80% depth of discharge.
d. Battery must have a cranking rating of 1,150 CCA.
e. Battery shall have a Reserve Capacity of at least 205 minutes.
f. Battery must have an operational temperature range of -40^0 C to +80^0 C.
g. Battery shall not exceed dimensions 13.00"L x 6.80"W x 9.50"H to the top of the stud terminals.
h. Battery terminal studs must be 3/8" stainless steel with tin-plated brass base terminal that is a minimum of .165" above the top cover to allow for the cable terminal rubber boot. Terminals are **Left positive, right negative** with each located approximately 3.03" from the battery front edge and 1.46" from the side edge.
i. Battery must have molded in positive and negative polarity symbols in the top cover with black indicator ring for negative terminal and red indicator ring for positive terminal.
j. Battery must have a smooth, flat clearance area for landing of cables or lugs. No raised cover plastic should interfere with cable connections.
k. Battery must have a centrally located "suitcase" lifting handle that lays flush with the battery top in the folded down position.

TS 40.1 Low-Voltage Batteries (24V)

Four Group 31 Maintenance-Free (AGM) Batteries
Four Group 31 Series deep cycling maintenance-free battery units shall be provided. Each battery shall have a purchase date no more than 120 days from the date of release for shipment to WMATA. The battery compartment must be well-ventilated to prevent hydrogen buildup while protecting the compartment from road spray, water intrusion and de-icing chemicals.

SAME SIZE TERMINAL ENDS
Positive and negative terminal ends shall be the same size.

TS 40.1.2 Battery Cables

The battery terminal ends and cables shall be color-coded with red for the primary positive, black for negative and another color for any intermediate voltage cables. Positive and negative battery cables shall not cross each other if at all possible, be flexible and sufficiently long to reach the batteries with the tray in the extended position without stretching or pulling on any connection and shall not lie directly on top of the batteries. Except as interrupted by the master battery switch, battery and starter wiring shall be continuous cables with connections secured by bolted terminals and shall conform to specification requirements of SAE Standard J1127 – Type SGT, SGX or GXL and SAE Recommended Practice J541.

2100 strand 4/0 cable or greater recommended.

Colors coded each voltage. RED (24V), Blue (12V) and Black (Chassis Ground)

TS 40.1.3 Jump Start

JUMP-START CONNECTOR A single connector, red in color, 350amp rated current capacity, compatible with Anderson Power Products Model # 6322G1. Provides direct connection to all batteries a series/parallel arrangement for 24 volt boosting of primary power. Conveniently accessible adjacent to battery master disconnect switch without opening large access panel.

TS 40.1.4 Battery Compartment

The battery compartment shall prevent accumulation of snow, ice and debris on top of the batteries and shall be vented and self-draining. It shall be accessible only from the outside of the vehicle. All components within the battery compartment, and the compartment itself, shall be protected from damage or corrosion from the electrolyte. The inside surface of the battery compartment's access door shall be electrically insulated, as required, to prevent the battery terminals from shorting on the door if the door is damaged in an accident or if a battery comes loose.

The battery compartment of enclosure shall be vented and self-draining. It shall be accessible only from outside the bus. All components within the battery compartment itself shall be protected from damage or corrosion from the electrolyte and gases emitted by the battery, and from snow, slush, salt, spray, mud, etc., generated from environmental conditions outside the vehicle. The Battery compartment location shall not expose the the batteries to temperatures exceeding the battery manufacturer's specifications under any operating conditions. The inside surface of the battery compartment's access door shall be electrically insulated, as required, to prevent the battery terminals from shorting on the door if the door is damaged in an accident or if a battery comes loose. The Master Disconnect Switch accessibility requirements are define section TS 40.1.6.

The Low voltage or auxiliary battery compartment shall be constructed of 304 stainless. The battery shall be vented and self-drained, and prevent accumulation of debris on the top of the batteries. It shall be accessible only from outside of the bus. All components within the battery compartment, and the compartment itself, shall be protected from damage or corrosion from the electrolyte. The inside surface of the battery compartment's access door shall be electrically insulated. Battery terminals shall under no circumstances be able to come into contact with the storage box lid. Batteries shall be properly secured to withstand road vibration and designed to ensure that their terminals do not come in contact with any part of the bus body or storage box and are not ejected or leak, even under severe crash conditions. Batteries shall be mounted in trays that are contracted of 304 stainless to resist corrosion and shall easily slide out of the body for service or replacement. Contractor shall submit plans to WMATA for review and approval of the battery storage system. Low voltage systems should be independent of high voltage systems, so that emergency lighting, cameras, and all other accessories remain operable in the event of a high voltage system failure. If the low voltage battery is removed from the bus, all high voltage system should be isolated within the battery boxes, regardless of the position of the master switch.

The battery quick disconnect access door shall be identified with a decal. The decal size shall not be less than 3.5 × 5 in. (8.89 × 12.7 cm).

The battery hold-down bracket shall be constructed of a non-metallic material (plastic or fiberglass).

This access door shall require a 5/16" square Key quarter turn lock to gain access to the switch. The door shall be flush-fitting and incorporate a spring tensioner or equal to retain the door in a closed position when not in use.

The batteries shall be securely mounted on a stainless steel or equivalent tray that can accommodate the size and weight of the batteries. The battery tray shall pull out easily and properly support the batteries while they are being serviced. The tray shall allow each individual battery to be easily serviced and replaced. A locking device shall retain the battery tray to the stowed position.

If not located in the engine compartment, the same fire-resistant properties must apply to the battery compartment. No sparking devices should be located within the battery box.

The batteries shall be located curb side. Street side will not be permitted.

No exposed wiring shall be allowed on the batteries and battery compartment.

TS 40.1.5 Auxiliary Electronic Power Supply

If required, gel-pack, or any form of sealed (non-venting) batteries used for auxiliary power are allowed to be mounted on the interior of the vehicle if they are contained in an enclosed, non-airtight compartment and accessible only to maintenance personnel. This compartment

shall contain a warning label prohibiting the use of lead-acid batteries. Batteries may not be mounted above the floor level

An Uninterruptable Power Supply [UPS] shall be provided. The system shall support 12 and 24 volt loads simultaneously, sized accordingly to support key-off power requirements of WMATA specified ancillary equipment, with a minimum total capacity of 100AH. System shall support automatic and instantaneous transfer and isolation of connected loads from vehicle batteries and alternator to UPS device. System shall automatically recharge during vehicle operation. State of health information shall be available to specified AVM system via J1939 network**.**

TS 40.1.6 Master Battery Switch

A single master switch shall be provided near the battery compartment for the disconnecting of all battery positives (12V and 24V), except for safety devices such as the fire suppression system and other system as specified. The location of the master battery switch shall be clearly identified on the exterior access door with 5/16" square key quarter turn latch, and shall be permanently marked so as to be easily understood by an individual unfamiliar with the vehicles. The master disconnect switch shall be accessible in less than 10 seconds for de-activation. The master disconnect switch shall be constructed so as to be unaffected by fumes and battery acid present in the battery compartment and include provisions for physical lock-out/tag-out.

The master switch shall be capable of carrying and interrupting the total circuit load.

SINGLE SWITCH

The batteries shall be equipped with a single switch for disconnecting both 12V and 24V power.

TS 40.1.7 Power Generation and Distribution

The power generating system shall maintain the charge on fully charged batteries, except when the vehicle is at standard idle with a total low voltage generator load exceeding 70 percent of the low voltage generator nameplate rating. Use fast idle shall maintain a charge on fully charged batteries so long as the total alternator load does not exceed 90 percent of the alternator nameplate rating.

Note: These percentages will typically allow operation of the HVAC, lights, wipers and some selected additional systems at fast idle.

The vehicle manufacturer shall provide to WMATA both at time of bid and actual production, an analysis of the estimated electrical load for each system.

REPRESENTATIVE EXAMPLES OF STATIC ELECTRICAL LOADS

(With batteries fully charged)

Footnote	Components	24V Load Amp	12V Load Amp
1	Interior Lights (All)	22.8	8.5
1	Intercom (inside & Outside)	8.5	6.6
1	Turn Signal(right)	10.6	10.4
1	All Hazard Flashers	12.7	12.9
2	Radio, Fare box, Destination Signs, Cameras and step well lights	26.1	11.8
3	HVAC and all applicable devices	150.0	N/A

1- Engine off And Master Run Switch in the “Run” position

2- Engine off and Master Run Switch in the “Nite Run” position

3- Engine running and Master Run Switch in the “Run” or Nite Run” position

Voltage monitoring and over-voltage output protection (recommended at 32V) shall be provided.

Dedicated power and ground shall be provided as specified by the component or system manufacturer. Cabling to the equipment must be sized to supply the current requirements with no greater than a 5 percent volt drop across the length of the cable.

TS 40.1.8 Circuit Protection

All branch circuits, except battery-to-starting motor and battery-to-generator/alternator circuits, shall be protected by current-limiting devices such as circuit breakers, fuses or solid state devices sized to the requirements of the circuit. Electronic circuit protection for the cranking motor shall be provided. Starter engagement shall be limited to 10 seconds maximum with cool down delay imposed. The circuit breakers or fuses shall be easily accessible for authorized personnel. Fuses shall be used only where it can be demonstrated that circuit breakers are not practicable. This requirement applies to in-line fuses supplied by either the Contractor or a Supplier. Fuse holders shall be constructed to be rugged and waterproof. All manual reset circuit breakers critical to the operation of the bus shall be mounted in a location convenient to the Authority mechanic with visible indication of open circuits. The Authority shall consider the application of automatic reset circuit breakers on a case-by-case basis. The Contractor shall show all in-line fuses in the final harness drawings. Any manually resettable circuit breakers shall provide a visible indication of open circuits. Any manually resettable circuit breakers shall provide a visible indication of open circuits.

Circuit breakers or fuses shall be sized to a minimum of 15 percent larger than the total circuit load. The current rating for the wire used for each circuit must exceed the size of the circuit protection being used.

TS 40.2 Grounds

The battery shall be grounded to the vehicle chassis/frame at one location only, as close to the batteries as possible. When using a chassis ground system, the chassis shall be grounded to the frame in multiple locations, evenly distributed throughout the vehicle to eliminate ground loops. No more than four ground ring/spade terminal connections shall be made per ground stud. Electronic equipment requiring an isolated ground to the battery (i.e., electronic ground, as determined by WMATA), shall not be grounded through the chassis.

TS 40.3 Low Voltage/Low Current Wiring and Terminals

All power and ground wiring shall conform to specification requirements of SAE Recommended Practice J1127, J1128 and J1292. Double insulation shall be maintained as close to the junction box, electrical compartment or terminals as possible. The requirement for double insulation shall be met by wrapping the harness with plastic electrical tape or by sheathing all wires and harnesses with non-conductive, rigid or flexible conduit.

Wiring shall be grouped, numbered and/or color-coded. Wiring harnesses shall not contain wires of different voltage classes unless all wires within the harness are insulated for the highest voltage present in the harness. Kinking, grounding at multiple points, stretching, and exceeding minimum bend radius shall be prevented.

Strain-relief fittings shall be provided at all points where wiring enters electrical compartments. Grommets or other protective material shall be installed at points where wiring penetrates metal structures outside of electrical enclosures. Wiring supports shall be protective and non-conductive at areas of wire contact and shall not be damaged by heat, water, solvents or chafing.

To the extent practicable, wiring shall not be located in environmentally exposed locations under the vehicle. Wiring and electrical equipment necessarily located under the vehicle shall be insulated from water, heat, corrosion and mechanical damage. Where feasible, front to rear electrical harnesses should be installed above the window line of the vehicle.

All wiring harnesses over 5 ft long and containing at least five wires shall include 10 percent (minimum one wire) excess wires for spares. This requirement for spare wires does not apply to data links and communication cables. Wiring harness length shall allow end terminals to be replaced twice without pulling, stretching or replacing the wire. Terminals shall be crimped to the wiring according to the connector manufacturer's recommendations for techniques and tools. All cable connectors shall be locking type, keyed and sealed, unless enclosed in watertight cabinets or vehicle interior. Pins shall be removable, crimp contact type, of the correct size and rating for the wire being terminated. Unused pin positions shall be sealed with sealing plugs. Adjacent connectors shall either use different inserts or different insert orientations to prevent incorrect connections. Battery cable connectors shall be crimped and soldered.

Terminals shall be crimped, corrosion-resistant and full ring type or interlocking lugs with insulating ferrules. When using pressure type screw terminal strips, only stranded wire shall be used. Insulation clearance shall ensure that wires have a minimum of "visible clearance" and a maximum of two times the conductor diameter or 1/16 in., whichever is less. When using shielded or coaxial cable, upon stripping of the insulation, the metallic braid shall be free from frayed strands that can penetrate the insulation of the inner wires.

Where ultrasonic splicing is used, the splice shall be covered in mastic-lined heat shrink tubing and T-splices may be used with 7 AWG or smaller wire. When a T-splice is used, it shall meet these additional requirements:

- It shall include a mechanical clamp in addition to solder on the splice.
- The wire shall support no mechanical load in the area of the splice.
- The wire shall be supported to prevent flexing.

All splicing shall be staggered in the harness so that no two splices are positioned in the same location within the harness.

Wiring located in the engine compartment shall be routed away from high-heat sources or shielded and/or insulated from temperatures exceeding the wiring and connector operating requirements.

The instrument panel and wiring shall be easily accessible for service from the driver's seat or top of the panel. The instrument panel shall be separately removable and replaceable without damaging the instrument panel or gauges. Wiring shall have sufficient length and be routed to permit service without stretching or chafing the wires.

TS 40.4 Electrical Components

All electrical components, including switches, relays, flashers and circuit breakers, shall be heavy-duty designs with either a successful history of application in heavy-duty vehicles or design specifications for an equivalent environment.

All electric motors shall be heavy-duty brushless type where practical, and have a continuous duty rating of no less than 40,000 hours (except cranking motors, washer pumps and wiper motors). All electric motors shall be easily accessible for servicing.

TS 40.5 Electrical Compartments

All relays, controllers, flashers, circuit breakers and other electrical components shall be mounted in easily accessible electrical compartments. All compartments exposed to the outside environment shall be corrosion-resistant and sealed. The components and their functions in each electrical compartment shall be identified and their location permanently recorded on a drawing attached to the inside of the access panel or door. The drawing shall be protected from oil, grease, fuel and abrasion.

The front compartment shall be completely serviceable from the driver's seat, vestibule or from the outside. "Rear start and run" controls shall be mounted in an accessible location in the engine compartment and shall be protected from the environment.

TS 41. General Electronic Requirements

If an electronic component has an internal real-time clock, it shall provide its own battery backup to monitor time when battery power is disconnected, and/or it may be updated by a network component. If an electronic component has an hour meter, it shall record accumulated service time without relying on battery backup.

All electronic component Suppliers shall ensure that their equipment is self-protecting in the event of shorts in the cabling, and also in over-voltage (over 32V DC on a 24V DC nominal voltage rating with a maximum of 50V DC) and reverse polarity conditions. If an electronic component is required to interface with other components, it shall not require external pull-up and/or pull-down resistors. Where this is not possible, the use of a pull-up or pull-down resistor shall be limited as much as possible and easily accessible and labeled.

TS 41.1 Wiring and Terminals

Kinking, grounding at multiple points, stretching and reducing the bend radius below the manufacturer's recommended minimum shall not be permitted.

TS 41.1.1 Discrete I/O (Inputs/Outputs)

All wiring to I/O devices, either at the harness level or individual wires, shall be labeled, stamped or color-coded in a fashion that allows unique identification at a spacing not exceeding 4 in. Wiring for each I/O device shall be bundled together. If the I/O terminals are the same voltages, then jumpers may be used to connect the common nodes of each I/O terminal.

TS 41.1.2 Shielding

All wiring that requires shielding shall meet the following minimum requirements. A shield shall be generated by connecting to a ground, which is sourced from a power distribution bus bar or chassis. A shield shall be connected at one location only, typically at one end of the cable. However certain standards or special requirements, such as SAE J1939 or RF applications, have separate shielding techniques that also shall be used as applicable.

NOTE: A shield grounded at both end forms a ground loop, which can cause intermittent control or faults.

When using shielded or coaxial cable, upon stripping of the insulation, the metallic braid shall be free from frayed strands, which can penetrate the insulation of the inner wires. To prevent the introduction of noise, the shield shall not be connected to the common side of a logic circuit.

TS 41.1.3 Communications

Cabling used for data transmission shall be jacketed in color coded material, specific to the data network connected. Each network shall be identified with a unique color, approved by WMATA. Marking should be continuous where possible; permanent color markers installed at a minimum of every four inches will be considered.
Communications networks that use power line carriers (e.g., data modulated on a 24V-power line) shall meet the most stringent applicable wiring and terminal specifications.

TS 41.1.4 Radio Frequency (RF)

RF components, such as radios, video devices, cameras, global positioning systems (GPS), etc., shall use coaxial cable to carry the signal. All RF systems require special design consideration for losses along the cable. Connectors shall be minimized, since each connector and crimp has a loss that will attribute to attenuation of the signal. Cabling should allow for the removal of antennas or attached electronics without removing the installed cable between them. If this cannot be done, then a conduit of sufficient size shall be provided for ease of attachment of antenna and cable assembly. The corresponding component vendors shall be consulted for proper application of equipment, including installation of cables.

TS 41.1.5 Audio

Cabling used for microphone level and line level signals shall be 22 AWG minimum with shielded twisted pair. Cabling used for amplifier level signals shall be 18 AWG minimum.

TS 42.Multiplexing

TS 42.1General

The primary purpose of the multiplexing system is control of components necessary to operate the vehicle. This is accomplished by processing information from input devices and controlling output devices through the use of an internal logic program.

Versatility and future expansion shall be provided for by expandable system architecture. The multiplex system shall be capable of accepting new inputs and outputs through the addition of new modules and/or the utilization of existing spare inputs and outputs. All like components in the multiplex system shall be modular and interchangeable with self-diagnostic capabilities. The modules shall be easily accessible for troubleshooting electrical failures and performing system maintenance. Multiplex input/output modules shall use solid-state devices to provide extended service life and individual circuit protection.

Ten percent of the total number of inputs and outputs, or at least one each for each voltage type utilized (0V, 12V, 24V), per module installed (Not per location) shall be designated as spares. Zone locations are: (1) behind the rear bulkhead; (2) forward of the bulkhead above the window line; and (3) forward of the bulkhead below the window line.

TS 42.2 System Configurations

Multiplexing may either be distributed or centralized. A distributed system shall process information on multiple control modules within the network. A centralized system shall process the information on a single control module. Either system shall consist of several modules connected to form a control network.

TS 42.2.1 I/O Signals

The input/output for the multiplex system may contain three types of electrical signals: discrete, analog or serial data.

Discrete signals shall reflect the on/off status of switches, levers, limit switches, lights, etc. Analog signals shall reflect numerical data as represented by a voltage signal (0-12V, 10-24V, etc.) or current signal (4-20 mA). Both types of analog signals shall represent the status of variable devices such as rheostats, potentiometers, temperature probes, etc. Serial data signals shall reflect ASCII or alphanumeric data used in the communication between other on-board components.

TS 42.2.2 Prewired Multiplex Provisions

Multiplex input and output spares, as defined in TS 42.1 to support future expansion shall be pre-wired and capped in the following distributions. Each identified provision shall be provided as an individually harnessed wiring branch consisting of (1) multiplex output, (1) Multiplex input, and (1) chassis ground. All wires shall be 16AWG, follow manufacturer's standards for wire color and indelible marking, be environmentally sealed against corrosion or decay, and secured in a readily visible and retrievable manner in the locations specified. These required provisions, though connected to active multiplex system components, shall be undefined and electrically inactive (no detectable current present on output wires and no effect on logical output decisions). These provisions shall be made independently and calculated separately from the spare wire requirements listed in TS 40.3.

Location and configuration of required provisions:

Location	Number of Provisions	Required Voltage / Current	Notes
Engine Compartment @ Rear Switch Panel area	2	One 24 volt 6A capable output One 12 volt 10A capable output Two active low (sink) inputs Two chassis grounds.	Multiplex outputs with assignable voltage may be provided in lieu of specific required voltages, as long as current requirements are met.
Rear interior electrical panel	2		
Equipment Closet	2		
Front Destination Sign Cabinet (or equivalent forward upper panel)	2		
Front Door Cabinet	1	One 24 volt 6A capable output One active low (sink) input One chassis ground	
Rear Door Cabinet	1		

TS 43. Data Communications

TS 43.1 General

All data communication networks shall be either in accordance with a nationally recognized interface standard, such as those published by SAE, IEEE or ISO, or shall be published to the Authority with the following minimum information:

- Protocol requirements for all timing issues (bit, byte, packet, inter-packet timing, idle line timing, etc.) packet sizes, error checking and transport (bulk transfer of data to/from the device).
- Data definition requirements that ensure access to diagnostic information and performance characteristics.
- The capability and procedures for uploading new application or configuration data.
- Access to revision levels of data, application software and firmware.
- The capability and procedures for uploading new firmware or application software.
- Evidence that applicable data shall be broadcast to the network in an efficient manner such that the overall network integrity is not compromised.

Any electronic vehicle components must conform to requirements of TS 41.1.3

TS 43.2 Drivetrain Level

Drivetrain components, consisting of the engine, transmission, retarder, anti-lock braking system and all other related components, shall be integrated and communicate fully with respect to vehicle operation with data using SAE Recommended Communications Protocols such as J1939 and/or J1708/J1587 with forward and backward compatibilities or other open protocols.

TS 43.2.1 Diagnostics, Fault Detection and Data Access

Drivetrain performance, maintenance and diagnostic data, and other electronic messages shall be formatted and transmitted on the communications networks.

The drivetrain level shall have the ability to record abnormal events in memory and provide diagnostic codes and other information to service personnel. At a minimum, this network level shall provide live/fail status, current hardware serial number, software/data revisions and uninterrupted timing functions.

TS 43.2.2 Programmability (Software)

The drivetrain level components shall be programmable by the Authority with limitations as specified by the sub-system Supplier.

TS 43.3 Multiplex Level

TS 43.3.1 Data Access

At a minimum, information shall be made available via a communication port on the multiplex system. The location of the communication port shall be easily accessible. A hardware gateway and/or wireless communications system are options if requested by the Authority. The communication port(s) shall be located as specified by the Authority.

TS 43.3.2 Diagnostics and Fault Detection

The multiplex system shall have a proven method of determining its status (system health and input/output status) and detecting either active (online) or inactive (offline) faults through the use of on-board visual/audible indicators.

In addition to the indicators, the system shall employ an advanced diagnostic and fault detection system, which shall be accessible via either a personal computer or a handheld unit. Either unit shall have the ability to check logic function. The diagnostic data can be incorporated into the information level network or the central data access system.

PROVIDE MOCK-UP BOARD

A mock-up board, where key components of the multiplexing system are replicated on a functional model, shall be provided as a tool for diagnostic, design verification and training purposes. If required, the mock-up board should price separately in the Pricing Schedule.

TS 43.3.3 Programmability (Software)

The Manufacturer, or his agent, shall provide software tools with appropriately licensed functional authority to create, generate, edit, modify, and compile ladder logic programming of the multiplexed vehicle electrical system, to enable WMATA to facilitate the modification of vehicle electrical function(s) without requiring the assistance of the Manufacturer or his agent. This licensing, if required, shall be limited to a single Seat/User, and renewed, as

required, for the design life of the vehicle. **No modifications shall be made by WMATA during the warranty period applicable to the 'Complete Bus'.**

The multiplex system shall have security provisions to protect its software from unwanted changes. This shall be achieved through any or all of the following procedures:

- password protection
- limited distribution of the configuration software
- limited access to the programming tools required to change the software
- hardware protection that prevents undesired changes to the software

Provisions for programming the multiplex system shall be possible through a PC or laptop. The multiplex system shall have proper revision control to ensure that the hardware and software are identical on each vehicle equipped with the system. Revision control shall be provided by all of the following:

- hardware component identification where labels are included on all multiplex hardware to identify components
- hardware series identification where all multiplex hardware displays the current hardware serial number and firmware revision employed by the module
- software revision identification where all copies of the software in service displays the most recent revision number
- a method of determining which version of the software is currently in use in the multiplex system

REVISION CONTROL LABELS SHALL BE ELECTRONIC.

PRINTED REVISION CONTROL LABELS SHALL ALSO BE PHYSICALLY LOCATED NEAR THE PROGRAMMING PORT.

TS 43.4 Electronic Noise Control

Electrical and electronic sub-systems and components on all buses shall not emit electromagnetic radiation that will interfere with on-board systems, components or equipment, telephone service, radio or TV reception or violate regulations of the Federal Communications Commission.

Electrical and electronic sub-systems on the coaches shall not be affected by external sources of RFI/EMI. This includes, but is not limited to, radio and TV transmission, portable electronic devices including computers in the vicinity of or onboard the buses, ac or dc power lines and RFI/EMI emissions from other vehicles.

DRIVER PROVISIONS, CONTROLS AND INSTRUMENTATION

TS 44. Driver's Area Controls

TS 44.1 General

In general when designing the driver's area, it is recommended that SAE J833, "Human Physical Dimensions," be used.

Switches and controls shall be divided into basic groups and assigned to specific areas, in conformance with SAE Recommended Practice J680, Revised 1988, "Location and Operation of Instruments and Controls in Motor Truck Cabs," and be essentially within the hand reach envelope described in SAE Recommended Practice J287, "Driver Hand Control Reach."

TS 44.2 Glare

The driver's work area shall be designed to minimize glare to the extent possible. Objects within and adjacent to this area shall be matte black or dark gray in color wherever possible to reduce the reflection of light onto the windshield. The use of polished metal and light-colored surfaces within and adjacent to the driver's area shall be avoided. Such object include dash panels, switches and controls, cowlings, windshield wipers and arms, barriers and modesty panels fare box hand rails, access panels and doors, fasteners, flooring ventilation and heating ducting, window and door framed and visors. Interior lighting located ahead of the standee line shall be controlled by the operator. Contractor shall provide details of their proposed standard operator area layout specifying their satisfaction of FMVSS and industry ergonomic requirements and standards.

TS 44.3 Visors/Sun Shades

FRONT AND SIDE SUN SHADE/VISOR

Adjustable sun visor(s) shall be provided for the driver's windshield and the driver's side window. Visors shall be shaped to minimize light leakage between the visor and windshield pillars. Visors shall store out of the way and shall not obstruct airflow from the climate control system or interfere with other equipment, such as the radio handset or the destination control. Deployment of the visors shall not restrict vision of the rearview mirrors. Visor adjustments shall be made easily by hand with positive locking and releasing devices and shall not be subject to damage by over-tightening. Sun visor construction and materials shall be strong enough to resist breakage during adjustments. Visors must be padded and shall not allow a visible light transmittance in excess of 10 percent. Visors, when deployed, shall be effective in the driver's field of view at angles more than 5 degrees above the horizontal**. If a Sun Shade is provided, it must have guide rods at the sides to avoid any movement**. Front shade or visor shall not block view of any driver monitoring device installed In a WMATA preferred location.

Driver's Window Sunscreens
An adjustable roller type sunscreen shall be provided over the driver's windshield and/or the driver's side window.**(WMATA to choose one or both)** The sunscreen shall be capable of being lowered to the midpoint of the driver's window. When deployed, the screen shall be secure, stable and shall not rattle, sway or intrude into the driver's field of view due to the motion of the coach or as a result of air movement. **Sun shade must have guide rods at the sides to avoid any back and forth movement.** Once lowered, the screen shall remain in the lowered position until returned to the stowed position by the driver. Sunscreen shall be shaped to minimize light leakage between the sunscreen or visor and windshield pillars to the extent possible. **WMATA shall approve the Sun Screen installation.**

TS 44.4 Driver's Controls

All frequently used controls must be in easily accessible locations for the safe operation of the bus shall be conveniently located. These include the door control, kneeling control, windshield wiper/washer controls, ramp control switches. They shall be identifiable by shape, touch and permanent markings. Controls also shall be located so that passengers may not easily tamper with control settings.

All switches and controls necessary for the safe operation of the bus shall be conveniently located in the operator's area and shall provide for ease of operation. Switches and controls shall be divided into basic groups and assigned to specific areas, in conformance with SAE Recommended Practice J680, Revised 1988, Location and Operation of instruments and control in Motor Track Cabs, and be essentially within the hand reach envelop described in SAE Recommended Practice J287, Driver Hand Control Reach. Operational controls, instrumentation, switches and other system con trolls shall not be mixed with ventilation diffusers and non-operational control or readouts. Control shall be located so that boarding passengers may not easily tamper with control settings. The door control, kneel control, windshield wiper/washer controls and run switch shall be in the most convenient operator locations. They shall be identifiable by shape, touch, and touch permanent markings. Doors shall be operated by a single control, conveniently located and operable in a horizontal plane by the operator's left hand. The setting of this control shall be easily determined by position and touch.

All panel-mounted switches and controls shall be marked by engraving, or with easily read identifiers, method to be approved by WMATA. Text designating position (on/off) shall be a minimum of 9 points, identifying legends shall be a minimum of 11 points. Extremely condensed or italic type fonts shall not be used. Graphic symbols shall conform to SAE Recommended Practice J2402, "Road Vehicles – Symbols for Controls, Indicators, and Tell Tales," where available and applicable. Color of switches and controls shall be dark with contrasting typography or symbols.

Mechanical switches and controls shall be replaceable, and the wiring at these controls shall be serviceable from a convenient location. Switches, controls and instruments shall be dust- and water-resistant.

Operator side control panel shall have protection installed to prevent damage to panel or inadvertent operation of controls from contact with seat belt.

TS 44.5 Normal Bus Operation Instrumentation and Controls

The following list identifies bus controls used to operate the bus. These controls are either frequently used or critical to the operation of the bus. They shall be located within easy reach of the operator. The operator shall not be required to stand or turn to view or actuate these controls unless specified otherwise.

Systems or components monitored by onboard diagnostics system shall be displayed in clear view of the operator and provide visual and/or audible indicators. The intensity of indicators shall permit easy determination of on/off status in bright sunlight but shall not cause a distraction or visibility problem at night. All indicators shall be illuminated using backlighting.

The indicator panel shall be located in Area 1 or Area 5, within easy view of the operator instrument panel. Chimes/Alarms should have capability for multiple frequencies and pulse rates and volume and “alarm acknowledge” capability to silence alarm temporarily. The audible alarm shall have capability for three separate frequencies and three separate pulse rates, individually assignable to unique conditions.

On-board displays visible to the operator shall be limited to indicating the status of those functions described herein that are necessary for the operation of the bus. All other indicators needed for diagnostics and their related interface hardware shall be concealed and protected from unauthorized access. Table 3 represents instruments and alarms. The intent of the overall physical layout of the indicators shall be in a logical grouping of systems and severity nature of the fault.

Consideration shall be provided for future additions of spare indicators as the capability of onboard diagnostic systems improves. Blank spaces shall contain LEDs.

