CITY OF CHARLOTTE
CHARLOTTE AREA TRANSIT SYSTEM

REQUEST FOR PROPOSALS

APRIL 25, 2023

REQUEST FOR PROPOSALS
RFP # 269-2023-1402
Bus Procurement Project

APRIL 25, 2023

Dear Sir or Madam:

The City of Charlotte, North Carolina, is now accepting Proposals for Bus Procurement Project. The requirements for submitting a Proposal are stated in the attached Request for Proposals (the "RFP"). Please review them carefully.

A **Non-Mandatory** Virtual Pre-Proposal Conference for the purpose of reviewing the RFP and answering questions regarding the Services will be held on **MAY 23, 2023 at 2:00 p.m. EST.** A video conferencing line has been set up for Companies to attend the Pre-Proposal Conference. **No onsite meeting will be held, and Service Provider(s) should not come to the City expecting to attend in person.** While attendance at the Pre-Proposal Conference is not mandatory, all interested Service Provider(s) are encouraged to participate. For Meeting information, please request this from Todd Holcomb at Todd.Holcomb@charlottenc.gov.

An electronic copy of the RFP in Microsoft Word format may be obtained on the City's Contracting Opportunities Site by searching for the RFP Title or Number.

All Proposals are due to City of Charlotte Department of General Services, City Procurement, 3rd Floor, CMGC 600 East Fourth Street, Charlotte, North Carolina 28202, no later than **JUNE 27, 2023 at 5:00 p.m. EST.**

One (1) electronic copy of the Proposal on a flash drive in a searchable format such as MS Word or Adobe Acrobat and one (1) original Proposal signed in ink by a company official authorized to make a legal and binding offer, must be submitted in a sealed box or opaque envelope plainly marked with the Proposal number and service description as follows (Further instruction IP 12):

Request for Proposals
Attention: Todd Holcomb
[Name of Company Submitting Proposal]
Bus Procurement Project
RFP # 269-2023-1402

RFP questions must be directed to Todd Holcomb, Department of General Services – City Procurement, per the enclosed instructions in Section 2.3. The City is an equal opportunity purchaser.

Sincerely,

Marcy Mars
Interim Chief Procurement Officer

cc: RFP Project Team
RFP file

Contents

SECTION 1: NOTICE OF REQUEST FOR PROPOSALS

NR 1. Description of the Work to be Done

The Charlotte Area Transit System (CATS), a department of the City of Charlotte (the "Agency") requests Proposals for the manufacture and delivery of transit buses ranging from 30 – 40 feet in accordance with the terms and conditions set forth in RFP 269-2023-1402. The estimated number of buses per year is 30. The Contract shall be a one-year term with four one-year options for renewal.

Buses are to be purchased in the following tiers; as pulled from the City of Charlotte Sustainable and Resilient Fleet Policy, as available and in following the City of Charlotte Strategic Energy Action Plan;

Tier I - Zero emission vehicle
Tier II - Alternative fueled internal combustion engine
Tier III - Hybrid internal combustion engine
Tier IV - Conventional internal combustion engine - Gasoline
Tier V - Conventional internal combustion engine - Diesel

NR 2. Obtaining Proposal Documents

Proposal documents may be obtained electronically at www.ips.state.nc.us and/or www.charlottenc.gov/doingbusiness by searching the website for Bid Number 269-2023-1402.

NR 3. Proposal Due Date and Submittal Requirements

Proposals must be received by the Charlotte Area Transit System by June 27, 2023.

1. The proposal must be in a sealed envelope, box, or appropriate package, with the name and address of the Proposer and Request for Proposal number clearly marked on the outside. For the purposes of this proposal, the time specified will be as defined by the time stamp at the Charlotte Area Transit System reception desk on the 3rd Floor of the CMGC, 600 East Fourth Street, Charlotte, NC 28202. Proposal must be mailed or delivered with the following addressee information:

   RFP# 269-2023-1402, Bus Procurement Project
   ATTN: Todd Holcomb
   Charlotte Area Transit System
   600 East Fourth Street, 3rd Floor
   Charlotte, NC 28202

   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.

2. Proposers are requested to submit to the Agency one hard copy marked "Original," , signed in ink by a company official authorized to make a legal and binding offer and one (1) electronic copy of the Proposal on a flash drive in a searchable format such as MS Word or Adobe Acrobat. 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.

NR 4. Validity of Proposals

Proposals and subsequent offers shall be valid for a period of 180 days.

NR 5. Pre-Proposal Meeting Information

A Non-Mandatory Pre-Proposal Meeting will be held on May 27, 2023. A video conferencing line has been set up for Companies to attend the Pre-Proposal Conference. **No onsite meeting will be held, and Service Provider(s) should not come to the City expecting to attend in person.** While attendance at the Pre-Proposal Conference is not mandatory, all interested Service Provider(s) are encouraged to participate. For Meeting information, please request this from Todd Holcomb at Todd.Holcomb@charlottenc.gov.

Please submit in writing (email preferred) any questions regarding the Request for Proposal to be answered at the conference to the attention of Todd Holcomb, as referenced above, emailed to todd.holcomb@charlottenc.gov by **May 12, 2023**. Submittal of questions before this deadline will allow for a more thorough response.

SECTION 2: INSTRUCTIONS TO PROPOSERS

IP 1. Quantities

The Work under these Contract documents consists of the manufacture and delivery of an estimated base order of thirty (30) hybrid/electric and associated goods and services such as spare parts, training materials and manual.

There will be One-Hundred and Ninety (190) options for additional transit buses.

IP 2. Proposed Schedule for the Procurement

The following is the solicitation schedule for Proposers:

- Pre-Proposal Meeting/teleconference: May 23, 2023.
- Proposer communications and requests: May 26, 2023
- Responses to Proposer's communications and/or Agency addenda: June 2, 2023
- Proposal Due Date: June 27, 2023

IP 3. Obtaining Proposal Documents

Refer to Section NR.2 Obtaining Proposal Documents.

IP 4. (Reserved)

IP 5. Pre-Proposal Meeting/Information for Proposers

Refer to Section NR5. Pre-Proposal Meeting Information.

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. 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.

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 Acknowledgement of Addenda. Failure to acknowledge in the Proposal receipt of addenda may at the Agency's sole option disqualify the Proposal. These addenda will be posted on the Internet at www.ips.state.nc.us and/or Contract Opportunities - City of Charlotte (charlottenc.gov), and may be accessed at this website by searching for Bid number **269-2023-1402.**

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

Pursuant to Title 49, Code of Federal Regulations, 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

This Contract is subject to the "Buy America" requirements of 49 United States Code (USC) §5323(j) and 49 Code of Federal Regulations (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 his or her 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 percent.

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:

- Todd Holcomb
- Procurement and Contract Management
- Charlotte Area Transit System
- 600 East Fourth Street, 3rd Floor
- Charlotte, NC 28202

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 4220.1F or its successor may be obtained from Todd Holcomb, todd.holcomb@charlottenc.gov. 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 4220.1F or its successor.

IP 11.2 Pre-Proposal Protests

Protests concerning the terms, conditions, or proposed form of procurement action must be submitted at least five (5) working days prior to the date established for the receipt of Proposals.

IP 11.3 Protests on the Recommended Award

Protests concerning a recommendation for award, on any ground not based upon the content of Proposal, must be filed with the Agency within five (5) working days after the date established for the receipt of Proposals. The Agency reserves the right to award a contract during protest.
Protests concerning award decisions, on any ground not based upon the content of the Proposal must be filed with the Agency within five (5) working days after such aggrieved person knows, or should have known, of the grounds of the protest.

AGENCY REVIEW
The Contracting Officer will respond in writing to the protestor within five (5) working days. The response will include a detailed discussion and determination regarding each substantive issue raised in the protest. The Protestor may appeal the Contracting Officer's decision to the Chief Procurement Officer. Any such appeal must be in writing and submitted within five (5) working days of the receipt of the Contracting Officer's decision. The Chief Procurement Officer will review the appeal and respond to each substantive issue raised in the appeal. The Chief Procurement Officer shall render a decision and send a formal written response to the protestor within five (5) working days. The Chief Procurement Officer's response shall be the final decision by the Agency. The Contracting Officer or Chief Procurement Officer reserves the right to extend the period in which to respond beyond five (5) working days if the issues presented in the protest so warrant.
The protestor may file a request for reconsideration of the final decision, within five (5) working days of such decision, if one or more of the following occurs:
1. New or additional data not previously known becomes available.

2. There has been an error of law or regulation.

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 the FTA C 4220.1F 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.

IP 12.2 Alternate and Multiple Proposals (Reserved)

No bidder shall submit more than one proposal unless multiple or alternate proposals are requested in the Special Conditions. Any multiple or alternate proposals must be brought to the City's attention either during the pre-proposal conference or submitted in writing at least five (5) working days prior to the proposal deadline.

IP 12.3 Proposal Format Requirements

Proposals must be developed on the forms provided in this package, and must follow the proposal content requirements in the order in which they appear in the proposal. Proposals must be typewritten and submitted on standard 8-1/2"x11" paper. The proposals should be printed double-sided and on recycled paper. Each page must be clearly and consecutively numbered. Proposals shall be submitted in four separately sealed packages identified below. Each package shall be marked as specified below and shall contain all of 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 printed original (marked clearly as such), and one flash drive 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

1. Letter of Transmittal
2. Technical Proposal
3. Acknowledgement of Addenda
4. Contractor Service and Parts Support Data
5. Exceptions to the Proposal Terms and Conditions
   The Proposer is to provide a proposal that meets the specifications. Proposals may be submitted with exceptions to the specifications, which must be denoted separately and must include an explanation of

the necessity for each. The Agency reserves the right to negotiate modification to any exceptions with any Proposers, within the competitive range. All exceptions not found to be unacceptable 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 exception. The proposer's exceptions should give an explanation why the Proposer is taking exception to the requirements and any impacts to other requirements. If exceptions are not noted, the City will assume that the Proposer's proposal meets those requirements as specified herein.

6. Vehicle Questionnaire

7. References and Non-Priced Information

   A brief description listing experience that your company has had in providing similar service that demonstrates your company's ability to provide the service described in your proposal. Provide a list of at least five (5) customer references (preferably public transit agencies), include the firm's name, the name, title, and telephone number of a contact person; the dollar amount of the contract; and the dates that these programs/projects were completed. The dates of all of the orders placed on the contract, quantity of vehicles, scheduled delivery date and actual delivery date should also be included.
   A statement as to any judgments, litigations, licensing violations, or other violations, outstanding or resolved, associated with your company. Furthermore, all liquidated damage claims for the past three years should be provided, including the agency issuing the claim, the amount, and reason for the claim.

8. Engineering organization chart, engineering change control procedure, field modification process
   A brief description of the experience and qualifications of the proposed key staff members assigned to this program/project and what percentage of their time will be devoted to the program/project. Show their function in the program/project and a detailed resume' for each person. Additionally, the Proposer must specify where the staff will be located and identify the program/project manager.

9. Manufacturing facilities plant layout, other contracts, staffing

10. Production and delivery schedule and other Contract commitments for the duration of this Contract
    Provide a list of all current contracts with the proposer, the dates of the orders placed on the contract, the scheduled delivery date of the vehicles and the actual delivery date of the vehicles. Any fleet defects identified on the order should be identified as well as the resolution. The Agency reserves the right to contact any of the listed agencies.

11. Management Plan

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.

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)
3. Form of Proposal Deviation, if applicable (with price data)

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

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 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 Proposer's proprietary/confidential information, then subject request will be referred to the Proposer for review and consideration. If 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

Proposals received pursuant to this RFP shall remain confidential up to fourteen days before the award of the contract except for material which qualifies as "trade secret" information under N.C. Gen. Stat. 66-152 et. seq. If Proposer believes any communication contains trade secrets or other proprietary information that the Proposer believes would cause substantial injury to the Proposer's competitive position if disclosed, the Proposer shall request that the Agency withhold from disclosure the proprietary information by marking each page in the Proposal containing such proprietary information as confidential. Proposal information believed to be confidential by the Proposer shall be provided in the Proprietary/Confidential Information Package only. Proposer may not designate its entire proposal or bid as confidential. Additionally, Proposer may not designate price proposal or other proposal forms as confidential.

If Proposer requests that the Agency withhold from disclosure information identified as confidential, and the Agency complies with the Proposer's request, Proposer shall assume all responsibility for any challenges resulting from the non-disclosure, indemnify and hold harmless the Agency from and against all damages

(including but not limited to attorneys' fees that may be awarded to the party requesting the Proposer information), and pay any and all cost and expenses related to the withholding of Proposer information. Proposer shall not make a claim, sue or maintain any legal action against the Agency or its, officers, employees or agents in connection with the withholding from disclosure of Proposer information.

If Proposer does not request that the Agency withhold from disclosure information identified as confidential, the Agency shall have no obligation to withhold the information from disclosure and may release the information sought without any liability to the Agency.

IP 12.5 Signing of Proposal Forms

All proposals must be submitted in the name of the legal entity or authorized agency. If the proposal is made by a sole owner, it shall be signed with his/her full name and his/her address shall be given. If the proposal is made by a partnership, it shall be signed with the partnership name by a member of the firm who shall also sign his/her own name, and the name and address of each member shall be given. If the Proposer is a corporation, the proposal shall be signed by the corporate officer consisting of one signature from either: (1) the chair of the board, president or vice president; or (2) the secretary, assistant secretary, chief financial officer, assistant treasurer or by a person authorized by the corporation to execute written proposals on its behalf, and the corporate seal affixed thereto. If the corporate seal is not affixed to the proposal, or it is executed by a person other than an officer, there must be attached to the proposal a certified copy of a resolution of the corporation authorizing such officer or person to execute written proposals for and on behalf of the corporation. If the proposal is made by a joint venture, it shall be signed on behalf of each participating company by officers or other individuals who have full and proper authority to do so.

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.

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

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 to 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 not to be responsible and the Proposal rejected. The requirements are as follows:

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:

    - 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.
    - 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.
    - 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 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 Proposer took to resolve any judgments, liens, Fleet Defects history or warranty claims. Evidence shall be by client references.

Proposal Evaluation Criteria

The Evaluation Committee will consider only those proposals, which have been considered responsive to the Request for Proposals. Any proposal, which fails to meet the material requirements of the Request for Proposals, or for which a fixed dollar amount cannot be precisely determined, will be considered a non-responsive proposal and will be rejected. Proposals shall be evaluated according to the following criteria listed by their relative degree of importance:

• Product Design and Performance
• Manufacturer's Performance and Capabilities
• Total Cost per Bus
• Delivery Schedule

1. **Product Design and Performance**
   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 criterion. Failure to complete the "required submissions" bus description for each type of vehicle will reduce the Proposers score for this criteria. All exceptions not found to be unacceptable 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 exception. Extra seating capacity and configuration beyond the minimum specified in the technical specifications will increase the Proposers score for this criterion. Bus manufacturing process, vehicle construction and system design, as well as documented reliability will be used in this evaluation, as well as other design and performance elements of the components, which comprise those systems. Test results, safety and maintenance factors, and the cost of maintenance and operation for the bus design and system components proposed will also be considered in determining a final value for this criterion. The evaluation committee will consider the reliability and warranties of the buses to be provided as well as fleet standardization of components.

2. **Manufacturer's Performance and Capabilities**
   This criterion will look mainly at the capability of the bus manufacturer as presented in the proposal. The evaluation committee may look at the manufacturer'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 in reaching a final point determination. The evaluation committee may also look at judgments, liens, fleet defect history, warranty claims, and the steps that the manufacturer took to resolve these concerns in assessing the overall capabilities of the manufacturer.

3. **Total Cost per BUS**
   This criterion will be evaluated by looking at the total costs provided by the Proposer for each bus configuration offered for all five years. Cost will be evaluated on both the base year of the contract as well as the option years. A base year cost for each bus type should be provided regardless of quantity ordered.

4. **Delivery Schedule**
   This factor will look mainly at the proposed delivery schedule for the first year deliveries in addition to, the remaining four year option delivery schedule. All deliveries must be made within 12 months of each order.

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 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:

   - Notice that discussions and negotiations are concluded.
   - Notice to submit a Best and Final Offer or most immediate previous offer will be considered.
   - Notice of a common date and time for submission and notice that any submission will be subject to late submission, modification, and withdrawal provisions of the RFP.
   - 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.

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.

IP 14.2 Availability of Funds

This procurement is subject to the availability of funding. The Agency utilizes funds from the Federal Transit Administration, the State of North Carolina, and local transit funds. The availability of funds will determine the Agency's ability to make purchases of transit buses.

IP 14.3 Agency Contract Approval Process

As soon as practical after opening the Proposals, the name of the apparent successful Company will be submitted to the Council for final approval of award and the Procurement Officer will provide Contract documents to the Company. In the event the Council approval is not received within one hundred eighty (180) calendar days after opening of the Proposals, the Company may request that it be released from the Proposal.

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 seven (7) 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.

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. (Reserved)

SECTION 3: GENERAL CONDITIONS

GC 1. Definitions

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

Agency: The Charlotte Area Transit System (CATS), a department of the City of Charlotte (the "City").

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 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 in 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 affects 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: A warranty available for purchase above the standard warranty.

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

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

Proposal: A promise, if accepted, to deliver equipment and services according to the underlying solicitation of the Agency 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.

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

Supplier: Any manufacturer, company or Agency providing units, components or subassemblies for inclusion in the bus that 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."

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

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

GC 2. Materials and Workmanship

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

GC 3. Conformance with Specifications and Drawings

Materials furnished and Work performed by the Contractor shall conform to the requirements of the Technical Specifications and other Contract documents. Notwithstanding the provision of drawings, technical specifications or other data by 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 though such details may not be 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.

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

Reference Sample Contract Section 4.1

GC 4.2 Risk of Loss

Reference Sample Contract Section 4.3

GC 5. Title and Warranty of Title

Reference Sample Contract Section 6

GC 6. Intellectual Property Warranty

Reference Sample Contract Section 7

GC 7. Data Rights

Reference Sample Contract Section 8

GC 7.1 Proprietary Rights/Rights in Data

Reference Sample Contract Section 8.1

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 any electronic control modules or other data-collection devices, to the extent necessary to enable the Contractor to perform reliability maintenance analysis, corrective action and/or other engineering type Work for the bus. This right expressly excludes access to information or data collected on any equipment not provided and installed by the Contractor.

GC 8. Changes

Reference Sample Contract Section 9

GC 9. Legal Clauses

GC 9.1 Indemnification

Reference Sample Contract Section 10

GC 9.2 Suspension of Work

Reference Sample Contract Section 11

GC 9.3 Excusable Delays/Force Majeure

Reference Sample Contract Section 12

GC 9.4 Termination

Reference Sample Contract Section 13

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 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 North Carolina without regard to conflict of law rules. The Contractor consents to the jurisdiction of the identified state, County of Mecklenburg.

GC 9.8 Disputes

Reference Sample Contract Section 14

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, FTA, the Comptroller General of the United States, the Secretary of the U.S. Department of Transportation, North Carolina or any of their duly authorized representatives access to any books, documents, papers and 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 U.S. Department of Transportation (if applicable) or the 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. 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, 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 U.S. Department of Transportation, 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, or 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 result 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.

GC 9.10 Confidential Information

Reference Sample Contract Section 15

GC 9.11 Conflicts of Interest, Gratuities

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

GC 9.12 General Nondiscrimination Clause

Reference Sample Contract Section 16

GC 9.13 Amendment and Waiver

GC 9.13.1 Amendment

Reference Sample Contract Section 17

GC 9.13.2 Waiver

Reference Sample Contract Section 18

GC 9.14 Remedies Not Exclusive

Reference Sample Contract Section 19.6

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

Reference Sample Contract Section 21

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

Reference Sample Contract Section 22

GC 9.20 Survival

Reference Sample Contract Section 23

GC 10. (Reserved)

SECTION 4: SPECIAL PROVISIONS

SP 1. Inspection, Tests and Repairs

SP 1.1 Pilot Bus

The Contractor shall produce one pilot vehicle for each type of vehicle with respect to the base order. This vehicle shall be one of the ultimate quantity 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 on the remaining vehicles.

SP1.2 In the event that the pilot vehicle does not initially comply with all performance criteria contained in the Technical Specifications, 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 the 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 a penalty for the noncompliance. The amount of the penalty shall be negotiated by the parties.

Configuration and Performance Approval

Reference Sample Contract Section 4.2

SP 1.3 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 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 1.4 Post-Delivery Tests

Reference Sample Contract Section 4.4

SP 1.5 Repairs after Non-Acceptance

Reference Sample Contract Section 4.5

SP 1.6 Repair Performance

Reference Sample Contract Section 4.6

SP 2. Deliveries

SP 2.1 Bus Delivery

Reference Sample Contract Section 5

SP 2.2 Delivery Schedule

Reference Sample Contract Section 5.2

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.

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	Hardcopy	1
2.	List of serialized units installed on each bus	Review		With each delivered bus	Electronic media	1 per bus
3.	Copy of Manufacturers' formal Quality Assurance Program	Review		Pre-award site visit	Hardcopy	1
4.	QA manufacturing certificate	Review		With each delivered bus	Hardcopy	1 per bus
5.	QA purchasing certifications acknowledging receipt of applicable specification	Review		30 days following first Pre-Production Meeting	Hardcopy	1 per major Supplier
6.	Pre-Delivery Bus Documentation Package	Review		With each delivered bus	Hardcopy	1 per bus
7.	Motor Vehicle Pollution Requirements Certificate	Review		With each bus	Hardcopy	1
8.	Engine Emissions Certificate—NOx levels	Review		Prior to completion of pilot bus	Hardcopy	1

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	Hardcopy	2 originals
10.	Driver's log and incident report	Review		With each bus delivery if drive-away service is used	Hardcopy	1 per bus
11.	Title documentation	Review		10 days prior to bus delivery	Hardcopy	1 per bus
12.	Performance bond	Review		30 days following execution of Contract	Hardcopy	1
13.	Insurance certificates	Approval		Before Work commences	Hardcopy	1
14.	Engineering support	Review		During Pre-Production Meeting	Contracts	1
15.	Training instructor information	Approval		30 days prior to delivery of pilot bus		
16.	Training curriculum	Approval		30 days prior to delivery of pilot bus	Electronic media	
17.	Teaching materials	Review		During classroom instruction	Hardcopy	1
18.	Professionally prepared mechanics' "Bus Orientation" training video	Review		30 days prior to first production bus	Electronic Media	20 each
19.	Final preventative maintenance manuals	Review		90 days after Agency written approval	Hardcopy Electronic media	10/100 buses 20
20.	Final diagnostic procedures manuals	Review		90 days after Agency written approval	Hardcopy Electronic media	10/100 buses 20
21.	Final parts manuals	Approval		90 days after Agency written approval	Hardcopy 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	Hardcopy Electronic media	2 2
23.	Draft preventative maintenance manuals (Agency approval/review period of 90 days from date of receipt)	Approval		With pilot bus	Hardcopy	10
24.	Draft diagnostic procedures manuals (Agency approval/review period of 90 days from date of receipt)	Approval		With pilot bus	Hardcopy	10

TABLE 1
Contract Deliverables

Deliverable		Agency Action	Reference Section	Due Date	Format	Quantity Due
25.	Draft parts manuals (Agency approval/review period of 90 days from date of receipt)	Approval		With pilot bus	Hardcopy	10
26.	List of OEM component repair manuals	Approval		With pilot bus	Hardcopy	10
27.	Draft operators' manuals (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	Hardcopy	10
28.	Final operators' manuals	Review		30 days following Agency approval of draft manual	Hardcopy	1 per bus
29.	Recommended spare parts list, including bill of materials	Review		60 days prior to shipment of first bus	Hardcopy	1
30.	Part number index	Approval		60 days prior to shipment of first bus	Hardcopy Spreadsheet	1 1
31.	Current price list	Review		90 days after Agency written approval of draft parts manual	Hardcopy	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	Hardcopy	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	Hardcopy	1
37.	Flooring certificate	Review		First Pre-Production Meeting	Certificate/ copy of purchase order	1
38.	Interior features – fire-resistance certificates	Review		Prior to pilot bus completion	Certificates	1
39.	Crashworthiness	Review		Pre-award audit	Certificate	1
40.	Technical review of electronic functionality	Approval		Prior to production	Hardcopy	1
41.	Interior security camera layout	Approval		Prior to pilot bus completion	Copies of interior views	1 each
42.	Technical review of power plant			Prior to production		
43.	Power plant certifications	Review		Prior to pilot bus completion	Hardcopy	1 each
44.	Striping layout	Approval		Prior to production	Hardcopy	1
45.	Resolution of issues "subject to Agency approval"	Approval		Prior to production	Hardcopy	1

SP 3. Options and Option Pricing

The Contractor hereby grants the Agency and any permissible assignee options ("Options") to purchase up to Two Hundred and Thirty (230) additional vehicles ("Option Vehicles"). The Options shall be valid for a period 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 five years following the effective date of the Contract ("Option Date").

