

Standard Bus Procurement Guidelines

A Standardized
Request for Proposal Contract Form
for the Transit Industry

**APTA BTS-BPG-GL-001-13**

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**Bus Procurement Guidelines Working
Group**

Standard Bus Procurement Guidelines

Abstract: This document outlines a request for proposals for a negotiated bus procurement contract. A request for proposals is generally used when the scope of work or specification is less well-defined. In addition, this type of procurement may be used in cases where the vehicle involves “emerging” technology or there is a requirement to discuss warranty provisions or design considerations. This document was developed using a cross-section of representatives from the public and private sectors of the public transit industry for use by transit agencies.

Keywords: bus, commuter bus, compressed natural gas bus, diesel bus, electric bus, hybrid bus, procurement, request for proposals, transit bus

Summary: Many industries have standard forms of contracts for the acquisition of goods and services. Buyers and sellers in those industries become familiar and comfortable with those forms. The goal of creating a common method of contracting enables participants to focus, when necessary, on negotiating only those issues for which a departure from the accepted norm is necessary or desirable. This approach will save considerable time and effort for the parties to a particular transaction. It also permits new provisions or evolving best practices to be incorporated into the standard contract for that industry efficiently and in a manner designed to benefit the entire industry. Finally, standardization leads to a consistency of interpretation that presumably should reduce the number of contract disputes and result in better prices for both the public and private sectors.



Foreword

The American Public Transportation Association is a standards development organization in North America. The process of developing standards is managed by the APTA Standards Program's Standards Development Oversight Council (SDOC). These activities are carried out through several standards policy and planning committees that have been established to address specific transportation modes, safety and security requirements, interoperability, and other topics.

APTA used a consensus-based process to develop this document and for its continued maintenance; this process is detailed in the [manual for the APTA Standards Program](#). This document was drafted in accordance with the approval criteria and editorial policy as described. Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

This document was prepared by the Standard Bus Procurement Guidelines Working Group as directed by the Bus Standards Policy Planning Committee.

This document represents a common viewpoint of those parties concerned with its provisions, namely transit operating/planning agencies, manufacturers, consultants, engineers and general interest groups. The application of any recommended practices or guidelines contained herein is voluntary. In some cases, federal and/or state regulations govern portions of a transit system's operations. In cases where there is a conflict or contradiction between an applicable law or regulation and this document, consult with a legal adviser to determine which document takes precedence.

This document supersedes APTA BTS-BPG-GL-001-13, Rev. 2.2, which has been revised. Below are sections where there are changes from the previous document version:

SECTION 3: GENERAL CONDITIONS

GC 1 Definitions

GC 3 Conformance with Specifications and Drawings GC 4. Inspection, Testing and Acceptance

GC 4.1 General

GC 5 Title and Warranty of Title

GC 7 Data Rights

GC 7.2 Access to Onboard Operational Data GC 8.2 Agency Changes

GC 9.1 Indemnification

GC 9.3 Excusable Delays/Force Majeure

GC 9.4.1. Termination for Convenience

SECTION 4: SPECIAL PROVISIONS

SP 1.1.1 Repairs by Contractor

SP 1.2 Pilot Bus

SP 1.5 Post-Delivery Tests



SP 3 Vehicle Options and Option Pricing SP 5.1 Payment Terms

SP 5.2 Performance Guarantee SP 5.3 Escalation

SP 6 Liquidated Damages for Late Delivery of the Bus SP 7.1 Contractor Service and Parts Support

SP 7.3 Parts Availability Guarantee

SECTION 7: WARRANTY REQUIREMENTS

WR 1.1.6 Propulsion System (Battery Electric) – Default

WR 1.1.7 Energy Storage System (ESS) (Battery Electric or Hybrid)

WR 1.3.1 Pass-Through Warranty

WR 1.4.1 Fleet Defects - Occurrence and Remedy

SECTION 8: QUALITY ASSURANCE

QA 2.2.2 Pre-Production Meetings

QA 3.2.3 Pre-Delivery Tests Required

QA 3.3 Post-Delivery Tests

Appendix C

Example 2: EVALUATION PROCESS

- Maintainability

Appendix G: Example of a Software Escrow Agreement

Has been deleted.

Appendix H: Guidelines for Selecting Electric Bus Specifications

- Section TS 8.1 Altoona Fuel Economy Tests



Participants

The American Public Transportation Association greatly appreciates the contributions of the **Standard Bus Procurement Guidelines Working Group** who made the revisions to this document. At the time this revised standard was completed, the full working group included the following members:

James LaRusch, *Raul V. Bravo + Associates*, Chair

Andy Abdallah, *SEPTA*
Richard Barbe, *AC Transit*
Gregory Beck, *MTA New York City Transit*
Maria Biszewski, *Chicago Transit Authority*
Kerry Bowden, *MTA New York City Transit*
Pat Breen, *SEPTA*
John Brundage, *Jacobs*
James Burke, *Kold-Ban International*
Amanda Burton, *Utah Transit Authority*
Jack Clark, *ITLC*
Chris Collet
John Condon, *Vapor Bus International*
Ben Crow, *Metropolitan Council*
Carlos Delgado, *Miami-Dade Transit*
John Dunn
Chad Engel, *Hanover Displays*
William Fay, *GILLIG*
Hugh Ferdows, *SUTRAK*
Mike Finnern, *WSP*
Jorge Flores, *Cap Metro*
David Frye, *Arlington County, Virginia*
Jeff Gagne
Susane Galarza, *MTA New York City Transit*
James Gallagher, *Bus Stuf*
Frank Golemis, *Vapor Bus International*
William Haber, *King County Metro*
Michael Hamm, *New Flyer of America*
Jason Hanlin
Roger Johnson, *RTC of Southern Nevada*
Harpal Kapoor, *Omni Strategy*
Caleb Keay, *Ventura Systems North America*
Dan Kemper
Randy King, *MGM Brakes*
James Knighton, *WMATA*
Joseph Kruczynski, *STV*
Garrett Krueger, *Bus Stuf*

Stephanie Laubenstein, *NFI Group*
Super Lee, *Ride*
Mark Magaldi, *TransMark*
Brent Martel, *New Flyer of America*
Ellen McCormack, *Chicago Transit Authority*
Ashlee McLaughlin, *Champaign-Urbana MTD*
Raymond Melleady, *United Safety & Survivability*
Michael Mills, *SEPTA*
William Mooney, *Facet Engineering*
TJ Nass, *United Safety & Survivability*
Matthew Nawn, *U.S. FTA*
Craig Norris
Heather Obora, *JTA*
Benjamin Park, *New Jersey Transit*
Mark Parsons, *King County Metro*
Michael Perez, *Hampton Roads Transit*
Cristiano Prado, *Proterra/PhoenixEV*
David Rands, *GILLIG*
Robert Rinaca, *Jacobs*
Brian Sabo, *RECARO*
Benoit Saint-Cyr, *Nova Bus*
John Schiavone, *ITLC*
Patrick Scully
Matthew Shaw, *Regional Transit Service*
Brian Sherlock, *Amalgamated Transit Union*
Kyle Stockley, *Utah Transit Authority*
Lurae Stuart, *WSP*
Ryan Vaughn, *Cummins*
Laura Vedder
Dan Vesper, *Bus Climate Control*
Tim Wagner, *Sound Transit*
Chelsey Waterman, *AECOM*
Kimberly Williams, *Houston Metro*
Jason Yan, *Ride*
Mohammed Yousuf, *U.S. FTA*



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Project team

Lisa Jerram, *American Public Transportation Association*
Scott Baker, *AECOM (lead consultant)*
James Zingale, *AECOM*
Corinne Mehas, *AECOM*
Phet Srisupapol, *AECOM*
Robert Brownstein
Stephanie Amoaning-Yankson
William Mooney
Viktor Zhong
Christina Jung, *American Public Transportation Association*
Natasha De La Cruz

Introduction for Users

This introduction is not part of APTA BTS-BPG-GL-001-13, “Standard Bus Procurement Guidelines”

How This Document Is Organized

The outline of RPF sections has been created to facilitate the development of a bus package that is consistent throughout the industry, providing a uniform format for numbering and organizing such documents. The use of standard formats for commonly used procurement contracts will improve the ability of industry participants to prepare contracts that contain all necessary provisions and incorporate best available practices.

It is understood that transit agencies will need to modify this document to reflect local and state rules, regulations and laws, and that they will insert the standard contract language that they have developed in the appropriate places in the document. However, modifications to the standard format should be made in a



manner that will maintain the structural integrity of the document. The numbering of unused articles should be maintained and accompanied by the notations “Not used” or “Reserved.”

This format for a bus contract RFP is organized as follows:

Section of RFP	Corresponding section of this document
The Notice of Request for Proposals contains general information to prospective Proposers regarding the RFP package and can also be used as notification of the RFP to the public or an advertisement of the procurement opportunity.	Section 1
The Instructions to Proposers provides detailed requirements that Proposers must follow in submitting their Proposals. This section also includes evaluation criteria and information of interest to Proposers regarding Agency Contract award procedures.	Section 2
The General Conditions, once customized by each Agency, should contain the standard terms and conditions and should be modified only by language added in the Special Provisions section..	Section 3
The Special Provisions should be customized to meet the Agency’s specific requirements for each individual project or Contract, as well as local and state requirements. The Special Provisions are intended to amend and supplement the General Conditions to meet the individual requirements of each project.	Section 4
The Federal Requirements should be removed when the project is not funded with federal funds.	Section 5
The Technical Specifications can be detached as a standalone document.	Section 6
The Warranty Requirements include requirements to warrant the operation of the bus.	Section 7
Quality Assurance covers manufacturing, inspection and acceptance procedures.	Section 8
Forms and Certifications are submitted with the Proposal, or the Proposal may be considered nonresponsive.	Section 9
The Contract will incorporate the surviving terms of the RFP, as well as the Contractor’s Proposal in a binding document to be executed by the Agency and the successful Proposer within a designated time period following award.	Section 10
Appendixes provide sample documents and guidelines needed for creation of a contract.	Appendixes



Instructions on How to Use This Document

Items noted in brackets and red font [example] are areas indicating Agency input and should be filled in accordingly. Text that is intended as instructions for the user, not as text for the contract, is indicated as “Note to User” in italics and indented text.

As this is a living document, references to other sections in the document are noted by title only. All section titles are listed in the Table of Contents.

The Technical Specifications section is designed for multiple bus lengths and propulsion types. By selecting “Default,” a basic bus technical specification will be developed. In areas where there are alternatives to the default, the Agency may select “Alternative” instead. Note that the selection of certain alternatives may present a conflict with other selections and should be carefully considered.



Standard Bus Procurement Guidelines: A Standardized Request for Proposal Contract Form for the Transit Industry

Request for Proposal

[Agency name]

[Agency logo]

[Title of procurement]

[Proposal number]

[Date of solicitation]



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SECTION 1: NOTICE OF REQUEST FOR PROPOSALS

NR 1 Description of the Work To Be Done

The Agency requests Proposals for the manufacture and delivery of [title of procurement] in accordance with the terms and conditions set forth in RFP [Proposal number]. The Contract shall be a firm-fixed-price Contract.

Specifically, the Agency is requesting the following types of buses: [Insert everything that is being procured in this solicitation.]

NR 2 Obtaining Proposal Documents

Proposal documents may be obtained from [name of person from whom documents are obtained], in person at [location to obtain proposal documents] or electronically, if available, at [electronic address]. Documents requested by mail will be packaged and sent postage paid.

NR 3 Proposal Due Date and Submittal Requirements

Proposals must be received by [local time, day and date].

1. Sealed Proposals shall be submitted to either of the following addresses:
 - a. For courier delivery or hand delivery: [Agency contact, room and address]
 - b. By U.S. mail: [Agency contact, room and address, if different from above]
2. Envelopes or boxes containing Proposals shall be sealed and clearly labeled with the Agency's Proposal number and the solicitation title: [Proposal number] [title of procurement]
3. Proposers are requested to submit to the Agency one hard copy marked "Original," two additional printed copies, and three CDs, each containing an electronic PDF copy of the Proposal. In case of any discrepancies, the hard copy will be considered by the Agency in evaluating the Proposal, and the electronic version is provided for the Agency's administrative convenience only. A Proposal is deemed to be late if it is received by the Agency after the deadline stated above. Proposals received after the submission deadline may be rejected.

NR 4 Validity of Proposals

Proposals and subsequent offers shall be valid for a period of [specify time period, typically not fewer than 90 and not more than 180 days].

NR 5 Pre-Proposal Meeting Information (Optional)

A Pre-Proposal Meeting will be held on [day and date]. The meeting will convene at [time] in the Agency's [meeting room name], located at [address of location]. Proposers may also participate via conference call. The call-in number and instructions are as follows: [conference call information].

Prospective Proposers are requested to submit written questions to the Contract administrator, identified below, in advance of the Pre-Proposal Meeting. In addition, questions may be submitted up to the date specified in "Proposed Schedule for the Procurement." Responses will be shared with all prospective Proposers. Prospective Proposers are reminded that any changes to the RFP will be by written addenda only, and that nothing stated at the Pre-Proposal Meeting shall change or qualify in any way any of the provisions in the RFP and shall not be binding on the Agency.

Request for Proposal

[Date of solicitation]

[Proposal number]

Contracting Officer's Contact Information:

Name: [name of Contracting Officer]

Title: [title of Contracting Officer]

Address: [address of Contracting Officer]

Phone number: [phone number of Contracting Officer]

Email: [email address of Contracting Officer]

Fax number: [fax number of Contracting Officer]

Additional contact: [additional contacts if applicable]

Identification of Source of Funding

Financial support of this project is provided through financial assistance grants from the Federal Transit Administration (FTA), State of [state], [Agency name] and [any other funding sources].

***NOTE TO USER:** Insert any other locally required notice provisions, including how to obtain the solicitation documents.*

Signed and Dated for Posting

Signature/Title

Date

SECTION 2: INSTRUCTIONS TO PROPOSERS

IP 1 Quantities

The Work under these Contract documents consists of the manufacture and delivery of a base order of [number and bus types] and [associated goods and services such as spare parts, training materials and manual].

There will be [number of optional vehicles] options for [bus types] and [associated goods and services].

IP 2 Proposed Schedule for the Procurement

The following is the solicitation schedule for Proposers:

- Pre-Proposal Meeting/teleconference: [date and time]
- Proposer communications and requests: [date and time]

NOTE TO USER: Due date should be at least 20 business days before Proposal Due Date.

- Responses to the Proposer's communications and/or Agency addenda: [date and time]

NOTE TO USER: Due date should be at least 10 business days before Proposal Due Date.

- Proposal Due Date: [date and time]

NOTE TO USER: The above are recommended dates based upon industry review.

IP 3 Obtaining Proposal Documents

Proposal documents may be obtained from [name], in person at [location] or electronically at [electronic address]. Documents requested by mail will be packaged and sent postage paid. Documents requested by courier will be packaged and sent only at the Proposers' expense.

IP 4 Proposal Security Requirements (Reserved)

[Insert as needed.]

NOTE TO USER: Reserved provision. Common industry practice is not to require a Proposal bond for RFPs.

IP 5 Pre-Proposal Meeting/Information for Proposers

A Pre-Proposal Meeting will be held on [date and time]. The meeting will convene at [time] in the Agency's [room name], located at [address]. Proposers can also participate via conference call. The call-in number and instructions are as follows: [conference call information]. Prospective Proposers are urged to make every effort to attend this meeting.

NOTE TO USER: A universal call-in number (either for North American or international participants, as appropriate) should be used so that Proposers outside the United States can participate in the conference call.

Prospective Proposers are requested to submit written questions to the Contracting Officer, identified above, in advance of the Pre-Proposal Meeting. In addition, questions may be submitted up to the date specified in "Proposed Schedule for the Procurement." Responses will be shared with all prospective Proposers. Prospective Proposers are reminded that any changes to the RFP will be by written addenda only, and nothing stated at the

Pre-Proposal Meeting shall change or qualify in any way any of the provisions in the RFP and shall not be binding on the Agency.

IP 6 Questions, Clarifications and Omissions

All correspondence, communication and contact in regard to any aspect of this solicitation or offers shall be only with the Contracting Officer identified above, [designated representative if applicable]. Unless otherwise instructed by the Contracting Officer, Proposers and their representatives shall not make any contact with or communicate with any member of the Agency, or its employees and consultants, other than the designated Contracting Officer, in regard to any aspect of this solicitation or offers.

At any time during this procurement up to the time specified in “Proposed Schedule for the Procurement,” Proposers may request, in writing, a clarification or interpretation of any aspect, a change to any requirement of the RFP, or any addenda to the RFP. Requests may include suggested substitutes for specified items and for any brand names, which whenever used in this solicitation shall mean the brand name or approved equal. Such written requests shall be made to the Contracting Officer. The Proposer making the request shall be responsible for its proper delivery to the Agency as identified on the form Request for Pre-Offer Change or Approved Equal. Any request for a change to any requirement of the Contract documents must be fully supported with technical data, test results or other pertinent information showing evidence that the exception will result in a condition equal to or better than that required by the RFP, without a substantial increase in cost or time requirements.

All responses to Request for Pre-Offer Change or Approved Equal shall be provided to all Proposers. Any response that is not confirmed by a written addendum shall not be official or binding on the Agency.

NOTE TO USER: *It is recommended that an Agency issue a separate addendum incorporating all approved changes that result from the Request for Pre-Offer Change or Approved Equal process in order to avoid conflicting documents. Furthermore, the Agency should answer all questions in a timely manner.*

If it should appear to a prospective Proposer that the performance of the Work under the Contract, or any of the matters relating thereto, is not sufficiently described or explained in the RFP or Contract documents, or that any conflict or discrepancy exists between different parts of the Contract or with any federal, state, local or Agency law, ordinance, rule, regulation, or other standard or requirement, then the Proposer shall submit a written request for clarification to the Agency within the time period specified above.

IP 7 Addenda to RFP

The Agency reserves the right to amend the RFP at any time in accordance with “Proposed Schedule for the Procurement.” Any amendments to the RFP shall be described in written addenda. Notification of or the addenda also will be distributed to all such prospective Proposers officially known to have received the RFP. Failure of any prospective Proposer to receive the notification or addenda shall not relieve the Proposer from any obligation under the RFP therein. All addenda issued shall become part of the RFP. Prospective Proposers shall acknowledge the receipt of each individual addendum in their Proposals on the form Acknowledgment of Addenda. Failure to acknowledge in the Proposal receipt of addenda may at the Agency’s sole option disqualify the Proposal.

If the Agency determines that the addenda may require significant changes in the preparation of Proposals, the deadline for submitting the Proposals may be postponed no fewer than ten (10) days from the date of issuance of addenda or by the number of days that the Agency determines will allow Proposers sufficient time to revise their Proposals. Any new Due Date shall be included in the addenda.

IP 8 DBE Requirements for Transit Vehicle Manufacturers

NOTE TO USER: *Retain title and add “Reserved” if the procurement is not federally funded.*

Pursuant to 49 CFR, Part 26.49, a Proposer, as a condition of being authorized to respond to this solicitation, must certify by completing the form DBE Approval Certification that it has on file with the Federal Transit Administration (FTA) an approved or not disapproved annual disadvantaged business enterprise (DBE) subcontracting participation goal.

IP 9 Buy America Certification

NOTE TO USER: *The following language should be used in those instances when federal funds are used in the Contract. If non-federal funds are used, then the Agency should insert any appropriate language. If neither applies, then keep the clause title and add the term "Reserved."*

This Contract is subject to the "Buy America" requirements of 49 United States Code (USC) §5323(j) and 49 CFR Part 661, as may be amended from time to time, and applicable federal regulations. Prospective Proposers' attention is directed to 49 CFR §661.11, "Rolling Stock Procurements." Prospective Proposers have the responsibility to comply with the cited and any governing statutes and regulations, including official interpretations.

A Proposer shall submit to the Agency the appropriate Buy America certification, included in this document, with all offers on FTA-funded contracts. Proposals that are not accompanied by a properly completed Buy America certification are subject to the provisions of 49 CFR 661.13 and will be rejected as nonresponsive.

The two signature blocks on the Buy America certificate are mutually exclusive. Proposers shall sign only one signature block on the certificate. Signing both signature blocks will make the Proposal nonresponsive. A false certification is a criminal act in violation of 18 USC §1001.

A Proposer who has submitted an incomplete Buy America certificate or an incorrect certificate of noncompliance through inadvertent or clerical error (but not including failure to sign the certificate, submission of certificates of both compliance and noncompliance, or failure to submit any certification), may submit to the FTA Chief Counsel within ten (10) days of Proposal opening a written explanation of the circumstances surrounding the submission of the incomplete or incorrect certification in accordance with 28 USC §1746, sworn under penalty of perjury, stating that the submission resulted from inadvertent or clerical error. The Proposer will also submit evidence of intent, such as information about the origin of the product, invoices or other working documents. The Proposer will simultaneously send a copy of this information to the Agency.

The FTA Chief Counsel may request additional information from the Proposer, if necessary. The Agency may not make Contract award until the FTA Chief Counsel issues their determination, except as provided in 49 CFR Part 661.15(m).

Certification based on ignorance of proper application of the Buy America requirements is not an inadvertent or clerical error.

A waiver from the Buy America provisions will be sought by the Agency from the FTA for the proposed awardee, if the grounds for a waiver exist. All Proposers seeking a waiver must submit to the Agency a timely request in writing, which shall include the facts and justification to support the granting of the waiver. Such waiver from the Buy America provisions may be granted if the FTA determines the following:

1. Their application would be inconsistent with the public interest;
2. Materials are not produced in the United States in sufficient and reasonably available quantities and of a satisfactory quality; or
3. Inclusion of domestic material will increase the cost of the overall Contract by more than 25%.

Any party may petition the FTA to investigate a successful Proposer's compliance with the Buy America certification. The procedures are set out in 49 CFR Part 661.15. If the FTA determines that the evidence indicates noncompliance, the FTA will require the Agency to initiate an investigation. The successful Proposer has the burden of proof to establish compliance with its certification. If the successful Proposer fails to so demonstrate compliance, then the successful Proposer will be required to substitute sufficient domestic materials without revision of the original Contract terms. Failure to do so will be a breach of the Contract and may lead to the initiation of debarment proceedings under 49 CFR Part 29.

IP 10 Conditions, Exceptions, Reservations or Understandings

Proposers are cautioned to limit exceptions, conditions and limitations to the provisions of this RFP, as they may be determined to be so fundamental as to cause rejection of the Proposal for not responding to the requirements of the RFP.

Any and all Deviations must be explicitly, fully and separately stated in the Proposal by completing the Form for Proposal Deviation, setting forth at a minimum the specific reasons for each Deviation so that it can be fully considered and, if appropriate, evaluated by the Agency. All Deviations shall be evaluated in accordance with the appropriate evaluation criteria and procedures and may result in the Proposer receiving a less favorable evaluation than without the Deviation.

The Form for Proposal Deviation shall be included in the Technical package.

IP 11 Protest Procedures

All protests must be in writing, stating the name and address of the protestor, a contact person, Contract number and title. Protests shall specify in detail the grounds of the protest and the facts supporting the protest.

IP 11.1 Address

All protests must be addressed as follows:

- Agency contact: [name of contact of protests]
- For special delivery or hand delivery: [special delivery address of contact for protests]
- For U.S. mail: [U.S. mail address of contact for protests]

Protests not properly addressed to the address shown above may not be considered by the Agency.

Copies of the Agency's protest procedures and the protest provisions of FTA Circular 4220.1G or its successor may be obtained from [appropriate contact name, address and phone number]. Proposals will be opened and a Notice of Award will be issued by the Agency in accordance with the Agency's protest procedures and the protest provisions of FTA Circular 4220.1G or its successor.

IP 11.2 Pre-Proposal Protests

Pre-Proposal protests are protests based upon the content of the solicitation documents. Three copies of Pre-Proposal protests must be received by the Agency's office no later than fifteen (15) calendar days prior to the Due Date. Protests will be considered and either denied or sustained in part or in whole, in writing, in a manner that provides verification of receipt, prior to the Due Date for Proposals. A written decision specifying the grounds for sustaining all or part of or denying the protest will be transmitted to the protestor prior to the Due Date for Proposals in a manner that provides verification of receipt prior to the Due Date for Proposals. If the protest is sustained, then the Proposal Due Date may be postponed and an addendum issued to the solicitation documents or, at the sole discretion of the Agency, the solicitation may be canceled. If the protest is denied, then Proposals will be received and opened on the scheduled date unless a protest is filed with the FTA. See "FTA Review," below.

IP 11.3 Protests on the Recommended Award

All Proposers will be notified of the recommended award. This notice will be transmitted to each Proposer at the address contained in its Proposal form in a manner that provides verification of receipt. Any Proposer whose Proposal has not lapsed may protest the recommended award on any ground not specified in “Pre-Proposal Protests,” above. Three (3) copies of a full and complete written statement specifying in detail the grounds of the protest and the facts supporting the protest must be received by the Agency at the appropriate address in “Address,” above, no later than fifteen (15) calendar days after the date such notification is received. Prior to the issuing of the Notice of Award, a written decision stating the grounds for allowing or denying the protest will be transmitted to the protestor and the Proposer recommended for award in a manner that provides verification of receipt.

IP 11.4 FTA Review

After such administrative remedies have been exhausted, an interested party may file a protest with the Federal Transit Administration of the U.S. Department of Transportation pursuant to the procedures provided in FTA C 4220.1G or its successor. FTA review is limited to the alleged failure of the Agency to have written protest procedures, the alleged failure of the Agency to follow those procedures, the alleged failure of the Agency to review a protest, or the alleged violation of federal law or regulation.

IP 12 Preparation of Proposals

IP 12.1 Use of Proposal Forms

Proposers are advised that the forms contained in this RFP are required to be used for submission of a Proposal.

***NOTE TO USER:** Agencies should use a submission format that can be completed electronically.*

IP 12.2 Alternate and Multiple Proposals (Reserved)

[Insert alternate proposals as needed.]

IP 12.3 Proposal Format Requirements

Proposals shall be submitted in four separately sealed packages identified below. Each package shall be marked as specified below and shall contain all the Proposal documents for which the package is required to be marked and shall include no other documents. These same requirements shall apply to any best and final offers (BAFOs) that may be requested.

Proposers shall submit one original (marked clearly as such), [number] hard copies, and [number] CDs, each containing an electronic PDF copy of the Proposal to the Agency. In case of any discrepancies, the original will be considered by the Agency in evaluating the Proposal, and the electronic version is provided for the Agency’s administrative convenience only.

The hard-copy Proposals shall be prepared double-sided on 8½ × 11 in. paper in at least 11-point font. The hard copies shall be contained in three-ring binders, the contents of which are identified on the outside. Use of 11 × 17 in. foldout sheets for large tables, charts or diagrams is permissible but should be limited. Elaborate formatting is not necessary. Do not provide promotional or advertising information, unless this information is requested and/or is necessary to support the technical submittal.

Package 1: Technical Proposal Requirements

***NOTE TO USER:** The Agency should develop and insert instructions to Proposers specifying the format and content of the Technical Proposal. These instructions will fully define the requirements for the organization and contents of the Technical Proposal.*

1. Letter of Transmittal
2. Technical Proposal
3. Acknowledgment of Addenda
4. Contractor Service and Parts Support Data
5. Form for Proposal Deviation (without price data)
6. Vehicle Questionnaire
7. References and Non-Priced Information
8. Engineering organization chart, engineering change control procedure, field modification process
9. Manufacturing facilities plant layout, other contracts, staffing
10. Production and delivery schedule and other Contract commitments for the duration of this Contract
11. Management Plan

NOTE TO USER: *The Agency may want to specify the information required for any Management Plan that is to be included in the Proposal, consistent with any specific management requirements and any evaluation criteria detailed in "Proposal Selection Process."*

Package 2: Price Proposal Requirements

Each Price Proposal shall be on the prescribed Proposal form(s) and shall be for the entire Contract, including all Proposal items.

NOTE TO USER: *The Agency is to specify the specific pricing data required and include the appropriate forms where prices are to be proposed. The Agency should also specify if Proposers must propose on all or some of the line items in the RFP. The Agency shall furnish to all prospective Proposers a list of applicable state and local taxes imposed by the Agency's state or local governments. The Agency shall be liable for any such state and local taxes applicable to the complete bus as delivered that are promulgated and become effective between the Due Date and the delivery date.*

1. Letter of Transmittal
2. Pricing Schedule, (including but not limited to such pricing elements as option buses, spare parts package, manuals, training, special tools and test equipment)

The Proposer is required to complete and execute the Agency's Pricing Schedule, contained as part of the Proposal documents, and provide same in the Price Proposal. The Contractor shall be liable for payment of all local taxes applicable to the complete bus as delivered and should add these amounts to the Proposal price.

Package 3: Qualification Package Requirements

1. Pre-Award Evaluation Data Form
2. A copy of the three (3) most recent financial statements audited by an independent third party or a statement from the Proposer regarding how financial information may be reviewed by the Agency
3. Letter for insurance, indicating the Contractor's ability to obtain the insurance coverage in accordance with the RFP requirements
4. Letter from a surety for a Performance Guarantee, if required, indicating the Contractor's ability to obtain financial guarantees in accordance with the RFP requirements
5. Form for Proposal Deviation, if applicable (without price data)
6. Proposal Form
7. All federal certifications: Buy America Certification, Debarment and Suspension Certification for Prospective Contractor, Debarment and Suspension Certification (Lower-Tier Covered Transaction), Non-Collusion Affidavit, Lobbying Certification, Certificate of Compliance with Bus Testing Requirement, DBE Approval Certification, and Federal Motor Vehicle Safety Standards

NOTE TO USER: *In lieu of #4 above, an Agency may allow the submission of a Letter from Parent Company, indicating the willingness of the parent company to provide the financial guarantee upon award for a possible cost reduction. See also “Qualification Requirements,” below.*

Package 4: Proprietary/Confidential Information Package Requirements

The Proposer is directed to collect and submit any information it deems to be proprietary or confidential in nature in a separate marked and sealed package. If there is no confidential information, then the Proposer should include a statement to that effect. Subject package shall be submitted in accordance with the terms and conditions governing the submittal of the Proposer’s Proposal to this RFP. Blanket-type identification by designating whole pages or sections as containing proprietary information, trade secrets, or confidential commercial and financial information will not ensure confidentiality. The specific proprietary information, trade secrets, or confidential commercial and financial information must be clearly identified as such.

The Proposer is advised that the Agency is public and as such may be subject to certain state and/or local Public Records Act provisions regarding the release of information concerning this RFP. If a request is received by the Agency for the release of the Proposer’s proprietary/confidential information, then subject request will be referred to the Proposer for review and consideration. If the Proposer chooses to declare the information proprietary/confidential and withhold it from release, then it shall defend and hold harmless the Agency from any legal action arising from such a declaration.

IP 12.4 Agency Treatment of Proprietary/Confidential Information

NOTE TO USER: *The following provision should be considered a guideline for drafting a clause consistent with local laws.*

Access to government records is governed by the [city, state or local open records law]. Except as otherwise required to be disclosed by applicable [optional city, state or local open records law], the Agency will exempt from disclosure proprietary information identified in Package 4.

Upon a request for records from a third party regarding this Proposal, the Agency will notify the Proposer in writing. The Proposer must respond within [number] business days with the identification of any and all “proprietary, trade secret, or confidential commercial or financial” information. Failure to respond within the allowed period shall be deemed an approval to release. The Proposer shall indemnify the Agency’s defense costs associated with its refusal to produce such identified information; otherwise, the requested information may be released.

The Agency shall employ sound business practices no less diligent than those used for the Agency’s own confidential information to protect the confidence of all licensed technology, software, documentation, drawings, schematics, manuals, data and other information and material provided by Proposers and the Contractor pursuant to the Contract that contain confidential commercial or financial information, trade secrets or proprietary information as defined in or pursuant to the [city, state or local open records law] against disclosure of such information and material to third parties, except as permitted by the Contract. The Contractor shall be responsible for ensuring that confidential commercial or financial information, trade secrets, or proprietary information—with such determinations to be made by the Agency at its sole discretion—bears appropriate notices relating to its confidential character.

IP 12.5 Signing of Proposal Forms

Proposals shall include firm name (and, in the event that the Proposer is a joint venture, the names of the individual firms comprising the joint venture); business address; and the name, title, business address, telephone number, facsimile (fax) number and email address of the responsible individual(s) who may be contacted during

the Proposal evaluation period for scheduling oral presentations and for receiving notices from the Agency. The Proposer shall submit with its Proposal a copy of the joint venture agreement.

Proposals shall be signed by those individual(s) authorized to bind the Proposer. The Proposer shall submit evidence of the official's authority to act for and bind the Proposer in all matters relating to the Proposal. (In the event that the Proposer is a joint venture or consortium, a representative of each of the members of the joint venture or consortium shall execute the Proposal. Each joint venture or consortium member is jointly and severally liable for the joint venture or consortium.)

NOTE TO USER: *The Agency should check applicable state law for any specific requirements.*

IP 12.6 Modification or Withdrawal of Proposals

A modification of a Proposal already received will be accepted by the Agency only if the modification is received prior to the Proposal Due Date, is specifically requested by the Agency or is made with a requested BAFO. All modifications shall be made in writing and executed and submitted in the same form and manner as the original Proposal.

A Proposer may withdraw a Proposal already received prior to the Proposal Due Date by submitting to the Agency, in the same manner as the original Proposal, a written request for withdrawal executed by the Proposer's authorized representative. After the Proposal Due Date, a Proposal may be withdrawn only if the Agency fails to award the Contract within the Proposal validity period prescribed in "Duration of the Validity of Proposals," or any agreed-upon extension thereof. The withdrawal of a Proposal does not prejudice the right of a Proposer to submit another Proposal within the time set for receipt of Proposals.

IP 12.7 Ownership and Cost of Proposal Development

All proposals will become the property of the Agency.

This RFP does not commit the Agency to enter into a Contract, to pay any costs incurred in the preparation or presentation of a Proposal, nor to procure or contract for the equipment.

NOTE TO USER: *An Agency needs to be mindful of the significant costs that Proposers incur in proposal development activities and that cancellation of a procurement after receipt of proposals can end up raising prices for the entire industry.*

IP 13 Proposal Evaluation, Negotiation and Selection

Proposals will be evaluated, negotiated, selected and any award made in accordance with the criteria and procedures described below. The approach and procedures are those applicable to a competitive negotiated procurement whereby Proposals are evaluated to determine which Proposals are within a Competitive Range. Discussions and negotiations may then be carried out with Proposers within the Competitive Range, after which BAFOs may be requested.

However, the Agency may select a Proposal for award without any discussions or negotiations or request for any BAFOs. Subject to the Agency's right to reject any or all Proposals, the Proposer whose Proposal is found to be most advantageous to the Agency will be selected, based upon consideration of the criteria of "Proposal Selection Process," below.

IP 13.1 Confidentiality of Proposals

Proposals will not be publicly opened. All Proposals and evaluations will be kept strictly confidential throughout the evaluation, negotiation and selection process, except as otherwise required by applicable law. Only the

members of the Selection Committee and Evaluation Team and other Agency officials, employees and agents having a legitimate interest will be provided access to the Proposals and evaluation results during this period.

IP 13.2 Duration of the Validity of Proposals

Proposals and subsequent offers shall be valid for the period stated in Section 1, “Notice of Request for Proposals.” The Agency may request Proposers to extend the period of time specified herein by written agreement between the Agency and the Proposer(s) concerned.

IP 13.3 Evaluation Committee

***NOTE TO USER:** The Agency should specify how it will organize the evaluation and appropriately title this section. The following is provided as an example. In some instances, a Selection Committee may be established to receive and review the results of the Evaluation Committee.*

An Evaluation Committee, which will include officers, employees and agents of the Agency, will be established. The Evaluation Committee will carry out the detailed evaluations, including establishing the Competitive Range, carrying out negotiations, and making the selection of the Proposer, if any, that may be awarded the Contract.

The Evaluation Committee may report its recommendations and findings to the appropriate Agency individual or body responsible for awarding the Contract.

IP 13.4 Review of Proposals for Responsiveness and Proposers for Responsibility

Each Proposal will be reviewed to determine if the Proposal is responsive to the submission requirements outlined in this RFP and if the Proposer is responsible.

A responsive Proposal is one that follows the requirements of this RFP, includes all documentation, is submitted in the format outlined in this RFP, is of timely submission, and has the appropriate signatures as required on each document. Failure to comply with these requirements may result in the Proposal being deemed nonresponsive.

A responsible Proposer is one that demonstrates the capability to satisfy the commercial and technical requirements set forth in the Solicitation. A Proposer’s failure to demonstrate that it is responsible may result in the proposal being rejected.

Any Proposal found to be nonresponsive or Proposer found to be non-responsible will not be considered further for award. Proposals that do not comply with the RFP instructions and requirements or do not include the required information may be rejected as insufficient and may not be further considered. The Agency reserves the right to request that a Proposer provide additional information and/or clarify information. The Agency’s determination regarding the responsiveness of a Proposal and the responsibility of a Proposer shall be final.

IP 13.5 Proposal Selection Process

The following describes the process by which Proposals will be evaluated and a selection made for a potential award. Any such selection of a Proposal shall be made by consideration of only the criteria set forth below.

“Qualification Requirements” specifies the requirements for determining responsible Proposers, all of which must be met by a Proposer for it to be found qualified. Final determination of a Proposer’s qualification will be made based upon all information received during the evaluation process and as a condition for award.

“Proposal Evaluation Criteria” contains all the evaluation criteria, and their relative order of importance, by which a Proposal from a qualified Proposer will be considered for selection. An award, if made, will be to a responsible

Proposer for a Proposal that is found to be in the Agency's best interests, based on price and other evaluation criteria considered. The procedures to be followed for these evaluations are provided in "Evaluation Procedures," below.

Qualification Requirements

The following are the requirements for qualifying responsible Proposers. All of these requirements should be met; therefore, they are not listed in any particular order of importance. Any Proposal that the Evaluation Committee finds does not meet these requirements, and cannot be made to meet these requirements, may be determined by the Evaluation Committee to be not responsible and the Proposal rejected. The requirements are as follows:

NOTE TO USER: *Requirements shown below are examples to serve as guidelines. The Agency is to choose and specify the appropriate requirements.*

1. Sufficient financial strength, resources and capability to finance the Work to be performed and to complete the Contract in a satisfactory manner, as measured by the following:
 - The Proposer's financial statements prepared in accordance with generally accepted accounting principles of the jurisdiction in which the Proposer is located, and audited by an independent certified public accountant; oral statement from the Proposer regarding how financial information may be reviewed by the Agency.

NOTE TO USER: *It is important only to determine if the Proposer will have sufficient financial strength to pay its bills on time, fund the cash flow and meet obligations to Subcontractors. The evaluation of financial strength should take into account the Proposer's other contractual commitments.*

- The Proposer's ability to secure financial guarantees, if required, as evidenced by a letter of commitment from an underwriter, surety or other guarantor confirming that the Proposer can provide the required guarantee.

NOTE TO USER: *Willingness of any parent company to provide the financial guarantee if required, in lieu of a bank guarantee, can be evidenced by a letter of commitment signed by an officer of the parent company having the authority to execute the parent company guarantee.*

- The Proposer's ability to obtain required insurance with coverage values that meet minimum requirements, evidenced by a letter from an underwriter confirming that the Proposer can be insured for the required amount.
2. Evidence that the human and physical resources are sufficient to perform the Contract as specified and to ensure delivery of all equipment within the time specified in the Contract, to include the following:
 - Engineering, management and service organizations with sufficient personnel and requisite disciplines, licenses, skills, experience and equipment to complete the Contract as required and to satisfy any engineering or service problems that may arise during the warranty period.
 - Adequate manufacturing facilities sufficient to produce and factory-test equipment on schedule.
 - A spare parts procurement and distribution system sufficient to support equipment maintenance without delays and a service organization with skills, experience and equipment sufficient to perform all warranty and on-site Work.
 3. Evidence that the Proposer is qualified in accordance with the provisions of Section 8, "Quality Assurance."

4. Evidence of satisfactory performance and integrity on contracts in making deliveries on time, meeting specifications and warranty provisions, parts availability, and steps the Proposer took to resolve any judgments, liens, Fleet Defects history or warranty claims. Evidence shall be by client references.

Proposal Evaluation Criteria

The following are the complete criteria, listed in their relative order of importance, by which Proposals from responsible Proposers will be evaluated and ranked for the purposes of determining any Competitive Range and to make any selection of a Proposal for a potential award. Any exceptions, conditions, reservations or understandings explicitly, fully and separately stated on the Form for Proposal Deviation, which do not cause the Agency to consider a Proposal to be outside the Competitive Range, will be evaluated according to the respective evaluation criteria and sub-criteria that they affect.

The criteria are listed numerically by their relative order of importance. However, certain criteria may have sub-criteria identified that are listed by their relative order of importance within the criterion they comprise. Also, certain sub-criteria may have sub-criteria that are listed by their relative degree of importance within the specific sub-criterion they comprise.

NOTE TO USER: *The Agency must define and insert the evaluation criteria to be used. At the option of the Agency, weights could be assigned to each criterion and sub-criterion and be shown in the document. At a minimum, the criteria must be listed by their order of importance in the evaluation. The following are suggested categories of evaluation criteria for Agency consideration, but they are not listed in a suggested order of importance:*

- *Technical*
- *Qualifications (resources, management, engineering, etc.)*
- *Price*
- *Delivery*
- *Other financial impacts*

Example evaluation criteria are presented in Appendix C at the end of this document.

IP 13.6 Evaluation Procedures

Proposals will be analyzed for conformance with the instructions and requirements of the RFP and Contract documents. Proposals that do not comply with these instructions and do not include the required information may be rejected as insufficient or not be considered for the Competitive Range. The Agency reserves the right to request that a Proposer provide any missing information and make corrections. Proposers are advised that the detailed evaluation forms and procedures will follow the same Proposal format and organization specified in “Preparation of Proposals.” Therefore, Proposers should pay close attention to and strictly follow all instructions. Submittal of a Proposal will signify that the Proposer has accepted the whole of the Contract documents, except such conditions, exceptions, reservations or understandings explicitly, fully and separately stated on the forms and according to the instructions of the Form for Proposal Deviation. Any such conditions, exceptions, reservations or understandings that do not result in the rejection of the Proposal are subject to evaluation under the criteria set forth in “Proposal Selection Process.”

Evaluations will be made in strict accordance with all the evaluation criteria specified in “Proposal Selection Process,” above. The Agency will choose the Proposal that it finds to be most advantageous to the Agency, based upon the evaluation criteria.

IP 13.7 Evaluations of Competitive Proposals

1. **Qualification of responsible Proposers.** Proposals will be evaluated to determine the responsibility of Proposers. A final determination of a Proposer’s responsibility will be made upon the basis of initial information submitted in the Proposal, any information submitted upon request by the Agency,

information submitted in a BAFO, and information resulting from Agency inquiry of the Proposer's references and its own knowledge of the Proposer.

2. **Detailed evaluation of Proposals and determination of Competitive Range.** The Agency will carry out and document its evaluations in accordance with the criteria and procedures set forth in "Proposal Selection Process." Any Proposal deficiencies that may render a Proposal unacceptable will be documented. The Agency will make specific note of questions, issues, concerns and areas requiring clarification by Proposers and to be discussed in any meetings with Proposers that the Agency finds to be within the Competitive Range.

Rankings of the Proposals against the evaluation will then be made for determining which Proposals are within the Competitive Range, or may reasonably be made to be within the Competitive Range.

3. **Proposals not within the Competitive Range.** Proposers of any Proposals that have been determined by the Agency as not in the Competitive Range, and that cannot be reasonably made to be within the Competitive Range, will be notified in accordance with the Agency's policies.
4. **Discussions with Proposers in the Competitive Range.** The Proposers whose Proposals are found by the Agency to be within the Competitive Range, or that may be reasonably made to be within the Competitive Range, will be notified and any questions or requests for clarifications provided to them in writing. Each such Proposer may be invited for an interview and discussions with the Agency to discuss answers to written or oral questions, clarifications and any facet of its Proposal.

In the event that a Proposal that has been included in the Competitive Range contains conditions, exceptions, reservations or understandings to any Contract requirements as provided in the Form for Proposal Deviation, said conditions, exceptions, reservations or understandings may be negotiated during these meetings. However, the Agency shall have the right to reject any and all such conditions and exceptions, and instruct the Proposer to amend its Proposal and remove said conditions and exceptions; and any Proposer failing to do so may cause the Agency to find such Proposal to be outside the Competitive Range.

No information, financial or otherwise, will be provided to any Proposer about any of the Proposals from other Proposers, to the extent permitted by applicable law. Proposers will not be given a specific price or specific financial requirements they must meet to gain further consideration, except that proposed prices may be considered to be too high with respect to the marketplace or unacceptable. Proposers will not be told of their rankings among the other Proposers prior to Contract award.

5. **Factory and site visits.** The Agency reserves the right to conduct factory visits of the Proposer's facilities and/or the facilities of major sub-suppliers included in the Proposal.
6. **Best and final offers.** After all interviews have been completed, the Proposers in the Competitive Range may be afforded the opportunity to amend their Proposals and make their BAFOs. The Request for BAFOs shall include the following:

NOTE TO USER: *The items shown below are for illustrative purposes only; the Agency will make the determination on what to include in its request for BAFOs.*

- Notice that discussions and negotiations are concluded.
- A complete listing of the conditions, exceptions, reservations or understandings that have been approved.
- A common date and time for submission of written BAFOs, allowing a reasonable opportunity for preparation of the written BAFOs.

- Notice that if any modification to a BAFO is submitted, it must be received by the date and time specified for the receipt of BAFOs.
- Notice to Proposers that do not submit a notice of withdrawal or a BAFO that their immediately previous Proposal will be construed as their BAFO.

Any modification to the initial Proposal made by a Proposer in its BAFO shall be identified in its BAFO. BAFOs will be evaluated by the Agency according to the same requirements and criteria as the initial Proposals (“Proposal Selection Process”). The Agency will make appropriate adjustments to the initial scores for any sub-criteria and criteria that have been affected by any Proposal modifications made by the BAFOs. These final scores and rankings within each criterion will again be arrayed by the Agency and considered according to the relative degrees of importance of the criteria defined in “Proposal Selection Process.”

The Agency will then choose the Proposal that it finds to be most advantageous to the Agency, based upon the evaluation criteria. The results of the evaluations and the selection of a Proposal for any award will be documented.

The Agency reserves the right to make an award to a Proposer whose Proposal it judges to be most advantageous to the Agency based upon the evaluation criteria, without conducting any written or oral discussions with any Proposers or solicitation of any BAFOs.

7. **Debriefing.** Subsequent to the award, the unsuccessful Proposers will be notified and may request a debriefing. Proposers will be debriefed in accordance with Agency policies, including information regarding the shortcomings of their Proposal.

IP 14 Response to Proposals

IP 14.1 Single Proposal Response

If only one Proposal is received in response to this RFP and it is found by the Agency to be acceptable, then a price or cost analysis, or both, possibly including an audit, may be performed by or for the Agency. The Proposer has agreed to such analysis by submitting a Proposal in response to this RFP.

NOTE TO USER: *The use of a third-party auditor is recommended to ensure confidentiality of cost and pricing data. The Proposer may require a nondisclosure agreement.*

IP 14.2 Availability of Funds

This procurement is subject to the availability of funding. [Insert a description of the funding for this procurement, including any conditions upon which funding is dependent.]

IP 14.3 Agency Contract Approval Process

[Insert a provision outlining its internal approval and award process, advising Proposers on the steps to be taken after completion of any evaluation process.]

IP 14.4 Agency Rights

The Agency reserves the right to cancel the procurement in whole or in part, at its sole discretion, at any time before the Contract is fully executed and approved on behalf of the Agency.

The Agency reserves the right to reject any or all Proposals, to undertake discussions with one or more Proposers, and to accept that Proposal or modified Proposal which, in its judgment, will be most advantageous to the Agency, considering price and other evaluation criteria. The Agency reserves the right to determine any specific Proposal that is conditional or not prepared in accordance with the instructions and requirements of this RFP to be

nonresponsive. The Agency reserves the right to waive any Defects, or minor informalities or irregularities in any Proposal that do not materially affect the Proposal or prejudice other Proposers.

If there is any evidence indicating that two or more Proposers are in collusion to restrict competition or are otherwise engaged in anti-competitive practices, the Proposals of all such Proposers shall be rejected, and such evidence may be a cause for disqualification of the participants in any future solicitations undertaken by the Agency.

The Agency may reject a Proposal that includes unacceptable Deviations as provided in the Form for Proposal Deviation.

IP 14.5 Execution of Contract

The acceptance of a Proposal for award, if made, shall be evidenced in writing by a notice of award of Contract delivered to the Proposer whose Proposal is accepted. Upon notice of award of the Contract to a Proposer, the Proposer shall commence performance under the Contract by furnishing any required bonds, and by furnishing copies of the certificates of insurance required to be procured by the Contractor pursuant to the Contract documents within [number] calendar days after the date of receipt of the notice of award. Failure to fulfill these requirements within the specified time is cause for termination of the Contract under “Termination for Default” in Section 3, “General Conditions”.

IP 15 Conflicts of Interests and Gratuities

Proposers are prohibited from engaging in any practice that may be considered a conflict of interest under existing Agency policies and/or state law, and to refrain from participating in any gifts, favors or other forms of compensation that may be viewed as a gratuity in accordance with existing policies and laws.

IP 16 Agency-Specific Provisions

[Insert as required.]

SECTION 3: GENERAL CONDITIONS

GC 1 Definitions

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

Agency: [Insert Agency name.]

Authorized Signer: The person who is executing this Contract on behalf of the Contractor, and who is authorized to bind the Contractor.

Best and Final Offer (BAFO): The last revised Proposal made by a Proposer. If a BAFO is not specifically requested by the Agency, or if the Proposer does not promptly respond to a request for a BAFO, then the most recent, current Proposal is the BAFO.

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.

Competitive Range: The range of proposals that are identified as the most highly rated, unless the range is further reduced for purposes of efficiency.

Contract: The Proposal and its acceptance by the Agency, as manifested by the Contract documents specified in Section 10, "Contract."

Contracting Officer: The person who is executing this Contract on behalf of the Agency and who has complete and final authority, except as limited herein.

Contractor: The successful Proposer who is awarded a Contract for providing all buses and equipment described in the Contract documents.

Days: Calendar days, unless otherwise stated.

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 affect its performance.

Due Date: The date and time by which Proposals must be received by the Agency as specified in Section 1, "Notice of Request for Proposals."

Extended Warranty: An additional warranty available for purchase above the standard warranty offered.

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.

Proposal: A promise, if accepted, to deliver equipment and services according to the underlying solicitation of the Agency and documented using the prescribed form in the solicitation, including any Proposal or BAFO.

Proposer: A legal entity that makes a Proposal.

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

Solicitation: An Agency's Request for Proposals.

Subcontractor: Any manufacturer, company or Agency that provides services (such as component installation or testing) and that may also provide units, components or subassemblies for inclusion in the bus. Subcontractor items provided shall require qualification by type and acceptance tests in accordance with the requirements defined in Section 8, "Quality Assurance" and the technical specifications.

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

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

Work: Any and all labor, supervision, services, materials, machinery, equipment, tools, supplies and/or 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 the Agency, except insofar as such equipment has been damaged by the failure of a part or component for which the Contractor is responsible, or except insofar as the damage to such equipment was caused by the Contractor during the manufacture of the bus.

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 the Agency, the Contractor shall have the responsibility of supplying all parts and details required to make the bus complete and ready for service, even if such details are not specifically mentioned in the drawings and specifications. Items that are installed by the Agency shall not be the responsibility of the Contractor unless they are included in this Contract.

Addition of any Third-Party equipment requested by the Agency, to be added to the base bus, shall require written technical specifications for the equipment. This includes, but is not limited to, a detailed description of the equipment's functionality, installation instructions and unit cost at the time of order. This requirement shall be clearly communicated, outlined and agreed upon in writing prior to the placement of an Order with the Contractor.

Omissions from the Contract specifications, or the inaccurate description of details of Work that are manifestly necessary to carry out the intent of the Contract specifications, or that are customarily performed, shall not relieve the Contractor from performing such omitted Work or inaccurately described details of the Work, and they shall be performed as if fully and correctly set forth and described.

GC 4 Inspection, Testing and Acceptance

GC 4.1 General

The Agency's Representative shall at all times have access to the Work, the Contractor and (through the Contractor) its Suppliers. The Contractor and its Suppliers shall furnish every reasonable facility for ascertaining that materials and workmanship are in accordance with the requirements of the Contract Documents. All Work done shall be subject to the Agency Representative's inspection and approval, in accordance with the approved Work products developed as a result of the Contract Documents.

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" subsection entitled "Pre-Delivery Tests," and they may be witnessed by the resident inspector. Once a bus passes these tests and inspections, the resident inspector shall authorize the release of the bus.

Within fifteen (15) calendar days after arrival at the designated point of delivery, the bus shall undergo the Agency tests defined in Section 8, "Quality Assurance" subsection entitled "Post-Delivery Tests." If the bus passes these tests, or if the Agency does not notify the Contractor of nonacceptance within 15 calendar days after delivery, then acceptance of the bus by the Agency occurs on the 15th day after delivery. If these post-delivery tests have not been completed for the bus because of infrastructure or other delays that are not the responsibility of the Contractor, then the Agency may issue a change to the Contract to modify the delivery schedule or extend the post-delivery test period. The equitable compensation provision in Section 3, "General Conditions" subsection entitled "Suspension of Work" for suspensions and delays shall apply. If the bus fails these tests, it shall not be accepted until the repair procedures defined in Section 4, "Special Provisions" subsection entitled "Repairs After Nonacceptance" have been carried out and the bus retested until it passes. Acceptance occurs earlier if the Agency notifies the Contractor of early acceptance or places the bus in revenue service.

NOTE TO USER: 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

The Agency shall assume risk of loss of the bus upon 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 en route, and it shall be delivered to the Agency with the bus. If the bus is released back to the Contractor for any reason, then the Contractor has the risk of loss upon such release.

GC 5 Title and Warranty of Title

Adequate documents for registering each bus in [jurisdiction] shall be provided to the Agency not fewer than ten (10) business days before delivery to the Agency. Regardless of the documents provided, title shall not pass from the Contractor to the agency until the Buy America Post Delivery Audit required by 49 CFR Part 663 is complete, and the Agency accepts the bus. Upon acceptance of each bus, the Contractor warrants that the title shall pass to the Agency free and clear of all encumbrances.

GC 6 Intellectual Property Warranty

The Agency shall advise the Contractor of any impending patent suit related to this Contract against the Agency and provide all information available. The Contractor shall defend any suit or proceeding brought against the Agency based on a claim that any equipment, or any part thereof, furnished under this Contract constitutes an infringement of any patent, and the Contractor shall pay all damages and costs awarded therein, excluding incidental and consequential damages against the Agency. In case said equipment, or any part thereof, is in such suit held to constitute infringement,

and use of said equipment or parts is enjoined, the Contractor shall, at its own expense and at its option, either procure for the Agency the right to continue using said equipment or part, replace same with non-infringing equipment, or modify it so that it becomes non-infringing.

The Contractor's obligations under this section are discharged and the Agency shall hold the Contractor harmless with respect to the equipment (or part) if it was specified by the Agency and all requests for substitutes were rejected, and the Contractor advised the Agency under "Questions, Clarifications and Omissions" of a potential infringement, in which case the Contractor shall be held harmless.

GC 7 Data Rights

GC 7.1 Proprietary Rights/Rights in Data

The term "Subject Data" used in this clause means recorded information, whether or not copyrighted, and includes:

- Contractor-created specifications, engineering drawings (including shop drawings and working drawings);
- Technical data, including manuals or instruction materials, and computer or microprocessor software delivered or specified to be delivered under the Contract;
- Patented materials, equipment, devices or processes;
- License requirements necessary or desirable for operation or maintenance of the equipment;
- Records and reports delivered, or specified to be delivered, under the Contract; and
- Any rights of copyright to which the Contractor, Subcontractor or Supplier purchases ownership for the purpose of performance of the Contract, and which are specifically paid for as such under the Contract.

The Subject Data shall remain the property of the Contractor; the Agency, however, shall have a perpetual, royalty-free, non-exclusive and irrevocable license to reproduce, publish or otherwise use (and authorize others to use) the Subject Data for the purposes of operating and maintaining the buses.

The Contractor agrees to include the requirements of this clause, modified as necessary to identify the affected parties, in each subcontract and supply Order placed under the Contract.

The Agency shall protect from disclosure the Contractor's proprietary information included in the Subject Data provided by the Contractor to the fullest extent of the law. In the event that the Contractor no longer supports the Subject Data, the Agency has the right to reverse-engineer the Subject Data and associated hardware.

GC 7.2 Access to Onboard Operational Data

The Agency grants to the Contractor the right to inspect, examine, download and otherwise obtain any information or data available from components provided by the Contractor, including but not limited to electronic control modules, video or audio devices or software, and/or other data-collection devices (collectively, "Onboard Operational Data"). This will be to the extent necessary to enable the Contractor to perform reliability maintenance analysis, corrective action and/or other engineering-type Work for the bus, the fleet or, more generally, for similar analysis across agencies. This right expressly excludes access to information or data collected on any equipment not provided and installed by the Contractor. The Contractor shall treat all Onboard Operational Data as confidential and protect it to the same or greater extent that it does its own confidential information. The Contractor shall not disclose Onboard Operational Data to any person or entity without the express written consent of the Agency. The Contractor shall not access, download, utilize or retain any personally identifiable information, as defined in 49 CFR Part 1520. The Contractor shall promptly notify the Agency upon learning of any unauthorized disclosure of the Onboard Operational Data.

GC 8 Changes

GC 8.1 Contractor Changes

Any proposed change in this Contract shall be submitted to the Agency for its prior approval. Oral change orders are not permitted. No change in this Contract shall be made without the prior written approval of the Contracting Officer. The Contractor shall be liable for all costs resulting from, and/or for satisfactorily correcting, any specification change not properly ordered by written modification to the Contract and signed by the Contracting Officer.

GC 8.2 Agency Changes

The Agency may initiate changes to the Contract by notifying the Contractor in writing, and the notification shall indicate the Agency approval necessary to change the contract. The Agency and the Contractor shall work together to accomplish the change with as little delay and additional cost as possible. The Agency and the Contractor will avoid any actions and any omissions that would unnecessarily increase the cost of the change. As soon as reasonably possible, but no later than thirty (30) calendar days after receipt of the notification of change, the Contractor shall submit to the Contracting Officer a detailed price and schedule Proposal for the Work to be performed. This Proposal shall be accepted or modified by negotiations between the Contractor and the Contracting Officer with the objective of reaching a bilateral agreement on price and other terms as soon as possible.

The parties may reach agreement on elements but not all of the initiated changes. The parties may execute a detailed modification of the contract, including those elements of the change on which they have reached agreement; the modification shall include any changes in time and price. The Contractor shall begin work on those changes and the Agency may request a detailed proposal on the remaining changes on which agreement has not yet been reached.

When the negotiations are successful, a detailed modification shall be executed in writing by both parties. If at any time the Contracting Officer determines it is necessary to proceed even though complete agreement has not been reached, the Contracting Officer may issue a change order requiring the Contractor to proceed, stating an equitable change in compensation, and binding both parties to the changed contract. Disagreements that cannot be resolved within negotiations shall be resolved in accordance with "Disputes," below. Regardless of any disputes, the Contractor shall proceed with the Work ordered.

GC 9 Legal Clauses

GC 9.1 Indemnification

GC 9.1.1 The Contractor shall, to the extent permitted by law: (1) protect, indemnify, and hold the Agency and its officers, employees and agents (including consultants) harmless from and against any and all liabilities, damages, claims, demands, liens, encumbrances, judgments, awards, losses, costs, expenses, and suits/actions/proceedings (including reasonable expenses, costs and attorneys' fees incurred by the Agency and its officers, employees and/or agents [including consultants]) in the defense, settlement or satisfaction thereof, of any injury, death, loss or damage to persons or property of any kind whatsoever, resulting from the misconduct or negligent acts, errors or omissions of the Contractor in the performance of the Contract (including misconduct, negligent acts and errors or omissions of its officers, employees, servants, agents, Subcontractors and Suppliers); (2) upon receipt of notice, and if given authority, the Contractor shall settle or undertake at its own expense the defense of any such suit, action or proceeding, including appeals, against the Agency and its officers, employees and agents (including consultants), relating to such injury, death, loss or damage. Each party shall promptly notify the other in writing of the notice or assertion of such claim, demand, lien, encumbrance, judgment, award, suit, action or other proceeding hereunder. The Contractor shall have sole charge and direction of the defense of such suit, action or proceeding. The Agency shall not make any admission that might be materially prejudicial to the Contractor unless the Contractor has failed to take over the conduct of any negotiations or defense within a reasonable time

after receipt of the notice and authority above provided. The Agency shall, at the request of the Contractor, furnish to the Contractor all reasonable assistance that may be necessary for the purpose of defending such suit, action or proceeding; and shall be repaid all reasonable costs incurred in doing so. The Agency shall have the right to be represented therein by an advisory council of its own selection at its own expense.

GC 9.1.2 The obligations of the Contractor under the above paragraph shall not extend to circumstances where the injury, death or damages are caused solely by the negligent acts, errors or omissions of the Agency, its officers, employees, agents or consultants. This includes, without limitation, negligence in: (1) the preparation of the Contract documents, or (2) the giving of directions or instructions with respect to the requirements of the Contract by written order. The obligations of the Contractor shall not extend to circumstances where the injury, death or damages were caused, in whole or in part, by the negligence of any third-party operator, not including an assignee or Subcontractor of the Contractor, subject to the right of contribution. In case of joint or concurrent negligence of the parties giving rise to a claim or loss against either one or both, each shall have full rights of contribution from the other.

GC 9.2 Suspension of Work

GC 9.2.1 The Agency may at any time, and for any reason, within its sole discretion issue a written order to the Contractor suspending, delaying or interrupting all or any part of the Work for a specified period of time.

GC 9.2.2 The Contractor shall comply immediately with any such written order and take all reasonable steps to minimize costs allocable to the Work covered by the suspension during the period of work stoppage. The Contractor shall continue the Work that is not included in the suspension and shall continue such ancillary activities as are not suspended. The Contractor shall resume performance of the suspended Work upon expiration of the notice of suspension, or upon direction from the Agency.

GC 9.2.3 The Contractor shall be allowed an equitable adjustment in the Contract price and/or an extension of the Contract time, to the extent that cost or delays are shown by the Contractor to be directly attributable to any suspension. However, no adjustment shall be made under this section for any suspension, delay or interruption due to the fault or negligence of the Contractor, or for which an equitable adjustment is provided for or excluded under any other term or condition of the Contract. As soon as reasonably possible, but no later than forty-five (45) calendar days (or the period of time agreed to by the parties) after receipt of the written suspension of work notice, the Contractor shall submit to the Contracting Officer a detailed price and schedule Proposal for the suspension, delay or interruption.

GC 9.3 Excusable Delays/Force Majeure

GC 9.3.1 If the Contractor is delayed at any time during the progress of the Work by the neglect or failure of the Agency, or by a cause as described below, then the time for completion and/or affected delivery date(s) shall be extended by the Agency subject to the following cumulative conditions:

- a. The cause of the delay arises after the Notice of Award and neither was, nor could have been, anticipated by the Contractor by reasonable investigation before such award. Such cause may also include force majeure events such as any event or circumstance beyond the reasonable control of the Contractor—including but not limited to an act of God; earthquake, flood and any other natural disaster; civil disturbance, strike or labor dispute; fire or explosion; war or other hostilities; embargo; or a delay caused by a failure of a Supplier or Subcontractor to provide supplies or services necessary to continue or complete the Work, where the failure was beyond the control of both the Contractor and Supplier or Subcontractor and without fault or negligence of either, and the supplies or services were not reasonably available from another source;
- b. The Contractor demonstrates that the completion of the Work and/or any affected deliveries will be actually and necessarily delayed;

- c. The Contractor has taken measures to avoid and/or mitigate the delay by the exercise of all reasonable precautions, efforts and measures, whether before or after the occurrence of the cause of delay; and
- d. The Contractor makes written request and provides other information to the Agency as described in paragraph GC 9.3.4 below.

A delay in meeting all of the conditions of this section shall be deemed an excusable delay. Any concurrent delay that does not constitute an excusable delay will not be the sole basis for denying a request hereunder. A delay that would have occurred even in the absence of the force majeure event shall not be excusable.

GC 9.3.2 None of the above shall relieve the Contractor of any liability for the payment of any liquidated damages owing from a failure to complete the Work by the time for completion that the Contractor is required to pay pursuant to “Liquidated Damages for Late Delivery of the Bus” for delays occurring prior to the beginning of, or subsequent to the ending of, the occurrence of an excusable delay.

GC 9.3.3 The Agency reserves the right to rescind or shorten any extension previously granted, if subsequently the Agency determines that any information provided by the Contractor in support of a request for an extension of time was erroneous; provided, however, that such information or facts, if known, would have resulted in a denial of the request for an excusable delay. Notwithstanding the above, the Agency will not rescind or shorten any extension previously granted if the Contractor acted in reliance upon the granting of such extension; and such extension was based on information that, although later found to have been erroneous, was submitted in good faith by the Contractor.

GC 9.3.4 No extension or adjustment of time shall be granted unless: (1) written notice of the delay is filed with the Agency within fourteen (14) calendar days after the commencement of the delay; and (2) a written application therefore, stating in reasonable detail the causes, the effect to date, the probable future effect on the performance of the Contractor under the Contract, and the portion or portions of the Work affected, is filed by the Contractor with the Agency within thirty (30) calendar days after the commencement of the delay. No such extension or adjustment shall be deemed a waiver of the rights of either party under this Contract. The Agency shall make its determination within thirty (30) [or insert time specified by regulation or law] calendar days after receipt of the application.