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TABLE 6
Transit Bus Instruments and Alarms

Device	Description	Location	Function	Visual/ Audible
Master run switch	Rotary, four-position detent	Side console	Master control switch shall be rotary cam design. Rotary switches that incorporate one or more rotating contact plates mating with fixed terminal connection metrics will not be permitted. OFF, DAY/RUN, NIGHT/RUN, PARK (exterior lamps enabled)	
Engine start, front	Approved momentary switch	Side console	Activates engine starter motor	
Engine start, rear	Approved momentary switch	Engine compartment	Activates engine starter motor	
Engine run, rear	Three-position toggle switch	Engine compartment	Permits running engine from rear start, normal front run position and off	
Drive selector	Touch panel switch	Side console	Provides selection of propulsion: forward, reverse and neutral	Gear selection
HVAC	Fully automatic. No switch required in driver's area.			
Driver's ventilation	Rotary, three-position detent	Side console or Dash left wing	Permits supplemental ventilation: fan off, low or high	
Defroster fan	Rotary, three-position detent	Side console or Dash left wing	Permits defroster: fan off, low, medium or high	
Defroster temperature	Auto only	Side console or Dash left wing	Adjusts defroster water flow and temperature control with main HVAC (TK or MCC) unit	
Windshield wiper	One-variable rotary position operating both wipers	Dash left wing	Variable speed control of left and right windshield wipers	
Windshield washer	Push button	Dash left wing	Activates windshield washers	
Dash panel lights	Rotary rheostat or stepping switch	Side Console or Dash left wing	No adjustment for light intensity in night run position for driver.	
Interior lights	Three-position switch	Side console	Selects mode of passenger compartment lighting: off, on, normal	
Fast idle	Two-position switch	Engine compartment	Selects high idle speed of engine	
WC ramp/ kneel enable	Two-position switch[1]	Side console or Dash right wing	Permits operation of ramp and kneel operations at each door remote panel	Amber light

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TABLE 6
Transit Bus Instruments and Alarms

Device	Description	Location	Function	Visual/ Audible
Front door ramp/kneel enable	Two-position keyed switch[1]	Front door remote or Dash right wing	Permits ramp and kneel activation from front door area, key required[1]	Amber light
Front door ramp	Three-position momentary switch	Right side of steering wheel	Permits deploy and stow of front ramp	Red light
Front kneel	Three-position momentary switch	Front door remote	Permits kneeling activation and raise and normal at front door remote location	Amber or red dash indicator. Ext alarm and Amber light
Silent alarm	Two position Toggle Switch	Side console	Activates emergency radio alarm at dispatch and permits covert microphone and/or enables destination sign emergency message	Green Panel Indicator
Video system event switch	Momentary on/off momentary switch with plastic guard	Side console	Triggers event equipment, triggers event light on dash	
Street Side mirror	Manual mirror			
Curb Side remote mirror	Two-position toggle type	Side console	Permits two-axis adjustment of right exterior mirrors upper and lower (convex)	
Passenger door control	Five-position handle type detent or two momentary push buttons	Side console, forward	Permits open/close control of front and rear passenger doors	Red light
Engine shutdown	15 minutes auto shut down.			
Engine shutdown override		Rear engine compartment.		
Hazard flashers	Two-position switch	Side console or Dash right wing	Activates emergency flashers	Two green lights
Fire suppression	Automatic System			
Mobile data terminal	Mobile data terminal coach operator interface panel	Above left dash wing	Facilitates driver interaction with communication system and master log-on	LCD display with visual status and text messages
Turn signals	Momentary push button (two required) raised from other switches	Left foot panel	Activates left and right turn signals	Two green lights and optional audible indicator
Mirror heater	Temperature activated		Permits heating of outside mirrors when required	
High beam	Detented push button	In left foot panel	Permits driver to toggle between low and high beam	Blue light

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TABLE 6
Transit Bus Instruments and Alarms

Device	Description	Location	Function	Visual/ Audible
Fare box interface	Fare box coach operator interface panel	Near farebox	Facilitates driver interaction with farebox system	LCD display
Destination sign interface	Destination sign interface panel	in approved location	Facilitates driver interaction with destination sign system, manual entry	LCD display
Low profile microphone	Low-profile discrete Mounting	Steering column	Permits driver to make announcements with both hands on the wheel and focusing on road conditions	
Parking brake	Pneumatic PPV	Side console or Dash left wing	Permits driver to apply and release parking brake	Red light
Park brake release	Pneumatic PPV	Vertical side of the side console or dash center	Permits driver to push and hold to release brakes	
Hill holder	Two-position momentary switch	Side console	Applies brakes to prevent bus from rolling	
Master door/ interlock	Multi-pole toggle, detented	Out of operator's reach	Permits driver override to disable door and brake/throttle interlock	Red light
Warning interlocks deactivated	Red indicator light	Dash panel center	Illuminates to warn drive that interlocks have been deactivated.	Red light
Retarder disable	Momentary toggle switch with logical detent.	Within reach of Operator or approved location	Permits driver override to disable brake retardation/regeneration	Red light
Driver seat Alarm	Parking Brake not activated	Behind or under driver seat	Leave driver seat without parking brake activation	
Alarm acknowledge	Push button momentary	Approved location	Permits driver to acknowledge alarm and silence alarm condition	
Rear door passenger sensor disable	Multi-pole toggle, detented	In sign compartment or Driver's barrier compartment	Permits driver to override rear door passenger sensing system	Dash indicator required
Indicator/ alarm test button	Momentary switch or programming[1]	Dash center panel	Permits driver to activate test of sentry, indicators and audible alarms	All visuals and audible
Auxiliary power	110-volt power receptacle	Inside SDS cabinet	Property to specify what function to supply	
Speedometer	Speedometer, and diagnostic capability, 5-mph increments	Dash center panel	Visual indication of speed, fault condition display	Visual
Air pressure gauge	Primary and secondary, 5 psi increments	Dash center panel	Visual indication of primary and secondary air systems	Red light and buzzer

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TABLE 6
Transit Bus Instruments and Alarms

Device	Description	Location	Function	Visual/ Audible
Fire detection	Coach operator display	Dash center	Two separate systems required; AFSS and independent heat sensing/fire detection. Separate operator notifications required for each system.	Buzzer and red light
Door obstruction	Sensing of door obstruction	Dash center	Indication of rear door sensitive edge activation	Red light and buzzer
Low system air pressure	Sensing low primary and secondary air tank pressure	Dash center	Indication of low air system pressure	Buzzer and red light
Methane detection function	Detection of system integrity	Dash center	Detects system failure	No start condition, amber light
Methane detection	Indication of 20% LED emergency light (LEL)	Dash center	Detects levels of methane	Flashing red at 20% LEL
Engine coolant indicator	Low coolant indicator may be supplied as audible alert and visual and text message	Within driver's sight	Detects low coolant condition	Separate indicator for each system
Hot engine indicator	Coolant temperature indicator may be supplied as audible alert and visual and text message	Stop Engine Light	Detects hot engine condition and initiates time delay shutdown	Red light
Low engine oil pressure indicator	Engine oil pressure indicator may be supplied as audible alert and visual and/or text message	Stop Engine Light	Detects low engine oil pressure condition and initiates time-delayed shutdown	Red light
ABS indicator	Detects system status	Dash center	Displays system failure	Amber light
HVAC indicator	Detects system status	Dash center	Displays system failure	Amber or red light
Charging system indicator (12/24 V)	Detect charging system status	Dash center	Detects no charge condition and optionally detects battery high, low, imbalance, no charge condition, and initiates time-delayed shutdown	Red light flashing or solid based on condition
DEF gauge	Level Indicator	Center dash	Displays level of DEF tank and indicates with warning light when low	
Active regeneration	Detects Status	Dash center	Indication of electric regeneration	Amber High Exhaust Temperature

1. Indicate area by drawing. Break up switches control from indicator lights.

Function	Standard Behavior / Operating Notes

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Left Turn Signal (Flashing)	• Floor Mounted Left turn Switch • Hazard switch • Day Run / Night Run positions only • Ramp not stowed • When Pre-trip Light test active
Right Turn Signal (Flashing)	• Floor Mounted Right turn Switch • Hazard switch • Day Run / Night Run positions only • Ramp not stowed • When Pre-trip light test active
Hazard Lights (Common w/ turn signal lamps)	• Side Console mounted two position toggle switch • Activate with front or rear doors open • Activate when reverse gear selected • Work in any master switch position • When on, prevents multiplex system 'sleep'
Side Mounted Signal Lights	• Located fore and aft of front and rear wheel locations • Amber in color • Four lights per side • Dual intensity LED lights • High intensity operation follows turn signals and hazard operation • Low intensity follows N/P switch positions
Mirror mounted Signal Lights	• Amber signal lights • Mounted on forward face of outside rearview mirrors • Master switch in Day run: o Lights follow turn signal and hazard operation, side for side. • Master switch in Night run: o Lights on steady o If turn signal or hazard activated, lights follow signal lamps side for side, then return to steady on when signals released. • Master switch in Park: o Lights on steady
Low Beam Headlamps	• On in Night Run switch position when High beams not selected. • On in Day run position when Parking Brake released • On when Pre-trip light test active
High beam headlamps	• On in Night Run switch position. • On when Pre-trip light test active

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Marker / Clearance Lights	• On in Night Run and Park switch positions • Flash when Silent Alarm switch active. • On when Pre-trip light test active
Tail lights	• On in Night Run and Park switch position • On when Pre-trip light test active
Stop lights	• Service brakes applied – Multiplex awake • Parking brake applied - D/N • Retarder applied – D/N • Brake interlock applied – D/N
High mounted stop lights	• Same operation as Stop Lights
Deceleration (rear safety) Lights	• Zero throttle above 5 MPH with a 2 second delay. o Unless turn signals active • Transmission not in neutral and either front or rear doors open. • Transmission placed in reverse
Pedestrian Warning Light	• Day Run or Night Run positions • Transmission in gear • Brake Interlock released
Rear door green light	• On when rear door is unlocked • On when emergency egress is activated
Kneeling / Ramp light	• Flashes while ramp is not stowed • Flashes when bus is kneeling or raising
Engine Compartment Warning Lights	• Flash with hazard lights if active.
Engine Compartment Service Lights	• On/Off with switch in engine control box • Off when multiplex goes to sleep
Battery Compartment lights	• On/Off with switch in battery compartment • Off when multiplex goes to sleep
Electrical service panel lights	• On/Off with switch in all electrical panels • Off when multiplex goes to sleep
Front Door service panel lights	• On/Off with switch in front door service panel • Off when multiplex goes to sleep
Rear door service panel lights	• On/Off with switch in rear door service panel • Off when multiplex goes to sleep
Instrument panel back-lighting	• On in Night Run and Park switch positions • Intensity not adjustable

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Instrument Panel Alarm Acknowledge	• Momentary switch permitting operator to silence alarm for existing condition(s) only. Additional Alarm requests will re-activate alarm, requiring additional acknowledge switch selection.
Driver's light	• On with switch in side console • D/N/P switch positions
Fare Box light	• On when entrance door open
Front Door Header lights	• On when front door open in D/N/P switch positions
Rear door header lights	• On when rear door open in D/N/P switch positions
Stepwell lights	• On in D/N/P switch positions
Interior passenger lights, except front positions	• Side console switch in ON position o Lights on if multiplex awake • Side console switch in NORMAL position o Lights on in D/N switch positions o Off when reverse gear selected o Curb side lights on in Park switch position.
Interior passenger lights, front positions (Actual lights specified by WMATA)	• Side console switch in ON position o Lights on if multiplex awake • Side console switch in NORMAL position o Lights on when front door open and Night Run switch position o Lights dim to 10% brightness when front door closed in Night Run position. o Off when reverse gear selected
ADA Under Seat Lights	• Master switch in Day run or Night run • Engine running • Front door open • Lights remain on after door close until bus reaches 3-5 MPH
Pre-trip Light test	• Master switch in Day run or Night run • Engine running • Transmission in neutral • Parking Brake applied • Both turn signals depressed for 3 seconds • Test active for two (2) minutes • All interior and exterior lights on • All interior lights on o Multi – filament lights (high beams and low beams; tail and stop) alternate flash to verify full function
Door Master switch	• Two position toggle switch

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	• Located in front destination sign cabinet with small access door provided for operation without opening sign door. • When Off position selected: o Brake interlock releases o Throttle interlock releases. o Fuel door starter inhibit is removed. o Interlock Released instrument panel indicator is illuminated o Instrument panel alarm is activated o Front and rear door operation is inhibited
Kneel/Ramp alarm	• On when bus kneeling or raising • On when ramp is in motion. • On when master switch off and parking brake released • On when Pre-trip light test active
Back up alarm	• On when transmission in reverse • On when Pre-trip light test active
Seat Occupancy Alarm	• Separate and unique audible warning. • On when driver seat unoccupied with parking brake released.
Ramp Deploy	• Engine must be running • Front door fully open • Transmission in neutral • Parking brake applied • Use of ramp must apply Interlock
Ramp Stow	• Engine must be running • Front door fully open • Transmission in neutral • Parking brake applied • Interlock must remain applied until stowed.
Kneel (lowering)	• Engine must be running • Front door fully open • Transmission in neutral • Parking brake applied • Cannot be knelt with ramp deployed. • Kneeling stops when switch is released, height must hold.
Kneel (raising)	• Bus must be knelt • Engine must be running • Front door fully open • Transmission in neutral • Parking brake applied • Returns to ride height when switch placed in Raise position

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	• Cannot be raised above ride height
Front passenger door	• Bus Stopped • Door Master Switch on • Day Run or Night Run switch positions • Front door positions of 5 position controller • Door remains open if bus is knelt • Door remains open if ramp is deployed • Open/Close speed = 2.5 – 3 Seconds. • Master switch Off or Park automatically dumps air (Pneumatic control) or disengages (electric control).
Rear Passenger Door	• Bus stopped • Door master switch on • Any master switch position; bus awake • Rear door positions of 5 position controller • Door is controlled only by driver • Doorway sensing system recycles a de-authorized door • Sensitive edges recycle a de-authorized door • Open / Close Speed = 2.5 – 3 Seconds • Emergency egress activation releases all door control for push-open operation. Resetting control and cycling door control restores function. • Maintenance Operation: o Engine control in Rear run o Door master switch on o 5 position door controller in any rear door closed position o Two position guarded toggle switch in rear door service compartment moved to labeled DOOR OPEN position. ▪ Guarded position is labeled DOOR CLOSE.
Vapor CLASS System	• Disable switch located in rear door service compartment. • When turned off: o CLASS Disabled instrument panel indicator – D/N o Dash buzzer – D/N
Brake Interlock	• Master switch Day Run / Night Run • Door Master switch on • Bus stopped • Any of the Following: o Front door not closed o Rear door not closed o Rear door emergency egress activated

	○ Bus kneeling ○ Ramp deployed ○ Hill hold activated ○ Transmission in neutral ○ Engine control switch in Rear Run • Brake application of 15PSI required to release.
Throttle Interlock	• Master switch Day Run / Night Run • Door Master switch on • Bus stopped • Any of the Following: ○ Front door not closed ○ Rear door not closed ○ Rear door emergency egress activated ○ Bus kneeling ○ Ramp deployed ○ Hill hold activated ○ Engine control switch in Rear Run • Brake application of 15PSI required to release
Engine Starter	• Master switch in Day Run or Night Run • Engine not already running • Transmission in neutral • Parking brake set • Fuel door closed • Engine and propulsion systems 'wait to start' sequences completed • Engine control switch in front run ○ Front start button depressed • Engine control in rear run ○ Rear start button depressed • Starter engaged for 10 second maximum.
Engine Idle Shutdown	• Engine control switch in Front run • Transmission in neutral • Parking brake set • Exhaust Regeneration not in progress • Above conditions met for 15 minutes causes engine and transmission systems to power off. • Load shedding: ○ 3 minutes following Idle shutdown, all Day Run and Night Run functions should shut down ○ Multiplex will remain awake.
Shift from neutral	• Master switch in Day run or Night run

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	• Engine control in Front run position • Brake application 15PSI or greater

Fire suppression shut-down	• All warnings and alarms for AFSS shall be presented by system control panel.
	• Upon fire system deployment, all fans are immediately disabled.
	  o Engine cooling
	  o HVAC
	• After 15 seconds, engine and propulsion systems are powered off.
	  o Emergency override switch activation adds additional 15 second delay to engine and propulsion shutdown.

Fire Detection Light and Alarm	• Additional system to automatic Fire Suppression. • Two (minimum) temperature sensors installed • Red dash indicator (FIRE) • Dash alarm activates.
Horn	• On with momentary steering wheel switch • Operates with multiplex awake
Air Dryer Operation	• Active with engine running if engine control in Front Run • Active when engine control in Rear Run regardless of engine running.
Coolant boost pump	• Controlled by HVAC for cabin/operator heat requirements • Controlled by multiplex for system fill/purge.
Drivers' Heat/Defrost	• Master switch in Day run or Night run • Driver's controls used to select operation.
Cabin HVAC	• Engine must be running • No operator controls. • Floor heaters to have temperature sensor at floor level and controlled by HVAC controller and cannot be used as a coolant by pass loop for fuel fired heater • HVAC set-point shall be 72 degrees F. • Engine run box HVAC Disable switch will disable. o Guarded toggle switch – closed position is enabled.
Stop Request sign	• Master switch in Day run or Night run position • Front door closed • Rear door closed • Stop request switch activated (any) • Sign remains lit until a door opened or momentary Cancel switch activated by operator
Stop Request Chime	• Master switch in Day run or Night run position • Front door closed

	• Rear door closed
	• Stop request switch activated (any)
	• Chime sounds once and will not sound again until a door is opened and closed.
	• Maintenance Operation:
	  o Master switch Park position
	  o Activation of any stop request switch will sound chime once

Handicap Stop Request Chime	• Master switch in Day run or Night run position • Front door closed • Rear door closed • Stop request switch activated (any) • Chime sounds twice and will not sound again until a door is opened and closed.

Fuel Fired Heater	• Controlled by Multiplex
	  o Requested by HVAC
	  o Requested by Engine
	• Disable switch located on rear switch box

Fast Idle	• Engine run switch in front run and Master switch in Day Run or Night Run or • Engine run switch in rear run. • Engine running • Transmission in neutral • Parking brake applied • Fast Idle enable switch on (rear switch box) • 5 second delay.
Instrument panel indicators	• Check Engine – Amber • Stop Engine – Red • Check Transmission / Check System– Amber • Hot Transmission / Stop System– Red • Turn Signals – Green • High Beams – Blue • Parking Brake – Red • Brakes on - Red • Kneel – Red • Low Air- Red • Stop Request- Amber • Handicap Stop Request-Amber • Hot Exhaust- Amber • Exhaust Regen Inhibit - Amber • Fuel Door Open – Amber

	• Low Coolant – Amber • Wait to Start – Amber • HVAC Fail – Amber • FIRE – Red • Interlock Released - Red • Charging Fail – Red • HVAC Disabled – Red • Seat Belt – Red • Rear Door – Red • CLASS Disabled - Red
Destination Signs	• Controlled by multiplex • On in Day Run and Night Run • Active for 15 Minutes after master run switch OFF • Not active in rear run • Must display WMATA “Bus is backing” message when reverse gear selected.
Destination sign heated window	• Master switch in Day run or Night run • Engine running • Driver’s defrost active
Fuel Door	• Dash light on steady when door is open and transmission in neutral • Bus will not start when open • Dash light flashes when door is open and transmission is in gear • Dash alarm pulses when door is open and transmission is in gear

Multiplex System	• Master run switch wakes system in any position except Off
	• Rear run and/or start switch wakes system
	• Hazard switch keeps system awake
	• Silent alarm switch keeps system awake
	• Sleep delay:
	  o Master run switch on then off= 15 minutes
	  o Rear run switch on then off=120 minutes.

Silent Alarm Switch	• Two position guarded toggle – brush guard not flip cap
	• Located on operator side console among other switches.
	• Unmarked green panel indicator directly above switch.
	• Input to multiplex. Responses:
	  o Causes marker/clearance lights to flash
	  o Engages CAD/AVL alarm relay for one second
	  o Signals Driver Coaching Camera for one second.
	  o Signals CCTV system for one second

CAD/AVL System	• On in D/N/P positions • On with silent alarm switch • On until multiplex goes to sleep
CCTV System	• On in D/N/P positions • Off with engine run switch in rear run position • On until multiplex goes to sleep
Driver Coaching Camera	• On in D/N/P positions • On in engine rear run • On until multiplex goes to sleep
Battery Rundown Protection	• Coach batteries are monitored for State of Charge o 12 and 24 volt strings are monitored independently. • If SOC falls below ~50% and master run switch is off, 12 and 24 volt main disconnects are activated. • Front or rear starter buttons will re-engage disconnects
Exhaust After-Treatment Controls	• Engine compartment switch box • Three position guarded toggle • Normal / Inhibit / Regen o Normal: Passive Regeneration permitted. o Inhibit: Passive Regeneration disallowed o Regen: Manual Regeneration commanded. • Guarded position (flip cap closed) places switch in Normal position.

TS 44.6 Driver Foot Controls

Accelerator and brake pedals shall be designed for ankle motion. Foot surfaces of the pedals shall be faced with wear-resistant, nonskid, replaceable material.

TS 44.6.1 Pedal Angle

The vertical angle of the accelerator and brake pedals shall be determined from a horizontal plane regardless of the slope of the cab floor. The accelerator and brake pedals shall be positioned at an angle of 37 to 50 degrees at the point of initiation of contact and extend downward to an angle of 10 to 18 degrees at full throttle.

The location of the brake and accelerator pedals shall be determined by the manufacturer, based on space needs, visibility, lower edge of windshield, and vertical H-point.

TS 44.6.2Pedal Dimensions and Position

The floor-mounted accelerator pedal shall be 10 to 12 in. long and 3 to 4 in. wide. Clearance around the pedal must allow for no interference precluding operation.

1 to 2 in. Between Brake and Accelerator Pedals
The accelerator and brake pedals shall be positioned such that the spacing between them, measured at the heel of the pedals, is between 1 and 2 in. Both pedals should be located approximately on the same plane coincident to the surface of the pedals.

TS 44.7 Brake and Accelerator Pedals

Brake Pedal
Non-adjustable brake and accelerator pedal.

TS 44.8 Driver Foot Switches

Floor-Mounted Foot Control Platform
The angle of the turn signal platform shall be determined from a horizontal plane, regardless of the slope of the cab floor. The turn signal platform shall be angled at a minimum of 10 degrees and a maximum of 37 degrees. It shall be located no closer to the seat front than the heel point of the accelerator pedal.

Turn Signal Controls
Turn signal controls shall be floor-mounted, foot-controlled, water-resistant, heavy-duty, momentary electronic proximity contact switches.

Foot Switch Control
The control switches for the turn signals shall be mounted on an inclined, floor-mounted stainless steel enclosure or metal plate mounted to an incline integrated into the driver's platform, located to the left of the steering column. The location and design of this enclosure shall be such that foot room for the operator is not impeded. The inclined mounting surface shall be skid-resistant. All other signals, including high beam and public address system shall be in approved location.

The foot switches shall be UL-listed, heavy-duty type, of a rugged, corrosion-resistant metal construction. The foot switches for the directional shall be momentary type, while those for the and the high beam shall be latching type. The spacing of the switches shall be such that inadvertent simultaneous deflection of switches is prevented.

TS 44.9 Driver PROTECTION SYSTEM (DPS)

FEATURE:
The driver protection system design shall be one piece design and shall not open more than 90 degrees. The driver protection system (DPS) must meet ADA requirements. Non-

transparent lower sections shall be constructed of a minimum 1/8" (3mm) thickness aluminum sheet and include reinforcement members with welded construction.
Forward most DPS upper glass shall slide rearward and operate with a force of less than 25lbf to initiate motion and a force of less than 15lbf to maintain motion.
Glazing material shall be a minimum of 5/16" (8mm) thickness and be of a tempered / laminated construction.
Glazing material shall comply with American National Institute, Standard ANSI/SAE Z26.1-1996 S5.2, FMVSS 571.205 49CFR, and SAE J673 #1 edge standards for automotive glazing and AS2 standard.
Upper glass shall be sliding type for driver to communicate with passengers and allow the driver to adjust the sliding glass into multiple positions, similar to how they would adjust the driver's window, without pinch points. Glass geometry shall allow for unobstructed view of surroundings, including rearward facing curbside mirrors.
Door shall open using a release knob that actuates with a force of less than 5lbf.
Door shall open and close using a pull handle and latch with a force of less than 20lbf from operator seat.
The primary DPS latching mechanism shall include a rotary slam type latch and utilize a minimum 1/2" diameter striker bar with fully captured engagement. The latch must be able to withstand a load of no less than 300lbf applied at the locking point.
DPS stanchion framing shall be constructed of a minimum 11 gauge (0.120" wall) 304 stainless steel material.
Driver Protection System (DPS) shall be easily operated. Driver Protection System (DPS) shall prevent sudden intrusion into operator's area. Driver Protection System (DPS) shall not cause objectionable noise and vibration during normal service operation. Driver Protection System (DPS) shall not prevent access to fare box payment or vault. Driver Protection System (DPS) shall allow for a reasonable communication between bus operator and passengers.
Driver Protection System (DPS) shall not have many visible fasteners and shall be black powder coated or anodized to complement the interior color of the bus. For maintenance purpose, the DPS shall take less than 60 minutes to remove and replace. Driver Protection System shall not affect vehicle adherence to ADA or other international standards as pertaining to aisle clearance and conformance to the standardized "Box Test. Driver Protection System shall include a stop mechanism to prevent from opening more than 90 degree or pass the passenger standee line. Driver Protection System latch mechanism release shall be inconspicuous to untrained personal and operated by means of a push out actuator knob.
Driver Protection System shall be designed to minimize glare and reflection from outside light sources during hours of darkness. No portion of the Driver Protection System latching mechanism or striker plate shall present a hazard during ingress and egress from the bus

operator area. The Driver Protection System door swing shall be accommodated by a rotary post hinge mechanism, free of pinch point and maintenance free operation.
Driver protection system shall be easy to open and close and tailored to work around existing bus equipment such as fare box, cameras and stanchions. Door lock catch shall not impede operator entry/exit from operator area and must be approved by WMATA.

TS 45. Driver's Amenities

TS 45.1 Coat Hanger

Coat Hanger
A suitable hanger shall be installed in a convenient, approved location for the driver's coat.

Coat Hook
A hook and loop shall be provided to secure the driver's coat.

TS 45.2 Storage Box

Storage Box
An enclosed driver storage area shall be provided with a positive latching door and/or lock. The minimum size is 14″ X 14″ X 14″ (355mm x 355mm x 355mm)

TS 46. Windshield Wipers and Washers

TS 46.1 Windshield Wipers

The bus shall be equipped with a windshield wiper for each half of the windshield. At 65 mph, no more than 10 percent of the wiped area shall be lost due to windshield wiper lift. For two-piece windshields, both wipers shall park along the center edges of the windshield glass. For single-piece windshields, wipers shall park along the bottom edge of the windshield. Windshield wiper motors and mechanisms shall be easily accessible for repairs or service. The fastener that secures the wiper arm and the drive mechanism shall be corrosion-resistant.

Intermittent Wiper with Variable Control
A variable-speed feature shall be provided to allow adjustment of wiper speed for each side of the windshield between approximately five (5) and twenty-five (25) cycles per minute.

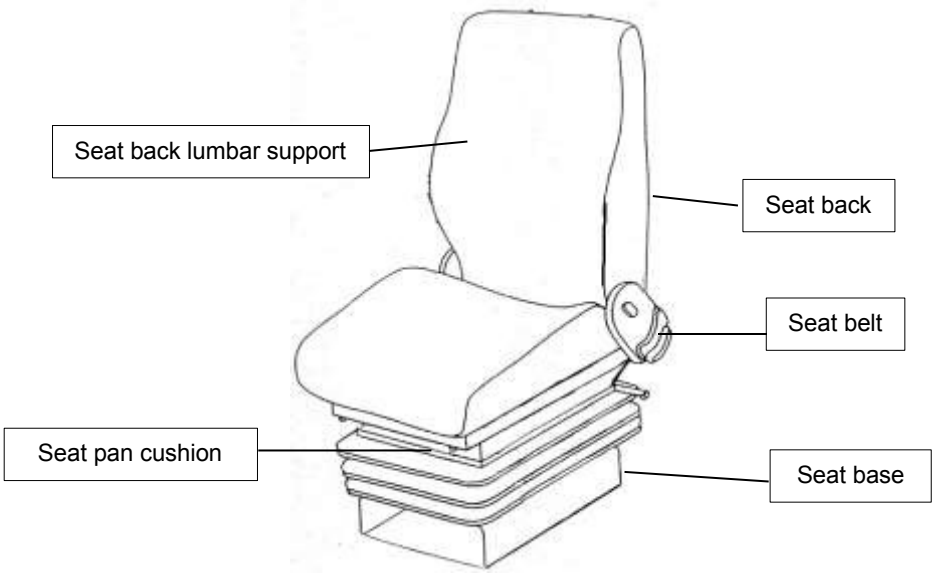
TS 46.2 Windshield Washers

The windshield washer system, when used with the wipers, shall deposit washing fluid evenly and completely wet the entire wiped area.

The windshield washer system shall have a minimum 3-gallon reservoir, located for easy refilling from outside of the bus. Reservoir pumps, lines and fittings shall be corrosion-resistant and must include a means to determine fluid level.

TS 47.Driver's Seat

FIGURE 6
Driver's Seat



TS 47.1Dimensions

The driver's seat shall be comfortable and adjustable so that people ranging in size from a 95th-percentile male to a 5th-percentile female may operate the bus. Graphical symbols shall confirm to SAE Recommended Practice (proposed) J1458 Universal Symbols for Seat and Suspension Adjustments

TS 47.1.1 Seat Pan Cushion Length

Measurement shall be from the front edge of the seat pan to the rear at its intersection with the seat back. The adjustment of the seat pan length shall be no less than 16.5 in. at its minimum length and no more than 20.5 in. at its maximum length. Seat Pan Cushion Height.

TS 47.1.2 Seat Pan Cushion Height

DIMENSIONS

Measurement shall be from the cab floor to the top of the level seat at its center midpoint. The seat shall adjust in height from a minimum of 14 in. to a maximum of 20 in., with a minimum 6 in. vertical range of adjustment.

TS 47.1.3 Seat Pan Cushion Slope

Measurement is the slope of the plane created by connecting the two high points of the seat, one at the rear of the seat at its intersection with the seat back and the other at the front of the seat just before it waterfalls downward at the edge. The slope can be measured using an inclinometer and shall be stated in degrees of incline relative to the horizontal plane (0 degrees). The seat pan shall adjust in its slope from no less than plus 12 degrees (rearward "bucket seat" incline), to no less than minus 5 degrees (forward slope).

TS 47.1.4 Seat Base Fore/Aft Adjustment

Measurement is the horizontal distance from the heel point to the front edge of the seat. The minimum and maximum distances shall be measured from the front edge of the seat when it is adjusted to its minimum seat pan depth (approximately 15 in.). On all low-floor buses, the seat-base shall travel horizontally a minimum of 9 in. It shall adjust no closer to the heel point than 6 in.

TS 47.1.5 Seat Pan Cushion Width

Measurement is the horizontal distance across the seat cushion. The seat pan cushion shall be 17 to 21 in. across at the front edge of the seat cushion and 20 to 23 in. across at the side bolsters.

TS 47.1.6 Seat Suspension

The driver's seat shall be appropriately dampened to support a minimum weight of 380 lbs. The suspension shall be capable of dampening adjustment in both directions*.*

Rubber snubbers shall be provided to prevent metal-to-metal contact.

TS 47.1.7 Seat Back

Width

Measurement is the distance between the outermost points of the front of the seat back, at or near its midpoint in height. The seat back width shall be no less than 19 in. Seat back will include dual recliner gears on both sides of the seat.

Height

Standard height seat back with no head rest.

TS 47.1.8 Seat Back Lumbar Support

Measurement is from the bottom of the seat back at its intersection with the seat pan to the top of the lumbar cushioning. The seat back shall provide adjustable depth lumbar back support with three individual operating lumbar cells within a minimum range of 7 to 11 in.

TS 47.1.9 Seat Back Angle Adjustment

The seat back angle shall be measured relative to a level seat pan, where 90 degrees is the upright position and 90 degrees-plus represents the amount of recline.

The seat back shall adjust in angle from a minimum of no more than 90 degrees (upright) to at least 105 degrees (reclined), with infinite adjustment in between.

TS 47.2 Seat Belt

The belt assembly should be an auto-locking retractor (ALR). All seat belts should be stored in automatic retractors. The belts shall be mounted to the seat frame so that the driver may adjust the seat without resetting the seat belt.

The seat and seat belt assemblies as installed in the bus shall withstand static horizontal forces as required in FMVSS 207 and 210.

Lap and Shoulder (Three-Point) Seat Belt
Seat belts shall be provided across the driver's lap and diagonally across the driver's chest. The driver shall be able to use both belts by connecting a single buckle on the right side of the seat cushion. 3-pt seatbelts must be emergency locking retractor (ELR) in design.

Orange three-point seatbelt webbing.

Lap Belt Length

THE LAP BELT ASSEMBLY SHALL BE EXTENDED LENGTH TO ACCOMMODATE OPERATORS OF ALL SIZES.

TS 47.3 Adjustable Armrest

No armrests.

TS 47.4 Seat Control Locations

While seated, the driver shall be able to make seat adjustments by hand without complexity, excessive effort or being pinched. Adjustment mechanisms shall hold the adjustments and shall not be subject to inadvertent changes.

TS 47.5 Seat Structure and Materials

The operator seat shall be contoured to provide maximum comfort for extended period of time. Cushions shall be fully padded with at least 3 inches of closed –cell polyurethane foam or material with equal properties, in the seating areas at the bottom and back. Upholstery shall be ventilated, transportation grade material.

All visually exposed metal on the operator's seat shall be powder coated black.

The seat and seatbelt assembly as installed in the bus shall withstand static horizontal forces as required in FMVSS 207 and 210. Seat shall withstand 10,000 lbs. impacts of a 40 pound sandbag dropped from a height of 12 inches. Seat cushion shall withstand 100,000 randomly

positioned 3 ½ inch drops of a squirming, 150 pounds, smooth surfaced buttocks shape striker with only minimal wear on the seat covering.

The Bus Manufacturer shall provide WMATA a certified test report fully documenting compliance with all the requirements define above. The test report shall contain a record of all testing activities, test diagrams testing equipment as well as data related to loads, deflections and permanent deformation of the seat assembly. The report shall include a statement of compliance with the requirements of this section TS 47 to TS 47.5

Cushion Material

Foam and fabric that meets FTA Docket 90A.

TS 47. 6 Pedestal

Stainless Steel.

TS 47.8 Mirrors

TS 47.8.1 Exterior Mirrors

The bus shall be equipped with corrosion-resistant, outside rearview mirrors on each side of the bus. Mirrors shall permit the operator to view the roadway along both the sides of the bus, including the rear wheels. Mirrors should be positioned to prevent blind spots. Mirrors shall have built in LED indicator lights. Location of the indicator light shall be WMATA approved location on mirror head.

Mirrors shall retract or fold sufficiently to allow bus washing operations but avoid contact with windshield.

Flat Mirrors on Both Sides The bus shall be equipped with two (2) flat outside mirrors, each with not less than 50 sq in. of reflective surface. The mirrors shall be located so as to provide the driver a view to the rear along both sides of the bus and shall be adjustable both in the horizontal and vertical directions to view the rearward scene. The roadside rearview mirror shall be positioned so that the driver's line of sight is not obstructed.

WMATA preference shall be combination of flat and convex mirrors and with this combination it may be lower than 76 inches shall be allowed. Contractor has to submit a drawing.

Curbside Mirrors

The curbside rearview mirror shall be mounted so that its lower edge is no less than 76 in. above the street surface.

Remote Adjustment of curb side mirror only.
The driver shall be able to adjust the curbside mirror remotely while seated in the driving position. The control for remote positioning of the mirror shall be a single switch or device.