The price of the Option Vehicles shall be the unit price of the base order vehicles, ("Base Order Price") adjusted by multiplying the base order price by the following fraction:

> *Latest Published Preliminary Index Number Prior to Notice of Exercise of Option / Index Number on Effective Date of the Contract*

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

Within thirty (30) days after delivery of the Notice of Exercise of 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 schedule for the purpose of the parties verifying available production capacity. The production schedule shall include a 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

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

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 4220.1F or its successors.

SP 5. Payment

Reference Sample Contract Section 24

SP 6. Liquidated Damages for Late Delivery of the Bus

Reference Sample Contract Section 19.4

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

SP 7.2 Documentation

The Agency requires both maintenance and parts manuals, including all text and images, to be available in an electronic media consistent with industry standards. The Agency's preferred format is HTML for deployment over its Windows based Intranet. Appropriate navigation and frame structures shall be provided within these documents. It is encouraged that electronic linkages exist with the vendor to enhance customer support opportunities, including e-mail. Draft design of this electronic documentation will be submitted within sixty (60) days of contract award by either CD-ROM or available via a secure download.

The Contractor shall provide one (1) copy of all manuals and records with the delivery of a Pilot Bus. A copy of the manuals for similar buses and equipment with notation to reflect required changes for the Agency buses is acceptable for this submittal. Concurrent with the delivery of the first serial production bus, the Contractor shall furnish to the Agency four (4) copies of interim laminated manuals (model specific content) for all applicable "Special Listings", "Maintenance Manuals" and "Parts Manuals" for the buses furnished under the Specification. This shall include electrical prints, parts interchange manual, pneumatic diagrams and hydraulic diagrams. Fourteen days after the delivery of the last production bus, the Contractor shall provide five (5) copies of all final Manuals complete with all applicable revisions included and inserted.
The Contractor shall provide fifty (50) standard operator's manual(s) as part of this Contract.

The Contractor also shall exert its best efforts to keep maintenance manuals, operator manuals and parts books up to date for a period of fifteen (15) years. The supplied manuals shall incorporate all equipment ordered on the buses covered by this procurement. In instances where copyright restrictions or other considerations prevent the Contractor from incorporating major components information into the bus parts and service manuals, separate manual sets as published by the subcomponent Supplier will be provided.

SP 7.3 Parts Availability Guarantee

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

Where the parts ordered by the 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 persons' 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 persons' names for all of 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:

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 (FMVSS)

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

SP 9. Insurance

Reference Sample Contract Section 25

SP 10. (Reserved)

SP 11. (Reserved)

SP 12. (Reserved)

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 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 Contractor agrees to maintain same until the Agency, the FTA Administrator, the Comptroller General or any of their duly authorized representatives have disposed of all such litigation, appeals, claims or exceptions related thereto. Reference 49 CFR 18.39(i)(11).

The following access to records requirements apply to this Contract:

FR 1.1 Local Governments

In accordance with 49 CFR 18.36(i), 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 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 his authorized representatives including any PMO Contractor access to Contractor's records and construction sites pertaining to a major capital project, defined at 49 USC 5302(a)1, which 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 his 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, which 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 $100,000.

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 Department of Transportation, whether or not expressly set forth in the preceding Contract provisions. All contractual provisions required by DOT, as set forth in FTA Circular 4220.1F 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 City of Charlotte requests that would cause City of Charlotte to be in violation of the 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 Agency and 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 that are 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 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 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 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 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 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 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 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 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 49 CFR Part 29. As such, the Contractor is required to verify that none of the Contractor, its principals, as defined at 49 CFR 29.995, or affiliates, as defined at 49 CFR 29.905, are excluded or disqualified as defined at 49 CFR 29.940 and 29.945.

The Contractor is required to comply with 49 CFR 29, Subpart C, and must include the requirement to comply with 49 CFR 29, Subpart C, in any lower tier covered transaction 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 City of Charlotte. If it is later determined that the Bidder or Proposer knowingly rendered an erroneous certification, in addition to remedies available to City of Charlotte, 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 49 CFR 29, 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 Title 49, Code of Federal Regulations, 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 City of Charlotte 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 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 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 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 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 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 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 assembled in the United States and have a 60 percent 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 that are 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 USCA 5323(c) and FTA's implementing regulation at 49 CFR Part 665 and shall perform the following:

1. A manufacturer of a new bus model or a bus produced with a major change in components or configuration shall provide a copy of the final test report to the recipient at a point in the procurement process specified by the recipient, which will be prior to the recipient's final acceptance of the first vehicle.
2. A manufacturer who releases a report under paragraph 1 above shall provide notice to the operator of the testing facility that the report is available to the public.
3. If the manufacturer represents that the vehicle was previously tested, the vehicle being sold should have the identical configuration and major components as the vehicle in the test report, which must be provided to the recipient prior to recipient's final acceptance of the first vehicle. If the configuration or components are not identical, the manufacturer shall provide a description of the change and the manufacturer's basis for concluding that it is not a major change requiring additional testing.
4. If the manufacturer represents that the vehicle is "grandfathered" (has been used in mass transit service in the United States before Oct. 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) component and subcomponent parts of the rolling stock to be purchased identified by manufacturer of the parts, their country of origin and costs; and (2) the location of the final assembly point for the rolling stock, including a description of the activities that will take place at the final assembly point and the cost of final assembly.
2. **Solicitation specification requirements:** The Contractor shall submit evidence that it will be capable of meeting the bid specifications.
3. **Federal Motor Vehicle Safety Standards (FMVSS):** The Contractor shall submit (1) manufacturer's FMVSS self-certification, Federal Motor Vehicle Safety Standards, that the vehicle complies with relevant FMVSS or (2) manufacturer's certified statement that the contracted buses will not be subject to FMVSS regulations.

FR 15. Cargo Preference

The Contractor agrees to the following:

- To use privately owned U.S.-flag commercial vessels to ship at least fifty (50) percent of the gross tonnage (computed separately for dry bulk carriers, dry cargo liners and tankers) involved, whenever shipping any equipment, material or commodities pursuant to the underlying Contract to the extent such vessels are available at fair and reasonable rates for U.S.-flag commercial vessels;
- To furnish within twenty (20) working days following the date of loading for shipments originating within the United States or within thirty (30) working days following the date of leading for shipments originating outside the United States, a legible copy of a rated, "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, DC 20590 and to the FTA recipient (through the Contractor in the case of a Subcontractor's bill-of-lading.)
- To include these requirements in all subcontracts issued pursuant to this Contract when the subcontract may involve the transport of equipment, material or commodities by ocean vessel.

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 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 he or she is 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 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 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 define 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.

It is the intent of this specification to describe the design requirements for buses rugged enough to withstand rigorous intensive daily transit service operations and provide maximum reliability and availability, with a minimum of maintenance and repair time. The bus shall exhibit maximum passenger appeal in appearance, comfort and safety, combined with excellence in reliability, operating characteristics, efficiency, and economy of operation.

The bus shall be fully compliant with the applicable requirements of the Americans with Disabilities Act (ADA) and any revisions published by the Architectural and Transportation Barriers Compliance Board or The Federal Transit Administration for fixed route operations. Where these specifications exceed the requirements of ADA, the specification requirement shall apply.

Included in this specification is the description of required equipment for use in four different vehicle designs: 30-foot to 40-foot low-floor urban buses, 40-foot suburban buses.

TS 2. Definitions

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 °C (50 °F) and 38 °C (100 °F).

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

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

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

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

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

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).

Cell: Simplest discrete component of the battery 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.

Code: A legal requirement.

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

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

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

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

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

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

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

dBA: Decibels with reference to 0.0002 microbar as measured on the "A" scale.

DC to DC Converter: A module that converts a source of direct current from one voltage level to another.

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

Defueling: The process of removing fuel from a tank.

Defueling Port: 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 pre-defined values, usually of a binary 0 or 1 nature, where 0 is battery ground potential and 1 is a defined battery positive potential.

DPF: Diesel particulate filter.

Driver's Eye Range: The 95th-percentile ellipse defined in SAE 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 percent 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, area occupied by feet of seated passengers, the vestibule area forward of the standee line, and any floor space indicated by manufacturer as non-standee areas, such as the floor space "swept" by passenger doors during operation. Floor area of 1.5 sq. ft. shall be allocated for the feet of each seated passenger 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).

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

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

Gross Load: 150 lb. for every designed passenger seating position, for the driver, and for each 1.5 sq. ft. of free floor space.

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

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

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

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

Hose: 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 (HDS): The mechanical and/or electromechanical components, including the engine, traction motors and energy storage system, which 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 who's 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: All tubes, flexible and hard, that carry fluids.

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

Local Regulations: Regulations below the state level.

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

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

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

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

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

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

Module: 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.

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 (OSI) reference model. This provides the mechanical, electrical, functional and procedural characteristics required to gain access to the transmission medium (e.g., cable) and is responsible for transporting binary information between computerized systems.

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 an NGV fuel container/cylinder, when subjected to a standard fire test as required by fuel container/cylinder standards.

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

Power: Work or energy divided by time

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

Propulsion System: System that provides propulsion for the vehicle proportional to operator commands. Includes, as applicable, engine, transmission, traction motors, the hybrid drive system,(HDS), energy storage system (ESS), and system controllers including all wiring and converter/inverter.

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

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

Rejectable Damage: In terms of NGV fuel containers/cylinders, this is damage as outlined in CGA C-6.4, “Methods for External Visual Inspection of Natural Gas Vehicle Fuel Containers and Their Installations,” and in agreement with the manufacturer’s recommendations.

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

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

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

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

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

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

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

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

Special Tools: Tools not normally stocked by the Agency.

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

Standard: A firm guideline from a consensus group. Standards 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 from the engine-driven generator or the regenerative braking system.

Stress Loops: The "pigtails" commonly used to absorb flexing in piping.

Structure: The basic body, including floor deck material and installation, load-bearing external panels, structural components, axle mounting provisions and suspension beams and attachment points.

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

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

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

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.

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

Zero-Emission Vehicle (ZEV): 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, FMVSS, etc.)
2. State requirements (in California, for example, it would be Title 13 Vehicle Code)
3. Local requirements
4. Referenced standards, practices and codes (SAE, ASTM, UL, ISO, etc.)
5. Technical content of this Technical Specification section

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.

Notwithstanding, anything in the Contract to the contrary, it is understood and agreed to by the Contractor that the Charlotte Area Transit System, herein referred to as "CATS" or the "Agency", provided the Technical Specification for the sole purpose of describing in general terms the performance required from each bus,

each bus's systems and the discrete subsystems that make up the bus. The specification provided by the Agency does not in any way constitute a design of the bus or of such subsystems or discrete components. It is further understood that the Agency makes no representations regarding the Technical Specifications. It shall be incumbent on the Contractor to verify the accuracy of the Technical Specifications prior to the time of the proposal submission.

This Technical Specification is intended to leave the Contractor free to provide its own detailed design for the basic vehicle and the vehicle's ancillary equipment. The Contractor shall assume complete and overall responsibility for the design and satisfactory operation of the vehicle and the vehicle's subsystems or component parts. The Contractor's responsibility includes, but is in no way limited to, ensuring that the design and manufacture of the vehicle and the vehicles component parts are appropriate, coordinated, and compatible and that they perform correctly throughout the life of the vehicle, whether together or individually.

The Contractor shall ensure that each manufacturer of major items of equipment (for example, engine, transmission, brakes, air conditioning, heating and cooling controls, doors and controls, seats, lighting) has a complete copy of the Technical Specifications. Sub-suppliers shall approve of and sign-off on the Contractor's specific application of their components. Proof of sub-suppliers' installation approval shall be provided to the Agency.

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 carry the gross vehicle weight, which shall not exceed the bus GVWR and shall not exceed the GAWR.

TS 5.3 Service Life

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.

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 a list of all special tools and pricing for maintaining this equipment as a supplement to the Pricing Schedule.

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

Any one component or unit used in the construction of these buses shall be an exact duplicate in design, manufacture and assembly for each bus in each order group in this Contract. Contractor shall identify and secure approval for any changes in components or unit construction provided within a Contract.

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

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

TS 5.6 Training and Technical Support

The Contractor shall have at least one qualified instructor who shall be available at the Agency's property for 4 calendar days between the hours of 0700 and 1530 per month for 2 months prior to, and 6 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, slide presentations and literature) for use by the Agency's own training staff, which become the property of the Agency.

Bus related training for the Agency's personnel shall consist of five phases:

a) Bus operation, which includes detecting and resolving in service problems and emergencies that result in minimal delays.
b) Maintenance of components or assemblies—which includes inspections, lubrication, adjustments, repairs, and replacements normally performed at the Maintenance Shop.
c) Overhaul or repair of components or assemblies normally performed at the Agency's overhaul shops including:

• Engine including DPF/hybrid /Electric
• Transmission/hybrid /Electric
• Starter
• Alternator
• Rear drive carrier
• Hydraulic pumps
• Water pumps
• Sterling boxes
• Hybrid Drive and Hybrid Battery System

d) Familiarization with renewal parts.
e) Facility support and OEM Liaison.

The Agency shall be responsible for providing classroom facilities and space for training aids. The Agency shall approve in advance the course content for each training program. Six (6) months after the NTP, the Contractor shall furnish the Agency with an outline of the training program for evaluation. The outline shall include the number of classroom and field instruction hours that the Contractor recommends for each system on the bus; the qualifications of the instructors; a list of training aids to be used and furnished; and a brief description of the scope of instruction to be covered.

The Contractor and appropriate suppliers shall train the Agency personnel on actual equipment whenever possible. The Contractor or suppliers shall be responsible for replacing any consumables and re-establishing the condition of any parts damaged as a direct result of training activities.

As part of the maintenance-training program, one (1) complete set of all special tools and test equipment necessary to service and maintain each bus system shall be provided at the time of delivery of the first production bus. Special tools are defined as those not readily available from an industry standard tool supplier, such as Snap-On or Matco. Examples of standard tools are combination wrenches, screws drivers, hammers or tools would normally be found in a mechanic tool box. Examples of special tools are temperature adapter, tachometer readers, valve driver, pressure probe, etc.

Instructions and/or training on how to use these special tools and equipment shall be provided at the same time. At the completion of the training program the special tools, test equipment, and training aids shall be turned over to the Agency in proper working order. The contractor shall assume that the Agency has no special tools for bus maintenance.

Operator Training
Operator training shall be based on the Operating Manual. To ensure the safety of maintenance personnel, operating personnel, and passengers, the Contractor shall supply two (2) sets of USB Flash Drives two (2) months prior to the delivery of the first production bus. The drives shall cover the following topics:

a) Revenue service preparation
b) Normal operating procedures
c) Emergency operating procedures
d) Moving a bus with a problem (fault).

One month after the delivery of the first production bus, the Contractor shall instruct two (2) groups of ten (10) representatives from the Operations Department during separate two (2) day training sessions. The training shall take place at the Maintenance Facility and as required, on-board fully operational buses.

A one (1) day, follow-up session shall be held for up to twenty (20) trainees. The follow-up shall take place one (1) month after the first six (6) buses have been accepted for revenue service. The Agency will provide the agenda at least one (1) week prior to the training. Contractor to provide Training Video for Operators

Maintenance Training
The Contractor shall provide sufficient training for the Agency's personnel to permit satisfactory servicing and maintenance of the buses at the Agency's garages. The training shall include classroom and "hands-on" instruction. The "hands-on" instruction shall be given on an operational bus or on functioning mockup training aids and include an introduction to faults, troubleshooting and subsequent repair.

Classroom instruction shall include not only the anatomy and functionality of the parts, but also the essentials of routine care, including lubrication schedules, adjustments, limits, test frequency, inspection frequency, troubleshooting, removal and replacement. At the conclusion of the classroom instructions, the Contractor shall furnish to the Agency a complete set of lesson plans and training aids including, but not limited to, classroom notes, films, photographs, displays, slides, and tapes used in presenting the courses.

The Contractor shall assume that the Agency's personnel have no knowledge of the features of the buses. The course of instruction should include systems integration familiarization and be given in two parts. The first part shall occur two months prior to the delivery of the first production bus and shall cover basic instruction, including fundamentals and general familiarization with the buses and bus components. The second part of the instruction shall begin approximately one month after the delivery of the first production bus. A final schedule for maintenance training shall be submitted to the Agency for approval six (6) months before scheduled delivery of the first production bus. Maintenance training shall include in-depth instruction covering as a minimum the maintenance diagnostic, trouble shooting, rebuild and repair activities normally performed at a garage on the following systems:

- Power module
- Bus electrical system
- Bus air system
- Engine and DPF systems
- Door Systems
- Mobility aid ramp
- Smart Bus Systems
- Transmission & Retarder

- Destination Signage
- Multiplex System
- Public Announcement system (PA)
  DEF / SCR System / Controls
- Operator Controls
- Fire Suppression System
- Hybrid Drive Systems
- Radio
- Towing and Recovering
- Fuel System
- Safety Procedures
- Fuel Alley Procedures
- AVL/APC System

High voltage training

- Rear axle assembly, including suspension and brakes
- Front axle assembly, including suspension and brakes
- HVAC system, including auxiliary heater and any floor level heating units and any EPA certifications required for handling refrigerants

The Contractor shall furnish fifty (50) copies of training manuals for each subject. In lieu of special training manuals, the Contractor may utilize the Running Repair and Service Manual, the Schedule Repair and Overhaul Manual and/or applicable Vendor Manuals for instructional purposes. In the event the Contractor utilizes such manuals, they will be in addition to the quantity, if any, specified in Section SP 7.2 Documentation.

The times and duration of the instruction periods, and the quantity of personnel available to attend class, shall be at the discretion of the Agency. The Agency will attempt to make six (6) trainees available for eight (8) hours per normal working day. The following minimum quantities of personnel to be instructed are provided as a guideline:

a) Engineers and supervisory personnel - Thirty (30)
b) Garage personnel – Thirty (30)
c) Maintenance Training Instructors – Six (6)

All of the above personnel will be made available for training no later than twelve (12) months after delivery of the first bus. The length of the instruction for each individual shall not be less than 200 hours.

Overhaul Shop Training
One month after the delivery of the first production bus the Contractor shall provide a training program that will permit satisfactory overhaul and repair of equipment normally performed at the Agency's overhaul shops. In addition to the equipment listed in Section 3.1.10.9.2, the Contractor shall also provide training on the following equipment:

a) Bus body panel including a section of vertical and horizontal support structure (to demonstrate proper method of repairing body damage)
b) Air compressor
c) Front side and rear destination sign with controller
d) One of each type of motor/blower
e) One of each type of electronic circuit boards on assemblies.

f) Air Ride Operator's Seat

Equipment overhaul training shall consist of three parts. The first part shall last one month and will be attended by thirty management, engineering, and shop personnel. It shall begin at the end of the garage maintenance training. The second part shall be a one-week "refresher course" given six (6) months after completion of the first part. The refresher course shall be attended by thirty personnel, not necessarily the same individuals attending the initial training. The agenda shall be provided by the Agency at least one month prior to the beginning of the refresher course. The third part shall be the factory training of two, Maintenance Instructors for both Engine and Transmission overhaul. The Contractor shall provide engine overhaul and transmission overhaul training at the respective vendor facilities. This training shall allow the Agency's Instructors to attain Factory Instructor Certification (FIC) in overhaul procedures, thus enabling the Agency's Instructors to certify additional repair personnel. The Agency's Instructors would be allowed to train and administer the relevant testing to allow membership and full benefits to certification programs offered by the vendor such as "Detroit Diesel Guild" Cummins Virtual College Program. The cost of factory training and certification of Six Agency Maintenance Instructors is borne by the Contractor. The Agency retains responsibility of its personnel undergoing its FIC training.

Training Aids
The full scope of training aids shall be negotiated prior to Contract execution. The following information is a general guideline of the Agency's training aid expectations.

The Contractor shall supply full size mock-up and component assemblies including necessary supporting and display racks, for the Agency to use initially and on a continuous basis as training aids. The mock-ups may be board mounted to conserve space and to enhance conception of the actual operation of the sub-systems. Configuration of the training aid is subject to the Agency's approval. The following training aids shall be delivered prior to commencement of training programs:

a) Power Module—Completely dressed and mounted upon a stand for operation (not under load) of engine and transmission with full instrumentation. Capable of operation without any auxiliary power supply or interfaces other than ventilated exhaust pipe. The module will contain the complete exhaust system, including the diesel particulate filter.

b) Diesel Engine—Complete engine, stand mounted, suitable for repeated disassembly and reassembly

c) Electrical System—Complete, full size, operational, board mounted, including multiplex system and interfaces with all electrical equipment. Can be plugged into 120VAC power for operational demonstration.

d) Transmission and Retarder—complete with coolers and plumbing, mounted on a stand suitable for repeated disassembly and reassembly.

e) Compressed Air System—complete with all valves and typical piping, operational, board mounted. Operation can be emulated by plugging into shop compressed air supply for operational demonstration.

f) Front & Rear Axle Assys.—Individually mounted with suspensions, on a stand suitable for repeated disassembly and reassembly.

g) Front & Rear Brake Assys.—Individually mounted on a stand suitable for repeated disassembly and reassembly.

h) HVAC System—Complete top unit with motor driven compressor and water supply that is stand mounted so that the unit is operable. System can be plugged into 120VAC power for operational demonstration. Any floor/underseat heating units shall be provided with typical piping and controls, mounted independent of the top HVAC unit.

i) Door System—Complete door and operator assembly including sensitive edges and safety devices. Both front and rear door, if not identical, mounted on a stand that can be plugged into 120VAC power and shop compressed air supply

j) Destination Signage System—Front, side and rear sign units mounted with controller and Contractor supplied interfaces to Smart Bus Systems. Can be plugged into 120VAC power supply for operational demonstration.

k) Fire Suppression System—Complete stand mounted system with devices to allow safe, small-scale, demonstration of all functions. Can be plugged into 120VAC power for operational demonstration.

l) Mobility Aid Ramp—Stand mounted that allows operation and repeated disassembly and reassembly. Can be plugged into 120VAC power for operational demonstration.

m) Anti-Lock Brake System—Module and valves mounted for demonstration of operation, testing and repair procedures. Can be plugged into 120VAC power for operational demonstration.

n) PA System — Complete and operational with all controls, inside and outside speaker, and Contractor supplied interfaces to Smart Bus Systems. Can be plugged into 120VAC power for operational demonstration.

p) Computers and current Software— Provide two (2) laptop computers or Dell tablets for each 10 buses purchased for the life of the contract and include all required hardware, soft-ware and connecting cables for servicing of bus systems including engine, HVAC, Hybrid drive, transmission, multiplex, ABS, destination signs and Smart Bus systems. Can be plugged into 120VAC or 12 volt DC power for operational demonstration. Laptops provided should be most current production Dell tablet or approved equal. Minimum requirements listed below.