GC 9.4 Termination

GC 9.4.1 Termination for Convenience

DEFAULT

The performance of work under this Contract may be terminated by the Agency in accordance with this clause in whole, or from time to time in part, whenever the Contracting Officer shall determine that such termination is in the best interest of the Agency. Any such termination shall be effected by delivery to the Contractor of a notice of termination specifying the extent to which performance of work under the contract will be terminated, and the date upon which such termination becomes effective.

After receipt of a notice of termination, and except as otherwise directed by the Contracting Officer, the Contractor shall do the following:

- Stop work under the contract on the date and to the extent specified in the notice of termination.
- Place no further orders or subcontracts for materials, services or facilities, except as may be necessary for completion of the portion of the work under the contract that is not terminated.
- Terminate all orders and subcontracts to the extent that they relate to the performance of work terminated by the notice of termination; assign to the agency in the manner, at the times and to the extent directed by the contracting officer, all of the right, title and interest of the Contractor under the orders and subcontracts so terminated, in which case the Agency shall have the right to settle or pay any or all claims arising out of the termination of such orders and subcontracts.
- Settle all outstanding liabilities and claims arising out of such termination of orders and subcontracts, with the approval or ratification of the contracting officer, to the extent that they may require, and for which approval or ratification shall be final for all the purposes of this clause.
- Transfer title to the Agency and deliver in the manner, at the times and to the extent, if any, directed by the contracting officer, the fabricated or unfabricated parts, work in process, completed work, supplies and/or other material produced as part of, or acquired in connection with the performance of, the work terminated; as well as the completed or partially completed plans, drawings, information and other property which, if the contract had been completed, would have been required to be furnished to the Agency.
- Use its best efforts to sell, in the manner, at the times, to the extent and at the price(s) directed or authorized by the contracting officer, any property of the types referred to above—provided, however, that the Contractor shall not be required to extend credit to any purchaser, and may acquire any such property under the conditions prescribed by, and at the prices approved by, the contracting officer; and provided further that the proceeds of any such transfer or disposition shall be applied in reduction of any payments to be made by the Agency to the Contractor under this contract, or that shall otherwise be credited to the price or cost of the Work covered by this contract or paid in such other manner as the Contracting Officer may direct.
- Complete performance of such part of the Work as shall not have been terminated by the notice of termination.
- Take such action as may be necessary, or as the Contracting Officer may direct, for the protection or preservation of the property related to this contract that is in the possession of the Contractor, and in which the Agency has or may acquire an interest.

The Contractor shall be paid its costs, including contract closeout costs, and profit on work performed up to the time of termination. The Contractor shall promptly submit its termination claim to the Agency to be paid. Settlement of claims by the Contractor under this termination-for-convenience clause shall be in accordance with the provisions set forth in Part 49 of the Federal Acquisition Regulations (48 CFR 49), except that wherever the word “government” appears, it shall be deleted, and the word “Agency” shall be substituted in lieu thereof.

ALTERNATIVE

[Federally funded grants require a contract provision to terminate contracts but do not require specific elements of that contract provision. The Agency may substitute its own termination-for-convenience clause.]

GC 9.4.2 Termination for Default

The Agency may, by written notice of default to the Contractor, terminate the whole or any part of this Contract if the Contractor fails to make delivery of the supplies, or perform the services, within the time specified herein or any extension thereof. The Agency may also do so if the Contractor fails to perform any of the other material provisions of the Contract, or fails to make progress as to endanger performance of this Contract in accordance with its terms; and if, in either of these two circumstances, does not cure such failure within a period of ten (10) business days, or such longer period as the Contracting Officer may authorize in writing after receipt of notice from the Contracting Officer specifying such failure.

If the Contract is terminated in whole or in part for default, the Agency may procure, upon such terms and in such manner as the Contracting Officer may deem appropriate, supplies or services similar to those so terminated. The Contractor shall be liable to the Agency for any excess costs for such similar supplies or services and shall continue the performance of this Contract to the extent not terminated under the provisions of this clause.

Except with respect to defaults of Subcontractors, the Contractor shall not be liable for any excess costs if the failure to perform the Contract arises out of a cause beyond the control, and without the fault or negligence, of the Contractor. If the failure to perform is caused by the default of a Subcontractor, and if such default arises out of causes beyond the control of both the Contractor and Subcontractor, and without the fault or negligence of either of them, then the Contractor shall not be liable for any excess costs for failure to perform, unless the supplies or services to be furnished by the Subcontractor were obtainable from other sources and in sufficient time to permit the Contractor to meet the required delivery schedule.

Payment for completed supplies delivered to and accepted by the Agency shall be at the Contract price. The Agency may withhold from amounts otherwise due the Contractor for such completed supplies, such sum as the Contracting Officer determines to be necessary to protect the Agency against loss because of outstanding liens or claims of former lienholders.

If, after notice of termination of this Contract under the provisions of this clause, it is determined for any reason that the Contractor was not in default under the provisions of this clause, or that the default was excusable under the provisions of this clause, then the rights and obligations of the parties shall be the same as if the notice of termination had been issued pursuant to termination for convenience of the Agency.

GC 9.5 Compliance with Laws and Regulations

The Contractor shall at all times comply with all applicable laws, regulations, policies, procedures and directives (together, the “Law”), including without limitation FTA regulations, policies, procedures, and directives, including those listed directly or by reference in the agreement between the Agency and FTA that funds any part of this Contract, as they may be amended or promulgated from time to time during the term of this Contract. Contractor’s failure to so comply shall constitute a material breach of this Contract.

GC 9.6 Changes of Law

Changes of Law that become effective after the Proposal due date may result in price changes. If a price adjustment is indicated, either upward or downward, it shall be negotiated between the Agency and the Contractor, and the final Contract price will be adjusted upward or downward to reflect such changes in the Law. Such price adjustment may be audited, where required.

GC 9.7 Governing Law and Choice of Forum

This Contract shall be governed by the laws of [state name] without regard to conflict of law rules. The Contractor consents to the jurisdiction of [state name], County of [county name].

GC 9.8 Disputes

NOTE TO USER: *The following section deals with disputes arising after Contract award and not during the procurement process. The latter are “protests” that should be dealt with under the Agency’s procurement procedures as outlined in “Protest Procedures.”*

Outlined below are example provisions and recommendations for drafting a dispute resolution clause to be included in the Contract. Included are stepped negotiations, submission for Agency executive decision and alternative dispute resolution. However, by mutual agreement, the matter may be taken immediately to any higher step in the resolution process, or a mutually agreed-to alternative dispute resolution process (which may include structured negotiations, mediation or arbitration) or litigation.

Except as otherwise provided in this Contract, any dispute concerning a question of fact arising under or related to this Contract, that is not disposed of by agreement, shall be decided in accordance with the following steps. However, by mutual agreement the matter may be taken immediately to any higher step in the dispute resolution process, or through a mutually agreed-upon alternative dispute resolution process (which may include structured negotiations, mediation or arbitration) or litigation. Pending final resolution of a dispute hereunder, the Contractor shall proceed diligently with the performance of the Contract, and in accordance with the contracting officer’s or chief executive officer’s decision, as the case may be.

1. **Notice of dispute.** All disputes shall be initiated through a written dispute notice submitted by either party to the other party within ten (10) calendar days of the determination of the dispute.
2. **Negotiation between Contracting Officers.** The parties shall attempt in good faith to resolve any dispute arising out of, or relating to, this Contract promptly by negotiation between executives who have the authority to settle the controversy, and who are at a higher level of management than the people with direct responsibility for administration of this Contract. Any party may give the other party written notice of any dispute not resolved in the normal course of business as provided in paragraph 1 above. Within fourteen (14) calendar days after delivery of the dispute notice, the receiving party shall submit to the other party a written response. The dispute notice and written response shall include (a) a statement of the party’s position and a summary of the arguments supporting that position, (b) any evidence supporting the party’s position, and (c) the name of the executive who will represent that party and of any others who will accompany the executive in negotiations. Within twenty-eight (28) calendar days after delivery of the dispute notice, the Contracting Officer of both parties shall meet at a mutually acceptable time and place, and thereafter as they reasonably deem necessary to attempt to resolve the dispute. All reasonable requests for information by one party to the other shall be honored.

If the matter has not been resolved by these people within forty-two (42) calendar days of the dispute notice, then the dispute may be referred to more senior executives of both parties who have authority to settle the dispute and who shall likewise meet to attempt to resolve the dispute.

3. **Chief executive officer’s decision.** Should the dispute not be resolved by negotiation between Contracting Officers as provided in paragraph 2 above, the Agency’s Contracting Officer shall submit a written request for decision to the Agency’s chief executive officer along with all documentation and minutes from the negotiations. The CEO shall issue a written decision within fourteen (14) days of receipt of a request.

- a. For disputes involving \$50,000 or less, the decision of the CEO shall be administratively final and conclusive. For disputes involving \$50,000 or less, it is the intent of the parties that such administratively final and conclusive decision pursuant to either this paragraph or paragraph 4 shall be overturned only if determined by a court of competent jurisdiction to be fraudulent, arbitrary, capricious, unsupported by the evidence or so grossly erroneous as to imply bad faith. For disputes greater than \$50,000, the decision of the CEO shall be administratively final and conclusive unless, within thirty (30) days from the date of delivery of the written decision, the Contractor appeals the decision in writing to the Agency's CEO or designee, who shall render a written decision within fourteen (14) days of delivery of such written appeal. Such decision by the CEO or their designee shall be administratively final and conclusive.
 - b. Within thirty (30) days of the issuance of any administratively final and conclusive decision under this paragraph, the Contractor shall notify the Agency in writing of the Contractor's agreement with the final decision. Failure to provide such written notice of agreement shall indicate an intent by the Contractor to litigate the claim.
 - c. Any dispute that is not resolved by the parties through the operation of the provisions of this paragraph, or any mutually agreed-upon alternative dispute resolution process pursuant to paragraph 4, may be submitted to any court in [state name].
 - d. Pending final resolution of a dispute hereunder, the Contractor shall proceed diligently with the performance of its obligations under the Contract, in accordance with the written directions of the Agency.
4. **Alternative dispute resolution.** If agreed upon by both parties, disputes may be resolved by a mutually agreed-upon alternative dispute resolution process that may include structured negotiations different from paragraph 2 above, mediation or arbitration.

NOTE TO USER: *If arbitration is not to be included, then the following clause is to be deleted. It is only an example of an arbitration clause that may be included. It is not intended as a recommendation but provided for the purpose of illustration.*

5. **Arbitration.** Disputes appealed to arbitration involving more than \$50,000, but less than \$250,000, shall be decided by a qualified and disinterested arbitrator, selected through the American Arbitration Association and mutually agreed upon by both parties. The arbitrator shall conduct all proceedings in accordance with the rules of the American Arbitration Association, and shall consider the Contract, equity, prevailing law and established commercial practices in rendering a decision.

Disputes appealed to arbitration involving \$250,000 or more shall be decided by three (3) qualified and disinterested arbitrators selected through the American Arbitration Association. One arbitrator shall be selected by each of the parties, and the two selected arbitrators shall select a third arbitrator within ten (10) calendar days of their selection. The arbitrators shall conduct all proceedings in accordance with the rules of the American Arbitration Association and shall consider the Contract, equity, the prevailing law and established commercial practice in rendering a decision.

DEFAULT

The decision of the arbitrators shall not be binding, and either party shall have the right to remedies provided by law.

ALTERNATIVE

The decision by the arbitrators shall be final and enforceable in any court having jurisdiction over the parties.

GC 9.9 Maintenance of Records; Access by Agency; Right to Audit Records

In accordance with 49 CFR §18.36(i), 49 CFR §19.48(d) and 49 USC §5325(a), provided that the Agency is the FTA recipient or a sub-grantee of the FTA recipient, the Contractor agrees to provide the Agency, the FTA, the Comptroller General of the United States, the Secretary of the U.S. Department of Transportation (USDOT), the State of [state name], or any of their duly authorized representatives, access to any books, documents, papers and/or records of the Contractor that are directly pertinent to, or relate to, this Contract (1) for the purpose of making audits, examinations, excerpts and transcriptions; and (2) when conducting an audit and inspection.

1. In the event of a sole-source Contract, single Proposal, single responsive Proposal, or competitive negotiated procurement, the Contractor shall maintain—and the Contracting Officer, the USDOT (if applicable) or representatives thereof shall have the right to examine—all books, records, documents, and other cost and pricing data related to the Contract price, unless such pricing is based on adequate price competition, established catalog or market prices of commercial items sold in substantial quantities to the public, or prices set by law or regulation, or combinations thereof. Data related to the negotiation or performance of the Contract shall be made available for the purpose of evaluating the accuracy, completeness and currency of the cost or pricing data. This right of examination shall extend to all documents necessary for adequate evaluation of the cost or pricing data, along with the computations and projections used therein, including review of accounting principles and practices that properly reflect all direct and indirect costs anticipated for the performance of the Contract.
2. For Contract modifications or change orders, the Contracting Officer, the USDOT, if applicable, or their representatives, shall have the right to examine all books, records, documents, and other cost and pricing data related to a Contract modification, unless such pricing is based on adequate price competition, established catalog or market prices of commercial items sold in substantial quantities to the public, prices set by law or regulation, or combinations thereof. Data related to the negotiation or performance of the Contract modification or change order shall be made available for the purpose of evaluating the accuracy, completeness and currency of the cost or pricing data. The right of examination shall extend to all documents necessary for adequate evaluation of the cost or pricing data, along with the computations and projections used therein, either before or after execution of the Contract modification or change order, for the purpose of conducting a cost analysis. If an examination made after execution of the Contract modification or change order reveals inaccurate, incomplete or out-of-date data, the Contracting Officer may renegotiate the Contract modification or change order price adjustment, and the Agency shall be entitled to any reductions in the price that would have resulted from the application of accurate, complete or up-to-date data.

The requirements of this section are in addition to other audit, inspection and record-keeping provisions specified elsewhere in the Contract documents.

NOTE TO USER: *The FTA does not require Contractors to flow down these requirements to Subcontractors.*

GC 9.10 Confidential Information

Access to government records is governed by the [insert city, state or local open records law]. Except as otherwise required by the [optional city, state or local open records law], the Agency will exempt from disclosure proprietary information, trade secrets, and confidential commercial and financial information submitted or disclosed during the Contract period. Any such proprietary information, trade secrets, or confidential commercial and financial information that a Contractor believes should be exempted from disclosure shall be specifically identified and marked as such. Blanket-type identification by designating whole pages or sections as containing proprietary information, trade secrets, or confidential commercial and financial information will not ensure confidentiality. The specific proprietary information, trade secrets, or confidential commercial and financial information must be clearly identified as such.

Upon a request for records from a third party regarding the Contract, the Agency will notify the Contractor in writing. The Contractor must respond within twenty (20) days with the identification of any and all proprietary, trade secret, or confidential commercial or financial information, and the Contractor shall indemnify the Agency's defense costs associated with its refusal to produce such identified information; otherwise, the requested information may be released.

The Agency shall employ sound business practices no less diligent than those used for the Agency's own confidential information to protect the confidence of all licensed technology, software, documentation, drawings, schematics, manuals, data, and other information and material provided by the Contractor pursuant to the Contract that contains confidential commercial or financial information, trade secrets or proprietary information as defined in or pursuant to the [city, state or local open records law] against disclosure of such information and material to third parties, except as permitted by the Contract. The Contractor shall be responsible for ensuring that all confidential commercial or financial information, trade secrets or proprietary information, with such determinations to be made by the Agency at its sole discretion, bears appropriate notice relating to its confidential character.

During the performance of the Work under the Contract, it may be necessary for either party (the "Discloser") to make confidential information available to the other party (the "Recipient"). The Recipient agrees to use all such information solely for the performance of the Work under the Contract, to hold all such information in confidence, and to not disclose same to any third party without the prior written consent of the Discloser. Likewise, the Recipient agrees that all information developed in connection with the Work under the Contract shall be used solely for the performance of the Work under the Contract and shall be held in confidence and not disclosed to any third party without the prior written consent of the Discloser.

This Confidentiality section shall survive the termination or expiration of the Contract.

GC 9.11 Conflicts of Interest, Gratuities

No member, officer or employee of the Agency or of a local public body during their tenure, or one year thereafter, shall have any interest, direct or indirect, in this Contract or the proceeds thereof.

[Insert Agency requirements in accordance with the appropriate ethics guidelines.]

GC 9.12 General Nondiscrimination Clause

In connection with the performance of Work provided for under this Contract, the Contractor agrees that it will not, on the grounds of race, religious creed, color, national origin, ancestry, physical disability, medical condition, marital status, sex, sexual orientation or age, discriminate or permit discrimination against any person or group of people in any manner prohibited by federal, state or local laws.

GC 9.13 Amendment and Waiver

GC 9.13.1 Amendment

Any modification or amendment of any provisions of any of the Contract documents shall be effective only if in writing, signed by authorized representatives of both the Agency and Contractor, and specifically referencing this Contract.

GC 9.13.2 Waiver

In the event that either party elects to waive its remedies for any breach by the other party of any covenant, term or condition of this Contract, such waiver shall not limit the waiving party's remedies for any succeeding breach of that, or of any other, term, covenant or condition of this Contract.

GC 9.14 Remedies Not Exclusive

The rights and remedies of the Agency provided herein shall not be exclusive and are in addition to any other rights and remedies provided by law or under the Contract.

GC 9.15 Counterparts

This Contract may be executed in any number of counterparts. All such counterparts shall be deemed to constitute one and the same instrument, and each of said counterparts shall be deemed an original thereof.

GC 9.16 Severability

Whenever possible, each provision of the Contract shall be interpreted in a manner as to be effective and valid under applicable law. However, if any provision, or part of any provision, should be prohibited or invalid under applicable law, then such provision, or part of such provision, shall be ineffective to the extent of such prohibition or invalidity without invalidating the remainder of such provision or the remaining provisions of the Contract.

GC 9.17 Third-Party Beneficiaries

No provisions of the Contract shall in any way inure to the benefit of any third party, including the public at large, so as to constitute such person a third-party beneficiary of the Contract, or of any one or more of the terms and conditions of the Contract, or otherwise give rise to any cause of action in any person not a party to the Contract, except as expressly provided elsewhere in the Contract.

GC 9.18 Assignment of Contract

Neither party will assign or subcontract its rights or obligations under the Contract without prior written permission of the other party, and no such assignment or subcontract will be effective until approved in writing by the other party.

GC 9.19 Independent Parties

The Contractor is an independent contractor with respect to the performance of all Work hereunder, retaining control over the detail of its own operations; and the Contractor shall not be considered the agent, employee, partner, fiduciary, or trustee of the Agency.

GC 9.20 Survival

The following sections shall survive the nominal expiration or discharge of other Contract obligations, and the Agency may obtain any remedy under law, Contract or equity to enforce the obligations of the Contractor that survive the manufacturing, warranty, and final payment periods:

- GC 6. Intellectual Property Warranty
- GC 7. Data Rights
- GC 9.1 Indemnification
- GC 9.7 Governing Law and Choice of Forum
- GC 9.8 Disputes
- GC 9.10 Confidential Information
- SP 7.3 Parts Availability Guarantee
- FR 1. Access to Records
- TS 5.6 Training

GC 10 Agency-Specific Provisions

[Insert as required.]

SECTION 4: SPECIAL PROVISIONS

NOTE TO USER: This section should be customized to meet the Agency's specific requirements for each individual project or Contract, as well as local and state requirements. The Special Provisions are intended to amend and supplement the General Conditions to meet the individual requirements of each project. These Provisions should be considered as guidance and can be modified, added to or deleted by the Agency as appropriate.

SP 1 Inspection, Tests and Repairs

SP 1.1 Repair Performance

SP 1.1.1 Repairs by Contractor

After nonacceptance of a bus, the Contractor must begin Work within five (5) working days after receiving notification from the Agency of failure of acceptance tests. The Agency shall make the bus available to complete repairs timely with the Contractor's repair schedule.

The Contractor shall be responsible for completing the required repairs. In its "notification of failure" of acceptance tests, the Agency may specify that space is available with the dates of availability for the Contractor to perform repairs, provided that this space will not generally include utilizing hoists, lifts or pits. The Contractor shall provide, at its own expense, all spare parts and tools required to complete the repairs. At the Agency's option, the Contractor may be required to remove the bus from the Agency's property while repairs are being made. If the bus is removed from the Agency's property, then 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.

SP 1.1.2 Repairs by the Agency

The Agency will not take responsibility for correcting Defects, except to replace defective parts as instructed by the Contractor.

1. **Parts used.** If the Agency performs the repairs after nonacceptance 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 Agency 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 Agency after nonacceptance of the bus, then these parts shall be shipped prepaid to the Agency.
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 Agency shall be reimbursed by the Contractor for labor. The amount shall be determined by the Agency for a qualified mechanic at a straight time wage rate of [amount per hour], which includes fringe benefits and overhead, adjusted for the Agency'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 Agency's service garage at the time the Defect correction is made.
5. **Reimbursement for parts.** The Agency 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 15% handling costs.

SP 1.2 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 the

Agency for a minimum of thirty (30) days prior to initiation of any production activities for the remaining vehicles, unless otherwise authorized in writing by the Agency. In the event that noncompliance is identified, the Agency shall, to the extent practicable, notify the Contractor of said noncompliance. No later than seven (7) days after the end of the 30-day test, the Agency shall issue a written report to the Contractor that advises the Contractor of any noncompliance issues and/or any proposed modifications or changes required to the remaining vehicles.

In the event that the pilot vehicle does not initially comply with all performance criteria contained in the Technical Specifications, a compromise has not been reached, and progress payment has been established, the Agency 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 compliance is subsequently determined to be impossible to achieve, the Agency may require all or a portion of the progress payment for the pilot vehicle to be forfeited as damages agreed to by the parties for the noncompliance. The amount of the damages shall be negotiated by the parties.

SP 1.3 Configuration and Performance Approval

In order to assess the Contractor's compliance with the Technical Specifications, the Agency 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 required, and the document shall become part of the official record of the pre-production meeting.

SP 1.4 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 Agency, 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's or Subcontractor's facility. The Contractor shall furnish to the Agency, prior to each first article inspection, a written inspection and demonstration plan for each item for review. The Agency's inspectors will attend each first article inspection unless the Agency 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 Agency, and all documents relating to the inspection shall be forwarded to the Agency.

SP 1.5 Post-Delivery Tests

The Agency will conduct acceptance tests as set out in in Section 8, "Quality Assurance" subsection entitled "Post Delivery 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 Agency. 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 nonacceptance. The Agency shall record details of all Defects on the appropriate test forms and shall notify the Contractor of acceptance or nonacceptance 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 the procedures defined in Special Provisions subsection entitled "Repairs After Nonacceptance."

SP 1.6 Repairs After Nonacceptance

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

SP 2 Deliveries

SP 2.1 Bus Delivery

Delivery of buses shall be determined by signed receipt of the Agency's designated agent(s): [agent's name and address], at the following point(s) of delivery, and may be preceded by a cursory inspection of the bus: [point(s) of delivery address].

SP 2.2 Delivery Schedule

The buses shall be delivered at a rate not to exceed [number] buses per week. Delivery shall be completed within [number] weeks after delivery of the executed Contract documents. Hours of delivery shall be [time range] on the following days of the week: [days for delivery].

SP 2.3 Contract Deliverables

Contract deliverables associated with this Contract are set forth in **Table 1**, 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 Agency 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 TO USER: *Table 1 provides a sample list of Contract deliverables. This list should be adapted by the Agency to reflect the Contract deliverables required by the Contract specifications.*

TABLE 1
Contract Deliverables

	Deliverable	Agency Action	Reference Section	Due Date	Format	Quantity Due
1.	Bus Testing—Altoona Test Report	Review		Prior to pilot bus delivery	Hard copy	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	Hard copy	1
4.	QA manufacturing certificate	Review		With each delivered bus	Hard copy	1 per bus
5.	QA purchasing certifications acknowledging receipt of applicable specification	Review		30 days following first pre-production meeting	Hard copy	1 per major Supplier
6.	Pre-Delivery Bus Documentation Package	Review		With each delivered bus	Hard copy	1 per bus
7.	Motor Vehicle Pollution Requirements Certificate	Review		With each bus	Hard copy	1
8.	Engine Emissions Certificate—NOx levels	Review		Prior to completion of pilot bus	Hard copy	1

TABLE 1
Contract Deliverables

Deliverable		Agency Action	Reference Section	Due Date	Format	Quantity Due
9.	Pre-production meeting minutes	Approval		30 days after each meeting	Hard copy	2 originals
10.	Driver's log and incident report	Review		With each bus delivery if drive-away service is used	Hard copy	1 per bus
11.	Title documentation	Review		10 days prior to bus delivery	Hard copy	1 per bus
12.	Performance bond	Review		30 days following execution of Contract	Hard copy	1
13.	Insurance certificates	Approval		Before Work commences	Hard copy	1
14.	Engineering support	Review		During pre-production meeting	Contracts	1
15.	Training instructor information	Approval		30 days prior to delivery of pilot bus		
16.	Training curriculum	Approval		30 days prior to delivery of pilot bus	Electronic media	
17.	Teaching materials	Review		During classroom instruction	Hard copy	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 Agency written approval	Hard copy Electronic media	10/100 buses 20
20.	Final diagnostic procedures manuals	Review		90 days after Agency written approval	Hard copy Electronic media	10/100 buses 20
21.	Final parts manuals	Approval		90 days after Agency written approval	Hard copy Electronic media	10/100 buses 20
22.	Component repair manuals (Agency approval/review period of 90 days from date of receipt)	Approval		90 days after Agency written approval of OEM component repair list	Hard copy Electronic media	2 2
23.	Draft preventative maintenance manuals (Agency approval/review period of 90 days from date of receipt)	Approval		With pilot bus	Hard copy	10
24.	Draft diagnostic procedures manuals (Agency approval/review period of 90 days from date of receipt)	Approval		With pilot bus	Hard copy	10
25.	Draft parts manuals (Agency approval/review period of 90 days from date of receipt)	Approval		With pilot bus	Hard copy	10

TABLE 1
Contract Deliverables

Deliverable		Agency Action	Reference Section	Due Date	Format	Quantity Due
26.	List of OEM component repair manuals	Approval		With pilot bus	Hard copy	10
27.	Draft operators' manuals (Agency approval/review period of 90 days from date of receipt)	Approval		With pilot bus or maximum of 30 days prior to start of production	Hard copy	10
28.	Final operators' manuals	Review		30 days following Agency approval of draft manual	Hard copy	1 per bus
29.	Recommended spare parts list, including bill of materials	Review		60 days prior to shipment of first bus	Hard copy	1
30.	Part number index	Approval		60 days prior to shipment of first bus	Hard copy Spreadsheet	1 1
31.	Current price list	Review		90 days after Agency written approval of draft parts manual	Hard copy	20
32.	In-process drawings	Review		30 days prior to production	Scale drawings	1
33.	Electrical and air schematics	Review		30 days prior to production	Hard copy	1
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 system program	Approval		First pre-production meeting	Hard copy	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	Hard copy	1
41.	Interior security camera layout	Approval		Prior to pilot bus completion	Copies of interior views	1 each
42.	Technical review of powerplant			Prior to production		
43.	Powerplant certifications	Review		Prior to pilot bus completion	Hard copy	1 each
44.	Striping layout	Approval		Prior to production	Hard copy	1
45.	Resolution of issues "subject to Agency approval"	Approval		Prior to production	Hard copy	1

SP 3 Vehicle Options and Option Pricing

The Contractor hereby grants the Agency and any permissible assignee options (“Options”) to purchase up to [number of option vehicles] additional vehicles (“Option Vehicles”). These Options shall be valid for a period of [period of time up to a maximum of five years] from the effective date of the Contract. There shall be no minimum order quantity for any permissible assignee. Subject to the Agency’s right to order modifications, the Option Vehicles shall have the same specifications as the vehicles purchased under this Contract. The Agency may exercise the Options by written notice to the Contractor (“Notice of Exercise of Option”) at any time on or before [period of time up to a maximum of five years] following the effective date of the Contract (“Option Date”).

Within thirty (30) days after delivery of an intent to exercise Option to the Contractor, the Contractor shall submit a proposed delivery schedule. Along with the proposed delivery schedule, the Contractor will provide the Agency with access to its production capacity forecast for the purpose of the parties verifying available production capacity. The production capacity forecast shall include reasonable time for mobilization and for coordinating with other vehicle orders, and it shall be based upon a production rate at least equal to the production rate actually realized with respect to the base order vehicles. The production capacity forecast need not disclose specific order or customer information and shall contain a representation that the gross capacity, committed quantities and available net production capacity in the production capacity forecast are a reasonable basis for obligating the Option Vehicle delivery dates under the terms of the Contract. If the parties are unable to agree on a production schedule, then the maximum term for the production of the Option Vehicles shall not exceed a total of [number] months after the date of the Notice of Exercise of Option. The Agency, or any permissible assignee, may issue a Notice of Exercise of Option at any time after the Contractor submits its proposed delivery schedule. The Contractor shall not commence production of Option Vehicles prior to the issuance of the Notice of Exercise of Option by either the Agency or any permissible assignee of the Agency for the Option Vehicles. The Notice of Exercise of Option shall incorporate the agreed production delivery schedule or the [number]-month maximum term, and shall constitute a notice to proceed with Option Vehicle production.

Except as otherwise specially provided in this Contract, all other terms of the Contract shall apply to the Option Vehicles.

The price of each Option Vehicle shall be the unit price of the base order vehicles (“Base Order Price”) adjusted as required by the terms of this Contract, including escalation as required under “Escalation.”

SP 4 Assignability of Options

If the Agency does not exercise the option(s) as listed in “Options and Option Pricing,” then the Agency reserves the right to assign the Option(s) to other grantees of FTA funds in accordance with FTA Circular 4220.1G or its successors.

NOTE TO USER: *If the Agency chooses to assign Options, it is recommended that it be done in conjunction with a formal written agreement, a sample of which is included as Appendix F.*

SP 5 Payment

The Agency shall pay and the Contractor shall accept the amounts set forth in the price schedule as full compensation for all costs and expenses of completing the Work in accordance with the Contract, including but not limited to all labor, equipment and material required; overhead; expenses; storage and shipping; risks and obligations; taxes (as applicable); fees and profit; and any unforeseen costs.

SP 5.1 Payment Terms

NOTE TO USER: Four options for payment are provided: (1) **DEFAULT:** Progress Payments at the Time of Major Component Installation, (2) **ALTERNATIVE:** Advance Payments at Issuance, (3) **ALTERNATIVE:** Progress Payments upon Approval for Shipping, and (4) **ALTERNATIVE:** Payments upon Acceptance. All four involve final payment of the vehicle purchase price upon acceptance. The Agency may select from these options or develop its own payment provision. It should be noted that restrictive payment requirements will increase the cost of the Contract. The provisions below should be reconciled to comply with any applicable prompt payment law or regulation.

The following four alternatives are model clauses that the Agency can use as a guideline in preparing any progress payment provisions. Progress payments are payments of a part of the contract value for contractor costs incurred or work done before completion of a bus; advance payments are payments made to a contractor before the contractor incurs contract costs. If progress or advance payments are to be included, then security for initial payments to the Contractor may be required of the Contractor through a performance bond, letter of credit, Uniform Commercial Code recording of a lien, or other acceptable form of security. The security amount should not be less than the Agency's financial exposure for cumulative payments relative to value received and in the control of the Agency. If FTA funding is being used, security may be required and will be required in the case of the payment upon issuance. If FTA funding is used, then FTA advance approval of the contract may be required in the case of advance payment (payment upon issuance).

All payments shall be made as provided herein, less any amounts for liquidated damages in accordance with Section 6, "Special Conditions" subsection entitled "Liquidated Damages for Late Delivery of the Bus."

The Agency shall make payments to the Contractor for buses at the times and in the manner set forth below.

Title to material included in any progress payment request shall pass to the Agency upon payment by the Agency. Said title shall be free of all encumbrances. However, such transfer of title shall not relieve the Contractor of its responsibility for the furnishing, installation, fabrication or inclusion of said materials as a deliverable element of buses procured in accordance with the requirements of the Contract. If FTA funds are being used, a post-delivery review must be completed before a bus title is transferred to the recipient, or before a bus is placed into revenue service, whichever is first.

DEFAULT

Progress Payment at the Time of Major Component Installation

The performance milestones and payment limits shall be as follows:

1. The Agency shall make payments for buses at **75%** of the unit price(s) for each bus itemized in the price schedule (with any required escalation added) upon verification by the Agency's inspector that said bus(es) have an engine (for diesel, CNG or hybrid buses) or energy storage system (for battery electric buses) installed in the vehicle. Invoices submitted under this milestone shall include a listing of all major components and component serial numbers that shall be the same as in the final bus record.
2. The Agency shall make payments for buses at **25%** of the unit price(s) for each bus itemized in the price schedule (with any required escalation added) upon the delivery and acceptance of each bus.

ALTERNATIVE**Advance Payment upon Issuance**

1. The Agency shall make payments for buses at **20%** of the unit price(s) for each bus itemized in the price schedule upon contract award (for base buses) or Exercise of Option (for Option buses). If escalation is required to the time of bus production, and the preliminary index to be used has not yet been published at the time of invoice for this Milestone 1, then the invoice shall be prepared by the Contractor without escalation and paid by the Agency without escalation; however 20% of the incremental escalation for the entire unit price(s) of the bus(es) shall be included in the first invoice for those buses prepared by the Contractor after publication of the preliminary price index and paid by the Agency, as a retroactive adjustment to the price of the buses for this Milestone 1.
2. The Agency shall make payments for buses at **60%** of the unit price(s) for each bus itemized in the price schedule (with any required escalation added) when the Agency verifies that the bus has been approved for shipment from the factory.
3. Upon delivery and acceptance, the Agency shall make payments for buses at **20%** of the unit price(s) for each bus (with any required escalation added) itemized in the price schedule.

ALTERNATIVE**Progress Payment upon Approval for Shipment**

1. The Agency shall make payment for buses at **75%** of the unit price(s) for each bus itemized in the price schedule (with any required escalation added) when the Agency verifies that the bus has been approved for shipment from the factory.
2. Upon delivery and acceptance, the Agency shall make payments for buses at **25%** of the unit price for each bus itemized in the price schedule (with any required escalation added).

ALTERNATIVE**Payments upon Acceptance**

The Agency shall make payments for buses at the unit prices itemized in the price schedule (with any required escalation added) within [number] calendar days after the delivery and acceptance of each bus and receipt of a proper invoice.

SP 5.2 Performance Guarantee (Optional)**DEFAULT**

No liquid or surety Performance Guarantee is required, but the Contractor shall fulfill all obligations under the Contract.

ALTERNATIVE

The Contractor shall furnish, at its own expense, a performance guarantee (in the form of a cashier's check, a letter of credit in a form approved by the Agency before Proposal submission, or a performance bond from a surety duly licensed to do business in the State of [Agency's state] and having a financial rating from A.M. Best Company of "A VIII" or better) in the amount of [dollar amount (not a percentage) of a performance bond] where there are no progress payments and payment is made upon delivery and acceptance—or, in the case of progress payments, set at the Agency's financial exposure for cumulative payments. A bond shall cover all of the Contractor's obligations under the Contract except for the warranty, and shall remain in force until said obligations have been fulfilled. The bond amount may be reduced as follows:

1. To **65%** of the original amount when 50% of the required number of buses are delivered and accepted;
2. To **30%** of the original amount when 75% of the required number of buses are delivered and accepted; and
3. To **0%** of the original amount when 100% of the required number of buses are delivered and accepted.

In the case that a surety becomes insolvent; its license is revoked or suspended; or, in the case of a surety approved on the basis that it is listed as an approved federal surety, such federal approval is revoked or suspended, the Contractor, within five (5) days after notice by the Agency, shall substitute other and sufficient surety or sureties. If the Contractor fails to do so, such failure shall be an event of default.

NOTE TO USER: *In such event as described above, the Agency may, in lieu of declaring the Contractor in default, deduct money for the risk or negotiate the purchase of a replacement bond.*

ALTERNATIVE

[Insert state performance bond requirement. Agency may include surety registration requirement, minimum rating by A.M. Best Company, and include step downs 1, 2 and 3 in the first alternative above as the Agency determines appropriate.]

SP 5.3 Escalation

DEFAULT

Agency Bears Escalation Risk Until Production

The Agency shall bear the risk of escalation to the extent provided in this section. The price of each vehicle shall be the unit price in the Price Schedule increased by the lesser of (a) the maximum escalation multiplier set at [insert maximum escalation multiplier to be allowed for the base order]; or (b) the ratio of the last preliminary price index published before the first vehicle is scheduled to be placed on the production line, according to a schedule mutually agreed by the parties and divided by the price index as of the award of the Contract.

Prior to execution of the Contract, the Agency and Contractor shall agree on a scheduled date or dates for beginning of production of the base order vehicles. For Option Vehicles, the beginning of production shall be based on the agreed production schedule for the Option Vehicles; or if a schedule is not agreed, then on the Contractor's latest proposed schedule scaled proportionately to the final production delivery date in the Notice of Exercise of Option.

The Index shall be the "Producer Price Index for Truck and Bus Bodies, Series No. 1413," published by the U.S. Department of Labor, Bureau of Labor Statistics; or, if such index is no longer in use, then such replacement as is most comparable to the Index designated by the Bureau of Labor Statistics, or as agreed by the parties.

ALTERNATIVE**Agency Bears Risk Until Payment**

The Agency shall bear the risk of escalation to the extent provided in this section.

Each payment required by Section 4, “Special Provisions” subsection entitled Payment Terms, shall be adjusted in proportion to the Producer Price Index (PPI) as specified in this section. The adjustment shall not exceed a maximum (“Maximum PPI”) as defined in this section.

For each payment due, the adjustment period (“Adjustment Period”) will be calculated from the original contract date of the base order (“Base Order Award Date”) to the payment due date, in compliance with the agreed schedule for completion of work and delivery (including any agreement for option vehicles, when applicable); and in compliance with the payment provisions in Section 5.1, “Payment Terms.” The Adjustment Period shall be stated in whole calendar months. For each payment due, the PPI deemed applicable at the date of contract award shall be the latest preliminary index published at Contract award date.

To facilitate agreement on award of the contract and exercise of any options, and to place a limit on the Agency’s obligation, no later than the date of award or of exercise of the option, the Agency shall project the maximum PPI applicable to each projected payment (“Maximum PPI”). The Agency shall project at contract award the Maximum PPI for base order payments, and if the contract provides for Option Vehicles, the Agency shall project the Maximum PPI for payments for Option Vehicles upon Notice of Exercise of Option. The maximum PPI shall be projected by multiplying the percentage increase over the most recent 12 months (one calendar year) of published PPI figures preceding the contract award or exercise of the option by 120%. The resulting rate of increase shall be applied to the latest PPI as of the contract award or exercise of the option for the Adjustment Period for the payment, to establish the Maximum PPI as of the payment due date.

The Allowable PPI as of the payment due date shall be the lesser of the latest published preliminary index as of the payment due date, or the Maximum PPI that had been set for the specific payment at the time of award or at the time of exercise of the option.

The payment due shall be computed as the payment due according to Section 4, “Special Provisions” subsection entitled Payment Terms for the base order of vehicles multiplied by the following adjustment factor:

Allowable PPI as of the payment due date divided by PPI deemed applicable on the contract award date.

The Index shall be the “Producer Price Index for Truck and Bus Bodies, Series No. 1413,” published by the U.S. Department of Labor, Bureau of Labor Statistics; or if such Index is no longer in use, such replacement that is most comparable to the Index as may be designated by the BLS, or as agreed by the parties.

ALTERNATIVE**No Escalation**

The Contractor shall bear the risk of escalation. The price of each vehicle shall be the base order price itemized in the price schedule.

SP 5.4 Payment of Taxes

Unless otherwise provided in this Contract, the Contractor shall pay all federal, state and local taxes, as well as duties applicable to and assessable against any Work, goods, services, processes and operations incidental to or involved in the Contract; this includes but is not limited to retail sales and use, transportation, export, import,

business and special taxes. The Contractor is responsible for ascertaining and paying the taxes when due. The total Contract price shall include compensation for all taxes the Contractor is required to pay by laws in effect on the Proposal Due Date. At the present time, the Agency asserts that the taxes applicable to this Contract are [list of current applicable taxes]. The Contractor will maintain auditable records, subject to Agency reviews, confirming that tax payments are current at all times.

SP 6 Liquidated Damages for Late Delivery of the Bus

It is mutually understood and agreed by and between the parties to the Contract that time is of the essence with respect to the completion of the Work, and that in case of any failure on the part of the Contractor to deliver the buses within the time specified in “Delivery Schedule,” except for any excusable delays as provided in “Excusable Delays/Force Majeure” or any extension thereof, the Agency will be damaged thereby. As the amount of said damages would be difficult, if not impossible, to be definitively ascertained and proven, it is hereby agreed that the amount of such damages due to the Agency shall be fixed at [dollar amount] per calendar day, per bus, not delivered in substantially good condition, as inspected by the Agency at the time released for shipment.

NOTE TO USER: See Appendix A, “Guidelines for Calculating Liquidated Damages.” If the Agency does not accept buses seven days per week, then it may consider basing damage calculations on “business days.”

The total amount of such liquidated damages shall not exceed 10% of the total Contract amount. If the total amount of the liquidated damages has reached this maximum, the Contractor shall not be relieved of any obligations under this Contract but shall continue to carry out and complete the work without delay.

The Contractor hereby agrees to pay the aforementioned amounts as fixed, agreed and liquidated damages, and not by way of penalty, to the Agency, and further authorizes the Agency to deduct the amount of the damages from money due the Contractor under the Contract, computed as aforesaid. If the money due the Contractor is insufficient, or no money is due the Contractor, then the Contractor shall pay the Agency the difference or the entire amount, whichever may be the case, within thirty (30) days after receipt of a written demand by the Contracting Officer.

The payment of aforesaid fixed, agreed and liquidated damages shall be in lieu of any damages for any loss of profit, loss of revenue, loss of use, or for any other direct, indirect, special or consequential losses or damages of any kind whatsoever that may be suffered by the Agency and arising at any time from the failure of the Contractor to fulfill the obligations referenced in this clause in a timely manner.

NOTE TO USER: In order to balance the risk in the Contract, which adds to the cost of the bus, the Agency may want to consider capping liquidated damages at an amount between 10% and 20% of the total Contract amount or negotiate an amount with the Contractor. In that case, the following language should be inserted: “The total amount of such liquidated damages shall not exceed [percentage] of the total Contract amount.”

The following may be considered for inclusion if early delivery will create savings for the Agency. The Agency may wish to modify “Excusable Delays” to determine the delivery date for the purposes of this incentive option: “In the event that the Contractor completes the Work earlier than required in ‘Delivery Schedule,’ the Contractor shall be paid an incentive of [amount] per calendar day, per bus, that is delivered and accepted early. The total amount of such incentive payments shall not exceed [percentage] of the total Contract amount.”

See Appendix B, “Guidelines for Calculating Early Delivery Incentives.”

SP 7 Service and Parts

SP 7.1 Contractor Service and Parts Support

The Contractor shall state on the form “Contractor Service and Parts Support Data” which representatives are responsible for assisting the Agency.

All prices quoted for parts and parts cost computations in the proposal shall be free on board (FOB) destination prices, and parts shall be furnished to the Agency FOB destination.

SP 7.2 Documentation

The Contractor shall provide an electronic copy and [number] printed current maintenance manual(s)—to include preventative maintenance procedures; diagnostic procedures or troubleshooting guides; major component service manuals; an electronic copy and [number] printed current parts manual(s); and an electronic copy and [number] printed standard operator’s manual(s)—as part of this Contract. The Contractor also shall exert its best efforts to keep maintenance manuals, operator’s 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.

SP 7.3 Parts Availability Guarantee

The Agency and Contractor agree that the vehicles shall be designed and constructed to remain in service for twelve years.

DEFAULT

Parts Availability with Best Efforts for Exceptions

The Contractor hereby guarantees to provide, within reasonable periods of time, for a period of at least twelve (12) years after the date of acceptance, the spare parts, software and all equipment necessary to maintain and repair the buses supplied under this Contract, unless the Contract includes an exception. In their proposals, Contractors may request an exception (1) for parts for which the Agency specified a brand name, Contractor requested an approved equal, and the Agency denied approval; and (2) for parts where the Agency’s specification is a sole-source specification, Contractor requested an approved equal or modification, and Agency denied the request. 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 published catalog prices.

For spare parts, software or equipment for which the Contractor does not guarantee availability and requests an exception (“Excepted Parts”), the Contractor shall list each item with the Contractor’s and any supplier’s part number in its proposal. When the Contractor becomes aware that any excepted part will probably be unavailable at a date before the bus reaches twelve (12) years of service life, the Contractor shall inform the agency of the available information. The Agency and Contractor shall collaborate in developing the maintenance steps that are most advantageous to the Agency to maintain the buses in service. The Contractor, at its discretion, may offer one or more proposals to the Agency to support maintenance or modification of the vehicles. The Agency shall have the option to request competitive proposals, which may include a proposal from the Contractor to accomplish the same or similar work as offered by the Contractor.

ALTERNATIVE**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 published catalog prices.

Where the parts ordered by the Agency are not received within two (2) 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 Agency, within eight (8) hours of the Agency's verbal or written request, the original Suppliers' and/or manufacturers' part numbers, company names, addresses, telephone numbers and contact people's names for all the specific parts not received by the Agency.

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

SP 7.4 Agency-Furnished Property

In the event that equipment or other goods or materials are specified in the Technical Specifications to be furnished by the Agency to the Contractor for incorporation in the Work, the following provisions shall apply:

- The Agency shall furnish the equipment, goods or materials in a timely manner so as not to delay Contract delivery or performance dates. If Agency-furnished property is received in a condition not suitable for the intended use, then the Contractor shall promptly notify the Agency, detailing the facts, and at the Agency's expense repair, modify, return or take such other action as directed by the Agency. The parties may conduct a joint inspection of the property before the Contractor takes possession to document its condition.
- The Agency retains title to all Agency-furnished property. Upon receipt of the Agency-furnished property, the Contractor assumes the charge and care of the property and bears the risk of loss or damage due to action of the elements or from any other cause. The Contractor shall provide appropriate protection for all such property during the progress of the Work. Should any Agency-furnished equipment or materials be damaged, such property shall be repaired or replaced at the Contractor's expense to the satisfaction of the Agency. No extension of time will be allowed for repair or replacement of such damaged items. Should the Contractor not repair or replace such damaged items, the Agency shall have the right to take corrective measures itself and deduct the cost from any sums owed to the Contractor.

Warranty administration and enforcement for Agency-furnished equipment are the responsibility of the Agency, unless the parties agree to transfer warranty responsibility to the Contractor. In the event that equipment or other goods or materials are specified in the Technical Specifications to be furnished by the Agency to the Contractor for incorporation in the Work, the following provisions shall apply:

1. The Agency shall furnish the equipment, goods or materials in a timely manner so as not to delay Contract delivery or performance dates. If Agency-furnished property is received in a condition not suitable for the intended use, then the Contractor shall promptly notify the Agency, detailing the facts, and at the Agency's expense repair, modify, return or take such other action as directed by the Agency.

The parties may conduct a joint inspection of the property before the Contractor takes possession to document its condition.

2. The Agency retains title to all Agency-furnished property. Upon receipt of the Agency-furnished property, the Contractor assumes the charge and care of the property and bears the risk of loss or damage due to action of the elements or from any other cause. The Contractor shall provide appropriate protection for all such property during the progress of the Work. Should any Agency-furnished equipment or materials be damaged, such property shall be repaired or replaced at the Contractor's expense to the satisfaction of the Agency. No extension of time will be allowed for repair or replacement of such damaged items. Should the Contractor not repair or replace such damaged items, the Agency shall have the right to take corrective measures itself and deduct the cost from any sums owed to the Contractor.
3. Warranty administration and enforcement for Agency-furnished equipment are the responsibility of the Agency, unless the parties agree to transfer warranty responsibility to the Contractor.

SP 8 Federal Motor Vehicle Safety Standards

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

SP 9 Insurance

NOTE TO USER: *Excessive or unnecessary insurance requirements can cost substantial sums and provide little or no benefit to the Agency. Conversely, inadequate insurance requirements can present an excessive risk to the Agency because of the potential that a loss will exceed the limits of coverage. The numbers identified below are examples and reflect current industry practice.*

The Contractor shall maintain in effect during the term of this Contract, including any warranty period, at its own expense, at least the following coverage and limits of insurance:

- Statutory Workers Compensation and Employers Liability insurance and/or qualified self-insurance program covering Supplier's employees while on Agency property.
- Commercial General Liability Insurance:
 - Bodily Injury and Property Damage, including Contractual Liability covering the indemnification contained herein, \$10,000,000 combined single limits per occurrence, \$10,000,000 aggregate, where applicable.
 - Product Liability: \$5,000,000 per occurrence, for a period of five (5) years after acceptance of the last bus delivered under this Contract (product liability coverage may be effected through one or more excess liability policies).
- Automobile Liability Insurance: Bodily Injury and Property Damage, \$1,000,000 combined single limits per occurrence.

The Contractor shall deliver to the Agency, within ten (10) days after receiving Notice of Award of this Contract, evidence of the above. Prior to the expiration of any insurance during the time required, the Supplier shall furnish evidence of renewal to the Agency's Contract Administrator.

SP 10 Sustainability

NOTE TO USER: *If the Agency has its own sustainability policy that includes the responsibility to make sure that all of its Contractors are informed of this policy, then the following language is recommended.*

The Agency recognizes that being sustainable (environmentally, economically and in terms of social responsibility) involves everyone, both internal and external to the Agency. The Agency expects its Contractors to have their own sustainability policies and programs in place and to provide services in line with the principles

established therein. Implementation of sustainable practices may include maximizing the use of environmentally and socially responsible materials and services; using energy-efficient and non-polluting vehicles, equipment, and processes; and/or ensuring employee awareness of sustainability initiatives.

The Agency has a sustainability policy that includes a responsibility to make sure that all of its Contractors are informed of this policy. The Contractor will provide the Agency with a statement indicating that responsible parties have read and understand the Agency's sustainability policies and that it agrees to use reasonable efforts to conduct its work and operations in a manner that is consistent with them. In addition, the Contractor will provide the Agency with a copy of its corporate sustainability policy.

SP 11 Agency-Specific Provisions

[Insert as required.]

SECTION 5: FEDERAL REQUIREMENTS

FR 1 Access to Records

The Contractor agrees to maintain all books, records, accounts and reports required under this Contract for a period of not less than three (3) years after the date of termination or expiration of this Contract, except in the event of litigation or settlement of claims arising from the performance of this Contract, in which case the Contractor agrees to maintain same until the Agency, the FTA Administrator, the Comptroller General of the United States or any of their duly authorized representatives have disposed of all such litigation, appeals, claims or exceptions related thereto. Reference 2 CFR 200.337 (a).

The following access-to-records requirements apply to this Contract.

FR 1.1 Local Governments

In accordance with 2 CFR 200.337 (a), the Contractor agrees to provide the Agency, the FTA Administrator, the Comptroller General of the United States, or any of their authorized representatives, access to any books, documents, papers and/or records of the Contractor that are directly pertinent to this Contract, for the purposes of making audits, examinations, excerpts and transcriptions. Contractor also agrees, pursuant to 49 CFR 633.17, to provide the FTA Administrator or their authorized representatives, including any PMO Contractor, access to the Contractor's records and construction sites pertaining to any major capital project (defined at 49 USC 5302(a)1), that is receiving federal financial assistance through the programs described at 49 USC 5307, 5309 or 5311.

FR 1.2 State Governments

In accordance with 49 CFR 633.17, the Contractor agrees to provide the Agency, the FTA Administrator or their authorized representatives, including any PMO Contractor, access to the Contractor's records and construction sites pertaining to a major capital project (defined at 49 USC 5302(a)1) that is receiving federal financial assistance through the programs described at 49 USC 5307, 5309 or 5311. By definition, a major capital project excludes contracts of less than the simplified acquisition threshold currently set at \$250,000.

The Contractor agrees to permit any of the foregoing parties to reproduce by any means whatsoever or to copy excerpts and transcriptions as reasonably needed.

FR 2 Federal Funding, Incorporation of FTA Terms and Federal Changes

The preceding provisions include, in part, certain standard terms and conditions required by the U.S. Department of Transportation (USDOT), whether or not expressly set forth in the preceding Contract provisions. All contractual provisions required by the USDOT, as set forth in FTA Circular 4220.1G or its successors, are hereby incorporated by reference. Anything to the contrary herein notwithstanding, all FTA-mandated terms shall be deemed to control in the event of a conflict with other provisions contained in this agreement. The Contractor shall not perform any act, fail to perform any act, or refuse to comply with any Agency requests that would cause the Agency to be in violation of FTA terms and conditions.

The Contractor shall at all times comply with all applicable FTA regulations, policies, procedures and directives, including without limitation those listed directly or by reference in the Master Agreement between the Agency and the FTA, as they may be amended or promulgated from time to time during the term of this Contract. Contractor's failure to so comply shall constitute a material breach of this Contract.

FR 3 Federal Energy Conservation Requirements

The Contractor agrees to comply with mandatory standards and policies relating to energy efficiency contained in the state energy conservation plan issued in compliance with the Energy Policy and Conservation Act.

FR 4 Civil Rights Requirements

The following requirements apply to the underlying Contract:

1. **Nondiscrimination:** In accordance with Title VI of the Civil Rights Act, as amended, 42 USC § 2000d; section 303 of the Age Discrimination Act of 1975, as amended, 42 USC § 6102; section 202 of the Americans with Disabilities Act of 1990, 42 USC § 12132; and federal transit law at 49 USC § 5332, the Contractor agrees that it will not discriminate against any employee or applicant for employment because of race, color, creed, national origin, sex, age or disability. In addition, the Contractor agrees to comply with applicable federal implementing regulations and other implementing requirements that the FTA may issue.
2. **Equal Employment Opportunity:** The following equal employment opportunity requirements apply to the underlying Contract:
 - a. **Race, Color, Creed, National Origin, Sex:** In accordance with Title VII of the Civil Rights Act, as amended, 42 USC § 2000e, and federal transit laws at 49 USC § 5332, the Contractor agrees to comply with all applicable equal employment opportunity requirements of U.S. Department of Labor (U.S. DOL) regulations, “Office of Federal Contract Compliance Programs, Equal Employment Opportunity, Department of Labor,” 41 CFR Parts 60 *et seq.*, (which implement Executive Order No. 11246, “Equal Employment Opportunity,” as amended by Executive Order No. 11375, “Amending Executive Order 11246 Relating to Equal Employment Opportunity,” 42 USC § 2000e note), and with any applicable federal statutes, executive orders, regulations and federal policies that may in the future affect construction activities undertaken in the course of the Project. The Contractor agrees to take affirmative action to ensure that applicants are employed, and that employees are treated during employment, without regard to their race, color, creed, national origin, sex or age. Such action shall include, but not be limited to, the following: employment; upgrading; demotion or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. In addition, the Contractor agrees to comply with any implementing requirements that the FTA may issue.
 - b. **Age:** In accordance with section 4 of the Age Discrimination in Employment Act of 1967, as amended, 29 USC § 623 and federal transit law at 49 USC § 5332, the Contractor agrees to refrain from discrimination against present and prospective employees for reason of age. In addition, the Contractor agrees to comply with any implementing requirements that the FTA may issue.
 - c. **Disabilities:** In accordance with section 102 of the Americans with Disabilities Act, as amended, 42 USC § 12112, the Contractor agrees that it will comply with the requirements of U.S. Equal Employment Opportunity Commission, “Regulations to Implement the Equal Employment Provisions of the Americans with Disabilities Act,” 29 CFR Part 1630, pertaining to employment of persons with disabilities. In addition, the Contractor agrees to comply with any implementing requirements that the FTA may issue.
3. The Contractor also agrees to include these requirements in each subcontract financed in whole or in part with federal assistance provided by the FTA, modified only if necessary to identify the affected parties.

FR 5 No Government Obligation to Third Parties

1. The Agency and Contractor acknowledge and agree that, notwithstanding any concurrence by the federal government in, or approval of the Solicitation or award of the underlying Contract, absent the express written consent by the federal government, the federal government is not a party to this Contract and shall not be subject to any obligations or liabilities to the Agency, Contractor or any other party (whether or not a party to that Contract) pertaining to any matter resulting from the underlying Contract.

2. The Contractor agrees to include the above clause in each subcontract financed in whole or in part with federal assistance provided by the FTA. It is further agreed that the clause shall not be modified, except to identify the Subcontractor who will be subject to its provisions.

FR 6 Program Fraud and False or Fraudulent Statements or Related Acts

1. The Contractor acknowledges that the provisions of the Program Fraud Civil Remedies Act of 1986, as amended, 31 USC §§ 3801 *et seq.* and U.S. DOT regulations, “Program Fraud Civil Remedies,” 49 CFR Part 31, apply to its actions pertaining to this Project. Upon execution of the underlying Contract, the Contractor certifies or affirms the truthfulness and accuracy of any statement it has made, it makes, it may make or it causes to be made pertaining to the underlying Contract or the FTA-assisted project for which this Contract Work is being performed. In addition to other penalties that may be applicable, the Contractor further acknowledges that if it makes, or causes to be made, a false, fictitious or fraudulent claim, statement, submission or certification, the federal government reserves the right to impose the penalties of the Program Fraud Civil Remedies Act of 1986 on the Contractor to the extent that the federal government deems appropriate.
2. The Contractor also acknowledges that if it makes, or causes to be made, a false, fictitious or fraudulent claim, statement, submission or certification to the federal government under a Contract connected with a project that is financed in whole or in part with federal assistance, originally awarded by FTA under the authority of 49 USC § 5307, the government reserves the right to impose the penalties of 18 USC § 1001 and 49 USC § 5307(n)(1) on the Contractor, to the extent the federal government deems appropriate.
3. The Contractor agrees to include the above two clauses in each subcontract financed in whole or in part with federal assistance provided by the FTA. It is further agreed that the clauses shall not be modified, except to identify the Subcontractor who will be subject to the provisions.

FR 7 Suspension and Debarment

This Contract is a covered transaction for purposes of 2 CFR Part 1200. As such, the Contractor is required to verify that none among the Contractor, its principals (as defined at 2 CFR 180.995) or its affiliates (as defined at 2 CFR 180.905) are excluded or disqualified (as defined at 2 CFR 180.935 and 180.940).

The Contractor is required to comply with 2 CFR Part 1200, Subpart C, and must include the requirement to comply with 2 CFR Part 1200, Subpart C, in any lower-tier covered transaction that it enters into.

By signing and submitting its bid or Proposal, the Bidder or Proposer certifies as follows:

The certification in this clause is a material representation of fact relied upon by the Agency. If it is later determined that the Bidder or Proposer knowingly rendered an erroneous certification, in addition to remedies available to the Agency, the federal government may pursue available remedies, including but not limited to suspension and/or debarment. The Bidder or Proposer agrees to comply with the requirements of 2 CFR Part 1200, Subpart C, while this Proposal is valid and throughout the period of any Contract that may arise from this Proposal. The Bidder or Proposer further agrees to include a provision requiring such compliance in its lower tier covered transactions.

FR 8 Disadvantaged Business Enterprise (DBE)

This Contract is subject to the requirements of 49 CFR Part 26, “Participation by Disadvantaged Business Enterprises in Department of Transportation Financial Assistance Programs.”

The Contractor shall maintain compliance with “DBE Approval Certification” throughout the period of Contract performance.

The Contractor shall not discriminate on the basis of race, color, national origin or sex in the performance of this Contract. The Contractor shall carry out applicable requirements of 49 CFR Part 26 in the award and administration of this DOT-assisted Contract. Failure by the Contractor to carry out these requirements is a material breach of this Contract, which may result in the termination of this Contract or such other remedy as the Agency deems appropriate. Each subcontract the Contractor signs with a Subcontractor must include the assurance in this paragraph (see 49 CFR 26.13(b)).

FR 9 Clean Water Requirements

1. The Contractor agrees to comply with all applicable standards, orders or regulations issued pursuant to the Federal Water Pollution Control Act, as amended, 33 USC 1251 *et seq.* The Contractor agrees to report each violation to the Agency and understands and agrees that the Agency will, in turn, report each violation as required to ensure notification to the FTA and the appropriate EPA Regional Office.
2. The Contractor also agrees to include these requirements in each subcontract exceeding \$100,000 financed in whole or in part with federal assistance provided by the FTA.

FR 10 Clean Air Requirements

1. The Contractor agrees to comply with all applicable standards, orders or regulations issued pursuant to the Clean Air Act, as amended, 42 USC §§ 7401 *et seq.* The Contractor agrees to report each violation to the Agency and understands and agrees that the Agency will, in turn, report each violation as required to ensure notification to the FTA and the appropriate EPA Regional Office.
2. The Contractor also agrees to include these requirements in each subcontract exceeding \$100,000 financed in whole or in part with federal assistance provided by the FTA.

FR 11 Compliance with Federal Lobbying Policy

Contractors who apply or bid for an award of \$100,000 or more shall file the certification required by 49 CFR Part 20, "New Restrictions on Lobbying." Each tier certifies to the tier above that it will not use, and has not used, federal appropriated funds to pay any person or organization for influencing or attempting to influence an officer or employee of any Agency, a member of Congress, an officer or employee of Congress, or an employee of a member of Congress in connection with obtaining any federal Contract, grant or any other award covered by 31 USC 1352. Each tier shall also disclose the name of any registrant under the Lobbying Disclosure Act of 1995 who has made lobbying contacts on its behalf with non-federal funds with respect to that federal Contract, grant or award covered by 31 USC 1352. Such disclosures are forwarded from tier to tier up to the recipient.

FR 12 Buy America

The Contractor agrees to comply with 49 USC 5323(j) and 49 CFR Part 661, which provide that federal funds may not be obligated unless steel, iron and manufactured products used in FTA-funded projects are produced in the United States, unless a waiver has been granted by the FTA or the product is subject to a general waiver. General waivers are listed in 49 CFR 661.7.

A general public interest waiver from the Buy America requirements applies to microprocessors, computers, microcomputers, software or other such devices, which are used solely for the purpose of processing or storing data. This general waiver does not extend to a product or device that merely contains a microprocessor or microcomputer and is not used solely for the purpose of processing or storing data.

Separate requirements for rolling stock are set out at 49 USC 5323(j)(2)(C) and 49 CFR 661.11. Rolling stock must be final assembled in the United States and have 70% domestic content.

A Bidder or Proposer must submit to the Agency the appropriate Buy America Certification with all offers on FTA-funded contracts, except those subject to a general waiver. Proposals not accompanied by a properly

completed Buy America certification are subject to the provisions of 49 CFR 661.13 and may be rejected as nonresponsive.

FR 13 Testing of New Bus Models

The Contractor agrees to comply with 49 USC 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 the 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.

If the manufacturer represents that the vehicle is "grandfathered" (i.e., 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 14 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) the component and subcomponent parts of the rolling stock to be purchased identified by the manufacturer of the parts, their country of origin and their percentage of 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:** The Contractor shall submit (1) a manufacturer's Federal Motor Vehicle Safety Standards (FMVSS) self-certification that the vehicle complies with relevant FMVSS, or (2) a manufacturer's certified statement that the contracted buses will not be subject to FMVSS regulations.

FR 15 Cargo Preference

The Contractor agrees to the following:

- To use privately owned U.S.-flag commercial vessels to ship at least 50% of the gross tonnage (computed separately for dry bulk carriers, dry cargo liners and tankers) involved, whenever shipping any equipment, material or commodity pursuant to the underlying Contract, to the extent that 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, “onboard” 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, D.C. 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.

FR 16 Fly America

The Contractor agrees to comply with 49 USC 40118 (the Fly America Act) in accordance with the General Services Administration’s regulations at 41 CFR Part 301-10, which provide that recipients and sub-recipients of federal funds and their Contractors are required to use U.S. flag air carriers for U.S. government-financed international air travel and transportation of their personal effects or property, to the extent that such service is available, unless travel by foreign air carrier is a matter of necessity, as defined by the Fly America Act. The Contractor shall submit, if a foreign air carrier was used, an appropriate certification or memorandum adequately explaining why service by a U.S.-flag air carrier was not available, or why it was necessary to use a foreign air carrier; and shall, in any event, provide a certificate of compliance with the Fly America requirements. The Contractor agrees to include the requirements of this section in all subcontracts that may involve international air transportation.

FR 17 Contract Work Hours and Safety Standards Act

1. **Overtime requirements:** No Contractor or Subcontractor contracting for any part of the Contract Work that may require or involve the employment of laborers or mechanics shall require or permit any such laborer or mechanic, in any workweek in which they are employed on such Work, to work in excess of 40 hours in such workweek, unless such laborer or mechanic receives compensation at a rate not less than one and one-half times the basic rate of pay for all hours worked in excess of 40 hours in such a workweek.
2. **Violation; liability for unpaid wages; liquidated damages:** In the event of any violation of the clause set forth in paragraph 1 of this section, the Contractor and any Subcontractor responsible therefore shall be liable for the unpaid wages. In addition, such Contractor and Subcontractor shall be liable to the United States for liquidated damages. Such liquidated damages shall be computed with respect to each individual laborer or mechanic, including watchmen and guards, employed in violation of the clause set forth in paragraph 1 of this section, in the sum of \$10 for each calendar day on which such individual was required or permitted to work in excess of the standard workweek of 40 hours without payment of the overtime wages as required by the clause set forth in paragraph 1 of this section.
3. **Withholding for unpaid wages and liquidated damages:** The Agency shall upon its own action or upon written request of an authorized representative of the Department of Labor withhold or cause to be withheld, from any monies payable on account of work performed by the Contractor or Subcontractor under any such contract or any other federal contract with the same Prime Contractor, or any other federally assisted contract subject to the Contract Work Hours and Safety Standards Act, which is held by the same Prime Contractor, such sums as may be determined to be necessary to satisfy any liabilities of such Contractor or Subcontractor for unpaid wages and liquidated damages as provided in the clause set forth in paragraph 2 of this section.
4. **Subcontracts:** The Contractor or Subcontractor shall insert in any subcontracts the clauses set forth in paragraphs 1 through 4 of this section and also a clause requiring the Subcontractors to include these clauses in any lower-tier subcontracts. The Prime Contractor shall be responsible for compliance by any Subcontractor or lower-tier Subcontractor with the clauses set forth in paragraphs 1 through 4 of this section.