Street-Side Mirrors

Street side and Curb side mirror head shall be same size as curb side.
Mirrors with integrated turn signal both sides and blind spot detection light on curb and street side mirror.
Mirrors with external and in glass mounted turn signal both sides.

TS 47.8.2 Interior Mirrors

Mirrors shall be provided for the driver to observe passengers throughout the bus without leaving the seat and without shoulder movement. The driver shall be able to observe passengers in the front/entrance and rear/exit areas, anywhere in the aisle, and in the rear seats.

Center Rearview An interior rear view mirror 7-1/2" x 16-1/2" or larger shall be mounted ahead of, and above the operator's position completely clear of driver's field of view through windshield to provide a general view of the interior of the bus. Mirror shall be flat. Mirror glass shall be tempered.

Front Entrance Area One interior mirror shall be mounted on the ceiling above the front entrance area to provide the operator view of the front entrance area and outside adjacent to the step. Mirror shall be rectangular shape, diminishing convex type approximately six (6) inches by nine (9) inches. Mirror glass shall be tempered.

Upper Right-Hand Corner One interior flat mirror shall be mounted at the upper right hand corner of windshield header panel of suitable size to provide the operator a clear, unobstructed view of the rear exit area mirror. Mirror diameter shall be eight (8) inches. Mirror glass shall be tempered glass.

Rear Exit Area One interior mirror shall be mounted on the ceiling near the rear door so as to provide the operator an unobstructed view of the rear exit area by looking in the mirror mounted upper right interior corner. Mounting of mirror to vertical stanchion at rear door will be allowed if necessary provided that stanchion strength is adequate to prevent twisting or damage and set bolt is provided to preclude rotation. Mirror shall be convex twelve (12) inch diameter and be sturdy design and shall withstand vibration. Mirror glass shall be tempered.

One interior, 6inch diameter round mirror shall be mounted at the front of the bus to provide the operator with clear view of the area immediately behind the driver's area and/or street side wheel house. Mirror glass shall be tempered.

Bike Rack One interior, 6 inch diameter, round mirror shall be mounted under the destination sign box at the front of the bus to provide the operator with a clear view of the bike rack.

Mirrors shall be include wrench flat to allow for ease removing, installing, and tightening of mirrors.

WINDOWS

TS 48. General

Detailed manufacturing drawings of the side and rear window glazing shall be provided. Drawing shall include reference to type of material, dimensions, window glazing part numbers, and any additional information which may be required to properly identify the window glazing material.

[Use with 40-ft length] A minimum of 10,000 sq in. of window area, including operator and door windows, shall be required on each side of the standard configuration bus.

[Use with 60-ft length] A minimum of 16,000 sq in. of window area, including operator and door windows, shall be required on each side of the standard configuration bus.

TS 49. Windshield

The windshield shall permit an operator's field of view as referenced in SAE Recommended Practice J1050. The vertically upward view shall be a minimum of 14 degrees, measured above the horizontal and excluding any shaded band. The vertically downward view shall permit detection of an object 3½ ft high no more than 2 ft in front of the bus. The horizontal view shall be a minimum of 90 degrees above the line of sight. Any binocular obscuration due to a center divider may be ignored when determining the 90-degree requirement, provided that the divider does not exceed a 3-degree angle in the operator's field of view. Windshield pillars shall not exceed 10 degrees of binocular obscuration. The windshield shall be designed and installed to minimize external glare as well as reflections from inside the bus.

The windshield shall be easily replaceable by removing zip-locks from the windshield retaining moldings. Bonded-in-place windshields shall not be used. Winglets may be bonded.

TS 49.1 Glazing

The windshield glazing material shall have a ¼ in. nominal thickness laminated safety glass conforming to the requirements of ANSI Z26.1 Test Grouping 1A and the Recommended Practices defined in SAE J673.

SHADED BAND
The upper portion of the windshield above the driver's field of view shall have a dark, shaded band with a minimum luminous transmittance of 5 percent when tested in accordance to ASTM D-1003.

Two-piece windshield.

TS 50. Driver's Side Window

The driver's side window shall be the sliding type, requiring only the rear half of sash to latch upon closing, and shall open sufficiently to permit the seated operator to easily adjust the street-side outside rearview mirror. When in an open position, the window shall not rattle or close during braking. This window section shall slide in tracks or channels designed to last the service life of the bus. The operator's side window shall not be bonded in place and shall be easily replaceable. The glazing material shall have a single-density tint.

The driver's view, perpendicular through operator's side window glazing, should extend a minimum of 33 in. (840 mm) to the rear of the heel point on the accelerator, and in any case must accommodate a 95th percentile male operator. The view through the glazing at the front of the assembly should begin not more than 26 in. (560 mm) above the operator's floor to ensure visibility of an under-mounted convex mirror. Driver's window construction shall maximize ability for full opening of the window. Front section of the window shall have handles on inside and outside for operator to be able to open from outside and inside as well. Location of the handle shall not block driver view to the street side outside mirror.

The driver's side window glazing material shall have a ¼ in. nominal thickness laminated safety glass conforming to the requirements of ANSI Z26.1-1996 Test Grouping 2 and the Recommended Practices defined in SAE J673.

The design shall prevent sections from freezing closed in the winter. Light transmittance shall be 75 percent on the glass area below 53 in. from the operator platform floor. On the top fixed over bottom slider configuration, the top fixed area above 53 in. may have a maximum 5 percent light transmittance.

Hidden Frame (Flush "Euro-look") Driver's Side Window
- Full slider (front section only)
  - Non-egress

Quick Change Operator's Side Window
Glazing in the window assembly shall be replaced without removing the window from its installed position on the bus or manipulation of the rubber molding surrounding the glazing.

The glazing shall be held in place mechanically by a formed metal extruded ring constructed to last the life of the vehicle.

TS 51. Side Windows

TS 51.1 Configurations

Side windows shall not be bonded in place, but shall be easily replaceable without disturbing adjacent windows and shall be mounted so that flexing or vibration from engine operation or normal road excitation is not apparent. All aluminum and steel material will be treated to prevent corrosion. The windows shall be designed and constructed to enable a 3M mechanic to remove and replace two windows in less than 10 minutes.

TS 51.2 Emergency Exit (Egress) Configuration

Minimum Egress
All side windows shall be fixed in position, except as necessary to meet the emergency escape requirements.

Standard Passenger Side Window Configurations

- Hidden frame (flush “Euro-look”) continuous glazing type.
    - Openable windows with inward-opening transom panels.

TS 51.3 Configuration

Operable Side Window Configurations
All side windows, except windows in passenger doors and those smaller than 500 sq in., shall have window panels that are operable by passengers (transom inserts). Each openable side window shall consist of “tip in” transom window. Openable window panels shall be equipped with latches that secure the window in the fully open and fully closed positions.

The passenger window configuration shall be a continuous window glazing configuration.

The windows shall be designed and constructed to enable a 3M mechanic to remove and replace two windows in less than 10 minutes.

All side windows shall be easily replaceable without disturbing adjacent windows and shall be mounted so that flexing or vibration from engine operation or normal road excitation is not apparent.

TS 51.4 Materials

Polycarbonate Glazing Panels
Side window glazing material shall have a minimum 3/16 in. nominal thickness. The material shall conform with the requirements of ANSI Z26.1-1996, "Standard for Type AS-5 Safety Glazing Materials," except for Test Number 17, which shall subject the specimens to 100 cycles with less than 4 percent hazing and 500 cycles with less than 12 percent hazing. Windows shall be polycarbonate sheet with an abrasion resistant coating on both sides of the window.

Windows on the bus sides and in the rear door shall be tinted a neutral color, complementary to the bus exterior. The maximum solar energy transmittance shall not exceed 37 percent, as measured by ASTM E-424, and the luminous transmittance shall be no less than 16 percent as measured by ASTM D-1003. Glazing over the destination signs shall not be tinted.

TS 51.5 Rear Window

Rear Window Requirement
A rear window shall be provided. The rear window shall be glazed with same material (including anti-vandalism provision if required) and tint as side windows. The glazing shall be set in rubber channels or be push-out type to meet FMVSS 217. If push-out type, it shall be one-piece, rugged sash design, meeting specifications for side windows.

REAR WINDOW REQUIREMENT FOR CLEAN DIESEL, AND ARTICULATED BUSES.

HEATING, VENTILATING AND AIR CONDITIONING

TS 52. Capacity and Performance

The HVAC climate control system shall be capable of controlling the temperature and maintaining the humidity levels of the interior of the bus as defined in the following paragraphs.

HVAC EQUIPPED.

Allow Either Roof- or Rear-Mounted HVAC (MCC, Thermo King, or approved equal) Unit
The HVAC unit may either be roof or rear-mounted.

DEFAULT Require rear- and roof-mounted HVAC unit (articulated buses)

With the bus running at the design operating profile with corresponding door opening cycle, and carrying a number of passengers equal to 150 percent of the seated load, the HVAC system shall control the average passenger compartment temperature within a range between 65 and 77°F, while maintaining the relative humidity to a value of 50 percent or less. The system shall maintain these conditions while subjected to any outside ambient temperatures within a range of 10 to 95°F and at any ambient relative humidity levels between 5 and 50 percent.

When the bus is operated in outside ambient temperatures of 95 to 115 °F, the interior temperature of the bus shall be permitted to raise 1º for each degree of exterior temperature in excess of 95 °F.

When bus is operated in outside ambient temperatures in the range of -10 to 10 °F, the interior temperature of the bus shall not fall below 55 °F while the bus is running on the design operating profile.

System capacity testing, including pull-down/warm-up, stabilization and profile, shall be conducted in accordance to the APTA's "Recommended Instrumentation and Performance Testing for Transit Bus Air Conditioning System. "Temperature measurements shall be made in accordance to this document with the following modifications: Driver's door open and closed position.

Three primary locations used for temperature probes are (1) 6 inches aft of front wheel housing, (2) centered between the two axles and (3) 6 inches aft of rear wheel housing. At each primary location, the nine (9) temperature sensing device shall be (A) 72 inches above the floor level, (B) 6 inches above top surface of seat cushion and (C) 6 inches above floor.

The recommended locations of temperature probes are only guidelines and may require slight modifications to address actual bus design. Care must be taken to avoid placement of sensing devices in the immediate path of an air duct outlet. In general, the locations are intended to accurately represent the interior passenger area.

Defroster operation shall not affect operating and set point of passenger cabin temperature.

Additional testing shall be performed as necessary to ensure compliance to performance requirements stated herein.

Capacity and Performance Requirements
The air-conditioning portion of the HVAC system shall be capable of reducing the passenger compartment temperature from 110 to 90 °F in less than 20 minutes after engine start-up.

Engine temperature shall be within the normal operating range at the time of start-up of the cool-down test, and the engine speed shall be limited to fast idle. During the cool-down period, the refrigerant pressure shall not exceed safe high-side pressures, and the condenser discharge air temperature, measured 6 in. from the surface of the coil, shall be less than 45 °F above the condenser inlet air temperature. The appropriate solar load as recommended in the APTA "Recommended Instrumentation and Performance Testing for Transit Bus Air Conditioning System," representing 4 p.m. on August 21, shall be used. There shall be no passengers on board, and the doors and windows shall be closed.

Colder Ambient Conditions
The pull-up requirements for the heating system shall be in accordance with Section 9 of APTA's "Recommended Instrumentation and Performance Testing for Transit Bus Air Conditioning." With ambient temperature at -20 °F, and vehicle cold soaked at that temperature, the bus heating system shall warm the interior passenger compartment to an average temperature of 70 °F ±1 °F within 70 minutes.

R407C or R134a
The air conditioning system shall meet these performance requirements using R407C or R134a refrigerant..

Where belt driven compressor is used, belt movement shall be controlled in both spans, over entire length of belt travel.

On coaches equipped with Diesel engines, an auxiliary heater fired by diesel fuel shall be provided to supplement the heat supplied by the engine and shall have an output necessary to meet the performance criteria specified as well as maintain engine manufacturer's minimum operating temperature in cold weather ambient conditions. The heater shall be equipped with safety device to prevent the following: over-fueling, overheating due to loss of coolant or water pump failure, and operation during conditions of low battery voltage. The auxiliary heater shall have capability of functioning in the supplement mode and preheat mode. The supplement mode shall automatically cycle the auxiliary heater ON and OFF according to the coolant temperature. No driver input shall be required when engine is running. The preheat mode shall be enabled through a single-pole double throw momentary switch. With master run switch in the off position, toggling the switch to its momentary upward (ON) position shall enable the auxiliary heater to operate in preheat. Once in preheat, the unit shall continue to operate and cycle until either the preheat switch is toggled to its momentary downward (OFF) position, or the master run switch is turned ON, or the time elapsed exceeds 60 minutes at which time the preheat mode will automatically be disabled. The supplement mode will always override the preheat mode.

The auxiliary heater coolant pump shall shut down when the coolant is up to temperature during the supplemental mode. With the engine running, there shall be coolant flow through

the heater all the time. The temperature sensor shall constantly measure the coolant temperature and cycle ON if require at which time the coolant pump turns on.

On coaches with auxiliary coolant heater, where coolant circuits are segregated (propulsion and cabin), the cabin circuit shall include a bypass branch, independent of the cabin heating components for the purpose of isolating coolant circulation from the floor heaters, defroster, and HVAC system. This branch shall be solenoid valve controlled and activated by the multiplexed electrical system when driver or passenger area heating is not required.

The auxiliary heater shall be equipped with a self-priming fuel pump. The unit shall be electronically controlled with appropriate diagnostics for troubleshooting. Operation, as well as, diagnostic data shall be stored and shall be retrievable through WMATA compatible PC

The auxiliary heater maintenance/diagnostic information shall be communicated through SAE J1939 vehicle's Automatic Vehicle Monitoring system.

TS 53. Controls and Temperature Uniformity

The HVAC system excluding the driver's heater/defroster shall be centrally controlled with an advanced electronic/diagnostic control system with provisions for extracting/reading data. The system shall be compliant with J1939 Communication Protocol for receiving and broadcasting of data.

Hot engine coolant water shall be delivered to the HVAC system driver's defroster/heater and other heater cores by means of an auxiliary coolant pump, sized for the required flow, which is brushless and seal less having a minimum maintenance free service life for both the brushless motor and the pump of at least 40,000 hours at full power.

Fully Automatic Climate Control System
The climate control system shall be fully automatic and control the interior average temperature to within ±1 °F of specified temperature control set-point.

Dual-Temperature Control Set Point
The temperature control set-point for the system in the cooling mode shall be 68 - 72 °F.

Interior temperature distribution shall be uniform to the extent practicable to prevent hot and/or cold spots. After stabilization with doors closed, the temperatures between any two points in the passenger compartment in the same vertical plane, and 6 to 72 in. above the floor, shall not vary by more than 5 °F with doors closed. The interior temperatures, measured at the same height above the floor, shall not vary more than ± 5 °F from the front to the rear from the average temperature determined in accordance with APTA's "Recommended Instrumentation and Performance Testing for Transit Bus Air Conditioning System." ▫▫▫▫▫▫▫▫▫▫ of greater than ± 5 °F will be allowed for limited, localized areas majority of the measured temperatures fall within the specified requirement.

TS 54 Air Flow

TS 54.1 Passenger Area

The cooling mode of the interior climate control system shall introduce air into the bus at or near the ceiling height at a minimum rate cubic ft per minute (cfm) per passenger based on the standard configuration bus carrying a number of passengers equal to 150 percent of the seated load. Airflow shall be evenly distributed throughout the bus, with air velocity not exceeding 100 ft per minute on any passenger. The ventilating mode shall provide air at a minimum flow rate of 20 cfm per passenger.

Airflow may be reduced to per passenger (150 percent of seated load) when operating in the heating mode. The fans shall not activate until the heating element has warmed sufficiently to ensure at least 70 °F air outlet temperature. The heating air outlet temperature shall not exceed 120 °F under any normal operating conditions.

The climate control blower motors and fan shall be designed such that their operation complies with the interior noise level requirements.

No "Fresh Air" Requirements
WMATA has the type of operating profile where door opening cycle results in effectively providing an adequate "fresh air" mixture.

TS 54.2 Driver's Area

The bus interior climate control system shall deliver at least 100 cfm of air to the driver's area when operating in the ventilating and cooling modes. Adjustable nozzles shall permit variable distribution or shutdown of the airflow. Airflow in the heating mode shall be reduced proportionally to the reduction of airflow into the passenger area. The windshield defroster unit shall meet the requirements of SAE Recommended Practice J382, "Windshield Defrosting Systems Performance Requirements," and shall have the capability of diverting heated air to the driver's feet and legs. The defroster or interior climate control system shall maintain visibility through the driver's side window.

The driver shall have full control over the defroster and driver's heater. The driver shall be able to adjust the temperature in the driver's area through air distribution and fans. The interior climate control system shall switch automatically to the ventilation mode if the refrigerant compressor or condenser fan fails.

TS 54.3 Controls for the Climate Control System (CCS)

The controls for the driver's compartment for heating, ventilation and cooling systems shall be integrated and shall meet the following requirements:

- The heat/defrost system fan shall be controlled by a separate switch that has an "off" position and at least two positions for speed control. All switches and controls shall preclude the possibility of clothing becoming entangled, and shields shall be provided,

if required. If the fans are approved by the WMATA, an "on-off" switch shall be located to the right of or near the main defroster switch.

- A manually operated control valve shall control the coolant flow through the heater core.
- **Cable operated water control not allowed. Electronically control coolant valve (actuator) shall be mounted outside of heater box for easy access.**

TS 54.4 Driver's Compartment Requirements

A separate heating, ventilation and defroster system for the driver's area shall be provided and shall be controlled by the driver. The system shall meet the following requirements:

- The heater and defroster system shall provide heating for the driver and heated air to completely defrost and defog the windshield, driver's side window, and the front door glasses in all operating conditions. Fan(s) shall be able to draw air from the bus body interior and/or the exterior through a control device and pass it through the heater core to the defroster system and over the driver's feet. A minimum capacity of 150 cfm shall be provided. The driver shall have complete control of the heat and fresh airflow for the driver's area.
- The defroster supply outlets shall be located at the lower edge of the windshield. These outlets shall be unbreakable and shall be free of sharp edges that can catch clothes during normal daily cleaning. The system shall be such that foreign objects such as coins or tickets cannot fall into the defroster air outlets. Adjustable ball vents or louvers shall be provided at the left of the driver's position to allow direction of air onto the side windows. Two (2) additional ball vents shall be located on the vertical front dash panel adjacent to the front door to allow direction of air onto the door windows and/or entrance area.

A separate ventilation system shall be provided to ensure driver comfort and shall be capable of providing fresh air in both the foot and head areas. Vents shall be controllable by the operator from the normal driving position. Decals shall be provided, indicating "operating instructions" and "open" and "closed" positions as well. When closed, vents shall be sealed to prevent the migration of water or air into the bus.

TS 54.5 Driver's Cooling

Requirements for operator's cooling shall be consistent with specifications noted in section TS.54.2 with driver's shield in closed position. **Additional fan shall be installed above the operator seat. A switch (on/off) shall be provided on the side console for easy access to operate the ceiling fan for comfort.**

TS 55. Air Filtration

Air shall be filtered before discharge into the passenger compartment. The filter shall meet the ANSI/ASHRAE 52.1 requirement for 5 percent or better atmospheric dust spot efficiency, 50 percent weight arrestance, and a minimum dust holding capacity of 120 g per 1000 cfm

cell. More efficient air filtration may be provided to maintain efficient heater and/or evaporator operation. Air filters shall be easily removable for service.

Cleanable Filters
Air filters shall be cleanable permanent filters.

TS 56. Roof Ventilators

NOTE: No front roof ventilator needed if bus manufacturer meets emergency exit requirements.

Two Roof Ventilators
Two roof ventilators (TranspecT2870 glass roof hatch or approved equal) shall be provided in the roof of the bus, one approximately over or just forward of the front axle and the other approximately over the rear axle.

Each ventilator shall be easily opened and closed manually by a 50th percentile female. If roof ventilator (s) cannot be reached by a 50th percentile female, then a tool shall be provided to allow this. When open with the bus in motion, this ventilator shall provide fresh air inside the bus. The ventilator shall cover an opening area no less than 425 sq. in. and shall be capable of being positioned as a scoop with either the leading or trailing edge open no less than 4 in., or with all four edges raised simultaneously to a height of no less than 3½ in. An escape hatch shall be incorporated into the roof ventilator. Roof ventilator(s) shall be sealed to prevent entry of water when closed.

TS 57. Maintainability

Manually controlled shut-off valves in the refrigerant lines shall allow isolation of the compressor and dehydrator filter for service. To the extent practicable, self-sealing couplings utilizing O-ring seals shall be used to break and seal the refrigerant lines during removal of major components, such as the refrigerant compressor. Shut-off valves may be provided in lieu of self-sealing couplings. The condenser shall be located to efficiently transfer heat to the atmosphere and shall not ingest air warmed above the ambient temperature by the bus mechanical equipment, or to discharge air into any other system of the bus. The location of the condenser shall preclude its obstruction by wheel splash, road dirt or debris. HVAC components located within 6 in. of floor level shall be constructed to resist damage and corrosion.

TS 58 Entrance/exit area heating

Heat shall be supplied to the entrance and exit areas to prevent accumulation of snow, ice or slush with bus operating under design operating profile and corresponding door opening cycle.

TS 59. Floor-Level Heating

Forced-Air Floor-Level Heating
Sufficient floor-level heaters shall be provided to evenly supply heated forced air through floor ducts across the length of bus. Floor ducts may be discontinued at the upper level, but additional provisions to prevent cold floors and ensure temperature uniformity shall be included. Control of the floor-level heating shall be through the main heating system electronic control.

EXTERIOR PANELS, FINISHES AND EXTERIOR LIGHTING

TS 60. Design

The bus shall have a clean, smooth, simple design, primarily derived from bus performance requirements and passenger service criteria. The exterior and body features, including grilles and louvers, shall be shaped to facilitate cleaning by automatic bus washers without snagging washer brushes. Water and dirt shall not be retained in or on anybody feature to freeze or bleed out onto the bus after leaving the washer. The body and windows shall be sealed to prevent leaking of air, dust or water under normal operating conditions and during cleaning in automatic bus washers for the service life of the bus.

Exterior panels shall be sufficiently stiff to minimize vibration, drumming or flexing while the bus is in service. When panels are lapped, the upper and forward panels shall act as a watershed. However, if entry of moisture into the interior of the vehicle is prevented by other means, then rear cap panels may be lapped otherwise. The windows, hatches and doors shall be able to be sealed. Accumulation of spray and splash generated by the bus's wheels shall be minimized on windows and mirrors.

TS 60.1 Materials

Body materials shall be selected and the body fabricated to reduce maintenance, extend durability and provide consistency of appearance throughout the service life of the bus. Detailing shall be kept simple, and add-on devices and trim shall be minimized and integrated into the basic design.

Requirements for protection against graffiti/vandalism for body material surfaces.

TS 60.2 Roof-Mounted Equipment

A non-skid clearly marked all possible walkway or steps shall be incorporated on the roof to provide access to equipment without damaging any system or bus paneling. **Large decals shall be provided non standing and non-walking zone for safety.**

TS 61. Pedestrian Safety

Exterior protrusions along the side and front of the bus greater than ½ in. and within 80 in. of the ground shall have a radius no less than the amount of the protrusion. The exterior rearview mirrors, cameras and required lights and reflectors are exempt from the protrusion

requirement. Advertising frames shall protrude no more than ⅞ in. from the body surface. Grilles, doors, bumpers and other features on the sides and rear of the bus shall be designed to minimize toeholds or handholds.

Exterior protrusions shall not cause a line-of-sight blockage for the driver.

TS 62. Repair and Replacement

TS 62.1 Side Body Panels

Exterior panels below the lower window (s) and within 35 inches above ground level shall be divided into sections that are repairable or replaceable by a 3M mechanic in less than 30 minutes for a section up to 5 feet long (excludes painting).Easily Replaceable Lower Side Body Panels
The lower section (approximately 17.5 in.) of the side body panels shall be made of impact-resistant material and shall be easily and quickly replaceable.

Easily Replaceable Full-Height Side Body Panels
Easily replaceable full-height side body panels between the window and floor shall be easily and quickly replaceable in sections.

TS 63. Rain Gutters

Rain gutters shall be provided to prevent water flowing from the roof onto the passenger doors and driver's side window. When the bus is decelerated, the gutters shall not drain onto the windshield, driver's side window or door boarding area. Must have two (2) drain holes on curb side and three (3) on street side in between windows. Cross-sections of the gutters shall be adequate for proper operation.

TS 64. License Plate Provisions

Provisions shall be made to mount standard-size U.S./Canada license plates per SAE J686 on the front and rear of the bus. These provisions shall direct-mount or recess the license plates so that they can be cleaned by automatic bus-washing equipment without being caught by the brushes. The rear license plate provision shall be illuminated per SAE J587.

Front Plate or Holder is required
Location to be provided to OEM by WMATA

TS 64.1 Rub rails

No requirement for rub rails.

TS 65. Fender Skirts

Features to minimize water spray from the bus in wet conditions shall be included in wheel housing design. Any fender skirts shall be easily replaceable. They shall be flexible if they

extend beyond the allowable body width. Wheels and tires shall be removable with the fender skirts in place.

TS 66. Wheel covers

Wheel covers not required.

TS 66.1 Splash Aprons

WMATA requires a full width rear splash apron front and rear. Installation subject to WMATA approval.

TS 67. Service Compartments and Access Doors

TS 67.1 Access Doors

Conventional hinged doors shall be used for the engine compartment and for all auxiliary equipment compartments including doors for checking the quantity and adding to the engine coolant, engine lubricant and transmission fluid. Access openings shall be sized for easy performance of tasks within the compartment, including tool operating space. Access doors shall be of rugged construction and shall maintain mechanical integrity and function under normal operations throughout the service life of the bus. They shall close flush with the body surface. All doors shall be hinged at the top or on the forward edge and shall be prevented from coming loose or opening during transit service or in bus washing operations**. Front defroster door may be bottom hinged. A secure locking mechanism must be provided to ensure the door will not inadvertently open during service.** Doors with top hinges shall have safety props stored behind the door or on the door frame. All access doors shall be retained in the open position by counterbalancing with over-center or gas-filled springs with safety props and shall be easily operable by one person. Springs and hinges shall be corrosion resistant. Latch handles shall be flush with, or recessed behind, the body contour and shall be sized to provide an adequate grip for opening. Access doors, when opened, shall not restrict access for servicing other components or systems.

If precluded by design, the manufacturer shall provide door design information specifying how the requirements are met.

TS 67.2 Access Door Latch/Locks

Requirement for Latches on Access Doors Access doors larger than 100 sq in. in area shall be equipped with corrosion-resistant flush-mounted latches or locks except for coolant and fuel fill access doors. All such access doors that require a tool to open shall be standardized throughout the vehicle and will require WMATA approved tool to open or lock. **Battery cut off switch access door must have a 5/16” sq. key lock.**

TS 68.Bumpers

TS 68.1 Location

Bumpers shall provide impact protection for the front and rear of the bus with the top of the bumper being no lower than 21 ± 2 in., above the ground. Bumper height shall be such that when one bus is parked behind another, a portion of the bumper faces will contact each other.

TS 68.2 Front Bumper

No part of the bus, including the bumper, shall be damaged as a result of a 5 mph impact of the bus at curb weight with a fixed, flat barrier perpendicular to the bus's longitudinal centerline. The bumper shall return to its pre-impact shape within 10 minutes of the impact. The bumper shall protect the bus from damage as a result of 6.5 mph impacts at any point by the common carriage with contoured impact surface defined in Figure 2 of FMVSS 301 loaded to 4000 lbs parallel to the longitudinal centerline of the bus. It shall protect the bus from damage as a result of 5.5 mph impacts into the corners at a 30-degree angle to the longitudinal centerline of the bus. The energy absorption system of the bumper shall be independent of every power system of the bus and shall not require service or maintenance in normal operation during the service life of the bus. The bumper may increase the overall bus length specified by no more than 7 in.

The front bumper shall be designed to accommodate a mounted bicycle rack capable of transporting up to two (2) bicycles. All necessary hardware **(to include bracketry) necessary** for mounting the Sportswork (Apex-2) or Byk-Rak (2 positions). The bicycle mounting bracket shall be easily removable to permit front end lift or flat towing without having to disassemble and/or remove any part(s) and/or section (s) of the front bumper assembly utilizing the "quick release" system.

Mounting provisions for integrated bike rack.

Integrated Design with Recessed Middle Portion Bumper shall be an integrated design with the coach styling and be recessed in the middle portion to provide for mounting of a bike rack if necessary.

TS 68.3 Rear Bumper

No part of the bus, including the bumper, shall be damaged as a result of a 2 mph impact with a fixed, flat barrier perpendicular to the longitudinal centerline of the bus. The bumper shall return to its pre-impact shape within 10 minutes of the impact. When using a yard tug with a smooth, flat plate bumper 2 ft wide contacting the horizontal centerline of the rear bumper, the bumper shall provide protection at speeds up to 5 mph, over pavement discontinuities up to 1 in. high, and at accelerations up to 2 mph/sec. The rear bumper shall protect the bus, when impacted anywhere along its width by the common carriage with contoured impact surface defined in Figure 2 of FMVSS 301 loaded to 4000 lbs, at 4 mph parallel to or up to a 30-degree angle to, the longitudinal centerline of the bus. The rear

bumper shall be shaped to preclude unauthorized riders standing on the bumper. The bumper shall not require service or maintenance in normal operation during the service life of the bus. The bumper may increase the overall bus length specified by no more than 7 in.

TS 68.4 Bumper Material

Bumper material shall be corrosion-resistant and withstand repeated impacts of the specified loads without sustaining damage. Visible surfaces shall be black. These bumper qualities shall be sustained throughout the service life of the bus.

TS 69. Finish and Color

TS 69.1 Appearance

All exterior surfaces shall be smooth and free of wrinkles and dents. Exterior surfaces to be painted shall be properly prepared as required by the paint system Supplier prior to application of paint to assure a proper bond between the basic surface and successive coats of original paint for the service life of the bus. Drilled holes and cutouts in exterior surfaces shall be made prior to cleaning, priming and painting, where possible, to prevent corrosion. The bus shall be completely painted prior to installation of exterior lights, windows, mirrors and other items that are applied to the exterior of the bus. Body filler materials may be used for surface dressing, but not for repair of damaged or improperly fitted panels.

Paint shall be applied smoothly and evenly with the finished surface free of visible dirt and the following other imperfections:

- blisters or bubbles appearing in the topcoat/clear coat film
- chips, scratches, or gouges of the surface finish
- cracks in the paint film
- craters where paint failed to cover due to surface contamination
- overspray
- peeling
- runs or sags from excessive flow and failure to adhere uniformly to the surface
- chemical stains and water spots
- dry patch due to incorrect mixing of paint activators
- buffing swirls
- excessive overspray
- orange peel

All exterior finished surfaces shall be impervious to diesel fuel, gasoline and commercial cleaning agents. Finished surfaces shall resist damage by controlled applications of commonly used graffiti-removing chemicals.

Proper adhesion between the basic surface and successive coats of the original paint shall be measured using an Ecometer adhesion tester as outlined in ASTM D4541-85. Adhesion shall be a minimum 300 ft-lbs. The bus manufacturer shall supply test samples of the exterior surface for each step of the painting process that may be subject to adhesion testing per

ASTM G4541-87 and ASTM D4145-85. ASTM D4541-93 may be used for inspection testing during assembly of the vehicle.

The exterior paint and graphics a comprised of base coat clear coat process and vinyl decals. Primarily the forward half of the bus is painted DuPont Silver Metallic 841 I44EGG and DuPont Clear coat 8420S. The rear half of the bus is painted DuPont Red 830650EG and DuPont Clear coat S42OSWMATA. The two paint colors are joined by a reverse "S" "swooshing blue and white decal extending from the bottom of the bus to the top of the roof. WMATA will provide a sample of the exterior paint and graphics layout. WMATA may reject any bus that does not comply with the approved exterior graphics scheme drawings. Upon inspection of the Pilot Bus, WMATA may direct the Contractor to make minor changes in the paint/graphics placement and color scheme, Consistent with the approved color scheme drawings, at no additional cost to WMATA**.**
The exterior and interior graphics shall be supplied by an Authority approved Graphics Vendor. All striping, decals, coach numbers, signage, monograms and appliqués will be provided by The Authority approved Vendor.
The selected contractor will furnish the Authority approved Graphics Vendor an electronic file showing the elevation drawings of the proposed bus and all interior and exterior graphics locations. In return, the Authority approved Graphics Vendor will furnish the successful bidder and WMATA complete engineering drawings with material specifications. This final layout will be provided within 3 weeks of receipt of the electronic file. The Authority approved Graphics Vendor will oversee installation of the entire graphics package to assure that all recommended 3M procedures are followed. All exterior graphics shall be manufactured from 3M 680C reflective vinyl material. Interior decals and signage material specifications shall be determined by WMATA.

High Gloss External Paint Finish Quality
Painted surfaces shall have a minimum 95 gloss and an orange peel rating of 7 or more on the Advanced Coating Technologies, Inc., orange peel standard panels set #APR 14941 or Authority accepted wave scan equipment. Paint shall last a minimum of six years with a minimum gloss of 90 as measured in ASTM E97-92, "Standard Test Method for Directional Reflectance."

Standard OEM exterior paint system.
Basecoat/Clear Coat paint system.

Maintenance-Free Exterior Finish, Color Impregnated Panels or Unpainted Panels
Except for periodic cleaning, exterior surfaces of the bus shall be maintenance-free, permanently colored and not require refinish/repaint for the life of the vehicle. In general, the exterior surfaces shall be WMATA approved paint scheme. Durable, peel-resistant, pressure-sensitive appliqués shall be used for any striping and coloring required.