- Solid state hard drive 1TB or at least 500GB
- Multiple usb/usbc ports, and ethernet port
- 16GB RAM
- Toughbook tablet with docking station
- I7 processor or better with windows 10 or above, 64 bit operating system

q) Smart Bus Systems — Vehicle logic systems and operator interface components to operate on 120VAC power supply in a desktop arrangement with simulated operational and failure modes.

r) Diesel Particulate Filter —A complete unit with supporting bracketry and related fasteners to access unit's modules (if applicable), stand mounted and suitable for repeated disassembly and reassembly.

s) Driver's Compartment Module- A complete driver's compartment mock-up that includes all switches and controls available to the driver. A fitting for the supply of shop compressed air shall be provided to allow proper operation of the seat and the correct feel to the brake pedal, parking brake control and emergency park brake release control. Supply of 110VAC electric power shall allow operation of all switch and control lights and

illumination of the diagnostic indicators. The module shall be no larger than necessary to correctly located all driver controls and of sufficient strength for transport by fork lift truck.

The Contractor shall supply one set color-coded schematics of above systems and integrated block diagrams of major equipment.

TS 5.6.1 Technical/Service Representatives

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."

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

The bus shall be capable of satisfying the requirements of this specification while operating in ambient temperature ranges of 10 °F to 115 °F, at relative humidity between 5 and 100 percent, 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.

TS 5.8 Noise

The Contractor is expected to meet interior and exterior noise requirements specified in Section 5.8.1 and Section 5.8.2. 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. 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

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.

TS 5.9 Fire Safety

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

TS 5.9.1 Materials

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.

TS 5.10 Fire Suppression

(DIESEL, HYBRID, BATTERY ELECTRIC)

Fire Detection and Suppression System

The bus shall be equipped with an Amerex fire detection/suppression system or approved equal. A fire control panel with audio/visual warning shall be provided to the operator's dash panel.

A fire sensing and suppression system shall be provided to monitor the engine compartment with no less than three (3) temperature sensors and sufficient monitoring of other areas where fire hazard exists. An optical infra-red flame detector shall be provided to monitor the engines turbo charger and surrounding area. The system shall meet or exceed the environmental requirements of SAE J1211. Upon detection, the system will alert the operator with visual and audible signals and initiate automatic engine shutdown and trigger the discharge of the fire suppression agent. Approval of the fire detection layout shall be approved during the pre-production meeting.

Three detectors will be located in the engine compartment area and one in the auxiliary heater area if it is located in an enclosed in a compartment. Detection of a fire may be by means of infrared/heat or rate of rise/heat. Detectors must be capable of operating in a range of -400F to 2500F without false detection from any source of light or steam cleaning.

A control panel shall electrically supervise the automatic fire suppression system following the wiring circuits for Power Supply, Fire/Heat Detected and System Actuation. Indication of Normal, Fault and fire conditions shall be displayed on the control monitor. The system control panel will shut down the engine within ten (10) seconds of a fire being detected through the engine protection shut down and override system. Integration of the fire suppression system warning lights with the bus warning light system is preferred with design considerations given to the convenience of the operator.

A minimum twenty-five (25) pound capacity agent cylinder of the stored pressure type shall be furnished and be constructed of welded steel and must conform to DOT specification 4BW, and be rated for twelve (12) years minimum hydrostatic retest. The cylinder shall be outfitted with a gauge that can be easily viewed and a forged brass valve assembly.

A minimum of four Brass nozzles shall be located in the engine compartment and one in the auxiliary heater compartment, if required, fitted with dust caps that, upon actuation, are displaced to allow full flow of the fire suppression agent. Fire suppression agent shall be Type ABC dry chemical. Visual inspection of the agent cylinder gauge shall be provided through one of the bus engine compartment service doors.

The Contractor shall provide written certification from the fire suppression manufacture that all installation requirements have been met and sufficient testing was made on the first bus system to ensure reliable firefighting operation.

TS 5.11 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.

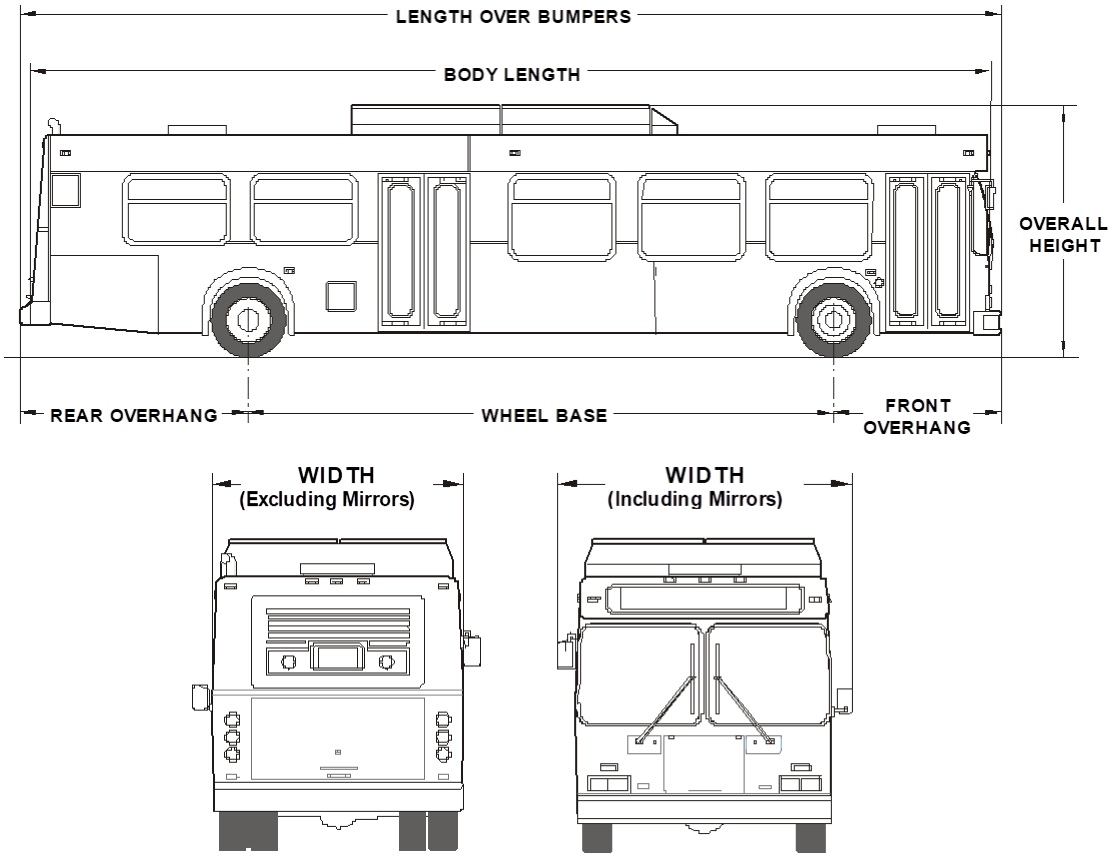
The Contractor shall provide a plan for reuse or recycling of replaced battery cells, modules and/or physical packs.

DIMENSIONS

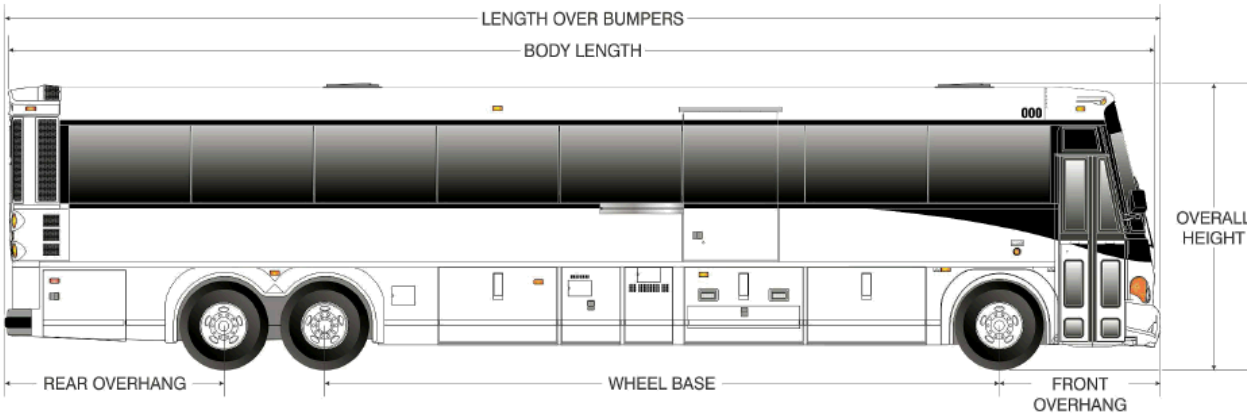
TS 6. Physical Size

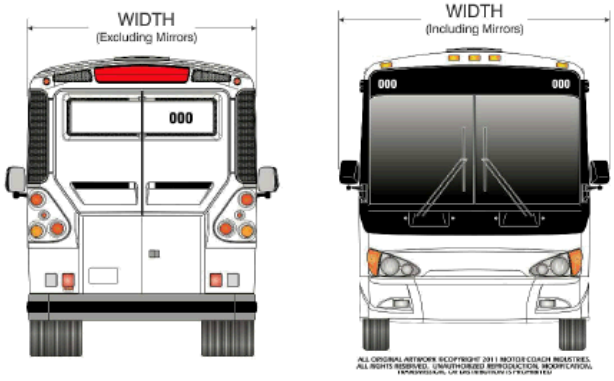
With exceptions such as exterior mirrors, marker and signal lights, bumpers, fender skirts, washers, wipers, ad frames, cameras, object detection systems, bicycle racks, feelers and rubrails, the bus shall have the following overall dimensions as shown in **Figure 1** at static conditions and design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

FIGURE 1
Transit Bus Exterior Dimensions



Commuter Coach Exterior Dimensions





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:** 29 ft, 11 in. to 34 ft, 11 in.
- **35 ft bus:** 35 ft 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

TS 6.2.1 Transit Coach

102 in. Width Bus

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

TS 6.2.2 Commuter Coach

102 in. Width Bus

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

TS 6.3 Bus Height

Maximum Overall Height

Maximum overall height shall be 145 in., including all rigid, roof-mounted items such as A/C, exhaust, fuel system and cover, etc.

TS 6.4 Step Height

TS 6.4.1 Transit Coach

The step height shall not exceed 16.5 in. at either doorway without kneeling and shall not exceed 15.5 in. at the step. A maximum of two steps are allowed to accommodate a raised aisle floor in the rear of the bus.

TS 6.4.2 Commuter Coach

The step height shall not exceed 16.5 in. at doorway without kneeling and shall not exceed 15.5 in. at the step.

TS 6.4.3 Articulated Coach

The step height shall not exceed 16.5 in. at either doorway without kneeling and shall not exceed 15.5 in. at the step.

TS 6.5 Underbody Clearance

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

TS 6.6 Ramp Clearances

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

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

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

Refer to **Table 2a**.

Table 2a
Default Breakover Angle

Angle	30 to 45 ft Bus	60 ft Bus
Approach	8.6 deg (min.)	8.6 deg (min.)
Front breakover	8 deg (min.)	10.2 deg (min.)
Rear breakover (articulated only)	N/A	8.7 deg (min.)
Departure	8.6 deg (min.)	8.6 deg (min.)

TS 6.7 Ground Clearance

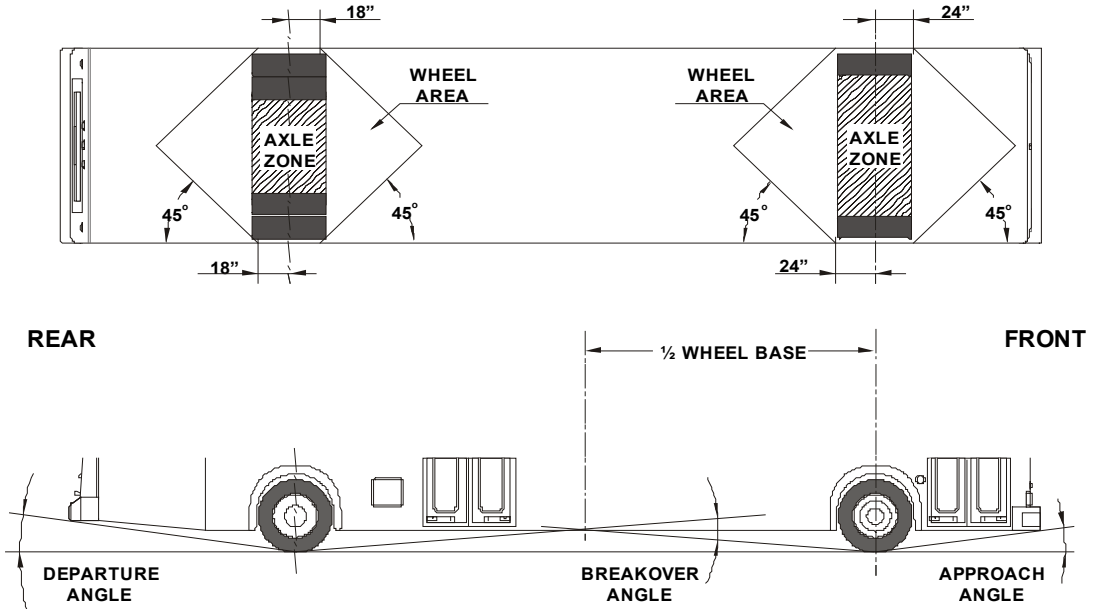
Ground clearance shall be no less than 10 in., (8 in. at jacking pad) except within the axle zone and wheel area.

Axle zone clearance, which is the projected area between tires and wheels on the same axial centerline, shall be no less than 5.5 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.

– **FIGURE 2**

Transit Bus Minimum Road Clearance



TS 6.8 Floor Height

TS 6.8.1 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 standard installed tires. A maximum of two steps are allowed to accommodate a raised aisle floor in the rear of the bus.

TS 6.8.2 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 standard installed tires.

TS 6.9 Interior Headroom

Headroom above the aisle and at the centerline of the aisle seats shall be no less than 78 in. in the forward half of the bus, tapering to no less than 74 in. forward of the rear settee. At the centerline of the window seats, headroom shall be no lower than 62 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 his or her head, padding shall be provided on the overhead paneling.

TS 6.10 Aisle Width

The minimum clear aisle width between pairs of transverse seats with all attached hardware shall be at least 22 in. The aisle width between the front wheelhouses shall be at least 35.5 in., and the entire area between the front wheelhouses shall be available for passengers and mobility aid devices.

VEHICLE PERFORMANCE

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

The bus shall be capable of achieving a top speed of 65 mph on a straight, level road at GVWR with all accessories operating. The bus shall be capable of safely maintaining the vehicle speed according to the recommendations by the tire manufacturer. The top speed and speedometer revolution should meet SAE J678. Manufacturer shall supply Agency with data if there is a variance between peak performance and sustained vehicle performance.

TS 7.2 Start ability and Gradeability

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

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 percent ascending grade continuous and 15 mph on a 10 percent ascending grade continuous.

TS 7.3 Acceleration

The acceleration shall meet the requirements in **Table 3** and shall be sufficiently gradual and smooth to prevent throwing standing passengers off-balance. Acceleration measurement shall commence when the accelerator is depressed.

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

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

1. Vehicle weight = GVWR

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

TS 7.3.1 Acceleration (Hybrid or Battery Electric Coach)

The propulsion and braking systems shall meet the performance requirements of the duty cycle.

Braking application and performance shall remain consistent across the highest possible range of battery system state of charge (SoC) or other variances related to regenerative braking. At very high or very low SoC, or at other conditions such as very cold or very hot battery temperatures, the application and performance of regenerative braking can be reduced but this must be done in a smooth and predicable manner. At no time should the application and performance of the mechanical friction brakes be affected by these conditions.

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 7.3.2 Acceleration (Commuter Coach)

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

TS 7.4 Operating Range

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

TS 7.4.1 Diesel (Transit Coach)

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

TS 7.4.2 Diesel (Commuter Coach)

A fuel tank with a minimum capacity 165 gallons shall be installed.

TS 7.4.3 Hybrid

The operating range of the coach when run on the design operating profile "Design Operating Profile" shall be at least 450 miles on a full tank of fuel.

TS 7.4.4 Battery Electric

The operating range of the coach when run on the design operating profile "Design Operating Profile" shall be at least 150 miles on a full state of charge.

TS 8. Fuel Economy/Range (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 set 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 8.1.1 Diesel (Transit Coach)

The operating range of the coach when run on the combined cycle shall be at least 350 miles or 20 hours with full fuel capacity.

TS 8.1.2 Diesel (Commuter Coach)

A fuel tank with a minimum capacity of 165 gallons shall be installed.

TS 8.1.3 Hybrid

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

TS 8.1.4 Battery Electric

The operating range of the coach shall be at least 150 miles on a full state of charge.

Agency shall define minimum operating range and time between charges.

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:** 0 °F to 110 °F
- **Bus weight:** GVWR

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:

Average route speed (nominal)	17.25	mph
Average route speed (worst case)	9	mph
Average distance between stops	.25	miles
Maximum required trip duration	82	minutes
Average required trip duration	32.09	minutes
Distance from depot to start of route	3.069	miles
Longest distance from depot	25.31	miles
Average miles per bus per day	136.157	miles
Longest miles per day for a bus	313.297	miles
Minimum layover time for charging during day	240	minutes
Average layover time for charging during day	240	minutes
Available depot charge time	4	hours
Minimum depot charge time required for full charge	4	hours
Maximum number of buses required to operate daily	169	buses

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.

POWERPLANT

TS 9. Engine

TS 9.1 Engine (Diesel and Hybrid)

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:** For commuter coaches, minimum rating horsepower of 400 and minimum torque rating of 1400 ft-lb shall be installed.

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 communications networks. The engine's electronic management system shall monitor operating conditions and provide instantaneous adjustments to optimize both engine and bus performance. The system shall be programmable to allow optimization of programmable features.

The engine 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 4 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.

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.

TS 9.2 Propulsion System (Hybrid or All Electric)

TS 9.2.1 Propulsion System Description (Hybrid)

The bus shall be powered by a hybrid propulsion system. The OEM 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 propulsion system shall comply with local, state and federal (maintenance) and other applicable sections.

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 9.2.2 Propulsion System Description (All Electric)

The bus shall be powered by an electric propulsion system. To the greatest extent practical, 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 OEM 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. Proposer is required to provide a list of applicable industry standards that the proposed propulsion system meets.

TS 9.2.3 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 9.2.4 Primary Propulsion Unit and Traction Motor(s)

The propulsion system components may be arranged in a variety of configurations. The traction motor must be capable of providing and retarding mechanical motion.

TS 9.2.5 Energy Storage System

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 similar 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 by an independent testing agency.

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 percent, then the useable capacity range shall be from 300 to 240 kWh.

The ESS shall be measured periodically during the 12-year design life of the bus per the following protocol by the bus manufacturer at an interval of at least every 2 years. 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.

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.

Both automatic and manual battery disconnect devices must be included and documented. Contactors shall be rated to interrupt the full load of the bus. Service and emergency manual disconnects must be included and their usage documented. Contractor shall provide a means to isolate the high-voltage battery during maintenance operations. Manual and automatic disconnects should open both poles of each physical battery pack.

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 GFI, to also include termination of charge.

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.

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.

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.

Battery Charging

The bus shall support an SAE-approved charging standard (SAE J1772 DC and/or SAE J3068 AC). 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 rear, left and right and located within a range of height from grade at normal suspension ride height between 35 and 50 in.

Charging

The bus shall support an SAE-approved charging standard. Proposers shall include a detailed description of their charging system and specify its compliance with one of 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.

DC Charging

The bus must 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.

Optional Charging Systems – The City of Charlotte would like to see pricing on all charging options. Below options are not required but we would like to see these options priced if available.

Overhead Conductive Charging

The bus must support published standards including SAE J3105 for overhead conductive bus charging. Proposers shall include a detailed description of their charging system and specify its compliance with one of 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.

Wireless Inductive Charging

The bus must support published standards including SAE J2954/2 for wireless inductive bus charging. Proposers shall include a detailed description of their charging system and specify its compliance with one of 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 9.2.6 Propulsion System Controller (PSC)

The PSC 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.

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.)

TS 9.2.7 Engine (Hybrid)

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: The Agency will provide desired fuel type.

The bus engine shall be a Cummins B6.7 heavy-duty diesel engine, with a minimum of 260BHP @ 2400RPM and peak torque of 620 foot lbs. @ 1600RPM, or approved equal.

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 4 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.

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 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

The engine shall be cooled by a water-based, pressure type, cooling system that does not permit boiling or coolant loss during the operations described above. Engine thermostats shall be easily accessible for replacement. Shutoff valves shall allow filter replacement without coolant loss. Valves shall permit complete shutoff of lines for the heating and defroster units, and water booster pumps. The water boost pump shall be a magnetically coupled, brushless design. All low points in the water-based cooling system shall be equipped with drain cocks. Air vent valves shall be fitted at high points in the cooling system unless it can be demonstrated that the system is self-purging.

A means of determining satisfactory engine 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.

The radiator and charge air cooler shall be of durable, corrosion-resistant construction with bolted-on removable tanks. Cooling fan system should be Modine thermal management system or approved equal.

The radiator shall be designed so a 2M mechanic can gain access to a substantial portion of the side facing the engine for the purpose of cleaning the radiator in five minutes or less.

There shall be no screen in front of the radiator.

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

Standard Control and Drive Design
Control and drive of the radiator and charge air cooler fan(s) shall be the Contractor’s standard design.

Self-Cleaning
Radiator and charge air cooler fan(s) shall be electrically driven and capable of automated reverse operations for periodic self-cleaning of the radiator and charge air cooler.

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

Cooling Fan Controls Modine or approved equal. Electric Fans
The cooling fan shall be temperature controlled, allowing the engine to reach operating temperature quickly. The temperature-controlled fan shall not be driven when the coolant temperature falls below the minimum level recommended by the engine manufacturer.