SECTION 6: TECHNICAL SPECIFICATIONS

GENERAL

TS 1 Scope

Technical specifications state requirements for heavy-duty transit buses and commuter coaches, 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

Ackerman Design: A geometric arrangement of linkages in the steering of a vehicle designed to solve the problem of wheels on the inside and outside of a turn needing to trace out circles of different radii.

Agency Operating Profile: The operational requirements under Agency-specific operating conditions that the bus must be able to achieve.

Alternative: An alternative specification condition to the default bus configuration. The Agency 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 and 38 °C (50 and 100 °F).

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

***NOTE TO USER:** 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.

Battery Pack: An electrical equivalent of a collection of cells or modules or physical sub-packs forming the highest-level energy storage system. Often multiple physical sub-packs are connected in series, and these may also be connected in parallel.

Braking Resistor: Device that converts electrical energy into heat, typically used as a retarder to supplement or replace the regenerative braking.

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).

Capacitor: A device that stores electrical energy in an electric field. It is a passive electronic component with two terminals.

Cell: Simplest discrete component of the energy storage system, such as a battery or a capacitor.

Charging Equipment: The equipment that encompasses all the components needed to convert, control and transfer electricity from the grid to the vehicle for the purpose of charging batteries. May include chargers, controllers, couplers, transformers, ventilation, etc. See *Electric Vehicle Supply Equipment (EVSE)*.

Charging Interface: The equipment and/or coupler used to create a connection between the charging equipment and the vehicle for the purpose of recharging a vehicle's batteries.

Charging Station: The location that houses the charging equipment connected to a utility's electric service to provide electricity to a vehicle's battery system through a charging interface.

Class A Voltage: Electric component or circuit with a maximum working voltage of less than 30 VAC (rms) or 60 VDC (ISO 6469-3), also referred to as "low voltage" (LV).

Class B Voltage: Electric component or circuit with a working voltage greater than 30 VAC (rms) and 60 VDC (ISO 6469-3), also referred to as "high voltage" (HV).

Code: A legal requirement.

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.

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 device that converts a source of direct current from one voltage level to another.

Diesel Exhaust Fluid (DEF): A solution of urea in water, used to reduce engine emissions of nitrogen oxides (NOx) in conjunction with a selective catalytic reduction system (SCR).

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 Agency.

Defueling: The process of removing fuel from a tank.

Defueling Port: A device that allows for vehicle defueling, or the point at which this occurs.

Design Operating Profile: The operational requirements under standard operating conditions that the bus must be able to achieve.

Destroyed: Physically made permanently unusable.

Discrete Signal: A signal that can take only predefined 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 J941, except that the height of the ellipse shall be determined from the seat at its reference height.

Electrical Pack: See *Battery Pack*.

Electric Vehicle Supply Equipment (EVSE): The conductors, including the ungrounded, grounded and equipment grounding conductors, the electric vehicle connectors, the attachment plugs, and all other fittings, devices, power outlets or apparatuses installed specifically for the purpose of delivering energy from the premise's wiring to the electric vehicle.

End of Life: A condition reached when an energy storage system fails to meet specified capacity, power or function in specified use conditions.

Energy Density: The relationship between the weight of an energy storage device and its power output in units of watt-hours per kilogram (Wh/kg).

Energy Storage System (ESS): A component or system of components that stores energy and for which its supply of energy is rechargeable by the on-vehicle system (engine/regenerative braking/generator) or an off-vehicle energy source.

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% of service pressure.

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.

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.

Free Floor Space: Floor area available to standees, excluding the area under seats, the area occupied by the feet of seated passengers, the vestibule area forward of the standee line, and any floor space indicated by the 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 protruding into the standee area.

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.

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).

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

Gross Axle Weight Rated (GAWR): 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 lb for every designed passenger seating position, for the driver, and for each 1.5 sq.ft of free floor space.

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

Gross Vehicle Weight Rated (GVWR): 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): Electric component or circuit with a working voltage greater than 30 VAC (rms) and 60 VDC (ISO 6469-3), also referred to as “Class B voltage.”

Hose: A flexible line.

Hybrid: A vehicle that uses two or more distinct power sources to propel the vehicle.

Hybrid System Controller (HSC): Regulates energy flow throughout hybrid system components in order to provide motive performance and accessory loads, as applicable, while maintaining critical system parameters (voltages, currents, temperatures, etc.) within specified operating ranges.

Hybrid Drive System: The mechanical and/or electromechanical components, including the engine, traction motors and energy storage system, that comprise the traction drive portion of the hybrid propulsion system.

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 a crack. See *Rupture*.

Line: Any tube-- flexible and hard -- that carries 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 any steps.

Low Voltage (LV): Electric component or circuit with a maximum working voltage of less than 30 VAC (rms) or 60 VDC (ISO 6469-3), also referred to as “Class A voltage.”

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: A collection of cells forming a physical and electrical subassembly contained within an enclosure.

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

Motor (Traction): An electric motor used to power the driving wheels of the bus.

Nameplate Capacity (or Nominal Capacity): The total amount of energy available between 0% state of charge (SoC) and 100% SoC.

Non-Drive Axle: a drive axle without the drive gear with a load rating sufficient for the load to GVWR.

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

Pack: A collection of cells or modules described on the basis of electrical or physical attributes, to include *Battery Pack* and *Physical Pack*.

Physical Layer: The first layer of the seven-layer International Standards Organization (ISO) Open Systems Interconnect 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.

Physical Pack: An enclosure consisting of a collection of cells or modules at a location or multiple locations. Physical packs differ from battery packs, as they are defined by layout rather than electrical equivalent.

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 natural gas vehicle (NGV) fuel container/cylinder, when subjected to a standard fire test as required by fuel container/cylinder standards.

***NOTE TO USER:** 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, engine, transmission, traction motors, the hybrid drive system, energy storage system (ESS), and system controllers including all wiring and converter/inverter.

Ramp: A device deployed by the bus operator to enable riders with disabilities, including wheeled mobility device users, to board and alight at a 1:6 maximum slope.

Real-Time Clock: 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 natural gas vehicle (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: 150 lb for every designed passenger seating position and for the driver.

Seated Load Weight (SLW): 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 TO USER:** 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.

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 manufactured or customized for a specific purpose applicable to work associated with the vehicle and not commercially available off the shelf from sources such as a hand tool vendor.

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.

Square Cubic Foot: A standard cubic foot defines an amount of gas contained in a volume of 1 cubic foot at standard temperature and pressure.

Standard: A firm guideline from a consensus group. Standards referenced in Section 6, “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.

State of Charge (SoC): Quantity of electric energy remaining in the battery relative to the maximum rated amp-hour (Ah) capacity of the battery expressed in a percentage. This is a dynamic measurement used for the energy storage system. A full SoC indicates that the energy storage system cannot accept further charging.

Stress Loops: The “pigtailed” commonly used to absorb flexing in piping.

Structure: The basic body, including floor deck material and installation, loadbearing external panels, structural components, axle mounting provisions, 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 TO USER:** Since this is a thermally activated device, it does not protect against overpressure from improper charging practices.*

Traction Control System (TCS): Typically (but not necessarily) a secondary function of the electronic stability control (ESC) designed to prevent loss of traction (i.e., wheel spin) of the driven road wheels. TCS is activated when throttle input and engine power and torque transfer are mismatched to the road surface conditions.

Transit Vehicle Manufacturer: As defined by the FTA, any manufacturer whose primary business purpose is to build vehicles specifically for public mass transportation.

Useable Capacity: Nameplate Capacity × Allowable Depth of Discharge (for example, 95%).

Valve: A device or natural object that regulates, directs or controls the flow of a fluid (gases, liquids, fluidized solids or slurries) by opening, closing or partially obstructing various passageways.

Warrantable End of Life (WEOL): A measure of battery degradation determined as the point at which the batteries can no longer provide the energy or power required to meet the design operating profile. It is expressed as a percentage of remaining battery capacity as compared with gross capacity at the beginning of useful life. For purposes of this specification, WEOL shall be a measure of the useful and intended life of the energy storage device.

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

Zero-Emission Vehicle: A vehicle that emits no tailpipe emissions from the onboard source of power.

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 issuance of this specification. The Contractor is responsible for complying with current referenced documents.

Any inconsistency in compliance with this Technical Specification and its referenced documents shall be resolved by giving precedence in the following order:

1. Federal requirements (Title 49 CFR, FMVSS, etc.)
2. State requirements (in California, for example, it would be Title 13 Vehicle Code)
3. Local requirements

4. Technical content of this Technical Specification section
5. Referenced standards, practices and codes (APTA, SAE, ASTM, UL, ISO, etc.)

As an attachment to this RFP, CER 9.3 identifies the specifications, standards, regulations and references used within the RFP. The form must be returned with a proposal and requires an indication of the state of compliance and an opportunity for listing other pertinent references. Please indicate “compliance” as full, partial or N/A (not applicable). If “partial” or “N/A,” please describe.

TS 4 Legal Requirements

The Contractor shall comply with all applicable federal, state and local regulations. These shall include but not be limited to the Americans with Disabilities Act (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 Federal Motor Vehicle Safety Standards (FMVSS) regulations and shall accommodate all applicable Federal Motor Carrier Safety Administration (FMCSA) regulations in effect at the location of the Agency and the date of manufacture. Unless stated otherwise, any forecasted regulatory changes are not to be considered for this procurement.

NOTE TO USER: *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 Agency 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.

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, longevity or performance.

Buses at gross vehicle weight (GVW) shall not exceed the tire factor limits, brake test criteria, structural design criteria or the gross vehicle weight rating (GVWR).

TS 5.2 Capacity

The vehicle shall be designed to operate at gross load, which shall not exceed the bus GVWR nor any individual GAWR.

TS 5.3 Service Life

DEFAULT

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

ALTERNATIVE

Agency-defined additional service life.

TS 5.4 Maintenance and Inspection

Scheduled maintenance tasks for buses shall be related and shall be in accordance with the manufacturer's recommended preventive maintenance schedule (along with routine daily service performed during the servicing). The overall PM schedule for buses shall be based upon a minimum of a 6000 mi interval and/or multiples of same.

The manufacturer is responsible for providing a written comprehensive 52-week and long-term rehab/replacement maintenance plan encompassing buses for their entire useful life. The plan should include times (in hours) to complete the jobs.

Test ports or connectors, as required, shall be provided for commonly checked functions on the bus, such as hydraulic, pneumatic, cooling, temperature, voltage, current and state of charge (SoC).

The Offeror shall give prime consideration to the routine problems of maintaining the vehicle. All vehicle components and systems, both mechanical and electrical, that 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 bus structure and/or equipment, such as seats and flooring under seats, in order to gain access to these areas. Each bus shall be designed to facilitate disassembly, reassembly, servicing or maintenance, using tools and equipment normally available as standard commercial items.

Requirements for the use of unique or specialized tools shall be minimized. The body and structure of the bus shall be designed for ease of maintenance and repair. Individual panels or other equipment that 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.

The Contractor shall provide an itemized list of all special tools and pricing for maintaining this equipment as a supplement to the Pricing Schedule.

NOTE TO USER: *Tools such as compartment door keys, bellows gauges, and other tools required for daily maintenance and inspection shall not be included in the special tools list and shall be furnished for each bus.*

TS 5.5 Interchangeability

Unless otherwise agreed, to the maximum extent possible, 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 or production run 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. Contractor shall identify and secure approval for any changes in components or unit construction provided within a Contract that has a different fit, form or function.

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

Regulatory changes may impact Manufacturer's ability to maintain interchangeability for a production run or order, including options, and are outside the control of the Manufacturer. Manufacturer will inform the customer of any impacts of regulatory changes.

TS 5.6 Training

NOTE TO USER: *The following language is illustrative; the Agency should carefully specify its training requirements, including training delivery (such as hands-on and classroom requirements). The Agency should insert language that specifies the hours when it wants the training to occur, the total number of hours of instruction it wants provided, what items it expects the curriculum to cover, and the format in which it expects the training and teaching aids to be provided (print, DVD, etc.). The Agency should also specify whether the cost of the training shall be included in the bid price or itemized separately, whether some or all of the training shall be provided by the Contractor or a third-party training provider, whether the training shall be limited to specific aspects of the Contractor's vehicle or be expanded to include foundational (basic) training, and whether at the conclusion of the training technicians shall have reached a level of proficiency that allows them to be certified by the Contractor and/or component manufacturer to perform all warranty related work.*

The Contractor shall have at least one qualified instructor who shall be available at the Agency's property for [number] calendar days between the hours of [starting time] and [closing time] per month for [number] months prior to, and [number] months after, acceptance of the first bus. Instructor(s) shall conduct schools and advise the personnel of the Agency on the proper operation and maintenance of the equipment. The Contractor also shall provide visual and other teaching aids (such as manuals, training mock-ups [if required], slide presentations and literature) for use by the Agency's own training staff, which become the property of the Agency.

DEFAULT

No requirement for mock-up board.

ALTERNATIVE

Training mock-ups are required in addition to other training materials and will be priced as an option in the order pricing.

ALTERNATIVE

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 be priced separately in the Pricing Schedule.

TS 5.6.1 Technical/Service Representatives

NOTE TO USER: *The following examples are illustrative; the Agency should carefully specify its support requirements.*

[example] The Contractor shall, at its own expense, have one or more competent technical service representatives available on request to assist the Agency 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."

[example] The Contractor shall provide full-time, on-site technical support representative for the buses and charging equipment for the first two years after bus delivery, with annual renewal options for 10 more years.

TS 5.7 Operating Environment

DEFAULT

The bus shall be capable of satisfying the requirements of this specification while operating in ambient temperature ranges of 10 to 115 °F, at relative humidity between 5% and 100%, and at altitudes up to 3000 ft 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 ft. Altitude requirements above 3000 ft will need separate discussions with propulsion/drive system manufacturer to ensure that performance requirements are not compromised. Speed, gradeability and acceleration performance requirements shall be met at, or corrected to, 77 °F, 29.31 inHg, dry air per SAE J1995.

ALTERNATIVE

[Agency to define worst-case heating (winter) and cooling (summer) loads specific to local environmental conditions, with reference to publicly available sources of historical weather data (e.g., NOAA.com, weather.gov or other source as specified by the Agency).]

TS 5.8 Noise

The Contractor is expected to meet the interior and exterior noise requirements specified in TS 5.8.1, “Interior Noise”, and TS 5.8.2, “Exterior Noise”. Furthermore, it shall be a design goal to minimize noise. Component layout and packaging, material selection, and build quality shall reflect that goal.

TS 5.8.1 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 80 dBA measured at the outside skin of the bus shall have a sound level of 65 dBA or lower at any point inside the bus, except in proximity to passenger door brush seals. These conditions shall prevail with all openings, including doors and windows, closed and with the propulsion/drive system and accessories switched off.

Maximum internal noise level shall not exceed 75 dBA in the operator’s area near normal operator ear level and 80 dBA in all other areas in the interior of the vehicles under all normal operating conditions at locations inside the bus in adherence with the standards of ISO 5128.

TS 5.8.2 Exterior Noise

DEFAULT

Airborne noise generated by the bus and measured from either side shall not exceed 80 dBA under full-power acceleration when operated at 0 to 35 mph at curb weight. The Contractor shall comply with the exterior noise requirements defined in local laws and ordinances identified by the Agency and SAE J366.

ALTERNATIVE

[Agency to state what noise level should be required.]

ALTERNATIVE

[Agency to specify requirements for noise generator requirement to allow for pedestrian safety. Such system should be consistent with the intent of and major functionality specified in 49 CFR 571.141.]

TS 5.8.3 Fire Safety

The bus shall be designed and manufactured in accordance with all applicable fire safety and smoke emission regulations.

ALTERNATIVE

[Agency to specify any additional specific fire safety requirements.]

TS 5.8.4 Materials

DEFAULT

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 FMVSS 302.

ALTERNATIVE

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-A, dated October 20, 1993. Materials entirely enclosed from the passenger compartment, such as insulation within the sidewalls and subfloor, need not comply. In addition, smaller components and items, such as seat grab rails, switch knobs, small light lenses, door seals, window seals, steering wheel, steering column and escape hatches shall be exempt from this requirement.

TS 5.9 Fire Suppression

DEFAULT

The bus shall have a fire suppression system in areas requested by the Agency and installed per system manufacturer's recommendations. [Specify type of fire suppression system (water or chemical based).]

ALTERNATIVE

Battery Electric

No fire suppression system needed.

ALTERNATIVE**Fire Suppression/Gas Detection**

The bus shall be equipped with a suitable means of automatically detecting and extinguishing fires and/or overtemperature situations that may cause unreliable or unsafe operation. If a combustible gas is used as a fuel source, then this same system shall incorporate an integrated gas detection and alarm feature. This system shall employ intrinsically safe detectors capable of reliable operation, alert and shutdown to ensure safe operation. Gas alerts shall occur at a trace level (approximately 20% of the lower flammability limit) and at a significant level (approximately 50% of the lower flammability limit). Shutdowns shall occur at a significant gas alert level. This system shall be connected to an uninterruptable power source and remain uninterrupted regardless of “run”/“ign” position of the vehicle. The quantity, location and technology for sensors, suppression, agents, etc. shall be best practice for the intended application and environment. Fire suppression piping located in the immediate area(s) being protected shall be fireproof and capable of surviving gross thermal events. The subject piping shall include the flow path between the fire suppression bottle and nozzles, with metalized rigid/flexible stainless steel preferred.

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.

The Contractor shall provide a plan for reuse or recycling of replaced battery cells, modules and/or physical packs.

TS 6 Physical Size

With exceptions such as exterior mirrors, marker and signal lights, fender skirts, washers, wipers, ad frames, cameras, object detection systems, bicycle racks, feelers, and rubrails, the bus shall have the overall dimensions specified in the following sections, using **Figure 1** as a reference, at static conditions and design height.

TS 6.1 Bus Length

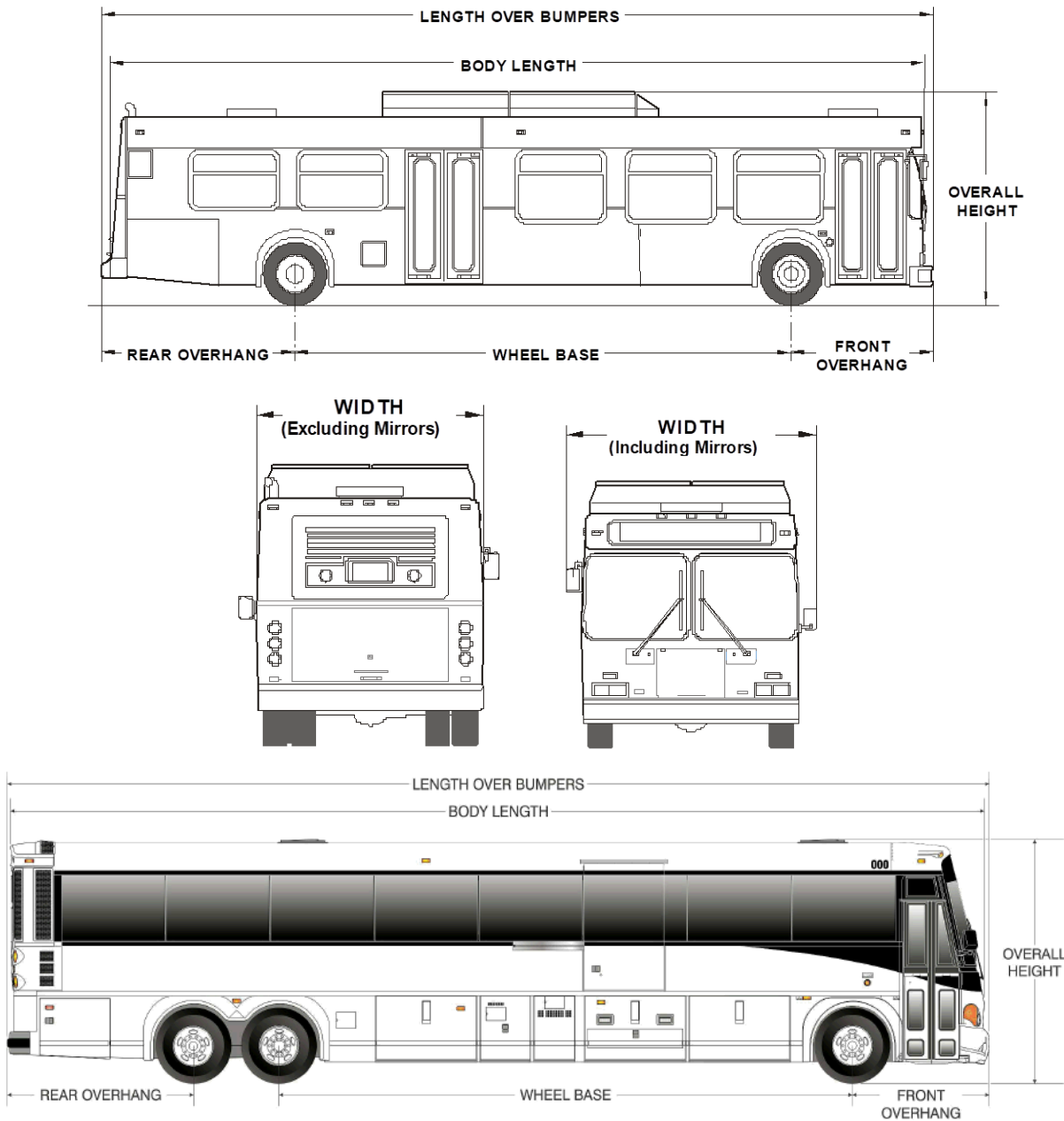
For ease of use, the following tolerances will be allowable for each given bus length. Bus length is determined as the measurement from bumper to bumper.

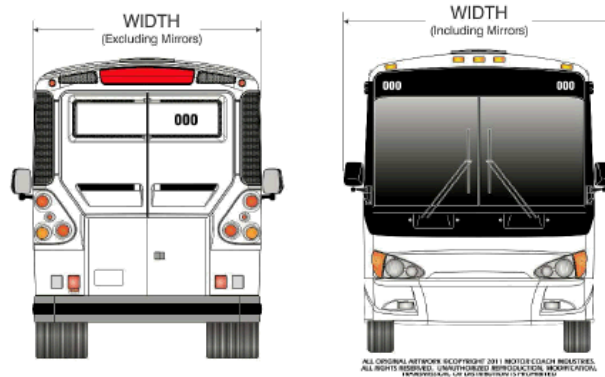
- **30 ft bus:** less than or equal to 30 ft
- **35 ft bus:** 30 ft 1 in. to 39 ft, 11 in.
- **40 ft bus:** 40 ft to 44 ft, 11 in.
- **45 ft bus:** 45 to 47 ft
- **60 ft (articulated) bus:** 59 to 65 ft

TS 6.2 Bus Width

NOTE TO USER: *Body width measurements are without mirrors.*

FIGURE 1
Transit Bus Exterior Dimensions





TS 6.2.1 Transit Coach

DEFAULT

102 in. Width Bus

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

ALTERNATIVE

96 in. Width Bus

Body width shall be 96 in. (+0, -1 in.).

TS 6.2.2 Commuter Coach

DEFAULT

102 in. Width Bus

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

ALTERNATIVE

96 in. Width Bus

Body width shall be 96 in. (+0, -1 in.).

TS 6.3 Bus Height

DEFAULT

Maximum Overall Height

Maximum overall height shall be 140 in., including all rigid, roof-mounted items such as A/C, antenna arrays, exhaust, fuel system and cover, etc.

ALTERNATIVE

Maximum Height

Maximum height shall be specified by Agency.

TS 6.4 Underbody Clearance

The bus shall maintain the minimum clearance dimensions as defined and shown in Figure 22 of SAE J1100, regardless of load up to the gross vehicle weight rating.

TS 6.5 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 breakover angle (see [Table 2](#)) 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

Breakover Angle – Approach and Departure

Angle	Note: Agency to Select		
	30 to 45 ft Bus (Default)	30 to 45 ft Bus (Alternative)	60 ft Bus
Approach	8.6 deg (min.)	8.6 deg (min.)	8.6 deg (min.)
Front breakover	8 deg (min.)	7.5 deg (min.)	10.2 deg (min.)
Rear breakover (60-ft articulated only)	N/A	N/A	8.7 deg (min.)
Departure	8.6 deg (min.)	7.5 deg (min.)	8.6 deg (min.)

TS 6.6 Ground Clearance

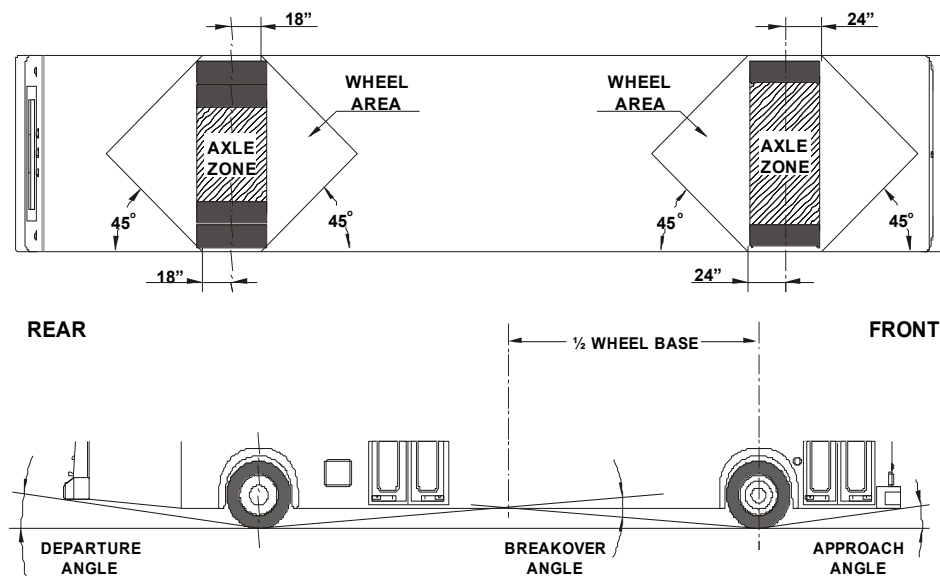
Ground clearance shall be no less than 9 in. (8 in. at jacking pad) except within the axle zone and wheel area.

Axle zone clearance, which is the projected area between tires and wheels on the same axial centerline, shall be no less than 5.4 in.

Wheel area clearance shall be no less than 8 in. for parts fixed to the bus body and 6 in. for parts that move vertically with the axles. See [Figure 2](#).

FIGURE 2

Transit Bus Minimum Road Clearance



TS 6.7 Floor Height

TS 6.7.1 Transit Coach

Height of the step above the street shall be no more than 16 in. measured at the centerline of the front and rear doorway. All floor measurements shall be with the bus at the design running height and on a level surface and with the specified installed tires.

A maximum of two steps are allowed to accommodate a raised aisle floor in the rear of the bus.

TS 6.7.2 Commuter Coach

Height of the step above the street shall be no more than 16 in. measured at the centerline of the doorway. All floor measurements shall be with the bus at the design running height and on a level surface and with the specified installed tires.

TS 6.8 Interior Headroom

Headroom above the aisle and at the centerline of the aisle seats shall be no less than 76.75 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 56 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 their head, padding shall be provided on the overhead paneling.

TS 7 Power Requirements

The system shall be sized to provide sufficient power to enable the bus to meet the defined acceleration, top speed, route, mileage, GVWR and gradeability requirements, while operating all accessories. This shall be verified using actual road test results and/or simulated vehicle performance data.

A loss of power to the bus shall not cause the driver to lose control of the bus or to lose steering or braking. The bus shall be able to be safely brought to a controlled stop.

TS 7.1 Top Speed

DEFAULT

The bus shall be capable of achieving a top speed of 65 mph on a straight, level road at a weight equal to the bus GVWR with all accessories operating. Manufacturer shall supply the Agency with data if there is a variance between peak performance and sustained vehicle performance.

ALTERNATIVE

[Agency to specify top speed limit.] The Manufacturer shall supply the Agency with data if there is a variance between peak performance and sustained vehicle performance.

NOTE TO USER: Increasing top speed in combination with more aggressive gradeability requirements may lead to higher design and operating costs and possibly have adverse effects on performance.

TS 7.2 Startability and Gradeability

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

DEFAULT

The propulsion system shall enable the bus to start from a full stop and achieve and maintain a speed of 40 mph on a 2.5% ascending grade continuous and 10 mph on a 10% ascending grade continuous. Unless otherwise noted, values are assumed to be sustained. Manufacturer shall supply Agency with data if there is a variance between peak performance and sustained vehicle performance.

ALTERNATIVE

[Agency to provide startability and gradeability requirements to the Contractor.] Unless otherwise noted, values are assumed to be sustained. Manufacturer shall supply Agency with data if there is a variance between peak performance and sustained vehicle performance.

NOTE TO USER: Increasing gradeability requirements in combination with higher top speed requirements may lead to higher design and operating costs and possibly have adverse effects on other performance characteristics.

TS 7.3 Acceleration

The acceleration shall meet the requirements in **Table 3**, regardless of propulsion type. Acceleration measurement shall commence when the accelerator is depressed. The maximum, instantaneous acceleration rate of the vehicle shall never exceed 0.130g. The rate of change of acceleration (jerk) shall be minimized throughout the acceleration/deceleration range and shall never exceed 0.30 g/s. This requirement shall be achieved regardless of operator action.

TABLE 3Maximum Start Acceleration Times on a Level Surface¹

Speed (mph)	Maximum time (seconds)
10	5
20	10
30	18
40	30
50	60
Top speed	

1. Vehicle weight = GVWR

NOTE TO USER: The system shall be programmable to allow optimization of acceleration. Performance may be affected when reprogramming. The manufacturer shall supply the new performance data.

ALTERNATIVE

The Contractor shall provide performance scans to the Agency based on the Agency's specific drivetrain configuration.

ALTERNATIVE

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 Section TS 8.

TS 7.4.1 Diesel (Transit and Commuter Coach)

DEFAULT

The operating range of the coach when run on the FTA cycle shall be at least 350 miles (560 km) or 20 hours when starting with a full fuel tank.

ALTERNATIVE

[Designate operating range and duty cycle.]

TS 7.4.2 CNG

DEFAULT

The operating range of the coach when run on the FTA ABD cycle shall be at least 350 miles or 20 hours with an initial gas-settled pressure of 3600 psi at 70 °F.

ALTERNATIVE

[Designate operating range and duty cycle.]

TS 7.4.3 Hybrid

DEFAULT

The operating range of the coach when run on the design operating profile “Design Operating Profile” shall be at least 350 miles on a full tank of fuel.

ALTERNATIVE

[Designate operating range and duty cycle.]

TS 8 Fuel Economy/Range and Design Operating Profile

The bus must be able to achieve operational requirements under standard operating conditions and in Agency-specific conditions. These conditions make up the design operating profile. The standard operating conditions are defined by the Bus Research Testing Center at Altoona, Pennsylvania (“Altoona”), and are used as a benchmark and as a means to compare the performance of various buses across a standard. The Agency-specific conditions are established to ensure that the bus will be able to meet the unique operational requirements of the Agency.

TS 8.1 Altoona Fuel Economy Tests

The Altoona Energy Economy and Range Test for buses is an energy consumption and range test for battery electric buses under Altoona’s pass/fail procedures. Buses are tested using the Manhattan cycle (a low average speed, highly transient urban cycle), the Orange County cycle (consists of urban and highway driving segments), and the EPA HD-UDDS cycle test results from the Energy Economy and Range Test or other applicable test procedures. Results shall include vehicle configuration and test environment information. Energy economy data shall be provided for each duty cycle.

TS 8.2 Agency Operating Profile: Battery Electric Bus

In addition to the Altoona-defined profile, the bus must also be able to meet the Agency operating profile addressing the needs presented below. The Proposer must validate that the proposed bus will meet the Agency operating profile using sound mathematical modeling and simulation or empirical methods. Proposers must demonstrate the agreement of their mathematical models and methods against Altoona results using the Manhattan cycle, the Orange County cycle, and the EPA HD-UDDS cycle test results from the Energy Economy and Range Test.

The Agency operating profile must be met under maximum auxiliary loads and at GVWR. It is assumed that buses will start daily duty cycle at maximum standard operating SoC. Batteries shall not be depleted below minimum standard operating SoC during operations. Minimum standard operating SoC shall allow for reserve battery capacity that the bus can draw upon to return to the closest charging point in degraded mode. Charging of the batteries during normal operations shall not exceed maximum standard operating SoC at any time during charging.

Nominal conditions

- **Ambient temperature:** 68 °F
- **Bus weight:** SLW

Worst-case conditions

- **Ambient temperature:** [Define worst-case heating and cooling loads when operating in local Agency environmental conditions (summer or winter, depending on location) as defined by NOAA.com, weather.gov or other website specified by the Agency.]
- **Bus weight:** GVWR

DEFAULT

Agency block information and route number(s) or name(s) are to be used as representatives of the Agency’s operating profile.

The following are general operating profile data: [Insert desired Agency profile.]

Average route speed (nominal)	_____	mph
Average route speed (worst case)	_____	mph
Average distance between stops	_____	miles
Maximum required trip duration	_____	minutes
Average required trip duration	_____	minutes
Distance from depot to start of route (dead-head)	_____	miles
Longest distance from depot	_____	miles
Average miles per bus per day	_____	miles
Longest miles per day for a bus	_____	miles
Minimum layover time for charging during day	_____	minutes
Average layover time for charging during day	_____	minutes
Available depot charge time	_____	hours
Minimum depot charge time required for full charge	_____	hours
Maximum number of buses required to operate daily	_____	buses
Operational margin	_____	% SoC

ALTERNATIVE

The Agency will supply [alternatively, “Proposers shall collect”] second-by-second route and duty cycle data for a bus on the actual route(s) for modeling purposes only. The data should include time (seconds), speed (mph), and grade (%) or elevation (ft) and may be collected with a GPS data logger and noise filtered. The GPS data may use or be augmented with elevation data from the U.S. Geological Survey and NASA to determine grades. [Insert desired Agency profile.]

Maximum required trip duration	_____	minutes
Average required trip duration	_____	minutes
Distance from depot to start of route (dead-head)	_____	miles
Furthest distance from depot	_____	miles
Average miles per bus per day (local)	_____	miles
Longest miles per day per bus	_____	miles
Minimum layover time for charging during day	_____	minutes
Average layover time for charging during day	_____	minutes
Maximum number of buses required to operate daily	_____	buses
Operational margin	_____	%SoC

ALTERNATIVE

The Agency will provide a percentage of each standard duty cycle (Manhattan cycle, Orange County cycle and EPA HD-UDDS) that is representative of its service.

The Contractor shall provide the following narratives with its Technical Proposal:

- Narrative description of the methods used to validate that the proposed system will meet the Agency operating profile under nominal and worst-case conditions. Detailed results should include, at a minimum, the following for both nominal and worst-case conditions:
 - expected bus range (miles)
 - fuel economy (kWh/mile)
 - auxiliary loads (kW)
- Projected performance on the Agency operating profile when the battery reaches end-of-life (EOL) state. The Proposer will provide specific details on EOL criteria. Detailed results should include, at a minimum, the following:
 - expected battery life from factory delivery under normal operating conditions (months)
 - EOL battery capacity (kWh)
 - EOL bus range (miles)
- Description of any required or recommended charge strategies or other bus operation strategies that are necessary to meet the Agency operating profile. Note that the Agency requires that operational impacts be minimized.
- Description of the flexibility and considerations necessary to place the proposed bus and its charging solution on any Agency route at the Agency’s discretion.
- Description of any required charge strategies, on-route charge requirements, bus blocking requirements or other bus operational requirements necessary to meet the Agency operating profile. Note that the Agency requires that operational impacts be minimized.
- Description of the flexibility and considerations necessary to place the proposed bus and its charging solution on any Agency route at the Agency’s discretion.

TS 9 Engine

TS 9.1 Engine (Diesel and CNG)

The engine shall comply with applicable local, state and/or federal emissions and useful life requirements. The engine shall have a design life of not less than 300,000 miles without replacement or major service. The lifetime estimate is based on the design operating profile.

NOTE TO USER: *The Agency will provide desired fuel type.*

The engine shall be equipped with an electronically controlled management system, compatible with either 12 or 24 V power distribution. The engine control system shall be capable of transmitting and receiving electronic inputs and data from other drivetrain components and broadcasting that data to other vehicle systems. Communication between electronic drivetrain components and other vehicle systems shall be made using the communication 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 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 lower than 30 °F (−1 °C) 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 Agency. 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.

The engine control system shall protect the engine against progressive damage. The system shall monitor conditions critical for safe operation and automatically derate power and/or speed and initiate engine shutdown as needed.

DEFAULT

Automatic Engine Protection/Shutdown Override Feature

A control shall be available to the operator/driver that when constantly depressed and released will delay the engine shutdown or allow the bus to be moved. Override action shall be recorded. This data shall be retrievable by the Agency.

ALTERNATIVE

No requirement for an automatic engine protection/shutdown override feature.

TS 9.2 Engine (CNG Only)

The engine shall meet all regulatory requirements when operating on fuel equal to the California Air Resources Board Specifications for Compressed Natural Gas #2292.5. The four predominant characteristics that must be met are methane, ethane, butane and propane.

TS 9.3 Propulsion System (Hybrid or Battery Electric)

TS 9.3.1 Propulsion System Description (Hybrid Only)

The bus shall be powered by a hybrid propulsion system. The vehicle manufacturer shall ensure 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, the propulsion system shall comply with applicable local, state and/or federal emissions and useful life requirements.

The hybrid drive system shall be rated for the GVWR or greater of the bus.

Labels should be posted on high-voltage devices to identify them as components containing high-voltage potential. These labels shall be applied in such a way that they can be seen when access doors are opened or closed, so as to protect both emergency and maintenance personnel.

A detailed description of the propulsion system shall be provided with the proposal. The description shall include a written narrative, a block diagram showing major propulsion system components, an illustration showing the physical layout of propulsion components and high-voltage wire routing within the vehicle, and a detailed wiring diagram and/or electrical schematic for the high-voltage system. Proposer is required to provide a list of applicable industry standards that the proposed propulsion system meets.

TS 9.3.2 Propulsion System Description (Battery Electric Only)

The bus shall be powered by an electric propulsion system. The electric propulsion system shall conform to SAE J2910 and SAE J2344.

The propulsion system shall not be supplemented by any onboard range extenders, including but not limited to internal combustion engines, gas turbines and/or hydrogen fuel cells.

The vehicle manufacturer shall ensure that the bus structure is suitable for the electric propulsion system and can be operated safely on the design operating profile (TS 8) for the service life of the bus (TS 5.3) without a structural failure. The propulsion system shall comply with applicable local, state and/or federal emissions and useful-life requirements.

Labels should be posted on high-voltage devices to identify them as components conducting high-voltage potential. These labels shall be applied in such a way that they can be seen when access doors are opened or closed, so as to protect both emergency and maintenance personnel.

A detailed description of the propulsion system shall be provided with the proposal. The description shall include a written narrative, a block diagram showing major propulsion system components, an illustration showing the physical layout of propulsion components and high-voltage wire routing within the vehicle, and a detailed wiring diagram and/or electrical schematic for the high-voltage system. The Proposer is required to provide a list of applicable industry standards that the proposed propulsion system meets.

TS 9.3.3 Propulsion System Service

The propulsion system shall be arranged so that accessibility for all routine maintenance is ensured. No special tools, other than dollies and hoists, shall be required to remove the propulsion system or any subsystems. The Agency recognizes that properly rated test equipment and safe electrical work practices are essential when servicing high-voltage components. The Contractor shall identify safe electrical work practices that are essential when servicing high-voltage components. The Contractor shall provide all specialty tools and diagnostic equipment required for maintaining the propulsion system in accordance with the Special Tools List.

TS 9.3.4 Energy Storage System

The energy storage system (ESS) shall be of a commercial design capable of operating in the Agency transit environment and design operating profile. The ESS shall use battery technology with a field-proven track record of safe, reliable and durable operation in similar transit applications. The ESS shall be designed, sized and selected to ensure that the vehicle performance specifications, compatibility with charging and other related requirements are met or exceeded, bearing in mind cost/benefit and reliability variables as they relate to the characteristics of the different battery types.

The ESS shall comply with ECE R100 Revision 2, UN/DOT 38.3 and/or SAE J2464 requirements for lithium batteries. For non-lithium batteries, the ESS shall comply with all appropriate applicable standards.

The Contractor shall deliver the bus with an installed, functioning ESS charged with sufficient usable energy for delivery and to be maneuvered around the Agency's property. The ESS shall be fully formed, installed and tested in accordance with the battery manufacturer's recommended practices. The ESS design, including containers, module bracing systems, thermal-management systems, battery-management systems, watering/venting systems, interconnections, fusing, and traction-controller and charger interfaces, shall be adequately described in the proposal. The proposal shall include a description of all battery maintenance requirements, including any periodic charge requirements necessary for cell balancing. The proposal shall also include a comprehensive statement of the warranty terms relating to the battery, including explanation of all disclaimers within the warranty. The battery life shall be stated in terms of cyclic life and calendar life in the proposal with a description of all factors that will affect the battery life, including charging, operation and environmental effects. The Agency operating profile shall be considered when making this analysis. A life-cycle cost analysis of the proposed battery system in the specified application shall be provided.

The battery system shall be capable of withstanding the current and voltage profiles necessary to accomplish daily recharge events within the defined operating profile.

Thermal management will be provided as needed to ensure optimal life and performance of the ESS over the environmental operating range. The battery thermal management system shall be adequate to maintain the battery within the battery manufacturer's recommended temperature range during operation in the specified duty cycle and climatic conditions.

Proposals shall include complete descriptions of all life-cycle testing procedures used to validate the life of batteries used for this application at the proposed charging rates, charge durations, and expected ambient temperatures and operating profiles. Proposers shall include documented results of life-cycle testing. Proposers shall include certification of battery life-cycle testing.

TS 9.3.4.1 Energy Storage System Capacity

The ESS shall have sufficient energy storage to meet the requirements of the intended duty cycle when new and up until the degradation has reached warrantable end of life (WEOL), or other such agreed upon end of life (EOL) capacity, as defined within the warranty terms of this RFP by percent remaining capacity. As an example, if the capacity when new is 300 kWh and the WEOL is at 80%, then the useable capacity range shall be from 300 to 240 kWh.

The vehicle manufacturer shall provide a test procedure and recommended test interval for periodically measuring ESS capacity during the 12-year design life of the bus. The test interval shall not be more than two years. The vehicle manufacturer shall certify that the test procedure provides true and accurate results. Periodic testing will be performed according to the documented procedure. The Agency may engage third parties to perform the vehicle manufacturer ESS capacity test procedure.

TS 9.3.4.2 Energy Storage System Safety

The ESS shall be placed on the bus to optimize both interior space and vehicle weight distribution. The batteries shall be load-distributed within the bus to equalize weight between the wheels on the same axles and to achieve appropriate weight distribution between axles so as not to adversely affect handling of the bus.

The bus body shall be designed and constructed to ensure that passengers and the operator will not be exposed to hazardous high voltage. This design will also minimize potential exposure to hazardous electrical current in the event of a vehicle accident. Analysis and test data shall be provided to the Agency. The vehicle and energy

storage system shall be designed and constructed to prevent gassing or fumes from the energy storage system from entering the interior of the bus, i.e., a vent path to the exterior, preferably at or above the roof, rearward.

Written confirmation from the battery manufacturer attesting to the safety of the proposed battery system in the specified application and charging profile shall be submitted as part of the proposal, and shall include full disclosure and discussion of any and all relevant issues or prior incidents relating to safety.

Proposals shall include complete descriptions of all safety standards followed in the design and manufacture of the battery system, safety testing procedures used to validate the safety of battery operation in this application, and documented results of safety testing to confirm that standards have been met.

All ESS disconnect means shall be compliant with all applicable standards and regulations for HV electric vehicles. The vehicle manufacturer shall provide documentation listing all standards, recommended practices and other design guidelines the ESS is compliant with.

The HV system and ESS shall include isolation protection between the HV and bus chassis system, to include automatic detection of isolation faults, alerts to the operator, diagnostic system and appropriate action to prevent personnel from HV exposure. Detection, alerting and vehicle control shall occur in accordance with SAE J2910. Detection shall be provided at two levels, as per J2910, and detection at any level shall be alerted to the operator and maintenance personnel.

The system described above may also be an integral part of the overall emergency shutdown system, with functions to include the following:

- Offers a quick, safe and organized means for the operator, maintenance personnel and/or first responders to shut down the HV system.
- Shutting down the system shall include at least:
 - “opening” all HV contactors;
 - discharging capacitors (if used); and
 - disconnecting any devices that could provide HV during normal operation and including during charging.
- Devices used to initiate shutdown shall be located within and outside the bus to satisfy ease of use by the mentioned personnel and shall be clearly marked as to location and use.
- In addition to manual use, this same functionality shall extend to the charging operation in the event of a fault sensed by the ground fault interrupter, to also include termination of charge.

TS 9.3.4.3 Battery Containers

Battery containers shall be constructed to withstand the rigors of transit service for the design life of the bus. Construction shall be of materials compatible with the battery electrolyte. All electrical connections shall be fully shielded and hand-operable. Connector and cabling design shall be such that inappropriate or unsafe connections are prevented. Vent-and-fill system components for individual packs or containers shall not require any disassembly on removal or installation of the battery packs or containers. Pack design must comprehend the protection of battery cabling and vent/watering system components during pack removal and installation. The batteries, when installed, shall be secured to the chassis to prevent any movement that may cause damage or personal harm while the vehicle is in operation.

TS 9.3.4.4 Battery Management System

The battery management system must be designed to ISO 26262, as applicable, safety principles to control state of charge, voltage, current and temperatures on a cell-to-cell level and provide diagnostic output at the lowest field-serviceable element. The diagnostic output must be made available to the maintainer.

As a minimum, the battery management system (BMS) must perform the following functions:

1. The BMS must be capable of monitoring the voltage of cells within each battery pack. The BMS must be able to read individual battery or block voltages at a frequency sufficient to ensure reliable, functional and safe operation.
2. The BMS must be capable of monitoring battery temperatures, mitigating damage to the battery and surroundings, and preventing thermal runaway.
3. The BMS must be capable of communicating when a battery fault (as defined by the battery manufacturer) has occurred and must be able to identify and communicate the location of the faulty battery in order to perform maintenance.
4. The BMS must be capable of engaging prudent safety interlocks when an unsafe battery condition has been detected.
5. The BMS must be able to monitor the battery SoC and provide information to the rest of the vehicle.
6. The BMS must be able to communicate all data to the bus level information system (reference TS 84) for storage and communication.
7. The BMS shall communicate the maximum charge and discharge current that is permitted (e.g., load-shedding).

TS 9.3.4.5 Battery Thermal Management

Thermal management shall be provided to ensure optimal life and performance of the ESS over the environmental operating range.

During operation, battery temperatures must never exceed the manufacturer's recommended range in the design operating profile and specified ambient conditions. Battery cooling must be sufficient to prevent the temperature from exceeding the battery manufacturer's recommended maximum temperature.

TS 9.3.4.6 High Voltage Battery Charging

The bus shall support an SAE-approved charging standard (SAE J1772 DC, SAE J3068 AC and/or SAE J3105-1). The Manufacturer shall provide a detailed description of its charging system and specify its compliance with one of the above-listed standards. Proposers shall include a description of the charging infrastructure required to install and operate the charging equipment. All charging systems provided for use with the bus and in conjunction with the battery management system must comply with the battery manufacturer's electrical and thermal limits.

The bus must be immobilized during all charging operations. Upon successful engagement of the charging interface, the bus shall be interlocked such that propulsion is rendered non-tractive and the brakes applied.

The charging receptacle located on the bus shall be at the [location (front/rear, left/right, approximate area)] and located within a range of height from grade at normal suspension ride height between [number] and [number] in.

DEFAULT FOR DC CHARGING

The bus shall support SAE J1772 DC. This means the bus would be capable of being charged from a direct current EVSE compliant with SAE J1772, using a Type 1 "J1772" CCS/Combo connector.

DEFAULT FOR AC CHARGING/ALTERNATE DC CHARGING

The bus shall support the SAE J3068 charging standard. This means that the bus would be capable of being charged from an alternating current or direct current EVSE compliant with SAE J3068, using a Type 2 connector for AC₆ plugs or CCS Combo 2 connector for AC₆ and DC₈/AC₆ plugs.

DEFAULT FOR OVERHEAD CONDUCTIVE CHARGING

The bus shall support the SAE J3105-1 charging standard. Proposers shall include a description of the charging infrastructure required to charge the bus on route and/or at the depot. Proposers shall describe the expected level of interoperability of the proposed charging system with other vehicles and transit buses.

The Proposer shall provide static or dynamic visual aids on the bus to assist the bus operator in lining up the bus under the overhead charger. If on-bus aids must be used in conjunction with fixed markings at bus charging position (external to bus), then the Proposer shall detail minimum requirements for external markings.

When bus has been successfully positioned under the charger, a green indicator light or icon on bus dash shall be illuminated to indicate “Charge Ready.”

Once the “Charge Ready” light or icon has been illuminated, the bus operator shall set parking brake and initiate pantograph deployment via a “Charge Start” button on the bus dash. The pantograph shall not deploy if parking brake is not set.

ALTERNATIVE FOR OVERHEAD CONDUCTIVE CHARGING

Once the bus operator has set the parking brake, pantograph shall automatically deploy.

When pantograph has deployed and current is flowing from charger to bus a second green indicator light or icon on the bus dash shall be illuminated to indicate “Bus Charging.” This indicator shall stay illuminated for duration of bus charging (current is flowing).

Charging current shall be disconnected and retraction of pantograph shall automatically be initiated when any of these conditions apply:

- On-bus ESS is at 100% SoC
- Charger or bus fault creates an unsafe condition.
- Bus operator terminates charge by pressing “Charge Stop” button on bus dash

DEFAULT FOR WIRELESS INDUCTIVE CHARGING

The bus must support published standards including [insert applicable standards, e.g., SAE J2954/2] for wireless inductive bus charging. Proposers shall include a detailed description of their charging system and specify its compliance with the above-listed standards. Proposers shall include a description of the charging infrastructure required to charge the bus on route and/or at the depot. Proposers shall describe the expected level of interoperability of the proposed charging system with other vehicles and transit buses.

TS 9.3.5 Propulsion System Controller (PSC)

The PSC regulates energy flow throughout hybrid or electric system components in order to provide motive performance, accessory loads and load-shedding, as applicable, while maintaining critical system parameters (voltages, currents, temperatures, etc.) within specified operating ranges.

The controller shall monitor and process inputs and execute outputs as appropriate to control the operation of all propulsion system components.

Energy storage system SoC correction methods stated in SAE J2711 shall be used (for all-electric or hybrid only.)

DEFAULT

PSC shall comply with Technical Specifications subsection, “Load-shedding and De-rating (Battery Electric Bus)” for the HVAC system.

ALTERNATIVE

Load-Shedding Plan

Contractor shall submit with its proposal an HVAC load-shedding strategy that complies with Technical Specifications subsection, “Load-shedding and De-rating (Battery Electric Bus).”

TS 9.3.6 Engine (Hybrid Only)

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

The Contractor shall provide the Agency with expected durability of the engine and related emission systems.

NOTE TO USER: *The Agency will provide desired fuel type.*

DEFAULT

Supplier shall recommend powerplant.

ALTERNATIVE

[Define required powerplant.]

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

The engine shall have onboard diagnostic capabilities, be 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 the operator’s area and near or inside the engine compartment. The onboard 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. Special equipment or procedures may be employed to start the engine when exposed to temperatures less than 30 °F (–1 °C) 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 Agency.

DEFAULT**Automatically Activated Fast Idle as Required**

The hybrid control system shall automatically manage engine speed as required to maintain optimum operation of all accessories, proper SoC and maximize fuel efficiency.

ALTERNATIVE

In the case of start-stop and EV-capable hybrids, an interlock system shall be added to powertrain access panels to prevent any inadvertent engine start while accessing a moving component. In the case of access opening, the engine shall immediately shut down.. All HV components and access panels leading to said components shall be equipped with a high-voltage interlock loop to ensure that the systems are immediately shut down in case of inadvertent access.

ALTERNATIVE**Standard Requirements for a Fast Idle Device**

The engine shall be equipped with an operator-controlled fast idle device. The fast idle control shall be a two-way switch mounted on the dash or side console and shall activate only with the transmission in neutral and the parking brake applied.

TS 9.4 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 as practicable 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 rated at minimum 1000 hours of salt spray according to ASTM B117, except between the air filter and turbocharger inlet, where piping may be constructed of flexible, heat-resistant material. 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 deg seal.

TS 10 Cooling Systems

The capacity of the cooling system shall be adequate to maintain design component temperatures under all operating conditions for the design life of the vehicle in the service area and environment of the Agency. The Contractor shall provide evidence that the cooling system selected has the capability to handle peak heat rejection from the traction motor, energy storage system, propulsion control system, and the intermediate and low-voltage power supply with a partially clogged radiator at maximum ambient temperature plus heat reflected off the pavement. The Contractor shall submit an analysis verifying cooling system capabilities. The entire cooling system shall be equipped with an electronic detection device to indicate overheating on the driver's control panel.

Operation of required battery thermal management systems shall be automatically controlled under all normally encountered operating and charging conditions and shall be powered by an onboard source at all times during operation. Thermal management shall be continuously monitored during all periods of charge and discharge with appropriate safety interlocks installed to react to adverse conditions.

Air intakes shall be properly positioned and configured to minimize the intake of water, road dust and debris and shall be adequately filtered.

In the event of a failure of the battery thermal management system (BTMS) subsequently resulting in battery temperature outside the allowable limits, the BMS shall limit, in a manner appropriate to the situation, the operation of the bus including charging. A diagnostic indicator shall accompany any BTMS failure.

A complete description of the battery thermal management systems shall accompany the bid package. Written confirmation from the battery manufacturer attesting to the suitability of the battery thermal management system shall be submitted to the Agency concurrent with or prior to delivery of the first bus.

TS 10.1 Component Thermal Management

Under the vehicle operating temperature range, the thermal management system shall be designed such that each component will remain in its allowed operating range.

Component temperature sensors may be used for monitoring, control or component/system protection. If equipped and serviceable, component temperature sensors shall be easily accessible. Under typical failure modes or out-of-limit conditions, component temperature sensors shall not disable the bus unless there is an immediate risk of hazardous fault propagation (e.g., temperature levels in the motor area known to start fires). In the event that a component temperature sensor must disable the bus, the component/system must comply with the automatic propulsion system protection/shutdown override feature requirement of TS 9.1.

Cooling fans shall be of durable, corrosion-resistant construction and designed so a mechanic can gain access. The cooling fan and mounting bracket shall be designed to withstand the thermal fatigue and vibration associated with the installed configuration.

DEFAULT

A means of determining satisfactory component coolant level shall be provided.

ALTERNATIVE

A means of determining satisfactory component coolant level shall be provided. A spring-loaded, push-button-type valve or lever shall be provided to safely release pressure or vacuum in the cooling system with both it and the water filler no more than 60 in. above the ground. Both shall be accessible through the same access door.

DEFAULT

The heat exchanger shall be of durable, corrosion-resistant construction.

ALTERNATIVE

For roof mounted radiators, a pressure filler will be provided in the engine compartment no more than 60 in. above the ground.

ALTERNATIVE

System shall include a coolant recovery tank.

ALTERNATIVE

The radiator shall be made of replaceable or serviceable components (i.e., fans, mounting brackets, radiator core).

TS 10.1.1 Radiator Screen

The radiator input shall be protected by an easily cleanable screen designed to collect large debris. The radiator and charge air cooler cores shall be easily cleaned (to include engine side core surface) with standard pressure-washing equipment.

TS 10.1.2 Coolant

Coolant shall be compliant with the thermal management system manufacturer's requirements.

TS 10.1.3 Drive Design

- **Standard control and drive design:** Control and drive of the radiator and charge air cooler fan(s) shall be the Contractor's standard design.
- **Electric fans:** The bus shall be equipped with an electric fan drive bus cooling system, including fan reversal (automatic at system start) as well as maintenance switch.

TS 10.1.4 Mounting**DEFAULT****Standard Mounting Design**

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

ALTERNATIVE**Higher Mounting Design**

The lower edge of the radiator and charge air cooler core(s) shall be mounted at a height no less than 3 ft above street level to minimize core fouling caused by dirt, debris, leaves, etc.

TS 10.2 Charge Air Cooling**DEFAULT**

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.

ALTERNATIVE

The charge air radiator shall 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.

TS 10.3 Transmission Cooling

If a transmission is present in the bus, the transmission shall be cooled by a heat exchanger sized to maintain operating fluid within the transmission manufacturer's recommended parameters of flow, pressure and

temperature. Where applicable, the transmission cooling system shall be matched to the retarder and engine cooling systems to ensure that all operating fluids remain within recommended temperature limits established by each component manufacturer. Where applicable, the engine cooling system should provide coolant bypass flow to the transmission cooling system with the engine thermostats closed.

ALTERNATIVE

The transmission shall not have a cooler.

ALTERNATIVE

If a transmission is present in the bus, then the thermal management system shall ensure that the transmission remains in its manufacturer-specified operating temperature range. See Section TS 10.1 for additional requirements related to component thermal management.

TS 11 Transmission

NOTE TO USER: *Not applicable to battery electric buses.*

If multiple-speed transmission is used, the transmission shall be automatic shift with torque converter, retarder and electronic controls. Gross input power, gross input torque and rated input speed shall be compatible with the propulsion system. 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.

The electronic controls shall be capable of transmitting and receiving electronic inputs and data from other drivetrain components and of broadcasting that data to other vehicle systems. Communication between electronic drivetrain components and other vehicle systems shall be made using the communication networks. Electronic controls shall be compatible with either 12 or 24 V power distribution, provide consistent shift quality, and compensate for changing conditions, such as variations in vehicle weight and engine or motor power. At a minimum, drivetrain components consisting of the motor(s), motor inverter(s), engine, transmission, retarder, TCS and anti-lock braking systems shall be powered by a dedicated and isolated ignition supply voltage to ensure that data communication among components exists when the vehicle ignition is switched to the “on” position.

The electronically controlled transmission shall have onboard 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. The onboard 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.

DEFAULT

A brake pedal application of 6 to 10 psi shall be required by the driver to engage forward or reverse range from the neutral position to prevent sudden acceleration of the bus from a parked position.

ALTERNATIVE

A brake pedal application of 15 to 20 psi shall be required by the driver to engage forward or reverse range from the neutral position to prevent sudden acceleration of the bus from a parked position.

DEFAULT**No Automatic Neutral Function**

The transmission shall not incorporate an automatic neutral shift function.

ALTERNATIVE**Automatic Neutral Function with Manual Reengagement**

The transmission shall automatically shift to neutral whenever the door brake interlock is applied or the parking brake is pulled for more than five minutes. The driver shall be required to first disengage the parking brake and then apply the service brake to reengage a forward or reverse range.

ALTERNATIVE**Automatic Neutral Function with Automatic Reengagement**

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. If the status of any one or more of the three signals changes, then the transmission shall immediately and automatically resume forward mode operation.

ALTERNATIVE**Hill Holder**

A vehicle hill holder function shall be integrated with an automatic or reduced engine load state function to prevent inadvertent vehicle movement while the transmission is not in forward range.

TS 12 Hydraulic Retarder (Transit Coach)

NOTE TO USER: *Not applicable to battery or hybrid electric buses.*

The powertrain 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 antilock braking system (ABS) and/or automatic traction control (ATC) shall override the operation of the brake retarder.

DEFAULT

Brake lights shall not illuminate when the retarder is activated.

ALTERNATIVE

Brake lights shall illuminate when the retarder is activated, provided that vehicle regulations allow for this function.

DEFAULT**Standard Requirement for Retarder Activation**

The retarder shall be adjustable within the limits of the powertrain and activated when the brake pedal is depressed. The Agency will work with the OEM/drive system manufacturer to determine retarder performance settings.

ALTERNATIVE**Throttle Pedal Activation of the Retarder**

The retarder shall become partially engaged (approximately one-third of its total application, with a resulting deceleration of no greater than 0.077g) when the throttle pedal is completely released. Maximum retarder shall be achieved when the brake pedal is depressed prior to engagement of service brakes, with a maximum resulting deceleration of approximately 0.20g in an empty bus. The resulting decelerations specified include the effects of engine braking, wind resistance and rolling resistance.

The thermostatically controlled cooling fan shall be activated when the retarder is engaged and the coolant temperature reaches the maximum operating temperature established by the engine and transmission manufacturers.

DEFAULT**Accessible Retarder Disable Switch**

The retarder disable switch shall be accessible to the seated driver.

ALTERNATIVE**Retarder Disable Switch Not Accessible**

The retarder disable switch is not required to be accessible to the seated driver.

ALTERNATIVE

Disabling retarder shall be recorded for Agency data collection.

ALTERNATIVE

Unless specified by the transmission manufacturer, a retarder disable switch will not be supplied.

TS 12.1 Additional Hybrid Acceleration Requirements (Hybrid or Battery Electric)

Braking application and performance shall remain consistent across the highest possible range of battery system SoC or other variances related to regenerative braking. At no time should the application and performance of the mechanical friction brakes be affected by these conditions.

TS 13 Engine Brake (Commuter Coach)

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

DEFAULT

Brake lights shall not illuminate when the engine brake is activated.

ALTERNATIVE

Brake lights shall illuminate when the engine brake is activated, provided that vehicle regulations allow for this function.

DEFAULT**Standard Requirement for Engine Brake Activation**

The engine brake shall be adjustable within the limits of the powertrain and activated when the brake pedal is depressed. The Agency will work with the OEM/drive system manufacturer to determine engine brake performance settings.

ALTERNATIVE**Throttle Pedal Activation of the Engine Brake**

The engine brake shall become partially engaged (approximately one-third of its total application, with a resulting deceleration of no greater than 0.077g) when the throttle pedal is completely released. Maximum engine braking shall be achieved when brake pedal is depressed prior to engagement of service brakes, with a maximum resulting deceleration of approximately 0.20g in an empty bus. The resulting decelerations specified include the effects of engine braking, wind resistance and rolling resistance.

The thermostatically controlled cooling fan shall be activated when the engine brake is engaged and the coolant temperature reaches the maximum operating temperature established by the engine and transmission manufacturers.

DEFAULT**Accessible Engine Brake Disable Switch**

The engine brake disable switch shall be accessible to the seated driver.

ALTERNATIVE**Engine Brake Disable Switch Not Accessible**

The engine brake disable switch is not required to be accessible to the seated driver.

ALTERNATIVE

Disabling engine brake shall be recorded for Agency data collection.

ALTERNATIVE

Unless specified by the engine manufacturer, an engine brake disable switch will not be supplied.

TS 13.1 Additional Hybrid Acceleration Requirements (Hybrid or Battery Electric)

Braking application and performance shall remain consistent across the highest possible range of battery system SoC or other variances related to regenerative braking. At no time should the application and performance of the mechanical friction brakes be affected by these conditions.

TS 14 Mounting of Powerplant

All powerplant mounting 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 powerplant so as not to affect performance of belt driven accessories or cause strain in piping and wiring connections to the powerplant.

TS 14.1 Service

All systems requiring routine maintenance shall be arranged for ease of access and maintenance. The Contractor shall list all special tools, fixtures or facility requirements recommended for servicing. All fillers shall be easily accessible with standard funnels, pour spouts and automatic dispensing equipment.

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. The muffler, exhaust system, air cleaner, air compressor, starter, alternator, radiator(s), all accessories, and any other component requiring service or replacement shall be easily removable and independent of the engine and transmission removal, or removal of electric traction system components (hybrid and battery electric buses). An engine oil pressure gauge and coolant temperature gauge(s) shall be provided in the engine compartment. These gauges shall be easily read during service and mounted in an area where they shall not be damaged during minor or major repairs.

An air cleaner with a dry filter element and a graduated air filter restriction indicator shall be provided. 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 the air filter.

DEFAULT

Engine oil and the radiator filler caps shall be mounted to the filler neck and closed with spring pressure or positive locks to prevent leakage per manufacturer's specifications. All fluid fill locations shall be properly labeled with permanent 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 magnetic-type drain plugs or magnets in pan.

ALTERNATIVE

Both engine oil fill and radiator caps shall be screw-type caps permanently tethered to the filler neck.

ALTERNATIVE

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 Agency.

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. All filters shall be easily accessible, and the filter bases shall be plumbed to ensure correct reinstallation.

ALTERNATIVE

Engine and transmission fill fittings are not required to be unique, but the fill ports shall be labeled and color-coded so as to be visibly different.

DEFAULT

No engine bypass oil filter.

ALTERNATIVE

Centrifugal, non-disposable engine bypass oil filter.