NOTE: WMATA will provide paint scheme and type of paint shall be use.

TS 70. Decals, Numbering and Signing

Monograms, numbers and other special signing shall be applied to the inside and outside of the bus as required. Signs shall be durable and fade-, chip- and peel-resistant. They may be painted signs, decals or pressure-sensitive appliqués. All decals shall be installed per the decal Supplier recommendations. Signs shall be provided in compliance with the ADA requirements defined in 49 CFR Part, Subpart B, 38.27.

The placement, size, appearance, content and fabrication of all decals, numbering, and signage shall be submitted for WMATA's approval based on existing WMATA buses and operational requirements. WMATA will supply samples of these items upon request from the Contractor.

The bus unit number series for this contract shall be provided after the bid award. Unit numbers shall run consecutively in the same order as the bus serial numbers starting with the lowest serial number. Detailed minimum requirements for the quantities, placement, size, appearance content and fabrication of signage are given in the following sections. The Contractor may propose additional signage for WMATA's approval to enhance customer service, safety, or other benefits. WMATA 'viii provide a layout of the exterior decaling for the bus.
The bus shall have six sets of four-digit, 4-inches in high unit numbers installed. There shall also be one set of four-digit. 24-inch high unit numbers installed on the roof. The exact location for installation will be approved by WMATA.

WMATA will provide a complete set of sample interior and exterior decals/graphics and installation locations to the successful proposer.

TS 70.1 Passenger Information

ADA priority seating signs as required and defined by 49 CFR, Part 38.27 shall be provided to identify the seats designated for passengers with disabilities.

Requirements for a public information system in accordance with 49 CFR, Part 38.35 shall be provided.

TS 71. Exterior Lighting

Exterior lighting and reflectors shall comply, as applicable, with Part 393, Subpart B of the FMCSA and FMVSS 108.

All exterior lights shall be designed to prevent entry and accumulation of moisture or dust and each lamp shall be replaceable in less than 5 minutes by a 2M mechanic helper. Commercially available dual intensity LED-type lamps shall be utilized at all exterior lamp locations except headlights. Lamps, lenses and fixtures shall be interchangeable to the extent practicable. Lights mounted on the engine compartment doors shall be protected from

the impact shock of door opening and closing. Light lenses shall be designed and located to prevent damage when running the vehicle through an automatic bus washer. Front marker (clearance) lights along with lights located on the roof and sides of the bus shall have protective shields or be of the flush mount type to protect the lens against minor impacts.

Standard Lamps
All LED lamps shall be standard installation of the OEM. The entire assembly shall be specifically coated to protect the light from chemical and abrasion degradation.

LED lamps used for tail, brake and turn signal lamps shall be of 4 inches in diameter.

TS 71.1 Backup Light/Alarm

Visible and audible warnings shall inform following vehicles or pedestrians of reverse operation. Visible reverse operation warning shall conform to SAE Standard J593. Audible reverse operation warning shall conform to SAE Recommended Practice J994 Type C or D.

TS 71.3 Doorway Lighting

Lamps at the front and rear passenger doorways shall comply with ADA requirements and shall activate only when the doors open. These lamps shall illuminate the street surface to a level of no less than 1 foot-candle for a distance of 3 ft outward from the outboard edge of the door threshold. The lights may be positioned above or below the lower daylight opening of the windows and shall be shielded to protect passengers' eyes from glare.

TS 71.3 Turn Signals

Standard LED Turn Signals
Turn-signal lights shall be provided on the front, rear, curb and street sides of the bus in accordance with FMVSS 108 and Part 393, Subpart B of the FMCSA as applicable.
Cornering lights, located aft of both front and forward of right rear wheels are required. Lights to be 4 inches diameter, and white in color. Location and installation to be approved by WMATA.

TS 71.4 Headlights

The Headlamps shall be designed for replacement without removing the headlamp bezel (If bezel part of the design).

Standard Installation
Standard OEM LED headlight installation shall be provided in accordance with FMVSS 108 and Part 393, Subpart B of the FMCSA as applicable.

Daytime Running Lights
Headlamps shall incorporate a daytime running light feature.

Headlamps
Headlamps shall be LED.

TS 71.5 Brake Lights

Brake lights shall be provided in accordance with FMVSS 108 and Part 393, Subpart B of the FMCSA as applicable.

High and Center Mount Red Brake Lamp
Bus shall include two red, LED strip lamp(s) along the backside of the bus above the engine compartment door in addition to the lower brake lamps required under FMVSS 108. The high and center mount brake lamp(s) shall illuminate steady with brake application.
(Size and location shall be approved by WMATA)

High and Center Mount Amber Turn Signal Lamps
Bus shall include two amber lights to operate with Turn Signals, one on each side. Size and location of the lights on the back of the bus shall be approved by WMATA.

TS 71.6 Service Area Lighting (Interior and Exterior)

LED lamps shall be provided in the engine and all other compartments where service may be required to generally illuminate the area for night emergency repairs or adjustments. These service areas shall include, but not be limited to, the engine compartment, the communication box, junction/apparatus panels and passenger door operator compartments. Lighting shall be adequate to light the space of the service areas to levels needed to complete typical emergency repairs and adjustments. The service area lamps shall be suitable for the environment in which they are mounted.

Engine compartment lamps shall be controlled by a switch mounted near the rear start controls. All other service area lamps shall be controlled by switches mounted on or convenient to the lamp assemblies. Power to the service area lighting shall be programmable. Power shall latch on with activation of the switch and shall be automatically discontinued (timed out) after 30 minutes to prevent damage caused by inadvertently leaving the service area lighting switch in the on position after repairs are made.

INTERIOR PANELS AND FINISHES

TS 72. General Requirements

Materials shall be selected on the basis of maintenance, durability, appearance, safety, flammability and tactile qualities. Materials shall be strong enough to resist everyday abuse

and be vandalism and corrosion resistant. Trim and attachment details shall be kept simple and unobtrusive. Interior trim shall be secured to avoid resonant vibrations under normal operational conditions.

Interior surfaces more than 10 in. below the lower edge of the side windows or windshield shall be shaped so that objects placed on them fall to the floor when the coach is parked on a level surface. Any components and other electrical components within close proximity to these surfaces shall also be resistant to this cleaning method.

Requirements for additional anti-graffiti/vandalism treatments for interior surfaces.

Internal surfaces, as possible, to be stainless steel or other resistant material.

TS 73. Interior Panels

Panels shall be easily replaceable and tamper-resistant. They shall be reinforced, as necessary, to resist vandalism and other rigors of transit bus service. Individual trim panels and parts shall be interchangeable to the extent practicable.

Interior panel required to meet FMVSS 302.

Fire Resistance Materials shall comply with the Recommended Fire Safety Practices defined in FTA Docket 90-A, dated October 20, 1993.

Composite material.

TS 73.1 Driver Area Barrier

A WMATA approved designed driver's security barrier/door shall be installed on the aisle side of the driver's compartment. The barrier/door shall have a solid bottom clear upper half. The barrier/door shall not interfere or obstruct the operator's visibility when seated on the driver's seat. Barrier/door shall be one piece design and cannot be open more than 90 degree. Upper section must be safety glass with anti-glare coated**. (See details in section 44.9)**

Wheel-Well-to-Ceiling Configuration of Driver's Barrier (Electronic Storage Box) The driver's barrier shall have a storage box for all electronic devices can be installed. It shall have three selves and door with keyed lock. The design of the Electronic Equipment Storage Box subject to WMATA approval. The SDS box shall be extended from the top of the street side wheel well to the ceiling. Location and shape must permit full driver seat travel

possibilities and accommodate the shoulders of a 95th percentile male. The Electronic Equipment Storage Box shall be painted flat black.

TS 73.2 Modesty Panels

Sturdy divider panels constructed of durable, unpainted, corrosion-resistant material complementing the interior shall be provided to act as both a physical and visual barrier for seated passengers.

Modesty panels shall be located at doorways to protect passengers on adjacent seats, and along front edge of rear upper level. Design and installation of modesty panels located in front of forward-facing seats shall include a handhold or grab handle along its top edge. These dividers shall be mounted on the sidewall and shall project toward the aisle no farther than passenger knee projection in longitudinal seats or the aisle side of the transverse seats. Modesty panels shall extend from at least the window opening of the side windows, and those forward of transverse seats shall extend downward to 1 and 1½ in. above the floor. Panels forward of longitudinal seats shall extend to below the level of the seat cushion. Dividers positioned at the doorways shall provide no less than a 2½ in. clearance between the modesty panel and a fully open, inward opening door, or the path of a deploying flip-out ramp to protect passengers from being pinched. Modesty panels installed at doorways shall be equipped with grab rails if passengers assist are not provided by other means.

The modesty panel and its mounting shall withstand a static force of 250 lbs applied to a 4 × 4 in. area in the center of the panel without permanent visible deformation.

Additional floor clearances for cleaning and toe clearance 1.5 inches.

TS 73.3 Front End

The entire front end of the bus shall be sealed to prevent debris accumulation behind the dash and to prevent the driver's feet from kicking or fouling wiring and other equipment. The front end shall be free of protrusions that are hazardous to passengers standing at the front of the standee line area of the bus during rapid decelerations. Paneling across the front of the bus and any trim around the driver's compartment shall be formed metal or composite material. Composite dash panels shall be reinforced as necessary, vandal-resistant and replaceable. All colored, painted and plated parts forward of the driver's barrier shall be finished with a surface that reduces glare. Any mounted equipment must have provision to support the weight of equipment.

TS 73.4 Rear Bulkhead

The rear bulkhead paneling shall be contoured to fit the ceiling, side walls and seat backs so that any litter or trash will tend to fall to the floor or seating surface when the bus is on a level surface. Any air vents in this area shall be louvered to reduce airflow noise and to reduce the probability of trash or liter being thrown or drawn through the grille. If it is necessary to remove the panel to service components located on the rear bulkhead, the panel shall be hinged or shall be able to be easily removed and replaced by a 3M mechanic in 5 minutes. Grilles

where access to or adjustment of equipment is required shall be heavy-duty and designed to minimize damage and limit unauthorized access.

TS 73.5 Headlining

Ceiling panels shall be made of durable, corrosion resistant, easily cleanable material. Headlining shall be supported to prevent buckling, drumming or flexing and shall be secured without loose edges. Headlining materials shall be treated or insulated to prevent marks due to condensation where panels are in contact with metal members. Moldings and trim strips, as required to make the edges tamperproof, shall be stainless steel, aluminum or plastic, colored to complement the ceiling material. Headlining panels covering operational equipment that is mounted above the ceiling shall be on hinges for ease of service but retained to prevent inadvertent opening. **Colors, pattern and materials for the headlining shall be approved by WMATA.**

TS 73.6 Fastening

Interior panels shall be attached so that there are no exposed unfinished or rough edges or rough surfaces. All fasteners must be stainless steel. Panels and fasteners shall not be easily removable by passengers. Exposed interior fasteners should be minimized, and where required shall be tamper-resistant.

TS 73.7 Insulation

Any insulation material used between the inner and outer panels shall minimize the entry and/or retention of moisture. Insulation properties shall be unimpaired during the service life of the bus. Any insulation material used inside the engine compartment shall not absorb or retain oils or water and shall be designed to prevent casual damage that may occur during maintenance operations.

The combination of inner and outer panels on the sides, roof, wheel wells and ends of the bus, and any material used between these panels, shall provide a thermal insulation sufficient to meet the interior temperature requirements. The bus body shall be thoroughly sealed so that the driver or passengers cannot feel drafts during normal operations with the passenger doors closed.

All insulation material shall comply with the recommended Fire Safety Practices defined in FTA Docket 90, dated October 20, 1993.

TS 73.8 Floor Covering

The floor covering shall have a non-skid walking surface that remains effective in all weather conditions and complies with all ADA requirements. The floor covering, as well as transitions of flooring material to the main floor and to the entrance and exit area, shall be smooth and present no tripping hazards. Seams shall be sealed/welded per manufacturer's specifications. The standee line shall be approximately 2 in. wide and shall extend across the bus aisle. The color and pattern shall be consistent throughout the floor covering. **The floor covering material and color shall be approved by WMATA.**

Additional Requirements
Any areas on the floor that are not intended for standees, such as areas "swept" during passenger door operation, shall be clearly and permanently marked with contrast in color.

The floor (including operators compartment) shall be easily cleaned and shall be arranged to minimize debris accumulation.

A one-piece center strip shall extend from the vertical wall of the rear settee between the aisle sides of transverse seats to the standee line. If the floor is of a bi-level construction, then the center strip shall be one piece at each level. The covering between the center strip and the wheel housings may be separate pieces. At the rear door, however, a separate piece as wide as the door shall extend from the street side wall to the outboard edge of the rear/exit area and it shall be yellow in color with "DO NOT STAND IN THIS AREA" embedded in the flooring material.

The floor under the seats shall be covered with smooth surface flooring material. The floor covering shall closely fit the sidewall in a fully sealed butt joint or extend to the top of the cove.

TS 73.9 Interior Lighting

The light source shall be located to minimize windshield glare, with distribution of the light focused primarily on the passengers' reading plane while casting sufficient light onto the advertising display. The lighting system may be designed to form part of or the entire air distribution duct.

The lens material shall be translucent polycarbonate. Lenses shall be designed to effectively "mask" the light source. Lenses shall be sealed to inhibit incursion of dust and insects yet be easily removable for service. Access panels shall be provided to allow servicing of components located behind light panels. If necessary, the entire light fixture shall be hinged.

TS 73.10 Passenger

All interior lighting shall be turned off whenever the transmission selector is in reverse and the engine run switch is in the "on" position.

The interior lighting design shall require the approval of WMATA.

All LED lights shall be provided interior of the bus.

First Light Modules Dim When Front Door is closed
When the master switch is in the "run" or "night/run" mode, the first light module on street side and first two lights on curb side of the coach shall automatically **dim (up to 25%)** when the front door is in the closed position and illuminate when the door is opened.

TS 73.11 Driver Area

The driver's area shall have a light to provide general illumination, and it shall illuminate the half of the steering wheel nearest the driver to a level of 8 to 10 foot-candles.

TS 73.12 Seating Areas

The interior lighting system shall provide a minimum 15 foot-candle illumination on a 1 sq ft plane at an angle of 45 degrees from horizontal, centered 33 in. above the floor and 24 in. in front of the seat back at each seat position. Allowable average light level for the rear bench seats shall be 7 foot-candles. **Light shall be provided under ADA seats on both sides. The light location and installation with shade shall be approved by WMATA.**

TS 73.13 Vestibules/Doors

Floor surface in the aisles shall be a minimum of 10 foot-candles, and the vestibule area a minimum of 4 foot-candles with the front doors open and a minimum of 2 foot-candle with the front doors closed. The front entrance area and curb lights shall illuminate when the front door is open and master run switch is in the "lights" positions. Rear exit area and curb lights shall illuminate when the rear door is unlocked.

TS 73.14 Step Lighting

Step lighting for the intermediate steps between lower and upper floor levels shall be a minimum of 4 foot-candles and shall illuminate in all engine run positions. The step lighting shall be low-profile to minimize tripping and snagging hazards for passengers and shall be shielded as necessary to protect passengers' eyes from glare.

TS 73.15 Ramp Lighting

Exterior and interior ramp lighting shall comply with CFR Part 49, Sections 19.29 and 19.31.

TS 73.16 Turn Table Lighting

Turn Table Light
A LED light fixture shall be mounted on all four corners of the turn table. The light fixture shall be capable of projecting a concentrated beam of light on the turn table area. This light will automatically come on whenever the front doors are opened and the run switch is in the "night run" or "night park" position

TS 73.17 Fare box Lighting

Fare box Light
A LED light fixture shall be mounted in the ceiling above the fare box location. The light fixture shall be capable of projecting a concentrated beam of light on the fare box. This light will automatically come on whenever the front doors are opened and the run switch is in the "night run" or "night park" position.

TS74. Fare Collection

Space and structural provisions shall be made for installation of currently available fare collection devices and shall be as far forward as practicable. Location of the fare collection device shall not restrict traffic in the vestibule, including wheelchairs if a front door loading device is used, and shall allow the driver to easily reach the fare box controls and to view the fare register. The fare box shall not restrict access to the driver area, shall not restrict operation of driver controls and shall not — either by itself or in combination with stanchions, transfer mounting, cutting and punching equipment, or route destination signs — restrict the driver's field of view per SAE Recommended Practice J1050. The location and mounting of the fare collection device shall allow use, without restriction, by passengers. The fare box location shall permit accessibility to the vault for easy manual removal or attachment of suction devices. Meters and counters on the fare box shall be readable on a daily basis. The floor under the fare box shall be reinforced as necessary to provide a sturdy mounting platform and to prevent shaking of the fare box.

Transfer mounting, cutting and punching equipment shall be located in a position convenient to the driver.

WMATA will install its own fare box.

TS 75. Interior Access Panels and Doors

Access for maintenance and replacement of equipment shall be provided by panels and doors that appear to be an integral part of the interior. Access doors shall be hinged with gas props or over-center springs, where practical, to hold the doors out of the mechanic's way. Panels shall prevent entry of mechanism lubricant into the bus interior. Panel fasteners shall be standardized so that only one tool is required to service all special fasteners within the bus.

Access Doors that Do Not Require Tools or Keys to Open
Access doors shall be secured with hand screws or latches. All fasteners that retain access panels shall be captive in the cover.

TS 75.1 Floor Panels

Access openings in the floor shall be sealed to prevent entry of fumes and water into the bus interior. Flooring material at or around access openings shall be flush with the floor and shall be edge-bound with stainless steel or another material that is acceptable to WMATA to prevent the edges from coming loose. Access openings shall be asymmetrical so that reinstalled flooring shall be properly aligned. Fasteners shall tighten flush with the floor.

The number of special fastener tools required for panel and access door fasteners shall be minimized.

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PASSENGER ACCOMMODATIONS

TS 76. Passenger Seating

TS 76.1 Arrangements and Seat Style

The passenger seating arrangement in the bus shall be such that seating capacity is maximized and in compliance to the following requirements.

Note: The WMATA recognizes that ramp location, foot room, hip-to-knee room, doorway type, width, seat construction, floor level type, seat spacing requirements, ramp or lift, number of wheelchair positions, etc. ultimately affect seating capacity and layout.

A bid evaluation factor for maximized seating capacity.

CANTILEVER SEAT CONFIGURATION

Passenger seats shall be arranged in a transverse, forward-facing configuration, except at the wheel housings and turntable, if applicable, where aisle-facing seats may be arranged as appropriate with due regard for passenger access and comfort. Other areas where aisle-facing seats may be provided are at wheelchair securement areas and platforms (such as for fuel tank storage space).

Passenger seating capacity with this arrangement shall be no less than 39 not including the operator, with the specified seating arrangement on a 40' bus. On a 60' bus the seating capacity shall be no less than 61.

Perimeter Seating Arrangement

Passenger seats shall be arranged in longitudinal rows facing the centerline of the bus. One row of transverse, forward facing seats shall be provided at the rear of the bus. Each seat shall have a minimum width of 17 in., not including any armrest. Seating capacity with this arrangement shall be no fewer than 39 seated passengers, not including the driver, with the specified seating arrangement.

Combination Forward-Facing and Perimeter Seating Arrangement

Passenger seats shall be arranged in a transverse, two-position forward-facing configuration at the front section of the bus, and in longitudinal rows facing the centerline of the bus with one row of transverse, forward facing seats provided at the rear of the bus. Each seat shall have a minimum width of 17 in., not including any armrest. Seating capacity with this arrangement shall be no less than 39 seated passengers, not including the driver, with the specified seating arrangement.

TS 76.2 Rearward Facing Seats

Rearward facing seats not allowed.

TS 76.3 Turntable Seating

Seats shall be approved by WMATA

TS 76.4 Padded Inserts/Cushioned Seats

Padded Seat Configuration

The seat shell shall be fully contoured for body form comfort and occupant retention. The shell must be designed with step-down relief in seat and back areas to accept padded inserts. The relief shall be 5/16" in depth and contoured to follow the configuration of the shell. Seat shells are to be provided in one (1), two (2) and three (3) passenger constructions with common frames to minimize weight.

The one (I) and two (2) passenger configured transverse seats shall consist of either a one or two passenger shell with separate seat and back inserts supported by a tubular steel frame. The one piece seat shell shall be securely fastened to the tubular steel frame without rivets in a manner to provide structural integrity to the seat.

Seating and interior trim shall have features to improve passenger comfort. The seat cushion and back shall be padded with a cellular foam product and is no less than ½-in. thick in areas contacted and loaded by passengers in the normal seated position and shall be covered with vinyl and/or fabric material.

The seat incorporates a waterfall design on the front and leading edge of the seat insert to insure continuous leg support for all ranges of passengers, from the 5th to 95th percentile. There shall be no "pinch points" or sharp edges in the seat's construction or installation, nor surfaces which impede circulation in the legs while in the seated position. Where three (3) passenger longitudinal (aisle facing) seats are required, the seat is to have one continuous shell with three individual sittings to match the style lines and accept the same inserts as all other seats in the vehicle.

The transverse seats shall have energy-absorbing, cut resistant colored textured thermoplastic grab handles capable of decelerating an occupant's head in a vehicle collision at a velocity of 22 feet per second. The grab handle shall be readily replaceable but attached securely to provide adequate and firm support.

The rear side of the transverse seat backs shall be covered with a panel made of high impact, strength textured, thermoplastic of 1/8" nominal thickness in #989 Blue. The back panel with the molded crash pad shall encompass the entire rearward frame structure and shall be recessed for increased passenger knee clearance. Coloring shall be consistent throughout the thickness of the material with no portion painted.

The bus shall be equipped with Authority approved "Pod Style" Securement System. All frames and mounting brackets shall be stainless steel with a "bead blasted" finish. Each wheelchair securement location shall be equipped with a wheelchair barrier and three (3) or four (4) passenger longitudinal flip-up seats, locking into position thus creating an area to accommodate a wheelchair. At the rear of

each w/c securement location, a barrier with remote release securement belts and a passenger restraint belt (one end mounted to the vehicle wall and the other to the barrier) will provide required and safe securement. (Deluxe Securement Belts). All accessibility components must comply with the requirements of the ADA.

Separate padded seat and back inserts shall be provided for each sitting. Inserts shall be minimum 3/4" in thickness and shall be comprised of a 20 ga steel contoured base panel with '/2" low smoke and flammability foam padding covered with Holdsworth — Anti-Microbial fabric #5621 6094 3267. (Federal Docket 90A). Seat and back inserts shall be attached with a floating/ratcheting device which self aligns and firmly secures to the shell eliminating rattling. The fasteners shall be capable of being cycled 25 times without diminished performance.

Seats, back cushions and other pads shall be securely attached and shall be detachable by means of a simple release mechanism so that they are easily removable by the maintenance staff but not by passengers. To the extent practicable, seat cushions and pads shall be interchangeable throughout the bus. Materials shall have high resistance to tearing, flexing and wetting.

The seat shell shall be fully contoured for body form comfort and occupant retention. The shell must be designed with step-down relief in seat and back areas to accept padded inserts. The relief shall be 5/16" in depth and contoured to follow the configuration of the shell.

The passenger seats shall be equipped with vandal-resistant padded inserts throughout the bus (measure to uncompressed surface).

TS 76.5 Drain-hole in Seats

No requirements for drain hole provision in seat inserts.

TS 76.6 Hip-to-Knee Room

Hip-to-knee room measured from the center of the seating position, from the front of one seat back horizontally across the highest part of the seat to vertical surface immediately in front, shall be a minimum of 27,5 in. At all seating positions in paired transverse seats immediately behind other seating positions, hip-to-knee room shall be no less than 26.5 in.

Allow variations in limited areas. In order to maximize seating capacity without unduly affecting passenger comfort, minor variations in the required hip-to-knee room will be allowed in limited areas. **All such areas shall be identified to WMATA prior to bid for approval.**

TS 76.7 Foot Room

Foot room, measured at the floor forward from a point vertically below the front of the seat cushion, shall be no less than 14 in. Seats immediately behind the wheel housings and modesty panels may have foot room reduced, provided the wheelhouse is shaped so that it may be used as a footrest or design of modesty panel effectively allows for foot room.

TS 76.8 Aisles

The aisle between the seats shall be no less than 20 in. wide at seated passenger hip height. Seat backs shall be shaped to increase this dimension to no less than 24 in. at 32 in. above the floor (standing passenger hip height).

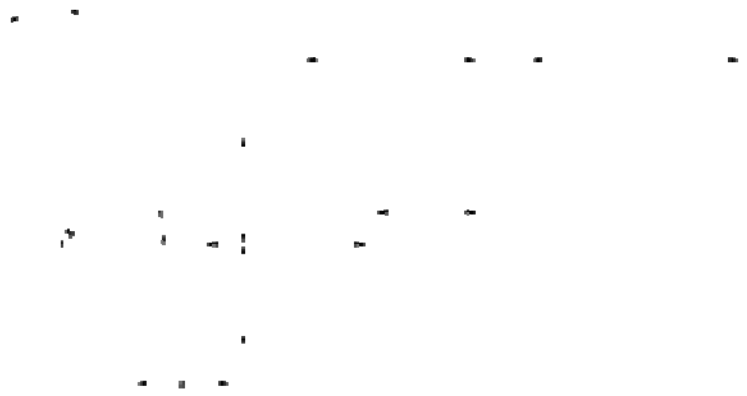
Thickness of the transverse seat backs shall be minimized at the bottom to increase passenger knee room and passenger capacity. The area between the longitudinal seat backs and the attachment to the bus sidewalls shall be designed to prevent debris accumulation.

Raised platforms for passenger seats shall not be allowed without WMATA's approval. If vehicle is of a sloped floor design, then raised platform for passenger seats may be provided in the rear sloped section.

All bidder(s) shall submit in accordance to requirements of section **IP.6, (**Question, Communication and Omissions), a copy of his proposed seat layout consist with these specifications showing hip-to-knee and foot room dimensions, stanchion layout and wheelchair maneuverability layout prior to bid for WMATA review and approval. The bidders shall also indicate on this layout Free Floor Space available to standees as defined Section 5.1.2 and include the calculation of the Free Floor Space area. As per section: **TS 76 for details.**

TS 76.9 Dimensions

FIGURE 7
Seating Dimensions and Standard Configuration



Seat dimensions for the various seating arrangements shall have the dimensions as follows (refer to Figure 7):

- The width, W, of the two-passenger transverse seat shall be a minimum 35 in.
- The length, L, shall be 17 in., ±1 in.
- The seat back height, B, shall be a minimum of 15 in.
- The seat height, H, shall be 17 in., ± 1 in. For the rear lounge (or settee) and longitudinal seats, and seats located above raised areas for storage of under-floor components, a cushion height of up to 18

in., ±2 in., will be allowed. This shall also be allowed for limited transverse seats, but only with the expressed approval of **WMATA.**

- Foot room = F, as per **TS 76**
- The seat cushion slope, S, shall be between 5 and 11 degrees.
- The seat back slope, C, shall be between 8 and 17 degrees.
- Hip to knee room = K. as per **TS 76**.
- The pitch, P, is shown as reference only.

TS 76.10 Structure and Design

The passenger seat frame and its supporting structure shall be constructed and mounted so that space under the seat is maximized and is completely free of obstructions to facilitate cleaning.

Seats, structures and restraints around the securement area should not infringe into the mobility device envelope or maneuverability.

CANTILEVER-MOUNTED SEATS

The transverse seat structure shall be fully cantilevered from the sidewall with sufficient strength for the intended service. The lowest part of the seat assembly that is within I 2 in. of the aisle shall be at least I 0 in. above the floor.

In locations at which cantilevered installation is precluded by design and/or structure, other seat mounting may be allowed.

The underside of the seat and the sidewall shall be configured to prevent debris accumulation and the transition from the seat underside to the bus sidewall to the floor cove radius shall be smooth. All transverse objects — including seat backs, modesty panels, and longitudinal seats — in front of forward-facing seats shall not impart a compressive load in excess of 1000 lbs onto the femur of passengers ranging in size from a 5th-percentile female to a 95th-percentile male during a 10g deceleration of the bus. This deceleration shall peak at 0.05 to 0.015 seconds from initiation. Permanent deformation of the seat resulting from two 95th-percentile males striking the seat back during this 10g deceleration shall not exceed 2 in., measured at the aisle side of the seat frame at height H. The seat back should not deflect more than 1.4 in., measured at the top of the seat back, in a controlled manner to minimize passenger injury. Structural failure of any part of the seat or sidewall shall not introduce a laceration hazard.

The seat assembly shall withstand static vertical forces of 500 lbs applied to the top of the seat cushion in each seating position with less than ¼-in. permanent deformation in the seat or its mountings. The seat assembly shall withstand static horizontal forces of 500 lbs evenly distributed along the top of the seat back with less than ¼-in. permanent deformation in the seat or its mountings. The seat backs at the aisle position and at the window position shall withstand repeated impacts of two 40-lb sandbags without visible deterioration. One sandbag shall strike the front 40,000 times and the other sandbag shall strike the rear 40,000 times.

Each sandbag shall be suspended on a 36-in. pendulum and shall strike the seat back 10,000 times each from distances of 6, 8, 10 and 12 in. Seats at both seating positions shall withstand 4000 vertical drops of a 40-lb sandbag without visible deterioration. The sandbag shall be dropped 1000 times each from heights of 6, 8, 10 and 12 in. Seat cushions shall withstand 100,000 randomly positioned 3½-in. drops of a squirming, 150-lb, smooth-surfaced, buttocks-shaped striker with only minimal wear on the seat covering and no failures to seat structure or cushion suspension components.

The back of each transverse seat shall incorporate a handhold no less than ⅞ in. in diameter for standees and seat access/egress. The handhold shall not be a safety hazard during severe decelerations. The handhold shall extend above the seat back near the aisle so that standees shall have a convenient vertical assist, no less than 4 in. long that may be grasped with the full hand. This handhold shall not cause a standee using this assist to interfere with a seated 50th-percentile male passenger. The handhold shall also be usable by a 5th-percentile female, as well as by larger passengers, to assist with seat access/egress for either transverse seating position. The upper rear portion of the seat back and the seat back handhold immediately forward of transverse seats shall be padded and/or constructed of energy absorbing materials. During a 10g deceleration of the bus, the HIC number (as defined by SAE Standard J211a) shall not exceed 400 for passengers ranging in size from a 5th percentile female through a 95th percentile male.

The seat back handhold may be deleted from seats that do not have another transverse seat directly behind and where a vertical assist is provided.

Longitudinal seats shall be the same general design as transverse seats but without seat back handholds. Longitudinal seats may be mounted on the wheelhouses. Armrests shall be included on the ends of each set of longitudinal seats except on the forward end of a seat set that is immediately to the rear of a transverse seat, the driver's barrier, or a modesty panel, when these fixtures perform the function of restraining passengers from sliding forward off the seat. Armrests are not required on longitudinal seats located in the wheelchair parking area that fold up when the armrest on the adjacent fixed longitudinal seat is within 3½ in. of the end of the seat cushion. Armrests shall be located from 7 to 9 in. above the seat cushion surface. The area between the armrest and the seat cushion shall be closed by a barrier or panel. The top and sides of the armrests shall have a minimum width of 1 in. and shall be free from sharp protrusions that form a safety hazard.

Seat back handhold and armrests shall withstand static horizontal and vertical forces of 250 lbs applied anywhere along their length with less than ¼-in. permanent deformation. Seat back handhold and armrests shall withstand 25,000 impacts in each direction of a horizontal force of 125 lbs with less than ¼-in. permanent deformation and without visible deterioration.

At WMATA's request a test report shall be provided by the contractor, fully documenting compliance with all the requirements defined above upon request. The test report shall contain a record of all testing activities, test diagrams, testing equipment, as well as test data related to loads, deflections and permanent

deformation of the seat assembly. The report shall include a statement of compliance with the requirements of this section of **TS 76.**

TS 76.11Construction and Materials

Seat shall be constructed with materials that comply with the physical test. Selected materials shall minimize damage from vandalism and shall reduce cleaning time. The seats shall be attached to the frame with tamper-resistant fasteners. Coloring shall be consistent throughout the seat material, with no visually exposed portion painted. Any exposed metal touching the sides or the floor of the bus shall be stainless steel. The seat, pads and cushions shall be contoured for individuality, lateral support and maximum comfort and shall fit the framework to reduce exposed edges.

The minimum radius of any part of the seat back, handhold or modesty panel in the head or chest impact zone shall be a nominal Y-i-in. The seat back and seat back handhold immediately forward of transverse seats shall be constructed of energy-absorbing materials to provide passenger protection and, in a severe crash, allow the passenger to deform the seating materials in the impact areas. Complete seat assemblies shall be interchangeable to the extent practicable.

Padded seat configuration:
Seating and interior shall have features to improve passenger comfort. The seat cushion and back shall be padded with a cellular foam product that complies with the physical test requirements cited in this document and is no less than 3/4 inches thick in areas contacted and loaded by passengers in the normal seated position and shall be covered vinyl and/or fabric material.
WMATA to select seat fabric.