TS 10.2 Charge Air Cooling

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

TS 10.3 Transmission Cooling

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.

TS 10.4 Hybrid Drive System Cooling

The thermal management system shall maintain hybrid system components within design operating temperature limits.

TS 11. Transmission

NOTE: 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 communications 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, ASR 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 timestamp 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.

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.

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.

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. Retarder (Transit Coach)

NOTE: 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 ABS and/or automatic traction control (ATC) shall override the operation of the brake retarder.

Brake lights shall illuminate when the retarder is activated.

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.

Accessible Retarder Disable Switch

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

Disabling retarder shall be recorded for Agency data collection.

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.

Brake lights shall illuminate when the retarder is activated.

Throttle Pedal Activation of the Retarder / Engine Brake

The retarder / 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 retarder 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 retarder is engaged, and the coolant temperature reaches the maximum operating temperature established by the engine and transmission manufacturers.

Accessible Retarder / Engine Brake Disable Switch

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

Disabling retarder / Engine Brake shall be recorded for Agency data collection.

TS 14. Mounting

All electrical/electronic hardware shall be serviceable. 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.

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

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, all accessories and any other component requiring service or replacement shall be easily removable and independent of the engine and transmission removal. An engine oil pressure gauge and coolant temperature gauge 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.

Engine oil and the radiator filler caps shall be hinged to the filler neck and closed with spring pressure or positive locks to prevent leakage. All fluid fill locations shall be properly labeled with 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.

An engine bypass oil filter shall be installed if recommended by the engine manufacturer.

Engine Oil Pressure and Coolant Temperature Display

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

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. Critical points in the hydraulic system shall be fitted with service ports so that portable diagnostic equipment may be connected or sensors for an off-board diagnostic system permanently attached to monitor system operation 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.

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 and installed per the manufacturer's recommendations.

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 15.3 Charge Air Piping

Charge air piping and fittings shall be designed to minimize air restrictions and leaks. Piping shall be as short as possible, and the number of bends shall be minimized. Bend radii shall be maximized to meet the pressure drop and temperature rise requirements of the engine manufacturer. The cross-section of all charge air piping shall not be less than the cross-section of the intake manifold inlet. Any changes in pipe diameter shall be gradual to ensure a smooth passage of air and to minimize restrictions. Piping shall be routed away from heat sources 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 16. Radiator

If liquid cooling is used, the radiator and/or heat exchanger shall be a heavy-duty metal unit, preferably constructed with a copper core. It is preferred to be of the tube type with bolted-on upper and lower tanks and with no solder-to-coolant contact. The radiator shall be accessible for cleaning. Any radiator shall be easily removable from the bus. Aluminum brazed/soldered radiator and/or heat exchanger may be used for low-temperature coolant systems only.

Radiator piping shall be stainless steel, 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. Fluid Transfer 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). Fluid lines shall not be the lowest point of the bus undercarriage.

TS 18. Fuel

TS 18.1 Fuel Lines

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

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

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

Fuel is to be ULSD.

TS 18.1.1 Fuel Lines, Diesel

Fuel and oil lines within the engine compartment shall be rigidly supported and shall be composed of steel tubing where practical except in locations where flexible lines are necessary. Flexible fluid lines shall be kept at a minimum and shall be as short as practical. They shall be routed or shielded so that failure of a line shall not allow fuel or oil to spray or drain onto any component operable above the auto ignition temperature of the fluid. Flexible lines shall be Teflon hoses with braided stainless steel jackets and shall have standard SAE or JIC brass or steel, reusable, swivel, end fittings. Premium hoses of alternative construction may be used with specific approval of the Agency. Hoses shall be individually supported and shall not touch one another or any part of the bus.

Fuel lines shall be rated and sized to prevent freezing and plugging due to condensation and/or fuel gelling in extreme winter.

The fuel lines forward of the engine bulkhead shall be in conformance to SAE Standard J1149 Type 1 for copper tubing, corrosion-resistant stainless steel tubing or SAE Standard J844 for nylon tubing color coded orange.

TS 18.2 Design and Construction

TS 18.2.1 Design and Construction, Diesel

Fuel Tank(s)

The understructure shall consist of structural stainless steel for maximum durability, reduced maintenance, and weight and improved corrosion resistance. It shall be welded, and Huck bolted throughout. Conventional bolt construction shall be with Grade 8 (traceable) hardware, and shall be used only where necessary to allow for routine disassembly (e.g., the closing cross member shall be bolted to allow for engine removal at overhaul). **No movement at bolted joints shall be allowed.**

Fuel Tank(s)

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 Spec. A240 stainless steel.

Installation

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

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

more than 25 gal of fuel over the unusable amount in the tank(s).The bus shall operate at idle on a 6 percent downgrade for 30 minutes starting with no more than 10 gal of fuel over the unusable amount in the tank(s).

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

Labeling

The capacity, date of manufacture, manufacturer name, location of manufacture, and certification of compliance to Federal Motor Carrier Safety 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 7 to 32 ft behind the centerline of the front door on the curbside 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.

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

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 Emco Wheaton or approved equal. The fuel filler cap shall be hinged.

When fuel fill door is open, bus will not go into gear.

TS 19. Emissions and Exhaust

TS 19.1 Emissions (All-Electric)

The vehicle shall not have any EPA-regulated exhaust emissions except as noted in TS 55.1, “Auxiliary Heater.”

TS 19.2 Exhaust Emissions

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

TS 19.3 Exhaust System (HFC)

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

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

TS 19.4 Exhaust Aftertreatment

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

TS 19.4.1 Diesel Exhaust Fluid Injection

If required by the engine manufacturer to meet NOx 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 ECM and a selective catalytic converter. The tanks shall be designed to store DEF in the operating environment described in the "Operating Environment" section.

The DEF filler shall accommodate a standard nozzle. The nozzle shall automatically shut off when the tank is essentially full. The DEF filler cap shall be a screw-on cap and located curbside.

The DEF fluid 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).

The DEF fluid lines shall be designed with heated lines for temperatures up to −20 °F (−28 °C).

TS 19.5 Particulate Aftertreatment

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

STRUCTURE

TS 20. General

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. Altoona Testing

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

If available, the Altoona Test Report shall be provided to the Agency with the Proposal submittal. If not available, then the report shall be provided prior to first acceptance of bus.

TS 21.1 Structural Validation

Baseline Structural Analysis

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

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 a compartment fire into the passenger compartment and shall be in accordance with the Recommended Fire Safety Practices defined in FTA Docket 90A, dated Oct. 20, 1993. Only necessary openings shall be allowed in the bulkhead, and these shall be fire-resistant. Any passageways for the climate control system air shall be separated from the engine compartment by fire-resistant material. Piping through the bulkhead shall have fire-resistant fittings sealed at the bulkhead. Wiring may pass through the bulkhead only if connectors or other means are provided to prevent or retard fire propagation through the bulkhead. Engine access panels in the bulkhead shall be fabricated of fire-resistant material and secured with fire-resistant fasteners. These panels, their fasteners and the bulkhead shall be constructed and reinforced to minimize warping of the panels during a fire that will compromise the integrity of the bulkhead.

TS 23.2 Crashworthiness (Transit Coach)

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

The bus shall withstand a 25 mph impact by a 4000 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 panels 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 sq. in. This load shall not result in deformation that prevents installation of new exterior panels to restore the original appearance of the bus.

TS 24. Corrosion

The bus flooring, sides, roof, understructure and axle suspension components shall be designed to resist corrosion or deterioration from atmospheric 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 with no structural detrimental effects to normally visible surfaces and no weight loss of over 1 percent. All exposed surfaces under the finished bus shall be generously sprayed with non-flammable resin type undercoating.

All interior and exterior metal surfaces shall be cleaned and treated to prevent rust and/or corrosion. After welding in areas where primer was previously applied, all joints shall be brushed to eliminate foreign matter and then the joint shall be cleaned with a phosphorus solution to provide a good base for good paint adhesion. Finally, the joint shall be painted with red oxide primer.

Aluminum panels shall be properly prepared and primed before final paint. All bolts, nuts, washers, clamps, clips, and similar parts shall be zinc or cadmium plated, or phosphate coated to prevent corrosion.

All exterior body seams, joints and overlapping panels shall be sealed against entry of water or dust. Where dissimilar metals meet, proper care shall be taken to prevent electrolytic corrosion.

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 the traction motor does not generate high voltage during towing. Extended rear towing eyes which also protect the oil pan when the buses are lifted from the front are required.

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.

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. The plug connector shall be a seven (7) wire receptacle assembly; Cole-Hersee No. 12063 or approved interchangeable equal.

No Provision of Glad-Hand Type Connectors for Towing

No glad-hand type connector shall be provided.

Lifted (Supported) Front Axle and Flat Towing Capability

Permanent, vehicle mounted, provisions shall be made for the Agency to recover the vehicle by lift towing at the front and rear using the Agency's stinger equipped recovery vehicle with standard lift tow attachments. The Agency's standard towing attachments are designed to pin to lift tow eyes at the front and rear of the bus. Theses standard Agency attachments will be available for review by the contractor at the first project meeting.

Provisions shall be made at the front of the vehicle to allow attachment of a rigid tow bar that shall permit flat towing of the bus, at curb weight. Each towing device shall accommodate a tow hook with a one (1) inch throat.

The towing devices, and tow bar design shall require specific approval of the Agency. The details of bus recovery and towing shall be discussed at the first Project Meeting. All buses should be equipped with skid plates to protect engine oil pan from damage when the vehicle is lifted and towed from the front.

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 a wheel and tire assembly. Jacking pads located on the axle or suspension near the wheels shall permit easy and safe jacking with the flat tire or dual set on a 6 in. high run-up block not wider than a single tire. The bus shall withstand such jacking at any one or any combination of wheel locations without permanent deformation or damage.

TS 27. Hoisting

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

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 ¼ in. or installed in a fully sealed butt joint. Similarly, a molding or cover shall prevent debris accumulation between the floor and wheel housings. The vehicle floor in the area of the entrance and exit doors shall have a lateral slope not exceeding 2 deg to allow for drainage.

Bi-Level Floor Design

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

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 ¼ in. or installed in a fully sealed butt joint. Similarly, a molding or cover shall prevent debris accumulation between the floor and wheel housings. The vehicle floor in the area of the entrance and exit doors shall have a lateral slope not exceeding 2 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 ¼ 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 ¼ in. or installed in a fully sealed butt joint. Similarly, a molding or cover shall prevent debris accumulation between the floor and wheel housings. The vehicle floor in the area of the entrance and exit doors shall have a lateral slope not exceeding 2 deg to allow for drainage.

Sloped Floor

Slope ahead aft the articulated joint shall not exceed 5.5 percent.

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 ½ in. diameter rod, with 1/32 in. radius, without permanent visible deformation.

TS 28.5 Construction

The floor shall be comprised of composite material and 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.

TS 28.6 Construction (Commuter Coach)

The floor shall be comprised of composite material and 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.

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 defection 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

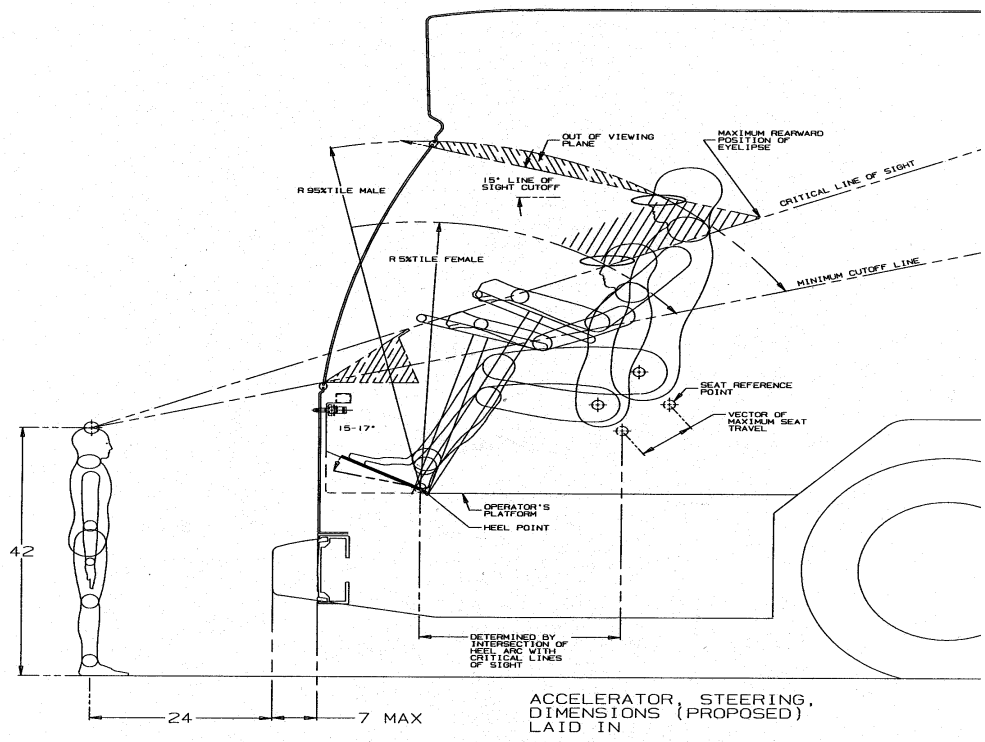
TS 29.1 Driver's Area

The covering of platform surfaces and risers, except where otherwise indicated, shall be the same material as specified for floor covering. Aluminum trim shall be provided along top edges of platforms unless integral nosing is provided.

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. A warning decal or sign shall be provided to alert the driver to the change in floor level. **Figure 2** illustrates a means by which the platform height can be determined, using the critical line of sight.

FIGURE 2
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.

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.

TS 29.4 Rear Step Area to Rear Area (Transit Coach)

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

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 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, or its use as a luggage rack.

Each of the front wheel housings interior shall be covered with a single FRP panel with a twenty-five (25) percent gloss black gel coat finish. The FRP covers shall be securely mounted to the bus structure and shall withstand kicking and other abuse by boarding passengers and shall carry the structural loads of the attached passenger assists and electrical locker without visual or sensual deformation. 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.

The rear wheel housings interior shall be covered with the same material as the bus flooring. Edges shall be trimmed with stainless steel or aluminum.

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.

No provision shall be made to chain 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 by one person for inspection and repairs. Turntable seats shall be quickly and easily removable by one person. 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 Agency shall approve the anti-jackknife joint. The interconnecting structure shall be designed to prevent separation of the lead and trailing units as a result of a road accident with a commercial or private vehicle. A means shall be provided so that the driver can override the control or recover from the situation. The bus shall be equipped with a reverse speed governor that shall apply the brake and accelerator interlocks when the bus speed in reverse gear exceeds 1.5 mph, but the bus shall have sufficient power in reverse to back out of wheel locator depressions at a floor hoist. The proposed configuration of these devices and the reverse-speed requirements shall be submitted for approval of the 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 to maximum deflection of the turntable. The raceway shall prevent chafing, binding, rubbing, crimping or leakage of all hydraulic, air, fuel and system support lines, as well as all electrical and electronic cabling through or to the turntable area. Lines shall be secured, separated and labeled at the lead and trailing unit bulkheads. Separation shall be maintained on the flexible portion of all lines through the use of a raceway. All electrical terminations and hose fittings shall be easily visible and easily tightened or removed without removing any other component. Lines, routing, securement and labeling shall be approved by the 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.

No bellows liner required.

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TS 31. Suspension

TS 31.1 General Requirements

The front, rear and mid (if articulated) suspensions shall be pneumatic type. The basic suspension system shall last the service life of the bus without major overhaul or replacement. 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 so the vehicle tracks 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

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.

TS 31.3.4 Kneeling

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 curbside of the front door, a minimum 2.5 in. diameter amber lens, shall be provided that will blink when the kneel feature is activated. Kneeling shall not be operational while the wheelchair ramp is deployed or in operation.

TS 32. Wheels and Tires

TS 32.1 Wheels

Wheels and rims shall be Alcoa high polished hub piloted Dura Flange wheels or equal. Commuter coach wheels shall be approved by the Agency. All wheels shall be removable without a puller. Wheels shall be compatible with tires in size and load-carrying capacity. Front wheels and tires shall be balanced as an assembly per SAE J1986. Rear wheels must have sufficient spacing between dual tires to permit the use of skid chains. Wheel nuts shall be torqued to the manufacturer's specification with disc-locks of an inch size (not metric) on all lug nuts.

One extra mounted and balanced wheel and tire assembly per axle shall be furnished with each bus.

A tire-pressure monitoring system shall be provided, to be approved by the Agency.

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.

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.

TS 33. Steering

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.

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

Electrically assisted steering shall be provided on battery-electric and hybrid coaches to reduce steering effort.

TS 33.1 Steering Axle (Transit Coach)

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.

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

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

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.

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

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 the engine at normal idling speed on clean, dry, level, commercial asphalt pavement and the tires inflated to recommended pressure.

Under these conditions, the torque required 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 position with minimal assistance from the driver.

TS 33.3.2 Steering Wheel, General

The steering wheel diameter shall be approximately 16 to 20 in.; the rim diameter shall be ⅞ to 1¼ 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 vital instrumentation is clearly visible at center neutral position (within the range of a 95th-percentile male, as described in SAE 1050a, Sections 4.2.2 and 4.2.3). Placement of steering column must be as far forward as possible, but either in line with or behind the instrument cluster.

TS 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.

TS 33.3.4 Steering Wheel Telescopic Adjustment

The steering wheel shall have full telescoping capability and have a minimum telescopic range of 2 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.

TABLE 4
Steering Wheel Height[1] 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 with a load rating sufficient for the bus loaded to GVWR. The drive axle shall have a design life to operate for not less than 300,000 miles on the design operating profile without replacement or major repairs. The lubricant drain plug shall be magnetic type. If a planetary gear design is employed, then the oil level in the planetary gears shall be easily checked through the plug or sight gauge. The axle and driveshaft components shall be rated for both propulsion and retardation modes with respect to duty cycle. If a planetary gear design is employed, then the planetary gear drain plugs shall also be magnetic.

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

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

TS 34.1 Non-Drive Axle

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

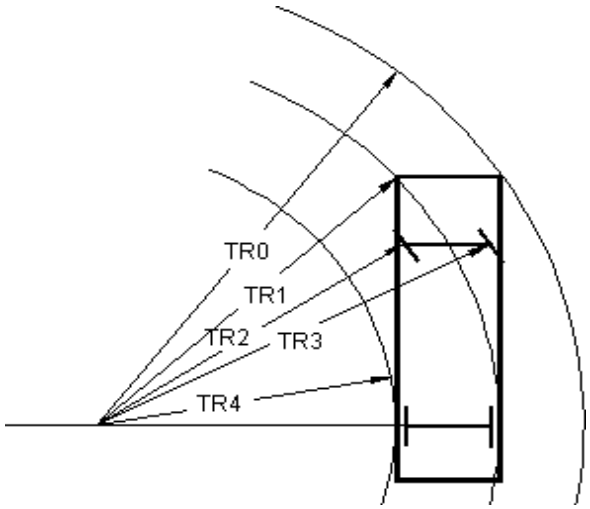
TS 35. Tag Axles (Commuter Coach)

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 RH rear curbside service door.

TS 36. Turning Radius

Bus Length (approximate)	Maximum Turning Radius (see Figure 3)
30 ft	31 ft (TR0)
35 ft	39 ft (TR0)
40 ft	40 ft (TRO)
45 ft	49 ft (TR0)
60 ft	44.5 ft (outside front axle, TR0) 17 ft (inside rearmost axle, TR4)

FIGURE 3
Turning Radius



TS 37. Brakes

TS 37.1 Service Brake

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

TS 37.1.1 Regenerative Braking (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. To protect the ESS system from over-charge, regenerative braking should be limited to above a certain SOC which is defined by the manufacturer; a written document and training should be provided to the Agency.

TS 37.2 Actuation

Service brakes shall be controlled and actuated by a compressed air system. Force to activate the brake pedal control shall be an essentially linear function of the bus deceleration rate and shall not exceed 75 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 his or her foot is rested flat on the pedal and the heel is touching the floor or heel pad of the pedal. The ECU for the ABS system shall be protected, yet in an accessible location to allow for ease of service.

Buses shall be equipped with an MGM E-Stroke brake system, which conforms to the requirements of all Federal and State of North Carolina regulations, designed so such conformance can be maintained throughout the normal adjustment cycle. A supplemental brake (transmission retarder) shall also be provided. The supplemental braking shall not be used in meeting regulatory criteria.

Braking forces shall be proportioned among the axles to assure balanced braking and equalize lining life between axles. Primary Braking shall be the rear axle.

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.

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

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.

No remote brake wear indicator shall be required.

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.

Disc Brakes on All Axles

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

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

TS 37.5 Hubs and Drums (Commuter Coach)

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.

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.

TS 37.6 Parking/Emergency Brake

Air Brakes

The parking brake shall be a spring-operated system, actuated by a valve that exhausts compressed air to apply the brakes. The parking brake may be manually enabled when the air pressure is at the operating level per FMVSS 121.

TS 38. Interlocks

TS 38.1 Passenger Door Interlocks

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.

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). The interlock engagement shall bring the bus to a smooth stop and shall be capable of holding a fully loaded bus on a 6 percent grade with the transmission in gear until the interlocks are released. These interlock functions shall be active whenever the vehicle master run switch is in any run position.

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

Non-adjustable brake interlock regulator.

Requiring Accelerator Interlock Whenever Front Doors Are Open

An accelerator interlock shall lock the accelerator in the closed position, and a brake interlock shall engage the service brake system to stop movement of the bus whenever front doors are open.

TS 39. Pneumatic System

TS 39.1 General

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

Provision shall be made to apply shop air to the bus air systems. A quick disconnect fitting shall be easily accessible and located in the engine 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 39.2 Air Compressor

DIESEL BUS

The engine-driven air compressor shall be sized to charge the air system from 40 psi to the governor cut-off pressure in less than 4 minutes while not exceeding the fast idle speed setting of the engine.

BATTERY-ELECTRIC & HYBRID BUS

The electrically driven air compressor shall be sized to charge the air system from 40 psi to the governor cut-off pressure in less than 4 minutes while not exceeding the fast idle speed setting of the engine.

TS 39.3 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:

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

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

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

TS 39.4 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 39.5 Air System Dryer

The air dryer shall prevent accumulation of moisture in the air system, rated for transit bus applications, and sized to meet all the requirements of the air system. Dryer purge time shall be compatible with the air compressor unload time to guarantee elimination of moisture and all contaminants from the air system. The Contractor shall provide test data indicating that the performance of the air system conforms to the requirements at the pre-production meeting. The air-dryer, mounting, location shall be protected by a dust shield. With the exception of the aforementioned dust shield no other bus equipment shall require removal to service the air dryer. Dryer installation shall conform to the original manufacturer’s recommendations. The air dryer shall be desiccant type, with electrically heated drain. Heater device shall be thermostatically controlled. The air dryer system shall require approval of the Agency at the pre-production meeting.

ELECTRICAL, ELECTRONIC AND DATA COMMUNICATION SYSTEMS

TS 40. 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.