DEFAULT**Engine Oil Pressure and Coolant Temperature Display**

Engine oil pressure and coolant temperature gauges required in engine compartment.

ALTERNATIVE**Oil Pressure and Coolant Temperature Display**

No engine oil pressure and coolant temperature gauges required in engine compartment.

ALTERNATIVE**Oil Pressure and Coolant Temperature Display**

Engine oil pressure and coolant temperature shall be displayed on the electronic C-COM gauge located on the engine switch box.

TS 15 Hydraulic Systems

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. 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 when applicable. A tamperproof priority system shall prevent the loss of power steering during operation of the bus if other devices are also powered by the hydraulic system.

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

DEFAULT

No requirement for hydraulic fluid level sensors.

ALTERNATIVE**Hydraulic System Sensors**

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

TS 15.1 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.

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 per the vehicle manufacturer's recommendations. Installation of these fluid lines shall be in accordance with the vehicle manufacturer's standards. Vehicle manufacturer recommendations and standards must comply with all required USDOT or industry standards.

TS 15.2 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).

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 16 Radiator

If liquid cooling is used, the radiator(s) and/or heat exchanger shall be a heavy-duty metal unit, designed and constructed for transit duty. The Contractor shall demonstrate the reliability and durability of the proposed heat exchanger. The radiator(s) shall be accessible for cleaning. Any radiator shall be easily removable from the bus.

ALTERNATIVE

[Agency to specify location of radiator.]

Radiator piping shall be stainless steel, aluminum, brass tubing or painted steel rated at 1000 hours of salt spray according to ASTM B117. Where 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 deg 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 17 Oil and Hydraulic Lines

All systems requiring lubrication shall meet or exceed component manufacturer's recommendation for installation, operation and maintenance. The fluid transfer lines shall be designed and intended 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). No fluid lines shall be below the frame line of the bus.

TS 18 Fuel

TS 18.1 Fuel Lines

Fuel lines shall be securely mounted, braced and supported as designed by the vehicle 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.

DEFAULT

[Agency to specify fuel type.]

ALTERNATIVE

Fuel of choice.

TS 18.1.1 Fuel Lines, (Diesel)

Fuel lines shall be capable of carrying the type of fuel specified by the Agency (i.e., up to B20 type fuel) and meet all USDOT standards and guidelines for diesel fuel transfer. Fuel lines shall not be used to secure other components (wires, air lines, etc.).

TS 18.1.2 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% 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 used as required. Fuel lines shall be identifiable as fuel lines only.

High-pressure CNG lines shall be pressure tested to a minimum of 125% of system working pressure prior to fueling. CNG; nitrogen; or clean, dry air shall be used to pressure-test the lines/assembly. The vehicle 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 locations 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., or 16.5 in. in a case of a specially designed rigid fuel hose.

TS 18.2 Fuel Tank – Design and Construction**TS 18.2.1 Design and Construction, (Diesel)****Fuel Tank(s)****DEFAULT**

The fuel tank(s) shall be of the vehicle manufacturer’s standard design.

ALTERNATIVE

The fuel tank(s) shall be made of corrosion-resistant stainless steel. The fuel tank shall be made of sufficiently heavy gauge 300 series or ASTM A240 stainless steel.

ALTERNATIVE

The fuel tank(s) shall be made of aluminum material.

ALTERNATIVE

The fuel tank(s) shall be made of high-density cross-linked polyethylene plastic material with or without baffles.

ALTERNATIVE

Protective shield mounted fully underneath the tank(s). Fuel tank shall be protected by a solid metal barrier mounted between the bottom of the fuel tank and the roadway surface. The barrier shall be securely mounted to the bus structure and shall cover the entire bottom surface area of the fuel tank.

Installation

The fuel tank(s) shall be securely mounted to the bus per manufacturer's standards and any applicable federal regulations/guidelines.

The fuel tank(s) shall be equipped with an external, hex-head drain plug. It shall be at least 3/8 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 ensure continuous full-power operation on a 6% 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% 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.

Labeling

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

Fuel Filler

The fuel filler shall be located a minimum of 7 ft behind the centerline of the front door on the curb side of the bus. The filler cap shall be retained to prevent loss and shall be recessed into the body so that spilled fuel will not run onto the outside surface of the bus. Fuel filler doors shall not interfere with other components on the bus (i.e., passenger doors, egress windows, side compartment doors).

The fuel lines forward of the engine bulkhead shall be in conformance to SAE standards.

DEFAULT

OEM to designate height of fuel filler.

ALTERNATIVE

[Agency to determine fuel filler location.]

ALTERNATIVE

Fuel filler door will be designed to prevent damage caused by other components of the bus (i.e., passenger doors, egress windows, side compartment doors, etc.) when in the open position.

DEFAULT**Dry-Break Fuel Filler**

The fuel filler shall accommodate a nozzle that forms a locked and sealed connection during the refueling process to eliminate spills. Fuel shall not be allowed to flow into the tank unless the nozzle has been properly coupled, locked and sealed to the filler. With the nozzle open, fuel shall enter the tank at a fill rate of not less than 40 gal per minute of foam-free fuel without causing the nozzle to shut off before the tank is full. The nozzle shall automatically shut off when the tank is essentially full. Once disconnected, fuel shall not be allowed to flow through the nozzle at any time. Any pressure over 3 psi shall be relieved from the fuel tank automatically. An audible signal shall indicate when the tank is essentially full. The dry break system shall be compatible with the Agency's system. The fuel filler cap shall be hinged.

ALTERNATIVE

The fuel filler shall accommodate a standard diesel fuel nozzle. The nozzle shall automatically shut off when the tank is essentially full. An audible signal shall indicate when the tank is essentially full. The fuel filler cap shall be a screw-on cap.

ALTERNATIVE

The fuel filler cap shall be hinged.

TS 18.2.2 Design and Construction (CNG)**Fuel Containers/Cylinders**

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

- 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.

Installation

Fuel cylinders shall be installed in accordance with the latest ANSI/IAS NGV2 standards, "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. In the case of a low-floor transit bus, the placement of tanks shall be limited to the roof of the vehicle or in the compartment above the engine of the vehicle.

Fuel cylinders, attached valves, pressure relief devices and mounting brackets should be installed and protected so that their operation is protected from bus washers and environmental agents such as rain, snow, ice or mud. These components should be protected from damage caused by road debris or collision and prevent any out-of-service situations with the vehicle.

The roof and area 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 use 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.

DEFAULT

The access panels shall not be interlocked.

ALTERNATIVE

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.

Labeling

CNG fuel systems shall be labeled in accordance with latest NFPA 52 standards, “Compressed Natural Gas (CNG) Vehicular Fuel Systems Code.”

Pressure Relief Devices (PRDs)

PRDs must be designed, constructed, manufactured and tested in accordance with ANSI/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 the outside.

Valves

Valves must be installed in accordance with ANSI/IAS NGV2 (1998), “Basic Requirements for Compressed Natural Gas Vehicle (NGV) Fuel Containers,” and NFPA 52, “Standard for Compressed Natural Gas (CNG) Vehicular Fuel Systems.”

Fuel Filler

The fuel filler shall be located a minimum of 7 ft behind the centerline of the front door on the curb side. 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 curb side of the bus. The access door shall be sized to allow full viewing of gauges, ease of hookups and maneuver of fuel nozzle.

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.

DEFAULT

A static ground plug shall be installed per NFPA 53 and shall be located on the right-hand rear strut.

DEFAULT

Fuel filler shall be on curb side.

ALTERNATIVE

Fuel filler shall be on street side.

ALTERNATIVE

[Specify fuel filler location.]

ALTERNATIVE

The access door interlock shall also power on the fuel level gauges/illumination when in the open position.

ALTERNATIVE

A static ground plug shall be installed near the fueling receptacle for grounding during refueling operations.

Fueling System

The CNG fueling port receptacle shall be an ANSI/AGA NGV1 or NGV2 certified receptacle as designated by the Agency. The coach shall be capable of being fueled by a nozzle determined by the Agency. 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-aways. 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 the Agency.

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 curb side of the coach, in a location compatible with the Agency’s defueling station operation. The defueling 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 the Agency.
- Components compatible with the Agency’s defueling operation.
- The piping and fittings onboard the bus shall be sized to allow the fueling station to meet the following operating parameters:

DEFAULT

Fuel system shall be sized to allow a bus with 20,000 scf on board to defuel within 2.5 hours.

ALTERNATIVE

The atmospheric-vent system shall allow a bus with 20,000 scf of onboard CNG storage to defuel to atmospheric pressure within 80 minutes.

ALTERNATIVE

Location/method of attaching CNG fuel system to earth ground.

TS 19 Emissions and Exhaust**TS 19.1 Emissions (Battery Electric)**

The vehicle shall not have any EPA-regulated exhaust emissions except as noted in Section 6, “Technical Specifications” subsection entitled “Auxiliary Heater.”

TS 19.2 Exhaust Emissions (All except Battery Electric)

The engine and related systems shall meet all applicable emission and engine design guidelines and standards at date of manufacture.

TS 19.3 Exhaust System

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 aftertreatment 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.

DEFAULT

Exhaust gases and waste heat shall be discharged from the street-side rear corner of the roof.

ALTERNATIVE

Exhaust gases and waste heat shall be discharged from the street-side under-rear bumper.

ALTERNATIVE

Exhaust gases and waste heat shall be discharged from the roadside rear corner roof, except for the auxiliary heater (if required), which shall be discharged from the roadside rear under-bumper area.

TS 19.4 Exhaust Aftertreatment

An exhaust aftertreatment system will be provided to ensure compliance to all applicable EPA regulations in effect at date of manufacture.

TS 19.4.1 Diesel Exhaust Fluid (DEF) Injection

If required by the engine manufacturer to meet NO_x level requirements specified by the EPA, a DEF injection system will be provided. The DEF system will minimally include a tank, an injector, a pump, an engine control module and a selective catalytic converter. The tanks shall be designed to store DEF in the operating environment described in Section 6, “Technical Specifications” subsection entitled “Operating Environment.”

DEFAULT

The DEF filler shall accommodate a standard nozzle. The nozzle shall automatically shut off when the tank is full. The DEF filler cap shall be a screw-on cap and located on the curb side. Construction and size of DEF reservoir should follow all OEM specifications.

ALTERNATIVE

The DEF filler shall accommodate a nozzle that forms a locked and sealed connection during the refueling process to eliminate spills. DEF shall not be allowed to flow into the tank unless the nozzle has been properly coupled, locked and sealed to the filler. With the nozzle open, DEF shall enter the tank at a fill rate of not less than 5 gal per minute without causing the nozzle to shut off before the tank is 85% full. The nozzle shall automatically shut off when the tank is at the proper fill level. Once disconnected, fluid shall not be allowed to flow through the nozzle at any time. The filler cap shall be installed on the receiver.

DEFAULT

The DEF lines shall be designed to prevent the DEF from freezing. The DEF injection system shall not be damaged from a cold soak at 10 °F (–12 °C).

ALTERNATIVE

The DEF lines shall be designed with heated lines for temperatures specified in the operating profile.

ALTERNATIVE

An audible signal shall indicate when the tank is full.

TS 19.5 Particulate Aftertreatment

If required by the engine manufacturer to meet particulate matter (PM) emission limits specified by the EPA, a diesel particulate filter (DPF) will be provided. The DPF system shall be designed to periodically remove accumulated carbonaceous particulate via oxidation (regenerate). Regeneration cycles and conditions will be defined by the engine manufacturer. Vehicle shall be equipped with a manual regeneration inhibit switch for utilization during maintenance operations.

TS 20 Structure**TS 20.1 Design**

The structure of the bus shall be designed to withstand the transit service conditions typical of an urban or intercity 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 Agency shall be considered for this purpose.

TS 21 FTA Required New Model Bus Testing

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

Any bus delivered under the Contract is a production bus unless the parties have agreed that it is a pilot bus to be used for preproduction purposes.

DEFAULT

FTA New Model Bus Test Report Provided to Agency 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 New Model Bus Tests. Prior to assembly of the first production bus, the vehicle manufacturer shall provide the Agency with a completed report of FTA New Model Bus Testing for the proposed bus model, along with a plan of corrective action to address deficiencies, breakdowns and other issues identified during FTA New Model Bus Testing. The bus model tested shall match the bus model proposed for procurement, including structure, axles and drivetrain. Base model and partial FTA New Model Bus Test reports are acceptable when the combination of these tests adequately represents the proposed bus model.

ALTERNATIVE

If available, the FTA New Model Bus Test Report shall be provided to the Agency with the Proposal submittal. If not available, then the report shall be provided prior to acceptance of the first production bus.

TS 21.1 Structural Validation

DEFAULT

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 FTA New Model Bus Testing or finite element analysis (FEA).

ALTERNATIVE

Detailed Structural Analysis

The structure of the proposed bus model shall have undergone structural testing prior to assembly of the first bus. [Agency to list additional testing desired.]

TS 22 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 23 Resonance and Vibration

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

TS 23.1 Propulsion Compartment Bulkheads

The passenger and propulsion system compartments shall be separated by a fire-resistant bulkhead. This bulkhead shall preclude or retard propagation of exhaust gasses and/or a propulsion compartment fire into the passenger compartment. The bulkhead shall be in accordance with the Recommended Fire Safety Practices defined in

FMVSS 302. 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 propulsion 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. Propulsion 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.

ALTERNATIVE

If the propulsion system doesn't contain combustion operations, then a fire-resistant bulkhead is not needed.

TS 23.2 Crashworthiness (Transit Coach)

The bus body and roof structure shall withstand a static load equal to 150% 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 lb automobile at any side, excluding doorways, along either side of the bus and the articulated joint, if applicable, 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 surfaces below 35 in. from ground level shall withstand a static load of 2000 lb applied perpendicular to the bus by a pad no larger than 5 in.². This load shall not result in deformation that prohibits restoration of original appearance of the bus.

ALTERNATIVE

The vehicle manufacturer shall conduct crashworthiness finite element analysis (FEA).

TS 24 Corrosion

The bus flooring, sides, roof, understructure and axle suspension components shall be designed to resist corrosion, including deterioration from environmental conditions and deicing 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 Agency's 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. Samples tested shall meet Criterion 10 of ASTM D610 and, if painted, have no perceptible blistering in accordance with ASTM D714.

DEFAULT

Corrosion-Resistance Requirements

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

ALTERNATIVE**Corrosion-Resistance Requirements**

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

ALTERNATIVE**Additional Corrosion-Resistance Requirements**

The vehicle shall be constructed using only inherently corrosion-resistant materials and fasteners such as stainless steel or composites to minimize deterioration. The structure shall not require corrosion-preventive coatings or aftertreatments, either during construction or throughout the service life of the vehicle.

TS 25 Towing

Each towing device shall withstand, without permanent deformation, tension loads up to 1.2 times the curb weight of the bus within 20 deg 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. The OEM shall provide a towing procedure that ensures that the traction motor does not generate high voltage during towing.

DEFAULT**Lifted (Supported) Front Axle and Flat Towing Capability**

The front towing provision locations shall allow attachment of adapters for a rigid tow bar and shall permit the lifting of the bus until the front wheels are clear off the ground in order to position the bus on the towing equipment by the front wheels. These towing provision locations shall also permit common flat towing.

ALTERNATIVE**Lifted (Unsupported) Front Axle and Flat Towing Capability**

The front towing provision locations 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 towing provision locations shall also permit common flat towing.

Two rear recovery towing provision locations 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 the bus. The method of attaching the tow bar or adapter shall require the specific approval of the Agency. Any tow bar or adapter exceeding 60 lb should have means to maneuver or allow for ease of use and application. Each towing provision location shall accommodate a towing adaptor or a crane hook with a 1 in. throat.

DEFAULT

Shop air connectors shall be provided at the front and 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.

ALTERNATIVE

A plug connector 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.

ALTERNATIVE

Shop air connectors shall be provided at the front and rear of the bus and shall be capable of supplying all pneumatic systems of the bus with externally sourced compressed air and allow the towing vehicle to control and operate the bus braking system during a towing operation. The location of these shop air connectors shall facilitate towing operations.

DEFAULT**No Provision of Glad-Hand-Type Connectors for Towing**

No glad-hand-type connector shall be provided.

ALTERNATIVE**Provision of Glad-Hand-Type Connectors for Towing**

Glad-hand-type connectors shall be provided at the front of the bus to allow the towing vehicle to control and operate the bus braking system during a towing operation.

TS 26 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 any 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. The bus shall withstand such jacking at any one or any combination of wheel locations without permanent deformation or damage.

DEFAULT**Yellow Pads**

Jacking pads shall be painted safety yellow.

ALTERNATIVE**Decals**

Apply decals to identify location of jacking pads.

TS 27 Hoisting

The bus axles or jacking plates shall accommodate the lifting pads of a two-post hoist system.

ALTERNATIVE FOR COMMUTER COACH

The bus axles or jacking plates shall accommodate the lifting pads of a three-post hoist system for 60 ft articulated buses.

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.

The vehicle shall be capable of lifting by the wheels and, as necessary to meet tire load requirements, the proper number for wheel lifts and/or adapters must be used.

TS 28 Floor

TS 28.1 Design (Transit Coach)

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 $\frac{1}{4}$ 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 deg to allow for drainage.

DEFAULT

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 increased slope shall be allowed on the upper level, not to exceed 3.5 deg (± 0.3 deg) off the horizontal.

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 12 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 sign shall be provided at the immediate platform area to alert passengers to the change in floor level.

ALTERNATIVE

Warning Decal for Change in Floor Level

If the vehicle is of a bi-level floor design, a warning decal shall be provided at the immediate platform area to alert passengers to the change in floor level.

ALTERNATIVE

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 deg off the horizontal.

ALTERNATIVE

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 $1\frac{1}{2}$ 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 28.2 Design (Commuter Coach)

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 $\frac{1}{4}$ 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 deg to allow for drainage.

The aisle of the bus shall be a sloped floor design and shall not exceed 5.5 deg off the horizontal or include one step not to exceed entrance door step heights. The floor shall be a continuous plane over the wheel housings. 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 $\frac{1}{4}$ in. or installed in a fully sealed butt joint.

TS 28.3 Design (Articulated Transit Coach)

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 $\frac{1}{4}$ 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 deg to allow for drainage.

DEFAULT

Sloped Floor

Slope ahead of the articulated joint shall not exceed 3.15 deg.

ALTERNATIVE

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 $1\frac{1}{2}$ 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 28.4 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 lb applied through the flat end of a $\frac{1}{2}$ in. diameter rod, with $\frac{1}{32}$ in. radius, without permanent visible deformation.

TS 28.5 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.

DEFAULT

Pressure-Preserved Plywood Panel

Plywood shall be certified at the time of manufacturing by an industry-approved third-party inspection agency such as APA – The Engineered Wood Association (formerly the American Plywood Association). Plywood shall be of a thickness adequate to support design loads, shall be manufactured with exterior glue, shall 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 shall be of a grade 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 that prevents decay and damage by insects. Preservative treatments shall use 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 agency. Pressure-preservative treated plywood shall have a moisture content at or below 15%.

ALTERNATIVE

Flooring with manufactured noise-reduction characteristics.

ALTERNATIVE

Composite flooring.

TS 28.6 Construction (Commuter Coach)

The floor shall consist of the subfloor and the floor covering that will last the life of the bus, providing that the operator has performed all the necessary maintenance practices as identified by the OEM in their service manuals. 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.

The floor deck may not be integral with the basic structure but shall be mounted on the structure securely to prevent chafing or horizontal movement. Sheet metal screws shall not be used to retain the floor. All floor fasteners shall be secured and protected from corrosion for the service life of the coach. 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 0.375 in. (10 mm) from the normal plane. The floor shall withstand the application of 3.0 times gross load weight without permanent detrimental deformation.

TS 29 Platforms

TS 29.1 Driver's Area

The 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 the top edges of platforms unless integral nosing is provided.

DEFAULT

No specific trim material specified.

ALTERNATIVE

[Agency to specify specific trim required.]

TS 29.2 Driver'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 or bike rack.

Notwithstanding this requirement, the platform height shall not position the driver such that the driver's vertical upward view is less than 15 deg.

DEFAULT

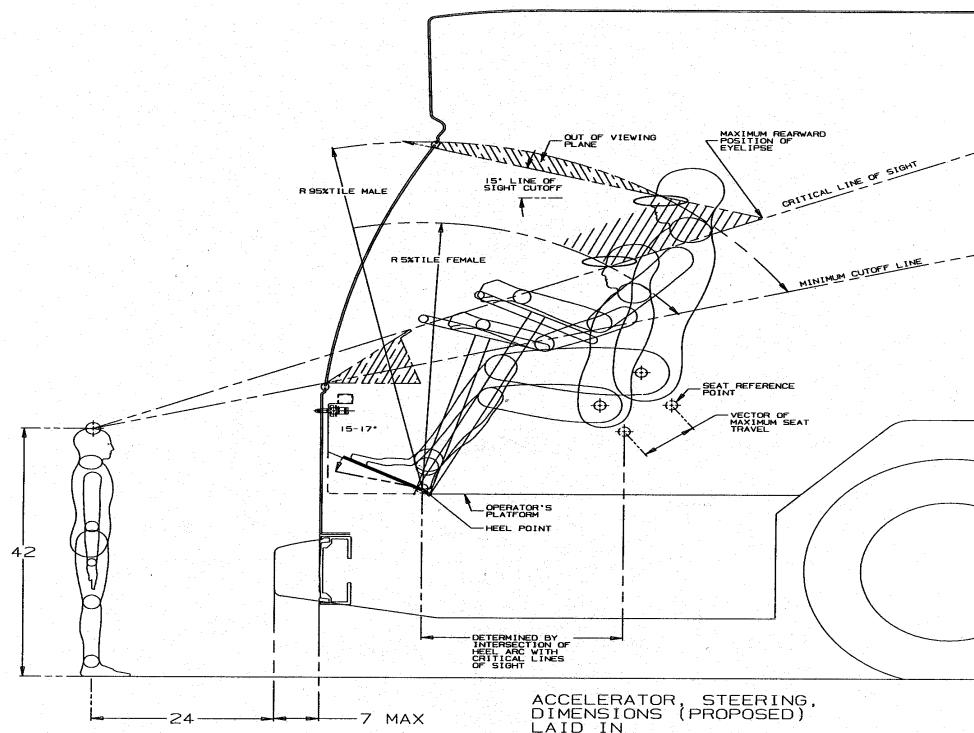
A warning decal or sign shall be provided to alert the driver to the change in floor level.

ALTERNATIVE

Yellow edge 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.

FIGURE 3
Determining Platform Height



TS 29.3 Farebox

Farebox placement should minimize impact to passenger access and minimize interference with the driver's line of sight. The floor under the farebox shall provide a sturdy mounting platform to prevent shaking of the farebox. Farebox installation shall not interfere with the driver's protection barrier or door.

DEFAULT

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.

ALTERNATIVE

No interface, no platform.

ALTERNATIVE

Stanchions

Stanchions shall be located around the farebox.

ALTERNATIVE

Fare collection electronic readers shall be located at entrance and exit doors.

TS 30 Wheel Housing

TS 30.1 Design and Construction

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

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

TS 30.2 Design and Construction (Transit Coach)

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.

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.

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.

The lower portion extending above the floor shall be equipped with scuff-resistant coating or stainless steel trim.

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.

Where wheel housings are equipped with seats or equipment enclosures, all fasteners passing through to the outside of the coach shall be fully sealed to prevent the intrusion of water into the coach.

DEFAULT

No provision shall be made to apply tire chain on buses.

ALTERNATIVE

The wheel housing shall be designed to have the ability to apply tire chains on buses.

TS 30.3 Articulated Joint (Articulated Transit Coach)

60 ft articulated 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 to 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. Underfloor turntable components shall be easily accessible. Floor plates must be easily lifted and secured in the open position or removeable by one person for inspection and repairs. Any turntable seats shall be quickly and easily removable by one person and shall comply with "Passenger Seating." The underfloor 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 interconnecting structure shall be designed to prevent separation of the lead and trailing units as a result of a road accident with a fixed or mobile object. 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 the bus speed in reverse gear exceeds 3 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 the approval of the Agency.

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 30.4 Raceway (Articulated Transit Coach)

A raceway shall be provided through the turntable area to accommodate 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 Agency.

Bulkhead fitting shall be provided for all lines: air, coolant, electrical, hydraulic and AC at both ends of the raceway. The bulkhead area shall be easily accessible for servicing.

TS 30.5 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 underfloor 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 its 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 Agency's option. Bellows shall be approved by the Agency.

DEFAULT

No bellows liner required.

ALTERNATIVE

Bellows liner shall be provided.

TS 31 Suspension

TS 31.1 General Requirements

The front, rear and mid (if articulated) suspensions shall be pneumatic type. The basic suspension structure shall last the service life of the bus without major overhaul or replacement, with the exception of hoses, shock absorbers, air bellows and other items defined within the "Warranty Requirements" section. 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 31.2 Alignment

All axles should be properly aligned for even tire wear and for the vehicle to track accurately within the size and geometry of the vehicle.

TS 31.3 Springs and Shock Absorbers

TS 31.3.1 Suspension Travel

The suspension system shall permit a minimum wheel travel of 2.75 in. jounce-upward travel of a wheel when the bus hits a bump (higher than street surface), and 2.75 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 31.3.2 Damping

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 fewer after hitting road perturbations. 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 31.3.3 Lubrication

DEFAULT

Standard Grease Fittings

All elements of steering, suspension and drive systems requiring scheduled lubrication shall be provided with grease fittings conforming to SAE 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 fewer than every 6000 miles.

ALTERNATIVE

Auto-lube.

ALTERNATIVE

Remote grease manifold.

TS 31.3.4 Kneeling

DEFAULT

A kneeling system shall lower the entrance(s) of the bus a minimum of 2 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 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 4 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 per 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 curb side 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.

ALTERNATIVE

Left-side kneel capabilities.

ALTERNATIVE

Full right-side kneel capabilities.

ALTERNATIVE

Full left-side kneel capabilities.

ALTERNATIVE

Full four-wheel kneel capabilities.

ALTERNATIVE

The full kneeling shall be activated in a continuous sequence without halt after downward toggle of the switch to prevent any confusion for embarking passenger and risk of injuries.

ALTERNATIVE

Automatic raising as door closes.

TS 32 Wheels and Tires

TS 32.1 Wheels

All wheels shall be interchangeable and shall be removable without a puller. Middle axle of articulated buses may utilize a super single if alternative is selected. Wheels shall be compatible with tires in size and load-carrying capacity. Front wheels and tires shall be balanced as an assembly.

DEFAULT**Painted Steel**

Wheels and rims shall be hub-piloted with powder-coated steel (maximum 3.5 mil) and shall resist rim flange wear.

ALTERNATIVE

Brushed aluminum.

ALTERNATIVE

One-sided polished aluminum.

ALTERNATIVE

Provide stud-piloted wheel.

ALTERNATIVE

Two-sided polished aluminum rims.

ALTERNATIVE

Super single to be used on the drive axle tires

DEFAULT

No tire-pressure monitoring system.

ALTERNATIVE

Tire-pressure monitoring system.

ALTERNATIVE

Loose lug nut indicator.

DEFAULT

Standard non-locking lug nut.

ALTERNATIVE

Three-piece captive locking lug nut.

TS 32.2 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.

DEFAULT

The tires shall be provided under a lease agreement between the Agency and the tire supplier and shall be the appropriate size and load range for the vehicle.

ALTERNATIVE

The tires shall be supplied by the Contractor.

ALTERNATIVE

Super single tire should be used. [Agency to designate preferences for the tire size.]

TS 33 Steering

DEFAULT

Hydraulically assisted 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. A loss of power to the bus shall not cause the driver to lose steering. The bus shall be able to be safely brought to a controlled stop.

ALTERNATIVE

On battery electric and hybrid coaches capable of supporting it, electrically driven hydraulic power steering may be used.

ALTERNATIVE

Electrically assisted steering shall be provided to reduce steering effort.

TS 33.1 Steering Axle (Transit Coach)

DEFAULT

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.

ALTERNATIVE**Oiled-Type Front Bearings**

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

ALTERNATIVE**Independent Suspension Axle**

The front axle shall be of an independent suspension design, non-driving, with a load rating sufficient for the bus loaded to GVWR and shall be equipped with sealed, oiled or grease-type front wheel bearings.

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.

Ackermann design shall reduce tire wear, minimize turn radius and optimize driver control during all operating conditions.

TS 33.2 Steering and Tag Axles (Commuter Coach)

The front and tag axles shall be solid beam, non-driving with a load rating sufficient for the bus loaded to GVWR and shall be equipped with unitized grease-type 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.

Ackermann design shall reduce tire wear, minimize turn radius and optimize driver control during all operating conditions.

TS 33.3 Steering Wheel**TS 33.3.1 Turning Effort**

Steering effort shall be measured with the bus at GVWR, stopped with the brakes released and propulsion system engaged and, as appropriate, in idle on clean, dry, level, commercial asphalt pavement and the tires inflated to recommended pressure.

Under these conditions, the torque required to turn the steering wheel 10 deg shall be no less than 5 ft-lb and no more than 10 ft-lb. Steering torque may increase to 70 ft-lb 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 lb 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-ahead position with minimal assistance from the driver.

TS 33.3.2 Steering Wheel, General

The steering wheel diameter shall be approximately 18 to 20 in.; the rim diameter shall be $\frac{7}{8}$ to $1\frac{1}{4}$ in. and shaped for firm grip with comfort for long periods of time.

Steering wheel spokes and wheel thickness shall ensure visibility of the dashboard so that 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 33.3.3 Steering Column Tilt

The steering column shall have full tilt capability with an adjustment range of no less than 40 deg from the vertical and easily adjustable by the driver and shall be accessible by a 5th-percentile female and 95th-percentile male. Driver's knees shall not contact wheel spokes at any adjustment or driving position.

ALTERNATIVE

Steering Column Tilt

The steering column shall have two separate tilt locations, one near the top of the column and one at the universal joint below the floor where the column is connected to the right angle steering box; tilt and telescope are controlled by levers on the left side of the column.

TS 33.3.4 Steering Wheel Telescopic Adjustment

The steering wheel shall have full telescoping capability and have a minimum telescopic range of 1.75 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. See [Table 4](#).

TABLE 4

Steering Wheel Height¹ 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 deg	29 in.	0 deg	34 in.
15 deg	26.2 in.	15 deg	31.2 in.
25 deg	24.6 in.	25 deg	29.6 in.
35 deg	22.5 in.	35 deg	27.5 in.

1. Measured from bottom portion closest to driver.

TS 34 Drive Axle

The bus shall be driven by a heavy-duty axle(s) 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 major repairs. The lubricant drain plug shall be magnetic type. If a planetary gear design is employed, then the oil level in the planetary gears shall be easily checked through the plug. The axle and driveshaft components shall be rated for both propulsion and retardation modes with respect to duty cycle. If a planetary gear design is employed, then the planetary gear drain plugs shall also be magnetic. Proper venting shall be provided, and it shall be sufficiently well constructed so as to not plug, kink or become otherwise degraded.

NOTE TO USER: *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 35 Tag Axles (Commuter Coach)

A tag axle shall be located behind the drive axle. The tag axle shall be a solid beam type with fixed steering. The tag axle shall have single tires the same size as the tires on the front and drive axles. Tag axle weight shall not exceed 14,000 lb. With full passenger seating capacity, load on any axle shall not exceed 22,400 lb. Combined load capacity weight on the drive and tag axles shall not exceed 36,500 lb. A tag axle unloading feature will allow full or partial unloading, or dumping of air from the tag axle air spring bellows. This feature enables weight to shift to the drive axle for more traction. Manual unloading valves are located inside the right-hand rear curbside service door.

ALTERNATIVE

Include dash mounted unloading valve switch.

ALTERNATIVE

Active steerable tag axle will be provided.

ALTERNATIVE

Passive steerable tag axle will be provided.

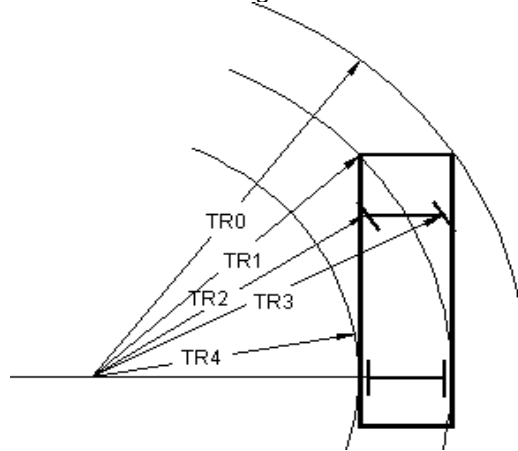
TS 36 Turning Radius

[Agency to fill in table 5]

TABLE 5
Maximum Turning Radius

Bus Length (approximate)	Maximum Turning Radius (see Figure 4)	Agency Requirement
30 ft	34 ft (TR0)	
35 ft	39 ft (TR0)	
40 ft	44 ft (TR0)	
45 ft	49 ft (TR0)	
60 ft	44.5 ft (outside front axle, TR0) 17 ft (inside rearmost axle, TR4)	

FIGURE 4
Turning Radius



TS 37 Brakes

TS 37.1 Service Brake

DEFAULT

Brakes shall be self-adjusting. Brake wear indicators (visible brake sensors) shall be provided. A loss of power to the bus shall not cause the driver to lose braking. The bus shall be able to be safely brought to a controlled stop.

ALTERNATIVE

Electronic brake monitoring system that includes a brake pad and wear sensor and alarm to notify driver and maintenance of unsafe brake conditions shall be provided.

ALTERNATIVE

Electronic brake monitoring system that includes a stroke indicator sensor and alarm to notify driver and maintenance of unsafe brake conditions shall be provided.

ALTERNATIVE

Visible indicators may be combined with electronic brake monitoring system and vehicle brake warning system to notify driver and maintenance personnel of unsafe brake conditions.

TS 37.1.1 Regenerative Braking (Battery Electric or Hybrid)

In addition to traditional mechanical friction service braking, the bus shall be equipped with regenerative braking designed to improve energy efficiency and extend brake lining service life. The application of regenerative braking shall cause a smooth blending of both regenerative and service brake function. Actuation of ABS and/or automatic traction control (ATC) shall override the operation of the regenerative brake. The ESS system should be designed to prevent overcharge during regenerative braking.

TS 37.2 Actuation

DEFAULT

Service brakes shall be controlled and actuated by a compressed air system. Force to activate the brake pedal control shall be a linear function of the bus deceleration rate and shall not exceed 80 lb 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 their foot is rested flat on the pedal and the heel is touching the floor or heel pad of the pedal. The electronic control unit for the ABS system shall be protected, yet in an accessible location to allow for ease of service.

The total braking effort shall be distributed among all wheels in such a ratio as to ensure equal friction material wear rate at all wheel locations. The manufacturer shall demonstrate compliance by providing a copy of a thermodynamic brake balance test upon request.

ALTERNATIVE

Hydraulic brakes.

DEFAULT

No automatic traction control.

ALTERNATIVE

Microprocessor-controlled ATC shall be integrated with transmission or drive system control.

ALTERNATIVE

Advance driver assistance system provides emergency braking system for protection of pedestrians and collision mitigation.

ALTERNATIVE

The ABS or electronic brake controller must support EBC1 (PGN 61441) "Brake Pedal Position" (SPN 521) to support and enhance fuel savings technologies.

TS 37.3 Friction Material

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 a chamfer indicating the thickness at which replacement becomes necessary shall be provided on each brake lining. The complete brake lining wear indicator shall be clearly visible from the hoist or pit without removing backing plates.

DEFAULT

No remote brake wear indicator shall be required.

ALTERNATIVE

Provide 100% copper free brake friction material.

ALTERNATIVE

[Agency to specify remote brake wear indicator to be provided.]

TS 37.4 Hubs and Drums/Discs)

Replaceable wheel bearing seals shall run on replaceable wear surfaces or be of an integral wear surface sealed design. Wheel bearing and hub seals and unitized hub assemblies shall not leak or weep lubricant when operating on the design operating profile for the duration of the initial manufacturer's warranty.

DEFAULT**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.

ALTERNATIVE**Drum Brakes**

The bus shall be equipped with brake drums. Brake drums shall allow machining for oversized linings per manufacturer's specifications.

ALTERNATIVE**Disc Brakes on Front Axle**

The bus shall be equipped with brake drums on the rear axle (and mid, if appropriate) and disc brakes on the front axle. The brake drums shall allow machining for oversize linings per manufacturer's specifications, and 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 the brake linings.

TS 37.5 Parking/Emergency Brake**DEFAULT****Air Brakes**

The parking brake shall be a spring-operated system, actuated by a valve that exhausts compressed air to apply the brakes, per FMVSS 121.

ALTERNATIVE**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. Air to the emergency brake release system shall be provided by a dedicated emergency air tank.

ALTERNATIVE

Hydraulic Brakes

If the bus is equipped with hydraulic brakes, then the braking system must comply with FMVSS 105, including both service and parking brake features.

TS 38 Pneumatic System

TS 38.1 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(s).

Provision shall be made to apply shop air to the bus air systems. A quick disconnect fitting shall be easily accessible and located in the powertrain compartment and near the front bumper area for towing. 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 38.2 Air Compressor

DEFAULT

The air compressor shall be sized to charge the air system from 40 psi to the governor cutoff pressure in less than 4 minutes while not exceeding the fast idle speed setting of the engine, if equipped.

TS 38.3 Air Lines and Fittings

Air lines, except necessary flexible lines, shall conform to the installation and material requirements of SAE J1149 for copper tubing with standard, brass, flared or ball sleeve fittings, or SAE J844 for nylon tubing if not subject to temperatures over 200 °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:

DEFAULT

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

ALTERNATIVE

Contractor to designate color-coding.

ALTERNATIVE

Provide quick-connect connectors for nylon tubing.

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 30 in. intervals or less.

The compressor discharge line between 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 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 38.4 Air Reservoirs

All air reservoirs shall meet the requirements of FMVSS 121 and SAE J10 and shall be equipped with drain plugs and guarded or flush-type drain valves. 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 38.5 Air System Dryer

An air dryer shall prevent accumulation of moisture and oil in the air system. An air dryer in the new condition shall provide a minimum dew point depression from ambient of 25 °F at ambient temperatures below 100 °F and operating at nominal full system pressure. This assumes the air temperature at the inlet of the air dryer is within 15 °F of ambient. The dew point depression from ambient shall be no less than 20 °F under those conditions at any time before recommended overhaul provided that the air dryer is serviced properly. The air dryer shall be able to provide these levels of dew point depression with the compressor running continuously. The air dryer system shall include one or more replaceable desiccant cartridges.

DEFAULT

No requirements for additional oil separator provision.

ALTERNATIVE

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.

ALTERNATIVE

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.

TS 39 Electrical, Electronic and Data Communication Systems

TS 39.1 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 bidirectional communication 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.

Data communication systems are divided into three levels for the use of multiple data networks (see **Figure 5** and **Figure 6**):

- Powertrain level
- Information level
- Multiplex level

FIGURE 5

Data Communication Systems Levels – Diesel Powertrain

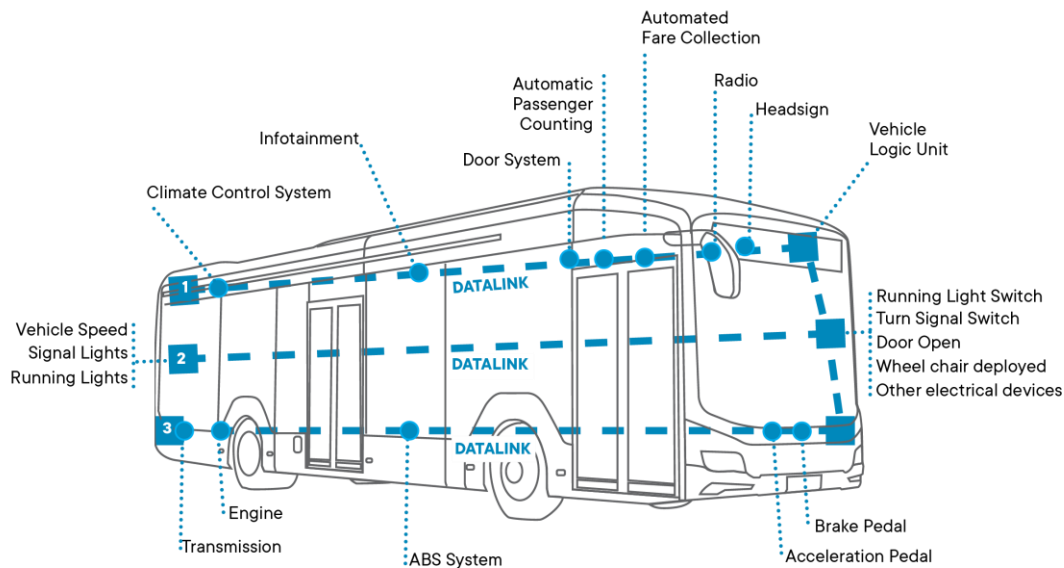
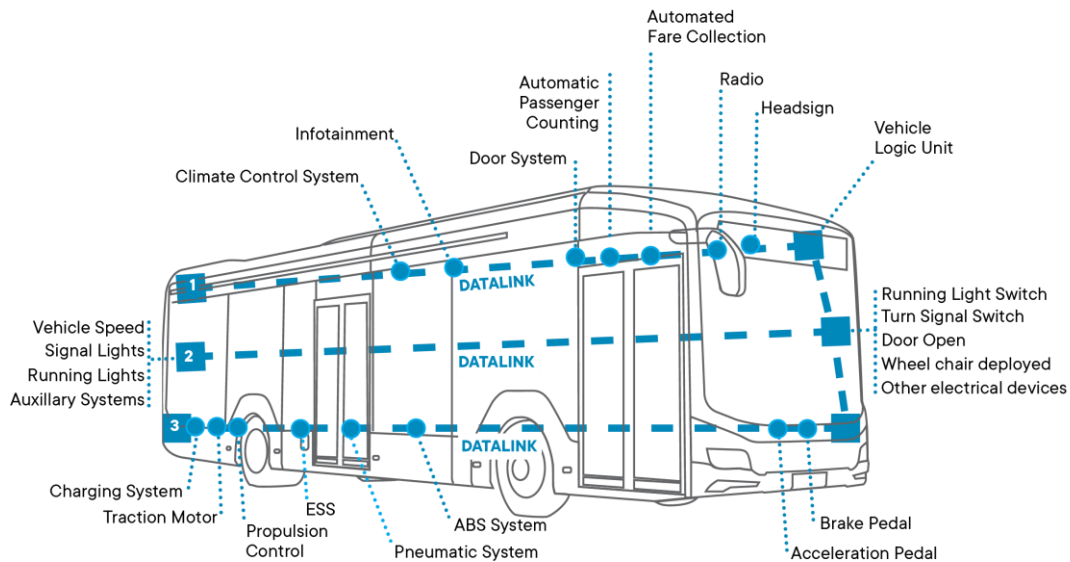


FIGURE 6

Data Communication Systems Levels – Battery Electric Powertrain



Information level systems that require vehicle information for their operations or provide information shall adhere to J1939 data standard.

TS 39.2 Data Communications Systems

Table 6 lists the minimum performance data signals that each system is required to make available to the ITS vehicle logic unit controller for a traditional diesel bus.

The lists represent commonly monitored signals by the vehicle monitoring system. These lists are not to be referred to or be construed as being the only data points required from components at any time, but the minimum data set required in addition to every other data element described within this document. All data, including faults, performance points, and subsystem controller firmware versions, are to be externalized by any onboard computer or component shall be provided to the ITS vehicle logic unit specified. All data must be configured in a nonproprietary format compliant with an industry standard protocol.

TABLE 6
Performance Data Signals

Vehicle Signal Names	
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 vehicle logic unit)
7	Front Door Open – discrete signal
8	Rear Door Open – discrete signal (if there is a center door, this signal should be combined with the rear door)
9	Wheeled mobility device Deployed – discrete signal
10	Stop Request – discrete signal (include wheeled mobility device stop request)
11	Reverse – discrete signal (active high)

Engine Signal Names	
1	All Diagnostic Fault Codes
2	Software Identification
3	Boost Pressure
4	Electrical Potential (Voltage)
5	Engine Average Fuel Economy
6	Engine Coolant Level
7	Engine Coolant Temperature
8	Engine Crankcase Pressure
9	Engine Fuel Rate – High Resolution
10	Engine Idle Shutdown has Shutdown Engine
11	Engine Intake Manifold 1 Temperature
12	Engine Oil Level
13	Engine Oil Pressure
14	Engine Protection System Has Shutdown Engine
15	Engine Shutdown Override Switch
16	Exhaust Gas Temp 1 = DPF Inlet Gas Temp
17	Exhaust Gas Temp 3 = DPF Outlet Gas Temp
18	Particulate Trap Active Regeneration Inhibited Due to Inhibit Switch
19	Particulate Trap Active Regeneration Status
20	Total Vehicle Distance
21	Wheel-Based Vehicle Speed
22	Vehicle Identification Number
23	Particulate Trap Outlet Gas Temperature
24	Unit Number (Power Unit)
25	Trip Distance – High Resolution
26	Maximum Vehicle Speed Limit
27	Intake Manifold Pressure
28	Engine Turbocharger Boost Pressure
29	Engine Trip Fuel – High Resolution
30	Engine Total Idle Hours
31	Engine Total Idle Fuel Used
32	Engine Total Hours of Operation
33	Engine Total Fuel Used – High Resolution signal
34	Engine Speed
35	Component Identification (Engine Serial Number)
36	Engine Exhaust Temperature
37	Catalyst Tank Temperature
38	Catalyst Tank Level
39	Engine Air Inlet Pressure
40	Number of Emergency Stops
41	Software Identification (Calibration Version)
42	Road Speed PGN65265 SPN84 at a consistent 100 ms broadcast rate
43	Calibration Information (DM19)
44	Engine Total Hours of Operation
45	Engine Air Inlet Temperature
46	Engine Serial Number

Transmission Signal Names	
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
Multiplex System Broadcast via J1939 CAN Network Signal Names	
1	Exhaust Regen Off
2	IVN Regen Enable
3	IVN Status
4	Reverse
5	Network Failure – Individual Modules
6	Engine Fuel Filter Clogged
7	Engine Air Filter Clogged
8	ABS Indicator
9	Alternator Charge Indicator
10	Coolant Level (as a percentage 0% to 100%)
11	Low Air Pressure
12	Check Engine
13	Stop Engine
14	Kneeling Active
15	Throttle Malfunction
16	A/C Failure
17	Wheeled mobility device Ramp Deployed – J1939
18	Wheeled mobility device Stop Request
19	Passenger Stop Request (does not include Wheeled mobility device Stop Request) – J1939
20	Fire Suppression System Active
21	Fire Shutdown Engine
22	Software Identification (if applicable)
23	Parking Brake Engaged
24	Air Compressor Status (Duty Cycle)
25	Wheeled mobility device – rate of deployment or system health (for example, amp draw of motor)
26	Charging System Monitor – Low Charge Indicator
27	Front Door Open Signal – J1939
28	Rear Door Open Signal – J1939
29	Wheeled mobility device Cycle Counts
30	Bus Battery Voltage
31	Seat Belt Status (if applicable)
32	Seat Alarm (pressure switch status) – if applicable
33	All Available Diagnostic Fault Codes
34	Air Pressure API (Each Tank Reporting Individually)

ABS System Signal Names	
1	All Diagnostic Fault Codes
2	Road Speed
3	ABS Active
4	Software Identification
5	Wheel Speed PGN65215 SPN904 at a consistent 100 ms broadcast rate
Door Systems Signal Names	
1	Diagnostic Fault Codes
2	Software Identifications
3	Front Door Open
4	Front Door Close
5	Rear Door #1 Open (bus with two or three doors only)
6	Rear Door #1 Close (bus with two or three doors only)
7	Rear Door #2 Open (bus with three doors only)
8	Rear Door #2 Close (bus with three doors only)
Climate Control System Signal Names	
1	All Diagnostic Fault Codes
2	Software Identification
3	Ambient Air Temperature
4	Discharge Air Temperature
5	Discharge Air #2 Temperature (if applicable on artic bus)
6	Return Air Temperature
7	Return Air All Zones Temperature (only apply to artic bus)
8	Water Inlet Temperature
9	Discharge Pressure
10	Suction Pressure
11	Operating Mode
12	Performance Data
13	Configuration File
14	Compressor Clutch Cycles
15	Compressor Hours
Artic Joint System Signal Names (Applies to Articulated Bus Only)	
1	All Diagnostic Fault Codes
2	Software Identification
Vehicle Logic Unit Signal Names	
1	All Diagnostic Fault Codes
2	Software Identification
Electric Vehicle Data Elements Signal Names	
1	All Diagnostic Fault Codes
2	Software Identification

For a battery electric bus, the items listed in **Table 6** which are applicable to an electric vehicle drive system, and the items in **Table 7** are the *minimum* performance data signals that each system is required to make available to the ITS vehicle logic unit controller for a battery electric bus.

The lists represent commonly monitored signals by the vehicle monitoring system. These lists are not to be referred to or be construed as being the only data points required from components at any time, but the minimum data set required in addition to every other data element described within this document. All data, including faults, performance points and subsystem controller firmware versions, are to be externalized by any onboard computer or component and shall be provided to the ITS vehicle logic unit specified. All data must be configured in nonproprietary format compliant with an industry standard protocol.

TABLE 7
Performance Data Signals for Battery Electric Buses

Powertrain System (Traction Motor/Propulsion Control/ESS) Signal Names	
1	Odometer
2	Trip Odometer
3	Vehicle Speed
4	ESS Operational SoC
5	ESS Current
6	ESS Voltage
7	ESS Charging Activity
8	Minimum and Maximum ESS Cell Temperature
9	Minimum and Maximum ESS Cell SoC
10	Minimum and Maximum ESS Cell Voltage
11	ESS Power Discharged
12	Master Run Switch Status
13	Accelerator Pedal Position
14	Brake Pedal Position
15	Parking or Emergency Brake Application
16	J1939 Health and Diagnostic Messages
17	Propulsion and Ancillary Systems Health and Diagnostic Messages
18	Visual/Audible Indications/Alarms
19	Traction Motor Power Input
20	Traction Motor Torque Percentage
21	Traction Motor RPM
22	Propulsion Inverter Power Input
23	Low Propulsion System Coolant Level
24	Regenerative Braking Power Recovered
25	Miles to 0% of Usable SoC
26	SoC per Unit of Distance
27	SoC per Unit of Elapsed Time
28	SoC per X Completed Stops
29	SoC Below X% When Returning to the Garage
30	Idle Time (foot brake applied)
31	Idle Time (parking brake applied)

Charging System Signal Names	
1	Charging system power input
2	Charging system performance
3	Garage charger power Input
4	Opportunity charger power input
5	Time to complete a full charge
Electric Vehicle Pneumatic System Signal Names	
1	Primary Pneumatic System Pressure
2	Secondary Pneumatic System Pressure
3	Auxiliary Pneumatic System Pressure (if applicable).
4	Air Compressor Inverter Power Input
Electric Vehicle HVAC System Signal Names	
1	HVAC Power Input
2	HVAC Status On/Off
3	HVAC Supply Air Temperature
4	HVAC Return Air Temperature
5	HVAC Wattage Consumption
6	HVAC Cabin Temperature Setpoint
7	Outside Air Temperature
8	Front Door Position
9	Exit Door Position
10	Diesel Fuel Fired Heater Fuel Consumption
11	Diesel Fuel Fired Heater Fuel Level
12	Low HVAC Systems Coolant Level
13	Primary HVAC Heat Source Fuel Supply Below X% When Returning to the Garage
Electric Vehicle Auxiliary Systems Signal Names	
1	Wheeled mobility device Ramp Position
2	Hydraulic Pump Inverter Power Input
3	DC to DC Converter Power Input

TS 39.3 Design

The electrical, electronic and data communication systems shall be easily separable from their interconnects by means of connectors.

TS 40 Environmental and Mounting Requirements

All electrical/electronic hardware mounted in the interior of the vehicle shall be resistant to tampering from passengers.

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 protective enclosure. The hardware shall be mounted in such a manner as to protect it from the environment.

The electrical system and its electronic components shall be capable of operating in the area of the vehicle in which they will be installed and comply with the shock and vibration requirements as recommended in SAE J1455, to the extent practical.

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.

The Agency shall follow recommendations from vehicle manufacturers and subsystem suppliers regarding methods to prevent damage from voltage spikes generated from welding, jump-starts, shorts, etc.

All electrical/electronic hardware and its mounting shall comply with the shock and vibration requirements of published industry standards (SAE, ISO, etc.).

TS 41 General Electrical Requirements

TS 41.1 Low-Voltage (Starting, Lighting and Ignition or “SLI”) Batteries

TS 41.1.1 The batteries shall be selected with sufficient cold-cranking amps (CCA) and have enough reserve capacity (RC) based on the small accessory electrical loads when the bus is parked/shut down. In order to maintain the SoC of the 24 VDC batteries during long periods when a bus is parked, a low SoC disconnect system is required. If the SoC drops below a preset value (e.g., 70% SoC), the system will pulse a bistable relay that opens the circuits of the small accessories, thereby isolating the 24 VDC batteries. When the bus driver turns the main switch to “ON,” the relay is pulsed again, reconnecting the 24 VDC batteries to the vehicle loads. Low-Voltage Batteries (24 V)

DEFAULT

Four Group 31 Maintenance-Free Batteries

Four Group 31 Series deep-cycling maintenance-free battery units shall be provided. Each battery shall have a minimum of 700 cold-cranking amps and minimum reserve capacity of 190 minutes at 80 °F. Each battery shall have a purchase date no more than one year from the date of release for shipment to the Agency.

ALTERNATIVE

Two 8D Battery Units

Two 8D battery units conforming to SAE J537 shall be provided. Each battery shall have a minimum of 1150 cold cranking amps. Each battery shall have a purchase date no more than 120 days from the date of release, and shall be fully maintained prior to shipment to the Agency. The battery compartment must be well-ventilated to prevent hydrogen buildup while protecting the compartment from road spray, water intrusion and deicing chemicals.

ALTERNATIVE

Two 8D Maintenance-Free Batteries

Each battery shall have a purchase date no more than 120 days from date of release and shall be fully maintained prior to shipment to the Agency. The battery compartment must be well-ventilated to prevent hydrogen build up while protecting the compartment from road spray, water intrusion and deicing chemicals.

ALTERNATIVE**Capacitor Start System**

A capacitor-based, energy storage starting system shall be provided to assist with starting the bus's engine. The system shall be isolated from the regular battery starting system to prevent the capacitors from draining during regular operation or long periods of downtime. The system shall be provided within a stainless-steel enclosure with the necessary relay and controls for proper functionality regarding discharging and recharging events. The system shall include an integrated PLC module to monitor and control capacitor output, input and diagnostics. This PLC shall provide SAE J1939 CAN bus communication. An LED functional indicator should be external to the stainless enclosure. The system should be passive to the driver, not requiring any extra switches, indicators or procedures for normal operation in starting the bus. The system should not require any modifications to the engine's standard alternator charging system or voltage regulator. The system should be powerful enough to energize the MUX system and start the engine even when the batteries are dead. Warranty on the capacitor module is to be stated at 12 years, 6 years full and 6 years prorated.

ALTERNATIVE**Four Group 31 AGM Batteries**

Four Group 31 Series deep-cycling, sealed, nonspillable, maintenance-free absorbed glass mat (AGM) batteries shall be provided. Each battery shall have a minimum of 1000 CCA at 0 °F. The batteries shall be designed and installed to withstand the operating environment. Each battery shall have a purchase date no more than one year from the date of release for shipment to the Agency.

ALTERNATIVE (BATTERY ELECTRIC)**Two Group 31 AGM Batteries**

Two Group 31 Series deep-cycling, sealed, nonspillable, maintenance-free absorbed glass mat (AGM) batteries shall be provided. Each battery shall have a minimum of 1000 CCA at 0 °F. The batteries shall be designed and installed to withstand the operating environment. Each battery shall have a purchase date no more than one year from the date of release for shipment to the Agency.

ALTERNATIVE (BATTERY ELECTRIC)**Two Appropriately Sized Batteries**

Two appropriately sized deep-cycling, sealed, nonspillable, maintenance-free absorbed glass mat (AGM) batteries shall be provided. The batteries shall be designed and installed to withstand the operating environment. Each battery shall have a purchase date no more than one year from the date of release for shipment to the Agency.

ALTERNATIVE**Two Group 31 AGM Batteries with Ultracapacitors**

Two deep-cycling, sealed, nonspillable, maintenance-free absorbed glass mat (AGM) batteries shall be provided. The batteries will have the appropriate CCA and RC rating for the Agency's operation. Each battery shall have a purchase date no more than one year from the date of release for shipment to the Agency. Ultracapacitors (supercapacitors) shall be used in conjunction with the AGM batteries to provide effective power storage and to ensure successful engine starting. The batteries and ultracapacitors shall be designed and installed to withstand the operating environment. The ultracapacitor system should be powerful enough to energize the MUX system and start the engine even when the batteries are dead.

Ultracapacitor technology is to be used for cranking applications and then employing AGM battery technology to manage auxiliary loads. The ultracapacitor system shall be isolated from the regular battery starting system to prevent the capacitors from draining during regular operation or long periods of downtime. The system should be passive to the driver, not requiring any extra switches, indicators or procedures for normal operation in starting the bus. The system should not require any modifications to the engine's standard alternator charging system or voltage regulator. The ultracapacitor system shall be provided with the necessary controls for proper functionality regarding discharging, recharging events and diagnostics. The ultracapacitor system should provide for an external functional indicator and shall provide SAE J1939 CAN bus communication.

ALTERNATIVE**Four Group 31 AGM Batteries with Ultracapacitors**

Four deep-cycling, sealed, nonspillable, maintenance-free absorbed glass mat (AGM) batteries shall be provided. The batteries will have the appropriate CCA and RC rating for the procuring agency's operation. Each battery shall have a purchase date no more than one year from the date of release for shipment to the Agency. Ultracapacitors (supercapacitors) shall be used in conjunction with the AGM batteries to provide effective power storage and to ensure successful engine starting. The batteries and ultracapacitors shall be designed and installed to withstand the operating environment. The ultracapacitor system should be powerful enough to energize the MUX system and start the engine even when the batteries are dead.

Ultracapacitor technology is to be used for cranking applications and then employing AGM battery technology to manage auxiliary loads. The ultracapacitor system shall be isolated from the regular battery starting system to prevent the capacitors from draining during regular operation or long periods of downtime. The system should be passive to the driver, not requiring any extra switches, indicators or procedures for normal operation in starting the bus. The system should not require any modifications to the engine's standard alternator charging system or voltage regulator. The ultracapacitor system shall be provided with the necessary controls for proper functionality regarding discharging, recharging events and diagnostics. The ultracapacitor system should provide for an external functional indicator and shall provide SAE J1939 CAN bus communication.

ALTERNATIVE

Two 8D maintenance-free batteries with ultracapacitors.

TS 41.1.2 Low-Voltage Battery Cables

The battery terminal ends and cable ends 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, shall be flexible, shall be 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, where applicable, shall be

continuous cables with connections secured by bolted terminals and shall conform to specification requirements of SAE J1127–Type SGR, SGT, SGX or GXL, and SAE J541 as applicable.

DEFAULT

No color code for voltage is required.

ALTERNATIVE

Color-code each voltage.

TS 41.1.3 Jump-Start Connector**DEFAULT**

No requirements for jump-start connector.

ALTERNATIVE**Jump-Start Connector**

A jump-start connector, red for 24 V and blue for 12 V, shall be provided in the engine compartment, equipped with dust cap and adequately protected from moisture, dirt and debris.

ALTERNATIVE**Jump-Start Connector**

A jump-start connector shall be located next to the battery disconnect switch.

TS 41.1.4 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 temperature should not exceed battery manufacturer's specification.

The vehicle shall be equipped with one or more 12 VDC and 24 VDC quick disconnect switches. The battery compartment door shall conveniently accommodate operation of 12 VDC and 24 VDC quick disconnect switch(es). A lockout/tagout means shall be provided to safeguard maintenance from the unexpected startup or power-on high voltage.

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 door shall be flush-fitting and incorporate a spring tensioner or equal to retain the door in a closed position when not in use.

DEFAULT**Non-Locking Access Door**

The access door shall not require any special locking devices to gain access to the switch, and it shall be accessible without removing or lifting the panel.

ALTERNATIVE**Locking Access Door**

The access door shall require an Agency-specified locking device (e.g., square key) to gain access to the switch, and it shall be accessible without removing or lifting the panel.

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, if applicable, shall pull out or swing out easily and properly support the batteries while they are being serviced. The tray shall allow each battery cell to be easily serviced. 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.

TS 41.1.5 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 vented (flooded) lead-acid batteries.

TS 41.1.6 Master Battery Switch

The location of the master battery switch shall be clearly identified on the exterior access panel, be accessible in less than 10 seconds for deactivation, and prevent corrosion from fumes and battery acid when the batteries are washed off or are in normal service.

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

DEFAULT**Single Switch**

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

ALTERNATIVE**Separate Switches**

The batteries shall be equipped with separate switches for disconnecting 12 V and 24 V power.

ALTERNATIVE**Solenoid Battery Cutoff**

A multiplex system activated battery cutoff solenoid to disconnect battery except critical items.

TS 41.1.7 Low-Voltage Generation and Distribution

The low-voltage generating system shall maintain the charge on fully charged batteries within battery supplier's specifications.

Voltage monitoring and overvoltage output protection (recommended at 32 V) shall be provided. Charging profile shall be maintained within battery manufacturer's guidelines or specifications.

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% volt drop across the length of the cable.

TS 41.1.8 Low-Voltage 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. The circuit breaker 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 inline fuses supplied by either the Contractor or a Supplier. Fuse holders shall be constructed to be rugged and shall be rated at appropriate IP rating for location of fuse holder based on manufacturer's recommendations. All manual reset circuit breakers critical to the operation of the bus shall be mounted in a location convenient to the Agency mechanic with visible indication of open circuits. The Contractor shall show all in-line fuses in the final harness drawings.

ALTERNATIVE

The use of automatic reset circuit breakers shall require Agency approval.

Circuit breakers or fuses shall be sized to a minimum of 15% 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 41.2 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 three ring terminal connections shall be made per ground stud with adequate spacing between studs, ensuring conductivity and serviceability. Electronic equipment requiring an isolated ground of the battery (i.e., electronic ground) shall not be grounded through the chassis.

TS 41.3 Low-Voltage and High-Voltage Wiring and Terminals

All power and ground wiring shall conform to specification requirements of SAE J1127, J1128 and J1292, except for the color code of J1292. All high-voltage power and ground wiring shall conform to specification requirements of SAE J1654 and J2910. In the case of conflicts with the requirements below, SAE standards shall apply. Double insulations shall be maintained as close to the junction box, electrical compartment or terminals as possible. The requirement for double insulations shall be met by wrapping the harness with plastic electrical tape or by sheathing all wires and harnesses with nonconductive, rigid or flexible conduit.

The bus shall be manufactured so that high-voltage systems and cabling do not interfere with the operation of low-voltage control systems. To this end, high-voltage cabling and low-voltage control wiring must be separated as far as practicable. Cabling and wiring must be installed damage-free. Additionally, parallel runs of high-voltage cabling and low-voltage control wiring shall be minimized.

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 nonconductive 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 or near high heat sources. 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% (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 the 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 use either different inserts or different insert orientations to prevent incorrect connections.

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 $\frac{1}{16}$ 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.

Ultrasonic and T-splices may be used with 8 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 splices shall be identified by placards or permanent labels in their appropriate location within the harness.

All splicing shall be staggered in the harness so that no two splices are positioned in the same location within the harness.

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 41.4 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 fewer than 40,000 hours (except cranking motors, washer pumps and wiper motors). All electric motors shall be easily accessible for servicing.

TS 41.5 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 according to SAE J1455. 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, the vestibule or the outside. For vehicles with an internal combustion engine, "Rear start and run" controls shall be mounted in an accessible location in the engine compartment and shall be protected from the environment.

TS 41.6 Terminals

DEFAULT

Same Size Terminal Ends

Positive and negative terminal ends shall be the same size.

ALTERNATIVE

Different Size Terminal Ends

Positive and negative terminal ends shall be different sizes.

NOTE TO USER: Agency to specify post size if different sized terminal ends are used.

TS 42 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 overvoltage (over 32 VDC on a 24 VDC nominal voltage rating with a maximum of 60 VDC) 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 be easily accessible and labeled.

TS 42.1 Wiring and Terminals

Kinking, grounding at multiple points, stretching and reducing the bend radius below the manufacturer's recommended minimum shall not be permitted according to SAE J1127. Proper work instructions, including for regular internal audits and calibration of tools, shall be provided.

TS 42.1.1 Discrete I/O (Inputs/Outputs)

All wiring to I/O devices, either at the harness level or individual wires, shall be labeled 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 42.1.2 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 radio frequency applications, have separate shielding techniques that also shall be used as applicable.

NOTE TO USER: *A shield grounded at both ends forms a ground loop, which can cause intermittent loss of 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 42.1.3 Communications

The data network cabling shall be selected and installed according to the selected protocol requirements. The physical layer of all network communications systems shall not be used for any purpose other than communication among the system components, unless provided for in the network specifications.

Communications networks that use power line carriers (e.g., data modulated on a 24 V power line) shall meet the most stringent applicable wiring and terminal specifications.

TS 42.1.4 Radio Frequency (RF)

RF components, such as radios, video devices, cameras, GPS, etc., shall use coaxial cable to carry the signal where applicable. 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 contribute 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 the antenna and cable assembly. The corresponding component vendors shall be consulted for proper application of equipment, including installation of cables.