TS 77. Passenger Assists

Passenger assists in the form of full grip, vertical stanchions or handholds shall be provided for the safety of standees and for ingress/egress. Passenger assists shall be convenient in location, shape, and size for both the 95th-percentile male and the 5th-percentile female standee. Starting from the entrance door and moving anywhere in the bus and out the exit door, a vertical assist shall be provided either as the vertical portion of seat back assist or as a separate item so that a 5th-percentile female passenger may easily move from one assist to another using one hand and the other without losing support. All handholds and stanchions at front doorway, around fare box, and at interior steps for bi-level designs shall be powder-coated in a high-contrast yellow color. The forward-most vertical stanchions on either side of the aisle immediately behind the driver's area and rear door modesty panels on both sides shall be:

Powder-coated yellow and all hardware shall be stainless steel.

TS 77.1Assists

Excluding those mounted on the seats and doors, the assists shall have a cross-sectional diameter between 1¼ and 1½ in. or shall provide an equivalent gripping surface with no corner radii less than ¼ in. All passenger assists shall permit a full hand grip with no less than 1½ in. of knuckle clearance around the assist. Passenger assists shall be designed to minimize catching or snagging of clothes or personal items and shall be capable of passing the NHTSA Drawstring Test.

Any joints in the assist structure shall be underneath supporting brackets and securely clamped to prevent passengers from moving or twisting the assists. Seat handholds may be of the same construction and finish as the seat frame. Door mounted passenger assists shall be of anodized aluminum, stainless steel or powder-coated metal. Connecting tees and angles may be powder-coated metal castings. Assists shall withstand a force of 300 lbs applied over a 12-in. lineal dimension in any direction normal to the assist without permanent visible deformation. All passenger assist components, including brackets, clamps, screw heads and other fasteners used on the passenger assists shall be designed to eliminate pinching, snagging and cutting hazards and shall be free from burrs or rough edges.

TS 77.2 Front Doorway

Front doors, or the entry area, shall be fitted with ADA-compliant assists. Assists shall be as far outward as practicable, but shall be located no farther inboard than 6 in. from the outside edge of the entrance step and shall be easily grasped by a 5th-percentile female boarding from street level. Door assists shall be functionally continuous with the horizontal front passenger assist and the vertical assist and the assists on the wheel housing or on the front modesty panel.

TS 77.3 Vestibule

The aisle side of the driver's barrier, the wheel housings, and when applicable the modesty panels shall be fitted with vertical passenger assists that are functionally continuous with the overhead assist and that extend to within 36 in. of the floor. These assists shall have sufficient clearance from the barrier to prevent inadvertent wedging of a passenger's arm.

A horizontal passenger assist shall be located across the front of the bus and shall prevent passengers from sustaining injuries on the fare collection device or windshield in the event of a sudden deceleration. Without restricting the vestibule space, the assist shall provide support for a boarding passenger from the front door through the fare collection procedure. The assist shall be no less than 36 in. above the floor. The assists at the front of the bus shall be arranged to permit a 5th-percentile female passenger to easily reach from the door assist, to the front assist, to vertical assists on the driver's barrier, wheel housings or front modesty panel.

TS 77.4 Rear Doorway(s)

Vertical assists that are functionally continuous with the overhead assist shall be provided at the aisle side of the transverse seat immediately forward of the rear door and on the aisle side of the rear door modesty panel(s). Passenger assists **may be** provided on modesty

panels that are functionally continuous with the rear door assists. Rear doors, or the exit area, shall be fitted with assists no less than ¾ inches in width and shall provide 1-1/2 inches of knuckle clearance between the assists and their mounting. The assist shall be designed to permit a 5th percentile female to easily move from one assist to another during the entire entrance and exiting process. The assist shall be no further inboard than 6 inches from the outside edge of the rear doorway.

TS 77.5 Overhead

Except forward of the standee line and at the rear door, a continuous, full grip, overhead assist shall be provided. This assist shall be located over the center of the aisle seating position of the transverse seats. The assist shall be no less than 70 in. above the floor.

Total of six (6) yellow Grab straps (three on each side) or other extensions as necessary shall be provided for sections where vertical assists are not available and for the use by passengers that cannot reach to 70 in.

Grab straps material and location shall be approved by WMATA.

Plastic, shall be yellow in color.

Overhead assists shall simultaneously support 150 lbs. on any 12-in. length. No more than 5 percent of the full grip feature shall be lost due to assist supports.

TS 77.6 Longitudinal Seat Assists

Longitudinal seats shall have vertical assists located between every other designated seating position, except for seats that fold/flip up to accommodate wheelchair securement. Assists shall extend from near the leading edge of the seat and shall be functionally continuous with the overhead assist. Assists shall be staggered across the aisle from each other where practicable and shall be no more than 52 in. apart or functionally continuous for a 5th percentile female passenger.

TS 77.7 Wheel Housing Barriers/Assists

Unless passenger seating is provided on top of wheel housing, passenger assists shall be mounted around the exposed sides of the wheel housings (and propulsion compartments if applicable), which shall also be designed to prevent passengers from sitting on wheel housings. Such passenger assists shall also effectively retain items, such as bags and luggage, placed on top of wheel housing.

TS 78. Passenger Doors

Two doorways shall be provided in the curbside of the bus for passenger ingress and egress. The front curbside doorway shall be forward of the front wheel and located so that the operator will be able to collect or monitor the collection of fares. Passenger doors and doorways shall comply with ADA requirements.

Washington Metropolitan Area Transit Authority
RFP Number: FQ18001/BTK

TABLE 7
Door Locations and Styles

Front Door						
Location	Slide Glide	Double (Two-Piece Pantograph		Single (One-Piece Pantograph)		Outside Sliding Plug
Forward of the front wheels and under direct observation of the driver.	**ONLY**					
Rear Doors(s)						
Location	Slide Guide	Outward Opening Swing With Manual Emergency Reset	Outward Opening Swing With Auto Emergency Reset	Double (Two-Piece Pantograph	Single (One-Piece Pantograph)	Outside Sliding Plug
Alternative 1: Curbside doorway centerline located rearward of the point midway between the front door centerline and the rearmost seat back.	**ONLY**					
Alternative 2: Curbside doorway located behind the rear axle.						
Alternative 3: Street-side rearward of the point midway between the front door centerline and the rearmost seat back.						
Alternative 4: Street-side located behind the rear axle.						
Alternative 5 (articulated only): Curbside located forward of the rear axle of the trailer section.	**ONLY**					
Alternative 6 (articulated only): Street-side located forward of the rear axle of the trailer section.						
Alternative 7 (articulated only): Curbside, located forward of center axle.						

TABLE 8
Door Operating Combinations

Front	Curbside Rear

Closed	Closed
Open	Closed
Open	Open
Closed	Open

Electric power door system

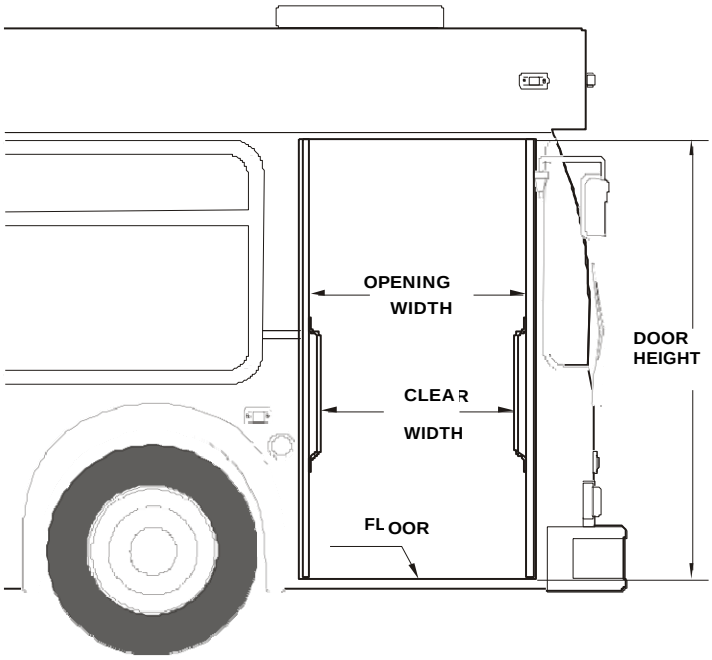
TS 78.1 Materials and Construction

Structure of the doors, their attachments, inside and outside trim panels and any mechanism exposed to the elements shall be corrosion-resistant. Door panel construction shall be of corrosion-resistant metal or reinforced non-metallic composite materials. When fully opened, the doors shall provide a firm support and shall not be damaged if used as an assist by passengers during ingress or egress. Door edges shall be sealed to prevent infiltration of exterior moisture, noise, dirt and air elements from entering the passenger compartment, to the maximum extent possible based on door types.

The closing edge of each door panel shall have no less than 2 in. of soft weather stripping. The doors, when closed, shall be effectively sealed, and the hard surfaces of the doors shall be at least 4 in. apart. The combined weather seal and window glazing elements of the front door shall not exceed 10 degrees of binocular obstruction of the driver's view through the closed door. The front leaves of the passenger door shall overlap the rear leave. Door assist shall be functionally continuous with the horizontal front passenger assist and the vertical assist on the wheel housing or on the front modesty panel.

TS 78.2 Dimensions

FIGURE 8
Transit Bus Minimum Door Opening



TRANSIT BUS MINIMUM DOOR OPENING
When open, the doors shall leave an opening no less than 76 in. in height.

32-in. Minimum Doorway Clear Width
Front door clear width shall be a minimum of 32 in. with the doors fully opened. Rear door opening clear width shall be a minimum of 24 in. with the doors fully opened. When open, the door shall leave a door height opening no less than 76 inches in height.

Doorway Clear Width Greater than 32 in.
The front door clear width shall be a minimum of 32 in. with the doors fully opened.

The rear door clear width shall be a minimum of 32 in. with the doors fully opened.

TS 78.3 Door Glazing

The both front and rear doors shall have full height glazing. Door glazing shall be easily replaceable.

Glazing material in the rear doorway door panels shall be the same material, thickness and color as the side windows defined in section **TS 51**.

The front door panel glazing material shall have a nominal ¼ in. thick laminated safety glass conforming with the requirements of ANSI Z26.1 Test Grouping 2 and the Recommended Practices defined in SAE J673.

Glazing material in the rear doorway door panels shall be same thickness and color as side windows.

TS 78.4 Door Projection

TS 78.4.1 Exterior

The exterior projection of the front doors beyond the side of the bus shall be minimized and shall not block the line of sight of the rear exit door via the curb side mirror when the doors are fully open. The exterior projection of both doors shall be minimized and shall not exceed 13 in. during the opening or closing cycles or when doors are fully opened

TS 78.4.2 Interior

Projection inside the bus shall not exceed 21inches. The closing edge of each panel shall have no less than 2 inches of soft weather stripping. The doors, when close, shall be effectively sealed and hard surfaces of the doors shall be at least 4 inches apart. The combined weather seal and window glazing elements of the front door shall not exceed 10 degrees of binocular obstruction of the operator's view through the closed door. Requirements for the sensitive door edges are defined in section TS 78.5.

Projection inside the bus shall not cause an obstruction of the rear door mirror or cause a hazard for standees.

TS 78.5 Door Height Above Pavement

It shall be possible to open and close either passenger door when the bus loaded to gross vehicle weight rating is not knelt and parked with the tires touching an 8-in.-high curb on a street sloping toward the curb so that the street side wheels are 5 in. higher than the right side wheels.

TS 78.6 Closing Force

Closing door edge speed shall not exceed 12 in. per second, and opening door speed shall not exceed 19 in. per second. Power doors shall not slam closed under any circumstance, even if the door is obstructed during the closing cycle. If a door is obstructed during the closing cycle, the pressure exerted on the obstruction shall not increase once initial contact has been made.

Power-close rear doors shall be equipped with an obstruction sensing system such that if an obstruction is within the path of the closing doors, the doors will stop and/or reverse direction prior to imparting a 10-lb force on 1 sq in. of that obstruction. If a contactless obstruction sensing system is employed, it shall be capable of discriminating between the normal doorway environment and passengers or other obstructions within the doorway, and of altering the zones of detection based upon the operating state of the door system.

Doors closed by a return spring or counterweight-type device shall be equipped with an obstruction-sensing device that, at a minimum, alerts the driver if an obstruction is detected between the closing doors. Doors closed by a return spring or counterweight type device, when unlocked, shall be capable of being pushed to the point where the door starts to open with a force not to exceed 20- lbs applied to the center edge of the forward door panel.

Whether or not the obstruction sensing system is present or functional, it shall be possible to withdraw a 1½ in. diameter cylinder from between the center edges of a closed and locked door with an outward force not greater than 35 lbs.

TS 78.7 Actuators

Doors shall open or close completely in not more than 3.5 seconds from the time of control actuation and shall be subject to the closing force requirements of section TS 78.6.

Door actuators shall be adjustable so that the door opening and closing speeds can be independently adjustable to satisfy the above requirements. Actuators and the complex door mechanism shall be concealed from passengers but shall be easily accessible for servicing. The door actuators shall be rebuildable..

Door actuators and associated linkages shall maximize door holding forces in the fully open and fully closed positions to provide firm, non-rattling, non-fluttering door panels while minimizing the force exerted by the doors on an obstruction midway between the fully open and closed positions.

The rear door actuator(s) shall be under the complete control of the vehicle operator and shall open and close in response to the position of the driver's door control. The vehicle operator shall unlock and enable the opening mechanism, which shall be annunciated by illumination of a green light near the door. After enabling and unlocking, the doors shall be opened by either the passenger manually pushing the door open, or by a powered mechanism actuated by passenger activation by passenger activation of a contactless sensing system a voice annunciator system is required, separate from the AVAS requirements elsewhere. System shall announce door opening and closing actions and warn passengers to stay clear of closed exit door. System shall include visual indications for hearing impaired patrons above exit door.

A switch located within reach of the seated operator shall, when actuated, restore rear door function to complete operator control, as described in the "Default."

Doors that employ a "swing" or pantograph geometry and/or are closed by a return spring or counterweight-type device shall be equipped with a positive mechanical holding device that automatically engages and prevents the actuation mechanism from being back-driven from the fully closed position. The holding device shall be overcome only when the driver's door

control is moved to an "Exit Door Enable" position and the vehicle is moving at a speed of less than 2 mph, or in the event of actuation of the emergency door release.

Locked doors shall require a force of more than 300 lbs to open manually. When the locked doors are manually forced to open, damage shall be limited to the bending of minor door linkage with no resulting damage to the doors, actuators or complex mechanism.

TS 78.8 Rear Door Control and Interlocks

See "Hardware Mounting" for door system interlock requirements.

The rear exit door(s) of the vehicle shall be equipped with a system to sense passengers and other objects in the doorway and between the fully open or partially closed door panels. This system shall utilize ultrasonic acoustic waves and intelligent signal processing techniques to sense objects in selected spaces depending upon the phase of the door operating cycle. The system shall be capable of selectively requesting opening of exit doors enabled by the vehicle operator, sensing passengers approaching the door opening from the interior of the vehicle and providing a door HOLD OPEN request; and of sensing passengers or other objects that intrude within defined zones during door closing and providing a REOPEN or HOLD OPEN request. The detection zone dimensions shall be user-programmable within the limits of the system components. The system shall be capable of resisting false detections due to environmental conditions, including rain and snow. The acoustic components shall be solid state devices and shall be packaged to withstand the transit bus environment. The acoustic sensing system shall be the CLASSTM system manufactured by the Vapor Corporation. Rear doors shall be operator-controlled. The rear door controls shall be limited to unlocking and enabling the opening mechanism, which shall be signaled by illumination of a green light near the door. The door shall he opened when a passenger attempts to touch the center edge of either door panel in the area of a decal displaying signage approved by the WMATA. This action by the passenger when the door is enabled will signal the door operator to open. CLASS equipped door systems will be provided with passenger assists designed to avoid interference with the detection zones of the acoustical sensors and shall meet the general requirements of passenger assist size, strength and knuckle clearance.
Passenger assists shall be located near the opened edge of the door panels and extend from 36 inches above the floor surface to within 36 inches of the street surface. The doors shall begin to close 2 seconds after the acoustical sensors cease to detect an object or passenger in the doorway. The door closing speed shall be adjustable and not exceed 12 inches per second for closing. Separate switch, convenient to the driver, shall convert the rear door to a power door with both opening and closing controlled by the driver. The Contractor shall provide a Master Door Switch which is located outside of the reach of a seated driver with which to close the rear doors, deactivate the door control system, and permit only emergency operation of the doors.

An alarm shall sound whenever the rear door is opened or attempted to be opened when rear doors are not powered. **When the rear doors are closed and locked, the doors shall be held closed by both a mechanical lock and an air lock. This redundancy is required. Failure of any one or both of the locks shall render the rear doors inoperable.**

TS 78.9 Emergency Operation

In the event of an emergency, it shall be possible to manually open doors designated as emergency exits from inside the bus using a force of no more than 25 lbs after actuating an unlocking device. The unlocking device shall be clearly marked as an emergency-only device and shall require two distinct actions to actuate. The respective door emergency unlocking device shall be accessible from the doorway area. The unlocking device shall be easily reset by the operator without special tools or opening the door mechanism enclosure. Doors that are required to be classified as "Emergency Exits" shall meet the requirements of FMVSS 217.

TS 78.10 Door Control

The door control shall be located in the operator's area within the hand reach envelope described in SAE Recommended Practice J287, "Driver Hand Control Reach." The driver's door control shall provide tactile feedback to indicate commanded door position and resist inadvertent door actuation.

The front door shall remain in commanded state position even if power is removed or lost.

TS 78.11 Door Controller

Five-Position Driver's Door Controller
The control device shall be protected from moisture. Mounting and location of the door control device handle shall be designed so that it is within comfortable, easy arm's reach of the seated driver. The door control device handle shall be free from interference by other equipment and have adequate clearance so as not to create a pinching hazard.

Position of the door control handle shall result in the following operation of the front and rear doors:

- **Center position:** Front door closed, rear door(s) closed or set to lock.
- **First position forward:** Front door open, rear door(s) closed or set to lock.
- **Second position forward:** Front door open, rear door(s) open or set to open.
- **First position back:** Front door closed, rear door(s) open or set to open.
- **Second position back:** Front door open, rear door(s) open or set to open.

TS 78.12 Door Open/Close

Operator-Controlled Front and Rear Doors
Operation of, and power to, the passenger doors shall be completely controlled by the operator.

A control or valve in the operator's compartment shall shut off the power to, and/or dump the power from, the front door mechanism to permit manual operation of the front door with the bus shut down. A master door switch, which is not within reach of the seated operator, when

set in the “off” position shall close the rear/center doors, deactivate the door control system, release the interlocks, and permit only manual operation of the rear/center doors.

TS 79. Accessibility Provisions

Space and body structural provisions shall be provided at the front door of the bus to accommodate a wheelchair loading system with all requirements defined in 49 CFR, Part 38, and subpart B: ADA Accessibility Specifications for Transportation Vehicles – Buses, Vans and system. Specific requirements, including the number of wheelchairs to be accommodated, the tie-down and securement devices, and fold-down seats, are provided.

TS 79.1 Loading Systems

- Low-floor ramp (RICON or Lift-U, or approved equal)

TS 79.2 Ramp

The wheelchair ramp control system must be capable of receiving multiplex command from vehicle interlocks.

The loading platform shall be covered with a replaceable or renewable nonskid material and shall be fitted with devices to prevent the wheelchair from rolling off the sides during loading or unloading.

Deployment or storage of the ramp shall require no more than 15 seconds. The device shall function without failure or adjustment for 500 cycles or 5000 miles in all-weather conditions on the design operating profile when activated once during the idle phase. A manual override system shall permit unloading a wheelchair and storing the device in the event of a primary power failure. The manual operation of the ramp shall not require more than 35 lbs of force.

Heavy-Duty Ramp System
Power units must meet other spec requirements (hydraulic or electric).

TS 79.3 Loading System.

An automatically-controlled, power-operated ramp system compliant to requirements defined in 49 CFR Part 38, Subpart B, §38.23c shall provide ingress and egress quickly, safely and comfortably, both in forward and rearward directions, for a passenger in a wheelchair from a level street or curb.

Front Door Location of Loading System, Flip-Out Design (Ricon or Lift-U, or approved equal) Ramp with 6:1 Slope
The wheelchair loading system shall be located at the front door, with the ramp being of a simple hinged, flip-out type design being capable of deploying to the ground at a maximum 6:1 slope.

TS 79.5 Wheelchair Accommodations

NOTE: WMATA shall approve acceptable securement system.

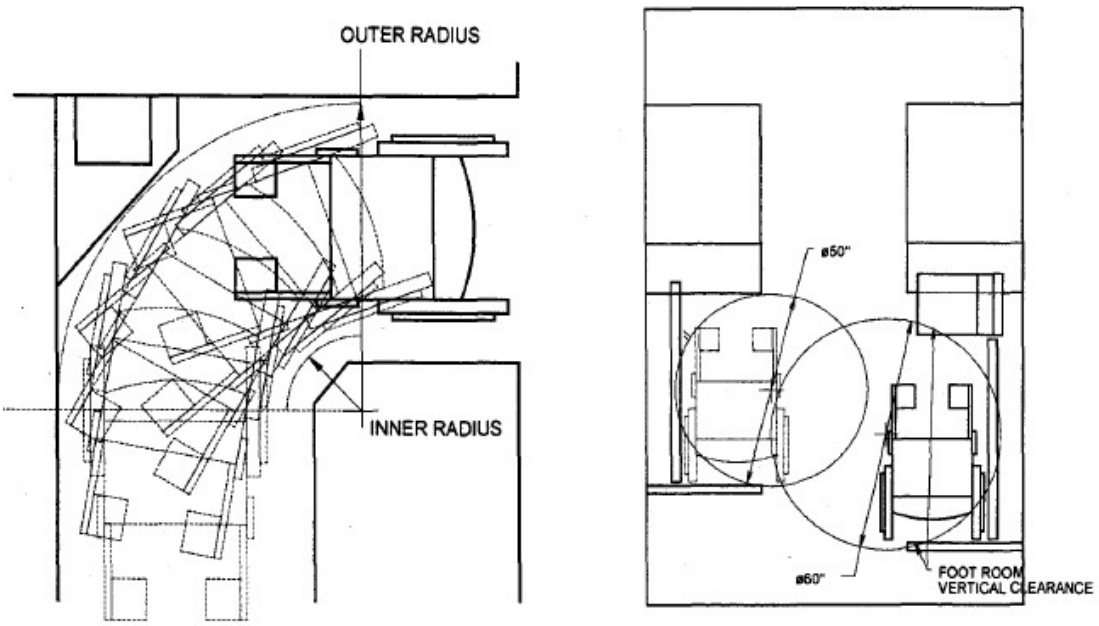
Two Forward-Facing Wheelchair Securement Locations
Two forward-facing locations, as close to the wheelchair loading system as practical, shall provide parking space and securement system compliant with ADA requirements for a passenger in a wheelchair.

TS 79.5.1 Loading System for Level Boarding on a 42- to 62-ft Low-Floor BRT

For level-entry boarding in applications such as BRT, where the vertical transition from the vehicle floor and the boarding and alighting surface is no more than 3 in., a bridge plate shall be used. Bridge plates 30 in. or longer shall support a load of 600 lbs, placed at the centroid of the ramp or bridge plate distributed over an area of 26 × 26 in., with a safety factor of at least 3, based on the ultimate strength of the material. Bridge plates shorter than 30 in. shall support a load of 300 lbs. When deployed to boarding and alighting surface, the slope of the bridge plate shall not exceed 7:1.

TS 79.6 Interior Circulation

Maneuvering room inside the bus shall accommodate easy travel for a passenger in a wheelchair from the loading device and from the designated securement area. It shall be designed so that no portion of the wheelchair protrudes into the aisle of the bus when parked in the designated parking space(s). When the positions are fully utilized, an aisle space of no less than 20 in. shall be maintained. As a guide, no width dimension should be less than 34 in. Areas requiring 90-degree turns of wheelchairs should have a clearance arc dimension no less than 45 in. and in the parking area where 180-degree turns are expected, space should be clear in a full 60-in.-diameter circle. A vertical clearance of 12 in. above the floor surface should be provided on the outside of turning areas for wheelchair footrest.



SIGNAGE AND COMMUNICATION

TS 80. Destination Signs

An automatic electronic LED destination sign system (Luminator or approved equal) shall be furnished on the front, on the right side near the front door, and on the rear of the vehicle. Display areas of destination signs shall be clearly visible in direct sunlight and/or at night. Front: SMT 16 X 160 or Titan 24 X 200; Side: 8 X 96 or 14 X 112; Rear 16 X 48; Dash 12 X 40.The sign system shall provide optimum visibility of the message display units for passengers and shall meet applicable ADA requirements defined in 49 CFR, Part 38.39.
Destination signs shall be installed in such a manner as to facilitate easy access for replacment of the entire sign assembly, or components such as LED's and electronic control modules, from inside the bus within 30 minutes. Lamps and associated parts shall be commercially available.

The Operator Display and Keyboard (ODK) shall be used to view and update display messages. The system control console shall utilize a multiple function keyboard with tactile response, designed especially forthe harsh transit environment.

The system control console shall contain a 4.3" color LCD touch screen display. Programmable multifunction keys shall be used for basic operation while the touch screen can be used for more advanced operations. The system control console shall provide audible feedback to alert the operator to view the display for a message, or beeps indicating that a key is depressed. The system control console shall continuously display the complete message associated with the selected destination code.

The ODK shall be capable of accepting single point logon information by interfacing to other on board systems via J-1708 or Ethernet for automated destination code and public relations code selection.

The system shall be capable of wireless message listing updates using 'store and forward' through an on board computer.

Destination messages, route designations, and public relations messages shall be independently selectable via a single ODK. The rear route number sign shall be controlled by the same ODK that operates the destination signs. The ODK display monitor readout shall show the exact information displayed on the destination signs and route number sign. The ODK shall be conveniently located for the bus operator and mounted in such a manner that will not pose any safety hazard. The ODK shall utilize a durable weatherproof keypad with tactile feel for destination message control functions.

The destination sign system shall be capable of programming I 0,000 message lines. The number of public relations messages shall be limited only by the remaining number of message lines not used for destination purposes. Sign displays shall have alternating message capability with programmable blanking time between message lines as may be required. Variable blanking times shall be programmable between 0.5 to 25 seconds in duration. Each line message or blanking time for each message shall be individually
Programmable. Sign system power hold timer shall be set to Zero; system operation shall be controlled via multiplex electrical command.

The LED's shall be surface mounted, allowing for the greatest visibility and readability. Signs shall Incorporate a monitoring system whereby information and diagnostics are broadcast to the AVM via J1939.

Destination Sign Programming
The electronic sign system shall be programmable via an integral connector located in the front destination sign area. Software shall be furnished for programming the sign system via Window-compatible, laptop computer. Software shall be capable of providing a high degree of flexibility to create, or select preprogrammed, fonts and graphic displays. The sign shall have the capability of being programmed in the field using a PC, jump drive or field programmer. The sign system shall allow for wireless downloading of destination sign message list through the Clever Devices system.

Route sign on the rear of the vehicle shall be provided.

All signs shall be controlled via a single human-machine interface (HMI).The ODK (Operator Display and Keyboard) box shall not be located within reach of the seated driver – location to be approved by WMATA.

The destination sign compartments shall meet the following minimum requirements:

- Compartments shall be designed to prevent condensation and entry of moisture and dirt.
- Compartments shall be designed to prevent fogging of both compartment window and glazing on unit itself.
- Access shall be provided to allow cleaning of inside compartment window and unit glazing.
- Front window shall have an exterior display area of no less than 8.5 in. high by 56 in. wide.

No active defogging required.

TS 80.1 Bus Is Backing Warning
The bus shall be wired to provide exclusive discrete signaling to the ODK when the bus is placed into reverse gear for the purpose of displaying a warning message on all signs. WMATA shall share details of this signaling with contractor as needed.

TS 80.2 Run Number Box/Bus Block Number.

An LED Run Box, with four (4) characters, four (4) inches high shall be mounted on the dash panel, located to the right corner of the bus. **(WMATA shall approve the location and installation of the box)** The sign shall be mounted with a shield extended close to windshield to eliminate glare and reflection in the windshield and shall minimize obstruction of the operator's view. Adjustment of the Run Number shall be provided from inside the bus with provisions for reading the sign during the adjustment operation. The list of required sign reading shall be programmed into HMI (Human Machine Interface) as define on **TS 80**.

TS 81. Passenger Information and Advertising

TS 81.1 Interior Displays

ADA priority seating signs as required and defined by 49 CFR, Part 38.27 shall be provided to identify the seats designated for passengers with disabilities.

Requirements for a public information system in accordance with 49 CFR, Part 38.35 shall be provided. Requirements for stop request signal system in accordance with 49 CFR, Part 38.35 shall be provided. Requirements for exterior signs in accordance with 49 CFR, Part 3

Provisions shall be made on the rear of the driver's barrier or electronic equipment box located on the street side wheel well for a frame to retain information such as routes and schedules.

Advertising media 11 in. high and 0.09 in. thick shall be retained near the juncture of the bus ceiling and sidewall. The retainers may be concave and shall support the media without adhesives. The media shall be illuminated by the interior light system.

TS 81.2 Interior Displays

Provisions shall be made to integrate advertising into the interior design of the bus. Advertising media, frames or supporting structures shall not detract from the readability of destination signs and signal lights, and shall not compromise passenger visibility. Advertising provisions shall not cause pedestrian hazards or foul automatic bus washing equipment, and shall not cover or interfere with doors, air passages, vehicle fittings, or in any other manner restrict the operation or serviceability of the bus. (WMATA shall approve the placement and dimensions of advertising area.)

TS 82. Passenger Stop Request/Exit Signal

Pull Cord Passenger Signal
A passenger "stop requested" signal system that complies with applicable ADA requirements defined in 49 CFR, Part 38.37 shall be provided. The system shall consist of a heavy-duty pull cable, chime and interior sign message. The pull cable (Yellow in color) shall be located the full length of the bus on the sidewalls at the level where the transom is located. If no transom window is required, the height of the pull cable shall approximate this transom level and shall be no greater than 63 in. as measured from the floor surface. It shall be easily accessible to all passengers, seated or standing. Pull cable(s) shall activate one or more solid state or magnetic proximity switches. At each wheelchair passenger position and at priority seating positions, additional provisions shall be included to allow a passenger in a mobility aid to easily activate the "stop requested" signal.

Additional "Stop Request" Button on Rear Door Stanchion
A heavy-duty "stop request" signal button shall be installed on modesty panel stanchion immediately forward of the rear door and clearly identified as "STOP."

A single "stop requested" chime shall sound when the system is first activated. A double chime shall sound anytime the system is activated from wheelchair passenger areas.

Exit signals located in the wheelchair passenger area shall be no higher than 4 feet above the floor. Instructions shall be provided to clearly indicate function and operation of these signals.

WMATA to specify the stop request system for wheelchair seating area

TS 83. Communications

TS 83.1 Camera Surveillance System

The bus shall be equipped with a sufficient number of cameras (up to 9 in 40' bus) and associated wiring provisions to allow continuous of the bus interior for purposes of security. The cameras shall be digital, color recording type, appropriately mounted to provide a clear view of entire passenger compartment and protected to prevent tampering and vandalism. The system shall be capable of recording capacity of no less than 480 hours at a resolution of, at least, 20 frames per second. The system shall be programmable to automatically tag events such as panic button activation or a hard deceleration/impact. An impact sensor shall be included with the system. Tagged events shall be stored on the hard drive. These programmable parameters, including corresponding resolution for such events, shall be reviewed and finalized with the manufacturer during pre-production. The hard drive component shall be removable with a 1 terabyte capacity. Images recorded and stored are to be digitally encrypted and have a resolution no less than 720 x 480. The system shall be capable of recording capacity of no less than 720 hours at a resolution of, at least 20 frames per second per camera.

System shall be programmable to automatically tag events, such as a panic button activation or Impact detection shall be independent/remote from Recorder mounting. A signal from remote event data recorder impact sensor shall trigger an event of hard deceleration/impact in the system via J1939. Tagged events shall be stored on the hard drive. CCTV GPS antennas will not be permitted; GPS shall be harvested from bus LAN/VAN. The stored video images shall be searchable by time and/or GPS coordinates.

The system shall be capable of downloading tagged events automatically when bus returns to garage/depot. The system shall also be capable of real-time video monitoring from a remote site through the Data uploads via Bus LAN/VAN. Additional wireless clients for CCTV/DVR will not be permitted. The programmable parameters, including corresponding resolution for such events, shall be reviewed and finalized with the manufacturer during pre-production. When retrieved, the tagged events shall be easily identifiable.

CCTV system shall be powered in all master switch positions, except the 'off' position. The camera system shall continue recording for 10 minutes after run power is shutdown, regardless of battery master switch position. One camera shall be mounted in the interior, forward-facing to provide view through windshield of outside area immediately in front of the bus. One shall be mounted on exterior, upper front curb side corner of the bus rear-facing to provide view of front and rear passenger doorway areas. One camera shall be mounted to view at rear and shall be quickly adjust to light changes. Remaining cameras shall be mounted in the interior of the bus. One camera shall be mounted near each of the front and rear doors, and one shall be mounted in the front section. The system module shall be located (WMATA shall approved the location) in a secured, sealed compartment with adequate provisions for easy removal/replacement of hard drive for downloading of recorded information. A provision shall be included to allow bus operator to electronically flag events recorded. Additionally, wiring provisions shall be made for receiving bus emergency alarm signal; marking and sequestering video for automatic upload. System shall also provide discrete signaling for external systems in response to system detection of impact/accelerometer and panic switch triggers. Specific information regarding required signal types, durations, and interfacing connector will be provided by WMATA as required. Adequate number of decals/signs notifying passengers of surveillance cameras on-board shall be installed in plain view throughout the bus.