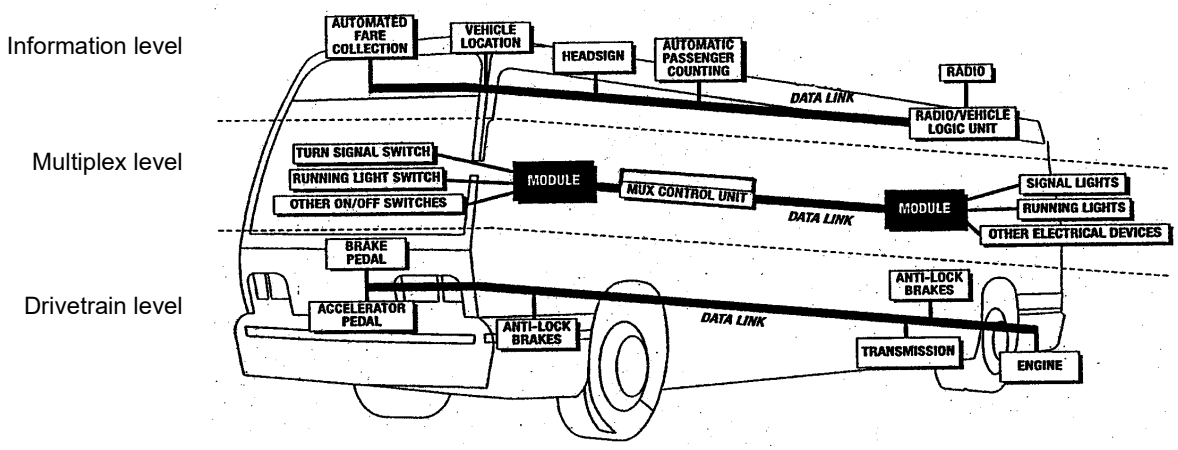
The data communication system consists of the bidirectional communications networks that electronic devices use to share data with other electronic devices and systems. Communication networks are essential to integrating electronic functions, both onboard the vehicle and off.

Information level systems that require vehicle information for their operations or provide information shall adhere to J1939 data standard.

Data communications systems are divided into three level store the use of multiple data networks (see **Figure 4**):

- **Powertrain level:** Components related to the powertrain, including the propulsion system components (engine, transmission and hybrid units)and anti-lock braking system (ABS), which may include traction control. At a minimum, powertrain components consisting of the engine, transmission, retarder, ASR and anti-lock braking systems shall be powered by a dedicated and isolated ignition supply voltage to ensure data communication between components exists when the vehicle ignition is switched to the "on" position.
- **Information level:** Components whose primary function is the collection, control or display of data that is not necessary to the safe drivability of the vehicle (i.e., the vehicle will continue to operate when those functions are inoperable). These components typically consist of those required for automatic vehicle location (AVL) systems, destination signs, fareboxes, passenger counters, radio systems, automated voice and signage systems, video surveillance and similar components.
- **Multiplex level:** Electrical or electronic devices controlled through input/output signals such as discrete, analog and serial data information (i.e., on/off switch inputs, relay or relay control outputs). Multiplexing is used to control components not typically found on the drivetrain or information levels, such as lights; wheelchair lifts; doors; heating, ventilation and air conditioning (HVAC) systems (if applicable); and gateway devices.

FIGURE 4
Data Communications Systems Levels



TS 40.1 Modular Design

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

TS 41. Environmental and Mounting Requirements

The electrical system and its electronic components shall be capable of operating in the area of the vehicle in which they will be installed, as recommended in SAE J1455.

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 bus manufacturers and subsystem suppliers regarding methods to prevent damage from voltage spikes generated from welding, jump-starts, shorts, etc.

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

All electrical/electronic hardware and its mounting shall comply with the shock and vibration requirements of published industry standards (SAE, ISO, etc.).

TS 42. General Electrical Requirements

TS 42.1 Low-Voltage (SLI) Batteries

Selected or specified batteries shall have a sufficient capacity to execute start after the as-delivered bus has been parked and off for a minimum of 48 hours.

TS 42.1.1 Low-Voltage Batteries (24 V)

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 2150 cold-cranking amps. Each battery shall have a purchase date no more than one year from the date of release for shipment to the Agency.

Same Size Terminal Ends

Positive and negative terminal ends shall be the same size.

(Diesel & Hybrid Bus) 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 2150 cold-cranking amps (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.

(Battery Electric Bus) 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 2150 cold cranking amps (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.

TS 42.1.2 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.

Color-code each voltage.

TS 42.1.3 Jump-Start Connector

A grey in color Whitaker plug, equipped with a dust cap and adequately protected from moisture, dirt and debris shall be provided in the engine compartment and next to the battery disconnect switch to jump-start the bus.

TS 42.1.4 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 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 switches.

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.

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.

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 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 42.1.5 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 42.1.6 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.

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

TS 42.1.7 Low-Voltage Generation and Distribution

The low-voltage generating systems shall maintain the charge on fully charged batteries, except in combustion engine cases, when the vehicle is at standard idle to allow-voltage generator load exceeding 70 percent of the low-voltage generator name plate rating.

Voltage monitoring and over-voltage 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 percent volt drop across the length of the cable.

TS 42.1.8 Circuit Protection

All branch circuits, except battery-to-starting-motor and battery-to-generator/alternator circuits, shall be protected by current-limiting devices such as circuit breakers, fuses or solid-state devices sized to the requirements of the circuit. 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 waterproof. 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 Agency shall consider the application of automatic reset circuit breakers on a case-by-case basis. The Contractor shall show all in-line fuses in the final harness drawings. Any manually resettable circuit breakers shall provide a visible indication of open circuits.

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

TS 42.2 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 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 42.3 Low-Voltage and High-Voltage Wiring and Terminals

All power and ground wiring shall conform to specification requirements of SAE J1127, J1128 and J1292. All high-voltage power and ground wiring shall conform to specification requirements of SAE J1763, 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 presenting 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. Wiring and electrical equipment necessarily located under the vehicle shall be insulated from water, heat, corrosion and mechanical damage. Where feasible, front-to-rear electrical harnesses should be installed above the window line of the vehicle.

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

Ultra-sonic 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 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 42.4 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, auxiliary heater pumps, defroster and wiper motors). All electric motors shall be easily accessible for servicing.

TS 42.5 Electrical Compartments

All relays, controllers, flashers, circuit breakers and other electrical components shall be mounted in easily accessible electrical compartments. All compartments exposed to the outside environment shall be corrosion-resistant and sealed. The components and their functions in each electrical compartment shall be identified and their location permanently recorded on a drawing attached to the inside of the access panel or door. The drawing shall be protected from oil, grease, fuel and abrasion.

The front compartment shall be completely serviceable from the driver's seat, vestibule or from the outside. 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 43. General Electronic Requirements

If an electronic component has an internal real-time clock, it shall provide its own battery backup to monitor time when battery power is disconnected, and/or it may be updated by a network component. If an electronic component has an hour meter, it shall record accumulated service time without relying on battery backup.

All electronic component suppliers shall ensure that their equipment is self-protecting in the event of shorts in the cabling, and also in over-voltage (over 32 VDC on a 24 VDC nominal voltage rating with a maximum of 50 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 easily accessible and labeled.

TS 43.1 Wiring and Terminals

Kinking, grounding at multiple points, stretching and reducing the bend radius below the manufacturer's recommended minimum shall not be permitted.

TS 43.1.1 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 43.1.2 Shielding

All wiring that requires shielding shall meet the following minimum requirements. A shield shall be generated by connecting to a ground, which is sourced from a power distribution bus bar or chassis. A shield shall be connected at one location only, typically at one end of the cable. However, certain standards or special

requirements, such as SAE J1939 or RF applications, have separate shielding techniques that also shall be used as applicable.

> **NOTE:** A shield grounded at both end forms a ground loop, which can cause intermittent 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 43.1.3 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 43.1.4 Radio Frequency (RF)

RF components, such as radios, video devices, cameras, global positioning systems (GPS), etc., shall use coaxial cable to carry the signal. All RF systems require special design consideration for losses along the cable. Connectors shall be minimized, since each connector and crimp has a loss that will 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 antenna and cable assembly. The corresponding component vendors shall be consulted for proper application of equipment, including installation of cables.

TS 43.1.5 Audio

Cabling used for microphone level and line level signals shall be 22 AWG minimum with shielded twisted pair. Cabling used for amplifier level signals shall be 18 AWG minimum.

TS 44. Multiplexing

TS 44.1 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.

Ten percent 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.

TS 44.2 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 44.2.1 I/O Signals

The input/output for the multiplex system may contain four types of electrical signals: discrete, modulating, analogue, 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 (0–12 V, 10–24 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 45. Data Communications

TS 45.1 General

All data communication networks shall be either in accordance with a nationally recognized interface standard, such as those published by SAE, IEEE or ISO, or shall be published to the 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.

Any electronic vehicle components used on a network shall be conformance tested to the corresponding network standard.

TS 45.2 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 45.2.1 Diagnostics, Fault Detection and Data Access

Drivetrain performance, maintenance and diagnostic data, and other electronic messages shall be formatted and transmitted on the communications networks.

The drivetrain level shall have the ability to record abnormal events in memory and provide diagnostic codes and other information to service personnel. At a minimum, this network level shall provide live/fail status, current hardware serial number, software/data revisions and uninterrupted timing functions.

TS 45.2.2 Programmability (Software)

The drivetrain-level components shall be programmable by the Agency with limitations as specified by the subsystem Supplier.

TS 45.3 Multiplex Level

TS 45.3.1 Data Access

At a minimum, information shall be made available via a communication port on the multiplex system. The location of the communication port shall be easily accessible. A hardware gateway and/or wireless communications system are options if requested by the Agency. The communication port(s) shall be located as specified by the Agency.

TS 45.3.2 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.

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 45.3.3 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 or laptop. The multiplex system shall have proper revision control to ensure that the hardware and software are identical on each vehicle equipped with the system. Revision control shall be provided by all of the following:

- Hardware component identification where labels are included on all multiplex hardware to identify components
- Hardware series identification where all multiplex hardware displays the current hardware serial number and firmware revision employed by the module
- Software revision identification where all copies of the software in service display the most recent revision number
- A method of determining which version of the software is currently in use in the multiplex system

Revision control labels shall be electronic.

TS 45.4 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).

DRIVER PROVISIONS, CONTROLS AND INSTRUMENTATION

TS 46. Driver's Area Controls

TS 46.1 General

In general, when designing the driver's area, it is recommended that SAE J833, "Human Physical Dimensions," be used.

Switches and controls shall be divided into basic groups and assigned to specific areas, in conformance with SAE J680, "Location and Operation of Instruments and Controls in Motor Truck Cabs," and be essentially within the hand reach envelope described in SAE J287, "Driver Hand Control Reach."

TS 46.2 Glare

The driver's work area shall be designed to minimize glare to the extent possible. Objects within and adjacent to this area shall be matte black or dark gray in color wherever possible to reduce the reflection of light onto the windshield. The use of polished metal and light-colored surfaces within and adjacent to the driver's area shall be avoided.

TS 46.3 Visors/Sun Shades

Front and Side Sun Shade/Visor

Adjustable sun visor(s) shall be provided for the driver's windshield and the driver's side window. Visors shall be shaped to minimize light leakage between the visor and windshield pillars. Visors shall store out of the way and shall not obstruct airflow from the climate control system or interfere with other equipment, such as the radio handset or the destination control. Deployment of the visors shall not restrict vision of the rearview mirrors. Visor adjustments shall be made easily by hand with positive locking and releasing devices and shall not be subject to damage by over-tightening. Sun visor construction and materials shall be strong enough to resist breakage during adjustments. Visors may be transparent but shall not allow a visible light transmittance in excess of 10 percent. Visors, when deployed, shall be effective in the driver's field of view at angles more than 5 deg above the horizontal.

TS 46.4 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 of the bus shall be conveniently located and shall provide for ease of operation. They shall be identifiable by shape, touch and permanent markings. Controls also shall be located so that passengers may not easily tamper with control settings.

All panel-mounted switches and controls shall be marked with easily read identifiers. 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.

All switches/controls in the driver's control area shall be mounted in an angled panel steep enough to discourage drivers from using it as a personal storage area for items like food, drinks, cell phones, etc.

The transmission shift selector shall be mounted in an angled panel steep enough to discourage drivers from using it as a personal storage area for electronic devices such as cell phones, music players, navigation systems, etc.

TS 46.5 Normal Bus Operation Instrumentation and Controls

The following list identifies bus controls used to operate the bus. These controls are either frequently used or critical to the operation of the bus. They shall be located within easy reach of the operator. The operator shall not be required to stand or turn to view or actuate these controls unless specified otherwise.

Systems or components monitored by onboard diagnostics system shall be displayed in clear view of the operator and provide visual and/or audible indicators. The intensity of indicators shall permit easy determination of on/off status in bright sunlight but shall not cause a distraction or visibility problem at night. All indicators shall be illuminated using backlighting.

The indicator panel shall be located in Area 1 or Area 5, within easy view of the operator instrument panel. 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. The intent of the overall physical layout of the indicators shall be in a logical grouping of systems and severity nature of the fault.

Consideration shall be provided for future additions of spare indicators as the capability of onboard diagnostic systems improves. Blank spaces shall contain LEDs.

Image 1
Front Center Console

Image 2
Street Side Lower Controls


FIRE
REGENERATIVE BRAKE
OFF/ON
NORMAL
RELEASE
DOOR AIR
HEATED MIRROR(S)
ON
OFF
RIGHT
POWER MIRRORS
LEFT

Image 3
Street Side Middle Controls

Image 4
Street Side Upper Controls

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Image 5
External Bus EV Control

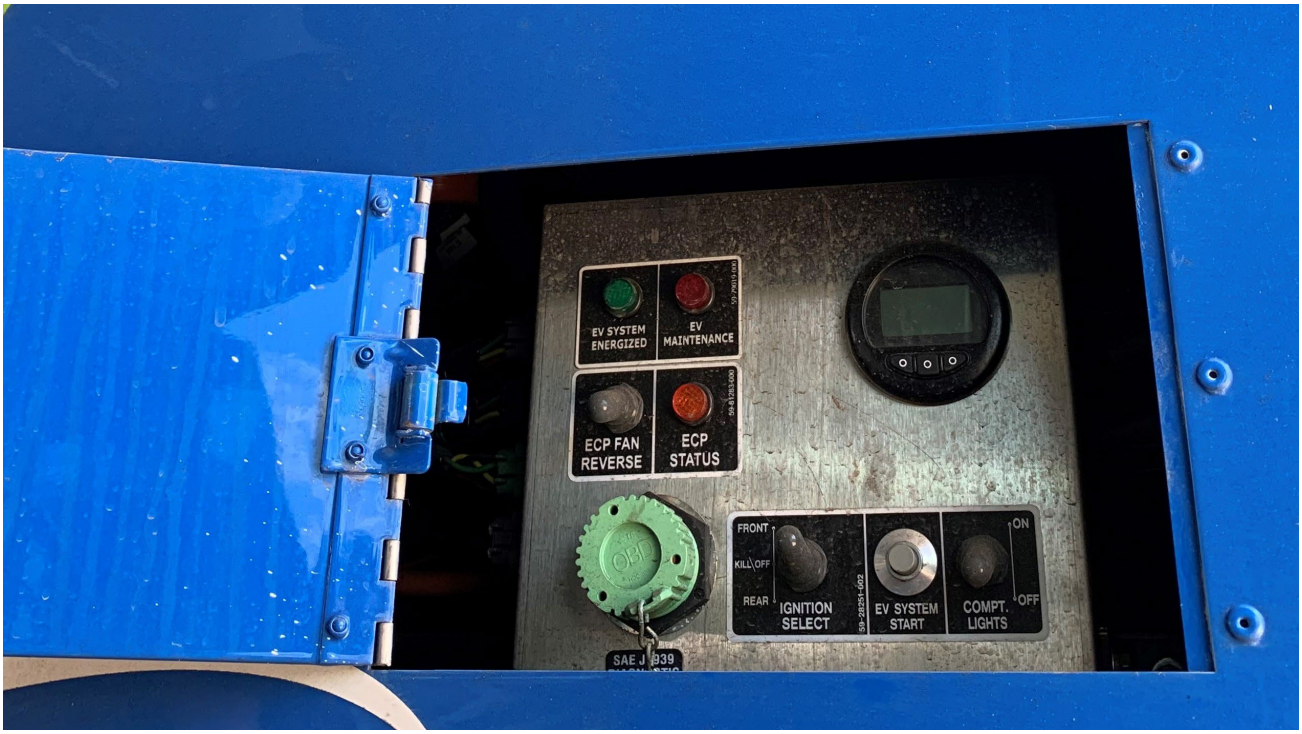

Image 6
Middle Bus Monitor

Image 7
Right of Operator Far Box

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Image 8
Street Side Above Operator Controls

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Image 9
Street Side Covert Button

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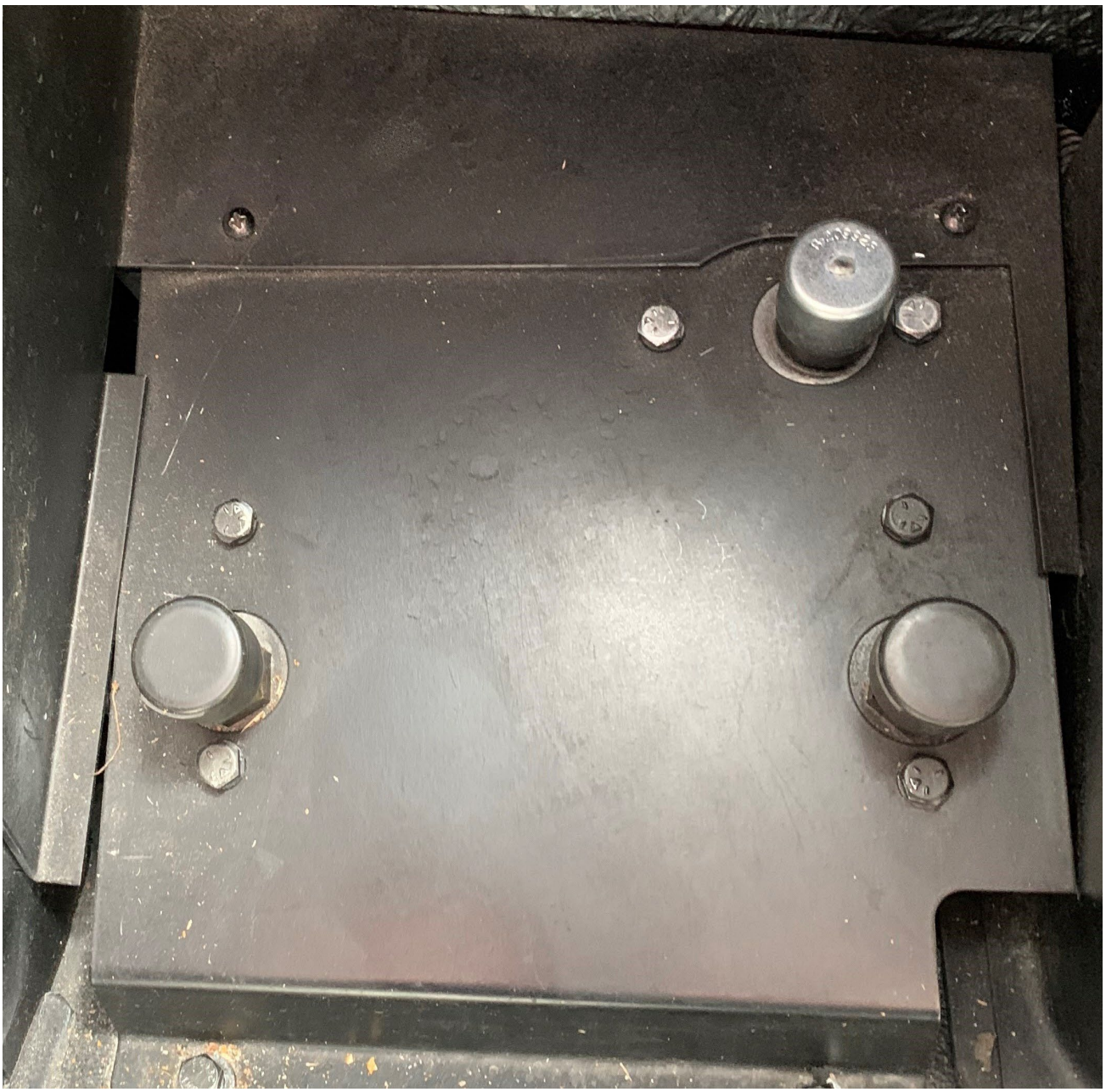
269-2023-1402

Image 10
Street Side Foot Controls



TS 46.6 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 46.6.1 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 18 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 46.6.2 Pedal Dimensions and Position

The floor-mounted accelerator pedal shall be 10 to 12 in. long and 3 to 4 in. wide. Clearance around the pedal must allow for no interference precluding operation.

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 46.7 Brake and Accelerator Pedals

Brake Pedal

Non-adjustable brake pedal.

TS 46.8 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.

Turn Signal Controls

Turn signal controls shall be floor-mounted, foot-controlled, water-resistant, heavy-duty, momentary contact switches.

Foot Switch Control

The control switches for the turn signals shall be mounted on an inclined, floor-mounted stainless steel enclosure or metal plate mounted to an incline integrated into the driver’s platform, located to the left of the steering column. The location and design of this enclosure shall be such that foot room for the operator is not impeded. The inclined mounting surface shall be skid-resistant. All other signals, including high beam and public address system, shall be in approved 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.

TS 47. Driver's Amenities

TS 47.1 Coat Hanger

Coat Hook

A hook and loop shall be provided to secure the driver's coat.

TS 47.2 Drink Holder

No drink holder.

TS 47.3 Storage Box

Storage Box

An enclosed driver storage area shall be provided with a positive latching door and/or lock. The minimum size is 2750 cu in.

TS 48. Windshield Wipers and Washers

TS 48.1 Windshield Wipers

The bus shall be equipped with a windshield wiper for each half of the windshield. At 60 mph, no more than 10 percent of the wiped area shall be lost due to windshield wiper lift. For two-piece windshields, both wipers shall park along the center edges of the windshield glass. For single-piece windshields, wipers shall park along the bottom edge of the windshield. Windshield wiper motors and mechanisms shall be easily accessible for repairs or service. The fastener that secures the wiper arm to the drive mechanism shall be corrosion resistant.

Single-control, electric two-speed intermittent wiper.

Intermittent Wiper with Variable Control

A variable-speed feature shall be provided to allow adjustment of wiper speed for each side of the windshield between approximately five and 25 cycles per minute.