TS 42.1.5 Audio

Cabling used for microphone level and line level signals shall meet EMC requirements per SAE J1113/1.

TS 43 Multiplexing

TS 43.1 General

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.

DEFAULT

10% of the total number of inputs and outputs, or at least one each for each voltage type utilized (0 V, 12 V, 24 V) at each module location shall be designated as spares.

ALTERNATIVE

No spares shall be designated.

TS 43.2 System Configuration

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 43.2.1 I/O Signals

The input/output for the multiplex system may contain four types of electrical signals: discrete, modulating, analogue and 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 to 12 V, 10 to 24 V, etc.) or current signal (4 to 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 onboard components.

TS 44 Data Communications**TS 44.1 General**

All data communications 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 Agency 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 level 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.
- Data communication initialization and after run time for components after the MRS is turned on or off—what the standard is and how the OEM defines it.

Any electronic vehicle components used on a network shall be conformance tested to the corresponding network standard.

TS 44.2 Drivetrain Level

Drivetrain components, consisting of the motor(s), motor inverter(s), engine, transmission, retarder, antilock 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. At a minimum, drivetrain components shall be powered by a dedicated and isolated ignition supply voltage to ensure that data communication among components exists when the vehicle ignition is switched to the “on” position.

TS 44.2.1 Diagnostics, Fault Detection and Data Access

Drivetrain performance, maintenance and diagnostic data, and other electronic messages shall be formatted and transmitted on the communication 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 44.2.2 Programmability (Software)

The drivetrain-level components shall be programmable by the Agency with limitations as specified by the subsystem Supplier.

TS 44.3 Multiplex Level

TS 44.3.1 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 communication system are options if requested by the Agency. The communication port(s) shall be located as specified by the Agency.

TS 44.3.2 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 onboard 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.

ALTERNATIVE

[Agency to specify remote diagnostics and fault detection for subcomponents of the vehicle where applicable.]

TS 44.3.3 Programmability (Software)

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, laptop or portable device. 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 display the most recent revision number
- a method of determining which version of the software is currently in use in the multiplex system

DEFAULT

Revision control labels shall be electronic.

ALTERNATIVE

Revision control labels shall be physically located near the programming port.

TS 44.4 Electromagnetic Compatibility (EMC)

Electrical and electronic subsystems and components on all buses shall not emit electromagnetic radiation that will interfere with onboard systems, components or equipment, telephone service, radio or TV reception, or violate regulations of the Federal Communications Commission.

Electrical and electronic subsystems 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.

As a recommendation, no vehicle component shall generate or be affected by RFI/EMI that can disturb the performance of electrical/electronic equipment as defined in CAN/CSA-CISPR 12-10, SAE J1113, SAE J1455 or UNECE Council Directive 95/54 (R10).

TS 45 Driver's Area Controls**TS 45.1 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 customer requirements and Manufacturer input. Switches and controls shall be essentially within the hand reach envelope of a 95th-percentile male and 5th-percentile female.

TS 45.2 Glare

The driver's work area shall be designed to minimize glare to the extent possible. The driver's work area includes all forward areas that reflect lighted objects to show reflection in windshield, as well as side window and door glass. 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 objects include dash panels, switches and controls, cowlings, windshield wipers and arms, barriers and modesty panels, fare stanchions, access panels and doors, fasteners, flooring, ventilation and heating ducting, window and door frames, and visors. Interior lighting located ahead of the standee line shall be controllable by the driver. Transit vehicle manufacturers shall make every effort to reduce glare and shall provide a plan response for how they mitigate glare on reflective materials to be reviewed by the Agency.

TS 45.3 Visors/Sun Shades

DEFAULT

Front and Side Sun Shade/Visor

Full-width adjustable sun visors 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 able to be made easily by the operator. Sun visor construction and materials shall be strong enough to resist breakage during adjustments. Visors shall be opaque, and when deployed, shall be adjustable downward to plain at the elevation of a 5th-percentile female seated eye height.

TS 45.4 Driver's Controls

Frequently used controls must be in easily accessible locations. These include the door control, kneel control, windshield wiper/washer controls, ramp, and lift and run switch. Any switches and controls necessary for the safe operation while underway shall be conveniently located and shall be tactilely identifiable or illuminated. for ease of night time operation to the extent possible.

All panel-mounted switches and controls shall be easily identifiable. Graphic symbols shall conform to SAE 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.

TS 45.5 Normal Bus Operation Instrumentation and Controls

Table 8 identifies common controls and indicators used to operate the bus. This table is for reference only and is not meant to be all inclusive. Controls shall be placed as conveniently as possible based on frequency of use and operator ergonomic considerations.

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. All indicators shall have a method of momentarily testing their operation. The audible alarm shall be tamper-resistant and shall have an outlet level between 80 and 83 dBA when measured at the location of the operator's ear.

Onboard 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.

All switches and controls shown in **Table 8** shall be placed based on frequency of use and ergonomic considerations.

TABLE 8.1 (Transit Coach)
Transit Bus Instruments and Alarms

Device	Function	Visual/Audible
Master run switch	Master control for bus, off, day run, night run and clearance ID lights	
System start, front	Activates vehicle systems	
System start, rear	Activates vehicle systems	
System run, rear	Permits activating vehicle system from rear start, normal front run position and off	Amber light
Drive selector	Provides selection of propulsion: forward, reverse and neutral	Gear selection
HVAC	Permits selection of passenger ventilation: off, cool, heat, low fan, high fan, or full auto with on/off only	
Driver's ventilation	Permits supplemental ventilation: fan off, low or high	
Defroster fan	Permits defroster: fan off, low, medium or high	
Defroster temperature	Adjusts defroster water flow and temperature	
Windshield wiper	Variable speed control of left and right windshield wipers	
Windshield washer	Activates windshield washers	
Dash panel lights	Provides adjustment for light intensity in night run position	
Interior lights	Selects mode of passenger compartment lighting	
WC ramp/kneel enable	Permits operation of ramp and kneel operations at each door remote panel	Amber light
Front door ramp/kneel enable	Permits ramp and kneel activation from front door area, key required ¹	Amber light
Front door ramp	Permits deploy and stow of front ramp	Red light
Front kneel	Permits kneeling activation and raise and normal at front door remote location	Amber or red dash indicator exterior alarm and amber light
Rear door ramp/kneel enable	Permits ramp and kneel activation from rear door area; key required ¹	Red light
Rear door ramp	Permits deploy and stow of rear ramp	
Rear kneel	Permits kneeling activation and raise and normal at rear door remote location	
Silent alarm	Activates emergency radio alarm at dispatch and permits covert microphone and/or enables destination sign emergency message	
Video system event switch	Triggers event equipment and event light on dash	Amber light
Left remote mirror	Permits two-axis adjustment of left exterior mirror	
Right remote mirror	Permits two-axis adjustment of right exterior mirror	
Mirror heater	Permits heating of outside mirrors when required	
Passenger door control	Permits open/close control of front and rear passenger doors	Red light
Rear door override	Allows driver to override activation of rear door	
System shutdown override	Permits driver to override auto system shutdown	

TABLE 8.1 (Transit Coach)
Transit Bus Instruments and Alarms

Device	Function	Visual/Audible
Hazard flashers	Activates emergency flashers	Two green lights
Fire suppression	Permits driver to override and manually discharge fire suppression system	Red light
Mobile data terminal	Facilitates driver interaction with communication system and master log-on	LCD display with visual status and text messages
Farebox interface	Facilitates driver interaction with farebox system	LCD display
Destination sign interface	Facilitates driver interaction with destination sign system, manual entry	LCD display
Turn signals	Activates left and right turn signals	Two green lights and optional audible indicator
PA manual	Permits driver to manually activate public address microphone	
Low-profile microphone	Permits driver to make announcements with both hands on the wheel and focusing on road conditions	
High beam	Permits driver to toggle between low and high beam	Blue light
Parking brake	Permits driver to apply and release parking brake	Red light
Hill holder	Applies brakes to prevent bus from rolling	
Master door/interlock	Permits driver override to disable door and brake/throttle interlock	Red light
Warning interlocks deactivated	Illuminates to warn driver that interlocks have been deactivated	Red light
Retarder disable	Permits driver override to disable brake retardation/regeneration	Red light
Rear door passenger sensor disable	Permits driver to override rear door passenger sensing system	
Indicator/alarm test button	Permits driver to activate test of sentry, indicators and audible alarms	All visuals and audibles
Auxiliary power	Property to specify what function to supply	
Speedometer	Visual indication of speed and distance traveled, accumulated vehicle mileage, fault condition display	Visual
Air pressure gauge	Visual indication of primary and secondary air systems	Visual
Fire detection	Indication of fire detection activation by zone/location	Buzzer and red light
Door obstruction	Indication of rear door sensitive edge activation	Red light and buzzer
Door ajar	Indication of rear door not properly closed	Buzzer or alarm and red light
Low system air pressure	Indication of low air system pressure	Buzzer and red light
System coolant indicator	Detects low coolant condition	Amber light
Hot system indicator	Detects system overheat condition and initiates time delay shutdown	Red light
ABS indicator	Displays system failure	Amber light
HVAC indicator	Displays system failure	Amber or red light

TABLE 8.1 (Transit Coach)
Transit Bus Instruments and Alarms

Device	Function	Visual/Audible
LV charging system indicator (12/24 V)	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
Bike rack deployed indicator	Indicates bike rack not being in fully stowed position	Amber or red light
HV charging system indicator (ESS)	Indicates when bus is connected to off-board charger and ESS is accepting charge	Visual
State of charge indicator	Indicates usable SoC of ESS	Visual
Low fuel indicator	Indicates low fuel level	Visual
Low DEF indicator	Indicates low DEF level	Visual
Turntable (articulated buses only)	Warning indication for hinge locking	Audible and amber warning and red light if locked
Turntable (articulated buses only)	Momentarily release interlock brakes due to overangled condition	

1. Indicate area by drawing. Break up switch control from indicator lights.

TABLE 8.2 (Alternative, Transit Coach)
Transit Bus Instruments and Alarms

Device	Description	Location	Function	Visual/ Audible
[Contractor to provide]				

TS 45.6 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 45.6.1 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 deg at the point of initiation of contact and extend downward to an angle of 10 to 27 deg 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 45.6.2 Pedal Dimensions and Position

The floor-mounted accelerator pedal shall be 9 to 12 in. long and 3 to 4 in. wide. Clearance around the pedal must allow for no interference precluding operation.

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 45.7 Brake and Accelerator Pedals

DEFAULT

Brake Pedal

Non-adjustable brake pedal.

ALTERNATIVE

Adjustable Brake and Accelerator Pedals

Both pedals shall be adjustable forward and rearward a minimum of 3 in. The adjustment shall be made by use of a toggle or rocker switch. Location of the rocker switch shall be approved by the Agency. The switch shall be clearly labeled to identify it as pedal adjustment and shall be within easy reach of the driver. Pedal adjustment shall be enabled only when the bus is stationary and the parking brake engaged.

TS 45.8 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 deg and a maximum of 37 deg. It shall be located no closer to the seat front than the heel point of the accelerator pedal.

DEFAULT

Turn Signal Controls

Turn signal controls shall be floor-mounted, foot-controlled, water-resistant, heavy-duty, momentary contact switches.

ALTERNATIVE

Turn Signal Controls

Adjustable turn signal platform.

DEFAULT

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. All other signals, including high beam and public address system, shall be in approved locations.

The foot switches shall be UL-listed, heavy-duty type, of a rugged, corrosion-resistant metal construction. The foot switches for the directional signals shall be momentary type, while those for the PA system and the high beam shall be latching type. The spacing of the switches shall be such that inadvertent simultaneous deflection of switches is prevented.

ALTERNATIVE**Other Floor-Mounted Controls**

The following may be floor-mounted, momentary or latching, as identified by the Agency:

- hazard
- silent alarm
- PA system

ALTERNATIVE

Steering column mounted (self-canceling).

TS 46 Driver's Amenities**TS 46.1 Coat Hanger****DEFAULT****Coat Hanger**

A suitable hanger shall be installed in a convenient location for the driver's coat.

ALTERNATIVE**Coat Hook**

A hook and loop shall be provided to secure the driver's coat.

TS 46.2 Drink Holder**DEFAULT**

No drink holder.

ALTERNATIVE**Drink Holder**

A device shall be provided to securely hold the driver's drink container, which may vary widely in diameter. It must be mounted within easy reach of the driver and must have sufficient vertical clearance for easy removal of the container. When the container is in the device, the driver's view of the road must not be obstructed, and leakage from the container must not fall on any switches, gauges or controls. A cup holder shall not be mounted in a location that, if a spill were to occur, damage to electrical and/or mechanical components would be imminent.

TS 46.3 Storage Box**DEFAULT****Storage Box**

An enclosed driver storage area shall be provided with a positive latching door and/or lock.

ALTERNATIVE

No storage box.

TS 47 Windshield Wipers and Washers**TS 47.1 Windshield Wipers**

The bus shall be equipped with a windshield wiper for each half of the windshield and shall comply with FMVSS 104. 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 fasteners that secure any of the wiper system serviceable components shall be corrosion-resistant.

DEFAULT

Single-control, electric two-speed intermittent wiper.

ALTERNATIVE**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 5 and 25 cycles per minute.

ALTERNATIVE

Multiple wiper systems and controls.

ALTERNATIVE**Non-Synchronized Wipers**

For non-synchronized wipers, separate controls for each side shall be supplied.

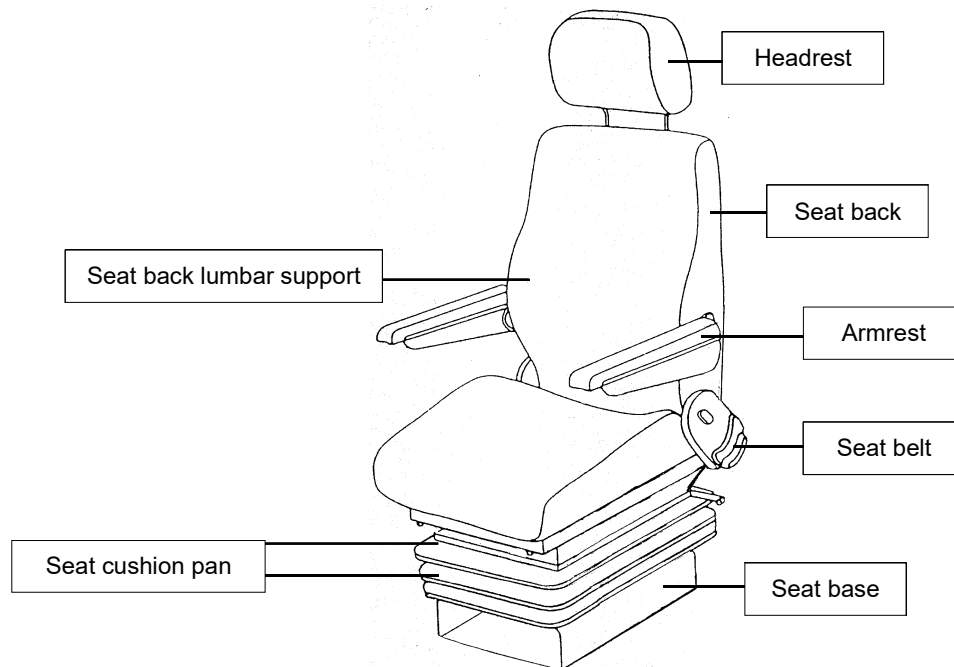
TS 47.2 Windshield Washers

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 gal reservoir, located for easy refilling from outside the bus. Reservoir pumps, lines and fittings shall be corrosion-resistant and must include a means to determine fluid level.

TS 48 Driver's Seat

FIGURE 7
Driver's Seat



TS 48.1 Dimensions

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, based on Hybrid III ADT MIL-STD-1472E.

TS 48.1.1 Seat Cushion Pan 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.

ALTERNATIVE

[Specify minimum and maximum seat cushion pan length.]

TS 48.1.2 Seat Height Adjustment

DEFAULT

Dimensions

Suspension adjustment minimum of 6 in. of height adjustment.

ALTERNATIVE

H-Point

The reference point for seat height shall be determined by establishing the H-point (hip point).

TS 48.1.3 Seat Pan Cushion Slope

The cushion should have an upward angle of at least 12 deg and cannot have a downward angle less than –5 deg.

TS 48.1.4 Seat Base Fore/Aft Adjustment

Seat shall have minimum of 9 in. of fore/aft travel. Seat shall be conformed and installed to accommodate people ranging in size from a 95th-percentile male to a 5th-percentile female to allow easy access to the operator's station. Seat shall be supplied with seat locking tracks with positive latching.

ALTERNATIVE

Minimum fore/aft travel of 11 in.

ALTERNATIVE

Assisted release.

TS 48.1.5 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 48.1.6 Seat Suspension

The driver's seat shall be appropriately dampened to support a minimum weight of 380 lb. The suspension shall be capable of dampening in both directions in the Z axis.

Rubber bumpers shall be provided to prevent metal-to-metal contact.

Seat suspension shall have a manually adjustable suspension.

ALTERNATIVE

Seat shall have an active or semi-active suspension.

TS 48.1.7 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.

TS 48.1.8 Headrests

DEFAULT

Adjustable headrest.

ALTERNATIVE

Integrated headrest.

TS 48.1.9 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 or functional equivalent to fit people ranging from the 5th percentile female to 95th percentile male.

TS 48.1.10 Seat Back Angle Adjustment

The seat back angle shall be measured relative to a level seat pan, where 90 deg is the upright position and 90 deg-plus represents the amount of recline.

The seat back shall adjust in angle from a minimum of no more than 90 deg (upright) to at least 105 deg (reclined), with infinite adjustment in between.

TS 48.2 Seat Belt

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 seatbelt assemblies as installed in the bus shall withstand static horizontal forces as required in FMVSS sections 207, 209 and 210.

DEFAULT

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. Three-point seatbelts must be emergency locking retractor in design.

ALTERNATIVE

Lap Belt Only

Lap belt shall be provided.

ALTERNATIVE

Adjustable-height D-ring.

ALTERNATIVE

All seatbelt assemblies shall come equipped with a warning switch device to remind operators to buckle up.

ALTERNATIVE

Three Point Seatbelt

Include a seatbelt presenter.

DEFAULT

Seatbelt webbing shall be black in color.

ALTERNATIVE

Seatbelt webbing shall be orange in color.

TS 48.2.1 Lap Belt Length**DEFAULT**

The lap belt assembly shall be a minimum of 72 in. in length.

ALTERNATIVE**Extension**

Add 8 in. extension.

TS 48.3 Adjustable Armrest**DEFAULT**

No armrests.

ALTERNATIVE

One armrest, right side.

ALTERNATIVE

One armrest, left side.

ALTERNATIVE

Two armrests.

TS 48.4 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 48.5 Seat Structure and Materials**Cushions**

Cushions shall be fully padded with at least 3 in. of materials in the seating areas at the bottom and back.

Cushion Materials**DEFAULT**

Open-cell polyurethane (FMVSS 302).

ALTERNATIVE

Foam and fabric that meets FTA Docket 90A.

TS 48.6 Pedestal

DEFAULT

Powder-coated steel.

ALTERNATIVE

Stainless steel.

TS 48.7 Seat Options

Choose among the following:

- heated seat
- occupant seat sensor
- fabric options
- seat air ventilation/cooling
- side bolsters adjustments
- Docket 90–compliant silicone foam cushion
- removable seat cushions for maintenance exchangeability

TS 48.8 Mirrors

TS 48.8.1 Exterior Mirrors

The bus shall be equipped with corrosion-resistant, outside rearview mirrors mounted with stable supports to minimize vibration. Mirrors shall be firmly attached to the bus to minimize vibration and to prevent loss of adjustment. Mirrors shall permit the driver to view the roadway along the sides of the bus, including the rear wheels. Mirrors should be positioned to prevent blind spots. Mirrors shall be mounted to allow the head and shoulders of a 95th-percentile male/5th-percentile female to be unobstructed.

Mirrors shall comply with FMVSS 111.

Mirrors shall retract or fold sufficiently to allow bus-washing operations but avoid contact with glazing or bus body.

DEFAULT

Exterior mirrors shall be installed without a breakaway mounting system.

ALTERNATIVE

Heated mirrors.

ALTERNATIVE

Remote-controlled mirrors.

ALTERNATIVE

Exterior mirrors shall be installed with a breakaway mounting system with a spring-loaded auto-return feature.

ALTERNATIVE

Spring-loaded mirror heads auto-return.

DEFAULT**Flat Mirrors on Both Sides**

The bus shall be equipped with two flat outside mirrors, each with not less than 50 in.² 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.

ALTERNATIVE

Combination of flat and convex mirrors referred to as transit-specific.

ALTERNATIVE**A-Pillar Camera**

A monitor shall be mounted on the A-pillar to allow seamless view through the A-pillar obstruction. The system shall utilize a forward-facing camera to capture a view of what is blocked by the A-pillar. The video shall be cut and stitched to ensure a seamless visual view of the windshield looking toward the side window.

ALTERNATIVE**Combination of Mirrors and CCTV Cameras**

The bus shall be equipped with a combination of mirrors and CCTV cameras. [The configuration will be Agency-specific.]

Curbside Mirrors

The curbside rearview mirror shall be mounted so that its lower edge is no less than 76 in. above the street surface. A lower mount may be required due to mirror configuration requests.

DEFAULT**Remote Adjustment of Curbside Mirror**

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.

ALTERNATIVE

Standard mirror, not heated, no remote adjustment.

ALTERNATIVE**Heated and Remote Mirrors**

The heaters shall be energized whenever the driver's heater and/or defroster is activated, or can be activated independently.

ALTERNATIVE

Add blind spot detection indicator.

Street-Side Mirrors**DEFAULT**

Standard mirror, not heated, no remote adjustment.

ALTERNATIVE**Remote Adjustment of Street-Side Mirror**

The driver shall be able to adjust the street-side mirror remotely while seated in the driving position. The control for remote positioning of the mirror shall be a single switch or device. The remote switch shall be a membrane-protected switch to mitigate moisture intrusion. Switch shall be IP66 rated.

ALTERNATIVE**Heated Street-Side Mirrors**

The street-side mirrors shall have heaters that energize whenever the driver's heater and/or defroster is activated, or can be activated independently.

ALTERNATIVE

Add blind spot detection indicator.

ALTERNATIVE

Mirrors with integrated turn signal imbedded in the glass.

ALTERNATIVE

Mirrors with external mounted turn signal on the exterior mirror housing.

TS 48.8.2 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 (if applicable), anywhere in the aisle, and in the rear seats.

ALTERNATIVE

Include embedded monitor behind the mirror glass to display multiple camera feeds. Mirror shall have full-size reflectivity with a smaller screen that is activated by a bus input (like a backup camera, or interior or exterior camera view to be displayed by a temporary bus input).

WINDOWS

TS 49 General

[Use with 30 ft length] A minimum of 6000 in.² of window area, including operator and door windows, shall be required on each side of the standard configuration bus.

[Use with 35 ft length] A minimum of 8000 in.² of window area, including operator and door windows, shall be required on each side of the standard configuration bus.

[Use with 40 ft length] A minimum of 10,000 in.² of window area, including operator and door windows, shall be required on each side of the standard configuration bus.

[Use with 45 ft length] A minimum of 12,000 in.² 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 in.² of window area, including operator and door windows, shall be required on each side of the standard configuration bus.

TS 50 Windshield

The windshield shall permit an operator's field of view as referenced in SAE J1050. The vertically upward view shall be a minimum of 14 deg, 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 deg above the line of sight. Any binocular obscuration due to a center divider may be ignored when determining the 90 deg requirement, provided that the divider does not exceed a 3 deg angle in the operator's field of view. Windshield pillars shall not exceed 10 deg of binocular obscuration. The windshield shall be designed and installed to minimize internal and external glare and reflections.

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.

ALTERNATIVE

Bonded windshields provided where available.

TS 50.1 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 AS-1 and the recommended practices defined in SAE J673.

DEFAULT

Shaded Band

The upper portion of the windshield above the driver's field of view shall have a dark, shaded band and marked AS-3, with a minimum luminous transmittance of 5% when tested in accordance to ASTM D1003.

ALTERNATIVE

Partial band required to allow view for camera and mirror viewing.

ALTERNATIVE

No band required.

DEFAULT

Two-piece windshield.

ALTERNATIVE

One-piece windshield.

ALTERNATIVE**Heated Glass Windshield**

Electrical defrosting of the windshield shall be provided and coordinated with the heater/defroster systems required in “Controls for the Climate Control System” and “Driver’s Compartment Requirements.”

TS 51 Glare

The windshield, operator-side window and door glass shall be designed to minimize glare to the extent possible. This includes all forward areas that reflect lighted objects to show reflection in the windshield, as well as side window and door glass. Transit vehicle manufacturers shall make every effort to reduce glare and shall provide a plan response for how they mitigate glare on reflective materials to be reviewed by the Agency.

TS 52 Driver’s-Side Window

The driver’s-side window shall be the sliding type, requiring only the rear half of the sash to latch upon closing, and shall open sufficiently to permit the seated operator to easily access and/or 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 be easily replaceable. The glazing material shall have a single-density tint.

The driver’s view, perpendicular through the 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.

DEFAULT

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 AS-2 and the recommended practices defined in SAE J673.

ALTERNATIVE

The driver’s-side window glazing material shall have a ¼ in. nominal thickness tempered safety glass conforming to the requirements of ANSI Z26.1-1996 Test Grouping AS-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% 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% light transmittance.

DEFAULT

Standard Driver's-Side Window, Traditional Frame

[Choose from the following options:

- **full slider**
- **egress**
- **non-egress]**

ALTERNATIVE

Hidden Frame (Flush) Driver's-Side Window

[Choose from the following options:

- **full slider**
- **egress**
- **non-egress]**

ALTERNATIVE

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 53 Side Windows

TS 53.1 Configuration

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.

TS 53.2 Emergency Exit (Egress) Configuration

DEFAULT

Minimum Egress

All side windows shall be fixed in position, except as necessary to meet the emergency escape requirements.

ALTERNATIVE

Maximum Egress

Every window shall be capable of being made an egress window to be determined by the Transit vehicle manufacturer.

TS 53.3 Configuration

DEFAULT

Standard Passenger Side Window Configurations

[Choose from the following options:

- traditional frame
 - full fixed
 - openable windows with inward-opening transom panels
 - openable windows with sliding transom panels
 - openable windows with a fixed transom panel and sliding lower panels
- hidden frame (flush)
 - full fixed
 - openable windows with inward-opening transom panels]

ALTERNATIVE

Quick Change Passenger Side Windows.

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.

TS 53.4 Materials

DEFAULT

Safety Glass Glazing Panels

Side windows glazing material shall have a minimum of $\frac{3}{16}$ in. nominal thickness tempered safety glass. The material shall conform to the requirements of ANSI Z26.1-1996 Test Grouping 2 and the recommended practices defined in SAE J673.

ALTERNATIVE

Polycarbonate Glazing Panels

Side window glazing material shall have a minimum $\frac{3}{16}$ 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% hazing and 500 cycles with less than 12% hazing. Windows shall be polycarbonate sheet with an abrasion-resistant coating on both sides of the window.

ALTERNATIVE

Acrylic Glazing Panels

Side window glazing material shall have a minimum of $\frac{3}{16}$ 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% hazing and 500 cycles with less than 12% hazing. Windows shall be cell cast acrylic sheet with an abrasion-resistant coating on both sides of the window.

ALTERNATIVE**Laminated Glazing Panels; Not Available on Hidden Frame (Seamless) Windows**

Side windows glazing material shall have a minimum of $\frac{3}{16}$ in. nominal thickness laminated safety glass. The material shall conform to applicable requirements of ANSI Z26.1-1996 and the recommended practices defined in SAE J673.

ALTERNATIVE**Laminated and Tempered Safety Glazing with Anti-Vandalism Polyester Sacrificial Film**

All glazing material that is aft of the standee line shall be equipped with 6 mm laminated polyester film. Material shall be easily installed and removed without the use of specialized tools. Polyester film shall adhere to the window and be resistant to peeling, curling and discoloration by ultraviolet rays. The film shall withstand normal cleaning operations.

ALTERNATIVE**Anti-Vandalism Sacrificial Liner ("Quick Change")**

All glazing material aft of the standee line shall be equipped with necessary bracketry, fasteners and clear acrylic liner that shall be easily removable in the event of vandalism. The acrylic liner shall be clear and shall have minimal effect on the transmittance of the underlying glazing. This material shall not be adversely affected by ultraviolet rays and shall withstand normal cleaning practices. The installation of the liner shall prevent clouding or fogging. This acrylic sacrificial liner must be replaced without removing the window from its installed position on the bus, without removing the tempered glazing from the sash, and without the removal or manipulation of the window assembly's rubber molding.

DEFAULT

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%, as measured by ASTM E424. Luminous transmittance shall be measured by ASTM D1003. Windows over the destination signs shall not be tinted.

ALTERNATIVE

All side and door windows shall be heat-rejecting glass with a solar heat gain coefficient (SHGC) of no greater than 40% and a visible light transmission of no less than 72%. Lower light transmission may be considered if SHGC values of less than 40% can be attained.

ALTERNATIVE

[Specify percentages.]

ALTERNATIVE**Anti-Vandalism Polyester Sacrificial Film**

All glazing material that is aft of the standee line shall be equipped with 6 mm laminated polyester film. This material shall be easily installed and removed without the use of specialized tools. Polyester film shall adhere to the window and be resistant to peeling, curling and discoloration by ultraviolet rays. The film shall withstand normal cleaning operations.

ALTERNATIVE

Multilayer film to be available.

ALTERNATIVE**Anti-Vandalism Sacrificial Liner (“Storm Window Type”)**

All glazing material aft of the standee line shall be equipped with necessary bracketry, fasteners and clear acrylic liner that shall be easily removable in the event of vandalism. The acrylic material shall be clear and shall have minimal effect on the transmittance of the underlying glazing. This material shall not be adversely affected by ultraviolet rays and shall withstand normal cleaning practices. The installation of the liner shall prevent clouding or fogging. A mechanic shall be able to easily remove and replace the acrylic liner without the use of any specialized tools in five minutes or less.

NOTE TO USER: All glass treatments must be permanent, within the glass and/or in the center membrane. Surface films are not permitted.

SHGC and light transmission performance shall be defined by the National Fenestration Rating Council.

TS 53.5 Rear Window**DEFAULT**

No requirement for rear window.

NOTE TO USER: A requirement for a rear-mounted HVAC unit will preclude a rear window.

ALTERNATIVE**Rear Window Requirement**

A rear window shall be provided. The rear window shall be glazed with the 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.

TS 54 HVAC 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.

DEFAULT

HVAC equipped. See below for configuration.

ALTERNATIVE**No Requirements for Cooling**

All requirements relevant to the HVAC cooling mode contained in this section, as well as throughout this specification, need not apply. All other requirements for heating and ventilation still apply.

DEFAULT**Allow Either Roof- or Rear-Mounted HVAC Unit**

The HVAC unit may be either roof- or rear-mounted. Note that a rear-mounted unit will preclude a rear window and that the term “roof-mounted unit” includes units mounted on top of or beneath the roof surface.

ALTERNATIVE (TRANSIT COACH)**Require Roof-Mounted HVAC Unit**

The HVAC unit shall be roof-mounted.

***NOTE TO USER:** This includes units mounted on top of or beneath the roof surface.*

ALTERNATIVE**Require Rear-Mounted HVAC Unit**

The HVAC unit shall be rear-mounted.

ALTERNATIVE**Require Underfloor HVAC Unit**

The HVAC unit shall be mounted under the floor.

ALTERNATIVE (ARTICULATED BUSES)

Require roof- and rear-mounted HVAC unit (articulated buses).

ALTERNATIVE (ARTICULATED BUSES)

Require roof-mounted HVAC units in both bus sections (articulated buses).

ALTERNATIVE (HYBRID OR BATTERY ELECTRIC)

AC or DC electrically driven air conditioning system with hermetic or semi-hermetic compressor(s), condenser fan and evaporator blower motors.

ALTERNATIVE (DIESEL OR CNG)

AC or DC electrically driven air conditioning system with hermetic or semi-hermetic AC compressor(s), condenser fan, evaporator blower motors and brushless AC generators.

ALTERNATIVE**AC Shore Power or Charging Station Connection**

Accessibility and serviceability of preventative maintenance components shall be provided, minimizing the maintenance personnel needed to work on the roof of the bus.

ALTERNATIVE**Heat Pump System**

The HVAC system shall be able to function as a heat pump system when needed.

With the bus running at the design operating profile with corresponding door opening cycle, and carrying a number of passengers equal to 150% of the seated load, the HVAC system shall control the average passenger compartment temperature within a range between 65 and 80 °F, while maintaining the relative humidity to a value of 50% 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%.

When the bus is operated in outside ambient temperatures of 95 to 115 °F, the interior temperature of the bus shall be permitted to rise 0.5 °F for each degree of exterior temperature in excess of 95 °F.

When the 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.

***NOTE TO USER:** 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.*

Additional testing shall be performed as necessary to ensure compliance to performance requirements stated herein.

ALTERNATIVE**R134a**

The air conditioning system shall meet these performance requirements using R134a.

ALTERNATIVE**R407C**

The air conditioning system shall meet these performance requirements using R407C.

ALTERNATIVE**Other**

[Specify how the air conditioning system shall meet these performance requirements and type of refrigerant.]

TS 54.1 Pull-Down/Pull-Up Test Requirements

The requirements of this section shall be subject to APTA BTS-HVAC-RP-003-04, “Transit Bus HVAC System Instrumentation and Performance Testing.”

DEFAULT (DIESEL AND CNG)**Pull-Down Test Capacity and Performance Requirements**

The air-conditioning portion of the HVAC system shall be capable of reducing the passenger compartment temperature from 115 to 95 °F in less than 20 minutes after engine startup. Engine temperature shall be within the normal operating range at the time of startup of the cooldown test, and the engine speed shall be limited to fast idle, which may be activated by a driver-controlled device. During the cooldown 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.

ALTERNATIVE (BATTERY ELECTRIC BUS)**Pull-Down Test 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 system startup in a 100 °F ambient temperature. During the cooldown 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 APTA BTS-HVAC-RP-003-04, "Transit Bus HVAC System Instrumentation and Performance Testing," representing 4 p.m. on August 21, shall be used. There shall be no passengers on board, and the doors, windows and fresh air openings shall be closed.

ALTERNATIVE**Pull-Down Test for Hotter Ambient Conditions (Engine-Driven Compressors)**

The air conditioning portion of the HVAC system shall be capable of reducing the passenger compartment temperature from 110 to 70 °F, ± 3 °F, in less than 30 minutes after system engagement, using R407C, for 30, 35, 40 and 60 ft buses. Engine temperature shall be within the normal operating range at the time of startup of the cooldown test, and the engine speed shall be limited to fast idle at three-quarters maximum governed speed that may be activated by a driver-controlled device. During the cooldown 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. No simulated solar load shall be used. There shall be no passengers on board, and the doors and windows shall be closed.

ALTERNATIVE**Pull-Down Test for Hotter Ambient Conditions (Electric Compressors)**

The air conditioning portion of the HVAC system shall be capable of reducing the passenger compartment temperature to 110 to 80° F, ± 3 °F, in less than 30 minutes for 30, 35, 40 and 60 ft buses. During the cooldown 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. No simulated solar load shall be used. There shall be no passengers on board, and the doors and windows shall be closed.

NOTE TO USER: Refrigerant selection may impact pull-down performance.

ALTERNATIVE**Pull-Up Test for Moderate Ambient Conditions**

The pull-up requirements for the heating system shall be in accordance with Section 10.1 of APTA BTS-HVAC-RP-003-04, "Transit Bus HVAC System Instrumentation and Performance Testing." 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, ± 2 °F, within 70 minutes.

ALTERNATIVE**Pull-Up Test for Colder Ambient Conditions**

The pull-up requirements for the heating system shall be in accordance with Section 10.1 of APTA BTS-HVAC-RP-003-04, "Transit Bus HVAC System Instrumentation and Performance Testing." 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, ± 2 °F, within 70 minutes.

TS 55 HVAC 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 SAE J1939 for receiving and broadcasting of data. The system shall comply with relevant portions of "Electrical, Electronic and Data Communication Systems" regarding data communication.

HVACs that use coolant pumps for driver's defroster/heat shall be sized for the required flow and be brushless, having a minimum maintenance-free service life for both the brushless motor and the pump of at least 40,000 hours at full power.

DEFAULT**Manual Mode Selection of Climate Control System**

After manual selection and/or activation of climate control system operation mode, all interior climate control system requirements for the selected mode shall be attained automatically to within ± 2 °F of specified temperature control setpoint.

ALTERNATIVE**Fully Automatic Climate Control System**

The climate control system shall be fully automatic and control the interior average temperature to within ± 2 °F of specified temperature control setpoint.

ALTERNATIVE

HVAC unit with reheat and recool.

DEFAULT**Single Control Setpoint at 70 °F**

The temperature control setpoint for the system shall be 70 °F.

ALTERNATIVE**Dual-Temperature Control Setpoint**

The temperature control setpoint for the system shall be [temperature] °F in the cooling mode and [temperature] °F in the heating mode.

ALTERNATIVE (BATTERY ELECTRIC BUS)**Reduced Energy Consumption Setpoint**

The HVAC system must be able to accommodate both fixed setpoints and the following sliding scale temperature control set points. The temperature control setpoint for the system shall be 70 °F when the ambient temperature is between 40 and 80 °F. The temperature control setpoint in the cooling mode shall be allowed to rise by 0.9 °F for each degree of exterior temperature in excess of 80 °F, with a maximum allowed setpoint of 78 °F. The temperature control setpoint in the heating mode shall be allowed to decrease by 0.667 °F for each degree of exterior temperature below 40 °F, with a minimum allowed setpoint of 60 °F.

***NOTE TO USER:** The sliding scale temperature control provides additional energy savings by adjusting the temperature setpoint based upon ambient temperature. The fixed setpoint allows temperature controls independent of ambient temperature. Having both control options allows the operator to apply the most appropriate control method.*

ALTERNATIVE**Manually Adjustable Temperature Control Setpoint (Driver Control)**

The climate control system shall have the provision to allow the driver to adjust the temperature control setpoint between [temperature] and [temperature] °F. After the driver has made the adjustment, all interior climate control system requirements shall be attained automatically, unless readjusted by the driver.

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 ventilating mode if the refrigerant compressor or condenser fan fails.

Interior temperature distribution shall be uniform to the extent practicable to prevent hot and 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 BTS-HVAC-RP-003-04, "Transit Bus HVAC System Instrumentation and Performance Testing." Variations of greater than ± 5 °F will be allowed for limited, localized areas provided that the majority of the measured temperatures fall within the specified requirement.

TS 55.1 Auxiliary Heater**DEFAULT**

No auxiliary heater.

ALTERNATIVE**Auxiliary Heater**

A properly sized auxiliary heater may be provided to supplement the heating system. The heater shall self-monitor required cycle times and vary the heat output to optimize cycle times and thermodynamics for the heating system. Heater control shall be via SAE J1939 CAN bus system and enabled at all ambient temperatures.

ALTERNATIVE (BATTERY ELECTRIC BUS)**Electric Grid Type Heaters**

The heating system will consist of electric grid type heaters.

ALTERNATIVE (BATTERY ELECTRIC BUS)**Optional Heating System for Low Ambient Temperatures**

The optional heating system will consist of one or more liquid heat exchangers, which will use heated coolant from a fuel-fired coolant heater to supplement or replace heat provided by the electric grid heater.

***NOTE TO USER:** This reduces battery consumption for passenger compartment heating in low ambient conditions.*

ALTERNATIVE**Hybrid Electricity/Fuel Auxiliary Heater**

The auxiliary heating system will be of the hybrid electricity/fuel type.

ALTERNATIVE**Electric Auxiliary Heater**

The auxiliary heating system will be electrically powered.

TS 55.2 Load-shedding and De-Rating (Battery Electric Bus)**DEFAULT****No Load-shedding or De-rating**

No provisions shall be made in the HVAC system for load-shedding. The Proposer will provide information on load-shedding based on geographic location.

ALTERNATIVE**Default Load-shedding or De-rating**

Default provisions shall be made in the HVAC system for full on/full off load-shedding.

ALTERNATIVE**Optional Multistage Load-shedding or De-rating**

HVAC control must include a method to provide multistage load-shedding when required to conserve battery power for increased range. The HVAC system may be operated with reduced performance to allow the bus to operate when the high-voltage batteries are below critical levels for a deeper discharge level.

TS 56 HVAC Airflow

TS 56.1 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 of 25 cubic feet per minute (cfm) per passenger based on the standard configuration bus carrying a number of passengers equal to 150% 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 15 cfm per passenger (150% 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.

DEFAULT

Requirement for 10% “Fresh Air” Mixture

The air shall be composed of no less than 10% outside air.

ALTERNATIVE

Air Purification System

The Contractor shall provide an air purification system and shall detail system efficacy in its Proposal.

ALTERNATIVE

Ultraviolet system.

TS 56.2 Driver’s Area

The bus interior climate control system shall deliver no less than 100 cfm of air to the driver’s area when operating in the heating, ventilating and cooling modes. Adjustable vents 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 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.

TS 56.3 Controls for the Climate Control System

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 Agency, an “on/off” switch shall be located to the right of or near the main defroster switch.
- Manually operated control.

- If a cable-operated manual control valve is used, then the cable length shall be kept to a minimum to reduce cable seizing.
- Heater water control valves shall be “positive” type, closed or open. The method of operating remote valves shall require the concurrence of the Agency project manager.

TS 56.4 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. Fans shall be able to draw air from the bus body interior and/or 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 100 cfm shall be provided. The driver shall have complete control of the heat and fresh airflow for the driver’s area.
- APTA BTS-HVAC-RP-003-04, “Transit Bus HVAC System Instrumentation and Performance Testing,” shall apply as applicable.
- The defroster supply outlets shall be located at the lower edge of the windshield. These outlets shall be durable 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.
- A 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 driver from the normal driving position. Decals shall be provided, indicating “operating instructions” and “open” and “closed” positions. When closed, vents shall be sealed to prevent the migration of water or air into the bus.

TS 56.5 Driver’s Cooling

DEFAULT

No dedicated evaporator.

ALTERNATIVE

Separate Dedicated Evaporator

Using a separate, dedicated evaporator, the climate control system shall be designed to maintain the driver’s compartment temperatures within the range specified for the passenger compartment. The unit shall operate when the climate control switch is in the “Cool” position. It shall have a separate thermostatic control.

ALTERNATIVE

A separate fan unit shall provide 100 cfm of air to the driver’s area through directionally adjustable nozzles and a variable fan control, both of which shall be located above and ahead of the driver.

ALTERNATIVE

Air from the evaporator shall be provided to the driver’s area through vents located overhead, or on the dash in front of the driver.

ALTERNATIVE

Driver's booster blower.

TS 57 HVAC Air Filtration

Air shall be filtered before entering the AC system and being discharged into the passenger compartment. The filter shall meet ANSI/ASHRAE 52.2 for the maximum possible MERV rating based upon the Manufacturer's design and the design operating environment. Air filters shall be easily removable for service.

DEFAULT**Cleanable Filters**

Air filters shall be cleanable.

ALTERNATIVE**Disposable Type Filters**

Air filters shall be of disposable type.

ALTERNATIVE**Other Type Filters**

Air filters shall be [type].

ALTERNATIVE**Minimum MERV Requirement**

[Specify MERV requirement.]

TS 58 Roof Ventilators

Each ventilator shall be easily opened and closed manually. 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 3 in., or with all four edges raised simultaneously to a height of no less than 33 in. An escape hatch shall be incorporated into the roof ventilator. Roof ventilator(s) shall be sealed to prevent entry of water when closed.

DEFAULT**One Roof Ventilator**

One ventilator shall be provided in the roof of the bus.

ALTERNATIVE**Two Roof Ventilators**

Two roof ventilators 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.

ALTERNATIVE**Two Roof Ventilators or Roof and Rear Window Egress**

Two roof ventilators 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, or a rear egress window can replace one rooftop escape hatch.

ALTERNATIVE (ARTICULATED BUSES)**Three Roof Ventilators****ALTERNATIVE**

An electronically controlled hatch shall be installed.

ALTERNATIVE

A tool shall be provided to manually open and close the hatch.

TS 59 HVAC Maintainability**DEFAULT****Maintainability**

The HVAC system shall be designed for cost-effective servicing and maintenance.

ALTERNATIVE**Maintainability and Valves**

The HVAC system shall be designed for cost-effective servicing and maintenance. Manually controlled shutoff valves in the refrigerant lines shall allow isolation of the compressor and dehydrator filter for service. To the extent practicable, self-sealing couplings using O-ring seals shall be used to break and seal the refrigerant lines during removal of major components, such as the refrigerant compressor. Shutoff valves may be provided in lieu of self-sealing couplings.

DEFAULT**Condenser Location**

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 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.

DEFAULT

Refrigerant pressures shall be accessible with diagnostic equipment.

ALTERNATIVE

High and low refrigerant pressure electronic or analog gauges shall be located in an easily accessible area.

ALTERNATIVE

High and low refrigerant pressure electronic or analog gauges to be located in the return air area.

***NOTE TO USER:** The Agency may include the following sections if an alternative for colder ambient performance is specified above.*

TS 60 HVAC Entrance/Exit Area Heating**DEFAULT**

No requirements for entrance/exit area heating.

ALTERNATIVE**Entrance/Exit Area Heating**

Heat shall be supplied to the entrance and exit areas to maintain a tread surface temperature no less than 35 °F in an ambient temperature of –10 °F to prevent accumulation of snow, ice or slush with the bus operating under design operating profile and corresponding door opening cycle.

TS 61 Floor-Level Heating**TS 61.1 Transit Coach****DEFAULT**

No requirements for floor-level heating.

ALTERNATIVE**Floor-Level Heating**

Sufficient floor-level heaters shall be provided. Control of the floor-level heating shall be through the main heating system.

ALTERNATIVE**Warm Wall Heating**

Sufficient heaters shall be provided with ducting to blow warm air upward through a cavity in the wall and discharge the warm air at the base of the windows. Control of the warm wall heating should be through the main heating system electronic control.

TS 61.2 Commuter Coach

Sufficient heaters shall be provided with ducting to blow warm air upward through a cavity in the wall and discharge the warm air at the base of the windows. Control of the warm wall heating shall be through the main heating system electronic control.

TS 62 Exterior Panels and Finishes: 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 any body 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 62.1 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.

DEFAULT

No requirement for protection against graffiti/vandalism for body material surfaces.

ALTERNATIVE

Requirements for protection against graffiti/vandalism for body material surfaces.

TS 62.2 Roof-Mounted Equipment (Transit Coach)

Coaches with roof mounted equipment shall install a nonskid, clearly marked walkway, or steps shall be incorporated on the roof, to provide access to equipment without damaging any system or bus paneling.

TS 63 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 64 Side Body Panel Repair and Replacement (Transit Coach)

TS 64.1 Transit Coach

Structural elements supporting exterior body panels shall allow side body panels below the windows to be repaired.

DEFAULT

Standard attachment of side body panels.

ALTERNATIVE**Easily Replaceable Lower Side Body Panels**

The lower section of the side body panels (low-floor buses) or skirt panels (high-floor buses) shall be made of impact-resistant material and shall be easily and quickly replaceable.

ALTERNATIVE**Easily Replaceable Full-Height Side Body Panels**

Full-height side body panels between the window and bottom sill shall be easily and quickly replaceable in sections. The Proposer shall indicate the time required to replace a panel.

ALTERNATIVE

Composite panel damage shall be confined to the impact area and repairable with common composite repair procedures.

TS 64.2 Commuter Coach

Structural elements supporting exterior body panels shall allow side body panels below the windows to be repaired.

TS 65 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. Cross-sections of the gutters shall be adequate for proper operation.

TS 66 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 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.

DEFAULT

No plate or holder provision is required.

ALTERNATIVE**Front Plate or Holder Required**

[Agency to specify location.]

TS 66.1 Rub rails**DEFAULT**

No requirement for rub rails.

TS 67 Fender Flares

DEFAULT

Features to minimize water spray from the bus in wet conditions shall be included in the wheel housing design. Any fender flares 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.

ALTERNATIVE

No fender skirts required.

TS 68 Wheel Covers (Transit Coach)

DEFAULT

Wheel covers not required.

ALTERNATIVE

Wheel covers required on non-steering axle, which shall not interfere with brake system cooling.

TS 68.1 Splash Aprons

DEFAULT

Standard Splash Aprons

Splash aprons, composed of ¼ in. minimum composition or rubberized fabric, shall be installed behind and/or in front of wheels as needed to reduce road splash and to protect underfloor components. The splash aprons shall extend downward to within 6 in. off the road surface at static conditions. Apron widths shall be no less than tire widths. Splash aprons shall be bolted to the bus understructure. Splash aprons and their attachments shall be inherently weaker than the structure to which they are attached. The flexible portions of the splash aprons shall not be included in the road clearance measurements. Splash apron shall be installed as necessary to protect the wheeled mobility device loading device from road splash. Other splash aprons shall be installed where necessary to protect bus equipment.

ALTERNATIVE (TRANSIT COACH)

Full-width rear splash apron.

ALTERNATIVE

Other Locations Required

Splash apron in front of either or both front wheels to reduce splashing on ramp/lift and left mirror.

ALTERNATIVE

No splash apron required.

TS 69 Service Compartments and Access Doors

TS 69.1 Access Doors (Transit Coach)

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. All access doors shall be retained in the open position by props or counterbalancing with overcenter 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 69.2 Access Doors (Commuter Coach)

Conventional 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. All access doors shall be retained in the open position. 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 69.3 Access Door Latch/Locks

DEFAULT

Requirement for Latches on Access Doors

Access doors larger than 100 sq.in. in area shall be equipped with corrosion-resistant flush or surface-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 a nominal $\frac{5}{16}$ in. square male tool to open or lock.

ALTERNATIVE

Other Locks and Latches

[Define any required locks or latches for access doors.]

TS 70 Bumpers

TS 70.1 Location

Bumpers shall provide impact protection for the front and rear of the bus with the top of the bumper being 27 in., ± 3 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 70.2 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 lb 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 deg 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.

DEFAULT

Standard bumper.

ALTERNATIVE

Integrated Design with Recessed Middle Portion

The 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.

ALTERNATIVE

No provisions for installing a bike rack shall be made.

ALTERNATIVE

Mounting provisions for integrated bike rack.

TS 70.3 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 per second. 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 lb, at 4 mph parallel to or up to a 30 deg angle to the longitudinal centerline of the bus. The rear bumper shall be shaped to prevent 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 70.4 Bumper Material

Bumper material shall be corrosion-resistant and shall withstand repeated impacts of the specified loads without sustaining damage. These bumper qualities shall be sustained throughout the service life of the bus.

TS 71 Finish and Color

TS 71.1 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 ensure 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 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 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 patches due to incorrect mixing of paint activators
- buffing swirls

All exterior finished surfaces shall be impervious (rubber components shall be resistant) 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 Elcometer Adhesion Tester as outlined in ASTM D4541-85. Adhesion shall be a minimum 300 ft-lb. The vehicle 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.

DEFAULT

Standard Contractor exterior paint finish quality.

ALTERNATIVE

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 Agency-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.

DEFAULT

Base coat/clear coat paint system.

ALTERNATIVE

Standard OEM exterior paint system.

ALTERNATIVE**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 white. Durable, peel-resistant, pressure-sensitive appliques shall be used for any striping and coloring required.

NOTE TO USER: *The Agency should insert approved paints, color scheme and graphics.*

TS 72 Decals, Numbering and Signing

Energy storage and delivery systems shall be identified in accordance with federal, state and local requirements, codes and standards.

ALTERNATIVE**Agency-Specified**

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 appliques. 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 38, Subpart B, 38.27.

NOTE TO USER: *The Agency should supply a list of interior and exterior decals, including size and location.*

TS 72.1 Passenger Information

ADA priority seating signs as required and defined by 49 CFR 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 38.35 shall be provided.

TS 73 Exterior Lighting

All exterior lights shall be designed to prevent entry and accumulation of moisture or dust. Lamps, lenses and fixtures shall be interchangeable to the extent practicable. Two hazard lamps at the rear of the bus shall be visible from behind when the engine service doors are opened. Light lenses shall be designed and located to prevent damage when running the vehicle through an automatic bus washer.

DEFAULT

Commercially available LED-type lamps shall be used at all exterior lamp locations.

ALTERNATIVE

Contractor to provide details of exterior lighting system.

DEFAULT

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.

DEFAULT

Standard Size

Size of LED lamps used for tail, brake and turn signal lamps shall be standard installation of OEM.

ALTERNATIVE

Larger Size

LED lamps used for tail, brake and turn signal lamps shall be a minimum of 7 sq.in.

ALTERNATIVE

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 or low-profile type to protect the lens against minor impacts.

ALTERNATIVE

Contractor shall provide exterior lights to alert public in the event of an emergency.

TS 73.1 Backup Light/Alarm

Visible and audible warnings shall inform following vehicles or pedestrians of reverse operation. Visible reverse operation warning shall conform to SAE J593. Audible reverse operation warning shall conform to SAE J994 Type C or D.

TS 73.2 Doorway Lighting

Lamps at the front and rear passenger doorways (if applicable) 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 fc 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 73.3 Turn Signals

Turn-signal lights, including any wraparound turn signals, shall be provided on the front, rear, curb and street sides of the bus in accordance with federal regulations.

TS 73.4 Headlamps

Headlamps shall be designed for ease of replacement.

DEFAULT

Standard Installation

Standard OEM headlamp installation shall be provided in accordance with federal regulations.

ALTERNATIVE

Daytime Running Lights

Headlamps shall incorporate a daytime running light feature.

ALTERNATIVE

LED

Headlamps shall be LED, sealed beam.

ALTERNATIVE

Halogen

Headlamps shall be halogen, sealed beam.

ALTERNATIVE

Specify Design Life

Headlamps' design life to be specified in units of hours by the Agency.

TS 73.5 Brake Lamps

TS 73.5.1 Transit Coach

Brake lamps shall be provided in accordance with federal regulations.

DEFAULT

No High/Center Mount Brake Lamp or Deceleration Warning Lamps

Bus shall not include a high/center mount brake lamp and/or deceleration warning indicator lamps.

ALTERNATIVE

High and Center Mount Red Brake Lamp

Bus shall include high and center mount red brake lamp(s) along the back side of the bus in addition to the lower brake lamps required under FMVSS. The high and center mount brake lamp(s) shall illuminate steadily with brake application. [Specify the size of the high and center mount red brake lamp(s).]

ALTERNATIVE

High and Center Mount Amber Lamp

Bus shall include high and center mount amber lamp(s) along the back side of the bus that illuminate steadily when the transmission is in forward mode and when the throttle is completely released (0% engagement). The amber lamps shall automatically extinguish, regardless of transmission and throttle condition, with brake application. Operation of the amber lamps shall be programmable with the multiplex system. [Specify the size of the high and center mount amber lamp(s).]

TS 73.5.2 Commuter Coach

Brake lamps shall be provided in accordance with federal regulations.

Bus shall include high and center mount red brake lamp(s) along the back side of the bus in addition to the lower brake lamps required under FMVSS. The high and center mount brake lamp(s) shall illuminate steadily with brake application.

TS 73.6 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 or in an approved location. 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. Power shall be automatically discontinued (timed out) after 30 minutes or turned off when the PLC is shut down after a predetermined time to prevent damage caused by inadvertently leaving the service area lighting switch in the “on” position after repairs are made.

TS 74 Interior Panels and Finishes: General Requirements

Materials shall be selected on the basis of maintenance, durability, appearance, safety, noise reduction, 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.

DEFAULT

No requirement for anti-graffiti/vandalism surface treatments.

ALTERNATIVE

Internal surfaces, as possible, to be stainless steel or other resistant material.

ALTERNATIVE

[Insert requirements for anti-graffiti/vandalism treatments for interior surfaces.]

TS 75 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.

DEFAULT

Interior panel required to meet FMVSS 302.

ALTERNATIVE**Fire-Resistance**

Materials shall comply with the Recommended Fire Safety Practices defined in FTA Docket 90-A, dated October 20, 1993.

ALTERNATIVE

Textured stainless steel.

ALTERNATIVE

Anodized or powder-coated aluminum.

ALTERNATIVE

Composite.

ALTERNATIVE

Scratch-resistant plastic.

ALTERNATIVE

Melamine-type material.

ALTERNATIVE

Carpeting or fabric.

TS 75.1 Driver Area Barrier**TS 75.1.1 Transit Coach**

A barrier or bulkhead between the driver and the street-side front passenger seat shall be provided. The barrier shall minimize glare and reflections in the windshield directly in front of the barrier from interior lighting during night operation. Location and shape must permit full seat travel and reclining possibilities that can accommodate the shoulders of a 95th-percentile male. The partition shall have a side return and stanchion to prevent passengers from reaching the driver by standing behind the driver's seat. The lower area between the seat and panel must be accessible to the driver. The partition must be strong enough in conjunction with the entire partition assembly for optional mounting of such equipment as flare kits, fire extinguishers (1.2 kg), microcomputer, public address amplifier, etc. The panel should be properly attached to minimize noise and rattles.

The driver's barrier shall extend from the ceiling to the surface below (e.g., floor or wheel well) and shall fit close to the bus-side windows and wall to prevent passengers from reaching the driver or the driver's personal effects. The driver's barrier shall extend continuously from the bus wall to the first stanchion immediately behind the driver to provide security to the driver and to limit passenger conversation.

TS 75.1.2 Driver Protection Door

The bus operator's area shall be isolated from passengers by a protective barrier. The barrier should be glazed on the upper section with a $\frac{3}{8}$ in. laminated safety glass compliant to the latest requirements of ANSI/SAE Z26.1.

The barrier shall be glazed on the upper section with a $\frac{3}{8}$ in. AS2 type laminated safety glass or equivalent. The glass shall have anti-glare, nonreflective coating on both sides. The barrier shall not obscure the driver's vision of the side windows or the rearview mirror. The barrier shall be mounted securely to the bus structure with a single hinge post. Individual strap hinges or piano-type hinges shall not be allowed. The barrier shall not interfere with access to the farebox or other devices mounted to the farebox pedestal. The barrier shall latch securely in the closed position. The latch shall be of a non-rattling type with a paddle handle release located such that the driver may reach over a closed barrier to open and gain access to the driver's area.

When mounted, the barrier shall comply with all ADA accessibility regulations for wheeled mobility device access.

ALTERNATIVE

The barrier shall incorporate two ventilation fans with variable speed control. These fans shall be capable of being configured as exhaust out of the driver area or ventilation into the driver area at the time of manufacture. There shall be a feature to quickly return the fans to the last speed setting when they are stopped.

ALTERNATIVE

The barrier shall incorporate two ventilation fans with variable speed control. These fans shall be capable of being configured as exhaust out of the driver area or ventilation into the driver area at the time of manufacture. There shall be a feature to quickly return the fans to the last speed setting when they are stopped. The barrier shall have a power window to allow interaction between the driver and passengers. The window shall have express-up and express-down functions whereby a single push of the window control switch will fully open or close the window.

TS 75.1.3 Commuter Coach

A barrier or bulkhead between the driver and the street-side front passenger seat shall be provided. The barrier shall minimize glare and reflections in the windshield directly in front of the barrier from interior lighting during night operation. Location and shape must permit full seat travel and reclining possibilities that can accommodate the shoulders of a 95th-percentile male. The partition shall have a side return and stanchion to prevent passengers from reaching the driver by standing behind the driver's seat. The lower area between the seat and panel must be accessible to the driver. The partition must be strong enough in conjunction with the entire partition assembly for mounting of such equipment as flare kits, fire extinguishers (1.2 kg), microcomputer, public address amplifier, etc. The panel should be properly attached to minimize noise and rattles.

The driver's barrier shall extend from the floor area to the ceiling and from the bus wall to the first stanchion immediately behind the driver to provide security to the driver and to limit passenger conversation.

TS 75.2 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.

Design and installation of modesty panels located in front of forward-facing seats shall include a handhold or grab handle along their 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 $1\frac{1}{2}$ in. and no more than 8.25 in. above the floor. At doorways, the panels shall extend downward to no more than 2 in. above the floor. Panels forward of longitudinal seats shall extend to below the level of the seat cushion. To prevent passengers from being pinched, dividers positioned at the doorways, where applicable, shall provide no less than a $2\frac{1}{2}$ 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. At the aft of the exit door, clearance shall be no less than 1.9 in. between the modesty panel and an inward opening door. Modesty panels installed at doorways shall be equipped with grab rails if passenger assists are not provided by other means.

The modesty panel and its mounting shall withstand a static force of 250 lb applied to a 4 × 4 in. area in the center of the panel without permanent visible deformation.

DEFAULT

Modesty panels shall be installed as stated.

ALTERNATIVE

Additional floor clearances for cleaning and toe clearance.

ALTERNATIVE

Clear non-glass panel from above the modesty panel to the top of the daylight opening and attached to the stanchion.

TS 75.3 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 75.4 Rear Bulkhead

The rear bulkhead (and articulated bus joint if applicable) and rear interior surfaces shall be of material suitable for exterior skin; painted and finished to exterior quality; or paneled with melamine-type material, composite, scratch-resistant plastic or carpeting and trimmed with stainless steel, aluminum or composite.

The rear bulkhead paneling shall be contoured to fit the ceiling, sidewalls 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 litter being thrown or drawn through the grille. If it is necessary to remove the panel to service components located on the rear bulkhead, then the panel shall be hinged or shall be able to be easily removed and replaced. Grilles where access to or adjustment of equipment is required shall be heavy-duty and designed to minimize damage and limit unauthorized access.

ALTERNATIVE (ARTICULATED BUS)

The rear bulkhead provisions shall apply to any bulkhead at the articulated joint.

TS 75.5 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.

TS 75.6 Fastening

Interior panels shall be attached so that there are no exposed unfinished, rough edges or rough surfaces. Fasteners should be corrosion-resistant. Panels and fasteners shall not be easily removable by passengers. Exposed interior fasteners should be minimized, and shall be tamper-resistant where required by the Agency.

TS 75.7 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.

DEFAULT

FMVSS 302

Insulation shall meet the requirements of FMVSS 302.

ALTERNATIVE

FTA Docket 90-A

All insulation materials shall comply with the Recommended Fire Safety Practices defined in FTA Docket 90-A, dated October 20, 1993.

TS 75.8 Floor Covering

The floor covering shall have a nonskid walking surface that remains effective in all weather conditions. 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 and shall not extend into the aisle. The color and pattern shall be consistent throughout the floor covering. The standee line shall be approximately 2 in. wide and shall extend across the bus aisle and contrast with the rest of the floor covering.

ALTERNATIVE

Additional Standee Marking

In addition to providing the standee line, 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.

The floor 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 strip as wide as the door shall extend from the center strip to the outboard edge of the rear/exit area. In the case of prefabricated floors with an integrated floor covering, the number of sections shall be minimized.

The floor under the seats shall be covered with smooth surface flooring material. The floor covering shall closely fit the sidewall. Flooring may fit the sidewall with a fully sealed butt joint, extend to the top of the cove, or be captured by the seat rail.

TS 76 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 76.1 Passenger Area Lighting

DEFAULT

First Row Lights Extinguish

The first light on each side (behind the driver and the front door) is normally turned on only when the front door is opened, in "night run" and "night park." As soon as the door closes, these lights shall go out. These lights shall be turned on at any time if the switch is in the "on" position.

ALTERNATIVE

Second Row Lights

To help eliminate windshield reflection on suburban roads where street lighting is at a low level, the second light on each side, when "night run" or "night park" is selected, shall be controlled by the switch; off in "off" and on in "normal." These lights shall be turned on at any time if the switch is in the "on" position.

ALTERNATIVE

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 each side of the coach shall automatically dim when the front door is in the closed position and illuminate when the door is opened. The amount of dimming shall be programmable by the Agency (to reduce glare at night).

All interior lighting shall be turned off whenever the vehicle is in reverse and the engine run switch is in the "on" position.

Interior passenger area lights shall be LED. The interior lighting design, including color or brightness, shall require the approval of the Agency.

TS 76.2 Driver's Area Lighting

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 10 to 30 fc.

TS 76.3 Seating Area Lighting (Transit Coach)

The interior lighting system shall provide a minimum 15 fc illumination on a 1 ft² plane at an angle of 45 deg 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 fc.

TS 76.4 Seating Area Lighting (Commuter Coach)

A minimum 10-module parcel rack without dividers and compartment doors shall be furnished over all two-passenger seating positions except in the wheeled mobility device door area. Retention cords shall run the length of the rack housing. The parcel rack edge, running along the full length of the aisle, shall incorporate a handhold for use by standees. Passenger headroom, measured from the rack end to the top of the seat headrest, shall be a minimum 17 in. (432 mm). Interior window post caps shall be ABS thermo-formed plastic, off-white in color to provide a clean, finished appearance. The interior of the rack shall be vinyl covered aluminum to complement the interior. Parcel racks shall be supported by polycarbonate glass-filled hangers spaced approximately 40 in. (1016 mm) apart. Total capacity shall be a minimum 109 ft³ (3 m³) to allow for ample storage space for carry-on items.

Passenger service modules mounted on the underside of the parcel rack shall include individually controlled and adjustable LED passenger reading lights; an exit signal push button, red in color; and individual air distribution outlets. These outlets shall be adjustable from fully closed to fully open position. A minimum of 26 speakers shall also be provided in the cluster panels for the driver-controlled public address system. Speakers shall broadcast, in a clear tone, announcements that are clearly perceived from all seat positions at approximately the same volume level. Passengers using the securement systems shall be provided identical amenities as provided for all other passengers, except that the parcel rack shall be deleted in the area of the wheeled mobility device lift door. Separate and independent notification will be provided on the dashboard indicator panel for stop request notification from securement positions.