Exterior CCTV cameras shall be securely mounted to reinforced bus body structure, independent of exterior painted surface to withstand impact from tree branches and bus washing activities. Exterior cameras shall also be equipped with protective enclosures or shielding. Rear cameras are exempt from the requirement of protective enclosures or

shielding. Placement of cameras (and camera angles) will need to be approved by The WMATA.

Passenger facing video displays shall be required. Two (2) video monitors shall be installed as follows:

1. One 19" diagonally measured screen shall be installed on the rear facing wall of the street side equipment cabinet, location to be above required advertising space defined elsewhere.

a. Monitor operation shall be controlled by multiplexed electrical system and activated in Day Run, Night Run and Park positions of the master run switch.

b. Mounting location shall provide clearest possible visibility to all passengers, seated and standing.

c. Video monitor shall be constructed of durable materials to resist vandalism and be approved for crashworthiness as installed. Monitor shall be securely mounted without sharp edges or pinch points and have no exposed wiring. No operating controls shall be available to passengers.

d. Monitor shall display cycling images of all connected CCTV cameras, with approximate dwell time of approximately 5 seconds per image. Details to be approved by WMATA.

2. One 10.1" diagonally measured screen shall be installed on the interior sidewall above the seated operator, facing the front door boarding passengers. Monitor shall be securely

mounted without sharp edges or pinch points and have no exposed wiring. No operating controls shall be available to operator.

a. Monitor operation shall be controlled by multiplexed electrical system, and shall activate under the following conditions:

i. Day Run and Night Run positions of the master run switch.

ii. Transmission not in neutral.

iii. Parking brake released.

iv. Front door not closed. Or;

v. Park position of the master run switch.

b. Placement of monitor shall not impede the movement of the bus operator, nor pose an injury hazard.

3. Monitor shall exclusively display the image of the CCTV camera facing the front door and farebox areas when activated.

TS 83.1.1 Driver Coaching Camera Provisions

Wiring and electrical provisions shall be provided in the destination sign cabinet at the approximate center windshield to support the installation of a WMATA-standard driver coaching camera. Specific details of this requirement will be provided to the contractor as needed.

TS 83.2 Automatic Voice Annunciation Systems (AVAS)

The bus shall be equipped with an automatic voice annunciation system. The voice annunciation system shall make automatically make next stop announcements for all fixed routes. A suitably sized **amber LED sign** shall be provided to display the next stop information which shall be visible and readable from all locations of the inside the bus. **(WMATA shall approve the sign and location.)** An operator control panel shall be provided and located panel shall be provided and located at the front of the vehicle to allow the operator to easily input his badge, route and run number information. Control of the exterior destination sign displays shall also be through this panel.

The AVAS shall be capable, via a GPS antenna to be provided as part of this system, of determining the vehicle's location and along with route and run number input, announce and display appropriate "next stop" information. The system shall be able to recognize when the bus has traveled outside its pre-determined route and display the massage, "OFF ROUTE", to the operator on the operator control panel. During this time no massages shall be displayed or announced on the AVAS. Once the system has determined that the bus has resumed its

route, the AVAS shall return to normal function. In case where GPS cannot pickup satellite signals to accurately determined its position, the AVAS shall temporarily revert to a bypass system, such as through use of a compass and number of stops counter.

The AVAS display shall meet the applicable requirements of 49 CFR, Part 38 and Subpart B: ADA Accessibility Specifications for Transportation Vehicle – Buses, Vans and Systems. The display shall be able to display messages that are, at least, 20 characters in length. The AVAS sign shall display "STOP REQUESTED" whenever the passenger stop requested signal system is activated (Section TS 82)

Automatic voice announcements shall be made through the vehicle's public address system. For the interior and exterior announcements, volume levels shall be separately and automatically adjusted within a limited range to compensate for ambient noise. The voice annunciation system shall have priority over the operator's gooseneck microphone.

The AVAS system shall be able to monitor, acquire and report bus maintenance information. WMATA shall select the specific bus maintenance data to be monitored and recorded for Automatic Vehicle Monitoring.

In addition, the AVAS shall be support integration or interoperability of other non-proprietary optional features as follows.

Automatic Passenger Counting

Automatic Vehicle Location Reporting.

Automatic Fare Collection

Wireless data communications

Bus Stop Information System

Next Bus Information

Multiplex System.

All necessary interconnecting cables and brackets shall be provided by the Contractor or the system supplier. The central processing unit and associated equipment for the AVAS shall be contained in a locked compartment. The necessary application software for data acquisition and management shall be provided along with all required hardware. Bus maintenance information shall be available through the vehicle electronic communication system, including propulsion system and climate control system data. This data shall be

communicated through the appropriate protocols (J1708, J1939) to the AVAS from which it can be downloaded through the infra-red system.

The contractor shall work with WMATA and its current supplier of AVAS equipment to ensure proper integration and compatibility with their existing equipment.

Additional information regarding onboard systems can be found in section STP 8 'Intelligent Vehicle System'

TS 83.2.1 Public Address System

A public address system shall be provided on each bus for facilitating radio system and driver-originated announcements to passengers.

TS 83.2.2 Speakers

8 in 40' / 10 in 60'bus interior loudspeakers shall be provided, semi-flush mounted, on alternate sides of the bus passenger compartment, installed with proper phasing. Total impedance seen at the input connecting end shall be 8 Ohms. Mounting shall be accomplished with riv-nuts and machine screws.

TS 83.3 Automatic Passenger Counter (APC)

An automatic passenger counting system shall be provided to accurately record and report the number of passengers that enter the vehicle whenever the bus is in service. APC sensors shall be provided in both the front and rear doorways.

With the followings:

- OVERHEAD SENSORS
- INTEGRATED WITH ON BOARD SYSTEMS
- REPORT PASSENGER COUNTS WITH 97% ACCURACY
- REAL TIME PASSENGER LOADING IN CAD SYSTEM
- CORRELATION WITH BUS
- INVULNERABLE TO SENSOR OBSTRUCTION

TS 83.4 Radio Handset and Control System

TS 83.4.1 Radio Compartment

A compartment shall be provided to accommodate a communication system. Required Services in equipment closet: 12 VDC@30A; 24 VDC 30A; 115 VAC @ 300W [service shall be provided as 2-outlet inverter and shall be sourced from 24 volt coach batteries, subject to required rundown protection. Multiplex Node location, prewired for 12 and 24 Volt distribution, with load calculations made independently of other required services (above).The communications system shall be securely mounted to the street side front wheelhouse compartment

and shall be approximately 20 inches wide by 20 inches deep and shall extend to the ceiling. Compartment shall have two (2) separate locking compartments. (If single door used, shall be secured by two 5/16" quarter turn locks in addition to a single keyed lock). Slide-out shelves shall be provided to house the radio system, AVAS and camera system. Panels/closeouts shall be provided if necessary to prevent dirt traps and ensure functionality as an operator's barrier. Window directly behind box shall be blocked off to eliminate need for cleaning/maintenance or can be eliminated/reduced in size. The compartment shall be fabricated in a durable fashion out of stainless steel or heavy-duty plastic material. Electronic equipment on bus shall be compliant to SAE J1708 and J1939. Contractor shall furnish and tall the following provisions.

Lighting shall be provided within cabinet of sufficient source(s) to clearly illuminate each shelf and all cabling/wiring from top to bottom, front to rear, for the purpose of maintenance in low ambient lighting conditions. Lighting shall be LED. All lighting within cabinet shall be control from a single toggle switch, labeled for this purpose, and located within easy reach of cabinet doorway.

TS 83.4.2 Handset

Contractor will install a provision for handset for driver use.

TS 83.4.3 Driver Display Unit (DDU)

Contractor shall install a driver display unit as close to the driver's instrument panel as possible.

TS 83.4.4 Emergency Alarm

Contractor shall install an emergency alarm. When activated the EA (Emergency Alarm) switch shall activate the "CALL COPS" message and coincidentally break the continuity in the radio system EA circuit, the result of which is to send a distress signal via the radio to WMATA's Bus Operations Control Center. WMATA radio circuit details shall be provided when needed to the Contractor. When activated, the EA switch function shall not change the operating mode of the interior sign(s) or audio annunciations.

TS 83.4.5 Emergency Alarm Provisions

Pursuant to TS 83.4.4, contractor shall install two (2) controls available to the operator for the purpose of signaling several other installed ancillary systems in emergency situations. These controls shall be provided as exclusive for the listed purpose; i.e. in lieu of other equipment manufacturers' supplied controls of similar application. Contractor shall also provide three multiplex controlled relays for connection to ancillary systems.

a. **Provided operator interfaces.**
    i. **Silent Alarm Toggle Switch.** A two-position toggle switch shall be provided as described in Table 6 of TS 44.5. Switch shall be of a heavy duty design, located in an unassuming area of the side console,

within ergonomic access of the seated operator, out of the path of inadvertent activation by normal activities such as connecting or removing seat belt, or stowing coat and belongings, with guard installed (Eaton 8492K1 or equivalent). Switch shall be wired as an input to the multiplexed electrical system. Switch shall not be labeled. In addition to the required functions described in table 6 of TS 44.5 (prevent multiplex sleep, flash clearance lights), specific switch responses are described here.

ii. **Indicator Light.** An LED indicator shall be installed directly above the Emergency Alarm Toggle Switch listed above. Indicator shall be one-half inch in diameter minimum and illuminate when multiplexed electrical system is 'awake' and Emergency Alarm Toggle Switch is moved to the active position. Indicator shall not be labeled.

iii. **Event Mark Pushbutton.** A heavy duty momentary action pushbutton switch shall be installed. Switch shall be located in the forward area of the operators side console, shall be of differing appearance from the propulsion start button to prevent inadvertent activation. Switch shall be wired as an input to the multiplexed electrical system, and be clearly labeled EVENT MARK.

b. Provided relay outputs.

iv. **CCTV Relay.** A multiplex controlled SPDT relay shall be provided to signal CCTV system. Relay shall be mounted in equipment closet. Control voltage shall be 24 volts. Three (3) prewired connections shall be made to separate, adjacent terminals of a #10 stud terminal strip within the equipment closet for the Common, Normally Open and Normally Closed terminals of the relay. Relays and connections shall be clearly identified on required equipment closet layout label.

v. **DriveCam Relay.** A multiplex controlled SPDT relay shall be provided to signal DriveCam system. Relay shall be mounted in equipment closet. Control voltage shall be 24 volts. Three (3) prewired connections shall be made to separate, adjacent terminals of a #10 stud terminal strip within the equipment closet for the Common, Normally Open and Normally Closed terminals of the relay. Relays and connections shall be clearly identified on required equipment closet layout label.

vi. **Silent Alarm Relay.** A multiplex controlled SPDT relay shall be provided to signal Intelligent Transportation System. Relay shall be mounted in equipment closet. Control voltage shall be 24 volts. Three (3) prewired connections shall be made to separate, adjacent terminals of a #10 stud terminal strip within the equipment closet for the Common, Normally Open and Normally Closed terminals of the relay. Relays and connections shall be clearly identified on required equipment closet layout label.

c. **Programming.** The contractor shall program the multiplex system to activate outputs in the following manner.

vii. **Event Mark Pushbutton.** With the Master Run Switch in any position and the multiplex system awake, depressing this switch will activate each relay defined above for 2 seconds, regardless of switch depress duration using 'One Shot' type logic. Relays shall not activate for more than two seconds in the event of a stuck input from the Event Mark Pushbutton.

viii. **Toggle Switch.** With the Master Run Switch in any position and the multiplex system awake, moving this switch to the active position (up is preferred) will activate each relay defined above for 2 seconds using 'One Shot' type logic. Relays shall not activate more than once per switch input.

TS 84. Event Data Recorder (EDR)

Manufacturer shall propose an Event data recorder (EDR) These units are to be installed as low as possible. The EDR's shall be able to communicate over the J l939 CAN line and shall each be equipped with 3-axis accelerometers. Settings are to be finalized with the WMATA during pre-production. EDR's shall broadcast via the Jl939 data communication link severe impact events to the vehicle monitoring system and also trigger an event in the camera system. The EDR shall also tag an
event from a signal received over the J1939 CAN line from the silent alarm switch signal and the camera event button and in turn broadcast these events to the vehicle monitoring system. The EDR shall also record the following operational data: head lights on or off, turn signals and hazard lights on or off, ignition on or off, low air pressure warning, whether moving in forward or reverse, idling, and if parking brake is on or off and vehicle speed, GPS position.

TS 85. Mobile Data Terminal (MDT)

Mounting and networking provisions for a mobile data terminal shall be made at the operator's front dash panel. Provisions shall include a mounting area and network cabling.

SECTION 5: WARRANTY REQUIREMENTS

WR 1. Basic Provisions

WR 1.1 Warranty Requirements

WR 1.1.1 Contractor Warranty

Warranties in this document are in addition to any statutory remedies or warranties imposed on the Contractor. Consistent with this requirement, the Contractor warrants and guarantees to the original Authority each complete bus and specific subsystems and components as follows. Performance requirements based on design criteria shall not be deemed a warranty item.

All warranty (manufacturer and all vendors) must start from the day buses send to revenue service by WMATA.

WR 1.1.2 Complete Bus

The complete bus, propulsion system, components, major subsystems and body and chassis structure are warranted to be free from Defects and Related Defects for one year or 50,000 miles, whichever comes first, beginning on the date of revenue service. The warranty is based on regular operation of the bus under the WMATA's operating conditions.

WR 1.1.3 Body and Chassis Structure

Body, body structure, structural elements of the suspension and engine cradle are warranted to be free from Defects and Related Defects for three years or 150,000 miles, whichever comes first.

Primary load-carrying members of the bus structure, including structural elements of the suspension, are warranted against corrosion failure and/or Fatigue Failure sufficient to cause a Class 1 or Class 2 Failure for a period of 12 years or 500,000 miles, whichever comes first.

WR 1.1.4 Propulsion System

Propulsion system components, specifically the engine, transmission and drive and non-drive axles shall be warranted to be free from Defects and Related Defects for the standard two years or 100,000 miles, whichever comes first. An Extended Warranty to a maximum of five years or 300,000 miles, whichever comes first, may be purchased at an additional cost. The propulsion system manufacturer's standard warranty, delineating items excluded from the Extended Warranty, submitted in accordance with the Request for Pre-Offer Change or Approved Equal or with the Form for Proposal Deviation.

WR 1.1.5 Emission Control System (ECS)

The Contractor warrants the emission control system for five years or 100,000 miles, whichever comes first. The ECS shall include, but is not limited to, the following components:

- complete exhaust system, including catalytic converter (if required)
- after-treatment device

- components identified as emission control devices

WR 1.1.6 Subsystems

Other subsystems shall be warranted to be free from Defects and Related Defects for two years or 100,000 miles, whichever comes first. Other subsystems are listed below:

- Brake system: Foundation brake components, including advancing mechanisms, as supplied with the axles, excluding friction surfaces.
- Destination signs: All destination sign equipment for the front, side and rear signs, power modules and operator control.
- Heating, ventilating: Roof and/or rear main unit only, excluding floor heaters and front defroster.
- AC unit and compressor: Roof and/or rear main unit only, excluding floor heaters and front defroster.
- Door systems: Door operating actuators and linkages.
- Air compressor
- Air dryer
- Wheelchair lift and ramp system: Lift and/or ramp parts and mechanical only
- Starter
- Alternator: Alternator only. Does not include the drive system.
- Charge air cooler: Charge air cooler including core, tanks and including related surrounding framework and fittings.
- Fire suppression: Fire suppression system including tank and extinguishing agent dispensing system
- Hydraulic/Electric systems: Including radiator fan drive and power steering as applicable.
- Engine cooling systems: Radiator including core, tanks and related framework, including surge tank.
- Transmission cooler
- Passenger seating excluding upholstery
- Fuel storage and delivery system
- Surveillance system including cameras and video recorders

WR 1.1.7 Extended Warranty

The Authority requires the following additional subsystems to be warranted to be free from Defects and Related Defects for two years or 100,000 miles, whichever comes first.

- All Coolant Pipes
- All Hoses
- All OEM Electrical Wiring and Harnesses.

WR 1.1.8 Serial Numbers

Upon delivery of each bus, the Contractor shall provide a complete electronic list of serialized units installed on each bus to facilitate warranty tracking. The list shall include, but is not limited to:

- engine
- transmission
- alternator
- starter
- A/C compressor and condenser/evaporator unit
- drive axle
- power steering unit
- fuel cylinders (if applicable)
- air compressor
- wheelchair ramp (if applicable)

The Contractor shall provide updated serial numbers resulting from warranty campaigns. The format of the list shall be approved by the Authority prior to delivery of the first production bus.

WR 1.1.9 Extension of Warranty

If, during the warranty period, repairs or modifications on any bus are made necessary by defective design, materials or workmanship but are not completed due to lack of material or inability to provide the proper repair for thirty (30) calendar days, the applicable warranty period shall be extended by the number of days equal to the delay period.

WR 1.2 Voiding of Warranty

The warranty shall not apply to the failure of any part or component of the bus that directly results from misuse, negligence, accident or repairs not conducted in accordance with the Contractor-provided maintenance manuals and with workmanship performed by adequately trained personnel in accordance with recognized standards of the industry. The warranty also shall be void if the Authority fails to conduct normal inspections and scheduled preventive maintenance procedures as recommended in the Contractor's maintenance manuals and if that omission caused the part or component failure. The Authority shall maintain documentation, auditable by the Contractor, verifying service activities in conformance with the Contractor's maintenance manuals.

WR 1.3 Exceptions and Additions to Warranty

The warranty shall not apply to the following items:

- scheduled maintenance items
- normal wear-out items
- items furnished by the Authority

Should the Authority require the use of a specific product and has rejected the Contractor's request for an alternate product, then the standard Supplier warranty for that product shall be the only warranty provided to the Authority. This product will not be eligible under "Fleet Defects," below.

The Contractor shall not be required to provide warranty information for any warranty that is less than or equal to the warranty periods listed.

WR 1.3.1 Pass-Through Warranty

Should the Contractor elect to not administer warranty claims on certain components and wish to transfer this responsibility to the sub-Suppliers, or to others, the Contractor shall request this waiver.

Contractor shall state in writing that the Authority's warranty reimbursements will not be impacted. The Contractor also shall state in writing any exceptions and reimbursement including all costs incurred in transport of vehicles and/or components. At any time during the warranty period, the Contractor may request approval from the Authority to assign its warranty obligations to others, but only on a case-by-case basis approved in writing by the Authority. Otherwise, the Contractor shall be solely responsible for the administration of the warranty as specified. Warranty administration by others does not eliminate the warranty liability and responsibility of the Contractor.

WR 1.3.2 Superior Warranty

The Contractor shall pass on to the Authority any warranty offered by a component Supplier that is superior to that required herein. The Contractor shall provide a list to the Authority noting the conditions and limitations of the Superior Warranty not later than the start of production. The Superior Warranty shall not be administered by the Contractor.

WR 1.4 Fleet Defects

WR 1.4.1 Occurrence and Remedy

A Fleet Defect is defined as cumulative failures of twenty-five (25) percent of the same components in the same or similar application in a minimum fleet size of twelve (12) or more buses where such items are covered by warranty. A Fleet Defect shall apply only to the base warranty period in sections entitled "Complete Bus," "Propulsion System" and "Major Subsystems." When a Fleet Defect is declared, the remaining warranty on that item/component stops. The warranty period does not restart until the Fleet Defect is corrected.

For the purpose of Fleet Defects, each option order shall be treated as a separate bus fleet. In addition, should there be a change in a major component within either the base order or an option order, the buses containing the new major component shall become a separate bus fleet for the purposes of Fleet Defects.

The Contractor shall correct a Fleet Defect under the warranty provisions defined in "Repair Procedures." After correcting the Defect, the Authority and the Contractor shall mutually agree to and the Contractor shall promptly undertake and complete a work program reasonably designed to prevent the occurrence of the same Defect in all other buses and spare parts purchased under this Contract. Where the specific Defect can be solely attributed to particular identifiable part(s), the work program shall include redesign and/or replacement of only the defectively designed and/or manufactured part(s). In all other cases, the work

program shall include inspection and/or correction of all of the buses in the fleet via a mutually agreed-to arrangement. The Contractor shall update, as necessary, technical support information (parts, service and operator's manuals) due to changes resulting from warranty repairs. The Authority may immediately declare a Defect in design resulting in a safety hazard to be a Fleet Defect. The Contractor shall be responsible to furnish, install and replace all defective units.

WR 1.4.2 Exceptions to Fleet Defect Provisions

The Fleet Defect warranty provisions shall not apply to Authority-supplied items, such as radios, fare collection equipment, communication systems and tires. In addition, Fleet Defects shall not apply to interior and exterior finishes, hoses, fittings and fabric.

WR 2. Repair Procedures

WR 2.1 Repair Performance

The Contractor is responsible for all warranty-covered repair Work. To the extent practicable, the Authority will allow the Contractor or its designated representative to perform such Work. At its discretion, the Authority may perform such Work if it determines it needs to do so based on transit service or other requirements. Such Work shall be reimbursed by the Contractor.

WR 2.2 Repairs by the Contractor

If the Authority detects a Defect within the warranty periods defined in this section, it shall, within thirty (30) days, notify the Contractor's designated representative. The Contractor or its designated representative shall, if requested, begin Work on warranty-covered repairs within five calendar days after receiving notification of a Defect from the Authority. The Authority shall make the bus available to complete repairs timely with the Contractor's repair schedule.

The Contractor shall provide at its own expense all spare parts, tools and space required to complete repairs. At the Authority's option, the Contractor may be required to remove the bus from the Authority's property while repairs are being affected. If the bus is removed from the Authority's property, repair procedures must be diligently pursued by the Contractor's representative.

WR 2.3 Repairs by the Authority

WR 2.3.1 Parts Used

If the Authority performs the warranty-covered repairs, it shall correct or repair the Defect and any Related Defects utilizing parts supplied by the Contractor specifically for this repair. At its discretion, the Authority may use Contractor-specified parts available from its own stock if deemed in its best interests.

WR 2.3.2 Contractor-Supplied Parts

The Authority may require that the Contractor supply parts for warranty-covered repairs being performed by the Authority. Those parts may be remanufactured but shall have the same form, fit and function, and warranty. The parts shall be shipped prepaid to the Authority from

any source selected by the Contractor within fourteen (14) days of receipt of the request for said parts and shall not be subject to an Authority handling charge.

WR 2.3.3 Defective Component Return

The Contractor may request that parts covered by the warranty be returned to the manufacturing plant. The freight costs for this action shall be paid by the Contractor. Materials should be returned in accordance with the procedures outlined in "Warranty Processing Procedures."

WR 2.3.4 Failure Analysis

The Contractor shall, upon specific request of the Authority, provide a failure analysis of Fleet Defect or safety-related parts, or major components, removed from buses under the terms of the warranty that could affect fleet operation. Such reports shall be delivered within 60 days of the receipt of failed parts.

WR 2.3.5 Reimbursement for Labor and Other Related Costs

The Authority shall be reimbursed by the Contractor for labor. The amount shall be determined by the Authority for a qualified mechanic at a straight time wage rate of $52.22 per hour, which includes fringe benefits and overhead adjusted for the Authority's most recently published rate in effect at the time the Work is performed, plus the cost of towing the bus if such action was necessary and if the bus was in the normal service area. These wage and fringe benefit rates shall not exceed the rates in effect in the Authority's service garage at the time the Defect correction is made.

WR 2.3.6 Reimbursement for Parts

The Authority shall be reimbursed by the Contractor for defective parts and for parts that must be replaced to correct the Defect. The reimbursement shall be at the current price at the time of repair and shall include taxes where applicable, plus fifteen (15) percent handling costs. Handling costs shall not be paid if part is supplied by Contractor and shipped to Authority.

WR 2.3.7 Reimbursement Requirements

The Contractor shall respond to the warranty claim with an accept/reject decision including necessary failure analysis no later than sixty (60) days after the Authority submits the claim and defective part(s), when requested. Reimbursement for all accepted claims shall occur no later than sixty (60) days from the date of acceptance of a valid claim. The Authority may dispute rejected claims or claims for which the Contractor did not reimburse the full amount. The parties agree to review disputed warranty claims during the following quarter to reach an equitable decision to permit the disputed claim to be resolved and closed. The parties also agree to review all claims at least once per quarter throughout the entire warranty period to ensure that open claims are being tracked and properly dispositioned.

WR 2.4 Warranty after Replacement/Repairs

If any component, unit or subsystem is repaired, rebuilt or replaced by the Contractor or by the Authority with the concurrence of the Contractor, the component, unit or subsystem shall have the unexpired warranty period of the original. Repairs shall not be warranted if the Contractor-provided or authorized parts are not used for the repair, unless the Contractor has failed to respond within five days, in accordance with "Repairs by the Contractor."

If an item is declared to be a Fleet Defect, the warranty stops with the declaration of the Fleet Defect. Once the Fleet Defect is corrected, the item(s) shall have three (3) months or remaining time and/or miles of the original warranty, whichever is greater. This remaining warranty period shall begin on the repair/replacement date for corrected items on each bus if the repairs are completed by the Contractor or on the date the Contractor provides all parts to the Authority.

WR 2.4.1 Warranty Processing Procedures

The following list represents requirements by the Contractor to the Authority for processing warranty claims. One failure per bus per claim is allowed.

- bus number and VIN
- total vehicle life mileage at time of repair
- date of failure/repair
- acceptance/in-service date
- Contractor part number and description
- component serial number
- description of failure
- all costs associated with each failure/repair (invoices may be required for third-party costs):
    - towing
    - road calls
    - labour
    - materials
    - parts
    - handling
    - troubleshooting time

WR 2.5 Forms

The Authority's forms will be accepted by the Contractor if all of the above information is included. Electronic submittal may be used if available between the Contractor and Authority.

WR 2.6 Return of Parts

When returning defective parts to the Contractor, the Authority shall tag each part with the following:

- bus number and VIN

- claim number
- part number
- serial number (if available)

WR 2.7 Timeframe

Each claim must be submitted no more than thirty (30) days from the date of failure and/or repair, whichever is later. All defective parts must be returned to the Contractor, when requested, no more than forty-five (45) days from date of repair.

WR 2.8 Reimbursements

Reimbursements are to be transmitted to the following address.

The Authority's Contracting Officer (CO) will provide the address to the awardee.

WR 2.9 Fleet Reliability Defects Design Goals.

The proposed coaches shall be capable of being utilized in WMATA base block revenue service and perform up to the Design Operating Profile as set forth in the Definition in Part I, Section 1.2 within acceptable failure limits set forth in this section.
As a Design Goal and a means of monitoring and verifying product performance, a test demonstration program shall be initiated and maintained over a two (2) year reliability period for all vehicle components, systems and sub-systems, (five (5) years on Basic Body and Skeletal Structure and Suspension System). Failure data will be recorded by the Authority for each coach, system and component; and this data compared with these requirements. In the event that the number of failures exceed the limits specified at any time during the Reliability Tests and Demonstration Program, the Contractor shall be required to evaluate this defect. Upon completion of the Contractor's evaluation, failure data will be accumulated for an additional six (6) months to determine if any improvements that are made have reduced system failures to the specified levels. The number of failures for each system, sub-system, and component shall be based upon WFVIATA failure report identifying all relevant failures as specified hereafter, as furnished to the Contractor during the preceding calendar month. This data shall be organized in a report format and forwarded to the Authority monthly by the tenth (10th) working day after the close of the preceding month.

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WR 2.10. Acceptable Failure Design Goals (Incidents of Failure per 50 Buses)

(For class 1, 2, 3, 4 failures)

COMPONENT-DESCRIPTION	6 MO	12 MC	18 MC	24 MO
4. ENGINE				
(A) APU Main	**1**	**2**	**3**	**4**
(B) Traction/Wheel	**1**	**2**	**3**	**4**
2 **DRIVE AXLE**				
(A) AXLE SHAFTS	**1**	**2**	**3**	**4**
(B) DRIVE GEAR & PINION	**1**	**2**	**3**	**4**
(C) BRAKE ROTORS	**1**	**2**	**3**	**4**
3 **SUSPENSION**				
(A) AIR BAGS	1	2	3	4
(B) LEVELING VALVES	1	2	3	4
4 **BRAKE & AIR SYSTEM**				
(A) Air valves to include Brake Relay Interlock Parking Brake	1	2	3	4
(B) Air Compressor	1	2	3	4
(C) Air Governor	1	2	3	4
(D) Door Actuator	1	2	3	4
(E) Door Control	1	2	3	4
(F) Windshield Wipers	1	2	3	4
(G) Air Dryer	1	2	3	4
(H) Brake System (Mechanical) e.g Calipers	1	2	3	4
5. H.V.A.C				
(A) A.C. Compressor	1	2	3	4
(B) Condenser	1	2	3	4
(C)) Evaporator	1	2	3	4
(D) Alternator/Regulator	1	2	3	4
CE) Roof Fan Motor	1	2	3	4
(F) Temperature Control Unit	1	2	3	4
(G) Blower Motors	1	2	3	4
(H) Defroster Motor	1	2	3	4

6. ELECTRICAL

(A) Destination Signs	1	2	3	4
(B) Switch Failure	1	2	3	4
(C) Relay Failure	1	2	3	4
(D)) Electric Fan	1	2	3	4

8. HYDRAULIC

(A) Hydraulic Pump	1	2	3	4
(B) Hydraulic Lines	1	2	3	4
(C) Hydraulic Cylinders	1	2	3	4
(D)) Electrical	1	2	3	4
Switches	1	2	3	4

9. BASIC SKELETAL STRUCTURE AND SUSPENSION SYSTEMS
Acceptable up to 60 months

10. BASIC BODY STRUCTURE
Acceptable UPTO 12 months.

WR 3.0 Service and Parts

The offeror shall provide a complete list of all purchased and manufactured parts, components, and equipment installed on the buses (OEM and Non-OEM) built under this contract. The list shall include nomenclature/description, contractor's part number, and the original supplier's and/or manufacturer's name, part number, address, and telephone number. The information shall be provided on either CD-ROM or DVD with the technical proposal.

This data will be held confidential and returned to the unsuccessful offeror's. The awardee shall update and finalize the data to reflect the final-built status of the buses delivered under this contract. Payment for the first bus will be conditioned on receipt of the updated data.

The offeror shall provide a complete list of parts with the offeror's part numbers and recommended stocking levels which the offeror considers to be the minimum necessary inventory on the transit property to effectively and efficiently maintain the offeror's buses for a period of 90 days (equivalent to 4 stock turns a year) following expiration of applicable warranties. The recommended stocking levels shall take into consideration demand and estimated delivery times. The list of parts shall be provided on either CD-ROM or DVD with the technical proposal. The offeror shall identify & as part of its price proposal the current price for each part, as a percent discount off the contractor's published list price or parts catalog, whichever is applicable, and shall reflect all cost required to implement the plan. This data will be held confidential and returned to the unsuccessful offeror's. The awardee shall update and finalize the data to reflect the final-built status of the buses delivered under this contract. And provide same with the delivery of the first bus. Payment for the first bus will be conditioned on receipt

of the updated data. Failure by WMATA to stock the pans and quantities recommended shall in no manner impose additional liabilities on WMATA or relieve the contractor of any obligation.

It is anticipated that the contractor will work closely with WMATA to establish business practices that will ensure maximum availability of parts to meet recurring demand. The offeror shall submit a serviceable parts plan' with the technical proposal. WMATA s objective is to implement "just-in-time-inventory" where the contractor will manage the inventory and distributing of the parts to the facility that has the need. As part of the plan, the offeror, based on past experience shall identify the spare part that will be provided for a period of three years after the expiration of applicable warranties. The plan shall describe the means and methods of inventorying, the method of distribution, the turn-around time and the like. The offeror's plan will be evaluated as pan of the technical proposal evaluation. The plan shall consider but not be limited to the following concepts:

I. Vendor managed inventory
2. Local vendor managed warehouses
3. Establishment of minimum/maximum inventory levels by the vendor for WMATA
4. Just-in-time delivery
5. Direct delivery to bus facilities throughout the Washington Metropolitan area
6. Business to Business (B2B) capability (seamless ordering and transfer of material to WMATA storerooms with minimal human involvement or intervention).

The offeror shall identify as part of its price proposal the current price for each part. as a percent discount off the contractor's published list price or parts catalog, whichever is applicable, and shall reflect all cost required to implement the plan.

SECTION 6: QUALITY ASSURANCE

QA 1. Contractor's In-Plant Quality Assurance Requirements

QA 1.1 Quality Assurance Organization

QA 1.1.1 Organization Establishment

The Contractor shall establish and maintain an effective in-plant quality assurance organization. It shall be a specifically defined organization and should be directly responsible to the Contractor's top management.

QA 1.1.2 Control

The quality assurance organization shall exercise quality control over all phases of production, from initiation of design through manufacture and preparation for delivery. The organization shall also control the quality of supplied articles.

QA 1.1.3 Authority and Responsibility

The quality assurance organization shall have the authority and responsibility for reliability, quality control, inspection planning, establishment of the quality control system, and acceptance/rejection of materials and manufactured articles in the production of the transit buses.

QA 1.2 Quality Assurance Organization Functions

QA 1.2.1 Minimum Functions

The quality assurance organization shall include the following minimum functions:

- **Work instructions:** The quality assurance organization shall verify inspection operation instructions to ascertain that the manufactured product meets all prescribed requirements.
- **Records maintenance:** The quality assurance organization shall maintain and use records and data essential to the effective operation of its program. These records and data shall be available for review by the resident inspectors. Inspection and test records for this procurement shall be available for a minimum of one year after inspections and tests are completed.
- **Corrective action:** The quality assurance organization shall detect and promptly ensure correction of any conditions that may result in the production of defective transit buses. These conditions may occur in designs, purchases, manufacture, tests or operations that culminate in defective supplies, services, facilities, technical data or standards.