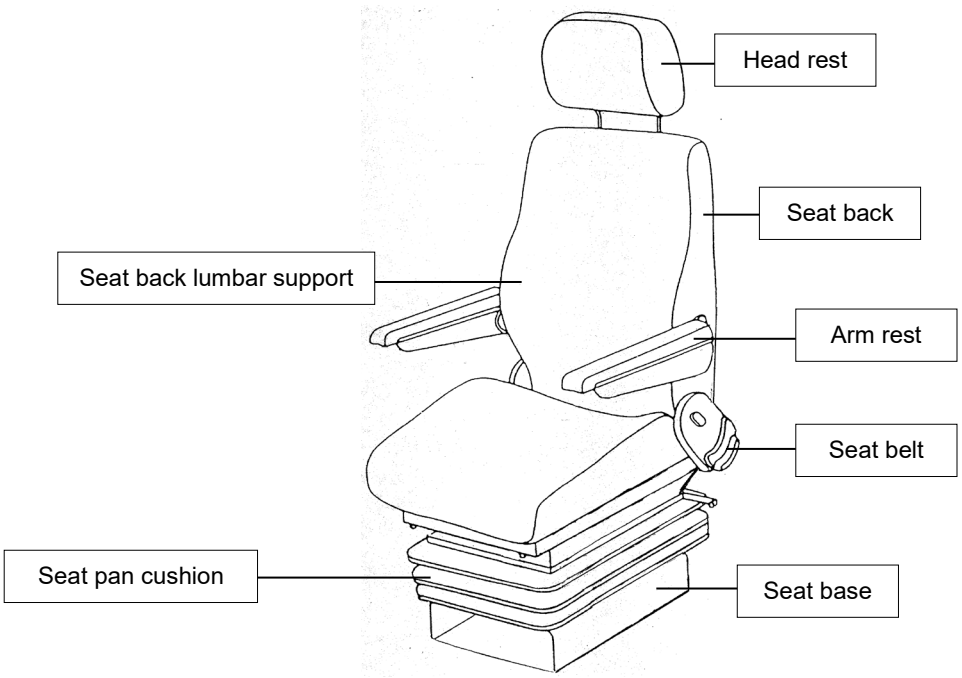
TS 48.2 Windshield Washers

The windshield washer system, when used with the wipers, shall deposit washing fluid evenly and completely wet the entire wiped area.

The windshield washer system shall have a minimum 3-gallon reservoir, located for easy refilling from outside the bus. Reservoir pumps, lines and fittings shall be corrosion-resistant and must include a means to determine fluid level.

TS 49. Driver's Seat

FIGURE 5
Driver's Seat



TS 49.1 Dimensions

The driver's seat shall be a Recaro that is comfortable and adjustable so that people ranging in size from a 95th-percentile male to a 5th-percentile female may operate the bus.

TS 49.1.1 Seat Pan Cushion Length

Measurement shall be from the front edge of the seat pan to the rear at its intersection with the seat back. The adjustment of the seat pan length shall be no less than 16.5 in. at its minimum length and no more than 20.5 in. at its maximum length.

TS 49.1.2 Seat Pan Cushion Height

Dimensions

Measurement shall be from the cab floor to the top of the level seat at its center midpoint. The seat shall adjust in height from a minimum of 14 in., with a minimum 6 in. vertical range of adjustment.

TS 49.1.3 Seat Pan Cushion Slope

Measurement is the slope of the plane created by connecting the two high points of the seat, one at the rear of the seat at its intersection with the seat back and the other at the front of the seat just before it waterfalls downward at the edge. The slope can be measured using an inclinometer and shall be stated in degrees of incline relative to the horizontal plane (0 deg). The seat pan shall adjust in its slope from no less than plus 12 deg (rearward "bucket seat" incline) to no less than minus 5 deg (forward slope).

TS 49.1.4 Seat Base Fore/Aft Adjustment

Measurement is the horizontal distance from the heel point to the front edge of the seat. The minimum and maximum distances shall be measured from the front edge of the seat when it is adjusted to its minimum seat pan depth (approximately 15 in.). On all low-floor buses, the seat base shall travel horizontally a minimum of 9 in. It shall adjust no closer to the heel point than 6 in. On all high-floor buses, the seat base shall travel a minimum of 9 in. and adjust no closer to the heel point than 6 in.

TS 49.1.5 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 49.1.6 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 adjustment in both directions**.**

Rubber bumpers shall be provided to prevent metal-to-metal contact.

TS 49.1.7 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 49.1.8 Headrests

Adjustable headrest.

TS 49.1.9 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 within a minimum range of 7 to 11 in.

TS 49.1.10 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 49.2 Seat Belt

The belt assembly should be an auto-locking retractor (ALR). All seat belts should be stored in automatic retractors. The belts shall be mounted to the seat frame so that the driver may adjust the seat without resetting the seat belt.

The seat and seatbelt assemblies as installed in the bus shall withstand static horizontal forces as required in FMVSS 207 and 210.

Lap and Shoulder (Three-Point) Seat Belt

Seat belts shall be provided across the driver's lap and diagonally across the driver's chest. The driver shall be able to use both belts by connecting a single buckle on the right side of the seat cushion. Three-point seatbelts must be emergency locking retractor (ELR) in design.

Adjustable-height D-ring.

All seatbelt assemblies shall come equipped with a warning switch device to remind operators to buckle up.

Orange three-point seatbelt webbing.

Lap Belt Length

80 in.

The lap belt assembly shall be a minimum of 80 in. in length.

TS 49.3 Adjustable Armrest

No armrests.

TS 49.4 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 49.5 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

Closed-cell polyurethane (FMVSS 302).

TS 49.6 Pedestal

Stainless steel.

TS 49.7 Seat Options

Seat Alarm
The bus horn shall sound when the driver is out of the seat and PP1 valve is not set (master switch on or off).

Seat Cushion Alarm Audio: In Addition To The Standard Audible Interior Alarms, Provide Programming To Include The Vehicles Exterior Horns When The Seat Is Unoccupied, & The Parking Brake Not Set.

TS 49.8 Mirrors

TS 49.8.1 Exterior Mirrors

The bus shall be equipped with a 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 with a breakaway mounting system. 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 retract or fold sufficiently to allow bus washing operations but avoid contact with windshield. A weatherproof Deutsch electrical connector, or approved equal shall be provided on the exterior of the bus, which enables the quick replacement of a damaged mirror.

Flat Mirrors on Both Sides
The bus shall be equipped with two flat outside mirrors, each with not less than 50 sq in. of reflective surface. The mirrors shall be located so as to provide the driver a view to the rear along both sides of the bus and shall be adjustable both in the horizontal and vertical directions to view the rearward scene. The roadside rearview mirror shall be positioned so that the driver's line of sight is not obstructed.

Combination of flat and convex mirrors referred to as transit specific.

The curbside and street side 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 requested mirror configuration requests.

Heated and Remote Mirrors
The heaters shall be energized whenever the driver's heater and/or defroster is activated, or can be activated independently. The driver shall be able to adjust ALL the mirrors remotely while seated in the driving position. The control for remote positioning of the mirror shall be a single switch or device.

TS 49.8.2 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 with a full standee load, anywhere in the aisle, and in the rear seats. The suggested mirror arrangement is as follows:

a) Buses shall be equipped with two inside rear view mirrors.

• Center rear view mirror above windshield shall be mounted on windshield header panel above and in front of driver. Dimensions shall be six (6) inches by thirty (30) inches. Mirror shall have a non-reflective black rim and mounting bracket made of steel. Mirror shall be positively mounted to allow for adjustment but to eliminate, to the maximum practical extent, mirror vibration.

• Right windshield header mirror shall be a six (6) inch round mirror. This mirror shall be located so as not to interfere with passengers, and shall have an adjustable mounting bracket.

• A mirror shall be mounted above the entrance door. It shall be seven (7) inch by ten (10) inch and shall have an adjustable mounting bracket.

b) A twelve (12) inch diameter mirror shall be mounted above and behind the rear exit door in such a way that it will not interfere with passengers.

WINDOWS

TS 50. General

Use with 30 ft length: A minimum of 6000 sq in. 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 sq in. 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 sq in. 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 sq in. of window area, including operator and door windows, shall be required on each side of the standard configuration bus.

Use with 60 ft length: A minimum of 16,000 sq in. of window area, including operator and door windows, shall be required on each side of the standard configuration bus.

TS 51. 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 external glare as well as reflections from inside the bus.

The windshield shall be easily replaceable by removing zip-locks from the windshield retaining moldings. Bonded-in-place windshields shall not be used. Winglets may be bonded.

TS 51.1 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.

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 percent when tested in accordance to ASTM D1003.

Two-piece windshield.

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 adjust the street-side outside rearview mirror. When in an open position, the window shall not rattle or close during braking. This window section shall slide in tracks or channels designed to last the service life of the bus. The operator's side window shall not be bonded in place and shall be easily replaceable. The glazing material shall have a single-density tint.

The driver's view, perpendicular through 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.

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.

The design shall prevent sections from freezing closed in the winter. Light transmittance shall be 75 percent on the glass area below 53 in. from the operator platform floor. On the top-fixed-over-bottom-slider configuration, the top fixed area above 53 in. may have a maximum 5 percent light transmittance.

Hidden Frame (Flush "Euro-Look") Driver's Side Window

- full slider
  - non-egress

Quick Change Operator's Side Window

Glazing in the window assembly shall be replaced without removing the window from its installed position on the bus or manipulation of the rubber molding surrounding the glazing. The glazing shall be held in place mechanically by a formed metal extruded ring constructed to last the life of the vehicle.

TS 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.

All passenger windows shall be manufactured by Dura or approved equal. Windows shall have black anodized aluminum frames. All windows shall be three-quarter (¾) lower egress and all windows of the same size shall be interchangeable. All egress handles shall be located towards the front of the bus.

Windows shall be designed to prevent the entrance of air and water when windows are closed. Near each window there shall be instructions on decals or aluminum plates that sufficiently explain emergency exit

procedures. Location of the metal decal shall be determined by the Agency. Emergency instructions shall be printed in both English and Spanish. All requirements of FMVSS217 shall be complied with.

Side windows shall extend from the shoulder height of the 5th-percentile, seated, female passenger to the eye level of the 95th-percentile, standing male passenger. Vertical mullions between windows including the trim shall not exceed seven (7) inches in width. The side windows shall be fixed with the top portion of the "tip in" style to allow adequate ventilation of the coach, and meet the emergency escape requirements of FMVSS-217. The side window assemblies shall be identical, as far as practical, throughout the coach. Window assemblies that open must be aligned to preclude water leakage and excessive wind noise into the coach. The "tip in" windows shall be hinged with positively retained props or restraints to prevent accidental opening or opening beyond design limit. All side windows shall be easily replaceable without disturbing adjacent windows and shall be mounted so that flexing or vibration from engine operation or normal road excitation is not apparent.

Adequate clearance shall be provided between the seat backs and the window frames to allow quick access to the emergency egress latches, which shall be red in color.

Windows shall be one-quarter inch (1/4) tempered safety glass GY-2094, conforming to FMVSS 205 and applicable requirements of ANSI Z26.1. Tempered glass shall be able to withstand scratching by rotating brush washers. Tempered Glazing shall not craze due to solar rays or cold temperatures. Glazing color shall be consistent from window to window with the exception of the upper destination sign window. Upper destination sign's window shall be clear in color. Maximum solar energy transmittance shall be forty-four (44) percent gray as measured by ASTME-424.

All passenger window one-quarter inch (1/4") tempered fixed glazing shall be protected by an acrylic liner. The acrylic liner shall be clear in color, one-sixteenth inch (1/16") or one-eighth inch (1/18") in thickness.

a) The acrylic shall be removable by Agency mechanics using simple hand tools.

b) Design must be simple where the worker can remove and replace the liner in less than one (1) minute.

c) The 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's rubber molding.

d) Removal and replacement of the liner shall not require the removal or the modification or any other parts or fasteners.

Eight (8) hours of training showing Agency personnel how to perform initial installation of the window assemblies and any techniques for removal and replacement of tempered or acrylic glazing. Contractor shall further supply up to four (4) hours of training for service workers on how to most efficiently remove and replace the sacrificial liners.

All window assemblies shall be warranted covering the integrity and deterioration of the glazing for a period of two (2) years in Agency normal service. This warranty shall cover all material, labor, and workmanship. "Normal service" excludes accidents, vandalism, and improper maintenance or installation.

TS 53.2 Emergency Exit (Egress) Configuration

Minimum Egress

All side windows shall be fixed in position, except as necessary to meet the emergency escape requirements.

Standard Passenger Side Window Configurations

- hidden frame (flush “Euro-look”)
  - full fixed

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. The glazing shall be held in place mechanically by a formed metal extruded ring constructed to last the life of the vehicle.

TS 53.3 Configuration

Fixed Side Windows

All side windows shall be fixed in position, except as necessary to meet the emergency escape requirements.

TS 53.4 Materials

Safety Glass Glazing Panels

Side windows glazing material shall have a minimum of 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.

Windows on the bus sides and in the rear door shall be tinted a neutral color, complementary to the bus exterior. The maximum solar energy transmittance shall not exceed 37 percent, as measured by ASTM E424. Luminous transmittance shall be measured by ASTM D1003. Windows over the destination signs shall not be tinted.

TS 53.5 Rear Window

No requirement for rear window.

HEATING, VENTILATING AND AIR CONDITIONING

TS 54. Capacity and Performance

The HVAC climate control system shall be capable of controlling the temperature and maintaining the humidity levels of the interior of the bus as defined in the following paragraphs.

HVAC equipped. See below for configuration.

Allow Either Roof- or Rear-Mounted HVAC Unit

The HVAC unit may either be 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.

AC or DC electrically driven A/C system with hermetic compressor(s), condenser fan and evaporator blower motors.

With the bus running at the design operating profile with corresponding door opening cycle, and carrying a number of passengers equal to 150 percent of the seated load, the HVAC system shall control the average passenger compartment temperature within arrange between 65 and 80 °F, while maintaining the relative humidity to a value of 50 percent or less. The system shall maintain these conditions while subjected to any outside ambient temperatures within a range of 10 to 95 °F and at any ambient relative humidity levels between 5 and 50 percent. Demonstrate this requirement after first reaching a stabilized interior temperature of 70 ±3 °F with full passenger and solar load.

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:** 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.

Capacity and Performance Requirements (Diesel)

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.

Capacity and Performance Requirements (Hybrid & Battery Electric)

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 the APTA "Recommended Instrumentation and Performance Testing for Transit Bus Air Conditioning System," representing 4 p.m. on Aug. 21, shall be used. There shall be no passengers on board, and the doors, windows and fresh air opening shall be closed.

R407C

The air conditioning system shall meet these performance requirements using R407C or approved equal.

TS 55. Controls and Temperature Uniformity

The HVAC system excluding the driver's heater/defroster shall be centrally controlled with an advanced electronic/diagnostic control system with provisions for extracting/reading data. The system shall be compliant with J1939 Communication Protocol for receiving and broadcasting of data.

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.

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.

Manually Adjustable Temperature Control Setpoint

The climate control system shall have the provision to allow the driver to adjust the temperature control setpoint at a minimum of between 68 and 72 °F. From then on, 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/or cold spots. After stabilization with doors closed, the temperatures between any two points in the passenger compartment in the same vertical plane, and 6 to 72 in. above the floor, shall not vary by more than 5 °F with doors closed. The interior temperatures, measured at the same height above the floor, shall not vary more than ±5 °F from the front to the rear from the average temperature determined in accordance with APTA's "Recommended Instrumentation and Performance Testing for Transit Bus Air Conditioning System." 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

No auxiliary heater.

TS 55.2 Load Shedding and Derating

No Load Shedding or Derating

No provisions shall be made in the HVAC system for load shedding. Proposer will provide information on load shedding based on geographic location.

Optional Multistage Load Shedding or Derating (Battery-Electric Bus)

HVAC control must include a method to provide multistage load shedding when required to conserve battery power. The HVAC system may be operated with reduced performance to allow the bus to operate when the high-voltage batteries are below critical levels.

TS 56. Air Flow

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 percent of the seated load. Airflow shall be evenly distributed throughout the bus, with air velocity not exceeding 100 ft per minute on any passenger. The ventilating mode shall provide air at a minimum flow rate of 20 cfm per passenger.

Airflow may be reduced to 15 cfm per passenger (150 percent of seated load) when operating in the heating mode. The fans shall not activate until the heating element has warmed sufficiently to ensure at least 70 °F air outlet temperature. The heating air outlet temperature shall not exceed 120 °F under any normal operating conditions.

The climate control blower motors and fan shall be designed such that their operation complies with the interior noise level requirements.

Requirement for 10 Percent "Fresh Air" Mixture

The air shall be composed of no less than 10 percent outside air.

TS 56.2 Driver's Area

The bus interior climate control system shall deliver at least 100 cfm of air to the driver's area when operating in the ventilating and cooling modes. Adjustable nozzles shall permit variable distribution or shutdown of the airflow. Airflow in the heating mode shall be reduced proportionally to the reduction of airflow into the passenger area. The windshield defroster unit shall meet the requirements of SAE 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 (CCS)

The controls for the driver's compartment for heating, ventilation and cooling systems shall be integrated and shall meet the following requirements:

- The heat/defrost system fan shall be controlled by a separate switch that has an "off" position and at least two positions for speed control. All switches and controls shall preclude the possibility of clothing becoming entangled, and shields shall be provided, if required. If the fans are approved by the Agency, an "on/off" switch shall be located to the right of or near the main defroster switch.
- A manually operated control valve shall control the coolant flow through the heater core.
- 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. Fan(s) 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.
- 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

No dedicated evaporator.

A separate fan unit shall provide 100 cfm of air to the driver's area through directionally adjustable nozzles and an infinitely variable fan control, both of which shall be located above and ahead of the driver.

Air from the evaporator shall be provided to the driver's area through vents located on the dash in front of the driver.

TS 57. Air Filtration

Air shall be filtered before entering the AC system and being discharged into the passenger compartment. The filter shall meet the ANSI/ASHRAE 52.1 requirement for 5 percent or better atmospheric dust spot efficiency, 50 percent weight arrestance, and a minimum dust holding capacity of 120 g per 1000 cfm cell. Air filters shall be easily removable for service.

Disposable Type Filters

Air filters shall be of disposable type.

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 4 in., or with all four edges raised simultaneously to a height of no less than 3½ in. An escape hatch shall be incorporated into the roof ventilator. Roof ventilator(s) shall be sealed to prevent entry of water when closed.

One Roof Ventilator
One ventilator shall be provided in the roof of the bus.

TS 59. Maintainability

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. The condenser shall be located to efficiently transfer heat to the atmosphere and shall not ingest air warmed above the ambient temperature by the bus mechanical equipment, or to discharge air into any other system of the bus. The location of the condenser shall preclude its obstruction by wheel splash, road dirt or debris. HVAC components located within 6 in. of floor level shall be constructed to resist damage and corrosion.

TS 60. Entrance/Exit Area Heating

No requirements for entrance/exit area heating.

TS 61. Floor-Level Heating

TS 61.1 Transit Coach

No requirements for floor-level heating.

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.

EXTERIOR PANELS, FINISHES AND EXTERIOR LIGHTING

TS 62. 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.

No requirement for protection against graffiti/vandalism for body material surfaces.

TS 62.2 Roof-Mounted Equipment (Transit Coach)

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. Repair and Replacement

TS 64.1 Side Body Panels (Transit Coach)

Structural elements supporting exterior body panels shall allow side body panels below the windows to be repaired in lengths not greater than 12.5 ft.

Welding, riveting, or adhesive attachment is deemed unacceptable, although adhesive, as a secondary method to control panel resonance will be permitted.

Side panels shall be simple enough in shape to allow fabrication with no more tooling than a shear, brake, and edge roller. Metal panels with compound curves, fluting, curved indentations, etc. will not be permitted.

Easily Replaceable Side Body Panels
Exterior panels below the rub-rail shall be divided into sections that are repairable or replaceable by 3M mechanic in less than thirty (30) minutes for a section up to five feet long (excludes painting).

Exterior side panels above the rub-rail and below the lower daylight opening shall be repairable or replaceable by a 3M mechanic in less than 1-1/2 hours for a section up to five (5) feet long (excludes painting).

TS 64.2 Side Body Panels (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 that they can be cleaned by

automatic bus-washing equipment without being caught by the brushes. The rear license plate provision shall be illuminated per SAE J587.

License plates shall be mounted on the streetside or center of the bus and shall not allow a toehold or handhold for unauthorized riders. Do not supply a tag cover.

TS 66.1 Rub rails

No requirement for rub rails.

TS 67. Fender Skirts

Features to minimize water spray from the bus in wet conditions shall be included in wheel housing design. Any fender skirts shall be easily replaceable. They shall be flexible if they extend beyond the allowable body width. Wheels and tires shall be removable with the fender skirts in place.

TS 68. Wheel Covers (Transit Coach)

Wheel covers not required.

TS 68.1 Splash Aprons

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 wheelchair loading device from road splash. Other splash aprons shall be installed where necessary to protect bus equipment.

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 over-center or gas-filled springs with safety props and shall be easily operable by one person. Springs and hinges shall be corrosion resistant. Latch handles shall be flush with, or recessed behind, the body contour and shall be sized to provide an adequate grip for opening. Access doors, when opened, shall not restrict access for servicing other components or systems. Major access doors shall be equipped with locks requiring a nominal 5/16-inch, square end tool to open. The locks shall be standardized so that only one tool is required to open all major access doors on the bus.

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

Requirement for Latches on Access Doors

Access doors larger than 100 sq in. in area shall be equipped with corrosion-resistant flush-mounted latches or locks except for coolant and fuel fill access doors. All such access doors that require a tool to open shall be standardized throughout the vehicle and will require a nominal 5/16 in. square male tool to open or lock.

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., ±2 in., above the ground. Bumper height shall be such that when one bus is parked behind another, a portion of the bumper faces will contact each other.

TS 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.

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.

The bumper shall have mounting provisions for integrated quick-release bike rack.

TS 70.2.1 Bike Racks

The Contractor shall mount a bicycle rack to the front bumper of the bus. The bike rack shall be installed as per the manufacturer's recommendations and shall not impact the bus approach angle. The bike rack shall be mounted to preclude damage to the windshield in the event of a frontal impact. The Agency would prefer quick release bike rack mount.

Appropriate decals shall be installed at the front of the bus to adequately describing the operation of the bicycle rack. Decals and decal location shall be approved by the Agency during the Pilot Bus review.
The bicycle rack shall be designed to carry two bicycles with fat tires. Each bike can be loaded/unloaded independently of the other.

In the deployed position the bike rack shall latch automatically in position. When not in use the bike rack shall fold upward against the front of the bus and latch securely in place.

The bike rack shall not interfere with the operation of the windshield wipers, access panels, or front lift tow or flat tow adapters. The bike rack shall be easily removable for seasonal and emergency detachment from the bus. Detachment shall not require removal or disassembly of the front bumper or any other bus mounted parts. Approval of the mounting location and installation will be provided by the Agency during the Pre-Production meetings. Bus must be equipped with indicator light visible to the Operator which will be illuminated when the back rack is down.

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. Visible surfaces shall be black, color subject to approval at the pre-production meeting. 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 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 bus manufacturer shall supply test samples of the exterior surface for each step of the painting process that may be subject to adhesion testing per ASTM G4541-87 and ASTM D4145-85. ASTM D4541-93 may be used for inspection testing during assembly of the vehicle.

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.”

Base coat/clear coat paint system.

> **NOTE:** The Agency should insert approved paints, color scheme and graphics.

TS 72. Decals, Numbering and Signing

Unless otherwise specified or approved by the Agency, all interior lettering, numbering, labeling, etc. shall be clearly printed on 0.080-inch anodized aluminum plate by either of the following processes:

a) Silk screen lettering covered with a clear protective finish.

b) Photo–etching and epoxy paint.