ALTERNATIVE

Parcel rack air conditioning will be provided.

TS 76.5 Vestibules/Doors Lighting (Transit Coach)

Floor surface in the aisles shall be a minimum of 10 fc, and the vestibule area a minimum of 4 fc with the front doors open and a maximum of 2 fc with the front doors closed. The front entrance area and curb lights shall illuminate when the front door is open and the master run switch is in the “lights” or “night run” position. Rear exit area and curb lights shall illuminate when the rear door is unlocked.

TS 76.6 Vestibules/Doors Lighting (Commuter Coach)

Floor surface in the aisles shall be a minimum of 2 fc, and the vestibule area in accordance with ADA requirements.

TS 76.7 Step Lighting

Step lighting for the intermediate steps between lower and upper floor levels shall be a minimum of 4 fc and shall illuminate in all vehicle 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 76.8 Ramp Lighting (Transit Coach)

Exterior and interior ramp lighting shall comply with federal regulations.

TS 76.9 Turntable Lighting (Articulated Coach)

Lighting in the turntable can be reduced to 7 fc.

TS 76.10 Farebox/Card Reader Lighting

TS 76.10.1 Transit Coach

DEFAULT (TRANSIT COACH)

Farebox Light

A light fixture shall be mounted in the ceiling above the farebox location. The fixture shall be capable of projecting a concentrated beam of light on the farebox. 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.

ALTERNATIVE (TRANSIT COACH)

No farebox light.

ALTERNATIVE (TRANSIT COACH)

Card Reader Light

A light fixture shall be mounted in the ceiling above the card reader location. The fixture shall be capable of projecting a concentrated beam of light on the card reader. 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.

ALTERNATIVE (TRANSIT COACH)

Provide a farebox and card reader light.

TS 76.10.2 Commuter Coach

DEFAULT (COMMUTER COACH)

No farebox light.

ALTERNATIVE (COMMUTER COACH)

Farebox Light

A light fixture shall be mounted in the ceiling above the farebox location. The fixture shall be capable of projecting a concentrated beam of light on the farebox. 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 77 Fare Collection

Space and structural provisions shall be made for installation of currently available fare collection devices, including card readers or validators as specified by the Agency, which shall be as far forward as practicable. Location of the fare collection device shall not restrict traffic in the vestibule, including wheeled mobility devices if a front door loading device is used, and shall allow the driver to easily reach the farebox controls and to view the fare register. The farebox shall not restrict access to the driver’s 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 J1050. The location and mounting of the fare collection device shall allow use, without restriction, by passengers. The farebox location shall permit accessibility to the vault for easy manual removal or attachment of suction devices. Meters and counters on the farebox shall be readable on a daily basis. The floor under the farebox shall be reinforced as necessary to provide a sturdy mounting platform and to prevent shaking of the farebox.

ALTERNATIVE

Rear Door Fare Equipment

[Specify space and structural provisions for rear door fare collection equipment, including card readers or validators.]

ALTERNATIVE

Transfer Equipment

Transfer mounting, cutting and punching equipment shall be located in a position convenient to the driver.

Contractor shall provide fare collection installation layout to the Agency for approval.

DEFAULT

Agency will install its own farebox/card reader.

ALTERNATIVE

Agency will specify a farebox/card reader for Contractor to install.

TS 78 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 overcenter springs, where practical, to hold the doors out of the mechanic's way. Panels shall prevent entry of mechanism lubricant into the bus interior. All fasteners that retain access panels shall be captive in the cover.

DEFAULT

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.

ALTERNATIVE

Access Doors with Locks

Access doors shall be secured with locks. The locks shall be standardized so that only one tool is required to open access doors on the bus.

TS 78.1 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 or sealant that is acceptable to the Agency to prevent the edges from coming loose. Access openings shall be asymmetrical or have distinct surface features or surface finishes indicating the proper part orientation so that reinstalled flooring shall be properly aligned. Fasteners protrusion shall be minimized, or flush with the floor.

The number of special fastener tools required for panel and access door fasteners shall be minimized.

TS 79 Passenger Seating

TS 79.1 Arrangements and Seat Style (Transit Coach)

The passenger seating arrangement in the bus shall be such that seating capacity is maximized and in compliance with the following requirements.

NOTE TO USER: *The Agency should recognize 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 wheeled mobility device positions, etc. ultimately affect seating capacity and layout.*

DEFAULT

Forward-Facing 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 wheeled mobility device securement areas and platforms (such as for fuel tank storage space).

ALTERNATIVE

Reclining seats.

ALTERNATIVE

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 [number] seated passengers, not including the driver, with the specified seating arrangement.

ALTERNATIVE

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 fewer than [number] seated passengers, not including the driver, with the specified seating arrangement.

TS 79.2 Arrangements and Seat Style (Commuter Coach)

DEFAULT

Forward-Facing Seat Configuration

Passenger seats shall be arranged in a forward-facing configuration with a minimum of [number] reclining and cushioned passenger seats. Contractor to provide seat layout to the Agency once the Agency has provided the seat manufacturer and model number.

ALTERNATIVE

[Specify options such as cup holder, headrests, footrests, etc.]

TS 79.3 Rearward Facing Seats (Transit Coach)**DEFAULT**

Allow rearward facing seats

ALTERNATIVE

Rearward facing seats not allowed.

TS 79.4 Turntable Seating (Articulated Coach)**DEFAULT**

Handholds shall be provided to enable safe passage through the articulation area. No seats shall be located on the turntable.

ALTERNATIVE

Turntable seats shall be quickly and easily removable by one technician but not by passengers.. Turntable seats shall be located so as to eliminate pinch points from the seat to any portion of the bus structure and/or articulation components at any time during bus operation including while in full lock.

TS 79.5 Seat USB**DEFAULT**

No USB.

ALTERNATIVE**USB**

Where feasible, USBs for each seat shall be placed within seat assemblies such that passengers may charge their portable device while in transit. Depending on location within the bus, the USB assembly should be located in either the front or back of a seat assembly and be easily reachable by a passenger without infringing on the space of other passengers within the bus. At a minimum the specifications for the USB assembly should have an IP64 rating and be a USB Type A receptacle with a 12 VDC input with an output of 5 V and a 2.4 A per charging port or a or Dual port Type A/C. [Add any additional specifications.]

TS 79.6 Padded Inserts/Cushioned Seats (Transit Coach)**DEFAULT****Unupholstered, Cosmetic, Unpadded Inserts**

The passenger seats shall be equipped with unupholstered, cosmetic, unpadded inserts throughout the bus.

ALTERNATIVE

Upholstered Vinyl, Unpadded Inserts

The seats shall be equipped with upholstered vandal-resistant vinyl, unpadded inserts throughout the bus.

ALTERNATIVE

Vinyl, Padded Inserts

The passenger seats shall be equipped with vinyl, padded inserts throughout the bus (measured to uncompressed surface).

ALTERNATIVE

Fabric, Unpadded Inserts

The passenger seats shall be equipped with fabric, unpadded inserts throughout the bus.

ALTERNATIVE

Fabric, Padded Inserts

The passenger seats shall be equipped with fabric, padded inserts throughout the bus (measure to uncompressed surface).

ALTERNATIVE

Combination Insert Seating Padded Inserts and Fully Cushioned

The passenger seats in the front section shall be equipped with inserts of choice, and those in the rear (aft of the rear/exit door) shall be equipped with inserts of choice.

TS 79.7 Seat Back Configuration

DEFAULT

Back Insert Seat Configuration

The seat back insert thickness shall not exceed 1 in. in the knee room area.

ALTERNATIVE

Cushioned Backs

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 be 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.

Seats, back cushions and other pads shall be securely attached and shall be detachable by means of a simple release mechanism so 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.

ALTERNATIVE**Cushioned Seat Configuration**

Seating and interior trim shall have features to maximize passenger comfort. The seat cushion shall be supported by springs. The seat cushion and back shall be padded with a cellular foam product and be no less than 2 in. thick in areas contacted and loaded by passengers in the normal seated position and shall be upholstered with vinyl and/or fabric materials.

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 maintenance personnel 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.

ALTERNATIVE**Combination of Inserts**

The passenger seats in the front section shall be equipped with [specify type] inserts, and those in the rear (aft of the rear/exit door) shall be equipped with [specify type] inserts.

TS 79.8 Drain Hole in Seats**DEFAULT**

No requirements for drain hole provision in seat inserts.

ALTERNATIVE**Requirement for Drain Hole Provision in Seat Inserts**

Provision, such as a small grommeted hole, to allow drainage shall be incorporated into seat insert. (Drain through hole, ¼ in. through hole, bottom seat only, one per seat.)

TS 79.9 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 a vertical surface immediately in front, shall be a minimum of 26 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.

TS 79.10 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 (Agency will approve acceptable dimensions).

TS 79.11 Aisles (Transit Coach)

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).

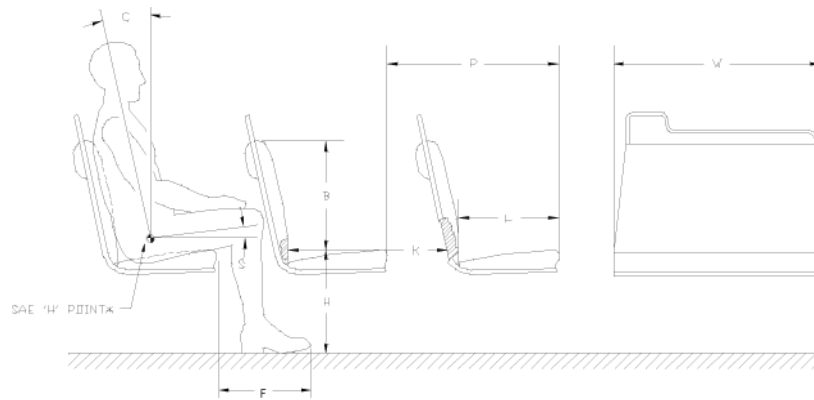
TS 79.12 Aisles (Commuter Coach)

The aisle between the seats shall be no less than 14 in. wide at seated passenger hip height.

TS 79.13 Dimensions (Transit Coach)

FIGURE 8

Seating Dimensions and Standard Configuration



DEFAULT

Seat dimensions for the various seating arrangements shall have dimensions as follows (refer to **Figure 8**):

- 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 underfloor components, a cushion height of 18 in., ± 2 in., will be allowed. This shall also be allowed for limited transverse seats, but only with the express approval of the Agency.
- Foot room, F – see Section 6 “Technical Specifications” subsection entitled “Foot Room”.
- The seat cushion slope, S, shall be between 5 and 11 deg.
- The seat back slope, C, shall be between 8 and 17 deg.
- Hip to knee room, K – see Section 6 “Technical Specifications” subsection entitled “Hip to Knee Room”.
- The pitch, P, is shown as reference only.

ALTERNATIVE

[Specify seat dimensions.]

TS 79.14 Structure and Design (Transit Coach)

Seating shall meet all acceptance criteria in **Table 9**.

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.

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 12 in. of the aisle shall be at least 10 in. above the floor.

In locations at which cantilevered installation is precluded by design and/or structure, other seat mounting may be allowed.

The back of each transverse seat shall incorporate a handhold no less than $\frac{7}{8}$ 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 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 wheeled mobility device parking area that fold up when the armrest on the adjacent fixed longitudinal seat is within $3\frac{1}{2}$ 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.

DEFAULT

Armrests as specified above shall be provided on longitudinal seats.

ALTERNATIVE

Armrests as specified or hip support which restrains passengers from sliding forward off the seat shall be provided on longitudinal seats.

TABLE 9
Passenger Seating Tests

Test	Description	Acceptance Criteria
Pendulum	Mass of two 95th-percentile males striking seat back during 10g deceleration	Permanent deformation <2 in. measured at aisle side seat frame; seat back deflection <14 in. measured at top of seat back
Vertical load	500 lb applied to top of each seat cushion	Permanent deformation <¼ in. in seat or mountings
Horizontal	500 lb evenly distributed along the top of the seat back of seat assembly	Permanent deformation <¼ in. in seat or mountings
Swing	Two 40 lb sandbags, suspended on 36 in. pendulum, strike seat back from front and rear, 10,000 times from distances of 6, 8, 10 and 12 in. (40,000 total impacts)	No visible deterioration
Drop Bag	40 lb sandbag, dropped on seat cushions 1000 times from heights of 6, 8, 10 and 12 in. (4000 total impacts)	No visible deterioration
Grabrail/Armrest Load	250 lb applied anywhere along the length, in both horizontal and vertical direction	Permanent deformation <¼ in.
Grabrail/Armrest Cyclic	125 lb horizontal force for 25,000 impacts in both directions	Permanent deformation <¼ in. and no visible deterioration
Jounce and Squirm	100,000 randomly positioned 3.5 in. drops of squirming, 150 lb, smooth surfaced, buttocks-shaped striker	Minimal wear of seat coverings, no failures to seat structure
HIC	Defined by SAE J211a for 10g deceleration	HIC number <400
Knee Impact	10g deceleration of 5th-percentile female to 95th-percentile male	Compressive load <1000 lb on femur

TS 79.15 Structure and Design (Commuter Coach)

Passenger seats shall be arranged in a transverse, forward-facing configuration.

No more than 10 seated positions shall be lost on any bus configuration to accommodate two wheeled mobility device passengers occupying the securement positions.

Each transverse, forward-facing seat, except the rear seats, shall accommodate two adult passengers. Floor seat tracks shall be stainless steel and shall be welded to the coach frame and be nearly flush with the finished floor. The wall tracks shall be stainless steel or aluminum and shall be bolted or riveted to the sidewall.

Seats shall be commuter coach reclining seats. Seat frames shall be constructed of high-strength, fatigue-resistant, welded steel with a durable powder-coated, corrosion-resistant colored finish that complements the coach interior. The seat frame shall be wall-mounted with heavy gauge steel brackets and shall be attached to the coach floor with a heavy duty stainless steel T pedestal. The seat back shall recline a minimum of 1 in. to a maximum of 5 in. (127 mm) maximum with an infinite number of stops. The reclining seat backs shall be provided with a dress-up feature to facilitate coach cleaning. Seat width shall be a minimum of 36 in. and a maximum of 40.5 in. (1029 mm). Aisle shall not be less than 14 in. (356 mm) wide.

TS 79.16 Construction and Materials (Transit Coach)

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 ¼ 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, to allow the passenger to deform the seating materials in the impact areas. Complete seat assemblies shall be interchangeable to the extent practicable.

TS 79.17 Construction and Materials (Commuter Coach)

DEFAULT

Seat cushions shall be supported by steel serpentine springs.

ALTERNATIVE

Seat cushions may be supported by means other than steel springs.

Seat covering shall be high-quality wool fabric or vinyl. Wool fabric shall be tested to a minimum of 60,000 rubs per the Wyzendeek test method, ASTM D4157.

Seat foam padding shall be polyurethane. Seat upholstery shall be able to be removed with ease for cleaning/replacement purposes.

DEFAULT

[Specify seat fabric.]

ALTERNATIVE

Contractor will select seat fabric on the basis of durability, ease of maintenance and pleasing texture and appearance.

TS 80 Passenger Assists (Transit Coach)

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 5th-percentile female standee and the 95th-percentile male standee and shall comply with most current, relevant regulations set forth in the ADA Accessibility Guidelines for Transportation Vehicles. 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 the 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 then the other without losing support. All handholds and stanchions at the front doorway, around the farebox, and at interior steps for bi-level designs shall be powder-coated in a high-contrast yellow color.

ALTERNATIVE

The forward-most vertical stanchions on either side of the aisle immediately behind the driver's area shall be powder-coated black.

ALTERNATIVE

The forward-most vertical stanchions on either side of the aisle immediately behind the driver's area shall be powder-coated yellow.

ALTERNATIVE

The forward-most vertical stanchions on either side of the aisle immediately behind the driver's area shall be a stainless steel finish.

TS 80.1 Assists (Transit Coach)

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 National Highway Traffic Safety Administration 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 lb 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 80.2 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, the vertical assist, and the assists on the wheel housing or on the front modesty panel.

TS 80.3 Vestibule (Transit Coach)

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 80.4 Rear Doorway(s) (Transit Coach)

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 shall 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 having a cross-sectional diameter between 1¼ and 1½ in. or providing an equivalent gripping surface with no corner radii less than ¼ in., and shall provide at least 1½ in. of knuckle clearance between the assists and their mounting. The assists shall be designed to permit a

5th-percentile female to easily move from one assist to another during the entire exiting process. The assists shall be located no farther inboard than 6 in. from the outside edge of the rear doorway step.

For an articulated bus, passenger assists will be provided to aid in the transition between the front and rear sections of the bus.

TS 80.5 Overhead (Transit Coach)

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. In the case of rear podium sections where headroom is constrained, the assist shall be no less than 67 in. above the floor.

DEFAULT

No requirements for overhead grab straps/extensions.

ALTERNATIVE

Grab straps or other extensions as necessary shall be provided for sections where vertical assists are not available and for use by passengers who cannot reach the continuous overhead assist.

DEFAULT

Grab straps shall be stainless steel.

ALTERNATIVE

Grab straps shall be fabric.

ALTERNATIVE

Grab straps shall be flip-up/non-flip.

ALTERNATIVE

Grab straps shall be plastic.

Overhead assists shall simultaneously support 150 lb on any 12 in. length. No more than 5% of the full grip feature shall be lost due to assist supports.

TS 80.6 Longitudinal Seat Assists (Transit Coach)

Longitudinal seats shall have vertical assists located between every other designated seating position, except for seats that fold/flip up to accommodate wheeled mobility device 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 80.7 Wheel Housing Barriers/Assists (Transit Coach)

Unless passenger seating is provided on top of wheel housings, 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 housings.

TS 81 Passenger Doors

TS 81.1 Transit Coach

Doorways will be provided in locations and styles as follows. Passenger doors and doorways shall comply with ADA requirements.

TS 81.1.1 Front door

Door shall be forward of the front wheels and under direct observation of the driver.

TS 81.1.2 Rear Door(s)

DEFAULT

Curbside doorway centerline located rearward of the point midway between the front door centerline and the rearmost seat back.

ALTERNATIVE

Curbside doorway located behind the rear axle.

ALTERNATIVE

Street-side doorway located rearward of the point midway between the front door centerline and the rearmost seat back.

ALTERNATIVE

Street-side doorway located behind the rear axle.

ALTERNATIVE (ARTICULATED BUS)

Curbside doorway located forward of the rear axle of the trailer section.

ALTERNATIVE (ARTICULATED BUS)

Street-side doorway located forward of the rear axle of the trailer section.

ALTERNATIVE (ARTICULATED BUS)

Curbside doorway located forward of the center axle.

In cases where street-side and curbside doors are chosen, provisions shall be made for operating the front door, curbside rear door(s) and street-side rear door(s) independently or in the combinations shown in **Table 10** while providing positive tactile feedback to the operator identifying the door control selection.

TABLE 10
Door Operating Combinations

Front	Curbside Rear	Street-Side Rear
Closed	Closed	Closed
Open	Closed	Closed
Open	Open	Closed
Open	Closed	Open
Open	Open	Open
Closed	Open	Closed
Closed	Closed	Open
Closed	Open	Open

DEFAULT**Air Powered**

The door system shall operate per specification at air pressures between 90 and 130 psi.

ALTERNATIVE**Electric**

The door system shall be electrically powered and shall operate per specification.

TS 81.2 Commuter Coach

The passenger door shall be forward of the front wheels and under direct observation of the driver.

TS 81.3 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 nonmetallic 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 minimize infiltration of exterior moisture, noise, dirt and air elements from entering the passenger compartment, to the maximum extent possible based on door types.

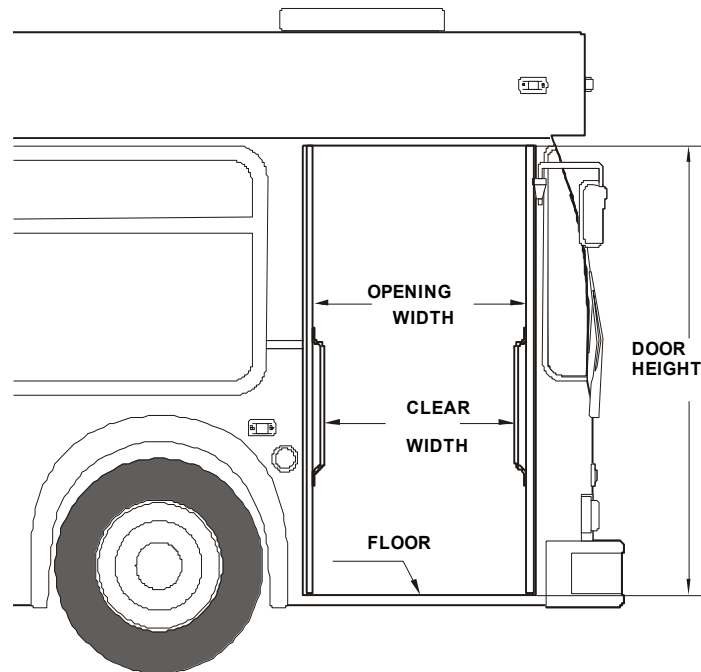
The closing edge of each door panel shall have no less than 2 in. of soft weather stripping. The doors, when closed, shall be effectively sealed, and the hard surfaces of the doors shall be at least 4 in. apart (not applicable to single doors). The combined weather seal and window glazing elements of the front door shall not exceed 10 deg of binocular obstruction of the driver's view through the closed door.

TS 81.4 Dimensions

TS 81.4.1 Transit Coach

FIGURE 9

Transit Bus Minimum Door Opening



When open, the doors shall leave an opening no less than 75 in. in height.

DEFAULT

31¾ in. Minimum Doorway Clear Width

Front door clear width shall be a minimum of 31¾ in. with the doors fully opened. Rear door opening clear width shall be a minimum of 24 in. with the doors fully opened. If a rear door ramp or lift is provided, then the clear door opening width shall be a minimum of 31¾ in. with door fully opened.

ALTERNATIVE

Doorway Clear Width Greater Than 31¾ in.

The front door clear width shall be a minimum of [number] in. with the doors fully opened. The rear door clear width shall be a minimum of [number] in. with the doors fully opened.

NOTE TO USER: If the Agency requires a minimum rear door clear width of 31¾ in. or greater and an outward opening (swing) door is specified, then the maximum outboard excursion of 13 in. may be exceeded.

TS 81.4.2 Commuter Coach

Minimum doorway width per ADA requirements.

TS 81.5 Door Glazing

The upper section of both front and rear doors shall be glazed for no less than 45% of the respective door opening area of each section. The lower section of the front door shall be glazed for no less than 25% of the door opening area of the section. Glazing material in the rear doorway door panels shall be defined by the Agency.

Door glazing shall be easily replaceable.

DEFAULT

Zip-type glazing rubber.

ALTERNATIVE

Quick-change glazing exterior frame.

ALTERNATIVE

Full exterior glass quick-change glazing hidden frame (tempered glass only).

ALTERNATIVE

Bonded or adhesive.

DEFAULT

Laminated Glass

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.

ALTERNATIVE

Tempered Glass

The front door panel glazing material shall have a nominal ¼ in. thick tempered glass conforming with the requirements of ANSI Z26.1 Test Grouping 2 and the recommended practices defined in SAE J673.

TS 81.6 Door Projection (Transit Coach)

TS 81.6.1 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 curbside mirror when the doors are fully open. The exterior projection of both doors shall be minimized and shall not exceed 14 in. during the opening or closing cycles or when doors are fully opened.

TS 81.6.2 Interior

Projection inside the bus shall not cause an obstruction of the rear door mirror or cause a hazard for standees.

TS 81.7 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 is 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 81.8 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 front and rear doors shall be equipped with an obstruction-sensing system. If a contactless obstruction sensing system is employed, then 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 25 lb 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 lb.

TS 81.8.1 Rear Door Closing Force (Transit Coach)

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 in.² of that obstruction.

TS 81.9 Actuators

Doors shall open or close completely in not more than 3.5 seconds from the time of initial door movement and shall be subject to the closing force requirements.

Control algorithms shall ensure satisfaction of the above requirements while maintaining safe door operation. In cases where these requirements are mutually exclusive, the safety requirement must be prioritized. Actuators and the complex door mechanism shall be concealed from passengers but shall be easily accessible for servicing. The door actuators shall be rebuildable. If powered by compressed air, exhaust from the door system shall be routed below the floor of the bus to prevent accumulation of any oil that may be present in the air system and to muffle sound.

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.

DEFAULT

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.

ALTERNATIVE

The rear doors shall be passenger-controlled. 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 of a touch bar or touch switch, or by passenger activation of a contactless sensing system. A switch located within reach of the seated operator shall, when actuated, restore rear door function to complete operator control, and shall open and close in response to the position of the driver's door control.

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 lb 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 81.9.1 Actuator (Commuter Coach)

The nominal door opening and closing speed shall be in the 3 to 5 second range. The maximum door opening and closing speeds will be regulated using fixed, maintenance-free orifices and airline sizes. If required, door speeds can be decreased with the addition of a flow-restricting device. Actuators and the complete door mechanism shall be concealed from passengers but shall be easily accessible for servicing.

TS 81.10 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 lb 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 81.11 Door Control

The door control shall be located in the operator's area toward the street side of the operator's controls within the hand reach envelope described in SAE J287, "Driver Hand Control Reach." The driver's door control shall provide tactile feedback to indicate commanded door position and resist inadvertent door actuation.

DEFAULT

The front door shall remain in commanded state position even if power is removed or lost.

ALTERNATIVE

[Specify.]

TS 81.12 Door Controller

TS 81.12.1 Transit Coach

DEFAULT

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.

ALTERNATIVE

Push-Button Door Controls

Doors shall be operated by push-button controls, conveniently located and operable within the driver's reach. The push buttons shall be labeled. There shall be a separate set of push-button controls for the front and rear door(s), as needed.

ALTERNATIVE

Two-position switch for front door only.

TS 81.12.2 Commuter Coach

Doors shall be operated by push-button controls, conveniently located and operable within the driver's reach. The push buttons shall be labeled.

TS 81.13 Door Open/Close

ALTERNATIVE

Operator-Controlled Front and Rear Doors (if Applicable)

Operation of, and power to, the passenger doors shall be completely controlled by the operator.

ALTERNATIVE (TRANSIT COACH)

Operator-Controlled Front and Passenger-Controlled Rear Doors

Operation of, and power to, the front passenger doors shall be completely controlled by the operator. Power to rear doors shall be controlled by the operator. After enabling, the rear doors shall be opened by the passenger.

ALTERNATIVE (TRANSIT COACH)**Operator-Controlled Front and Passenger-Controlled Rear Doors with Provision for Driver Override**

Operation of, and power to, the front passenger doors shall be completely controlled by the operator. Power to rear doors shall be controlled by the operator. After enabling, the rear doors shall be opened by the passenger. A switch shall be provided to enable the driver to obtain full control of the rear doors.

DEFAULT

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 (if applicable), deactivate the door control system, release the interlocks and permit only manual operation of the rear/center doors.

ALTERNATIVE

An exterior door control switch shall be installed.

ALTERNATIVE

An air dump valve which will allow manual operation doors shall be accessible from the exterior of the bus.

TS 81.14 Passenger Door Interlocks

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

A positive brake application shall be required to engage or disengage the interlock system.

Doors shall not open until the bus is less than 2 mph and the brake interlock is engaged. Once the vehicle has come to a full stop, 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 mid/rear door enable or open position, or a mid or rear door panel is opened more than 3 in. from the fully closed position (as measured at the leading edge of the door panel from the door closed position). Sensors will be used to sense the closed position of each door panel. The interlock engagement shall be capable of holding a fully loaded bus on a 6% grade until the interlocks are released; for diesel and CNG propulsion, this holding capability on a 6% grade may be met with the transmission in gear. These interlock functions shall be active whenever the vehicle master run switch is in any run position.

See [Table 11](#).

DEFAULT

Non-adjustable brake interlock regulator.

ALTERNATIVE

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

ALTERNATIVE

No positive brake application shall be required to engage or to disengage the interlock system.

ALTERNATIVE

Braking effort of brake interlock regulator adjustable with hand tools to be configured and set to meet stopping and hill hold requirements.

DEFAULT

No requirements for accelerator and brake interlocks whenever front doors are open.

ALTERNATIVE

Require 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.

ALTERNATIVE

Require Positive Brake Activation

To prevent vehicle braking using only the door controls as vehicle speed drops below 2 mph, a positive brake application is required to engage accelerator and brake interlocks as the bus is coming to a full stop. To ensure that it is safe to move the bus from a full stop, a positive brake application by the driver is required to disengage the interlocks after doors close and lock.

TABLE 11
Passenger Door Interlocks

Brake Pedal	Vehicle Speed	Rear Door Controller Position	Brake/ Accelerator Interlocks	Service Brakes	Doors	Remarks
Normal Driving						
OFF	>2 mph	Closed	Off	Off	Closed	
ON	>2 mph	Closed	Off	Off	Closed	
OFF	<2 mph	Closed	Off	Off	Closed	
ON	<2 mph	Closed	Off	Off	Closed	
Accidental or Intentional Door Control Actuation						
OFF	>2 mph	Open	Off	Off	Closed	Driver accidentally places door controller in open position.
ON	>2 mph	Open	Off	Off	Closed	
OFF	<2 mph	Open	Off	Off	Closed	Bus coasts below 2 mph.
ON	<2 mph	Open	On	Off	Open	Interlocks turn on and doors start to open <i>after</i> brake application when speed is below 2 mph.
ON	<2 mph	Open	On	On	Open	Full stop. Doors fully open.
OFF	<2 mph	Open	On	On	Open	Driver releases brake pedal.
OFF	<2 mph	Close	On	On	Open	Driver commands door to close. Doors start to close.
OFF	<2 mph	Close	On	On	Closed	Doors fully closed and locked. Interlocks remain on. Brake application required to cancel.
ON	<2 mph	Close	Off	Off	Closed	Positive brake application cancels interlocks. Bus can now move.

TS 82 Accessibility Provisions

Space and body structural provisions shall be provided at the front or rear door of the bus to accommodate a wheeled mobility device loading system and shall comply with ADA regulations on mobility aid accessibility.

TS 82.1 Loading Systems

There are two options:

- low-floor ramp
- platform (boarding bridge plate) level boarding

TS 82.2 Loading System for 30 to 60 ft Low-Floor Bus

The wheeled mobility device ramp control system must be capable of receiving multiplex commands from vehicle interlocks.

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 wheeled mobility device from a level street or curb. This ramp system shall allow manual deployment when necessary.

DEFAULT

Wheeled mobility device ramp mounted in front step well.

ALTERNATIVE

Wheeled mobility device ramp mounted in rear center door location.

ALTERNATIVE**Folding Ramp**

When the system is not in use, the passageway shall appear normal. In the stored position of the ramp, no tripping hazards shall be present, and any resulting gaps shall be minimized. The controls shall be simple to operate with no complex phasing operations required, and the loading system operation shall be under the surveillance and complete control of the driver. If the loading system and controls are at the rear doors, then a keyed switch shall be provided in the driver's area to disable the loading system. The bus shall be prevented from moving during the loading or unloading cycle by a throttle and brake interlock system. The loading system shall be inhibited from stowing/deploying when a passenger is on the ramp/platform. A passenger departing or boarding via the ramp shall be able to easily obtain support by grasping the passenger assist located on the doors or other assists provided for this purpose. The platform shall be designed to protect the ramp from damage and people on the sidewalk from injury during the extension/retraction or lowering/raising phases of operation.

The loading platform shall be covered with a replaceable or renewable nonskid material and shall be fitted with devices to prevent the wheeled mobility device 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 wheeled mobility device and storing the device in the event of a primary power failure. The manual operation of the ramp shall not require more than 35 lb of force.

ALTERNATIVE**Heavy-Duty Ramp System**

Power units must meet other spec requirements (hydraulic or electric).

TS 82.3 Configuration**DEFAULT****Front Door Location of Loading System, Flip-Out Design Ramp with 6:1 Slope**

The wheeled mobility device 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.

ALTERNATIVE**Rear/Center Door Location of Loading System, Flip-Out Design Ramp with 4:1 Slope**

The wheeled mobility device loading system shall be located at the rear/center door, with the ramp being of a simple hinged, flip-out type design being capable of deploying to the ground at a maximum 4:1 slope.

ALTERNATIVE**Rear/Center Door Location of Loading System, Flip-Out Design Ramp with 6:1 Slope**

The wheeled mobility device loading system shall be located at the rear/center door, with the ramp being a flip-out type design being capable of deploying to the ground at a maximum 6:1 slope.

ALTERNATIVE**Front Door Location of Loading System, Flip-Out Design Ramp with Continuous 6:1 slope**

The wheeled mobility device loading system shall be located at the front door, with the ramp being a flip-out type design being capable of deploying to the ground at a maximum continuous 6:1 slope.

ALTERNATIVE**Rear/Center Door Location of Loading System, Flip-Out Design Ramp with Continuous 6:1 Slope**

The wheeled mobility device loading system shall be located at the rear/center door, with the ramp being a flip-out type design being capable of deploying to the ground at a maximum continuous 6:1 slope.

TS 82.4 Loading System for Level Boarding on a 45 to 60 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 lb, 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 lb. When deployed to boarding and alighting surface, the slope of the bridge plate shall not exceed 6:1.

ALTERNATIVE**Rear Door Location of Bridge Plate Loading System**

The bridge plate loading system shall be located at the rear/center door.

TS 82.5 Wheeled Mobility Device Accommodations

All passenger securement devices must be stowed off the floor and out of the way when not in use.

NOTE TO USER: Agency will approve acceptable securement system.

DEFAULT**Two Forward-Facing Wheeled Mobility Device Securement Locations**

Two forward-facing locations, as close to the wheeled mobility device loading system as practical, shall provide parking space and securement system compliant with ADA requirements for a passenger in a wheeled mobility device. The default securement system shall be a four-point, universal and adjustable belt system that attaches to floor-mounted and/or seat-stanchion connection points. The belt system shall be installed in such a manner that it does not interfere with the ability of the passenger to maneuver into the securement area. Automated wheeled mobility device securement systems may be proposed for Agency approval as an optional replacement to the traditional four-point securement system. All securement systems must fully comply with all ADA requirements.

ALTERNATIVE**Additional (Beyond Two) Number of Wheeled Mobility Device Securement Locations**

[number] forward-facing location(s), as close to the wheeled mobility device loading system as practical, shall provide parking space and a securement system compliant with ADA requirements for a passenger in a wheeled mobility device.

ALTERNATIVE**Non-Forward Facing**

[number] non-forward-facing location(s), as close to the wheeled mobility device loading system as practical, shall provide parking space and a securement system compliant with ADA requirements for a passenger in a wheeled mobility device.

TS 82.6 Interior Circulation

Maneuvering room inside the bus shall be compliant with 49 CFR Part 38, Subpart B, §38.29, and accommodate easy travel for a passenger in a wheeled mobility device from the loading device and from the designated securement area. It shall be designed so that no portion of the wheeled mobility device 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 22 in. shall be maintained. As a guide, no width dimension should be less than 34 in. Areas requiring 90 deg turns of wheeled mobility devices should have a clearance arc dimension no less than 45 in., and in the parking area where 180 deg 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 wheeled mobility device footrests.

TS 83 Wheeled Mobility Device Lifts (Commuter Coach)**TS 83.1 Lift**

A travel lift and two mobility device securement areas shall be provided. The lift assembly shall comply with all current ADA and FMVSS 403 and 404 requirements. The lift shall be installed below the floor line at the No. 2 right-hand luggage bay on the curbside of the coach. The Manufacturer shall verify number of seated passengers. The Manufacturer must obtain the Agency's approval of the final seating layout.

DEFAULT**Forward-Facing Securement Areas**

Two forward-facing mobility device securement areas shall be provided.

ALTERNATIVE**At Least One Forward-Facing Securement Area**

At least one forward facing mobility device securement area shall be provided. Other mobility device securement areas may be forward or rearward facing.

The lift shall be controlled by a dash-mounted toggle switch and a rear lift area toggle switch, and operated by up/down switches on a pendant mounted to the lift support bracket inside the No. 2 baggage bay. The lift restraint belt must be buckled before the lift can be raised or lowered. The safety interlock circuit can be energized to operate the lift only if the transmission is in neutral, the parking brake is applied, engine fast idle is on, the dash-mounted master switch is on, the lift secondary switch is on, and the lift restraint belt is buckled.

The wheeled mobility device loading system shall provide safe, comfortable and rapid ingress and egress for applicable passengers from the street level or a curb. When not in use, the lift shall stow in the luggage bay. The lift mechanism shall include a threshold warning function to provide passengers a visual and audible warning that the platform is away from the threshold area as well as an anti-stow function that will prevent stowing of the lift platform when occupied by a passenger. . The outer barrier shall be automatically controlled and shall be such that it cannot be overridden by the loading system operator. A dash-mounted indicator light shall be provided and shall be illuminated when the loading system is activated. The interlock shall apply, the bus shall not move and the engine throttle/propulsion system shall be disabled whenever the wheeled mobility device loading system is activated. If the lift door is open or ajar, the interlock shall remain engaged. Brackets, clamps, screw heads and other fasteners used on the passenger assists shall be anodized aluminum or stainless steel and shall be flush with the surface and free of rough edges.

The lift control mounted on the lift structure shall have push button up/down switches. The toggle electrical supply switch shall be located in close proximity to the controller. This toggle switch must be turned on prior to the lift operation. All lift control switches shall be permanently labeled. Decals shall not be permitted. The stow guard switch shall be red in color if used. . These switches shall be incorporated in a handheld pendant.

The lift shall include a hinged platform to bridge the coach floor to the lift platform. The bridge shall be hinged and locked in an upward position to act as a barrier when the lift is in use. The bridge shall also allow lift passenger ingress/egress easily from the platform. Lift travel speeds and lift operation shall be adjusted to the lift manufacturer's specifications upon completion of the lift installation into each coach and before coach delivery. The individual handrails shall fold and stow automatically with the lift.

The lift shall include an emergency system in case of driver operation malfunction. Should an emergency situation occur, the lift operator shall release the push-button switch on the handheld pendant to immediately stop the lift cycle. The emergency hand pump handles and pump shall be located in an enclosed box at the rear wall of the No. 1 right-hand luggage bay door. The handle shall be stored adjacent to the pump to allow immediate usage.

TS 83.2 Lift Door

The lift door shall be a single-leaf design that operates in a sliding track mounted both above and below the door leaf. The door shall open by sliding to the rear of the coach and shall remain on a horizontal plane throughout the opening and closing process. No pin-hinged doors shall be provided. The vehicle must be in neutral and the parking brake activated for the lift to operate. The accelerator shall be automatically disabled and the fast idle system activated when either the lift master switch is turned on or the lift door is open in order to provide maximum safety and security. These features shall be wired to the lift master switch to allow activation only when the vehicle is in neutral. The coach directional (hazard) lights will also flash on/off. After the lift operation is completed, the lift shall be properly stored and secured, with the access door closed and the lift master switch at the dash in the "off" position in order to move the coach.

The lift door shall have a window in line with the other passenger windows and shall not detract from the appearance of the coach. The door latch mechanism shall be located in the lower section of the door so that operators in the 5th-percentile female range can operate the lift door.

The lift storage door shall not block the visual observation to the lift assembly while using the manual override mode of the lift. A lift door design consisting of a horizontally hinged lift platform egress door mounted within a vertical motion pantograph luggage door is a preferred design.

TS 83.3 Lift Doorway

The installation of the lift to the coach structure as well as the installation of the lift door into the sidewall of the coach shall not affect the structural integrity of the coach. The parcel rack module above the wheeled mobility device lift platform area shall be permanently removed to provide additional headroom. The modified rack shall

be professionally finished at all ends. A threshold warning module with a red warning light and an acoustic sensor shall be mounted in the ceiling structure above the wheeled mobility device lift entrance doorway. The heating and air ducts shall be rerouted around the lift area to ensure proper interior air conditioning/heating airflow and distribution. A passenger chime tape switch shall be mounted on the sidewall at the two wheeled mobility device securement positions. Each coach shall have adequate information decals installed that detail the proper lift operation in both the normal and manual modes of operation.

TS 83.4 Lighting Requirements

Lighting for the lift areas shall be designed to meet Title 13 and ADA and FMVSS 404 standards. Lighting shall be provided to effectively illuminate the lift area. Light shall be wired through the lift master toggle switch on the driver's dash and shall automatically illuminate when this switch is in the "on" position. The lighting design shall minimize the effect of glare on passengers entering the bus through the wheeled mobility device lift door. During lift operation, the street surface shall be illuminated to a minimum of 6 candlepower a distance of 3 ft beyond the external dimensions of the lift platform once deployed and lowered. Additional lighting shall be provided to ensure illumination of the instruction placard and the manual override pump when it is in use.

TS 83.5 Securement System

The vehicle interior shall permit the securement of two passengers in forward-facing wheeled mobility devices in which the primary position shall be on the street side of the coach directly across from the lift. Securement areas shall be a minimum 30 × 48 in. as required by the ADA.

The default securement system shall be a four-point, universal and adjustable belt system that attaches to floor-mounted and/or seat-stanchion connection points. The belt system shall be installed in a manner such that it does not interfere with the ability of the passenger to maneuver into the securement area. Automated wheeled mobility device securement systems may be proposed as an optional replacement to the traditional four-point securement system. All securement systems must fully comply with all ADA requirements.

A separate three-point, driver applied seatbelt securement (lap and shoulder) shall be provided to effectively secure wheeled mobility device passengers. To further secure the passenger during the lift operation, a retractable seat belt strap shall be provided at the ingress/egress area of the lift platform. A minimum 10.5 in. high barrier shall also be provided at the rear of the lift area for additional passenger protection.

TS 84 Destination Signs

DEFAULT

A destination sign system shall be furnished on the front, on the right side near the front door and shall comply with the ADA.

ALTERNATIVE

Route sign on the rear of the vehicle.

ALTERNATIVE

Street and Curbside Route Sign

The sign located near the front door shall not block the driver's critical horizontal line of sight. Display areas of destination signs shall be clearly visible in direct sunlight and/or at night. Parts shall be commercially available.

All signs shall be controlled via a single human-machine interface (HMI). In the absence of a single mobile data terminal, the HMI shall be conveniently located for the bus driver within reach of the seated driver.

DEFAULT

The driver shall be able to access the sign controller while seated.

ALTERNATIVE

The sign controller shall not be located within reach of the seated driver.

DEFAULT

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 the unit itself.
- Access shall be provided to allow cleaning of inside compartment window and unit glazing.
- The front window shall have an exterior display area of no less than 8.5 in. high by 56 in. wide.

ALTERNATIVE

No active defogging required.

ALTERNATIVE

Run number sign shall be installed.

TS 85 Passenger Information and Advertising (Transit Coach)

TS 85.1 Interior Displays

Provisions shall be made on the rear of the driver's barrier or equipment box located on the 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 85.2 Exterior Displays

Provisions shall be made to integrate advertising into the exterior 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 or vehicle fittings, or in any other manner restrict the operation or serviceability of the bus.

TS 86 Passenger Stop Request/Exit Signal

TS 86.1 Transit Coach

DEFAULT

Touch Tape 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 touch tape, chime and interior sign message. The touch tape shall be accessible to all seated passengers, with provisions for standees. It shall be easily accessible to all passengers, seated or standing. Vertical touch tape shall be provided at each window mullion and adjacent to each wheeled mobility device parking position and in priority seating positions. In addition, each wheeled mobility device area shall have a stop request device that is activated through the application of broad physical pressure, such as a button with a large surface area, which can be activated without the need of grasping, pulling or fine motor skills.

ALTERNATIVE

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 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, then 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 wheeled mobility device passenger position and at priority seating positions, additional provisions shall be included to allow a passenger using a mobility aid to easily activate the “stop requested” signal without having to grasp or pull.

An auxiliary passenger “stop requested” signal shall be installed at the rear door to provide passengers standing in the rear door/exit area a convenient means of activating the signal system. The signal shall be a heavy-duty push button type located in the rear door vicinity. Button shall be clearly identified as STOP.

DEFAULT

No requirements for additional “stop request” button on rear door stanchion.

ALTERNATIVE

Additional “Stop Request” Button on Rear Door Stanchion

A heavy-duty “stop request” signal button shall be installed on the modesty panel stanchion immediately forward of the rear door and clearly identified as “STOP.”

ALTERNATIVE

“Stop request” signal buttons shall be available at intervals to be determined by the Agency.

TS 86.2 Commuter Coach

A heavy-duty “stop request” signal button shall be installed at every seat location except the rear cross seat.

TS 86.3 Signal Chime

DEFAULT (TRANSIT COACH)

A single “stop requested” chime shall sound when the system is first activated. A double chime shall sound anytime the system is activated from wheeled mobility device passenger areas. Audible chimes shall be accompanied by a visual display/signal that indicates to passengers inside the bus that a stop has been requested.

Exit signals located in the wheeled mobility device passenger area shall be no higher than 4 ft above the floor. Instructions shall be provided to clearly indicate function and operation of these signals.

ALTERNATIVE (TRANSIT COACH)

Passenger signal system shall be arranged with push-button switches accessible by each seated passenger and on stanchions and at rear door locations for standees. In addition, each wheeled mobility device area shall have a stop request device that is activated through the application of broad physical pressure, such as a button with a large surface area, which can be activated without the need of grasping, pulling or fine motor skills

DEFAULT (COMMUTER COACH)

A single “stop requested” chime shall sound when the system is first activated. A double chime shall sound anytime the system is activated from wheeled mobility device passenger areas. Audible chimes shall be accompanied by a visual display/signal that indicates to passengers inside the bus that a stop has been requested.

Stop request actuators located in the wheeled mobility device passenger area shall be no higher than 4 ft above the floor. Instructions shall be provided to clearly indicate the function and operation of these signals. In addition, each wheeled mobility device area shall have a stop request device that is activated through the application of broad physical pressure, such as a button with a large surface area, which can be activated without the need of grasping, pulling or fine motor skills.

ALTERNATIVE (COMMUTER COACH)

[Agency to specify the stop request system for wheeled mobility device seating area in compliance with ADA requirements.]

TS 87 Communications

TS 87.1 Camera Surveillance System

DEFAULT

No surveillance system provisions required.

ALTERNATIVE

Provide all wiring and mounting locations for a multi-camera surveillance system for the later provision of and installation of cameras, recorder, microphone, etc. [Specify the camera system cable to be installed, the locations for pre-wiring and the quantity.]

ALTERNATIVE

[Specify all wiring and mounting locations for a multi-camera surveillance system, including the installation of cameras, recorder, microphone, etc. Specify the number of interior and exterior cameras to be provided and installed.]

TS 87.2 Public Address System

A public address system shall be provided on each bus for facilitating automated stop announcements and driver-originated announcements to passengers.

TS 87.2.1 Speakers**DEFAULT**

[number] interior loudspeakers shall be provided, semi-flush mounted, on alternate sides of the bus passenger compartment, installed with proper phasing. Speaker impedance shall match load requirements of the amplifier.

TS 87.3 Automatic Passenger Counter (APC)**DEFAULT**

No APC system shall be installed.

ALTERNATIVE

An infrared [or specify other technology] APC system shall be installed. [Provide details of APC system, including installation locations and number of buses to be equipped.]

TS 87.4 Radio Handset and Control System Options**TS 87.4.1 Driver's Speaker**

Each bus shall have a recessed speaker in the ceiling panel above the driver. This speaker shall be the same component used for the speakers in the passenger compartment. It shall have 8 ohms of impedance.

TS 87.4.2 Handset

Contractor shall install a handset for driver use.

TS 87.4.3 Driver Display Unit

Contractor shall install a driver display unit as close to the driver's instrument panel as possible.

TS 87.4.4 Emergency Alarm

Contractor shall install an emergency alarm that is accessible to the driver but hidden from view.

TS 88 Event Data Recorder**DEFAULT**

No event data recorder shall be installed.

ALTERNATIVE

[Specify event data recorder requirements.]

TS 89 Approved Equals

Table 12 lists products that have been approved for the bus procurement. The list contains products that are of interest to the Agency and is not intended to be a comprehensive listing of every product required for the manufacture of the subject buses. Product categories not listed are left to the discretion of the Contractor so long as the product complies with the specifications. Product specification information is for reference only and may not reflect the latest or future improvements by manufacturers. Any change, revision or substitution of specified products requires approval of the Agency. To add to or revise this list, the Contractor must submit a written request per the Specification by the due date found in the RFP for approved equals.

NOTE TO USER: Agencies are encouraged to list as many suppliers as possible.

TABLE 12
Approved Equals Products

Product	Manufacturer	Product Specification

TS 90 Life Cycle Cost

Manufacturer shall provide a 12-year life cycle cost projection based on the Agency’s duty cycle with its cost proposal.

Fuel or energy consumption, all preventive and corrective maintenance labor, parts and supplies expense, and any rehabilitation or other required investment to maintain the bus in a state of good repair for 12 years, shall be included. Bus operator labor and daily servicing labor shall not be included.

SECTION 7: 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 Agency each complete bus and specific subsystems and components as follows. Performance requirements based on design criteria shall not be deemed a warranty item.

WR 1.1.2 Complete Bus (Diesel, CNG, Hybrid)

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 but not longer than 15 days after acceptance under “Inspection, Testing and Acceptance.” The warranty is based on regular operation of the bus under the operating conditions prevailing in the Agency’s locale.

WR 1.1.3 Complete Bus (Battery Electric)

DEFAULT

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 but not longer than 15 days after acceptance under “Inspection, Testing and Acceptance.” The warranty is based on regular operation of the bus under the operating conditions prevailing in the Agency’s locale.

ALTERNATIVE

The complete bus, propulsion system, components, major subsystems and body and chassis structure are warranted to be free from Defects and Related Defects for two years or 100,000 miles, whichever comes first, beginning on the date of revenue service but not longer than 15 days after acceptance under “Inspection, Testing and Acceptance.” The warranty is based on regular operation of the bus under the operating conditions prevailing in the Agency’s locale.

WR 1.1.4 Body and Chassis Structure

Body, body structure, and 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 1.1.5 Propulsion System (Diesel, CNG, Hybrid)

Propulsion system components, including the engine, transmission or drive motors, and generators (for hybrid technology) and drive and non-drive axles, shall be warranted to be free from Defects and Related Defects for the standard two (2) years or 100,000 miles, whichever comes first. An Extended Warranty to a maximum of five (5) 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, should be submitted

in accordance with the Request for Pre-Offer Change or Approved Equal, or with the Form for Proposal Deviation.

WR 1.1.6 Propulsion System (Battery Electric)

DEFAULT

In its proposal, the Contractor shall provide information on standard warranties and available extended warranty options.

ALTERNATIVE

Propulsion system components, including the traction motor(s), traction motor controller(s), transmission, drive motors, drive and non-drive axles, and any other propulsion system-related line replacement components, shall be warranted to be free from Defects and Related Defects for the standard twelve (12) years or 500,000 miles, whichever comes first. The propulsion system manufacturer's standard warranty, delineating items excluded from the Extended Warranty, should be submitted in accordance with the Request for Pre-Offer Change or Approved Equal or with the Form for Proposal Deviation.

ALTERNATIVE

Propulsion system components, including the traction motor(s), traction motor controller(s), transmission, drive motors, drive and non-drive axles, and any other propulsion system-related line replacement components, shall be warranted to be free from Defects and Related Defects for the standard six (6) years or 300,000 miles, whichever comes first. An optional Extended Warranty of twelve (12) years or 500,000 miles, whichever comes first, shall be submitted with the proposal. The propulsion system manufacturer's standard warranty, delineating items excluded from the Extended Warranty, should be submitted in accordance with the Request for Pre-Offer Change or Approved Equal or with the Form for Proposal Deviation.

WR 1.1.7 Energy Storage System (Hybrid or Battery Electric)

DEFAULT

In its proposal, the Contractor shall provide information on standard warranties and available extended warranties options.

ALTERNATIVE

The energy storage system (ESS), including the traction battery, battery management system and any other ESS-related line replacement component, shall be warranted to be free from Defects and Related Defects for six (6) years or 300,000 miles, whichever comes first, beginning on the date of bus acceptance under "Inspection, Testing and Acceptance," per this RFP. The ESS shall also be warranted for six (6) years or 300,000 miles, whichever comes first, to remain within warrantable end of life. An optional Extended Warranty of twelve (12) years or 500,000 miles shall be submitted with the proposal. The ESS original specified energy storage capacity and Warrantable End of Life (see definition of Warrantable End of Life in section TS 2), as a percentage of the original specified energy capacity, shall be clearly defined by the Proposer. Acceptable methods for measuring or obtaining ESS storage capacity with respect to its original specified capacity shall be clearly identified by the Manufacturer. The Manufacturer will propose the test method and certify that the results are true and accurate. The test will be performed according to a documented test procedure. The Agency is allowed to engage third parties for capacity testing. If applicable, the proposal shall include a comprehensive statement of any additional warranty terms relating to the ESS, including explanation of all disclaimers within the warranty.

ALTERNATIVE

The energy storage system (ESS), including the traction battery, battery management system and any other ESS-related line replacement component, shall be warranted to be free from Defects and Related Defects for twelve (12) years or 500,000 miles, whichever comes first, beginning on the date of bus acceptance under "Inspection, Testing and Acceptance," per this RFP. The ESS shall also be warranted for twelve (12) years or 500,000 miles, whichever comes first, to remain within warrantable end of life. The ESS original specified energy storage capacity and Warrantable End of Life (see definition of Warrantable End of Life in section TS 2), as a percentage of the original specified energy capacity, shall be clearly defined by the Proposer. Acceptable methods for measuring or obtaining ESS storage capacity with respect to its original specified capacity shall be clearly identified by the Manufacturer. The Manufacturer will propose the test method and certify that the results are true and accurate. The test will be performed according to a documented test procedure. The Agency is allowed to engage third parties for capacity testing. If applicable, the proposal shall include a comprehensive statement of any additional warranty terms relating to the ESS, including explanation of all disclaimers within the warranty.

ALTERNATIVE

The energy storage system (ESS) shall be leased. The ESS, including the traction battery, battery management system and any other ESS-related line replacement component, shall be warranted to be free from Defects and Related Defects for the term of the ESS lease. The ESS shall also be warranted for the term of the lease to remain within Warrantable End of Life (see definition of Warrantable End of Life in section TS 2). The ESS original specified energy storage capacity and Warrantable End of Life, as a percentage of the original specified energy capacity, shall be clearly defined by the Proposer. Acceptable methods for measuring or obtaining ESS storage capacity with respect to its original specified capacity shall be clearly identified by the Manufacturer. The Manufacturer will propose the test method and certify that the results are true and accurate. The test will be performed according to a documented test procedure. The Agency is allowed to engage third parties for capacity testing. If applicable, the proposal shall include a comprehensive statement of any additional warranty terms relating to the ESS, including explanation of all disclaimers within the warranty.

WR 1.1.8 Emission Control System (ECS)

The Contractor warrants the emission control system (ECS) 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)
- aftertreatment device
- components identified as emission control devices

WR 1.1.9 Subsystems

The following subsystems shall be warranted to be free from Defects and Related Defects for two (2) years or 100,000 miles, whichever comes first:

- 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

- Wheeled mobility device 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 and tanks, and including related surrounding framework and fittings
- Fire suppression: Fire suppression system, including tank and extinguishing agent dispensing system
- Hydraulic systems, including radiator fan drive and power steering as applicable
- Propulsion system cooling systems: Radiator, including core, tanks and related framework, surge tank and transmission cooler
- Power electronics: DC/DC converters, inverters, if supplied
- Passenger seating: Excluding upholstery
- Fuel storage and delivery system
- Surveillance system: Including cameras and video recorders

The following subsystems shall be warranted to be free from Defects and Related Defects for twelve (12) years or 500,000 miles, whichever comes first:

- Low-voltage and high-voltage electrical wiring and harnesses (12 years)

WR 1.1.10 Extended Warranty

The Agency requires the following additional subsystems to be warranted to be free from Defects and Related Defects for two (2) years or 100,000 miles, whichever comes first.

- [Insert as appropriate.]

WR 1.1.11 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. If supplied with the bus, the list shall include, but not be limited to, the following:

- Engine or traction motor(s)
- Propulsion system controller/inverter(s)
- Energy storage pack(s) or module(s)
- Power electronics: DC/DC converters, inverters
- Transmission
- Alternator
- Starter
- HVAC system and major components
- Drive axle
- Power steering unit
- Fuel cylinders (if applicable)
- Air compressor
- Wheeled mobility device ramp (if applicable)

The Contractor shall provide updated serial numbers resulting from warranty campaigns. The format of the list shall be approved by the Agency prior to delivery of the first production bus.

WR 1.1.12 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, then 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 Contractor-provided maintenance manuals and workmanship performed by adequately trained personnel (in accordance with recognized standards of the industry). The warranty also shall be void if the Agency fails to conduct normal inspections and scheduled preventive maintenance procedures as recommended in the Contractor's maintenance manuals, and if that omission causes the part or component failure. The Agency 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 Agency

Should the Agency 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 Agency. This product will not be eligible under the subsection entitled "Fleet Defects."

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

Agency and Contractor agree that the warranty terms of this Contract apply in general to systems, components, and parts supplied by suppliers and subcontractors, and that the Contractor will generally be the exclusive point of contact and administer the Agency's warranty claims under this Contract. The Contractor hereby guarantees to provide, within reasonable periods of time, the completed warranty work or reimbursement required by this Contract for all systems, components and parts, software, and all equipment necessary to maintain and repair the buses supplied under this Contract.

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.

DEFAULT**Contractor Administration of Warranty with Best Efforts for Supplier or Subcontractor Exceptions**

If a Supplier or Subcontractor will not allow the Contractor to administer the warranty, a Contractor may request an exception in their proposal (1) for parts for which the Agency specified a brand name, the Contractor requested an approved equal, and the Agency denied approval; and (2) for parts where the Agency's specification was a sole source specification, the Contractor requested an approved equal or modification, and the Agency denied the request. The Agency may include the exception requests in its evaluation of proposals, and may request revised offers.

For each system, component, part, software module or item of equipment for which the Contractor does not promise full Contractor administration of the warranty ("Excepted Parts"), the Contractor shall list each item with the Contractor's and Supplier's part number in its proposal and the reason that full, required warranty administration is not promised by the Contractor.

If the Contract includes Excepted Parts, and the Contractor requests approval from the Agency to assign its warranty obligation to a third party, the Contractor shall certify to the Agency that the Contractor has attempted in good faith to administer the component supplier's warranty program, and that the component supplier will not allow the Contractor to administer its warranty program. The Agency shall approve the transfer of warranty administration responsibility.

ALTERNATIVE**Contractor Administration of Warranty with Assignment at Agency's Discretion**

At any time during the warranty period, the Contractor may request approval from the Agency to assign its warranty obligations to others, but only on a case-by-case basis approved in writing by the Agency. 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.

If the Agency approves the transfer of administration for warranty claim responsibility from the Contractor to a Supplier or Subcontractor, then:

- a. The Contractor shall supply adequate documentation that the component Supplier affirmatively accepts responsibility for warranty service;
- b. The Contractor shall state in writing that the Agency'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. The Contractor shall supply all information necessary to enforce the warranty;
- c. The Contractor shall agree to assist the Agency in any actions to enforce the warranty; and
- d. The Agency shall agree to accept this pass-through warranty and relieve the Contractor of further responsibility for that warranty, except as detailed herein.

WR 1.3.2 Superior Warranty

The Contractor shall pass on to the Agency any warranty offered by a component Supplier that is superior to that required herein. The Contractor shall provide a list to the Agency noting the conditions and limitations of the Superior Warranty no 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 25% of the same components in the same or similar application in a minimum fleet size of twenty (20) 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 Agency 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 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 Agency may immediately declare a Defect in design resulting in a safety hazard to be a Fleet Defect. The Contractor shall be responsible for furnishing, installing and replacing all defective units.

WR 1.4.2 Exceptions to Fleet Defect Provisions

The Fleet Defect warranty provisions shall not apply to Agency-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 Agency will allow the Contractor, or its designated representative, to perform such Work. At its discretion, the Agency 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 Agency 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 (5) calendar days after receiving notification of a Defect from the Agency. The Agency 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 Agency’s option, the Contractor may be required to remove the bus from the Agency’s property while repairs are being effected. If the bus is removed from the Agency’s property, then repair procedures must be diligently pursued by the Contractor’s representative.

WR 2.3 Repairs by the Agency

WR 2.3.1 Parts Used

If the Agency performs the warranty-covered repairs, then 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 Agency may use Contractor-specified parts available from its own stock if deemed in its best interests.

WR 2.3.2 Contractor-Supplied Parts

The Agency may require that the Contractor supply parts for warranty-covered repairs being performed by the Agency. Those parts may be remanufactured but shall have the same form, fit and function, and warranty. The parts shall be shipped prepaid to the Agency 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 Agency 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 Agency, 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 sixty (60) days of the receipt of failed parts.

WR 2.3.5 Reimbursement for Labor and Other Related Costs

The Agency shall be reimbursed by the Contractor for labor. The amount shall be determined by the Agency for a qualified mechanic at a straight time wage rate of [wage] per hour, which includes fringe benefits and overhead, adjusted for the Agency’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 Agency’s service garage at the time the Defect correction is made.

WR 2.3.6 Reimbursement for Parts

The Agency shall be reimbursed by the Contractor for defective parts and 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 15% handling costs. Handling costs shall not be paid if parts are supplied by the Contractor and shipped to the Agency.

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 Agency 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 Agency 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 Agency with the concurrence of the Contractor, then that component, unit or subsystem shall have the unexpired warranty period of the original. Repairs shall not be warranted if Contractor-provided or authorized parts are not used for the repair, unless the Contractor has failed to respond within five (5) days, in accordance with “Repairs by the Contractor.”

If an item is declared to be a Fleet Defect, then 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 the 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 that the Contractor provides all parts to the Agency.

WR 2.4.1 Warranty Processing Procedures

The following list represents requirements by the Contractor to the Agency 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), such as for:
 - labor
 - materials
 - parts
 - handling
- Association with component failure eligible for warranty for costs claimed, such as:
 - towing
 - road calls
 - troubleshooting time

WR 2.5 Forms

The Agency’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 the Agency.

WR 2.6 Return of Parts

When returning defective parts to the Contractor, the Agency 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 the date of repair.

WR 2.8 Reimbursements

Reimbursements are to be transmitted to the following address:

[Insert address.]

SECTION 8: 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 authority over 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 this 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 with 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 documented Work instructions, adequate production equipment, and special working environments if necessary.
- **Completed items:** A system for final inspection and testing 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 analyses, tests and other quality control procedures may be used when appropriate in the quality assurance process.
- **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. At 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 a 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 Agency 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 Agency.

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, propulsion system 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

The Agency shall be represented at the Contractor's plant by resident inspectors. Resident inspectors may be Agency employees or outside contractors. The Agency shall provide the identity 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 this procurement. The presence of these resident inspectors in the plant shall not relieve the Contractor of its responsibility to meet all the requirements of this procurement. The Agency shall designate a primary resident inspector, whose duties and responsibilities are delineated in "Pre-Production Meetings," "Authority," and "Pre-Delivery Tests." Contractor and resident inspector relations shall be governed by the guidelines included as Attachment A to this section.

QA 2.2.2 Pre-Production Meetings

The primary resident inspector may participate in design review and pre-production meetings with the Agency. At these meetings, the configuration of the buses and the manufacturing processes shall be finalized, and all Contract documentation provided to the inspector. If the final configuration includes any changes, the Agency and the Contractor shall work together to accomplish the change with as little delay as possible. These changes cannot be done within thirty (30) calendar days before production.

No less than thirty (30) calendar 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, then the Agency shall approve the modification, repair or method of correction to the extent that the Contract specifications were 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 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 inter-plant telephones, internet access, file cabinet(s) and chairs.

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 Agency's inspector(s) and any other Agency 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 Agency. These acceptance tests shall include pre-delivery inspections and testing by the Contractor, and inspections and testing by the Agency 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 Agency. These pre-delivery tests shall include visual and measured inspections, as well as testing the total bus operation—and, if electric drive, the charging operation. The tests shall be conducted and documented in accordance with written test plans approved by the Agency.

Additional tests may be conducted at the Contractor's discretion to ensure that completed buses have attained the required quality and have met the requirements in Section 6, "Technical Specifications." The Agency 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 a Contractor 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 configurations. 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 dimensions 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 or electronic files showing the performance of each bus shall be produced and provided to the Agency. 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 3.2.3 Pre-Delivery Tests Required

The Agency and Contractor shall complete the following tests prior to delivery of each bus:

[Insert Agency-specific pre-delivery test requirements.]

QA 3.3 Post-Delivery Tests

The Agency and Contractor shall conduct post-delivery tests within the required time after the delivery of each bus to the designated point of delivery, as set out in sections GC 4 and GC 5. The Agency and Contractor shall complete the following post-delivery tests:

[Insert Agency-specific post-delivery test requirements.]

QA 4 Agency-Specific Requirements

[Insert Agency-specific quality assurance requirements.]

Attachment A: New Bus Manufacturing Inspection Guidelines

Pre-Production Meeting Responsibilities

Agency

- Provides conformed copy of technical requirements.
- Recommended staff to be involved may include the following:
 - project manager
 - technical engineer
 - contract administrator
 - quality assurance administrator
 - warranty administrator
- Process for inspector's role (to deal with Agency) for negotiated changes after freeze date.
- Contractual requirements:
 - milestones
 - documentation
 - title requirements
 - deliverables
 - payments
 - reliability tracking

Manufacturer

- Identifies any open issues.
- Recommended staff to be involved may include the following:
 - project manager
 - technical engineer(s)
 - contract administrator
 - quality assurance administrator
 - warranty administrator
- Production flow (buses/week, shifts).
- Delivery schedule and off-site component build-up schedule.
- Bus QA documentation (including supplier application approvals and/or any certifications required for the specific production).
- Communication flow/decision-making.