QA 1.2.2 Basic Standards and Facilities

The following standards and facilities shall be basic in the quality assurance process:

- **Configuration control:** The Contractor shall maintain drawings, assembly procedures, and other documentation that completely describe a qualified bus that meets all of the options and special requirements of this procurement. The quality

assurance organization shall verify that each transit bus is manufactured in accordance with these controlled drawings, procedures, and documentation.

- **Measuring and testing facilities:** The Contractor shall provide and maintain the necessary gauges and other measuring and testing devices for use by the quality assurance organization to verify that the buses conform to all specification requirements. These devices shall be calibrated at established periods against certified measurement standards that have known, valid relationships to national standards.
- **Production tooling as media of inspection:** When production jigs, fixtures, tooling masters, templates, patterns, and other devices are used as media of inspection, they shall be proved for accuracy at formally established intervals and adjusted, replaced, or repaired as required to maintain quality.
- **Equipment use by resident inspectors:** The Contractor's gauges and other measuring and testing devices shall be made available for use by the resident inspectors to verify that the buses conform to all specification requirements. If necessary, the Contractor's personnel shall be made available to operate the devices and to verify their condition and accuracy.

QA 1.2.3 Maintenance of Control

The Contractor shall maintain quality control of purchases:

- **Supplier control:** The Contractor shall require that each Supplier maintains a quality control program for the services and supplies that it provides. The Contractor's quality assurance organization shall inspect and test materials provided by Suppliers for conformance to specification requirements. Materials that have been inspected, tested, and approved shall be identified as acceptable to the point of use in the manufacturing or assembly processes. Controls shall be established to prevent inadvertent use of nonconforming materials.
- **Purchasing data:** The Contractor shall verify that all applicable specification requirements are properly included or referenced in purchase orders of articles to be used on transit buses.

QA 1.2.4 Manufacturing Control

- **Controlled conditions:** The Contractor shall ensure that all basic production operations, as well as all other processing and fabricating, are performed under controlled conditions. Establishment of these controlled conditions shall be based on the documented Work instructions, adequate production equipment and special working environments if necessary.
- **Completed items:** A system for final inspection and test of completed transit buses shall be provided by the quality assurance organization. It shall measure the overall quality of each completed bus.
- **Nonconforming materials:** The quality assurance organization shall monitor the Contractor's system for controlling nonconforming materials. The system shall include procedures for identification, segregation and disposition.

- **Statistical techniques:** Statistical analysis, tests and other quality control procedures may be used when appropriate in the quality assurance processes.
- **Inspection status:** A system shall be maintained by the quality assurance organization for identifying the inspection status of components and completed transit buses. Identification may include cards, tags or other normal quality control devices.

QA 1.2.5 Inspection System

The quality assurance organization shall establish, maintain and periodically audit a fully documented inspection system. The system shall prescribe inspection and test of materials, Work in process and completed articles. As a minimum, it shall include the following controls:

- **Inspection personnel:** Sufficient trained inspectors shall be used to ensure that all materials, components and assemblies are inspected for conformance with the qualified bus design.
- **Inspection records:** Acceptance, rework or rejection identification shall be attached to inspected articles. Articles that have been accepted as a result of approved materials review actions shall be identified. Articles that have been reworked to specified drawing configurations shall not require special identification. Articles rejected as unsuitable or scrap shall be plainly marked and controlled to prevent installation on the bus. Articles that become obsolete as a result of engineering changes or other actions shall be controlled to prevent unauthorized assembly or installation. Unusable articles shall be isolated and then scrapped. Discrepancies noted by the Contractor or resident inspectors during assembly shall be entered by the inspection personnel on a record that accompanies the major component, subassembly, assembly, or bus from start of assembly through final inspection. Actions shall be taken to correct discrepancies or deficiencies in the manufacturing processes, procedures or other conditions that cause articles to be in nonconformity with the requirements of the Contract specifications. The inspection personnel shall verify the corrective actions and mark the discrepancy record. If discrepancies cannot be corrected by replacing the nonconforming materials, then the Authority shall approve the modification, repair or method of correction to the extent that the Contract specifications are affected.
- **Quality assurance audits:** The quality assurance organization shall establish and maintain a quality control audit program. Records of this program shall be subject to review by the Authority.

QA 2. Inspection

QA 2.1 Inspection Stations

Inspection stations shall be at the best locations to provide for the Work content and characteristics to be inspected. Stations shall provide the facilities and equipment to inspect structural, electrical, hydraulic and other components and assemblies for compliance with the design requirements.

Stations shall also be at the best locations to inspect or test characteristics before they are concealed by subsequent fabrication or assembly operations. These locations shall minimally include underbody structure completion, body framing completion, body prior to paint preparation, water test, engine installation completion, underbody dress-up and completion, bus prior to final paint touchup, bus prior to road test and bus final road test completion.

QA 2.2 Resident Inspectors

QA 2.2.1 Resident Inspector's Role

WMATA shall be represented at the Contractor's plant by resident inspectors, as required by FTA. Resident inspectors may be WMATA employees or outside contractors. WMATA shall provide the identify of each inspector and shall also identify their level of authority in writing. They shall monitor, in the Contractor's plant, the manufacture of transit buses built under the procurement. The presence of these resident inspectors in the plant shall not relieve the Contractor of its responsibility to meet all of the requirements of this procurement. The Authority shall designate a primary resident inspector, whose duties and responsibilities are delineated in "Pre-Production Meetings," "Authority" and "Pre-Delivery Tests," below. Contractor and resident inspector relations shall be governed by the guidelines included as Attachment A to this "Section 8: Quality Assurance."

QA 2.2.2 Pre-Production Meetings

The primary resident inspector may participate in design review and pre-production meetings with the WMATA. At these meetings, the configuration of the buses and the manufacturing processes shall be finalized, and all Contract documentation provided to the inspector.

No less than thirty (30) days prior to the beginning of bus manufacture, the primary resident inspector may meet with the Contractor's quality assurance manager and may conduct a pre-production audit meeting. They shall review the inspection procedures and finalize inspection checklists. The resident inspectors may begin monitoring bus construction activities two weeks prior to the start of bus fabrication.

QA 2.2.3 Authority

Records and data maintained by the quality assurance organization shall be available for review by the resident inspectors. Inspection and test records for this procurement shall be available for a minimum of one year after inspections and tests are completed.

The Contractor's gauges and other measuring and testing devices shall be made available for use by the resident inspectors to verify that the buses conform to all specification requirements. If necessary, the Contractor's personnel shall be made available to operate the devices and to verify their condition and accuracy.

Discrepancies noted by the resident inspector during assembly shall be entered by the Contractor's inspection personnel on a record that accompanies the major component, subassembly, assembly or bus from start of assembly through final inspection. Actions shall be taken to correct discrepancies or deficiencies in the manufacturing processes, procedures or other conditions that cause articles to be in nonconformity with the requirements of the

Contract specifications. The inspection personnel shall verify the corrective actions and mark the discrepancy record. If discrepancies cannot be corrected by replacing the nonconforming materials, the Authority shall approve the modification, repair or method of correction to the extent that the Contract specifications are affected.

The primary resident inspector shall remain in the Contractor's plant for the duration of bus assembly Work under this Contract. Only the primary resident inspector or designee shall be authorized to release the buses for delivery. The resident inspectors shall be authorized to approve the pre-delivery acceptance tests. Upon request to the quality assurance supervisors, the resident inspectors shall have access to the Contractor's quality assurance files related to this procurement. These files shall include drawings, assembly procedures, material standards, parts lists, inspection processing and reports, and records of Defects.

QA 2.2.4 Support Provisions

The Contractor shall provide office space for the resident inspectors in close proximity to the final assembly area. This office space shall be equipped with desks, outside and interplant telephones, Internet access, file cabinet, chairs, secure wireless network access (WIFI)

QA 2.2.5 Compliance with Safety Requirements

At the time of the Pre-Production meeting, the Contractor shall provide all safety and other operational restrictions that govern the Contractor's facilities. These issues will be discussed and the parties will agree which rules/restrictions will govern the Authority's inspector(s) and any other Authority representatives during the course of the Contract.

QA 3. Acceptance Tests

QA 3.1 Responsibility

Fully documented tests shall be conducted on each production bus following manufacture to determine its acceptance to the Authority. These acceptance tests shall include pre-delivery inspections and testing by the Contractor and inspections and testing by the Authority after the buses have been delivered.

QA 3.2 Pre-Delivery Tests

The Contractor shall conduct acceptance tests at its plant on each bus following completion of manufacture and before delivery to the Authority. These pre-delivery tests shall include visual and measured inspections, as well as testing the total bus operation. The tests shall be conducted and documented in accordance with written test plans approved by the Authority.

Additional tests may be conducted at the Contractor's discretion to ensure that the completed buses have attained the required quality and have met the requirements in Section 6: Technical Specifications. The Authority may, prior to commencement of production, demand that the Contractor demonstrate compliance with any requirement in that section if there is evidence that prior tests have been invalidated by the Contractor's change of Supplier or change in manufacturing process. Such demonstration shall be by actual test, or by supplying

a report of a previously performed test on similar or like components and configuration. Any additional testing shall be recorded on appropriate test forms provided by the Contractor and shall be conducted before acceptance of the bus.

The pre-delivery tests shall be scheduled and conducted with thirty (30) days' notice so that they may be witnessed by the resident inspectors, who may accept or reject the results of the tests. The results of pre-delivery tests, and any other tests, shall be filed with the assembly inspection records for each bus. The underfloor equipment shall be available for inspection by the resident inspectors, using a pit or bus hoist provided by the Contractor. A hoist, scaffold or elevated platform shall be provided by the Contractor to easily and safely inspect bus roofs. Delivery of each bus shall require written authorization of the primary resident inspector. Authorization forms for the release of each bus for delivery shall be provided by the Contractor. An executed copy of the authorization shall accompany the delivery of each bus.

QA 3.2.1 Visual and Measured Inspections

Visual and measured inspections shall be conducted with the bus in a static condition. The purpose of the inspection testing includes verification of overall dimension and weight requirements, that required components are included and are ready for operation, and that components and subsystems designed to operate with the bus in a static condition do function as designed.

QA 3.2.2 Total Bus Operation

Total bus operation shall be evaluated during road tests. The purpose of the road tests is to observe and verify the operation of the bus as a system and to verify the functional operation of the subsystems that can be operated only while the bus is in motion.

Each bus shall be driven for a minimum of fifteen (15) miles during the road tests. If requested, computerized diagnostic printouts showing the performance of each bus shall be produced and provided to the Authority. Observed Defects shall be recorded on the test forms. The bus shall be retested when Defects are corrected and adjustments are made. This process shall continue until Defects or required adjustments are no longer detected.

QA 4. Authority-Specific Requirements

Approved Equal Process:

The Washington Metropolitan Area Transit Authority requires that all **"APPROVED EQUAL"** product/components must be submitted for one (1) year WMATA test and evaluation period **prior to approval** for use on WMATA buses. **The test and evaluation process is conducted in the WMATA operating environment and using the WMATA operating duty cycle.** The specific product/component submitted for "approved equal" status must achieve a satisfactory and reliable level of performance with no product/component failures during the test and evaluation period. A minimum five (5) sample product/components must be provided and installed on five (5) existing WMATA fleet bus by the manufacturer, at no cost to WMATA, for the

approved equal test and evaluation process. (For larger components i.e. engine, transmission and HVAC a smaller quantity requirement may be considered by WMATA). Contingent upon achieving successful final results for the test and evaluation process, the specific product/component may be granted an “approved equal” by WMATA.

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Attachment A: New Bus Manufacturing Inspection Guidelines

This attachment was developed by the APTA Bus Equipment and Maintenance Committee and is intended as a guideline for use by transit systems (Agencies) and vehicle manufacturers (Contractors).

Two lists are included to reflect the expectations of both the transit system and the vehicle manufacturer.

Pre-Building Phase

Bus Manufacturer's Expectations	Transit System's Expectations

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1. Contract/transit system inspectors must be given all Contract documentation before beginning the inspection process. 2. The bus manufacturer's inspection process should be reviewed at pre-production audit meeting. Inspectors should be present and understand the difference among various manufacturing processes. At least one key customer and manufacturer representative who will follow the entire procurement from start to finish should be present. 3. When change orders are required, they need to be made as early in the process as possible. If change orders have an impact on the delivery schedule, consideration should be given to a delivery schedule revision. 4. Transit system inspection forms should be provided to manufacturers prior to the build so that the manufacturers will know what items the customer believes are critical. The inspection forms should be provided to the manufacturer after completion so that the Defects to be corrected can be identified. 5. If the transit system requires sole-source components, it should obtain assistance for the first installation of new components. 6. The transit system should have a decision maker at the pre-production audit meeting. 7. The transit system should make every effort to inform manufacturers of what they want. Hidden agenda items buried in the Contract to not promote the cooperative environment desired. 8. The parties should agree on what necessitates a line shutdown before the build begins.	1. Manufacturers should have a formal, approved quality assurance (QA) program and must adhere to the program. Any changes in the approved program must be resubmitted to the transit system for approval. 2. At the pre-production audit meeting with the transit system: • Representatives from contracts, engineering, quality and production should be represented. • Manufacturers should ensure good communication among their departments regarding Contract requirements. • A formal sales release must be ready for review at the meeting, and a final sales release must be ready before production. • Manufacturers should not use the meeting to sell parts. • Manufacturers should supply test information and other documents required to meet expectations. 3. Manufacturers should have application and installation approvals from Suppliers whenever possible. On installations of new major components, the sub-Supplier must be present at initial production. 4. Manufacturers should read and understand the specification prior to bid. Specification clarifications should be made during the approved equals process. Ask the appropriate questions at pre-bid meetings. 5. The manufacturer's service representative should be involved with the pre-production audit meeting and initial production, and/or at final acceptance. 6. Prior to build, the manufacturer should be able to provide the transit system a complete Bill of Materials for the buses to be built.

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Process During Building Phase

Bus Manufacturer's Expectations	Transit System's Expectations
1. One person should be the primary inspector from start to finish. The primary inspector should be included in the design review process and pre-production meetings. The rotation of personnel with different expectations and standards causes difficulties. The first or second bus should stay at the manufacturer's location as a quality standard and be delivered last. 2. An adequate number of experienced inspectors should be available to prevent production line movement delays. 3. Inspectors should be available to support the manufacturing effort Monday through Friday, consistent with the manufacturer's production personnel hours. 4. Inspection should be conducted in a cooperative, professional manner. The inspector must *want* to solve problems. 5. Only one person should be able to make stop ship calls, and the reason for the stop ship *must* be immediately available. The stop ship should be in writing. 6. Problems identified should be brought to the attention of the manufacturer at the stage when they occur rather than at a future stage or when the vehicle is complete.	1. The resident inspector should have access to a complete set of engineering drawings and documents for the bus being built. Engineering or manufacturing changes must be formally documented and included in documents provided to transit systems. 2. Manufacturers should maintain the build schedule if possible. Changes in the build schedule and requests for overtime and weekend Work must be communicated as early as possible. 3. Buses that are not ready or complete should not be presented for final inspection. (No repeat snags allowed after first 10 buses in production). 4. Manufacturers should have a formal internal/external communications process and feedback for inspection problems and resolutions. Manufacturers should provide early resolution of problems identified by inspectors. QA procedures must be revised to reflect problem corrections. 5. The attitude of manufacturers and QA personnel is important; remember who the customer is. However, there must be mutual respect. 6. The WMATA is not responsible for redesigning the bus, correcting problems or providing manufacturing quality. It audits only. Manufacturers should not need a learning period to determine acceptable quality standards. 7. Buses should be identical and interchangeable within an order unless provided by the WMATA. 8. Inspection Work should be spread evenly during the workday to the extent possible.

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Post-Building Phase

Bus Manufacturer's Expectations	Transit System's Expectations
1. To ensure prompt payment, the transit system should increase the rate of the final acceptance process. 2. The on-property final acceptance inspection should be primarily for shipping damage and Defects that occur during shipment. It should not be a complete vehicle inspection with criteria different from those used at the plant.	1. Defects noted at the property final inspection should be repaired in a timely and acceptable manner.

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REQUEST FOR PRE-OFFER CHANGE OR APPROVED EQUAL

This form must be used for requested clarifications, changes, substitutes or approval of items equal to items specified with a brand name and must be submitted as far in advance of the Due Date, as specified in "Questions, Clarifications and Omissions."

Request #: **Proposer:** **RFP Section:** **Page:**		
Questions/clarification or approved equal:]		
Authority action:	□ Approved □ See addendum	□ Denied □ See response below
Authority response:		

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CER 1. Acknowledgement of Addenda

Failure to acknowledge receipt of all addenda may cause the Proposal to be considered nonresponsive to the Solicitation. Acknowledged receipt of each addendum must be clearly established and included with the Proposal.

The undersigned acknowledges receipt of the following addenda to the documents: Addendum No.: Dated: Addendum No.: Dated: Addendum No.: Dated: Addendum No.: Dated:
Proposer: Name: Title: Phone: Street address: City, state, ZIP:
_____ Authorized signature Date

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CER 2. Contractor Service and Parts Support Data

Location of nearest Technical Service Representative to Authority

Name:
Address:
Telephone:
Describe technical services readily available from said representative:

Location of nearest Parts Distribution Center to Authority:

Name:
Address:
Telephone:
Describe the extent of parts available at said center:

Policy for delivery of parts and components to be purchased for service and maintenance:

Regular method of shipment:
Cost to Authority:

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CER 3. Form for Proposal Deviation

This form shall be completed for each condition, exception, reservation or understanding (i.e., Deviation) in the Proposal according to "Conditions, Exceptions, Reservations or Understandings." One copy without any price/cost information is to be placed in the Technical Proposal as specified in "Technical Proposal Requirements," and a separate copy with any price/cost information placed in the Price Proposal as specified in "Price Proposal Requirements."

Deviation No.:	**Contractor:**	**RFP section:**	**Page:**
Complete description of Deviation:			
Rationale (pros and cons):			

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CER 3.1 Certificate of Compliance with Bus Testing Requirement

The undersigned certifies that the vehicle offered in this procurement complies and will, when delivered, comply with 49 USC § 5323(c) and FTA's implementing regulation at 49 CFR Part 665 according to the indicated one of the following three alternatives.

Mark one and only one of the three blank spaces with an "X."

1.____ The buses offered herewith have been tested in accordance with 49 CFR Part 665 on_____(date). If multiple buses are being proposed, provide additional bus testing information below or on attached sheet. The vehicles being sold should have the identical configuration and major components as the vehicle in the test report, which must be submitted with this Proposal. If the configuration or components are not identical, then the manufacturer shall provide with its Proposal a description of the change and the manufacturer's basis for concluding that it is not a major change requiring additional testing. If multiple buses are being proposed, testing data on additional buses shall be listed on the bottom of this page.

2.____ The manufacturer represents that the vehicle is "grandfathered" (has been used in mass transit service in the United States before October 1, 1988, and is currently being produced without a major change in configuration or components), and submits with this Proposal the name and address of the recipient of such a vehicle and the details of that vehicle's configuration and major components.

3.____ The vehicle is a new model and will be tested and the results will be submitted to the Authority prior to acceptance of the first bus.

The undersigned understands that misrepresenting the testing status of a vehicle acquired with federal financial assistance may subject the undersigned to civil penalties as outlined in the Department of Transportation's regulation on Program Fraud Civil Remedies, 49 CFR Part 31. In addition, the undersigned understands that FTA may suspend or debar a manufacturer under the procedures in 49 CFR Part 29.

Company name:

Name and title of the proposer's authorized official:

_____

Authorized signature Date

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CER 3.3 Federal Motor Vehicle Safety Standards

The Proposer and (if selected) Contractor shall submit (1) manufacturer's FMVSS self-certification sticker information that the vehicle complies with relevant FMVSS or (2) manufacturer's certified statement that the contracted buses will not be subject to FMVSS regulations.

Company name:

Name of signer:

Title:

Authorized signature Date

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CER 5. Vehicle Questionnaire

NOTE: This is a sample form. The Authority should customize to comply with its proposed requirements.

This form must be completed and included in the Technical Proposal.

GENERAL COACH DATA SHEET:

[40FT BRT STYLE CNG]

Bus Manufacturer: _____

Bus Model Number: _____

Basic Body Construction Type: _____

General Dimensions

Overall length	Over bumpers		feet		inches
	Over body		feet		inches
Overall width	Over body excluding mirrors and lights		feet		inches
	Over body including mirrors		feet		inches
	Over tires		feet		inches
Overall height (maximum)			feet		inches

Angle of approach	9	Degrees
Angle of departure	9	Degrees
Breakover angle 1	9	Degrees
Breakover angle 2		Degrees

Doorway clear opening (at widest point) _____ inches

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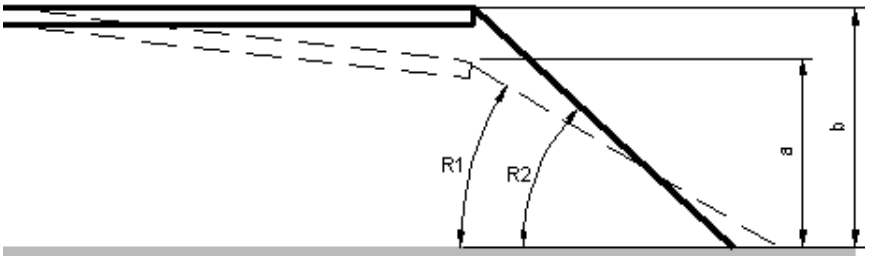
	Width with grab handles	**Width** without grab handles	**Height**
Front door	Inches	inches	inches
Center door (1)	Inches	inches	inches
Center door (2)	Inches	inches	inches
Rear door	Inches	inches	inches

Front axle floor height above ground (centerline of bus)	inches
Center axle floor height above ground (centerline of bus)	inches
Rear axle floor height above ground (centerline of bus)	inches
Step height from ground (measured at center of doorway)	inches



	Front doorway	Center doorway	Ramp angle	Rear doorway
Kneeled	inches (a)	inches (a)	degrees (R1)	inches (a)
Unkneeled	inches (b)	inches (b)	degrees (R2)	inches (b)

Interior head room (floor to ceiling at center of aisle)

First axle location	inches
Center of articulation	inches
Rear axle location	inches
Rear settee (in front of seat)	inches

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Aisle width

Minimum width on floor between first axle wheel housings		inches
Minimum width on floor between center axle (1) wheel housings		inches
Minimum width on floor between center axle (2) wheel housings		inches
Minimum width on floor between rear axle wheel housings		inches

Minimum ground clearance

Outside axles zones		inches
Inside axles zones		inches

Horizontal turning envelope (see diagram below)

Outside body turning radius, TR0 (including bumper)		feet		inches
Inside Body Turning Radius innermost point, TR4 (including bumper)		feet		inches

Wheel base

First axle to center/rear axle		inches
Center axle to rear axle		inches

Overhang, centerline of axle over bumper

Front		Inches
Rear		Inches

Floor

Maximum interior floor slope (from horizontal)		degrees

Capacity

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Total number of passenger sittings		
Passenger seating manufacturer/model number		
Total number of standing passengers (1 per 1.5 sq. ft.)		
Minimum hip to knee space		inches
Maximum hip to knee space		inches
Restraint system type and model number		

Bus weight

	Curb weight		**Curb weight plus seated load***		**GVWR**	
First axle		lbs		lbs		lbs
Center axle		lbs		lbs		lbs
Rear axle		lbs		lbs		lbs
Total		lbs		lbs		lbs

* Including operator and passengers at 150 lbs per person

Steering Axles

Manufacturer	
Type and weight rating	
Model number	

Drive axle (□ Center □ Rear)

Manufacturer	
Type and weight rating	
Model number	

Drive axle ratio

Differential ratio	
Hub reduction ratio (if used)	

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Final axle ratio (if hub reduction is used)	

Brake system

Make/type of fundamental system	
First axle brake chamber model	
Center axle brake chamber model	
Rear axle brake chamber model	
First axle slack adjuster	
Manufacturer	
Model number	
Center axle slack adjuster	
Manufacturer	
Model number	
Rear axle slack adjuster	
Manufacturer	
Model number	
First axle brake drum/rotor	
Manufacturer	
Center axle brake drum/rotor	
Manufacturer	
Rear axle brake drum/rotor	
Manufacturer	

Air compressor

Manufacturer		
Type		
Model number		
Rated capacity		cfm
Capacity at idle		cfm
Maximum warranted speed		rpm
Idle speed		rmp

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Drive type		
Governor cut-in pressure		psi
Governor cut-out pressure		psi

Air Reservoir Capacity

Manufacturer

Supply reservoir number and size		/		cubic inches total
Primary reservoir number and size		/		cubic inches total
Secondary reservoir number and size		/		cubic inches total
Parking reservoir number and size		/		cubic inches total
Accessory reservoir number and size		/		cubic inches total
Other reservoir number and size		/		cubic inches total

Cooling System

	Radiator	Charge air cooler
Manufacturer		
Type		
Model number		
Number of tubes		
Fins per inch		
Fin thickness (inches)		
Fin construction		

Total cooling system capacity (gallons)		gallons
Radiator fan manufacturer		
Fan speed/control type (mech/elect/hyb)		
Surge tank capacity		gallons

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Surge tank material		
Overheat alarm temperature		degrees F
Shutdown temperature settings		degrees F

Electrical

Primary interior lighting system

Manufacturer	
Type	
Model number	

Alternator

Manufacturer		
Type		
Model number		
Output at idle		Amps

Voltage regulator

Manufacturer	
Model number	

Voltage equalizer

Manufacturer	
Model number	

Auxiliary inverter (120/240)

Manufacturer	
Model number	
Inverter technology	
Output voltage(s)	

Starter motor

Manufacturer	

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Voltage	
Model number	

Engine

Manufacturer	
Model number/version	
Horsepower/torque rating	

Fire Suppression/Methane Detection System

Manufacturer				
Model number				
Number of detectors		Fire		methane
Type of detector	□ Thermal □ Optical			
Battery backup	□ Yes □ No			

Bumpers

Manufacturer	
Type	

Fuel and Exhaust System

Fuel type	
Operating range and route profile	

Fuel tanks (liquid fuels)

Manufacturer				
Capacity (total and usable)		Gallons /		Gallons
Construction material				
Quantity and location of tanks				

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Fuel tanks (gaseous fuels)

Manufacturer				
Capacity (total and usable)		SCF /		SCF
Construction material				
Quantity and location of tanks				

Exhaust system

Diesel particulate filter manufacturer	
Describe DPF electronic interface	
Muffler manufacturer (if applicable)	

Air Suspension

	Front	Middle	Rear
Air spring manufacturer			
Air spring quantity per axle			
Shock absorber manufacturer			
Shock absorber quantity per axle			

Steering

Pump manufacturer		
Pump model number		
Steering gear manufacturer		
Steering gear model number		
Steering gear type		
Steering wheel diameter		inches
Maximum effort at steering wheel*		

* Unloaded stationary coach on dry asphalt pavement

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□ **Transmission /** □ **Hybrid drive system** (check one)

Manufacturer	
Type	
Model number	
Number of forward speeds	
Traction motor horsepower rating	
Type ventilation/cooling	

Propshaft

Manufacturer	

Wheels

Manufacturer	
Type	
Size	
Mounting type	
Bolt circle diameter	
Protective coating	

Tires

Manufacturer	
Type	
Size	
Load range/air pressure	

Door System

Door panels	**Manufacturer**	**Type**
Front door		
Center door (1)		
Center door (2)		
Rear door		

Actuating mechanism (air, electric, spring, other)

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Manufacturer	
Front door	
Center door (1)	
Center door (2)	
Rear door	

Heating and Ventilating Equipment

Heating system capacity		Btu
Air conditioning system capacity		Btu
Ventilating capacity		CFM per passenger
Manufacturer and model		
Refrigerant type		

Driving heater

Manufacturer	
Type	
Model number	
Capacity	

Auxiliary heater

Manufacturer	
Type	
Model number	
Capacity	

Floor heaters

Manufacturer	
Type/number	
Model number	
Capacity	

Passenger Loading System

Manufacturer	

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Type (hydraulic, electric or both)	
Model number	
Capacity (lbs.)	

Dimensions

Width of ramp		inches
Length of ramp		inches

Cycle times	**Normal idle**		**Fast idle**	
Stowed to ground		Seconds		seconds
Ground to stow		Seconds		seconds

Electronics

Video system manufacturer	
Video system model number	
Number of cameras	
Multiplex system manufacturer	
Multiplex system model number	
Automatic passenger counter system manufacturer	
Automatic passenger counter system model number	
Destination sign manufacturer	
Destination sign model number	
AVL/AVM system manufacturer	
AVL/AVM system model number	
Passenger information system manufacturer	
Passenger information system model number	
Signal prioritization system manufacturer	
Signal prioritization system model number	

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Coach Body Fittings

Passenger windows manufacturer	

Exterior/interior mirrors

Size	
Manufacturer	
Model number	
Manufacturer part numbers	

Bicycle racks

Manufacturer	
Model number	

Paint system

Manufacturer	
Type	

Operator control layout diagram:

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GENERAL COACH DATA SHEET:

[40FT BRT STYLE CLEAN DIESEL]

Bus Manufacturer: _____

Bus Model Number: _____

Basic Body Construction Type: _____

General Dimensions

Overall length	Over bumpers		feet		inches
	Over body		feet		inches
Overall width	Over body excluding mirrors and lights		feet		inches
	Over body including mirrors		feet		inches
	Over tires		feet		inches
Overall height (maximum)			feet		inches

Angle of approach		Degrees
Angle of departure		Degrees
Breakover angle 1		Degrees
Breakover angle 2		Degrees

Doorway clear opening (at widest point) _____ inches

	Width with grab handles		**Width** without grab handles		**Height**	
Front door		Inches		inches		inches
Center door (1)		Inches		inches		inches

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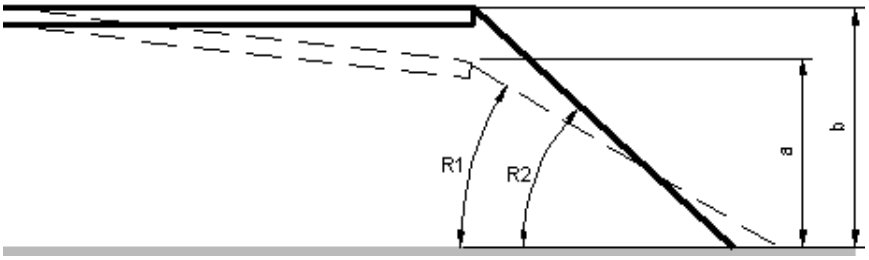
Center door (2)	Inches	inches	inches
Rear door	Inches	inches	inches

Front axle floor height above ground (centerline of bus)	inches
Center axle floor height above ground (centerline of bus)	inches
Rear axle floor height above ground (centerline of bus)	inches
Step height from ground (measured at center of doorway)	inches



	Front doorway	Center doorway	Ramp angle	Rear doorway
Kneeled	inches (a)	inches (a)	degrees (R1)	inches (a)
Unkneeled	inches (b)	inches (b)	degrees (R2)	inches (b)

Interior head room (floor to ceiling at center of aisle)

First axle location	inches
Center of articulation	inches
Rear axle location	inches
Rear settee (in front of seat)	inches

Aisle width

Minimum width on floor between first axle wheel housings	inches

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Minimum width on floor between center axle (1) wheel housings		inches
Minimum width on floor between center axle (2) wheel housings		inches
Minimum width on floor between rear axle wheel housings		inches

Minimum ground clearance

Outside axles zones		inches
Inside axles zones		inches

Horizontal turning envelope (see diagram below)

Outside body turning radius, TR0 (including bumper)		feet		inches
Inside Body Turning Radius innermost point, TR4 (including bumper)		feet		inches

Wheel base

First axle to center/rear axle		inches
Center axle to rear axle		inches

Overhang, centerline of axle over bumper

Front		Inches
Rear		Inches

Floor

Maximum interior floor slope (from horizontal)		degrees

Capacity

Total number of passenger sittings	
Passenger seating manufacturer/model number	
Total number of standing passengers (1 per 1.5 sq. ft.)	