The plates shall be mechanically fastened in a manner approved by the Agency. All text shall be Helvetica medium, all caps. Graphics shall be provided as follows:

a) Bus numbers shall be provided in six inch numerals in eight locations as listed below in a sequence to be selected by the Agency. The location is to be approved by the Agency. The numbers shall be white on black or black on white or non-black.

- Right front approximately four (4) inches below the windshield.
- Right side above entry door.
- Left side above the driver's window.
- In the center (left to right) of the rear of the bus, five (5) feet above the pavement. Locations to be approved by the Agency.
- Centered (L to R) on the panel above the windshield on the inside of the bus.
- Left and right rear corners of the bus, centered in the white paint area below the belt line, approximately three (3) feet from the rear of the bus.
- Inside surface of engine door when open. Print so numbers will be right side up when door is open.
- On outside of engine belt guard

b) Bus numbers shall also be painted on the roof in the maximum size possible. The Agency prefers that the numbers be thirty (30) inches high. The number shall be vertical starting at the front of the bus.

c) A logo type design shall be applied to the bus exterior in areas to be selected by the Agency. Logo design shall be furnished by the Agency.

d) The bidder will not affix to the exterior or interior of the bus any logos or identification without the prior written permission of the Agency.

e) Additional Agency-approved graphics shall be provided for passenger and safety information.

f) At least one sign shall be provided on each side of the bus interior to indicate that seats at the front are priority seats for elderly and persons with disabilities.

g) The following decals shall be supplied, as a minimum:

MESSAGE	**LOCATION**	**COLOR***
"No Smoking, Eating or Drinking or Radios", using universal symbols	Interior above windshield and rear bulkhead	Mfg. Std.
(Operating Instructions), Starting, etc.	Interior above windshield	Mfg. Std.
Caution Label, English and Spanish	Entrance door posts	White 2"
Fire Extinguisher	Front Safety Compartment	White Mfg. Std.
"Watch your step", English and Spanish	Front & Rear stepwell	Red 2" Reflective
(Operating Instructions), English and Spanish	Above exit door	Black Mfg. Std.
(Operating Instructions), English and Spanish	At emergency escapes	Mfg. Std.
"For passenger safety, Federal law prohibits operation of this bus while anyone is standing forward of the white line", English and Spanish	Interior above windshield	Mfg. Std.
"As a courtesy, please allow handicapped and elderly passengers to use these seats", English and Spanish	Above front longitudinal seats	Mfg. Std
“Wheelchair Seating Area. Securements are located below these seats.”, English and Spanish with wheelchair logo	Wheelchair seating areas	Mfg. Std.

“Wheelchair Riders have priority in this area.”, English and Spanish with wheelchair logo	Wheelchair seating areas	Mfg. Std.
"Exit Door", English and Spanish	Above exit door	Red Mfg. Std.
"Front Door Air Valve"	Side console on valve	Mfg. Std.
"Ultra-Low Sulfur Diesel Fuel Only"	Inside fuel filler door	Mfg. Std.
“Windshield Washer Bottle Fill”	As appropriate	Mfg. Std.
Welding Caution	As appropriate	Mfg. Std.
“Shop Air Fill”	As appropriate	Mfg. Std.
Radiator Fill Procedure	As appropriate	Mfg. Std.
"Oil"	Inside oil filler door	Mfg. Std.
"Caution 'Water' Hot"	Inside surge tank filler door	Mfg. Std.
"Caution – Negative Ground”	Inside battery compartment door	Mfg. Std
“Battery Disconnect”	Outside battery compartment door	Mfg. Std
“Battery Switch, On/Off”	Inside battery compartment door	Mfg. Std
“Authorized Personnel Only”	Electronic Locker	Mfg. Std
Fan Caution	Inside engine compartment	Mfg. Std.
"Exit through back door"	Interior above windshield	Mfg. Std
"Wait for light", English and Spanish	Interior above rear door to right	Black Mfg. Std
"Push door to open"	2 locations-Interior on top panel of each door	Black Mfg. Std
Bus Numbers	8 locations: See Painting and Decals section on previous page	Black on White, or White on Black

TS 72.1 Passenger Information

ADA priority seating signs as required and defined by 49 CFR shall be provided to identify the seats designated for passengers with disabilities.

Requirements for a public information system in accordance with 49 CFR 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.

Commercially available LED-type lamps shall be used at all exterior lamp locations.

Potted Lamps

LED lamps shall be potted type and designed to last the life of the bus.

Larger Size

LED lamps used for tail, brake and turn signal lamps shall be a minimum of sq 7 in.

Front marker (clearance) lights along with lights located on the roof and sides of the bus shall have protective shields or be of the flush mount type to protect the lens against minor impacts.

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 footcandle (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

Standard Turn Signals

Turn-signal lights 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. A dimmer switch shall be mounted on the floor between and above the turn signal switches. The instrument panel shall have a high beam indicator lamp.

Standard Installation

Standard OEM headlamp installation shall be provided in accordance with federal regulations.

Daytime Running Lights

Headlamps shall incorporate a daytime running light feature.

LED

Headlamps shall be LED/halogen, sealed beam.

TS 73.5 Brake Lamps

TS 73.5.1 Transit Coach

Brake lamps shall be provided in accordance with federal regulations.

No High/Center Mount Brake Lamp

Bus shall not include a high/center mount brake lamp. A red LED "STOP" lamp shall be mounted at the lower back panel. Four, (4), seven (7) -inch round, Brake LED lights shall be mounted at the rear of bus. Two (2) of the four (4) brake lights shall be mounted on the rear center of the bus, the remaining two (2) lights shall be mounted near the reverse and turn signal lights in the middle position. Mounting position shall be approved by the Agency. Brake lamp(s) shall illuminate steadily with brake application.

TS 73.5.2 Commuter Coach

Brake lamps shall be provided in accordance with federal regulations.

Bus shall include red, high and center mount 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 License Plate Light

The license plate light shall be LED and located in the right lower quadrant of the engine door.

TS 73.7 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 and shall be automatically discontinued (timed out) after 30 minutes to prevent damage caused by inadvertently leaving the service area lighting switch in the “on” position after repairs are made.

INTERIOR PANELS AND FINISHES

TS 74. 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.

The walls shall have a graffiti resistance rating of one (1) as per Section 21 of the APTA Transit Security Guidelines Manual or by other appropriate materials as approved by the Agency. The ceiling shall have a rating of two (2) or better. All other interior surfaces shall have a low-glare finish with a glossometer reading between four (4) and fourteen (14), per ASTM D 523, machine direction, using a sixty (60) degree glossometer. Side and rear end time panels shall be one-eighth (1/8) inch thick, minimum.

Internal surfaces, as possible, to be stainless steel or other resistant material.

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.

Interior panel required to meet FMVSS 302.

Fire Resistance

Materials shall comply with the Recommended Fire Safety Practices defined in FTA Docket 90-A, dated Oct. 20,1993.

Interior side trim panels and driver's barrier shall be melamine, 0.12 inch thick minimum thickness, or other approved composite plastic trim panel material. It shall permit easy removal of paint, greasy fingerprints, and ink from felt tip pens.

Interior mullion trim, moldings, and trim strips shall be stainless steel, or anodized aluminum. Individual trim panels and parts shall be interchangeable to the extent practical.

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 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.

Full-Height (Floor-to-Ceiling) Configuration of Driver’s Barrier

The driver’s barrier shall extend continuously 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 75.1.2 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 and 1½ in. above the floor. Panels forward of longitudinal seats shall extend to below the level of the seat cushion. Dividers positioned at the doorways, where applicable, shall provide no less than a 2½ in. clearance between the modesty panel and a fully open, inward opening door, or the path of a deploying flip-out ramp to protect passengers from being pinched. Modesty panels installed at doorways shall be equipped with grab rails if 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.

Modesty panels shall be installed as stated.

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 rear interior surfaces shall be 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 liter 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.

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 where required shall be tamper-resistant.

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.

FMVSS 302

Insulation shall meet the requirements of FMVSS 302.

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. 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.

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.

The floor under the seats shall be covered with smooth surface flooring material. The floor covering shall closely fit the sidewall in a fully sealed butt joint or extend to the top of the cove.

TS 75.9 Interior Lighting

The light source shall be located to minimize windshield glare, with distribution of the light focused primarily on the passengers' reading plane while casting sufficient light onto the advertising display. The lighting system may be designed to form part of or the entire air distribution duct.

The lens material shall be translucent polycarbonate. Lenses shall be designed to effectively "mask" the light source. Lenses shall be sealed to inhibit incursion of dust and insects yet be easily removable for service. Access panels shall be provided to allow servicing of components located behind light panels. If necessary, the entire light fixture shall be hinged.

TS 75.10 Passenger Area Lighting

First Row Lights

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.

All interior lighting shall be turned off whenever the vehicle is in reverse and the engine run switch is in the "on" position.

The interior lighting design shall require the approval of the Agency.

All interior and overhead lighting shall be LEDs.
Lamp fixtures and lenses shall be fire-resistant and compliant to NFPA130 requirement for lighting fixtures and shall not drip flaming material onto seats or interior trim if burned. Advertising media located in this area shall be illuminated by direct lighting. No advertisement frames shall be illuminated from behind the media.

A doorway and rear step lighting system shall be illuminated when the master switch is in RUN and NIGHT RUN positions, except the front doorway which shall be extinguished when the front door is closed. Illumination shall be provided by LED strip lighting at both locations. The system shall provide no less than two (2) foot-candles of illumination on the steps and in the entry and exit areas or on the ramp when deployed. These lights shall be shielded to protect passengers' eyes from glare. Light fixtures shall be totally enclosed, water tight, and manufactured from a non-corrosive material designed to provide ease of cleaning as well as lamp and housing removal, and shall not be easily removable by passengers. Doorway and step lights shall be protected from damage caused by passengers kicking lenses or fixtures and shall not be a hazard to passengers.

Street Side Light Modules Dim/Extinguish When Front Door is Closed
When the master switch is in the "run" or "night/run" mode, All street side lights of the coach shall automatically extinguish or dim when the front door is in the closed position and illuminate when the door is opened.

TS 75.11 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 5 to 10 fc.

TS 75.12 Seating Area Lighting (Transit Coach)

The interior lighting system shall provide a minimum 15 fc illumination on a 1 sq ft 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 75.13 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 wheelchair 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 cu ft (3 m^3) 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 wheelchair lift door. Separate and independent notification will be provided on the dashboard indicator panel for stop request notification from securement positions.

TS 75.14 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 minimum 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 75.15 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 75.16 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 75.17 Ramp Lighting (Transit Coach)

Exterior and interior ramp lighting shall comply with federal regulations.

TS 75.18 Turntable Lighting (Articulated Coach)

Lighting in the turntable can be reduced to 7 fc.

TS 75.19 Farebox/Card Reader Lighting

TS 75.19.1 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.

TS 75.19.2 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 76. Fare Collection

Space and structural provisions shall be made for installation of currently available fare collection devices, which shall be as far forward as practicable. Location of the fare collection device shall not restrict traffic in the vestibule, including wheelchairs if a front door loading device is used, and shall allow the driver to easily reach the 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.

Contractor shall provide fare collection installation layout to the Agency for approval.

Transfer mounting, cutting and punching equipment shall be located in a position convenient to the driver.

Agency will specify a farebox/card reader for Contractor to install.

TS 77. Interior Access Panels and Doors (Transit Coach)

Access for maintenance and replacement of equipment shall be provided by panels and doors that appear to be an integral part of the interior. Access doors shall be hinged with gas props or over center springs, where practical, to hold the doors out of the mechanic’s way. Panels shall prevent entry of mechanism lubricant into the bus interior. All fasteners that retain access panels shall be captive in the cover.

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 77.1 Floor Panels

Access openings in the floor shall be sealed to prevent entry of fumes and water into the bus interior. Flooring material at or around access openings shall be flush with the floor and shall be edge-bound with stainless steel or another material that is acceptable to the Agency to prevent the edges from coming loose. Access openings

shall be asymmetrical so that reinstalled flooring shall be properly aligned. Fasteners shall tighten flush with the floor.

The number of special fastener tools required for panel and access door fasteners shall be minimized.

PASSENGER ACCOMMODATIONS

TS 78. Passenger Seating

TS 78.1 Arrangements and Seat Style (Transit Coach)

The passenger seating arrangement in the bus shall be such that seating capacity is maximized and in compliance to the following requirements.

> **NOTE:** The Agency recognizes that ramp location, foot room, hip-to-knee room, doorway type, width, seat construction, floor level type, seat spacing requirements, ramp or lift, number of wheelchair positions, etc. ultimately affect seating capacity and layout.

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 wheelchair securement areas and platforms (such as for fuel tank storage space).

TS 78.2 Rearward Facing Seats (Transit Coach)

Rearward facing seats not allowed.

TS 78.3 Padded Inserts/Cushioned Seats (Transit Coach)

Non-Padded Inserts, Upholstered

The seats shall be equipped with upholstered vandal-resistant inserts throughout the bus.

TS 78.4 Seat Back Configuration

Non-Padded Inserts, Upholstered

The seats shall be equipped with upholstered vandal-resistant inserts throughout the bus.

All seats will be equipped with USB charging ports, the location will be approved by the Agency at Pre-Production meeting.

TS 78.5 Drain Hole in Seats

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 78.6 Arrangements and Seat Style (Commuter Coach)

Forward-Facing Seat Configuration

Passenger seats shall be arranged in forward-facing configuration with a minimum of 55 reclining and cushioned passenger seats. Contractor to provide seat layout to the Agency once the Agency has provided the seat manufacturer and model number.

TS 78.7 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 27 in.

TS 78.8 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 78.9 Aisles (Transit Coach)

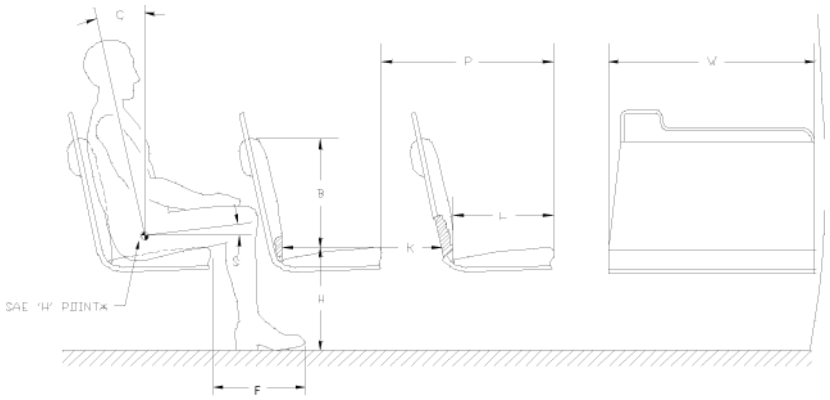
The aisle between the seats shall be no less than 22 in. wide at seated passenger hip height. Seat backs shall be shaped to increase this dimension to no less than 24 in. at 32 in. above the floor (standing passenger hip height).

TS 78.10 Aisles (Commuter Coach)

The aisle between the seats shall be no less than 14 in. wide at seated passenger hip height.

TS 78.11 Dimensions (Transit Coach)

FIGURE 6
Seating Dimensions and Standard Configuration



Seat dimensions for the various seating arrangements shall have the dimensions as follows (refer to **Figure 6**):

- 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 up to 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.
- 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.
- The pitch, P, is shown as reference only.

TS 78.12 Structure and Design (Transit Coach)

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.

All transverse objects—including seat backs, modesty panels and longitudinal seats—in front of forward-facing seats shall not impart a compressive load in excess of 1000 lb. onto the femur of passengers ranging in size from a 5th-percentile female to a 95th-percentile male during a 10g deceleration of the bus. This deceleration shall peak at 0.05 to 0.015 seconds from initiation. Permanent deformation of the seat resulting from two 95th-percentile males striking the seat back during this 10g deceleration shall not exceed 2 in., measured at the aisle side of the seat frame at height H. The seat back should not deflect more than 14 in., measured at the top of the seat back, in a controlled manner to minimize passenger injury. Structural failure of any part of the seat or sidewall shall not introduce a laceration hazard.

The seat assembly shall withstand static vertical forces of 500 lb. applied to the top of the seat cushion in each seating position with less than ¼ in. permanent deformation in the seat or its mountings. The seat assembly shall withstand static horizontal forces of 500 lb. evenly distributed along the top of the seat back with less than ¼ in. permanent deformation in the seat or its mountings. The seat backs at the aisle position and at the window position shall withstand repeated impacts of two 40 lb. sandbags without visible deterioration. One sandbag shall strike the front 40,000 times and the other sandbag shall strike the rear 40,000 times. Each sandbag shall be suspended on a 36 in. pendulum and shall strike the seat back 10,000 times each from distances of 6, 8, 10 and 12 in. Seats at both seating positions shall withstand 4000 vertical drops of a 40 lb. sandbag without visible deterioration. The sandbag shall be dropped 1000 times each from heights of 6, 8, 10 and 12 in. Seat cushions shall withstand 100,000 randomly positioned 3½ in. drops of a squirming, 150 lb.,

smooth-surfaced, buttocks-shaped striker with only minimal wear on the seat covering and no failures to seat structure or cushion suspension components.

The back of each transverse seat shall incorporate a handhold no less than ⅞ in. in diameter for standees and seat access/egress. The handhold shall not be a safety hazard during severe decelerations. The handhold shall extend above the seat back near the aisle so that standees shall have a convenient vertical assist, no less than 4 in. long, that may be grasped with the full hand. This handhold shall not cause a standee using this assist to interfere with a seated 50th-percentile male passenger. The handhold shall also be usable by a 5th-percentile female, as well as by larger passengers, to assist with seat access/egress for either transverse seating position. The upper rear portion of the seat back and the seat back handhold immediately forward of transverse seats shall be padded and/or constructed of energy-absorbing materials. During a 10g deceleration of the bus, the HIC number (as defined by SAE J211a) shall not exceed 400 for passengers ranging in size from a 5th percentile female through a 95th percentile male.

The seat back handhold may be deleted from seats that do not have another transverse seat directly behind and where a vertical assist is provided.

Longitudinal seats shall be the same general design as transverse seats but without seat back handholds. Longitudinal seats may be mounted on the wheelhouses. Armrests shall be included on the ends of each set of longitudinal seats except on the forward end of a seat set that is immediately to the rear of a transverse seat, the driver's barrier or a modesty panel, when these fixtures perform the function of restraining passengers from sliding forward off the seat. Armrests are not required on longitudinal seats located in the wheelchair parking area that fold up when the armrest on the adjacent fixed longitudinal seat is within 3½ in. of the end of the seat cushion. Armrests shall be located from 7 to 9 in. above the seat cushion surface. The area between the armrest and the seat cushion shall be closed by a barrier or panel. The top and sides of the armrests shall have a minimum width of 1 in. and shall be free from sharp protrusions that form a safety hazard.

Seat back handhold and armrests shall withstand static horizontal and vertical forces of 250 lb. applied anywhere along their length with less than ¼ in. permanent deformation. Seat back handhold and armrests shall withstand 25,000 impacts in each direction of a horizontal force of 125 lb. with less than ¼ in. permanent deformation and without visible deterioration.

TS 78.13 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 wheelchair 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 40.50 in. (1029 mm). Aisle shall not be less than 14 in. (356 mm) wide.

TS 78.14 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 78.15 Construction and Materials (Commuter Coach)

Seat cushions shall be supported by steel serpentine 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.

Seat foam padding shall be polyurethane. Seat upholstery shall be able to be removed with ease for cleaning/replacement purposes.

Agency to select seat fabric.

TS 79. 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. 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 a stainless steel finish.

The forward-most vertical stanchions on either side of the aisle immediately behind the driver’s area shall be a stainless steel finish.

TS 79.1 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 NHTSA Drawstring Test.

Any joints in the assist structure shall be underneath supporting brackets and securely clamped to prevent passengers from moving or twisting the assists. Seat handholds may be of the same construction and finish as

the seat frame. Door-mounted passenger assists shall be of anodized aluminum, stainless steel or powder-coated metal. Connecting tees and angles may be powder-coated metal castings. Assists shall withstand a force of 300 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 79.2 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 79.3 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 79.4 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.

> **NOTE:** For an articulated bus, passenger assists will be provided to aid in the transition between the front and rear sections of the bus.

TS 79.5 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.

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 to 70 in.

Grab straps shall be fabric.

Overhead assists shall simultaneously support 150 lb. on any 12 in. length. No more than 5 percent of the full grip feature shall be lost due to assist supports.

TS 79.6 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 wheelchair securement. Assists shall extend from near the leading edge of the seat and shall be functionally continuous with the overhead assist. Assists shall be staggered across the aisle from each other where practicable and shall be no more than 52 in. apart or functionally continuous for a 5th percentile female passenger.

TS 79.7 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 80. Passenger Doors

TS 80.1 Transit Coach

Doorways will be provided in locations and styles as follows. Passenger doors and doorways shall comply with ADA requirements.

TS 80.1.1 Front door

Door shall be forward of the front wheels and under direct observation of the driver.

TS 80.1.2 Rear Door(s)

Curbside doorway centerline located rearward of the point midway between the front door centerline and the rearmost seat back.

Provisions shall be made for operating the front door and rear door(s) independently or in the combinations shown in **Table 7** while providing positive tactile feedback to the operator identifying the door control selection.

Front	Curbside Rear
Closed	Closed
Open	Closed
Open	Open
Closed	Open

If air-powered, the door system shall operate per specification at air pressures between 90 and 130 psi.

TS 80.2 Commuter Coach

TS 80.2.1 Front door

Forward of the front wheels and under direct observation of the driver.

TS 80.3 Materials and Construction

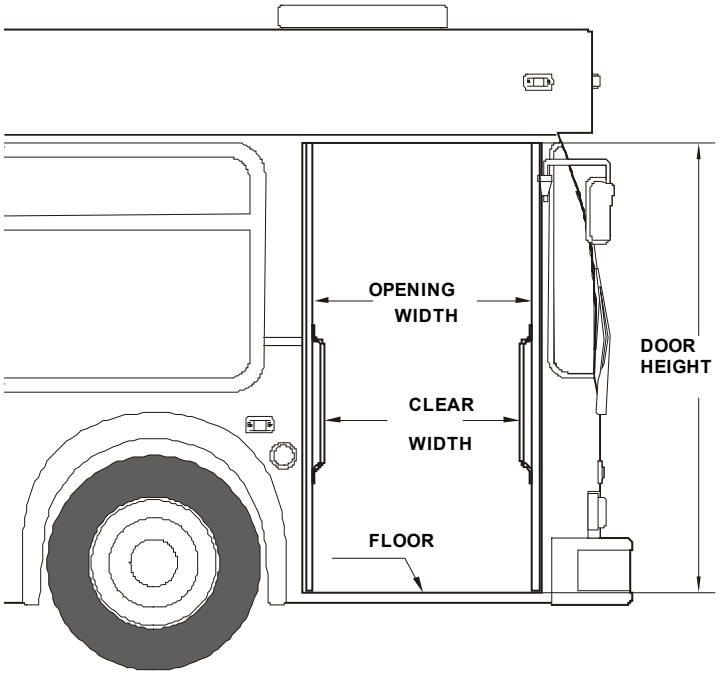
Structure of the doors, their attachments, inside and outside trim panels and any mechanism exposed to the elements shall be corrosion resistant. Door panel construction shall be of corrosion-resistant metal or reinforced non-metallic composite materials. When fully opened, the doors shall provide a firm support and shall not be damaged if used as an assist by passengers during ingress or egress. Door edges shall be sealed to prevent infiltration of exterior moisture, noise, dirt and air elements from entering the passenger compartment, to the maximum extent possible based on door types.