Inspector

- Agrees on decisions inspectors can and cannot make.
- Primary contact for problems, etc.
- Production flow process (description of manufacturing by station).
- Factory hours (manage inspection schedule based on production hours).
- Plant rules.
- Safety requirements.
- Orientation requirements.
- Work environment.
- Inspector's office space (per contract).

NOTE TO USER: *As a result of this meeting, documentation should be produced detailing final production requirements and the planned configuration of the bus.*

Build Schedule

The bus manufacturer's contract administrator shall supply a fleet build production schedule based on the dates in the Notice to Proceed, and a description of the manufacturer's schedule for plant operations.

The production schedule should contain specific milestone dates, such as the following:

- First vehicle on production line (date on which any work will begin)
- First vehicle off production line
- First vehicle through manufacturer's quality assurance inspections
- First vehicle shipped to the Agency
- Last vehicle on production line
- Last vehicle off production line
- Last vehicle shipped to the Agency

Plant Tour (if Meeting at Manufacturer's Location)

The Agency will review the entire process from start to finish and review the work completed at each line station, including quality control measures.

Prototype/Pilot Vehicle Production

The Contractor shall conduct acceptance tests at its plant on each bus following completion of manufacture, and before delivery to the Agency. These pre-delivery tests shall include visual and measured inspections, as well as testing of the total bus operation. The tests shall be conducted and documented in accordance with written test plans approved by the Agency. 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.

Additional tests may be conducted at the Agency's discretion to ensure that the completed buses have attained the required quality and have met the requirements in Section 6, "Technical Specifications." The Agency 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 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.

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.

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 15 miles during the road tests. If requested, computerized diagnostic printouts showing the performance of each bus shall be produced and provided to the Agency. 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.

Post-Delivery Tests

The Agency shall conduct acceptance tests on each delivered bus. These tests shall be completed within 15 days after bus delivery and shall be conducted in accordance with the Agency's 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 Agency. The post-delivery tests shall include visual inspection and bus operations. No post-delivery test shall apply new criteria that are different from criteria applied in a pre-delivery test.

Buses that fail to pass the post-delivery tests are subject to nonacceptance. The Agency shall record details of all defects on the appropriate test forms and shall notify the Contractor of acceptance or nonacceptance of each bus after completion of the tests. The defects detected during these tests shall be repaired according to procedures defined in the contract.

Prototype/Pilot Vehicle Acceptance

In order to assess the Contractor's compliance with the Technical Specifications, the Agency 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 become part of the official record of the pre-production meeting.

Potential dimensional/performance tests that may be included in the Configuration and Performance Review include the following:

- complete electrical system audit
- dimensional requirements audit
- seating capacity
- water test
- water runoff test
- function test of systems/subsystems and components
- sound/noise level tests
- vehicle top speed
- acceleration tests
- brake stop tests
- airflow tests
- PA function tests
- air/brake system audit
- individual axle weight
- standee capacity
- body deflection tests
- silent alarm function test
- interior lighting
- exterior lighting
- gradeability test
- kneeling system function
- HVAC pull-down/heat
- speedometer
- outside air infiltration (smoke)
- wheeled mobility device ramps

- propulsion system performance qualification
 - This test shall be jointly conducted by the Contractor and the propulsion system manufacturer (including, but not limited to, charge air cooler performance, air to boil test, loss of coolant, fuel system, electrical inputs and protection systems).
- transmission performance qualifications
 - This test shall be jointly conducted by the Contractor and the transmission manufacturer (including, but not limited to, retarder operation, heat exchanger, interface with ABS and electrical inputs).

Buy America Audit

A post-delivery Buy America audit is required for federally funded bus procurements (see 49 CFR Part 663 for additional information). The on-site resident inspectors are to monitor the production processes to verify compliance with final assembly requirements identified by the Buy America pre-award audit. This audit is to verify compliance with final assembly requirements and final documentation of Buy America compliance, and must be completed prior to title transfer.

NOTE TO USER: *If there is not a pilot/prototype bus, then the Buy America post-delivery audit should be performed following completion of the first serial production bus. In addition to monitoring of the production processes, the Agency must verify compliance with the stipulation that more than 70% of the costs of all components were produced in the United States. Finally, the Agency must execute the required certificates.*

Resident Inspection Process for Serial Production

At the discretion of the Agency, a decision will be made to perform resident inspection using the Agency's personnel, a contract inspector or a combination of both. This decision is based on factors such as the availability of personnel, knowledge/expertise in bus build project management, the size of the bus order, etc.

NOTE TO USER: *The decision to have the resident inspection performed by Agency personnel results in a firm understanding and knowledge of the bus and affords the opportunity to identify parts that will be needed for general maintenance down the road.*

Inspector Responsibilities

The resident inspection process for the serial production of the buses begins following the completion and acceptance of the prototype or pilot vehicle if required, or according to the serial bus production schedule. Resident inspectors should represent the Agency for all build-related issues (quality, conformance, etc.). Resident inspectors can also address contractual-type issues but should only do so under the consult of the Agency's contracts administrator.

Resident inspectors are sent to the manufacturer's facility according to a Resident Inspection Schedule. Typically, one or two inspectors arrive on-site at the manufacturing facility about one week prior to actual production to setup the resident inspection process and to begin preliminary quality assurance inspections for items such as powerplant build-up and wire harness production; as well as to inspect incoming parts, fasteners, fluids, etc., that will be used in the production of the buses. During the serial production of the buses, the resident inspectors should monitor the production of each bus, verifying the quality of materials, components, subassemblies and manufacturing standards. In addition, the configuration of each vehicle should be audited using the vehicle manufacturer's build specification and other documents to ensure contract compliance and uniformity.

Inspector Rotation/Scheduling

During the resident inspection phase, a single inspector or multiple inspectors can be used. If it is decided to use multiple inspectors, then the inspectors can be rotated on a biweekly-to-monthly basis as required. During the

rotation of inspectors, a sufficient period of overlap should be provided to guarantee the consistency of the resident inspection process.

Resident Inspector Orientation

A resident inspector orientation by the bus manufacturer should take place upon the arrival of the initial inspection team. The orientation should include expectations for the use of personal protective equipment (safety shoes, safety glasses, etc.), daily check-in and check-out requirements, lines of communication, use of production documents (such as speed memos and line movement charts), inspector/production meetings, inspector office arrangements, and anything else pertinent to the inspection team's involvement during the build. Many of the above items should already have been formalized during the pre-production meeting.

Audits, Inspections and Tests

The resident inspection process monitors the production of each vehicle. Inspection stations should be strategically placed to test or inspect components or other installations before they are concealed by subsequent fabrication or assembly operations. These locations are typically placed for the inspection of underbody structure, body framing, electrical panels and harnesses, air and hydraulic line routings, installation of insulation, powerplant build-up and installation, rust inhibitor/undercoating application, floor installation, front suspension alignment, and other critical areas.

Vehicle Inspections

Each bus is subjected to a series of inspections after it reaches the point of final completion on the assembly line. Typically, the vehicle manufacturer performs its own quality assurance inspections following assembly line completion before releasing each bus to the resident inspectors. The inspections for each vehicle are documented, signed off upon passing and included in the vehicle record.

These are the typical inspections performed on each bus by the resident inspectors:

- water test inspection
- road test inspection
- interior inspection (including functionality)
- hoist/undercarriage inspection
- exterior inspection (including roof)
- electrical inspection
- wheeled mobility device ramp/lift inspection

Water Test Inspection

The water test inspection checks the integrity of the vehicle's body seams, window frame seals and other exterior component closeouts for their ability to keep rainwater, road splash, melting snow and slush, and other exterior water from entering the inside of the vehicle. The vehicle's interior is inspected for signs of moisture and water leaks. To perform the leak inspection, interior ceiling and side panels are removed, and access doors are opened. If any moisture or water is detected, then the source of the leak will be located and repaired by the manufacturer, and the vehicle will be tested again.

Road Test Inspection

The road test inspection checks all the vehicle's systems and subsystems while the vehicle is in operation. Typically, the road test inspection is performed immediately following the water test inspection to reveal any standing water that may be present due to a leak, but was not noticed during the "static" water test. Objectionable vibrations, air leakage and other factors that affect ride quality are recorded and reported to the vehicle manufacturer for resolution. Vehicle stability, performance, braking and interlock systems, HVAC, and other critical areas are checked to ensure that the vehicle is complete and ready to provide safe and reliable service.

The following tests may be performed and recorded during the road test:

- acceleration test
- top speed test
- gradeability test
- service brake test
- parking brake test
- turning effort test
- turning radius test
- shift quality
- quality of retarder or regenerative braking action

During the road test, a vehicle may be taken to a weigh station to record the vehicle's front axle weight, rear axle weight and total vehicle (curb) weight.

Interior Inspection

The interior inspection checks the fit and finish of the interior installations. In addition, the inspection also verifies the installation and function of systems and subsystems according to the build specification. All systems and functions accessed from the interior are inspected for functionality, appearance and safety.

Examples of systems/functions inspected include the following:

- interior and exterior lighting controls
- front and rear door systems
- flooring installation
- passenger and operator's seat systems
- wheeled mobility device securement and ramp systems
- fire suppression system
- electrical installations (multiplex, telltale wiring, panels, etc.)
- window systems and emergency escape portals
- operator dash/side panel controls/indicators

Hoist/Undercarriage Inspection

The hoist/undercarriage inspection checks the installation of components, wiring, air lines, presence of fluid leaks, etc., located under the vehicle. Typically, this inspection is performed following the road test. The vehicle is lifted onto a hoist or pulled over a pit for the inspection. Areas inspected are the front suspension, air bags, air line routings, electrical connections and routings, drivetrain components, linkages, and any other system or component that may be prone to early failure due to inadequate installation techniques. All lines, cables, hoses, etc., are inspected for proper securement and protection to prevent rubbing, chafing or any other condition that could result in a failure. The engine/powerplant and HVAC compartments are also inspected during this time.

Exterior Inspection

The exterior inspection checks the fit and finish of components installed on the exterior of the vehicle. Access panels are opened and accessories are inspected for proper installation. In addition, vehicle paint, graphics and proper decals are also inspected. Acceptable paint finish quality (orange peel, adhesion, etc.) should be agreed on with the vehicle manufacturer prior to production to ensure consistency of inspections.

Electrical Inspection

The vehicle's main electrical panels and other subpanels are inspected for proper components, to include relays, fuses, modules, terminal strips, decals, etc. In addition, electrical harnesses are inspected for proper wiring and

termination techniques, bulkhead protection, looming, and other items that could result in future electrical failure. Onboard vehicle compartment schematics are verified for accuracy.

Wheeled mobility device Ramp Inspection

The wheeled mobility device ramp assembly is inspected for proper installation and performance. Clearances critical to the operation of the ramp are verified, and the ramp's electrical systems are inspected to ensure appropriate wire routings and protection. The successful integration of the ramp assembly into the vehicle is verified, and the vehicle interlocks are checked during automatic and manual ramp operation.

Audits

During serial production of the bus's quality assurance inspection, tests may be performed to ensure that the manufacturer's quality standards are being followed. These inspection audits could be on items such as torque wrench calibrations, proper techniques for fastener installations, proper use and type of adhesives, use of correct installation drawings on the production line, etc.

Communication

The lines of communication, formal and informal, should be discussed and outlined in the pre-production meeting. As previously discussed, resident inspectors should represent the Agency for all bus-build related issues (quality, conformance, etc.). Resident inspectors can relay communications addressing contractual type issues but should do so only under the consult of the Agency's contract administrator. Actual personnel contacts for the manufacturing facility should be established during resident inspector orientation. These contacts could include quality assurance, production, material handling, engineering and buy-off area personnel.

Documentation

The following documents/reports are typically generated during the bus build process:

- Vehicle build specification
- Sales order
- Pre-production meeting notes
- Prototype and production correspondence (vehicle build file)
- Manufacturer's vehicle record (warranty file):
 - Vehicle line documents
 - Serialization documents (warranty file)
 - Alignment verification
 - Brake testing
 - HVAC testing and checkout
 - Manufacturer's QA checklist and sign-off
 - Weight slip (prototype and warranty file)
 - Prototype performance tests document (vehicle build file):
 - Acceleration Test
 - Top Speed Test
 - Gradeability Test
 - Interior Noise Test A – Stationary
 - Interior Noise Test B – Dynamic
 - Exterior Noise Test A – Pull Away
 - Exterior Noise Test B – Pass-By
 - Exterior Noise Test C – Curb Idle
 - Turning Radius Test
 - Turning Effort Test

- Parking Brake Test
- Service Brake Test
- Vehicle acceptance inspections – production (warranty file)
 - Water Test Inspection Report
 - Road Test Inspection Report
 - Interior Inspection Report
 - Hoist/Undercarriage Inspection Report
 - Exterior Inspection Report
 - Electrical Inspection Report
 - Wheeled mobility device Inspection Report
- Speed memos (warranty file)
- Agency vehicle inspection record (warranty file)
- Release for delivery documentation (warranty file)
- Post-production acceptance – Certificate of Acceptance (accounting)
- Post-Delivery Inspection Report – (fleet management and warranty files)

Vehicle Release for Delivery

Upon satisfactory completion of all inspection, audit and test criteria, and resolution of any outstanding issues affecting the purchase of any or all buses, proper documentation (the Release for Delivery) is signed by the designated resident inspector authorizing the bus manufacturer to deliver the vehicle to the Agency's facility, where it will undergo a post-delivery inspection process and final acceptance. The satisfactory sign-off of the Release for Delivery should complete the resident inspector's duties for each bus. In final preparation for delivery, the bus manufacturer may request the resident inspector to do a final walk-through of the bus after it has been cleaned and prepped for shipping.

Post-Delivery and Final Acceptance

The Agency shall conduct acceptance tests on each delivered bus. These tests shall be completed within 15 days after bus delivery and shall be conducted in accordance with the Agency's 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 Agency. The post-delivery tests shall include visual inspection, along with a verification of system(s) functionality and overall bus operations. No post-delivery test shall apply new criteria that are different from criteria applied in a pre-delivery test.

Buses that fail to pass the post-delivery tests are subject to nonacceptance. The Agency shall record details of all defects on the appropriate test forms and shall notify the Contractor of acceptance or nonacceptance of each bus within five days after completion of the tests. The defects detected during these tests shall be repaired according to procedures defined in the contract after nonacceptance.

Certificate of Acceptance

- **Accepted**
- **Not accepted:** In the event that the bus does not meet all requirements for acceptance, the Agency must identify reasons for nonacceptance and work with the OEM to develop a timeline of addressing the problem for satisfactory resolution and redelivery.
- **Conditional acceptance:** In the event that the bus does not meet all requirements for acceptance, the Agency may conditionally accept the bus and place it into revenue service pending receipt of Contractor furnished materials and/or labor necessary to address the identified issue(s).

SECTION 9: FORMS AND CERTIFICATIONS

CER 1 Proposer's Checklist

RFP [name of procurement]

Package 1: Technical Proposal

- ☐ 1. Letter of Transmittal
- ☐ 2. Technical Proposal
- ☐ 3. Acknowledgment of Addenda
- ☐ 4. Form for Proposal Deviation
- ☐ 5. Vehicle Questionnaire
- ☐ 6. References and non-priced information (if provided by the Proposer)
- ☐ 7. Engineering organization chart, engineering change control procedure, field modification process
- ☐ 8. Manufacturing facility plant layout, other contracts, staffing
- ☐ 9. Production schedule and other Contract commitments for the duration of this Contract
- ☐ 10. Quality Assurance Program

Package 2: Price Proposal

- ☐ 1. Letter of Transmittal
- ☐ 2. Pricing Schedule (including option buses, spare parts package, engineering, manuals, training, special tools and test equipment)

Package 3: Qualifications Package

- ☐ 1. Pre-Award Evaluation Data Form
- ☐ 2. A copy of the three (3) most recent audited financial statements or a statement from the Proposer regarding how financial information may be reviewed by the Agency
- ☐ 3. Letter for insurance
- ☐ 4. Letter for performance bond (if applicable)
- ☐ 5. Letter of commitment for parental financial guarantee (if applicable)
- ☐ 6. Proposal Form

Package 4: Proprietary/Confidential Information

- ☐ 1. Proprietary/Confidential Information

There may be items in the first three packages that are included in Package 4 because they are considered to be proprietary/confidential information. When this occurs, the Proposer must note that fact in packages 1 through 3.

CER 2 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.”

[Agency name]
[RFP number and title]

Request #:	
Proposer:	
RFP Section:	
Page:	
Questions/clarification or approved equal:	
Agency action:	☐ Approved ☐ See addendum
	☐ Denied ☐ See response below
Agency response:	

CER 3 Acknowledgment 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

CER 4 Contractor Service and Parts Support Data

Location of nearest Technical Service Representative to Agency

Name:
Address:
Telephone:
Describe technical services readily available from said representative:

Location of nearest Parts Distribution Center to Agency:

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 Agency:

CER 5 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.”

[Agency name]
[RFP number and title]

Deviation No.:	Contractor:	RFP section:	Page:
Complete description of Deviation:			
Rationale (pros and cons):			

CER 6 Pricing Schedule

NOTE TO USER: The following is an example of what a pricing schedule might look like and should be customized by the Agency to reflect the costs for its procurement.

[Agency name]
[RFP number and title]

	All prices are to be in United States dollars	
	Unit Price	Extension
[quantity, size, type and description] buses		
Manuals	Lump Sum	
Training	Lump Sum	
Spare parts package		
Test equipment and special tools		
Extended Warranty [identify subsystem]		
Extended Warranty [identify subsystem]		
Extended Warranty [identify subsystem]		
Extended Warranty [identify subsystem]		
Other [specify]		
Sales tax (if applicable)		
Delivery charges		
TOTAL PROPOSED PRICE		
ADA equipment (included in above unit prices)		

This form is to be completed and included in the Price Package.

CER 7 Pre-Award Evaluation Data Form

NOTE TO USER: This form is to be completed and included in the *Qualification Package*. Attach additional pages if required.

[Agency name]

[RFP number and title]

1. Name of firm: 2. Address: 3. ☐ Individual ☐ Partnership ☐ Corporation ☐ Joint Venture 4. Date organized: State in which incorporated: 5. Names of officers or partners: a. b. c. d. e. 6. How long has your firm been in business under its present name?
7. Attach as SCHEDULE ONE a list of similar current contracts that demonstrate your available capacity, including the quantity and type of bus, name of contracting party, percentage completed and expected completion date. 8. Attach as SCHEDULE TWO a list of at least three similar contracts that demonstrate your technical proficiency, each with the name of the contracting party and number and they type of buses completed within the past five years. 9. Have you been terminated or defaulted, in the past five years, on any Contract you were awarded? ☐ Yes ☐ No If yes, then attach as SCHEDULE THREE the full particulars regarding each occurrence. 10. Attach as SCHEDULE FOUR the Proposer's last three (3) financial statements prepared in accordance with generally accepted accounting principles of the jurisdiction in which the Proposer is located, and audited by an independent certified public accountant; or a statement from the Proposer regarding how financial information may be reviewed by the Agency (This may require execution of an acceptable nondisclosure agreement between the Agency and the Proposer.) 11. Attach as SCHEDULE FIVE a list of all principal Subcontractors and the percentage and character of Work (Contract amount) that each will perform on this Contract. 12. If the Contractor or Subcontractor is a joint venture, submit PRE-AWARD EVALUATION DATA forms for each member of the joint venture.
The above information is confidential and will not be divulged to any unauthorized personnel.
The undersigned certifies to the accuracy of all information: Name and title: Company: _____ Authorized signature _____ Date

CER 8 Federal Certifications
CER 8.1 Buy America Certification

This form is to be submitted with an offer exceeding the small purchase threshold for federal assistance programs, currently set at \$100,000.

Certificate of Compliance	
The Proposer hereby certifies that it will comply with the requirements of 49 USC Section 5323(j)(2)(C), Section 165(b)(3) of the Surface Transportation Assistance Act of 1982, as amended, and the regulations of 49 CFR 661.11:	
Name and title: Company:	
Authorized signature	Date

Certificate of Non-Compliance	
The Proposer hereby certifies that it cannot comply with the requirements of 49 USC Section 5323(j)(2)(C) and Section 165(b)(3) of the Surface Transportation Assistance Act of 1982, as amended, but may qualify for an exception to the requirements consistent with 49 USC Sections 5323(j)(2)(B) or (j)(2)(D), Sections 165(b)(2) or (b)(4) of the Surface Transportation Assistance Act, as amended, and regulations in 49 CFR 661.7.	
Name and title: Company:	
Authorized signature	Date

CER 8.2 Debarment and Suspension Certification for Prospective Contractor

Primary covered transactions must be completed by the Proposer for contract value over \$25,000.

Choose one alternative:

- ☐ The Proposer, [name], certifies to the best of its knowledge and belief that it and its principals:
1. Are not presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from covered transactions by any federal department or agency;
 2. Have not within a three-year period preceding this Proposal been convicted of or had a civil judgment rendered against them for commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public (federal, state or local) transaction or Contract under a public transaction; violation of federal or state antitrust statutes or commission or embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements, or receiving stolen property;
 3. Are not presently indicted for or otherwise criminally or civilly charged by a governmental entity (federal, state, or local) with commission of any of the offenses enumerated in Paragraph 2 of this certification; and
 4. Have not within a three-year period preceding this Proposal had one or more public transactions (federal, state or local) terminated for cause or default.

OR

- ☐ The Proposer is unable to certify to all of the statements in this certification, and attaches its explanation to this certification. (In explanation, certify to those statements that can be certified to and explain those that cannot.)

The Proposer certifies or affirms the truthfulness and accuracy of the contents of the statements submitted on or with this certification and understands that the provisions of Title 31 USC § Sections 3801 are applicable thereto.

Executed in [city and state].

Name:

Authorized signature

Date

CER 8.3 Debarment and Suspension Certification (Lower-Tier Covered Transaction)

This form is to be submitted by each Subcontractor receiving an amount exceeding \$25,000.

The prospective lower-tier participant (Proposer) certifies, by submission of this Proposal, that neither it nor its principals as defined at 49 CFR § 29.105(p) is presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from participation in this transaction by any federal department or agency.

If the prospective Proposer is unable to certify to the statement above, it shall attach an explanation, and indicate that it has done so by placing an "X" in the following space: _____

THE PROPOSER, _____, CERTIFIES OR AFFIRMS THE TRUTHFULNESS AND ACCURACY OF EACH STATEMENT OF ITS CERTIFICATION AND EXPLANATION, IF ANY. IN ADDITION, THE PROPOSER UNDERSTANDS AND AGREES THAT THE PROVISIONS OF 31 USC §§ 3801 *ET SEQ.* APPLY TO THIS CERTIFICATION AND EXPLANATION, IF ANY.

Name and title of the Proposer's authorized official:

Authorized signature

Date

This affidavit is to be filled out and executed by the Proposer; if a corporation makes the bid, then by its properly executed agent. The name of the individual swearing to the affidavit should appear on the line marked "Name of Affiant." The affiant's capacity, when a partner or officer of a corporation, should be inserted on the line marked "Capacity." The representative of the Proposer should sign their individual name at the end, not a partnership or corporation name, and swear to this affidavit before a notary public, who must attach their seal.

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CER 8.5 Lobbying Certification

This form is to be submitted with an offer exceeding \$100,000.

The Proposer certifies, to the best of its knowledge and belief, that:

1. No federal appropriated funds have been paid or will be paid, by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of a federal department or agency, a member of the U.S. Congress, an officer or employee of the U.S. Congress, or an employee of a member of the U.S. Congress in connection with the awarding of any federal Contract, the making of any federal grant, the making of any federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment or modification thereof.
2. If any funds other than federal appropriated funds have been paid or will be paid to any person for making lobbying contacts to an officer or employee of any agency, a member of Congress, an officer or employee of Congress, or an employee of a member of Congress in connection with this federal Contract, grant, loan or cooperative agreement, the undersigned shall complete and submit Standard Form LLL, "Disclosure Form to Report Lobbying," in accordance with its instruction, as amended by "Government-wide Guidance for New Restrictions on Lobbying," 61 Fed. Reg. 1413 (1/19/96).
3. The undersigned shall require that the language of this certification be included in the award documents for all sub awards at all tiers (including subcontracts, sub-grants and contracts under grants, loans and cooperative agreements) and that all sub-recipients shall certify and disclose accordingly. This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by 31, USC §1352 (as amended by the Lobbying Disclosure Act of 1995). Any person who fails to file the required certification shall be subject to a civil penalty of not less than \$10,000 and not more than \$100,000 for each such failure.

THE PROPOSER, _____, CERTIFIES OR AFFIRMS THE TRUTHFULNESS AND ACCURACY OF EACH STATEMENT OF ITS CERTIFICATION AND DISCLOSURE, IF ANY. IN ADDITION, THE PROPOSER UNDERSTANDS AND AGREES THAT THE PROVISIONS OF 31 USC §§ 3801 ET SEQ. APPLY TO THIS CERTIFICATION AND DISCLOSURE, IF ANY.

Name of the Bidder or Proposer's authorized official:

Title: _____

Signature

Date

Per paragraph 2 of the included form Lobbying Certification, add Standard Form LLL, "Disclosure Form to Report Lobbying," if applicable.

CER 8.6 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 Agency 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

CER 8.7 DBE Approval Certification

I hereby certify that the Proposer has complied with the requirements of 49 CFR 26, Participation by Disadvantaged Business Enterprises in USDOT Programs, and that its goals have not been disapproved by the Federal Transit Administration.

Name and title of the Proposer's authorized official:

Authorized signature

Date

CER 8.8 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

CER 9 Other Certifications
CER 9.1 Proposal Form

NOTE TO USER: *The following is an example of a Proposal form to be modified as appropriate by the Agency and included in the RFP.*

The Proposer shall complete the following form and include it in the price Proposal.

PROPOSAL	
By execution below by duly authorized representative(s) of the Proposer, the Proposer hereby offers to furnish equipment and services as specified in its Proposal submitted to [Agency name] in response to Request for Proposal No. [RFP number] in its entirety.	
Proposer: _____	
Street address: _____	
City, state, ZIP: _____	
Name and title of Authorized Signer(s): _____	
Name and title of Authorized Signer(s): _____	
Phone: _____	
_____	_____
Authorized signature	Date
_____	_____
Authorized signature	Date

CER 9.2 Notice of Award

NOTE TO USER: *This form is included as an example. Standard industry practice is to execute a separate Contract as provided as an example in Appendix D.*

By execution below, [Agency name] accepts Proposal as indicated above.

Contracting officer: _____

Authorized signature

Date

CER 9.3 Certification of Compliance with Standards, Certifications and Regulations

CER 9.3 identifies the specifications, standards, regulations, and references used within this RFP. This form must be completed and included in the Technical Proposal and requires an indication of the state of compliance and an opportunity for listing other pertinent references. Please indicate compliance as “Full,” “Partial” or “N/A” (not applicable). If “Partial” or “N/A,” please describe.

Standard	Title	Compliance	If “Partial” or “N/A,” Please Describe
SAE J10	Automotive and Off-Highway Air Brake Reservoir Performance and Identification Requirements - Truck and Bus J10_201312		
SAE J211a	Instrumentation for Impact Test J211A_197112		
SAE J287	Driver Hand Control Reach J287_201603		
SAE J366	Exterior Sound Level for Heavy Trucks and Buses (stabilized September 2011) J366_201109		
SAE J382	Windshield Defrosting Systems Performance Requirements-- Trucks, Buses, and Multipurpose Vehicles (canceled September 2000) J382_200009		
SAE J534	Lubrication Fittings J534_201508		
SAE J537	Storage Batteries J537_201604		
SAE J541	Voltage Drop for Starting Motor Circuits (canceled July 2013) J541_201307		
SAE J587	License Plate Illumination Devices (Rear Registration Plate Illumination Devices) J587_201711		
SAE J593	Backup Lamp (Reversing Lamp) J593_201606		
SAE J673	Automotive Safety Glazing Materials J673_201506		
SAE J680	Location and Operation of Air Brake Controls in Motor Truck Cabs J680_201508		
SAE J686	Motor Vehicle License Plates (stabilized July 2012) J686_201207		
SAE J689	Curbstone Clearance, Approach, Departure, and Ramp Breakover Angles—Passenger Car and Light Truck (canceled Aug 2009) J689_200908		
SAE J833	Human Physical Dimensions		
SAE J844	Nonmetallic Air Brake System Tubing (stabilized December 2012) J844_201212		
SAE J941	Motor Vehicle Drivers' Eye Locations J941_201003		
SAE J994	Alarm—Backup—Electric Laboratory Performance Testing J994_201409		
SAE J1050	Describing and Measuring the Driver's Field of View J1050_200902		
SAE J1113	Electromagnetic Compatibility Measurement Procedures and Limits for Components of Vehicles, Boats (up to 15 m), and Machines (Except Aircraft) (16.6 Hz to 18 GHz) J1113/1_201810		
SAE J1127	Low Voltage Battery Cable J1127_201512		

Request for Proposal

[Date of solicitation]

[Proposal number]

Standard	Title	Compliance	If “Partial” or “N/A,” Please Describe
SAE J1128	Low Voltage Primary Cable J1128_201512		
SAE J1149	Metallic Air Brake System Tubing and Pipe (stabilized October 2015) J1149_201510		
SAE J1292	Automobile and Motor Coach Wiring (stabilized April 2016) J1292_201604		
SAE J1308	Fan Guard for Off-Road Machines J1308_201312		
SAE J1455	Recommended Environmental Practices for Electronic Equipment Design in Heavy-Duty Vehicle Applications J1455_201703		
SAE J1587	Electronic Data Interchange Between Microcomputer Systems in Heavy-Duty Vehicle Applications (stabilized January 2013) J1587_201301		
SAE J1654	Unshielded High Voltage Primary Cable J1654_201609		
SAE J1708	Serial Data Communications Between Microcomputer Systems in Heavy-Duty Vehicle Applications (stabilized September 2016) J1708_201609		
SAE J1763	A Conceptual Its Architecture: An Atis Perspective (canceled May 2003) J1763_200304		
SAE J1772	SAE Electric Vehicle and Plug in Hybrid Electric Vehicle Conductive Charge Coupler J1772_201710		
SAE J1939	Serial Control and Communications Heavy Duty Vehicle Network - Top Level Document J1939_201808		
SAE J1986	Balance Weight and Rim Flange Design Specifications, Test Procedures, and Performance Recommendations J1986_201603		
SAE J1995	Engine Power Test Code - Spark Ignition and Compression Ignition - Gross Power and Torque Rating J1995_201401		
SAE J2344	Guidelines for Electric Vehicle Safety J2344_201003		
SAE J2402	Road Vehicles—Symbols for Controls, Indicators, and Tell-tales J2402_201001		
SAE J2464	Electric and Hybrid Electric Vehicle Rechargeable Energy Storage System (RESS) Safety and Abuse Testing J2464_200911		
SAE J2711	Recommended Practice for Measuring Fuel Economy and Emissions of Hybrid-Electric and Conventional Heavy-Duty Vehicles (stabilized July 2018) J2711_201807		
SAE J2910	Recommended Practice for the Design and Test of Hybrid Electric and Electric Trucks and Buses for Electrical Safety J2910_201404		
SAE J3068	Electric Vehicle Power Transfer System Using a Three-Phase Capable Coupler J3068_201804		
FMVSS 105	Hydraulic and Electric Brake Systems		
FMVSS 121	Air Brake Systems		
FMVSS 207	Seating Systems		
FMVSS 210	Seat Belt Assembly Anchorages		

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Standard	Title	Compliance	If “Partial” or “N/A,” Please Describe
FMVSS 217	Bus Emergency Exits and Window Retention and Release		
FMVSS 301	Fuel System Integrity		
FMVSS 302	Flammability of Interior Materials		
FMVSS 403	Platform Lift Systems for Motor Vehicles		
FMVSS 404	Platform Lift Installations in Motor Vehicles		
ANSI/IAS NGV2 (1998)	Basic Requirements for Compressed Natural Gas Vehicle (NGV) Fuel Containers		
ANSI/IAS PRD1 (1998)	Pressure Relief Devices For Natural Gas Vehicle (NGV) Fuel Containers		
ANSI Z26.1	Safety Glazing Materials for Glazing Motor Vehicles and Motor Vehicle Equipment Operating on Land Highways - Safety Standard		
ANSI/ASHR AE 52.1	Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size		
ASTM A240	Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications		
ASTM A269	Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service		
ASTM B117	Standard Practice for Operating Salt Spray (Fog) Apparatus		
ASTM D1003	Standard Test Method for Haze and Luminous Transmittance of Transparent Plastics		
ASTM D4541-85	Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers		
ASTM E162- 90	Standard Test Method for Surface Flammability of Materials Using a Radiant Heat Energy Source		
ASTM E424	Standard Test Methods for Solar Energy Transmittance and Reflectance (Terrestrial) of Sheet Materials		
ECE R100 Rev 2	Uniform provisions concerning the approval of vehicles with regard to specific requirements for the electric power train		
FTA Docket 90A	Recommended Fire Safety Practices for Transit Bus and Van Materials Selection		
CGA C-6.4	Methods for External Visual Inspection of Natural Gas Vehicle (NGV) Fuel Containers and Their Installation		
NGV-3.1/ CGA-12.3	Fuel system components for compressed natural gas powered vehicles		
CARB 2292.5	Specifications for Compressed Natural Gas		
UL 935	Standard for Fluorescent-Lamp Ballasts		
ISO 5128	Acoustics – Measurement of noise inside motor vehicles		
ISO 26262	Road Vehicles – Functional Safety		
NFPA-52	Vehicular Natural Gas Fuel Systems Code		

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Standard	Title	Compliance	If “Partial” or “N/A,” Please Describe
PS 1-95	Construction and Industrial Plywood		
UN/DOT 38.3	UN Transportation Testing for Lithium Batteries		
UNECE Council Directive 95/54 (R10)	Adapting to technical progress Council Directive 72/245/EEC on the approximation of the laws of the Member States relating to the suppression of radio interference produced by spark-ignition engines fitted to motor vehicles and amending Directive 70/156/EEC on the approximation of the laws of the Member States relating to the type-approval of motor vehicles and their trailers		

CER 10 Vehicle Technical Information

NOTE TO USER: This is a sample form. The Agency should customize it to comply with its proposed requirements.

This form must be completed and included in the Technical Proposal.

GENERAL COACH DATA SHEET
[bus type]

Bus manufacturer:	
Bus model:	
Understructure manufacturer:	
Model number:	

Basic Body Construction

Type:	
Tubing or frame member thickness and dimensions	
Overstructure	
Understructure	
Skin thickness and material	
Roof	
Sidewall	
Skirt panel	
Front end	
Rear end	

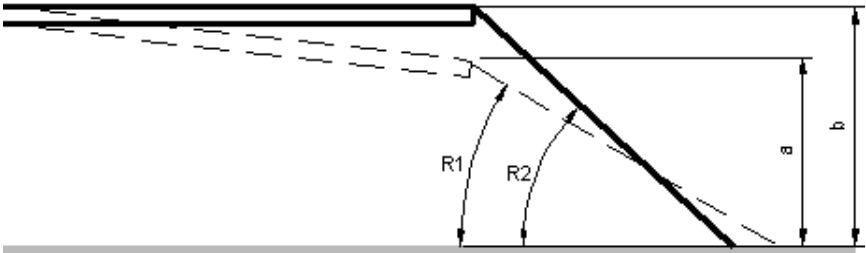
Dimensions

Overall length	Over bumpers		ft		in.
	Over body		ft		in.
Overall width	Over body excluding mirrors		ft		in.
	Over body including mirrors—driving position		ft		in.
	Over tires front axles		ft		in.
	Over tires center axle		ft		in.
	Over tires rear axles		ft		in.
Overall height (maximum)			ft		in.
Overall height (main roof line)			ft		in.

Angle of approach		deg
Breakover angle		deg
Breakover angle (rear)		deg
Angle of departure		deg

Doorway Dimensions	Front		Rear	
Width between door posts		in.		in.
Door width between panels		in.		in.
Clear door width		in.		in.
Doorway height		in.		in.
Knuckle clearance		in.		in.

Step height from ground measured at center of doorway



	Front doorway, empty	Ramp angle	Rear Doorway, empty
Kneeled	a. in.	R1 deg	a. in.
Unkneeled	b. in.	R2 deg	b. in.

Interior headroom (center of aisle)

Front axle location	in.
Center axle location	in.
Rear axle location	in.

Aisle width between transverse seats in.

Floor height above ground (centerline of bus)

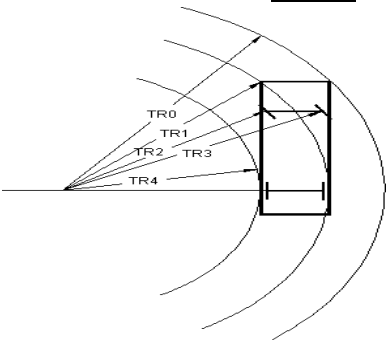
At front door	in.
At front axle	in.
At drive axle	in.
At rear door	in.

Minimum ground clearance (between bus and ground, with bus unkneeled)

Excluding axles	in.
Including axles	in.

Horizontal turning envelope (see diagram below)

Outside body turning radius, TR0 (including bumper)		ft		in.
Front inner corner radius, TR1		ft		in.
Front wheel inner turning radius, TR2		ft		in.
Front wheel outer turning radius, TR3		ft		in.
Inside Body Turning Radius innermost point, TR4 (including bumper)		ft		in.



Wheel base

Front		in.
Rear		in.

Overhang, centerline of axle over bumper

Front		in.
Rear		in.

Floor

Interior length		ft		in.
Interior width (excluding coving)		ft		in.
Total standee area (approximately)		ft ²		
Minimum distance between wheelhouses:	Front		in.	
	Rear		in.	
	Center		in.	
Maximum interior floor slope (from horizontal)		deg		

Passenger capacity provided

Total maximum seating		
Standee capacity		
Minimum hip to knee room		in.
Minimum foot room		in.

Weight

	No. of people	Front axle			Center axle			Rear axle			Total bus
		Left	Right	Total	Left	Right	Total	Left	Right	Total	
Empty bus, full fuel and farebox											
Fully seated, full fuel and farebox											
Fully loaded standee and fully seated, full fuel and farebox											
Crush load (1.5x fully loaded)											
GVWR											
GAWR											

Engine, main

Manufacturer					
Type and weight rating					
Model number					
Bore		in.			
Stroke		in.			
Displacement		in. ³			
Compression ratio					
Injector type and size					
Net SAE horsepower		hp	at		RPM
Net SAE torque		lb/ft	at		RPM
Crankcase oil capacity					
New engine, dry		gal			
New engine, wet		gal			
Turbocharger make and model					
Maximum speed, no load		RPM			
Maximum speed, full load		RPM			
Speed at idle		RPM			
Speed at fast idle		RPM			

Engine information/graphs to be attached with this form:

Engine speed vs. road speed
 Torque vs. engine speed
 Horsepower vs. engine speed
 Fuel consumption vs. engine speed
 Vehicle speed vs. time (both loaded and unloaded)
 Vehicle speed vs. grade (both loaded and unloaded)
 Acceleration vs. time
 Change of acceleration vs. time

Traction Motor

Manufacturer		
Model number		
Type		
Max power at speed		kW @ rpm
Max torque at speed		N-m @ rpm
Continuous rated power		kW
Average efficiency		%
Max motor speed		rpm
Cooling type		

Attach torque-speed curve and efficiency maps

Hybrid drive or transmission

Manufacturer				
Type				
Speeds				
Gear ratios	Forward:		Reverse:	
Shift speeds				
1st–2nd		mph		
2nd–3rd		mph		
3rd–4th		mph		
4th–5th (if applicable)		mph		
5th–6th (if applicable)		mph		
Fuel capacity (including heat exchanger and filters)				

Voltage regulator

Manufacturer	
Model	

Voltage equalizer

Manufacturer	
Model	

Alternator

Manufacturer			
Type			
Model			
Output at idle		amps	
Output at maximum speed		amps	
Maximum warranted speed		rpm	
Speed at idle (approximately)		rpm	
Drive type			

Auxiliary Inverter(s)

Manufacturer(s)	
Model Number(s)	
Output voltage(s)	

DC-DC Converter(s)

Manufacturer(s)	
Model Number(s)	
Output voltage(s)	

Auxiliary (Hotel) Loads as Installed

List of Accessories, excluding HVAC

Accessory	Average Power Consumption on Agency Design Operating Profile (kW)	Max Power Consumption (kW)

Starter motor

Manufacturer	
Type	
Model	

Air compressor

Manufacturer			
Type			
Rated capacity		CFM	
Capacity at idle (approximately)		CFM	
Capacity at maximum speed (engine)		CFM	
Maximum warranted speed		rpm	
Speed idle		rpm	
Drive type			
Governor:			
Cut-in pressure		psi	
Cut-out pressure		psi	

Axles

First

Manufacturer		
Type		
Model number		
Gross axle weight rating		lb
Axle load		lb

Second

Manufacturer		
Type		
Model number		
Gross axle weight rating		lb
Axle load		lb

Third

Manufacturer		
Type		
Model number		
Gross axle weight rating		lb
Axle load		lb
Axle ratio		

Suspension system

Manufacturer		
Type:	First:	
	Second:	
	Third:	
Springs:	First:	
	Second:	
	Third:	

Joint

Manufacturer	
Type	
Model number	

Wheels and tires

Wheels

Make	
Size	
Capacity	
Material	

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Tires

Manufacturer			
Type			
Size			
Load range/air pressure			psi

Steering, power

Pump

Manufacturer and model number			
Type			
Relief pressure			psi

Booster/gear box

Manufacturer and model number			
Type			
Ratio			

Power steering fluid capacity		gal
Maximum effort at steering wheel		lb (unloaded stationary coach on dry asphalt pavement)
Steering wheel diameter		in.

Brakes

Make of fundamental brake system			
Brake chambers vendor size and part number:	First:		
	Second:		
	Third:		
Brake operation effort			

Slack adjuster's vendor's type and part numbers

First:	Right:	
	Left:	
Second:	Right:	
	Left:	
Third:	Right:	
	Left:	
Length:	First take-up:	
	Second take-up:	
	Third take-up:	

Brake drums/discs

First:	Manufacturer		
	Part number		
	Diameter		in.

Second:	Manufacturer	
	Part number	
	Diameter	in.
Third:	Manufacturer	
	Part number	
	Diameter	in.
Brake lining manufacturer		
Type		

Brake lining identification

First:	Forward	
	Reverse	
Second:	Forward	
	Reverse	
Third:	Forward	
	Reverse	

Brake linings per shoe

First	
Second	
Third	

Brake lining widths

First		in.
Second		in.
Third		in.

Brake lining lengths

First		in.
Second		in.
Third		in.

Brake lining thickness in.

Brake lining per axle

First		in. ²
Second		in. ²
Third		in. ²

Cooling system**Radiator/charge air cooler**

Manufacturer				
Type				
Model number				
Number of tubes				
Tubes outer diameter		in.		in.
Fins per inch		fins		
Fin thickness		in.		
Total cooling and heating system capacity		gal		
Radiator fan speed control				
Surge tank capacity		qt		
Engine thermostat temperature setting: Initial opening (fully closed)		°F		
Fully open		°F		
Overheat alarm temperature sending unit setting		°F		
Shutdown temperature setting		°F		

Air reservoir capacity

Supply reservoir		in. ³
Primary reservoir		in. ³
Secondary reservoir		in. ³
Packing reservoir		in. ³
Accessory reservoir		in. ³
Other reservoir type		in. ³

Heating, ventilation and air conditioning equipment

Heating system capacity		BTU/hr
Electrical load at maximum heating capacity		kW
Air conditioning capacity		BTU
Electrical load at maximum cooling capacity		kW
Ventilating capacity		CFM

Compressor

Manufacturer				
Model				
Number of cylinders				
Drive ratio				
Maximum warranted speed		rpm		
Operating speed		rpm (recommended)		
Weight		lb		
Oil capacity	Dry		gal	
	Wet		gal	

Refrigerant: Type lb

Condenser

Manufacturer			
Model			
Number of fins/in.			
Outer diameter of tube		in.	
Fin thickness		in.	

Condenser fan

Manufacturer			
Model			
Fan diameter		in.	
Speed maximum		rpm	
Flow rate (maximum)		CFM	

Receiver

Manufacturer			
Model			
Capacity		lb	

Condenser fan drive motors

Manufacturer			
Model			
Type			
Horsepower		hp	
Operating speed		rpm	

Evaporator fan drive motors

Manufacturer			
Model			
Type			
Horsepower		hp	
Operating speed		rpm	

Evaporator(s)

Manufacturer			
Model			
Number of rows			
Number of fins/in.			
Outer diameter of tube		in.	
Fin thickness		in.	
Number of evaporators			

Expansion valve

Manufacturer	
Model	

Filter-drier

Manufacturer	
Model	

Heater cores

Manufacturer		
Model		
Capacity		Btu/hr
Number of rows		
Number of fins/in.		
Outer diameter of tube		in.
Fin thickness		in.
Number of heater cores		

Floor heater blowers

Front	
Rear	

Controls

Manufacturer	
Model	

Driver's heater

Manufacturer		
Model		
Capacity		Btu/hr

Ventilation system

Type	
------	--

Coolant heater

Make		
Model		
Capacity		Btu

Interior lighting

Manufacturer	
Type	

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Number of fixtures

Size of fixtures

Power pack

Doors**Front**

Manufacturer of operating equipment

Type of door

Type of operating equipment

Rear

Manufacturer of operating equipment

Type of door

Type of operating equipment

Passenger windows**Front**

Manufacturer

Model

Type

Number:

Side

Rear

Sizes:

Glazing:

Type

Thickness

Color of tint

Light transmission

Mirrors

	Size	Type	Manufacturer	Part no.	Model no.
Right side exterior					
Left side exterior					
Center rearview					
Front entrance area					
Upper-right corner					
Rear exit area					

Seats**Passenger**

Manufacturer

Model

Type

Operator

Manufacturer	
Model and part number	
Type	

Paint

Manufacturer	
Type	

Wheeled mobility device ramp equipment

Manufacturer			
Model number			
Capacity		lb	
Width of platform		in.	
Length of platform		in.	
System fluid capacity		qt	
Type of fluid used			
Operating hydraulic pressure		psi	
Hydraulic cylinders:	Size		
	Number		

Wheeled mobility device securement equipment

Manufacturer	
Model number	

Destination signs

Manufacturer	
Type	

Character length

Front destination		in.
Front route		in.
Curbside destination		in.
Rear route		in.

Character height

Front destination		in.
Front route		in.
Curbside destination		in.
Rear route		in.

Number of characters

Front destination	
Front route	
Curbside destination	
Rear route	

Message width

Front destination		in.
Front route		in.
Curbside destination		in.
Rear route		in.

Electrical

Multiplex system

Manufacturer	
Model number	

Energy Storage

Low Voltage

Manufacturer	
Model number	
Type	
Cold cranking amps	

High Voltage

Type/chemistry	
Manufacturer (cell)	
Model (cell)	
Nominal cell voltage	
Minimum cell voltage	
Maximum cell voltage	
Cell capacity (Ah)	
Manufacturer/supplier (pack or smallest removable unit)	
Model name (pack or smallest removable unit)	

Weight of pack (smallest removable unit)		lb
Gross energy capacity of each pack (smallest removable unit)		kWh
Total number of packs in ESS		
Gross energy capacity of ESS when new		kWh
Usable energy capacity of ESS when new		kWh
Gross energy capacity of ESS at warrantable end of life		kWh
Usable energy capacity of ESS at warrantable end of life		kWh
Nominal voltage of ESS		V

Minimum allowable operating SoC		%
Maximum allowable operating SoC		%
Tested cycle until warrantable end of life		
Average ESS operating efficiency		%
Operating temperature range		°F

Energy storage cooling system		
Manufacturer		
Model number		
Type (e.g., forced air, liquid)		
Average power consumption		kW
Max power consumption		kW
Battery management system		
Manufacturer		
Model number		

Charging Compatibility

Charger inlet type	
Charging standards/compatibility	

Communication System

GPS

Manufacturer	
Model number	

PA system

	Manufacturer	Model number	Number
Amplifier			
Microphone			
Internal speakers			
External speaker			

Security camera system

Manufacturer		
Model number		
Number of cameras		
Storage capacity		

Bike racks

Manufacturer	
Model number	

Fire detection system

Manufacturer			
Model number			
Fire detectors			
Type (thermal or optical)			
Number of detectors			

Automatic voice annunciator system

Manufacturer			
Model and part number			

Annunciator LED sign

Number of signs		
Housing dimensions		
Character length		in.
Character height		in.
Character width		in.

GPS antenna

Manufacturer			
Model and part number			

Automatic passenger counter

Manufacturer			
Model and part number	a.		
	b.		
	c.		
Sensor type			

Real-time bus arrival prediction system

	Manufacturer	Model number
Router		
Cellular modem		
Charge protection		

Electronic tire pressure monitoring system

Manufacturer			
Model number			

Electronic brake stroke/wear indicator system

Manufacturer	
Model number	

All information above is accurate to the time frame upon submission. The Agency reserves the right to update above data if changes occur, upon consultation with the customer.

SECTION 10: CONTRACT

[Agency to insert its Form of Contract. A sample Contract is provided in Appendix D.]

SECTION 11: APPENDIXES

Appendix A: Guidelines for Calculating Liquidated Damages

Calculation of Liquidated Damages

Prior to its Solicitation, the Agency should document and file for the record its derivation of the amount of liquidated damage that is entered in “Liquidated Damages for Late Delivery of the Bus.” The following identifies some suggested areas for consideration by which an Agency may be damaged if buses are not delivered as contracted.

For determining amounts for liquidated damages, the following guidance is provided:

1. The liquidated damage amount must not be punitive but shall be based upon damages that the Agency would incur as a result of the delay.
2. The liquidated damage amount must be calculated on the basis of damages that the Agency would incur and be substantiated by experience data.
3. A definition of days and any exempted days for delay should be included.

Cost to Retain Old Fleet

If the purpose of the procurement is to replace older buses that are being retired, there can be two areas of damage that are additive: extra cost of maintenance and cost of purchasing or renting additional buses to meet fleet availability requirements.

1. **Extra cost of maintenance.** The *difference* in maintenance costs, old buses minus new ones, is a realistic damage, assuming that older buses will be continued in service for the duration and not replaced with alternative leased buses.
2. **Cost to obtain additional buses to meet fleet availability.** Reliability of the older buses is not expected to be as good as for new ones, and they can be expected to be out of service for maintenance or repair for longer periods than new ones. Therefore, additional buses may be needed to ensure that required service on routes is met.

Cost to Obtain Alternative Fleet

The damage may be attributed to requirements to obtain an alternative fleet for the duration of the delay. Such may be precipitated because a sales agreement on the old buses being replaced is expected to have been executed prior to the Contract delivery date for new buses or because the new buses are needed for new or expanded services.

1. **Cost to replace old buses being sold.** This approach is an alternative to the cost of retaining the old fleet of (1) above. It is suggested that the liquidated damage be the lower of this alternative and that of (1).
2. **Cost to meet requirements for new or expanded service.** Under this approach, the liquidated damage would simply be the daily costs of the alternative fleet as calculated above.

Increased Contract Administrative Costs

Delays in delivery will increase the period that the Contract must be administered and possibly increase the effort or waste the effort of either in-house staff or consultants for in-plant inspection and to assist in taking delivery and acceptance.

1. **Increased Contract period.** The amount of the damage can be calculated as the average daily cost of Contract administration, apart from any technical services.
2. **Increased technical services.** Technical services for in-plant inspection and to assist in taking delivery and acceptance will have been budgeted consistent with the Contract schedule. The extra budget for these services could be determined as a daily rate.

Fines

Damages may include fines for which a court has already imposed or can be expected to be imposed on the Agency not meeting required emission (noise or air quality) reductions or features mandated by the Americans with Disabilities Act. Include this element only if the Agency can prove its vulnerability for such fines and if a purpose of the procurement is to comply with such laws or ordinances.

Fuel Consumption

If the new buses are expected to consume less fuel per passenger capacity, then the difference in fuel consumption costs per day may be included.

Appendix B: Guidelines for Calculating Early Delivery Incentives

Any provision of incentive payments for early delivery should be made on the basis of savings that may be reasonably expected to accrue to the Agency. Prior to its Solicitation, the Agency should document and file for the record its derivation of the amount of any incentive that would be entered in the option provided in “Liquidated Damages for Late Delivery of the Bus.” It is suggested that any savings be shared between the Contractor and the Agency on the basis of some predetermined ratio, not exceeding an amount approximately that of the anticipated profit under the Contract. The following provides suggested areas in which an Agency may accrue savings for early delivery.

Savings to Retire Old Fleet Early

If the purpose of the procurement is to replace older buses that are being retired, there can be savings in maintenance costs. The *difference* in maintenance costs, old buses minus new ones, could be a savings if the old fleet can be retired early.

Decreased Contract Administrative Costs

Early delivery can decrease the period that the Contract must be administered. The amount of savings can be calculated as the average daily cost of Contract administration, apart from any technical services.

Fines

If the Agency is being fined or can be expected to be imposed for failure to meet court-mandated emissions standards or requirements of the Americans with Disabilities Act, and early delivery reduces any such fines, savings will accrue. This element should be included *only* if the Agency can prove its vulnerability to such fines and if a purpose of the procurement is to comply with such laws or ordinances.

Fuel Consumption

If the new buses are expected to consume less fuel per passenger capacity, then the *difference* in fuel consumption costs per day may be included as a savings if the old fleet can in fact be replaced by the early delivered fleet.

Appendix C: Examples of Evaluation Criteria

Agencies should insert the proposal evaluation process and criteria, preferably in descending order of importance. For example, pricing could be the first (most important), last (least important), or otherwise ranked in order. The FTA's Best Practices Procurement Manual (<https://www.transit.dot.gov/sites/fta.dot.gov/files/docs/funding/procurement/8286/fta-best-practices-procurement-and-lessons-learned-manual-2016.pdf>) also includes suggested evaluation criteria in Section 4.

EXAMPLE 1: EVALUATION OF PROPOSALS AND SELECTION PROCESS

A. Evaluation/Selection Committee

An Evaluation/Selection Committee ("Committee"), which may include Agency staff, consortium members, and possibly one or more outside experts, will review and screen the Proposals submitted according to the pre-established criteria as set forth below.

B. Pre-Proposal Meeting (maximum of 5 points)

Attendance at the Pre-Proposal Meeting on [date].

C. Technical Evaluation Criteria (maximum of 80 points)

Proposals will be evaluated using the following principal selection criteria:

- **Product design and performance (0–30 points):** The information provided by the Proposer in its technical submittal relating to the buses to be provided will be utilized to evaluate the Proposal in relation to this factor. Vehicle construction and system design, as well as documented reliability, may be used in this evaluation, as well as other design and performance elements of the components that comprise those systems. At a minimum, test results, safety and maintenance factors, and cost of normal operation for the bus design and system components proposed may be considered in determining a final value for this factor.
- **Proposer's reputation and performance (0–30 points):** The Committee will consider the capability and reputation of the Proposer as presented in the Proposal, or as is determined by review of information available from references or other resources. The evaluation may look at the Proposer's overall organizational and financial capabilities and consider key components such as organizational reporting structure, quality control, quality assurance, research and development, technical, training and parts support, response time, product capabilities, ability to furnish multiple bus configurations, bonding capacity, and financial history, as well as other considerations, in reaching a final point determination. The committee may also look at judgments, liens, Fleet Defect history, warranty claims, and the steps that the manufacturer has taken to resolve these concerns, in assessing the overall reputation of the manufacturer.
- **Delivery schedule (0–20 points):** The Committee will review the proposed delivery schedule for the Agency's minimum purchase of coaches. Delivery schedules that fulfill the delivery requirements, with evidence that the schedule can be accomplished, may receive higher points for this category.

D. Cost Proposal Evaluation (maximum of 20 points)

As described below, the proposed cost as submitted by the Proposer on the Agency's form will be assigned a maximum of 20 points. The Contractor is *required* to use the Agency's form, without alteration, for submittal of its cost Proposal. *Please DO NOT use your own forms.*

The cost will be evaluated in the following manner:

Cost Proposal Criteria (0–20 points)

- The Cost Proposal criteria will be based on the “Total of Both the Low-Floor and Standard Floor Bus,” Line 3.C. of Appendix B, as noted in Section 8.B.6, “Sum of Total Base Offer per Bus.”
- The lowest average Cost Proposal will receive 20 points. Every other Proposal previously found to be in the Competitive Range will be given points proportionately in relation to the lowest price. This point total will be calculated by dividing the lowest price by the total price of the Proposal being evaluated; the result will then be multiplied by the maximum weight for price (20 points) to arrive at a Cost Proposal score.

EXAMPLE: $\text{Lowest Proposed Price} / \text{Proposer's Proposed Price} \times 20 = \text{Proposal Score}$

The application of the above formula will result in a uniform assignment of points relative to the criterion of price.

Evaluation Methodology

The maximum number of points achievable in each of the aforementioned areas is as follows:

- Attendance at Pre-Proposal Meeting: 0–5 points
- Product design and performance: 0–30 points
- Manufacturer’s reputation and performance: 0–30 points
- Delivery schedule: 0–20 points
- Cost proposal: 0–20 points

TOTAL POSSIBLE POINTS: 105

EXAMPLE 2: EVALUATION PROCESS

Following receipt of the Proposals, the Proposals will be evaluated for compliance with the following minimum requirements. Those Proposals that do not demonstrate evidence of compliance may not be considered beyond the preliminary review.

Minimum Requirements

- The Proposer must be an existing vehicle manufacturer with an existing manufacturing facility.
- The Proposal must be for a high-capacity vehicle with a nominal length not to exceed 45 ft.
- The vehicle must be constructed from composite material.
- The proposed vehicle must have the capability for either a CNG propulsion system or for a gasoline/hybrid propulsion system.
- The proposed vehicle must have a minimum of 44 seats.

Proposals found to be compliant with the minimum qualifications will then be evaluated to determine those Proposals that represent technically acceptable offers.

Each Proposal will be rated according to the following ratings:

- **Exceptional:** Exceeds evaluation standard in a way beneficial to the Agency, and has no significant weaknesses. Innovative, comprehensive and complete in all details. Low-risk. Complies with all primary program objectives for the procurement.
- **Acceptable:** Meets evaluation standards, and any weaknesses are readily correctable. Limited risk. Complies with many of the primary program objectives for the procurement.

- **Marginal:** Fails to meet evaluation standard; however, any significant deficiencies are correctable. Lacks essential information to support Proposal. Moderate risk. Complies with only one or two of the program objectives for the procurement.
- **Unacceptable:** Fails to meet evaluation standard, and the deficiency is uncorrectable. Proposal would have to undergo a major revision to become acceptable. Demonstrated lack of understanding of the Agency's requirements or omissions of major areas. Unacceptable risk. Complies with none or one of the program objectives for the procurement.

Performance risk is the evaluation of each Proposer's present and past work to assess confidence in the Proposer's ability to perform against a proposed Contract. The following definitions are used when assessing performance risk:

- **High:** Significant doubt exists, based on the Proposer's performance record, that the Proposer can perform the proposed effort.
- **Moderate:** Some doubt exists, based on the Proposer's performance record, that the Proposer can perform the proposed effort.
- **Low:** Little doubt exists, based on the Proposer's performance record, that the Proposer can perform the proposed effort.
- **Not applicable:** No significant performance record is identifiable.

The Agency may require clarifications or oral interviews with Proposers. Discussions may also be held with Proposers to determine acceptability of proposed Deviations, and/or to address deficiencies and weaknesses of the Proposal. See "Agency Rights" for additional information.

After completion of the evaluations, the Agency shall request pricing from those firms that have submitted technically acceptable Proposals. These firms will be given approximately one week to submit pricing. The received pricing will then be reviewed. The Agency does not anticipate negotiation of price offers. The award will be made to the Proposer that possesses the appropriate facility, as well as the managerial, financial and technical capabilities necessary to fulfill the requirements of the Contract; and whose Proposal conforms to Solicitation requirements and is judged by an integrated assessment of the evaluation criteria to be the most advantageous to the Agency once price and other factors are considered.

For the purposes of this procurement, all evaluation factors other than price, when combined, are significantly more important than the cost/price area in this acquisition. Therefore, the Agency may select other than the lowest-priced, technically-acceptable Proposal if it is determined that the additional technical merit offered is worth the additional cost in relation to other Proposals received. For evaluation purposes, if Proposals become more technically equivalent, then price becomes relatively more important.

The Agency is more concerned with obtaining superior technical features than with making an award at the lowest overall price to the Agency. However, the Agency will not make an award at a significantly higher overall cost to the Agency to achieve slightly superior technical features.

The Agency reserves the right to reject any or all Proposals, to waive informalities or irregularities to the extent permitted by law in any Proposal received, and to be the sole judge of the merits of the respective Proposals received.

Evaluation Criteria

The award will be based upon the factors listed below, in addition to price, and may not necessarily be made to the lowest-price Proposer. Factors are ranked in order of importance, with the most important factor listed first.

1. Minimum vehicle performance requirements
2. Vehicle structure

3. Advanced design provisions
4. Proposed technical Deviations
5. Manufacturing process
6. Qualifications of the Proposer
7. Past performance and current commitments
8. Maintainability
9. Proposed operating cost and reliability
10. Emissions
11. System safety provisions
12. Technical support
13. Project management
14. Deviations from Contract terms and conditions

The primary sub-criteria under each factor are the following:

1. Performance requirements:

- a. Vehicle performance
- b. Reduced exterior sound levels
- c. Minimum range requirements
- d. Compliance with general performance requirements

2. Vehicle structure:

- a. Previous service experience of the vehicle, if applicable
- b. Current and/or planned durability testing, including existing test results
- c. Physical dimensions
- d. Interior layout, including compliance with ADA requirements
- e. Layout of the operator's compartment, including the operator's field of view
- f. Available ergonomic information
- g. Functional enhancements, including integration of electronic controls and minimizing the number of gauges and switches

3. **Advanced design provisions:** This addresses the design characteristics, including how the design complies with the program's design objectives.

4. **Proposed technical deviations:** This addresses the effect and acceptability of proposed technical deviations, including proposed benefits to the Agency and Deviations that will result in cost reductions.

5. **Manufacturing process:** This addresses the proposed manufacturing process, including a detailed description of the proposed facilities where the Work would be done.

6. Proposed quality assurance program

7. Qualifications of the Proposer:

- a. Organizational chart showing the organization proposed for this Contract
- b. History of the Proposer, including information about manufacturing capabilities
- c. Experience in producing the same or similar vehicles as those being proposed, with emphasis on experience in producing CNG and gasoline/hybrid vehicles
- d. Experience in producing composite-structure vehicles
- e. Maintenance and warranty experience, including a qualified staff to provide the necessary services
- f. The Proposer's ISO certification(s) or equivalent

8. Proposer's facilities to be used for significant portions of the Work, including Subcontractors' facilities:

- a. Location of the facility and whether the facility is owned or leased
- b. Work to be performed at the facility
- c. Capacity and resources available at the facility for fulfillment of this Contract
- d. Length of time the facility has been in operation to do the kind of Work proposed to be performed at the facility.

9. Past performance and current commitments:

- a. Reference list
- b. Proposer's Work underway, or for which the Proposer is committed

10. Maintainability:

- a. Maintainability of the proposed powerplant, including exceptions to parts availability and exceptions to pass-through warranty
- b. Maintainability of proposed component parts, including exceptions to parts availability and exceptions to pass-through warranty
- c. Maintenance requirements
- d. Skills needed to perform maintenance Work
- e. Required special equipment, tools or maintenance facility requirements that must be implemented to maintain the vehicles
- f. Proposed diagnostic equipment needed to maintain the vehicles
- g. Proposed "built-in" diagnostic equipment, if offered
- h. Reasonableness of proposed scheduled maintenance requirements
- i. Proposed spare parts package required to support the schedule maintenance and replacement of major components

11. Proposed operating costs and reliability:

- a. Expected reliability and service life of major proposed components

12. Projected emissions of the vehicle

13. System safety provisions:

- a. Proposed safety features
- b. Knowledge of state codes and regulations affecting vehicles
- c. Vehicle code changes required for the vehicle to legally operate in the state, if any

14. Technical support:

- a. Identification of proposed parts and service center
- b. Service center staffing and qualifications
- c. Availability of electronic maintenance documentation and comprehensive plan for providing technical updates for the life of the proposed vehicles
- d. Proposed availability of spare parts, including methodology for storing parts locally and for expediting needed parts
- e. Proposed training plans and instruction program
- f. Proposed diagnostic equipment required to maintain the vehicles
- g. Provision of advanced features such as wireless self-diagnostics and/or database management

15. Project management:

- a. Proposed general project schedule and plan to ensure schedule compliance or to expedite the delivery schedule
- b. Experience of the proposed project management team, including the experience of key personnel.

- c. Experience of technical personnel supporting each area of technical expertise as required by the Contract specifications, including test and system integration personnel
- d. Experience of the proposed key contact for the project, including the level of authority that this individual will have to make decisions that are “binding” on the Proposer
- e. Plan for the coordination of major Suppliers and Subcontractors, if any
- f. Major component Suppliers and the products to be provided by each for this Contract
- g. The interface relationships between engineering, manufacturing, program control, quality control and test departments
- h. Proposed critical path schedule for the production of the pilot vehicle and remaining vehicles, as well as the methodology for controlling the schedule

16. Proposed Deviations from nontechnical terms and conditions:

- a. Rationale for the proposed Deviation
- b. Benefit and/or risk to Agency if the request is granted

Certifications

The certifications will be reviewed for proper execution and responsiveness.