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Minimum hip to knee space		inches
Maximum hip to knee space		inches
Restraint system type and model number		

Bus weight

	Curb weight		**Curb weight plus seated load***		**GVWR**	
First axle		lbs		lbs		lbs
Center axle		lbs		lbs		lbs
Rear axle		lbs		lbs		lbs
Total		lbs		lbs		lbs

* Including operator and passengers at 150 lbs per person

Steering Axles

Manufacturer	
Type and weight rating	
Model number	

Drive axle (□ Center □ Rear)

Manufacturer	
Type and weight rating	
Model number	

Drive axle ratio

Differential ratio	
Hub reduction ratio (if used)	
Final axle ratio (if hub reduction is used)	

Brake system

Make/type of fundamental system	
First axle brake chamber model	

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Center axle brake chamber model	
Rear axle brake chamber model	
First axle slack adjuster	
Manufacturer	
Model number	
Center axle slack adjuster	
Manufacturer	
Model number	
Rear axle slack adjuster	
Manufacturer	
Model number	
First axle brake drum/rotor	
Manufacturer	
Center axle brake drum/rotor	
Manufacturer	
Rear axle brake drum/rotor	
Manufacturer	

Air compressor

Manufacturer		
Type		
Model number		
Rated capacity		cfm
Capacity at idle		cfm
Maximum warranted speed		rpm
Idle speed		rmp
Drive type		
Governor cut-in pressure		psi
Governor cut-out pressure		psi

Air Reservoir Capacity

Manufacturer

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Supply reservoir number and size		/	cubic inches total
Primary reservoir number and size		/	cubic inches total
Secondary reservoir number and size		/	cubic inches total
Parking reservoir number and size		/	cubic inches total
Accessory reservoir number and size		/	cubic inches total
Other reservoir number and size		/	cubic inches total

Cooling System

	Radiator	Charge air cooler
Manufacturer		
Type		
Model number		
Number of tubes		
Fins per inch		
Fin thickness (inches)		
Fin construction		

Total cooling system capacity (gallons)		gallons
Radiator fan manufacturer		
Fan speed/control type (mech/elect/hyb)		
Surge tank capacity		gallons
Surge tank material		
Overheat alarm temperature		degrees F
Shutdown temperature settings		degrees F

Electrical

Primary interior lighting system

Manufacturer	

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Type	
Model number	

Alternator

Manufacturer	
Type	
Model number	
Output at idle	Amps

Voltage regulator

Manufacturer	
Model number	

Voltage equalizer

Manufacturer	
Model number	

Auxiliary inverter (120/240)

Manufacturer	
Model number	
Inverter technology	
Output voltage(s)	

Starter motor

Manufacturer	
Voltage	
Model number	

Energy storage

Batteries – low voltage

Manufacturer	

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Type	
Model number	
Cold cranking amps	

Batteries/energy storage – high voltage

Manufacturer	
Type	
Model number	
Energy density	
Specific power	
Operating temperature range	
Cooling/heating system	

Ultra-capacitor

Manufacturer	
Model number	

Ultra-capacitor ratings: Provide data sheet for energy efficiency, estimated calendar life, cycle life, voltage (each capacitor and each module), working and peak power, and weight

Engine

Manufacturer	
Model number/version	
Horsepower/torque rating	

Fire Suppression/Methane Detection System

Manufacturer				
Model number				
Number of detectors		Fire		methane
Type of detector	□ Thermal □ Optical			
Battery backup	□ Yes □ No			

Bumpers

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Manufacturer	
Type	

Fuel and Exhaust System

Fuel type	
Operating range and route profile	

Fuel tanks (liquid fuels)

Manufacturer				
Capacity (total and usable)		Gallons /		Gallons
Construction material				
Quantity and location of tanks				

Fuel tanks (gaseous fuels)

Manufacturer				
Capacity (total and usable)		SCF /		SCF
Construction material				
Quantity and location of tanks				

Exhaust system

Diesel particulate filter manufacturer	
Describe DPF electronic interface	
Muffler manufacturer (if applicable)	

Air Suspension

	Front	Middle	Rear
Air spring manufacturer			
Air spring quantity per axle			

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Shock absorber manufacturer		
Shock absorber quantity per axle		

Steering

Pump manufacturer		
Pump model number		
Steering gear manufacturer		
Steering gear model number		
Steering gear type		
Steering wheel diameter		inches
Maximum effort at steering wheel*		

* Unloaded stationary coach on dry asphalt pavement

□ **Transmission /** □ **Hybrid drive system** (check one)

Manufacturer	
Type	
Model number	
Number of forward speeds	
Traction motor horsepower rating	
Type ventilation/cooling	

Propshaft

Manufacturer	

Wheels

Manufacturer	
Type	
Size	
Mounting type	
Bolt circle diameter	

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Protective coating	

Tires

Manufacturer	
Type	
Size	
Load range/air pressure	

Door System

Door panels	**Manufacturer**	**Type**
Front door		
Center door (1)		
Center door (2)		
Rear door		

Actuating mechanism (air, electric, spring, other)

Manufacturer	
Front door	
Center door (1)	
Center door (2)	
Rear door	

Heating and Ventilating Equipment

Heating system capacity		Btu
Air conditioning system capacity		Btu
Ventilating capacity		CFM per passenger
Manufacturer and model		
Refrigerant type		

Driving heater

Manufacturer	
Type	
Model number	

Washington Metropolitan Area Transit Authority
RFP Number: FQ18001/BTK

Capacity	

Auxiliary heater

Manufacturer	
Type	
Model number	
Capacity	

Floor heaters

Manufacturer	
Type/number	
Model number	
Capacity	

Passenger Loading System

Manufacturer	
Type (hydraulic, electric or both)	
Model number	
Capacity (lbs.)	

Dimensions

Width of ramp		inches
Length of ramp		inches

Cycle times	**Normal idle**		**Fast idle**	
Stowed to ground		Seconds		seconds
Ground to stow		Seconds		seconds

Electronics

Video system manufacturer	
Video system model number	

Washington Metropolitan Area Transit Authority
RFP Number: FQ18001/BTK

Number of cameras	
Multiplex system manufacturer	
Multiplex system model number	
Automatic passenger counter system manufacturer	
Automatic passenger counter system model number	
Destination sign manufacturer	
Destination sign model number	
AVL/AVM system manufacturer	
AVL/AVM system model number	
Passenger information system manufacturer	
Passenger information system model number	
Signal prioritization system manufacturer	
Signal prioritization system model number	

Coach Body Fittings

Passenger windows manufacturer	

Exterior/interior mirrors

Size	
Manufacturer	
Model number	
Manufacturer part numbers	

Bicycle racks

Manufacturer	
Model number	

Paint system

Manufacturer	
Type	

Washington Metropolitan Area Transit Authority
RFP Number: FQ18001/BTK

Operator control layout diagram:

GENERAL COACH DATA SHEET:

[60FT BRT STYLE CNG]

Bus Manufacturer: _____

Bus Model Number: _____

Basic Body Construction Type: _____

General Dimensions

Overall length	Over bumpers		feet		inches
	Over body		feet		inches
Overall width	Over body excluding mirrors and lights		feet		inches
	Over body including mirrors		feet		inches
	Over tires		feet		inches
Overall height (maximum)			feet		inches

Washington Metropolitan Area Transit Authority
RFP Number: FQ18001/BTK

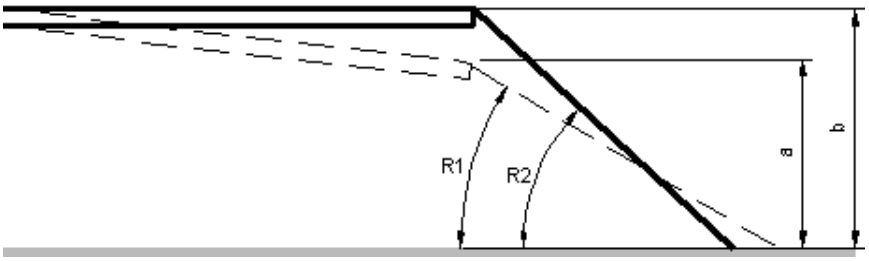
Angle of approach	9	Degrees
Angle of departure	9	Degrees
Breakover angle 1	9	Degrees
Breakover angle 2		Degrees

Doorway clear opening (at widest point)		inches

	Width with grab handles		**Width** without grab handles		**Height**	
Front door		Inches		inches		inches
Center door (1)		Inches		inches		inches
Center door (2)		Inches		inches		inches
Rear door		Inches		inches		inches

Front axle floor height above ground (centerline of bus)		inches
Center axle floor height above ground (centerline of bus)		inches
Rear axle floor height above ground (centerline of bus)		inches
Step height from ground (measured at center of doorway)		inches

Washington Metropolitan Area Transit Authority
RFP Number: FQ18001/BTK



	Front doorway		Center doorway		Ramp angle		Rear doorway	
Kneeled		inches (a)		inches (a)		degrees (R1)		inches (a)
Unkneeled		inches (b)		inches (b)		degrees (R2)		inches (b)

Interior head room (floor to ceiling at center of aisle)

First axle location		inches
Center of articulation		inches
Rear axle location		inches
Rear settee (in front of seat)		inches

Aisle width

Minimum width on floor between first axle wheel housings		inches
Minimum width on floor between center axle (1) wheel housings		inches
Minimum width on floor between center axle (2) wheel housings		inches
Minimum width on floor between rear axle wheel housings		inches

Minimum ground clearance

Outside axles zones		inches
Inside axles zones		inches

Washington Metropolitan Area Transit Authority
RFP Number: FQ18001/BTK

Horizontal turning envelope (see diagram below)

Outside body turning radius, TR0 (including bumper)		feet		inches
Inside Body Turning Radius innermost point, TR4 (including bumper)		feet		inches

Wheel base

First axle to center/rear axle		inches
Center axle to rear axle		inches

Overhang, centerline of axle over bumper

Front		Inches
Rear		Inches

Floor

Maximum interior floor slope (from horizontal)		degrees

Capacity

Total number of passenger sittings		
Passenger seating manufacturer/model number		
Total number of standing passengers (1 per 1.5 sq. ft.)		
Minimum hip to knee space		inches
Maximum hip to knee space		inches
Restraint system type and model number		

Bus weight

	Curb weight		**Curb weight plus seated load***		**GVWR**	
First axle		lbs		lbs		lbs
Center axle		lbs		lbs		lbs
Rear axle		lbs		lbs		lbs
Total		lbs		lbs		lbs

Washington Metropolitan Area Transit Authority
RFP Number: FQ18001/BTK

* Including operator and passengers at 150 lbs per person

Steering Axles

Manufacturer	
Type and weight rating	
Model number	

Drive axle (□ Center □ Rear)

Manufacturer	
Type and weight rating	
Model number	

Drive axle ratio

Differential ratio	
Hub reduction ratio (if used)	
Final axle ratio (if hub reduction is used)	

Brake system

Make/type of fundamental system	
First axle brake chamber model	
Center axle brake chamber model	
Rear axle brake chamber model	
First axle slack adjuster	
Manufacturer	
Model number	
Center axle slack adjuster	
Manufacturer	
Model number	
Rear axle slack adjuster	

Washington Metropolitan Area Transit Authority
RFP Number: FQ18001/BTK

Manufacturer	
Model number	
First axle brake drum/rotor	
Manufacturer	
Center axle brake drum/rotor	
Manufacturer	
Rear axle brake drum/rotor	
Manufacturer	

Air compressor

Manufacturer		
Type		
Model number		
Rated capacity		cfm
Capacity at idle		cfm
Maximum warranted speed		rpm
Idle speed		rmp
Drive type		
Governor cut-in pressure		psi
Governor cut-out pressure		psi

Air Reservoir Capacity

Manufacturer

Supply reservoir number and size		/	cubic inches total
Primary reservoir number and size		/	cubic inches total
Secondary reservoir number and size		/	cubic inches total
Parking reservoir number and size		/	cubic inches total
Accessory reservoir number and size		/	cubic inches total
Other reservoir number and size		/	cubic inches total

Washington Metropolitan Area Transit Authority
RFP Number: FQ18001/BTK

Cooling System

	Radiator	Charge air cooler
Manufacturer		
Type		
Model number		
Number of tubes		
Fins per inch		
Fin thickness (inches)		
Fin construction		

Total cooling system capacity (gallons)		gallons
Radiator fan manufacturer		
Fan speed/control type (mech/elect/hyb)		
Surge tank capacity		gallons
Surge tank material		
Overheat alarm temperature		degrees F
Shutdown temperature settings		degrees F

Electrical

Primary interior lighting system

Manufacturer	
Type	
Model number	

Alternator

Manufacturer		
Type		
Model number		
Output at idle		Amps

Washington Metropolitan Area Transit Authority
RFP Number: FQ18001/BTK

Voltage regulator

Manufacturer	
Model number	

Voltage equalizer

Manufacturer	
Model number	

Auxiliary inverter (120/240)

Manufacturer	
Model number	
Inverter technology	
Output voltage(s)	

Starter motor

Manufacturer	
Voltage	
Model number	

Energy storage

Batteries – low voltage

Manufacturer	
Type	
Model number	
Cold cranking amps	

Batteries/energy storage – high voltage

Manufacturer	
Type	
Model number	
Energy density	

Washington Metropolitan Area Transit Authority
RFP Number: FQ18001/BTK

Specific power	
Operating temperature range	
Cooling/heating system	

Ultra-capacitor

Manufacturer	
Model number	

Ultra-capacitor ratings: Provide data sheet for energy efficiency, estimated calendar life, cycle life, voltage (each capacitor and each module), working and peak power, and weight

Engine

Manufacturer	
Model number/version	
Horsepower/torque rating	

Fire Suppression/Methane Detection System

Manufacturer				
Model number				
Number of detectors		Fire		Methane
Type of detector	□ Thermal □ Optical			
Battery backup	□ Yes □ No			

Bumpers

Manufacturer	
Type	

Fuel and Exhaust System

Fuel type	
Operating range and route profile	

Fuel tanks (liquid fuels)

Washington Metropolitan Area Transit Authority
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Manufacturer				
Capacity (total and usable)		Gallons /		Gallons
Construction material				
Quantity and location of tanks				

Fuel tanks (gaseous fuels)

Manufacturer				
Capacity (total and usable)		SCF /		SCF
Construction material				
Quantity and location of tanks				

Exhaust system

Diesel particulate filter manufacturer	
Describe DPF electronic interface	
Muffler manufacturer (if applicable)	

Air Suspension

	Front	Middle	Rear
Air spring manufacturer			
Air spring quantity per axle			
Shock absorber manufacturer			
Shock absorber quantity per axle			

Steering

Pump manufacturer	
Pump model number	
Steering gear manufacturer	
Steering gear model number	

Washington Metropolitan Area Transit Authority
RFP Number: FQ18001/BTK

Steering gear type		
Steering wheel diameter		inches
Maximum effort at steering wheel*		

* Unloaded stationary coach on dry asphalt pavement

Articulation

Articulation joint manufacturer	
Articulation joint model number	
Bellows manufacturer	
Bellows model number	

□ **Transmission /** □ **Hybrid drive system** (check one)

Manufacturer	
Type	
Model number	
Number of forward speeds	
Traction motor horsepower rating	
Type ventilation/cooling	

Propshaft

Manufacturer	

Wheels

Manufacturer	
Type	
Size	
Mounting type	
Bolt circle diameter	
Protective coating	

Tires

Manufacturer	

Washington Metropolitan Area Transit Authority
RFP Number: FQ18001/BTK

Type	
Size	
Load range/air pressure	

Door System

Door panels	**Manufacturer**	**Type**
Front door		
Center door (1)		
Center door (2)		
Rear door		

Actuating mechanism (air, electric, spring, other)

Manufacturer	
Front door	
Center door (1)	
Center door (2)	
Rear door	

Heating and Ventilating Equipment

Heating system capacity		Btu
Air conditioning system capacity		Btu
Ventilating capacity		CFM per passenger
Manufacturer and model		
Refrigerant type		

Driving heater

Manufacturer	
Type	
Model number	
Capacity	

Auxiliary heater

Manufacturer	

Washington Metropolitan Area Transit Authority
RFP Number: FQ18001/BTK

Type	
Model number	
Capacity	

Floor heaters

Manufacturer	
Type/number	
Model number	
Capacity	

Passenger Loading System

Manufacturer	
Type (hydraulic, electric or both)	
Model number	
Capacity (lbs.)	

Dimensions

Width of ramp		Inches
Length of ramp		Inches

Cycle times	**Normal idle**		**Fast idle**	
Stowed to ground		Seconds		Seconds
Ground to stow		Seconds		Seconds

Electronics

Video system manufacturer	
Video system model number	
Number of cameras	
Multiplex system manufacturer	
Multiplex system model number	
Automatic passenger counter system manufacturer	

Washington Metropolitan Area Transit Authority
RFP Number: FQ18001/BTK

Automatic passenger counter system model number	
Destination sign manufacturer	
Destination sign model number	
AVL/AVM system manufacturer	
AVL/AVM system model number	
Passenger information system manufacturer	
Passenger information system model number	
Signal prioritization system manufacturer	
Signal prioritization system model number	

Coach Body Fittings

Passenger windows manufacturer	

Exterior/interior mirrors

Size	
Manufacturer	
Model number	
Manufacturer part numbers	

Bicycle racks

Manufacturer	
Model number	

Paint system

Manufacturer	
Type	

Operator control layout diagram:

Washington Metropolitan Area Transit Authority
RFP Number: FQ18001/BTK

GENERAL COACH DATA SHEET:

[60FT BRT STYLE CLEAN DIESEL]

Bus Manufacturer: _____

Bus Model Number: _____

Basic Body Construction Type: _____

General Dimensions

Overall length	Over bumpers		feet		inches
	Over body		feet		inches
Overall width	Over body excluding mirrors and lights		feet		inches
	Over body including mirrors		feet		inches
	Over tires		feet		inches
Overall height (maximum)			feet		inches

Washington Metropolitan Area Transit Authority
RFP Number: FQ18001/BTK

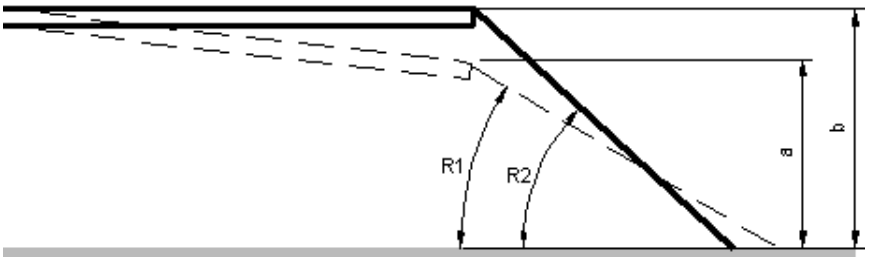
Angle of approach	9	Degrees
Angle of departure	9	Degrees
Breakover angle 1	9	Degrees
Breakover angle 2		Degrees

Doorway clear opening (at widest point)		inches

	Width with grab handles		**Width** without grab handles		**Height**	
Front door		Inches		inches		inches
Center door (1)		Inches		inches		inches
Center door (2)		Inches		inches		inches
Rear door		Inches		inches		inches

Front axle floor height above ground (centerline of bus)		inches
Center axle floor height above ground (centerline of bus)		inches
Rear axle floor height above ground (centerline of bus)		inches
Step height from ground (measured at center of doorway)		inches

Washington Metropolitan Area Transit Authority
RFP Number: FQ18001/BTK



	Front doorway		Center doorway		Ramp angle		Rear doorway	
Kneeled		inches (a)		inches (a)		degrees (R1)		inches (a)
Unkneeled		inches (b)		inches (b)		degrees (R2)		inches (b)

Interior head room (floor to ceiling at center of aisle)

First axle location		inches
Center of articulation		inches
Rear axle location		inches
Rear settee (in front of seat)		inches

Aisle width

Minimum width on floor between first axle wheel housings		inches
Minimum width on floor between center axle (1) wheel housings		inches
Minimum width on floor between center axle (2) wheel housings		inches
Minimum width on floor between rear axle wheel housings		inches

Minimum ground clearance

Outside axles zones		inches
Inside axles zones		inches

Washington Metropolitan Area Transit Authority
RFP Number: FQ18001/BTK

Horizontal turning envelope (see diagram below)

Outside body turning radius, TR0 (including bumper)		feet		inches
Inside Body Turning Radius innermost point, TR4 (including bumper)		feet		inches

Wheel base

First axle to center/rear axle		inches
Center axle to rear axle		inches

Overhang, centerline of axle over bumper

Front		inches
Rear		inches

Floor

Maximum interior floor slope (from horizontal)		degrees

Capacity

Total number of passenger sittings		
Passenger seating manufacturer/model number		
Total number of standing passengers (1 per 1.5 sq. ft.)		
Minimum hip to knee space		inches
Maximum hip to knee space		inches
Restraint system type and model number		

Bus weight

	Curb weight		Curb weight plus seated load*		GVWR	
First axle		lbs		lbs		lbs
Center axle		lbs		lbs		lbs
Rear axle		lbs		lbs		lbs
Total		lbs		lbs		lbs

Washington Metropolitan Area Transit Authority
RFP Number: FQ18001/BTK

* Including operator and passengers at 150 lbs per person

Steering Axles

Manufacturer	
Type and weight rating	
Model number	

Drive axle (□ Center □ Rear)

Manufacturer	
Type and weight rating	
Model number	

Drive axle ratio

Differential ratio	
Hub reduction ratio (if used)	
Final axle ratio (if hub reduction is used)	

Brake system

Make/type of fundamental system	
First axle brake chamber model	
Center axle brake chamber model	
Rear axle brake chamber model	
First axle slack adjuster	
Manufacturer	
Model number	
Center axle slack adjuster	
Manufacturer	
Model number	
Rear axle slack adjuster	

Washington Metropolitan Area Transit Authority
RFP Number: FQ18001/BTK

Manufacturer	
Model number	
First axle brake drum/rotor	
Manufacturer	
Center axle brake drum/rotor	
Manufacturer	
Rear axle brake drum/rotor	
Manufacturer	

Air compressor

Manufacturer		
Type		
Model number		
Rated capacity		cfm
Capacity at idle		cfm
Maximum warranted speed		rpm
Idle speed		rmp
Drive type		
Governor cut-in pressure		psi
Governor cut-out pressure		psi

Air Reservoir Capacity

Manufacturer

Supply reservoir number and size		/	cubic inches total
Primary reservoir number and size		/	cubic inches total
Secondary reservoir number and size		/	cubic inches total
Parking reservoir number and size		/	cubic inches total
Accessory reservoir number and size		/	cubic inches total
Other reservoir number and size		/	cubic inches total

Washington Metropolitan Area Transit Authority
RFP Number: FQ18001/BTK

Cooling System

	Radiator	Charge air cooler
Manufacturer		
Type		
Model number		
Number of tubes		
Fins per inch		
Fin thickness (inches)		
Fin construction		

Total cooling system capacity (gallons)		gallons
Radiator fan manufacturer		
Fan speed/control type (mech/elect/hyb)		
Surge tank capacity		gallons
Surge tank material		
Overheat alarm temperature		degrees F
Shutdown temperature settings		degrees F

Washington Metropolitan Area Transit Authority
RFP Number: FQ18001/BTK

Electrical

Primary interior lighting system

Manufacturer	
Type	
Model number	

Alternator

Manufacturer	
Type	
Model number	
Output at idle	amps

Voltage regulator

Manufacturer	
Model number	

Voltage equalizer

Manufacturer	
Model number	

Auxiliary inverter (120/240)

Manufacturer	
Model number	
Inverter technology	
Output voltage(s)	

Starter motor

Manufacturer	
Voltage	
Model number	

Energy storage

Washington Metropolitan Area Transit Authority
RFP Number: FQ18001/BTK

Batteries – low voltage

Manufacturer	
Type	
Model number	
Cold cranking amps	

Batteries/energy storage – high voltage

Manufacturer	
Type	
Model number	
Energy density	
Specific power	
Operating temperature range	
Cooling/heating system	

Ultra-capacitor

Manufacturer	
Model number	

Ultra-capacitor ratings: Provide data sheet for energy efficiency, estimated calendar life, cycle life, voltage (each capacitor and each module), working and peak power, and weight

Engine

Manufacturer	
Model number/version	
Horsepower/torque rating	

Fire Suppression/Methane Detection System

Manufacturer	
Model number	
Number of detectors	____ fire ____ methane
Type of detector	□ Thermal □ Optical
Battery backup	□ Yes □ No

Washington Metropolitan Area Transit Authority
RFP Number: FQ18001/BTK

Bumpers

Manufacturer	
Type	

Fuel and Exhaust System

Fuel type	
Operating range and route profile	

Fuel tanks (liquid fuels)

Manufacturer				
Capacity (total and usable)		Gallons /		Gallons
Construction material				
Quantity and location of tanks				

Fuel tanks (gaseous fuels)

Manufacturer				
Capacity (total and usable)		SCF /		SCF
Construction material				
Quantity and location of tanks				

Exhaust system

Diesel particulate filter manufacturer	
Describe DPF electronic interface	
Muffler manufacturer (if applicable)	

Air Suspension

	Front	Middle	Rear
Air spring manufacturer			

Washington Metropolitan Area Transit Authority
RFP Number: FQ18001/BTK

Air spring quantity per axle			
Shock absorber manufacturer			
Shock absorber quantity per axle			

Steering

Pump manufacturer		
Pump model number		
Steering gear manufacturer		
Steering gear model number		
Steering gear type		
Steering wheel diameter		inches
Maximum effort at steering wheel*		

* Unloaded stationary coach on dry asphalt pavement

Articulation

Articulation joint manufacturer	
Articulation joint model number	
Bellows manufacturer	
Bellows model number	

□ **Transmission /** □ **Hybrid drive system** (check one)

Manufacturer	
Type	
Model number	
Number of forward speeds	
Traction motor horsepower rating	
Type ventilation/cooling	

Propshaft

Washington Metropolitan Area Transit Authority
RFP Number: FQ18001/BTK

Manufacturer	

Wheels

Manufacturer	
Type	
Size	
Mounting type	
Bolt circle diameter	
Protective coating	

Tires

Manufacturer	
Type	
Size	
Load range/air pressure	

Door System

Door panels	**Manufacturer**	**Type**
Front door		
Center door (1)		
Center door (2)		
Rear door		

Actuating mechanism (air, electric, spring, other)

Manufacturer	
Front door	
Center door (1)	
Center door (2)	
Rear door	

Heating and Ventilating Equipment

Heating system capacity		Btu
Air conditioning system capacity		Btu

Washington Metropolitan Area Transit Authority
RFP Number: FQ18001/BTK

Ventilating capacity	CFM per passenger
Manufacturer and model	
Refrigerant type	

Driving heater

Manufacturer	
Type	
Model number	
Capacity	

Auxiliary heater

Manufacturer	
Type	
Model number	
Capacity	

Floor heaters

Manufacturer	
Type/number	
Model number	
Capacity	

Passenger Loading System

Manufacturer	
Type (hydraulic, electric or both)	
Model number	
Capacity (lbs.)	

Dimensions

Width of ramp	inches
Length of ramp	inches

Washington Metropolitan Area Transit Authority
RFP Number: FQ18001/BTK

Cycle times	**Normal idle**	**Fast idle**
Stowed to ground	seconds	seconds
Ground to stow	seconds	seconds

Electronics

Video system manufacturer	
Video system model number	
Number of cameras	
Multiplex system manufacturer	
Multiplex system model number	
Automatic passenger counter system manufacturer	
Automatic passenger counter system model number	
Destination sign manufacturer	
Destination sign model number	
AVL/AVM system manufacturer	
AVL/AVM system model number	
Passenger information system manufacturer	
Passenger information system model number	
Signal prioritization system manufacturer	
Signal prioritization system model number	

Coach Body Fittings

Passenger windows manufacturer	

Exterior/interior mirrors

Size	
Manufacturer	

Washington Metropolitan Area Transit Authority
RFP Number: FQ18001/BTK

Model number	
Manufacturer part numbers	

Bicycle racks

Manufacturer	
Model number	

Paint system

Manufacturer	
Type	

Operator control layout diagram:

Washington Metropolitan Area Transit Authority
RFP Number: FQ18001/BTK

EXHIBIT B
CERTIFICATE AS TO DEPOSIT OF ADDITIONAL SOURCE CODES

_____("Licensor") hereby certifies to _____("Licensee) that Licensor has delivered to Escrow Agent on_____, 20 , to be held in escrow pursuant to the terms of the Escrow Agreement dated as of_____, 20 , among Licensor, Licensee and Escrow Agent, one copy of each of the following Source Codes:

(Describe Source Codes)

Dated: _ _ _ _____ _ _ __, 20__

CONTRACTOR
as Licensor: _____
Name and title

_____ _____
Signature Date

Washington Metropolitan Area Transit Authority
RFP Number: FQ18001/BTK

References

SAE #	Title	Date Published
J10	Methods of Test for Paints - Part J10: Determination of Deposition Efficiency of Coating Powders	Sep 15, 1998
J211	Instrumentation for Impact Test—Part 2: Photographic Instrumentation	May 1, 2001
J287	Driver Hand Control Reach	Feb 1, 2007
J366	Exterior Sound Level for Heavy Trucks and Buses	Feb 1, 1987
J382	Windshield Defrosting Systems Performance Requirements - Trucks, Buses, and Multipurpose Vehicles.	Jan 1, 1994
J534	Lubrication Fittings	May 1, 2008
J537	Storage Batteries	Sep 1, 2000
J541	Voltage Drop for Starting Motor Circuits	Oct 1, 1996
J587	License Plate Illumination Devices (Rear Registration Plate Illumination Devices)	Sep 1, 2003
J593	Backup Lamps (Reversing Lamps)	Sep 1, 2005
J673	Automotive Safety Glasses	Oct 1, 2005
J680	Location and Operation of Instruments and Controls in Motor Truck Cabs, Recommended Practice	Sep 1, 1988
J686	Motor Vehicle License Plates	Oct 1, 1999
J689	Curbstone Clearance, Approach, Departure, and Ramp Breakover Angles—Passenger Car and Light Truck	Aug 1, 2009
J833	Human Physical Dimensions	May 1, 2003
J844	Nonmetallic Air Brake System Tubing	Nov 1, 2004
J941	Motor Vehicle Drivers' Eye Locations	Mar 1, 2010
J994	Alarm—Backup—Electric Laboratory Performance Testing	Mar 1, 2009
J1050	Describing and Measuring the Driver's Field of View	Jan 1, 2003
J1113	Electromagnetic Compatibility Component Test Procedure Part 42, Conducted Transient Emissions	Oct 1, 2006
J1127	Low Voltage Battery Cable	Mar 1, 2010
J1128	Low Voltage Primary Cable	Dec 1, 2005
J1149	Metallic Air Brake System Tubing and Pipe	Aug 1, 2007
J1292	Automobile and Motor Coach Wiring	Jan 1, 2008
J1455	Recommended Environmental Practices for Electronic Equipment Design in Heavy-Duty Vehicle Applications	Jun 1, 2006
J1587	Joint SAE/TMC Electronic Data Interchange between Microcomputer Systems in Heavy-Duty Vehicle Applications, Recommended Practice	Jan 1, 1996
J1708	Serial Data Communications Between Microcomputer Systems in Heavy-Duty Vehicle Applications	Oct 1, 2008
J1986	Balance Weight and Rim Flange Design Specifications, Test Procedures, and Performance Recommendations	Jan 1, 2006
J1939	Data Link Layer	Dec 1, 2006
J1995	Engine Power Test Code - Spark Ignition and Compression Ignition - Gross Power Rating, Standard;	Jun 1, 1990
J2402	Road Vehicles—Symbols for Controls, Indicators, and Tell-tales	Jan 1, 2010
J2711	Recommended Practice for Measuring Fuel Economy and Emissions of Hybrid-Electric and Conventional Heavy-Duty Vehicles	Sept 1, 2002

Washington Metropolitan Area Transit Authority
RFP Number: FQ18001/BTK

Abbreviation and Acronyms

A/C	air conditioning
ABS	anti-lock braking system
AC	alternating current
ACQ	alkaline copper quaternary
ADA	Americans with Disabilities Act
Ah	amp hour
ALR	auto-locking retractor
APA	The Engineered Wood Association, formerly the American Plywood Association
APC	automatic passenger counter
APTA	American Public Transportation Association
ASTM	ASTM International, formerly the American Society for Testing and Materials
ATC	automatic traction control
AVL	automatic vehicle location
AWG	American Wire Gauge
BAFO	Best and Final Offer
BMS	Battery Management System
BRT	bus rapid transit
CARB	California Air Resources Board
CCS	climate control system
CCTV	closed-circuit television
cfm	cubic feet per minute
CGA	Compressed Gas Association
CNG	compressed natural gas
dB	decibel
DBE	disadvantaged business enterprise
DC	direct current
DDU	driver display unit
DEF	diesel exhaust fluid
DOT	Department of Transportation
DPF	diesel particulate filter
ECM	Engine Control and Monitoring
ECS	emission control system
ELR	emergency locking retractor
EMI	electromagnetic interference
EPA	Environmental Protection Authority
ESS	energy storage system
FEA	Finite Element Analysis
FEMA	failure mode effects analysis
FMCSA	Federal Motor Carrier Safety Administration
FMCSR	Federal Motor Carrier Safety Regulations
FMVSS	Federal Motor Vehicle Safety Standards
FTA	Federal Transit Administration
GAWR	gross axle weight rated
GPS	global positioning system
GVW	gross vehicle weight

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GVWR	gross vehicle weight rated
H-point	hip-point
HDS	hybrid drive system human-
HMI	machine interface hybrid
HSC	system controller high
HV	voltage
HVAC	heating, ventilation and air conditioning
I/O	input/output
IEEE	Institute of Electrical and Electronics Engineers
ISO	International Standards Organization
LEL	LED emergency light
LV	low voltage
mA	milliampere
MDT	mobile data terminal
MPa	mega-Pascal
NC	normally closed
NFPA	National Fire Protection Association
NGV	natural gas vehicle
NOx	nitrogen oxide
NO	normally open
NTP	notice to proceed
OEM	original equipment manufacturer
OSI	Open Systems Interconnect
PA	public address
PMO	project management oversight
PPU	primary propulsion unit
PPU	prime power init
PPV	price per vehicle
PRD	pressure relief device
psi	pounds per square inch
RF	radio frequency
RFI	radio frequency interference real-
RTC	time clock
SAE	SAE International, formerly the Society of Automotive Engineers
scf	standard cubic feet
SLW	seated load weight
SOC	state of change
UL	Underwriters Laboratories
UNECE	United Nations Economic Commission for Europe
VDC	volts of direct current
Wh	watt-hours
VIN	vehicle information number