Type of Contract to be Awarded

The Agency intends to award a fixed-price Contract per unit for up to [number] vehicles. The services of the Contractor will be based on the scope of Work as outlined in Section 1, “Description of Work.”

Period for Acceptance

The Proposal shall be valid for [number] calendar days from the date stipulated in the RFP for receipt of Proposals. If this offer is accepted within that time period, the Proposer agrees to furnish all services and items as stipulated in the RFP and in any accompanying amendments.

Appendix D: Sample Contract

NOTE TO USER: The following is a sample Contract, which is included as an illustration of a format that an Agency may choose to use.

CONTRACT

1. Contract Documents and Order of Precedence

The Contract consists of the documents listed below. In case of any conflict among these documents, the order of precedence shall be:

1. Form of Contract
2. Section 4, "Special Provisions"
3. Section 3, "General Conditions," and Section 5, "Federal Requirements"
4. Section 6, "Technical Specifications," Section 7, "Warranty Requirements," and Section 8, "Quality Assurance"
5. Contractor's Best and Final Offer (including Contractor Proposal)

NOTE TO USER: An Agency may issue a conformed Contract that comprises all of the changes, Deviations, and addenda that were a part of the negotiation process. In that case, the above order of precedence would be applicable. Absent a conformed Contract, it may be appropriate to include the Contractor's final Proposal and BAFO as accepted by the Agency as the first document in the order of precedence. It should be noted that this alternative could present more risk to the Agency, as the Contractor's BAFO and Proposal could contradict the RFP requirements and would prevail over them.

In this instance, the order of precedence might be as follows:

1. Form of Contract
2. Contractor's Best and Final Offer (including Contractor Proposal)
3. Addenda
4. Section 4, "Special Conditions"
5. Section 3, "General Conditions" and Section 5, "Federal Requirements"
6. Section 6, "Technical Specifications," Section 7, "Warranty Requirements," and Section 8, "Quality Assurance"

A modification or change to any Contract document shall take its precedence from the term it amends. All other documents and terms and conditions shall remain unchanged.

2. Compensation

The Agency shall pay [dollar amount in both words and numbers of the base Contract], and the Contractor shall accept the amount as full compensation for all costs and expenses of completing the Work in accordance with the Contract, including but not limited to all labor and material required, overhead, storage and shipping, risks and obligations, taxes (as applicable), fees and profit, and any unforeseen costs.

NOTE TO USER: The Agency may insert a full pricing schedule here.

3. Contract Term and Period of Performance

The effective date of this Contract shall be the effective date set forth in the Notice to Proceed. The Contractor shall commence work after the effective date of the Contract, upon receipt of the Notice to Proceed.

The base Contract will contain orders for [number and type of vehicles]. The Contract delivery date for the vehicles, in accordance with the delivery schedule set forth in "Delivery Schedule" shall be [date].

If any option is exercised, the option vehicles or other option items shall be delivered in accordance with the schedule contained in the Notice of Exercise of Option.

4. Notices

Any Notice legally required to be given by one party to another under the Contract shall be in writing, dated and signed by the party giving such Notice, or by a duly authorized representative of such party.

Notices shall not be effective unless transmitted by any method that provides confirmation of transmission and delivery, such as fax, certified mail or registered mail, and addressed to:

[Insert Agency name, address, point of contact and Contract number.]

[Insert Contractor name, address and point of contact.]

5. Entire Agreement

This Contract constitutes the complete and entire agreement between the Agency and Contractor and supersedes any prior representations, understandings, communications, commitments, agreements or Proposals, oral or written, that are not incorporated as a part of the Contract.

[Agency to insert its normal signature format in accordance with its governing law and regulations. The Agency should ensure that the signature format conforms to state law and Agency policy.]

Contractor name

Signature of authorized official

(Print or type name and title)

Date

Tax ID number

Agency name

Signature of authorized official

(Print or type name and title)

Date

Approved as to form by:

Name and title

Appendix E: Sample Performance Bond Form

NOTE TO USER: The following is a sample Performance Bond, which is included as an illustration of a format that an Agency may choose to use.

FAITHFUL PERFORMANCE BOND

[Agency name]

CONTRACT NO. ____

[title of procurement]

PERFORMANCE BOND

WHEREAS the [Agency name] has awarded to _____ (“Principal”), Contract No. _____, Up To [quantity and type of bus] AND

WHEREAS Principal is required under the terms of the Contract to furnish a Bond for the faithful performance of the Contract;

NOW, THEREFORE, we _____, as Principal, and _____, (“Surety”), as Surety, are held and firmly bound unto [Agency] in the sum of [amount], in lawful money of the United States of America, for payment of which sum well and truly to be made, we bind ourselves, our heirs, executors, administrators, successors, and assigns, jointly and severably, firmly by these presents. In case suit is brought upon this Bond, Surety shall pay reasonable attorneys’ fees to [Agency] in an amount to be fixed by the court. In no event shall the surety be liable under this Bond for an amount greater than the aggregate penal sum designated in this paragraph.

The condition of this obligation is such that, if the hereby-bonded Principal or its heirs, executors, administrators, successors, assigns, or Subcontractors shall in all things stand to and abide by and well and truly keep and perform all the undertakings, terms, covenants, conditions and agreements in the Contract and any alteration thereof, made as therein provided, all within the time and in the manner therein-designated and in all respects according to their true intent and meaning, then this obligation shall become null and void; otherwise, it shall be and remain in full force and effect.

Further, Surety, for value received, hereby stipulates and agrees that no change, extension of time, alteration, or modification of the Contract, or of the Goods to be furnished thereunder, shall in any way affect its obligations under this Bond, and it does hereby waive notice of any such change, extension of time, alteration, or modification of the Contract or of the Goods and Technical Services to be performed thereunder.

IN WITNESS WHEREOF, three identical counterparts of this instrument, each of which shall for all purposes be deemed an original hereof, have been duly executed by Principal and Surety named herein, on the ____ day of _____, 20__, the name and corporate seal of each corporate party being hereto affixed and these presents duly signed by its undersigned representative pursuant to authority of its governing body.

By _____
("Principal")

By _____
("Surety")

By _____

Appendix F: Sample Assignment of an Option to Purchase Agreement

[Agency name], "Assignor," hereby assigns to _____ of _____, "Assignee," its option to purchase from, "Seller," _____ floor transit Vehicles ("Option Vehicles") at a price and under the terms and conditions contained in Assignor's Contract No. [Contract number], dated with Seller ("Contract").

Such option commenced, per terms of Contract, on, and may be exercised at any time on or before.

With respect to the Option Vehicles assigned hereunder and this Assignment, Assignee agrees to perform all covenants, conditions and obligations required of Assignor under said Contract and agrees to defend, indemnify and hold Assignor harmless from any liability or obligation under said Contract. Assignee further agrees to hold Assignor harmless from any deficiency or Defect in the legality or enforcement of the terms of said Contract or option to purchase thereunder. Assignee agrees and understands that Assignor is not acting as a broker or agent in this transaction and is not representing Seller or Assignee, but rather is acting as a principle in assigning its interest in the above-referenced option to purchase the Option Vehicles under the Contract to Assignee.

Assignee hereby unconditionally releases and covenants not to sue Assignor upon any claims, liabilities, damages, obligations or judgments whatsoever, in law or in equity, whether known or unknown, or claimed, which they or either of them have or claim to have or which they or either of them may have or claim to have in the future against Assignor, with respect to the Option Vehicles or any rights whatsoever assigned hereunder.

Dated this _____ day of _____, 20____

Assignor

Assignee

I hereby accept and approve the terms of this agreement and agree to hold Assignor harmless from any further liability or obligation under our agreement.

Seller

Appendix G: Guidelines for Selecting Battery Electric Bus Specifications

General Approach and Considerations

Transit agencies can choose from a number of electric drive propulsion and refueling/charging options for transit buses. This *Standard Bus Procurement Guidelines* document was updated in April 2021 to include one of these options: battery electric buses that may utilize depot-based charging, and/or on-route charging. Agencies should note that other options are available, such as fuel cell electric with hydrogen refueling, and trolleybuses. It is anticipated that the transit industry overall will utilize a mix of options to achieve the unique objectives and characteristics of their operation when deploying zero-emission buses.

Transit agencies are very familiar with, and accustomed to, using APTA's *Standard Bus Procurement Guidelines* when purchasing conventional bus technologies. However, the emergence of zero-emission buses has introduced different—and more complex—factors that must be considered to achieve the greatest benefits from these advanced technology vehicles and avoid costly deployment failures. These procurement guidelines related to battery electric buses are intended to offer guidance to agencies on the considerations that are unique to that technology; this should thus be reflected in procurement documents (e.g., range, charging preference). As every transit agency has a unique set of attributes, and the variety of available zero-emission bus technologies must be matched and managed accordingly, there is not a one-size-fits-all approach for the procurement of battery electric buses. Moreover, considerations may evolve as agencies fully transition to zero emission fleets.

Factors Affecting Range

A single range value is difficult to specify for electric buses for a few reasons. First, there are multiple ways to meet an agency's range requirements or block durations with various bus/charger combinations. For instance, a bus with a small battery pack (i.e., less energy capacity) can be used in combination with on-route or opportunity charging to meet longer-range needs. Alternatively, a bus with large battery packs (i.e., more energy capacity) can be used in combination with depot charging to meet certain needs. Therefore, range specifications for a bus need to be considered in the context of the overall charging and operations solution.

Second, unlike diesel or CNG buses, there are many operational factors outside of battery size that can significantly affect range for electric buses. These include route average speed, route grades, driving behavior, outside air temperature, thermal comfort setpoints for passengers and driver, passenger loads, and battery state of health. These factors make specifying and verifying range difficult.

Section TS 8.2 has attempted to provide a form for procuring agencies to identify the conditions for its specific environment so that bus manufacturers can 1) propose an appropriate bus and charging solution and 2) provide appropriate range expectations for the agency.

Section TS 8, "Fuel Economy/Range and Design Operating Profile," now includes specific references to battery electric buses that are critical for consideration when developing procurement documents.

Section TS 8.1, "Altoona Fuel Economy Tests," evaluates the range for battery electric buses and provides an "apples-to-apples" comparison of range across a set standard for all buses. The buses are tested under Altoona's pass/fail procedures on three duty cycles: Manhattan cycle, Orange County cycle, and EPA HD-UDDS cycle. The Manhattan duty cycle represents dense urban operation with frequent stops and low speeds. The Orange County duty cycle represents urban operation with average stops and speeds. The EPA HD-UDDS cycle represents sparse urban operation with higher average speeds and durations at highway speed. However, results from Altoona testing do not reflect how a particular battery electric bus model will operate in a transit agency's specific environment.

Section TS 8.2, "Agency Operating Profile: Battery Electric Bus" is now part of the *Standard Bus Procurement Guidelines* and allows agencies the opportunity to provide their unique operational requirements. In

order for transit agencies to procure electric buses that meet the requirements of their specific fleet and duty cycle, it is important to define and communicate those operational requirements to proposing manufacturers. Accurate definition of an agency's characteristics allows manufacturers to propose a bus configuration that will sufficiently meet those needs. It also allows manufacturers to provide accurate expectations of how the buses will behave in that particular operation.

Section TS 8.2 provides a few different methods for an agency to determine and communicate those operational requirements depending on their resources and capabilities. It should be noted that while these methods are used in an attempt to get accurate range expectations and comparisons for all proposed buses, the bus manufacturers will use various methods to predict range and this could affect results.

The default agency inputs in Section TS 8.2 allow for the most basic characterization of an agency's operation by providing general route information. However, a more refined and accurate characterization and proposal response can be obtained by using the alternatives provided. Under the first alternative, a transit agency may either provide, or request that Proposers collect, route and duty cycle data for bus modeling and bus simulation purposes. This alternative will allow for the most personalized operational analysis of a bus on the agency's route or routes.

If a transit agency is unable to provide or request route-specific information, then the second alternative can be used in its Specification, for which it will provide an estimated percentage of each standard duty cycle (Manhattan, Orange County, and EPA HD-UDDS) that is representative of its service.

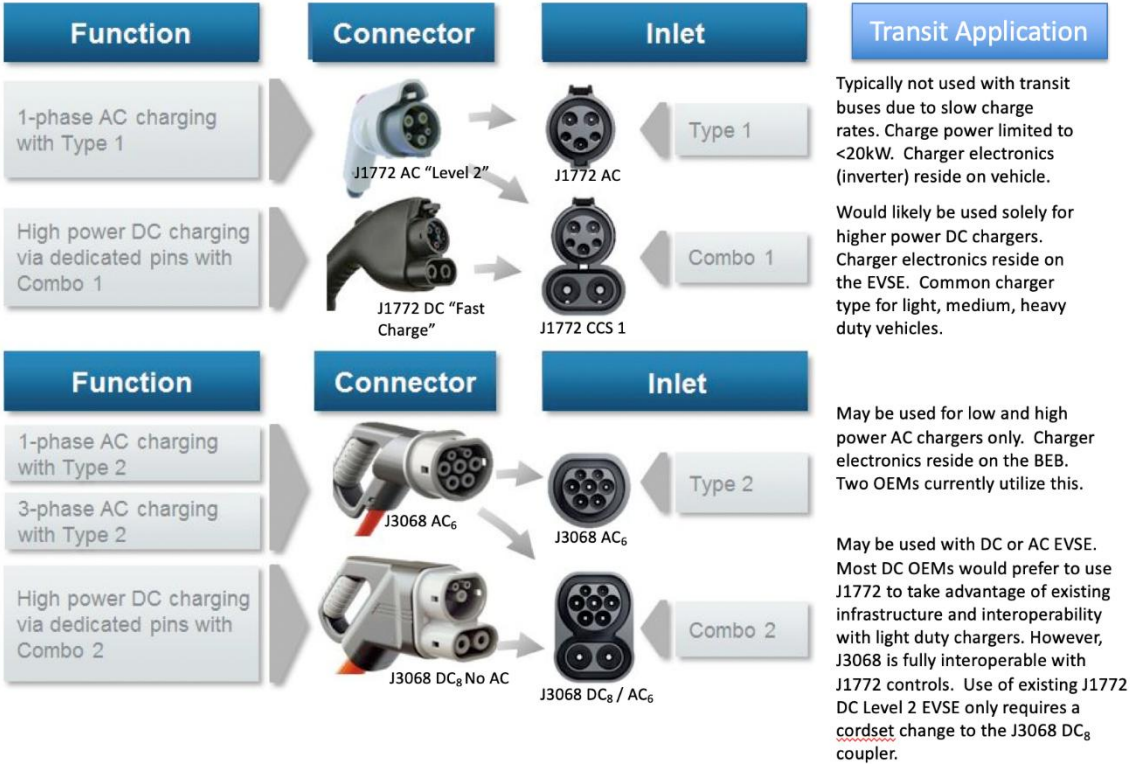
In addition, Section TS 8.2 requires Proposers to provide a narrative with their Technical Proposal addressing specific operational characteristics of the proposed battery electric bus based on the characteristics defined by the agency.

Charging Types (Part of Section TS 9.3.5)

When making decisions regarding bus-side charging requirements, agencies must consider a few things, including the following:

- The overall charging strategy (i.e., bus and charging combinations)—depot, on-route overhead or wireless (static or dynamic)—that it has selected in order to meet its routes. This may have been identified either prior to the procurement or through the procurement process. Either way, the bus receptacle must match the intended charger type.
- If the agency has existing electric vehicle supply equipment (EVSE), it must consider whether or not to stay consistent with its existing charger types and allow for the procured buses to have the capability of charging at those chargers. If the agency does not have existing EVSE, it still must consider allowing for interoperability with future procurements. Having to maintain and manage various types of EVSE and electric buses with respect to charging may lead to increased operations costs or potential conversion costs.

The agency must ensure that the technical specifications for the chargers being procured are consistent with the buses being procured. Procurement of the chargers and buses may or may not be accomplished under the same procurement process, but either way, specifications must be aligned to ensure interoperability with respect to physical interconnection, communication and electrical power transfer. Further, while standards can help ensure interoperability with respect to mechanical coupling, electrical compatibility and communication, bus and charger combinations should still be verified if compatibility is not already established by the OEM and charger manufacturer. The figure below notes the different plug-in charger types and the SAE standards they use. Please note that an overhead conductive charger should conform to SAE J3105-1 and a wireless charger should conform to the SAE J2954-2 standard.



Energy Storage System Capacity (part of TS 9.3.5)

As of the time of developing this appendix, there was no established, standardized method for measuring battery state of health. Measuring battery capacity onboard a bus is difficult and may not be precise; or, in the case of simply measuring the amount of energy dispensed in a charge cycle, may be able to provide discharge capacity of the battery. Measured battery capacity is affected by discharge rate and must be accounted for or normalized. Absent a standard, agencies must rely on the OEMs to provide the measurement and/or method in order to agree with the measurement expectations for which stated capacity and warranty are provided.

Section TS 9.3.5 attempts to allow for OEMs to provide a method for measuring battery capacity, while also allowing for independent third-party measurement. Industry groups are working on establishing a standardized method for measuring battery capacity and state of health for the all-electric transit bus in particular. Once this is established, this section should be modified by the user to reflect that standard.

Fire Suppression Section, TS 5.10

The default is “no fire suppression system” because, in a battery electric bus, the BMS is the primary source of fire prevention and detection for traction batteries. The most effective means of safety in the event of a fire is evacuation.

Appendix H: Sample Technical Specifications for Charging Equipment

Guide to Using This Appendix

This appendix provides language that an agency can use for the technical specifications in a request for proposals for battery electric bus charging equipment. These technical specifications can be used either for an RFP for the bus and the charging equipment or for a separate RFP for the charging equipment.

This appendix includes language only for the Technical Specifications section of the RFP. For terms and conditions, agencies can refer to the relevant sections in this *Standard Bus Procurement Guidelines* document, including Section 3, “General Conditions,” and Section 4, “Special Provisions.”

This appendix is not intended to be used for procurements involving a “turn-key” solution (which may include related engineering procurement construction (EPC) services, installation services, etc.) and/or providing charging as a service.

The technical specifications language is designed to cover three charging types: plug-in, overhead conductive and wireless charging. Language relevant only to one charging type is covered in a section specific to that type. All other sections are relevant to all charging types.

As in the rest of this *Standard Bus Procurement Guidelines* document, the language provided is intended to be used directly by the agency in its RFP. Please note the following:

- Brackets “[]” indicate places where the agency needs to insert or select the correct language.
- Explanatory notes for document users are labeled “Note to User.”

Charging Equipment Technical Specifications Language

1. Scope of Work

[Agency name] (“the Agency”) is issuing this RFP for battery electric bus charging equipment procurement. The Agency requests that Proposers present installation-ready solutions to support electric bus charging in accordance with the requirements described herein.

The Agency requires that cost and lead times for delivery of proposed solutions be included in the response and that costs be broken down by component (charger and electronic components, pantograph, structural assembly, software, warranty, etc.) where such components can be supplied separately. The Agency requests that Proposers include certifications and specifications applicable to the products offered as solutions with their responses, including but not limited to Buy America compliance, UL listing status and/or NRTL certification.

1.1 Definitions and Abbreviations

Agency: The Agency itself or a third-party representative or consultant that is authorized to operate on behalf of the Agency.

ASCE: American Society of Civil Engineers.

electric vehicle supply equipment (EVSE): Defined as “the conductors, including the ungrounded, grounded and equipment-grounding conductors; the electric vehicle connectors; the attachment plugs and all other fittings, devices, power outlets or apparatuses installed specifically for the purpose of delivering energy from the premises’ wiring to the electric vehicle” by NEC Article 625. For the purposes of this document, the chargers defined below are considered a subset of EVSE.

overhead conductive charger: An overhead pantograph charger conforming to the SAE J3105-1 standard capable of delivering up to 450 kW or higher to the bus to support automated, on-demand, conductive charging. Can be used for depot or on-route charging operations.

plug-in charger: An SAE J1772 CCS Type 1 (DC connection) or SAE J3068 (AC connection) plug-in charger, capable of delivering power to the bus up to 150 kW or higher, to support overnight charging, generally at a parking stall.

SAE: Society of Automotive Engineers.

vehicle to grid (V2G): The ability to provide power from a plug-in electric vehicle back to the electrical grid in addition to managing its power load when charging from the grid.

wireless inductive charger: A wireless charger with a demonstrated capability of delivering power from 25 kW to hundreds of kilowatts to the bus with a corresponding wireless receiver to support automated, on-demand, inductive charging. Can be used for depot or on-route charging operations. Standards for heavy-duty vehicles currently under development.

1.2 Agency Operating Conditions

1.2.1 Planned Site Description

NOTE TO USER: *Select the desired charging equipment option or options.*

The Agency, in support of its battery electric bus deployment, is soliciting:

- plug-in charging equipment to be located at [facility description and address]
- overhead conductive charging equipment to be located at [facility description and address]
- wireless charging equipment to be located at [facility description and address]

The preliminary and approximate location of the charging interface(s) is shown in [description or reference to charging location]. The exact location(s) will be determined during design in cooperation with the Agency.

NOTE TO USER: *In this section, provide or describe the following in order to receive accurate, relevant and complete proposals.*

- [Procurement, design (30/60/90 plans), construction and installation plans. If site design work has been done, Agency to provide design drawings. It is recommended that the Agency provide 30% design phase drawings.]
- [Process for coordination with local utility.]
- [Information related to local utility description and applicable utility rate structures, existing or planned.]
- [Existing site conditions, including but not limited to survey information, surface conditions, utility feeds both overhead and underground, electrical panel tie-ins and capacity, space constraints that may affect equipment, etc. The Agency should include site plans, drawings, photographs, single line electrical, etc.]
- [Planned distances from utility service to bus charging locations including, if known, from transformer/switchgear to charger(s), from charger(s) to dispensers, and dispensers to bus receptacles.]
- [Overall project schedule and details on installation requirements and schedule.]
- [Future plans for expansion of electric fleet and need for future-proofing, including bus storage layouts, existing and planned.]

Proposers shall provide installation instructions, including footprint drawings for proposed equipment. If possible, Proposers should provide recommended “best-fit configuration” for universal installation of chargers.

1.2.2 Battery Electric Bus Operation Strategy

Below is an overview of the Agency's [current and/or planned] operating strategy for the battery electric buses and chargers:

1. The Agency is seeking charging equipment capable of charging [number, make and model] battery electric buses that are [briefly describe bus technical specs, battery capacity and any other equipment being charged]. Each bus will have max continuous current demand of [X amps, if known].
2. The Agency is seeking depot [plug-in, overhead pantograph, wireless] charging that will accommodate charging levels between 50 and 200 kW per port and is expected to rely on depot charging overnight between [hh:mm] and [hh:mm].
3. The Agency is seeking depot fast-lane charging that will accommodate [describe overhead fast lane charging needs].
4. The Agency is seeking on-route opportunity charging that will accommodate [describe overhead conductive charging and/or wireless charging needs].
5. Buses will have charge ports and receptacles to allow for the use of plug-in charging per SAE J1772 CCS 1 and/or SAE J3068. Charge receptacles are located at [describe location on bus].
6. Buses will have dwell times available for depot charging ranging from [X minutes] to [X hours] and for on-route opportunity charging from [X minutes] to [X minutes].
7. Buses will have charge bars installed to allow for the use of overhead infrastructure mounted pantograph charging per SAE J3105-1.
8. Buses and charge stations are expected to integrate with third-party hardware and software systems for charge management and operational data collection and reporting. [If known, provide list of known software to integrate with.]

1.2.3 Agency Operating Conditions

The following identifies the anticipated operating conditions for the bus and chargers. The Agency operates buses throughout [area]. The following is intended to ensure that the charger is capable of operating in these conditions.

If unable to operate in these operating conditions, please specify the capability of the proposed chargers.

Alternative 1

The charging equipment must operate in the identified climate conditions specified below:

1. Ambient temperatures between [area low temp] °F and [area high temp] °F.
2. Humidity levels as high as [area high humidity] %.
3. [Optional language] Rain, snow and ice conditions.
4. [Optional language] Severe winter road maintenance processes, including sand, salt, calcium chloride, calcium magnesium acetate and magnesium chloride.
5. [Optional language] Severe airborne dust conditions (particles could comprise a combination of silicate, road salt and glacier dust, with particle size as small as 0.01 µm).
6. Outdoor [and/or indoor] parking and outdoor [and/or indoor] charging in the above-mentioned temperature and elements.

Alternative 2

The charging equipment must operate in any possible anticipated climate condition for [city or county, state].

2. Standards and Regulations

2.1 Design Requirements

1. Charging equipment must comply with all applicable federal, state and local legislation, regulations, codes, standards, permits, approvals, authorizations and other requirements (collectively, "regulations") in effect at the date of acceptance.

2. The charging equipment shall be UL classified or field certified for the intended purpose prior to acceptance.
3. Communication shall be OCPP 1.6-J (or newer) compliant and can also be locally programmed.

The following specific standards and regulations shall apply to the charging equipment (latest version at time of acceptance):

STANDARDS FOR EV CHARGING EQUIPMENT SAFETY: Applicable to All		
Reference	Name	Notes
OSHA	Occupational Safety and Health Administration	All work must be accomplished compliant with OSHA regulations, as expressed in 29 CFR 1910 and 29 CFR 1926. Further, all contractors must identify their Designated Competent Person to the CAR.
NFPA	National Fire Protection Association	NFPA 70, Article 625 is relevant for EVSE and covered under UL 2202 and 2231-1 and -2. NFPA 70E is relevant for safe work practices to protect personnel exposure to major electrical hazards, including arc flash.
NEC	National Electrical Code	NEC Article 625 is relevant for EVSE and covered under UL 2202 and 2231-1 and -2. There will be additional NEC requirements that will impact site design, cable sizes, etc.
EMC compliance	FCC Part 15 Class A	For plug-in applications FCC Part 15 Class A handles EMC. It may be worthwhile, for large projects, to coordinate a project specific EMC study.
IEEE/ANSI C95.1	Standard for Safety Levels with Respect to Human Exposure to Electric, Magnetic, and Electromagnetic Fields, 0 Hz to 300 GHz	
STANDARDS FOR COMPLIANCE WITH BUILDING CODES: Applicable to All		
ASCE 7	Associated Criteria for Buildings and Other Structures	
COMMUNICATION STANDARDS: Applicable to All		
OCPP 1.6-J (or newer)	Open Charge Point Protocol 1.6-J	
OpenADR 2.0 (optional)	Open Automated Demand Response	Recommended for agencies interested in energy management and capable, or potentially capable, of automated demand response functionality.
ISO 15118 (optional)	Road vehicles: Vehicle-to-Grid Communication Interface	Applicable only for agencies requesting or requiring vehicle-to-grid capability for bidirectional charging. Not applicable for unidirectional charging only.
STANDARDS FOR DC PLUG-IN CHARGING		
SAE J1772	Electric Vehicle and Plug-In Hybrid Electric Vehicle Conductive Charge Coupler	
UL 62	Flexible Cords and Cables	Applicable to the electric vehicle charging cable and not the charging system as a whole.
UL 1741SA or UL 9741 (optional)	Bidirectional EV Charging System Equipment	Applicable only for agencies requesting or requiring vehicle-to-grid capability for bidirectional charging. Not applicable for unidirectional charging only.

UL 2202	Electric Vehicle Charging System Equipment	
UL 2231	Standard for Personnel Protection Systems for Electric Vehicle (EV) Supply Circuits	
UL 2251	Plugs, Receptacles and Couplers for Electric Vehicles	UL 2251 applies to charging up to 600 VAC or VDC. Some bus charging regularly exceeds 600 VDC and therefore may not be applicable.
STANDARDS FOR AC PLUG-IN CHARGING		
SAE J3068	Electric Vehicle Power Transfer System Using a Three-Phase Capable Coupler (for AC charging)	CCS 2 generally not applicable for plug-in DC charging equipment.
UL 62	Flexible Cords and Cables	Applies to the electric vehicle charging cable and not the charging system as a whole.
UL 1741SA or UL 9741 (optional)	Bidirectional EV Charging System Equipment	Applicable only to agencies requesting or requiring vehicle-to-grid capability for bidirectional charging. Not applicable for unidirectional charging only.
UL 2202	Electric Vehicle Charging System Equipment	
UL 2231	Standard for Personnel Protection Systems for Electric Vehicle (EV) Supply Circuits	
UL 2251	Plugs, Receptacles and Couplers for Electric Vehicles	UL 2251 applies to charging up to 600 VAC or VDC. Some bus charging regularly exceeds 600 VDC and therefore may not be applicable.
UL 2594	Electric Vehicle Supply Equipment	
STANDARDS FOR OVERHEAD CHARGING		
SAE J3105-1	Electric Vehicle Power Transfer System Using Conductive Automated Connection Devices	
UL 2202	Electric Vehicle Charging System Equipment	
STANDARDS FOR WIRELESS CHARGING		
NOTE TO USER: Various standards for wireless charging are currently under development. Once a recognized standard is adopted and published, the Agency should include those here.		

NOTE TO USER: Individual (or associated) components of the chargers or charging systems should be evaluated by applicable UL standards.

2.2 Supporting Materials

The Proposer shall provide a detailed description of the charging infrastructure required to charge the bus and specify its compliance with SAE J1772 DC (for DC plug-in charging), SAE J3068 (for AC plug-in charging), SAE J3105-1 (for overhead charging), and any other standards that may be applicable. The Proposer shall describe the expected level of interoperability of the proposed charging system with other vehicles and transit buses. Specifically, the Proposer shall identify and document interoperability for Agency vehicle models, both delivered and planned, including [list all prior vehicles received and any vehicles delivered within 12 to 36 months of commissioning charging equipment].

The Proposer shall provide a list of standards and regulations that the proposed equipment meets, including but not limited to those listed in the table above.

3. Plug-In Charger Technical Specifications

3.1 Design Requirements

1. The chargers shall be capable of connecting to three-phase, 60 Hz electrical supply at 480 VAC, or approved alternative.

Alternative: The chargers shall be capable of connecting to three-phase, 60 Hz electrical supply at 208 VAC, or approved alternative.

Alternative: The chargers shall be capable of connecting to three-phase, 60 Hz electrical supply at 240 VAC, or approved alternative.

Alternative: Charging system must be able to dispense a rated continuous output of at least [50 kW, 125 kW or other].

NOTE TO USER: *Chargers will dispense power as commanded by the battery management system of a range of vehicle types. Actual charge power is dependent on vehicle battery voltage and will decrease as battery voltage increases.*

2. [Agency to provide battery size and time to charge from empty to full SoC.]
3. While charging, power factor shall exceed 95% (or 0.95).
4. Standby power consumption must be minimized.
5. The charging equipment shall be capable of operating continuously in the manufacturer's designed operating profile without performance or safety degradations in the conditions defined in "Agency Operating Conditions," Section 1.2 of this appendix.
6. The connectors shall not be energized except when mated with the bus mounted receptacle.
7. Access doors shall be lockable (cabinets keyed the same) and use secure latching.
8. Chargers shall be equipped with robust cable management hardware sufficient to safely and effectively store charging cables, for [length] cable length, while providing operators ease of connection to the bus.

Alternative: Chargers shall be equipped with a pedestal-mounted cable management system.

Alternative: Chargers shall be equipped with an overhead mounted reel cable management system.

Alternative: Chargers shall be equipped with lockable cable management for out-of-service conditions, in order to safely prevent access to equipment without de-energizing.

9. Chargers shall allow the Agency to set operational power limits.
10. New charging sessions shall be automatically restarted after power outage and restoration, to the extent safe and in accordance with applicable standards.
11. Controls shall include features to prevent progressive charging system damage resulting from any one or more operating issues, or out-of-limit operating conditions.
12. If electronics enclosures are located outdoors, they must be rated at NEMA 3R or above.
13. Each charger shall be capable of communication to an external network for purposes of charge management and control.

3.2 Preferences

NOTE TO USER: *If the Agency requires any of the following, move to Design Requirements above.*

1. Charging equipment with multiple dispensers is capable of providing power to all connected buses so as to provide battery and cabin temperature preconditioning.

2. If multiple dispensers cannot be powered simultaneously, charging equipment provides a means of sequencing among the dispensers during and after charging to provide battery and cabin temperature preconditioning, as well as to continually restore any charge that may be lost in the bus while the dispenser was unpowered.
3. Charging equipment is capable of scheduled completion of charges and temperature preconditioning activities where the schedule is settable and changeable by the Agency.
4. Chargers shall be equipped with local operator panel at dispenser for automatic or manual operation, for retrieving diagnostic codes, and for resetting charge session.
5. External [emergency disconnect switch or main breaker shutoff] shall be provided and meet electrical codes, standards and requirements

3.3 Supporting Materials

1. The Proposer shall provide complete charging equipment specifications for the equipment being proposed.
2. The Proposer shall provide information and options for power supply requirements for individual chargers.
3. The Proposer shall provide mounting and installation manuals and site design guides for all necessary components, including civil, electrical, mechanical and communication infrastructure requirements.
4. The Proposer shall provide a complete description of the vendor qualifications that may be required to perform work related to installation or maintenance of the Proposer's equipment.
5. The bid package shall contain a complete description of the charging equipment, including:
 - a. compliance with charge standards, electrical safety standards and UL classification;
 - b. charger efficiency;
 - c. charger dimensions;
 - d. connector type;
 - e. number of connectors;
 - f. connector cable length(s) offered;
 - g. electrical disconnect switch for each charger;
 - h. charge method (AC or DC);
 - i. rated power output;
 - j. standby power consumption;
 - k. enclosure IP and/or NEMA ratings;
 - l. country of origin;
 - m. [Buy America compliance, if required];
 - n. ambient operating temperature ratings;
 - o. equipment thermal management;
 - p. a graph showing continuous current output versus voltage throughout the operating range; and
 - q. details on:
 - charging instructions;
 - automatic and manual control capabilities;
 - dispenser control panel display features and operator functions, if equipped;
 - communication management options (cellular, Ethernet, fiber, Wi-Fi);
 - operations and maintenance manuals;
 - options for preventive maintenance (contract with OEM terms/cost, training to perform with own forces/contracted third party); and
 - maintenance requirements.
6. Charger manufacturer shall describe all transit bus models that charger has been validated for, if that validation included direct participation by the bus manufacturer, and note any exceptions.
7. Charger manufacturer shall provide list of all locations and contact information for installations of the proposed charger.

8. If the chargers are capable of supporting multiple dispenser outputs, the Proposer must clearly describe the total number of potential dispenser outputs, the power level for each dispenser, charge sequencing logic for multiple buses connected to the same charger, and any additional charging hardware cost for each dispenser. If separated charging stanchions or overhead reels are available or provided, the Proposer shall describe their layout, installation and operation requirements.
9. The Proposer shall propose a method for control of the charging cycle to manage the use of power from the utility grid for reduction of peak demand charges and general fleet charging management. If a charge management software solution is proposed, charging shall be able to be controlled by an OCPP-compliant system.
10. The Proposer shall describe any automatic or “smart” charging features, including programmable charging capability, networking multiple chargers, charge monitoring, remote charge management, vehicle-to-grid capability, and charge data collection and reporting. Describe whether these features are provided as a standard offering or as an option to the proposal submission. If certain features are provided as an option, clearly describe costs. Describe both up-front costs and any necessary subscription service costs.
11. The Proposer shall describe the cable management hardware being offered, including functionality, specifications, dimensions, drawings, installation requirements and component replacement costs. If optional cable management systems are available, provide additional details on costs for those systems.

4. Overhead Conductive Chargers – Technical Specifications

4.1 Design Requirements

1. The overhead conductive charging stations must comply with all applicable local, state and federal codes.
2. The chargers shall be capable of connection to three-phase, 60 Hz electrical supply.
3. The overhead pantograph support structural element shall be designed so it can attach to horizontal ground as a freestanding structural element.

Alternative: The overhead pantograph support structure shall be designed so it can securely attach to an Agency-supplied charge mast, canopy or roof.

4. The charging system must be able to dispense a rated continuous output of [150 kW, 300 kW, 450 kW] or higher.

NOTE TO USER: Chargers will dispense power as commanded by the battery management system of a range of vehicle types. Actual charge power is dependent on vehicle battery voltage and will decrease as battery voltage increases.

5. The charging equipment shall be capable of operating continuously without performance or safety degradations in the conditions outlined in Section 1.2 of this appendix.
6. The charging equipment shall be capable of safely and effectively making connection and operating in the Agency operating conditions defined above and up to [X inches of snow or X inches of ice], without manual intervention.
7. To ensure proper bus alignment, charger shall utilize communication links in accordance with SAE J3105 standards to determine bus identity and when bus is properly aligned for extension of pantograph. Charger must be able to safely and effectively operate in a multi-lane environment with other pantographs mounted 12 ft away and simultaneously approaching buses.
8. Charging equipment shall be rated for wind and seismic loadings as determined by ASCE 7, with an importance factor of 1.0, while supporting a retracted or operationally extended pantograph.
9. While charging, power factor shall exceed 95% (or 0.95).
10. Standby power consumption must be minimized.
11. The connectors shall not be energized except when mated with the bus charge rails.
12. Access doors shall be lockable (cabinets keyed the same) and use secure latching.
13. Chargers shall be capable of setting operational limitations on charging.

14. New charging sessions shall be automatically restarted after power outage and restoration, to the extent safe and in accordance with applicable standards.
15. Controls shall include features to prevent progressive charging system damage resulting from any one or more operating issues or out-of-limit operating conditions.
16. If electronics enclosures are located outdoors, they must be rated at NEMA 3R or above.
17. Each charger shall be capable of communication to an external network for purposes of charge management and control.
18. The overhead pantograph shall be capable of manually disconnecting and retracting the charging interface in the event of a system or power failure.
19. All manual operations for the chargers must include detailed, explicit instructions for ensuring that power is removed and the system is safe prior to any work on the system.

4.2 Preferences

NOTE TO USER: *If the Agency requires any of the following, move to Design Requirements above.*

1. Chargers shall be equipped with local operator panel for manual operation, for retrieving diagnostic codes and for resetting charge session.
2. The charging system must be equipped with [local operator panel, cloud-based system] for manual operation, retrieving diagnostic codes, and resetting charging sessions for the set of chargers being offered.
3. External [emergency disconnect switch or main breaker shutoff] shall be provided and meet electrical codes, standards and requirements

4.3 Supporting Materials

1. The Agency requests the Proposer to describe its proposals with sufficient detail for the Agency to assess the structural adequacy of the overhead support structure solution by providing either structural substantiation or by providing sufficient detail for the Agency to substantiate the structure to meet local codes and requirements.
2. The Proposer shall provide complete charging equipment specifications for the equipment being proposed.
3. The Proposer shall provide information and options for power supply requirements for individual chargers.
4. The Proposer shall provide mounting and installation manuals for all necessary components, including civil, electrical and mechanical infrastructure requirements.
5. If the Proposer has multiple options above the required power level, those options should be clearly described, including costs for each.
6. The Proposer shall provide a complete description of the vendor qualifications that may be required to perform work related to installation or maintenance of the Proposer's equipment.
7. The bid package shall contain a complete description of the charging equipment, including:
 - a. compliance with charge standards, electrical safety standards and UL classification;
 - b. charger efficiency;
 - c. charger dimensions;
 - d. connector type;
 - e. rated power output;
 - f. standby power consumption;
 - g. a graph showing continuous current output versus voltage throughout the full operating range;
 - h. IP and/or NEMA ratings;
 - i. country of origin;
 - j. [Buy America compliance, if required];
 - k. ambient operating temperature ratings;

- l. equipment thermal management; and
- m. details on:
 - charging instructions;
 - automatic and manual control capabilities;
 - dispenser control panel display features and operator functions, if equipped;
 - communication management options (cellular, Ethernet, fiber, Wi-Fi);
 - operations and maintenance manuals;
 - options for preventive maintenance (contract with OEM terms/cost, training to perform with own forces/contracted third party);
 - electrical disconnect switch description; and
 - maintenance requirements.
8. Charger manufacturer shall describe all transit bus models that charger has been validated for and note any exceptions.
9. Charger manufacturer shall provide list of all locations and contact information for installations of the proposed charger.
10. The Proposer must describe the methods for ensuring that charging equipment is capable of safely and effectively making connection and operating in snow and freezing environment.
11. The Proposer must describe any bus-side connector requirements or recommendations.
12. The Proposer must describe software and connectivity options, web tools, APIs, etc. to facilitate data transmission to back offices and remote management of the charger.

5. Wireless Chargers – Technical Specifications

5.1 Design Requirements

1. The wireless charging stations must comply with all applicable local, state and federal codes.
2. The chargers shall be capable of connection to three-phase, 60 Hz electrical supply.
3. The charging system must be rated at [75 kW, 125 kW, 150 kW, 250 kW, 300 kW, 450 kW, 500 kW] or higher.

NOTE TO USER: *Chargers will dispense power as commanded by the battery management system of a range of vehicle types. Actual charge power is dependent on vehicle battery voltage and will decrease as battery voltage increases.*

4. The charging equipment shall be capable of operating continuously without performance or safety degradations in the conditions outlined in Section 1.2 of this appendix.
5. The charging equipment shall be capable of safely and effectively operating in the operating conditions defined above and including snow, ice, dirt, rain and standing water conditions, without manual intervention.
6. To ensure proper bus alignment, the charger shall utilize communication links to determine bus identity and when bus is properly aligned. The charger must be able to safely and effectively operate in a multi-lane environment without the risk of interference with other equipment.
7. While charging, power factor shall exceed 95% (or 0.95).
8. Standby power consumption must be minimized.
9. The primary charging pad shall not be energized except when coupled with the bus side secondary pad.
10. Access doors shall be lockable (cabinets keyed the same) and use secure latching.
11. Chargers shall be capable of setting operational limitations on charging.
12. New charging sessions shall be automatically restarted after power outage and restoration, to the extent safe and in accordance with applicable standards.
13. Controls shall include features to prevent progressive charging system damage resulting from any one or more operating issues, or out-of-limit operating conditions.
14. If electronics enclosures are located outdoors, they must be rated at NEMA 3R or above.

15. Emergency disconnect switch shall be provided and meet electrical codes, standards and requirements [if desired or required].
16. Each charger shall be capable of communication to an external network for purposes of charge management and control.

5.2 Preferences

NOTE TO USER: *If the Agency requires any of the following, move to Design Requirements above.*

1. Vehicle shall be equipped with operator control panel for manual operation, for retrieving diagnostic codes and for resetting charge session.
2. Charging system must be equipped with [local operator panel, cloud-based system] for manual operation, retrieving diagnostic codes and resetting charging sessions for the set of chargers being offered.

NOTE TO USER: *Power electronics may be placed away from the charging pads (e.g., 40 ft).*

5.3 Supporting Materials

1. The Proposer shall provide complete charging equipment specifications for the equipment being proposed.
2. The Proposer shall provide power supply requirements for individual chargers.
3. The Proposer shall provide mounting and installation manuals for all necessary components, including civil, electrical and mechanical infrastructure requirements.
4. If the Proposer has multiple options above the required power level, those options should be clearly described, including costs for each.
5. The Proposer shall provide a complete description of the vendor qualifications that may be required to perform work related to installation or maintenance of the Proposer's equipment.
6. The bid package shall contain a complete description of the charging equipment, including:
 - a. compliance with charge standards, electrical safety standards and UL classification;
 - b. charger efficiency;
 - c. charger dimensions;
 - d. rated power output;
 - e. standby power consumption;
 - f. a graph showing continuous current output versus voltage throughout the full operating range;
 - g. IP and/or NEMA ratings;
 - h. country of origin;
 - i. [Buy America compliance, if required];
 - j. ambient operating temperature ratings;
 - k. equipment thermal management; and
 - l. details on:
 - charging instructions;
 - automatic and manual control capabilities;
 - HMI features and operator functions, if equipped;
 - communication management options (cellular, Ethernet, fiber, Wi-Fi);
 - operations and maintenance manuals;
 - options for preventive maintenance (contract with OEM terms/cost, training to perform with own forces/contracted third party);
 - electrical disconnect switch description; and
 - maintenance requirements.
7. The charger manufacturer shall describe all transit bus models that charger has been validated for and note any exceptions.

8. The charger manufacturer shall provide list of all locations and contact information for installations of the proposed charger.
9. The Proposer must describe software and connectivity options, web tools, APIs, etc. to facilitate data transmission to back offices and remote management of the charger.

6. Data Logging and Telematics

6.1 Design Requirements

1. The Proposer shall provide the Agency the ability to access raw data generated by the chargers at no additional charge for the duration of the Agency's ownership of the chargers. The Agency recognizes that additional convenience functionality, wireless transmission, or processing capability or services may incur additional costs.
2. The Proposer shall provide the Agency sufficient means to fully decode network traffic to engineering units, including proprietary protocols or messages.
3. The Proposer shall provide the Agency with the ability to physically connect to the monitoring system to view, retrieve and analyze charger data. The Proposer shall provide connectors for the Agency's use for the purpose of adding third-party data monitoring equipment. The Proposer shall provide diagrams that identify the location and pinouts of such connectors. The hardware for data collection and transmission shall be located behind a hinged and lockable panel with connection to the device(s) easily accessible.
4. The system shall be capable of collecting and providing reports to the Agency for the purpose of analyzing charger performance. Data collected and provided shall include but not be limited to energy consumption of the chargers and charge power output, as well as fault and diagnostic codes. The Agency prefers that at least the following summary reports be readily available and accessible for analytics and diagnostics:
 - a. All charging session details in accordance with OCPP 1.6-J or newer, including but not limited to transaction ID, charger ID, bus ID, timestamp, duration of charge, DC output energy (kWh), AC input energy (kWh), max power output (kW), bus connection start time, bus disconnection time, charging start time, charging stop time, energy delivered by programmable utility rate time of use periods, session termination reason (fault/diagnostic codes), start vehicle SoC, and end vehicle SoC.
 - b. Idle energy consumption.
5. The system shall have sufficient onboard storage to buffer data during brief loss of connection to the data network.

Alternative: The Proposer shall retain cloud-based storage data for at least one year's worth of collected information.

Alternative: Data shall also be made available to the Agency via a web-based tool and/or APIs. The Proposer shall be capable of providing a management and analytic software platform or database repository to monitor, log, track and analyze charger data.

6.2 Preferences

1. High-resolution, high-frequency data is preferred. The Agency favors systems that can provide second-by-second data over systems that provide only aggregated data.
2. The chargers shall include instrumentation capable of metering and logging data and transmitting it to cloud storage, including but not limited to the following capabilities:
 - a. Measures and displays kilowatt-hours consumed and real-time load in kilowatt-hours within 1% accuracy.
 - b. Records energy (kilowatt-hours) for both the DC output and AC input.
 - c. Records fault codes and timestamp.
 - d. Maintains interval data storage in a first-in, first-out format.
 - e. Data is recorded and stored at 10-second intervals during charging sessions and 15-minute intervals during idle periods.

6.3 Supporting Materials

1. The Proposer shall describe the type, resolution and frequency of the available data.
2. The Proposer shall provide information on management and analytic software platform or system used to log, track and analyze charger data.
3. The Proposer shall provide an exemplar of the diagnostic software.
4. The Proposer shall list information that can be readily accessible independently by the Agency.
5. The Proposer shall list items that are tracked for maintenance and preventive maintenance.

7. Inspection, Acceptance and Commissioning

7.1 Requirements

1. The purpose of the factory acceptance test 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 Agency, the Proposer shall cause Agency-witnessed factory acceptance testing to be conducted. Factory acceptance testing may include both a physical configuration inspection and a functional demonstration. Factory acceptance testing shall be conducted at the Proposer or Subcontractor's facility. The Proposer shall furnish to the Agency prior to factory acceptance testing a written inspection and demonstration plan for each item for review. The Agency's inspectors will attend factory acceptance testing unless the Agency provides a written waiver of its right to attend any such inspection. The results of factory acceptance testing shall be documented by the Proposer in a format deemed acceptable by the Agency, and all documents relating to the testing shall be forwarded to the Agency.
2. Upon delivery and installation, inspections will be carried out by the Agency to ensure compliance with all requirements, standards and regulations herein. The Agency will prepare a punch list as a result of physical inspections, startup tests and functional demonstrations. The punch list and completion schedule will be agreed upon by the Agency and the Proposer.
3. The Proposer shall provide, and the Agency shall agree to, an Acceptance Testing and Commissioning Plan for all supplied equipment that shall include detailed instructions and requirements for verifying complete functionality of the full charging system (i.e., dispensers; power converters; mounting hardware and equipment; and all required wires, cables and connections). In addition, the plan must include instructions for demonstrating the successful operation of any data monitoring and charge management functionality or services. Acceptance testing and commissioning shall also ensure that the charging solution integrates with and charges with a pilot bus or the electric buses being used (both delivered and on order) in accordance with the Electric Bus Operation Strategy above and applicable interoperability standards. At the time of acceptance testing and commissioning, the Proposer shall submit a written report to the Agency listing all incidents and unusual system performance issues, as well as documenting correct function per the approved commissioning plan.

7.2 Supporting Material

1. The Proposer shall provide an Acceptance Test and Commissioning Plan.

7.3 Requirement for charging system acceptance

1. The charging systems will be considered complete and accepted for ownership by the Agency upon the Agency's issue of notice of final acceptance to the Proposer. The Agency's final acceptance will be issued immediately upon the Proposer's demonstration to the Agency that the depot charging systems designed, delivered, assembled and installed/constructed by the Proposer are fully compliant with all

requirements, and that all punch list items are complete. Minimum requirements for completion of the charging system are:

- a. the design, delivery, assembly and installation of complete and fully functional depot charging systems;
- b. successful completion of all necessary inspections as required by authorities having jurisdiction (AHJs) and receipt of all necessary operating approvals as required by AHJs;
- c. successful completion of UL field certification, if required; and
- d. The Proposer's successful testing of charging system performance by completing the tests outlined below (Section 7.4).

Alternative: Preliminary acceptance will be granted when the requirements above are complete. A revenue service performance period will be conducted on each charger to confirm consistent and reliable operations. Chargers will be operated by the Agency. The performance period is [two, three, six] months commencing on or about [date or milestone definition]. Final acceptance will be granted when [90%, 95%, other] availability is achieved over the performance period duration.

Charger Availability %

$$= \frac{(\text{Days Charger Available for Service} + \text{Days Out of Service Outside of Equipment Provider's Control})}{(\text{Cumulative Days of Performance Period Completed})}$$

Alternative: All payments shall be made as provided herein, less a retention of [retention percentage] plus any additional amount retained as provided below and less any amounts for liquidated damages. The Agency shall make payments for chargers at the unit prices itemized in the price schedule within [number] calendar days after the delivery and preliminary acceptance of each charger and receipt of a proper invoice. The Agency shall make payments for spare parts and/or equipment at the unit prices itemized in the price schedule within [number] calendar days after the delivery and acceptance of said spare parts and/or equipment and receipt of a proper invoice. The Agency shall make a final payment for all retained funds within [number] calendar days of receipt of a final proper invoice and:

- delivery and acceptance of all contract deliverables, including manuals and other documentation required by the contract;
- Proposer provision of any certifications as required by law and/or regulations; and
- completion of performance period required under the contract and issuance of final acceptance.]

7.4 Performance Tests

7.4.1 Requirement for Plug-In Chargers Only

1. At a minimum, the Proposer shall demonstrate [three, five, other] successful charge initiations and terminations and a minimum of one hour of continuous bulk charging with [a bus, X buses] on each of the plug-in chargers. Completely charging [a bus, X buses] to full SoC is required, along with verification that the charger successfully ramps down current when approaching full SoC and terminates the charge session, as applicable.
2. The Proposer shall provide a commissioning certificate from the Agency-approved commissioning authority.
3. The Proposer shall demonstrate charging at rated power or maximum power the bus will accept, whichever is lower, for 15 minutes.

7.4.2 Requirement for Overhead Conductive Chargers Only

1. At a minimum, the Proposer shall demonstrate 20 successful charge initiations with [a bus, X buses] on each of the overhead conductive chargers.
2. The Proposer shall provide a commissioning certificate, from the Agency-approved commissioning authority.

3. The Proposer shall demonstrate charging at rated power or maximum power the bus will accept, whichever is lower, for 15 minutes. Completely charging a bus to full SoC, including successful charge termination, is required.
4. If possible, the Proposer shall also demonstrate that all combinations of any two concurrent charging operations in the same vicinity successfully initiate and maintain a charge event, as well as with a simultaneous approaching bus.

7.5 Functional Test Requirements

1. Noise measurements:
 - Tests shall be conducted by the Proposer in the presence of Agency representatives to ensure that airborne noise generated by the depot charging system while operating at full capacity does not exceed 60 dBA when measured 25 ft from charging system equipment in any direction. The Proposer shall also ensure compliance with the exterior noise requirements defined in local laws and ordinances.
2. Normal stop conditions:
 - Tests of all available charger and bus-side methods to stop a charge session shall be conducted to determine their effectiveness in accordance with the requirements of SAE J1772 or J3105, as applicable.
3. Emergency shutdown system:
 - Tests of manual shutdown devices on the charging systems shall be conducted to determine their effectiveness in accordance with the emergency stop requirements of SAE J1772 or J3105, as applicable. To the extent possible without inflicting damage to charging or bus equipment, all automated emergency stop conditions shall also be simulated to determine their effectiveness in accordance with the emergency stop requirements of SAE J1772 or J3105, as applicable.
4. Remote monitoring provisions:
 - All remote monitoring, control and data logging functionality shall be verified by the Proposer.
5. Design specification validation:
 - Design specifications may be tested upon indication of an overriding issue or fault. In this event, the Proposer shall provide the necessary tests and equipment to verify the equipment specification. If the Proposer cannot provide an in situ test, the Agency may determine an appropriate test for verification in collaboration with the Proposer. For example, thermal management systems designed to maintain acceptable operating temperatures may be tested to determine their effectiveness. Temperature readings may be recorded to verify that equipment is operating within the designed range.
6. Ancillary items:
 - The operation and function of ancillary items of the charging system shall be tested in the presence of Agency representatives. Deficiencies shall be recorded and corrected by the Proposer to the satisfaction of the Agency. Ancillary items shall include but not be limited to depot charging system lighting, doors, locks, control panels, switches and security systems.
 - Punch lists resulting from inspections of charging system carried out by Agency representatives are addressed and completed to the satisfaction of the Agency.
 - The Proposer has presented the Agency with all required deliverables per the contract terms, including but not limited to product information/verification forms, installation/startup checklists, functional performance tests, final customer experience report, operator and maintenance manuals, system manuals and diagrams, and parts manuals.
 - The Proposer has completed all contract-specified operational training.
 - The Proposer and the Agency have agreed to a schedule of operations training and maintenance training to be provided by the Proposer.

Deficiencies for any of the above tests shall be recorded and corrected by the Proposer to the satisfaction of the Agency. Punch lists resulting from these tests shall be addressed and completed to the satisfaction of the Agency.

Final commissioning of the depot charging systems will be completed on the electric buses upon their arrival on the Agency's property. The Proposer shall coordinate with the bus OEMs to ensure that each plug-in and overhead fast charger integrates with and charges [each bus, X buses], as applicable.

8. Manuals, Diagrams, Training and Recommended Spare Parts

8.1 Operating Manual Requirements

1. The Proposer shall provide the Agency with three identically bound sets of operating manuals for the plug-in and fast lane overhead charging systems. Operating manuals shall include step-by-step instructions to properly start, utilize, control and shut down charging system components. The operating manuals shall include instruction in the proper utilization of the charging systems and procedures to be observed. The target audience for the operating manuals shall be Agency fleet servicing personnel charged with opening, undertaking and closing the fleet refueling process.
2. The Proposer shall also provide the Agency with operating manuals in electronic (PDF) format. The operating manuals in electronic format shall be duplicate in content and organization to the bound sets of operating manuals for the charging systems.
3. The Agency shall have final approval for content of delivered operating manuals.

8.2 Diagram Requirements

1. The Proposer shall provide single-line electrical diagrams for the installed charger bank in both PDF and CAD formats. Diagrams shall include, at a minimum, all the chargers, conductors and switches, and show the connection to primary electrical service.
2. The Proposer shall provide mechanical layout diagrams of equipment showing all equipment footprint dimensions, conduit entry points and wire termination locations in both PDF and CAD format.

8.3 Maintenance Manual Requirements

1. The Proposer shall provide the Agency with three identically bound sets of maintenance manuals for the plug-in and fast lane charging systems. Maintenance manuals shall include step-by-step instructions to properly maintain all plug-in and fast lane charging systems and equipment/components. In addition to process and instrumentation drawings and detailed descriptions of system function and operation, maintenance manuals shall, at a minimum, include information on proper troubleshooting steps, system logic, preventive maintenance procedures and checklists, and repair procedures for all major components and systems. Maintenance manuals shall include all applicable wiring and logic diagrams.
2. The target audience for the maintenance manuals shall be Agency personnel or third-party contractors charged with maintenance of Agency facilities.
3. The Proposer shall also provide the Agency with maintenance manuals in electronic text-selectable (PDF) format. The maintenance manuals in electronic format shall be duplicate in content and organization to the bound sets of maintenance manuals for the on-route and depot charging systems.
4. The Agency shall have final approval for content of delivered maintenance manuals.

8.4 Parts Manual Requirements

1. The Proposer shall provide the Agency with three identically bound sets of parts manuals for the depot charging systems. Parts manuals shall include the process and instrumentation drawings; graphical parts breakdowns (parts diagrams); and associated parts lists for all major systems, assemblies, components and subcomponents of the charging systems. The parts diagrams shall be organized and clearly associated with parts lists using unique identifiers. Parts lists shall minimally define serviceable parts by system, assembly, noun name of part, the major component the part relates to, original equipment manufacturer, the OEM part number, life expectancy (in years or usage), unique part number, and quantity per associated assembly. The Proposer shall identify any parts or special tools needed for recurring preventive maintenance.
2. The Proposer shall also provide the Agency with parts manuals in electronic (PDF) format. The parts manuals in electronic format shall be duplicate in content and organization to the bound sets of parts

manuals for the on-route and depot charging systems. Electronic manuals shall be compatible with the Agency's parts catalog documentation software. Manuals shall be text-selectable. Parts lists and associated parts graphics are preferred to be received in Excel format to facilitate seamless integration or parts lists with the Agency's system and its relational database.

3. The Agency shall have final approval for the content of delivered parts manuals.

8.5 Training Requirements

1. The Proposer shall provide 40 hours of training for Agency operating and maintenance personnel upon initial system installation and for future maintenance of the system. The training plan shall consist of the following details: description of the courses, suggested attendees, course length and suggested timing.
2. The Agency reserves the right to modify the proposed training plan to meet its needs.
3. The instructor must be capable of training 10 Agency personnel simultaneously in each course.
4. The Proposer must provide a one-hour biannual webinar for new Agency employees and a refresher course within 60 days before expiration of the warranty.
5. The Proposer shall provide the training syllabus and all training material for review and approval by the Agency project manager prior to commencement of training. The Proposer shall provide all necessary equipment to facilitate the training. The Agency will specify the time and location for delivery for the on-site training courses at a later date after consulting with the Proposer for availability.
6. The Proposer shall provide training in video format for future training of Agency personnel.

8.6 Recommended Spare Parts Requirements

1. The Proposer shall provide the Agency with a list of recommended spare parts for the charging systems. Recommended spare parts lists shall, at a minimum, define serviceable parts by system, assembly, noun name of part, the major component the part relates to, original equipment manufacturer, the OEM part number, life expectancy (in years or usage), unit price, unique part number, and quantity per associated assembly.
2. The Proposer shall provide the Agency with a list of recommended spare parts to have on hand for the first year of maintenance and repair after final commissioning.
3. The Proposer shall also provide the Agency with a list of recommended spare parts for the charging systems in electronic (PDF and Excel) format. The list of recommended spare parts for the charging systems in electronic format shall be duplicate in content and organization to the hard copy of the recommended list of spare parts for the charging systems. The purpose of the electronic spare parts list is to import into the Agency's electronic parts catalog system.

9. Update Requirements

1. For a period of 15 years following the Agency's final acceptance of the charging systems, or life of the equipment, whichever is longer, the Proposer shall provide the Agency with all updates to maintenance manuals, parts lists and procedures for all systems, equipment or components of the charging system as issued by the Proposer and/or supplier to the Proposer.
2. The Proposer shall provide, within reasonable periods of time, the spare parts, hardware, software, firmware and all equipment necessary to maintain and repair the chargers for a period of at least 15 years or the life of the equipment, whichever is longer, 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.
3. Changes to chargers, including hardware, software and firmware, must be coordinated with the Agency to minimize disruptions to service. Remote updates must be scheduled with and approved by the Agency. Additionally, the Proposer must provide evidence to the Agency that the change has been successfully tested with the same model of buses provided by the Proposer. If this is not possible, the Proposer must submit a test plan to the Agency, and the Agency must approve the test plan before work to implement the change at the Agency can commence. If initial validation or verification must be done on Agency

equipment, then the upgrades may only be made to a single charging unit and verified for a period of 14 days in service before rolling upgrades out to the remainder of the chargers in the fleet. If upgrades experience any issues during install or the 14-day period, then the chargers must be reverted back to the last working version until the issues are resolved at the factory.

10. Warranty Requirements

1. The Proposer shall provide a minimum [two, five, other]-year parts and labor warranty, [including, excluding] preventive maintenance, on the charging systems, which shall commence upon the date of [final acceptance, revenue service (not to exceed 90 days after final acceptance)] of each charging system as issued by the Agency. The Proposer should clearly define all terms of the warranty in its response, and include the costs of the warranty in the cost proposal. The Proposer is also invited to list other available warranty options in the proposal narrative, clearly defining all terms.
2. Voiding the warranty:
 - a. The warranty shall not apply to any depot charging system failure or damage resulting from accident, misuse or negligence for which the Proposer is not responsible. Normal use shall include conditions prevalent in the normal (day-to-day) Agency operational and maintenance procedures. Normal use shall also include the environmental conditions specified in Section 1.2 of this appendix.
3. Warranty repairs:
 - a. A representative of the OEM of the malfunctioning equipment must be on-site at the Agency's property within 24 hours of receiving notice of a charging system issue from the Agency. The malfunctioning system or component must be properly functioning within 48 hours of receiving notice of a charging system issue from the Agency.
 - b. If during the warranty period, any replacement, repair or modification on a charging system component made necessary by defective design, materials or workmanship is not completed within 48 hours, then the warranty period for the entire charging system shall be extended by the number of days equal to the delay period.
 - c. Any parts taken from Agency inventory to perform warranty work will be replaced under warranty.

NOTE TO USER: If required, the Agency can refer to APTA's Standard Bus Procurement Guidelines, Section 7, "Warranty Requirements," and Subsection WR 2, "Repair Procedures," for additional language defining conditions for repairs performed by the Agency.

11. Timeline

1. The Proposer shall provide estimated lead time for delivery of the proposed charging equipment with the responses to this request.

Alternative: Delivery of chargers shall be determined by signed receipt of the Agency's designated agent(s), [agent's name and address], at the following point(s) of delivery and may be preceded by a cursory inspection of the charger: [point(s) of delivery address].

Alternative: Delivery shall be completed within [number] weeks after delivery of the executed Contract documents. Hours of delivery shall be [time range] on the following days of the week: [days for delivery].

Abbreviations and Acronyms

A/C	air conditioning
ABS	antilock braking system
AC	alternating current
ADA	Americans with Disabilities Act
AGM	absorbed glass mat
Ah	amp hour
APC	automatic passenger counter
ASCE	American Society of Civil Engineers
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
CCA	cold-cranking amps
CCS	Combined Charging 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
DEF	diesel exhaust fluid
DPF	diesel particulate filter
ECS	emission control system
EMI	electromagnetic interference
EPA	Environmental Protection Agency
EOL	end of life
ESS	energy storage system
EVSE	electric vehicle supply equipment
fc	foot-candle
FEA	Finite Element Analysis
FEMA	failure mode effects analysis
FMCSA	Federal Motor Carrier Safety Administration
FMVSS	Federal Motor Vehicle Safety Standards
FTA	Federal Transit Administration
GAWR	gross axle weight rated
GPS	Global Positioning System
GVW	gross vehicle weight
GVWR	gross vehicle weight rated
H-point	hip-point
HIC	Head Injury Criterion
HMI	human-machine interface
HSC	hybrid system controller
HV	high voltage
HVAC	heating, ventilation and air conditioning
I/O	input/output

IEEE	Institute of Electrical and Electronics Engineers
inHg	inches of mercury
ISO	International Standards Organization
JIC	Joint Industry Council
kJ	kilojoule
LV	low voltage
mA	milliamper
MERV	Minimum Efficiency Reporting Value
MPa	mega-Pascal
NFPA	National Fire Protection Association
NGV	natural gas vehicle
NOx	nitrogen oxides
NRTL	Nationally Recognized Testing Laboratories
OCPP	Open Charge Point Protocol
OEM	original equipment manufacturer
PA	public address
PM	preventive maintenance
PRD	pressure relief device
PSC	propulsion system controller
psi	pounds per square inch
RF	radio frequency
RFI	radio frequency interference
SAE	SAE International, formerly the Society of Automotive Engineers
scf	standard cubic feet
SHGC	solar heat gain coefficient
SLW	seated load weight
SoC	state of charge
UL	Underwriters Laboratories
UNECE	United Nations Economic Commission for Europe
UPS	uninterruptable power supply
USC	United States Code
USDOT	United States Department of Transportation
VDC	volts of direct current
WEOL	warrantable end of life
Wh	watt-hours
VIN	vehicle information number

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