The closing edge of each door panel shall have no less than 2 in. of soft weather stripping. The doors, when closed, shall be effectively sealed, and the hard surfaces of the doors shall be at least 4 in. apart (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 80.4 Dimensions

TS 80.4.1 Transit Coach

FIGURE 7
Transit Bus Minimum Door Opening



When open, the doors shall leave an opening no less than 75 in. in height.

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 arear door ramp or lift is provided, then the clear door opening width shall be a minimum of 31¾ in. with door fully opened.

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 80.4.2 Commuter Coach

Minimum doorway width per ADA requirements.

TS 80.5 Door Glazing

The upper section of both front and rear doors shall be glazed for no less than 45 percent of the respective door opening area of each section. The lower section of the front door shall be glazed for no less than 25 percent of the door opening area of the section.

Door glazing shall be easily replaceable.

Zip type glazing rubber.

The front door panel glazing material shall have a nominal ¼ in. thick laminated safety glass conforming with the requirements of ANSI Z26.1 Test Grouping 2 and the recommended practices defined in SAE J673.

Glazing material in the rear doorway door panels shall be defined by the Agency.

TS 80.6 Door Projection (Transit Coach)

TS 80.6.1 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 80.6.2 Interior

Projection inside the bus shall not cause an obstruction of the rear door mirror or cause a hazard for standees.

TS 80.7 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 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 80.8 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.

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 80.8.1 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 sq in. of that obstruction. 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.

TS 80.9 Actuators

Doors shall open or close completely in not more than 3.5 seconds from the time of control actuation and shall be subject to the closing force requirements.

Door actuators shall be adjustable so that the door opening and closing speeds can be independently adjustable to satisfy the above requirements. Actuators and the complex door mechanism shall be concealed from passengers but shall be easily accessible for servicing. The door actuators shall be rebuildable. 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.

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, as described in the Default.

Doors that employ a “swing” or pantograph geometry and/or are closed by a return spring or counterweight-type device shall be equipped with a positive mechanical holding device that automatically engages and prevents the actuation mechanism from being back-driven from the fully closed position. The holding device shall be overcome only when the driver’s door control is moved to an “Exit Door Enable” position and the vehicle is moving at a speed of less than 2 mph, or in the event of actuation of the emergency door release.

Locked doors shall require a force of more than 300 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 80.9.1 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 80.10 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 80.11 Door Control

The door control shall be located in the operator's area 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.

Door control located on street side as specified by Agency.

The front door shall close if power is removed or lost when air is applied.

TS 80.12 Door Controller

TS 80.12.1 Transit Coach

Five-Position Driver's Door Controller

The control device shall be protected from moisture. Mounting and location of the door control device handle shall be designed so that it is within comfortable, easy arm's reach of the seated driver. The door control device handle shall be free from interference by other equipment and have adequate clearance so as not to create a pinching hazard.

Position of the door control handle shall result in the following operation of the front and rear doors:

- **Center position:** Front door closed, rear door(s) closed or set to lock.
- **First position forward:** Front door open, rear door(s) closed or set to lock.
- **Second position forward:** Front door open, rear door(s) open or set to open.
- **First position back:** Front door closed, rear door(s) open or set to open.
- **Second position back:** Front door open, rear door(s) open or set to open.

TS 80.12.2 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 80.13 Door Open/Close

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.

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.

TS 81. Accessibility Provisions

Space and body structural provisions shall be provided at the front or rear door of the bus to accommodate a wheelchair loading system.

TS 81.1 Loading Systems

- low-floor ramp

TS 81.2 Lift/ramp

The wheelchair lift control system must be capable of receiving multiplex commands from vehicle interlocks.

An automatically controlled, power-operated wheelchair lift system compliant to requirements defined in 49 CFR 571.403 (FMVSS 403) shall provide ingress and egress quickly, safely and comfortably, both in forward and rearward directions, for a passenger in a wheelchair from a level street or curb.

Wheelchair lift or ramp mounted in front step well.

Heavy-Duty Ramp System

Power units must meet other spec requirements (electric).

TS 81.3 Loading System for 30 to 60 ft Low-Floor Bus

An automatically controlled, power-operated ramp system compliant to requirements defined in 49 CFR Part 38, Subpart B, §38.23c shall provide ingress and egress quickly, safely and comfortably, both in forward and rearward directions, for a passenger in a wheelchair from a level street or curb.

Front Door Location of Loading System, Flip-Out Design Ramp with 6:1 Slope

The wheelchair loading system shall be located at the front door, with the ramp being of a simple hinged, flip-out type design being capable of deploying to the ground at a maximum 6:1 slope.

TS 81.4 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.

Front Door Location of Bridge Plate Loading System

The bridge plate loading system shall be located at the front door.

TS 81.5 Wheelchair Accommodations

All passenger securement devices must be stowed off the floor and out of the way when not in use.

Two Forward-Facing Wheelchair Securement Locations

Two forward-facing locations, as close to the wheelchair loading system as practical, shall provide parking space and securement system compliant with ADA requirements for a passenger in a wheelchair.

Commuter and Transit Coach

One (1) Q-pod forward-facing location, as close to the wheelchair loading system as practical on street side, shall provide parking space and securement system compliant with ADA requirements for a passenger in a wheelchair. One (1) Gen II Quantum or approved equal, rear facing wheelchair securement system on curb side with modesty panel with TFT Monitor in front of closest forward-facing seat. Other options to be approved by agency.

TS 81.6 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 wheelchair from the loading device and from the designated securement area. It shall be designed so that no portion of the wheelchair protrudes into the aisle of the bus when parked in the designated parking space(s). When the positions are fully utilized, an aisle space of no less than 22 in. shall be maintained. As a guide, no width dimension should be less than 34 in. Areas requiring 90 deg turns of wheelchairs 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 wheelchair footrests.

TS 82. Wheelchair Lifts (Commuter Coach)

TS 82.1 Lift

A travel lift and two forward-facing 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 number 2 right-hand luggage bay on the curbside of the coach.

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 number 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 park 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 wheelchair 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 device to provide “passenger on platform” information and to prevent stowing the lift platform when a passenger is sensed. 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 wheelchair 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, and the stow/deploy switch shall be black in color. 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 incorporate a visual aid to ensure that they are folded in the proper order.

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 controller 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 number 1 right-hand luggage bay door. The handle shall be stored adjacent to the pump to allow immediate usage.

TS 82.2 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 82.3 Lift Width

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 wheelchair 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 wheelchair 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 wheelchair 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 82.4 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 wheelchair 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 82.5 Securement System

The vehicle interior shall permit the securement of two wheelchair passengers in which the primary position shall be on the street side of the coach directly across from the lift. The street side securement system shall be forward facing, with the curb side securement system being rear facing. Securement areas shall be a minimum 30 × 48 in. as required by the ADA.

A separate three-point belt securement shall be provided to effectively secure wheelchair 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 82.6 Roof Ventilation/Escape Hatches

Two roof ventilators shall be provided and designed to perform as escape hatches. One ventilator/escape hatch shall be located in the roof at the front of the coach, another in the roof at the rear of the coach.

A single rooftop escape hatch.

SIGNAGE AND COMMUNICATION

TS 83. Destination Signs

An electronic all LED destination sign system shall be furnished on the front, on the right side near the front door. The electronic destination information system shall be ADA compliant. The LEDs on all signs shall be Silver / White in color.

Route sign on the rear of the vehicle.

All signs shall be controlled via a single human-machine interface (HMI). In the absence of a single mobile data terminal (MDT), the HMI shall be conveniently located for the bus driver within reach of the seated driver.

The driver shall be able to access the sign while seated.
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.

Run number sign shall be installed.

TS 84. Passenger Information and Advertising (Transit Coach)

TS 84.1 Interior Displays

Provisions shall be made on the rear of the driver's barrier or equipment box located on the wheel well for a TFT Monitor to be installed for advertising and 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 84.2 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, vehicle fittings or in any other manner restrict the operation or serviceability of the bus.

TS 85. Passenger Stop Request/Exit Signal

TS 85.1 Transit Coach

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 wheelchair passenger position and at priority seating positions, additional provisions shall be included to allow a passenger in a mobility aid to easily activate the "stop requested" signal.

No requirements for additional "stop request" button on rear door stanchion.

TS 85.2 Commuter Coach

A heavy-duty "stop request" signal button shall be installed at every seat location except the rear cross seat.

TS 85.3 Signal Chime

A single "stop requested" chime shall sound when the system is first activated. A double chime shall sound anytime the system is activated from wheelchair passenger areas.

Exit signals located in the wheelchair passenger area shall be no higher than 4 ft above the floor. Instructions shall be provided to clearly indicate function and operation of these signals.

TS 86.4 Chime Request / Next Stop Monitor

Middle of the bus dual facing monitor for next stop

TS 86. Communications

TS 86.1 Camera Surveillance System

The Contractor shall provide and install a Video surveillance system, as well as sufficient shelf space in the contractor provided lockable enclosure (equipment cabinet) for the on-board security camera equipment outlined in this section. The Contractor will be installing the surveillance equipment (i.e., DVRs, Cameras, Microphones, etc.)

VIDEO SURVEILLANCE SYSTEM:
Vehicles shall include an On-board Digital Video Surveillance System capable of supporting up to thirty-two (32) IP cameras with additional external POE switches. The system must be fully compatible with CATS existing Transit Solutions (TSI) Nexview software suite. This system shall include a Transit Solutions (TSI) Nexus - NVR (Network Video Recorder) or approved equal. The onboard video surveillance system shall also include all necessary components for total system functionality comprised of the following components (Note: All equipment locations specified below are approximate. Final locations shall be reviewed and approved by CATS at or before the pre-production meeting.):

Vehicle Equipment (Quantity Per Vehicle):

- One (1) TSI NEXUS-NVR (Network Video Recorder), or approved equal, capable of supporting up to (32) IP cameras with additional external POE switches.

- One (1) Solid State Drive (SSD) with a minimum of 4TB capacity.
- One (1) 8 port POE switch with 2 high-speed uplink ports
- Eight (8) IP Cameras in the following locations:
    - One (1) interior color IP camera to be mounted inside the bus facing forward through the front windshield to capture the road view. Camera shall support a resolution of 1080p or better. Camera shall include integrated audio.
    - One (1) exterior color IP camera viewing the Curb Side Exterior of the bus. Camera shall support a resolution of 1080p or better and be a minimum IP67 rated.
    - One (1) exterior color IP camera viewing the Street Side Exterior of the bus. Camera shall support a resolution of 1080p or better and be a minimum IP67 rated.
    - One (1) exterior color IP camera viewing the rear of the bus. Camera shall support a resolution of 1080p or better and be a minimum IP67 rated.
    - One (1) interior color IP camera for viewing the Front Passenger Entry Door. Camera shall support a resolution of 1080p or better. Camera shall include integrated audio.
    - One (1) interior color IP camera for viewing the Front Passenger Seating Area. Camera shall support a resolution of 1080p or better. Camera shall include integrated audio.
    - One (1) interior color IP camera for viewing the Rear Passenger Entry Door. Camera shall support a resolution of 1080p or better. Camera shall include integrated audio.
    - One (1) interior color IP camera for viewing the Rear Passenger Seating Area. Camera shall support a resolution of 1080p or better. Camera shall include integrated audio.
- Option to add two (2) 360-degree internal IP cameras with audio.
- Option to add one (1) Passenger awareness monitor integrated with NEXUS-NVR.
- Integration with Sierra Wireless On-board Router for cellular, wireless, and GPS communications.
- Discrete signal interface for the following:
    - Left Turn Signal (operational)
    - Right Turn Signal (operational)
    - Brake Operation

The bus digital video security recording system shall not interfere electrically with the operation of the transit bus or with its onboard electronic equipment such as the radio, farebox, engine controls, transmission or other electronic equipment. Furthermore, the unit shall be FCC tested and approved. The digital video recorder shall be installed in a lockable cabinet or enclosure.

The system shall be installed according to industry standards meeting Society of Automotive Engineers recommended practices. All cables, wiring, interconnections, switches, and circuit breakers/fuses shall be heavy-duty and specifically designed for their purposes and automotive application. The selected wire sizes and insulation shall be based on the current carrying capability voltage drop, mechanical strength temperature and flexibility requirements. Video and audio wires selected shall be gauged to minimize signal loss.

IP Camera Specifications:

The Exterior IP cameras on this installation shall have a minimum rating of IP67. The cameras shall automatically switch from color to black & white recording in low light conditions via integrated IR LED's. The enclosures shall be vandal resistant, secure, lockable, shock-resistant, dust resistant and weather and water-resistant and shall be made of impact-resistant non-toxic material.

All Interior IP cameras shall have a built-in microphone, and the ability to automatically switch from color to black &white recording in low light conditions via integrated IR LED's.

Network Video Recorder (NVR) Specifications:

The NVR shall be equipped with a built in 3-axis G-force sensor.
The NVR shall be capable of being mounted in any orientation without detriment to its operation.
The NVR shall have two (2) Ethernet ports to allow external programming and system diagnostics. Built-in software shall perform full and continuous system diagnostics and is capable of reporting failures.
The NVR shall require no operator interface other than the Master Switch operation to effectuate operation, initiate shutdown, maintain the system, service or program the system, or prepare the system for operation.
The NVR operating system software shall be of an embedded type contained within a firmware chip. The operating system shall be written specifically for HVR operation and allow for the largest available drives to be used. Consumer-based operating systems residing on internal hard drives are not acceptable because they are subject to frequent failure.
The NVR shall have the ability to record up to thirty-two (32) IP cameras via optional TSI network switches.
The NVR shall be capable of recording up to (32) channels of digitized audio via external IP cameras with integrated microphones.

In addition to accurate time and date, the NVR shall append with image data the following five (5) signal and alarm programmable analog vehicle parameters and the buses in this procurement shall be equipped and delivered recording these vehicle parameters:

- vehicle speed
- left signal (directional)
- right signal (directional)
- brake operation
- event switch

The NVR shall have the ability to dynamically change video and audio settings during operation. Frame rates range up to 30 fps per camera. The HVR shall be capable of recording multiple differing frame rates and differing levels of image quality per camera at the same time.

The NVR shall maintain a log file of its actions, which are stored on the removable hard drive. This information includes the time and date of the action and includes: ignition on/off, events start and stop, camera failure, drive errors, and other diagnostics.
The NVR shall comply with all the requirements of the "Buy America Act" (49 CFR Part 661), at the component level.
The NVR shall have the capability to interface with diagnostic software operated from either a workstation or portable computer for system troubleshooting and configuration purposes.
The NVR shall interface with a Panic/Event Button that will be hardwired to CATS preferred CAD/AVL supplier's emergency alarm button. When a system input such as an emergency alarm button is activated the video recording unit shall tag the event. When retrieved, the tagged event shall be easily identifiable.

Hybrid Video Recorder (HVR) Specifications:

The HVR shall be capable of being mounted in any orientation without detriment to its operation.
The HVR shall have two (2) Ethernet ports to allow external programming and system diagnostics. Built-in software shall perform full and continuous system diagnostics and is capable of reporting failures.
The HVR shall require no operator interface other than the Master Switch operation to effectuate operation, initiate shutdown, maintain the system, service or program the system, or prepare the system for operation.
The HVR operating system software shall be of an embedded type contained within a firmware chip. The operating system shall be written specifically for HVR operation and allow for the largest available drives to be used. Consumer-based operating systems residing on internal hard drives are not acceptable because they are subject to frequent failure.
The HVR shall have the ability to record twelve (12) analog channels and up to thirty-two (32) IP cameras via optional TSI network switches.
The HVR shall be capable of recording up to (32) channels of digitized audio via external IP cameras with integrated microphones.

In addition to accurate time and date, the HVR shall append with image data the following five (5) signal and alarm programmable analog vehicle parameters and the buses in this procurement shall be equipped and delivered recording these vehicle parameters:

- vehicle speed
- left signal (directional)
- right signal (directional)
- brake operation
- event switch

The HVR shall have the ability to dynamically change video and audio settings during operation. Frame rates range up to 30 fps per camera. The HVR shall be capable of recording multiple differing frame rates and differing levels of image quality per camera at the same time.

The HVR shall maintain a log file of its actions, which are stored on the removable hard drive. This information includes the time and date of the action and includes: ignition on/off, events start and stop, camera failure, drive errors, and other diagnostics.
The HVR shall comply with all the requirements of the "Buy America Act" (49 CFR Part 661), at the component level.
The HVR shall have the capability to interface with diagnostic software operated from either a workstation or portable computer for system troubleshooting and configuration purposes.
The HVR shall interface with a Panic/Event Button that will be hardwired to CATS preferred CAD/AVL supplier's emergency alarm button. When a system input such as an emergency alarm button is activated the video recording unit shall tag the event. When retrieved, the tagged event shall be easily identifiable.

Solid State Drive (SSD) Specifications:
The removable Solid State Drive shall be secured in place by a key lock mounted on the NVR. Total storage capacity shall be at least 4 TB (terabytes).

Duration of recording on the solid-state drive (SSD) is determined by video capture quality, drive size, and aggregate frame rate. The RDD shall support a minimum of 3-weeks of recording with eight cameras.

Cable Harness Specifications:

The Contractor shall provide and install a cable harness for the Agency's camera surveillance system. All cable for the Security Camera System shall be installed in appropriately sized conduit and in accordance with the specifications outlined in this section.

The Contractor shall provide and install an on-board security camera system cable harness that meets the following specifications:

- 16 AWG – 3 Conductor power cable from a 24V power source to the equipment cabinet
- 18 AWG – 2 Conductor accessory cable shall be used for powering the 802.11AC access point and connecting to the CAD/AVL vendors emergency alarm switch.
- CAT6 Ethernet Cabling, with vibration resistant "locking" boot, that can be "unlocked" by hand without the use of a tool. This cabling shall be run from the HVR's "Network Switch" location to each of the applicable IP camera locations, and between the HVR's "Network Switch" and the 802.11AC Access Point.
- All cable shall be routed from the Equipment Cabinet to each device such that the cable is hidden behind panels and out of view. All cable shall have approximately 1 foot of service loop left available on each end. All cable running with at least one other cable in a span shall be zip-tied every 12" until the service loop. At all points where cable passes through interior or exterior body panels, cable shall be loomed to protect the cable from chaffing.
- At points where all cables unite and pass into the equipment cabinet from other locations within the bus, the cable shall be loomed, with appropriately sized loom, and secured at both ends with electrical tape. The last 36" of cable shall be exposed at the end of the harness to breakout different device cable to its proper DVR connection location.

Removable Disk Drive (RDD) Specifications:

The removable drive shall be secured in place by a key lock mounted on the HVR. Total storage capacity shall be at least 4 TB (terabytes).

Duration of recording on the removable disk drive (RDD) is determined by video capture quality, drive size, and aggregate frame rate. The RDD shall support a minimum of 3-weeks of recording with eight cameras.

Wireless Specifications:

The HVR shall support wireless connectivity. Data from the hard drive canister shall be transferable via a compatible 802.11ac wireless Ethernet Bridge and downloadable to a server via a wireless network. The transferred or downloaded data shall be reviewable by a workstation that has an installed copy of the vender's video reviewing software. The system shall also be capable of delivering video data and system health status information automatically to the server for review.

All cable for the Security Camera System shall be installed in appropriately sized conduit and in accordance with the specifications outlined in this section. Final harness and conduit installation plans and layouts shall be approved by CATS at the pre-production meeting.

All equipment locations specified below are approximate. Final locations for coiled cable shall be reviewed and approved by CATS at or before the pre-production meeting.

Cable Terminations

All cable shall be terminated using the following connector types. Specific size of connectors (BNC, molex, etc.) shall be finalized as part of the pre-production meeting.

1. **Camera Cable Connectors**

All camera cable (camera signal portion) shall be terminated with male BNC connectors and crimped accordingly using appropriate specialized BNC crimping tools.

All camera cable (Siamese 2 conductor portion of the cable) shall be terminated on the camera end with a two pin male Molex connector. This connector shall be applied using appropriate specialized Molex crimping tools.

All camera cable (Siamese 2 conductor portion of the cable) on the DVR end shall be terminated with #10 ring terminals to connect to the bus bar mounted in the Equipment Cabinet (see below).

2. **Access Point Power Cable Connectors**

All access point power cable shall be terminated on the access point end with a two pin male molex connector. This connector shall be applied using appropriate specialized Molex crimping tools.

All access point power cable shall be terminated on the DVR end with two #10 ring terminals for power.

3. **Access Point Ethernet Cable Connectors**

All access point Ethernet cable shall be pre-terminated, pre-molded, with RJ45 connectors at both ends.

4. **Event Button Cable Connectors**

All event button cable shall be terminated on the event button end with .187 female disconnects to connect to the event button terminals.

All event button cable shall be terminated on the DVR end with bare leads.

5. **DVR Power Cable Connectors**

All DVR power cable shall be connected to 24V constant power (white insulator within 16 AWG 3 conductor cable), 24V ignition (green insulator within 16 AWG 3 conductor cable), and ground (black insulator within 16 AWG 3 conductor cable). The constant power and ignition power shall be fused with 10 Amp and 3 Amps fuses respectively. These cables shall be properly capped so as to eliminate the chance of a short before the system is installed.

Equipment Cabinet Terminal Strip (Bus Bars)

The equipment cabinet shall come equipped with four bus bars, each with four #10 posts, for device power from the DVR. These bus bars shall be mounted within the equipment that will allow for easy removal of connected #10 ring terminals.

Cable Routing, Securing and Labeling

All cable shall be routed from the Equipment Cabinet to each device such that the cable is hidden behind panels and out of view. All cable shall have approximately 1 foot of service loop left available on each end. All cable running with at least one other cable in a span shall be zip-tied every 12” until the service loop. At all points where cable passes through interior or exterior body panels, cable shall be loomed to protect the cable from chaffing.

All cable shall be individually labeled with the device name for that specific cable, at both ends of the cable. Labels shall be approximately 6” from cable ends.

Cable Loom

At points where all cables unite and pass into the equipment cabinet from other locations within the bus, the cable shall be loomed, with appropriately sized loom, and secured at both ends with electrical tape. The last 36” of cable shall be exposed at the end of the harness to breakout different device cable to its proper DVR connection location.

Electronics Cabinet

Given the anticipated design and the horizontal surface over the streetside front wheelhouse, a full size electronics cabinet shall be provided to accommodate the two-way radio, ITS equipment and inclusion of the overall electronic systems in the bus. The cabinet shall meet appropriate NEMA standards and must be approved by the Agency.

The electronics cabinet shall be splash-proof when the service door is secured and made of a minimum of twelve (12) gauge stainless steel or fourteen (14) gauge 5052 H32 aluminum construction, suitably reinforced. The cabinet shall be painted with polyurethane enamel in a color selected by the Agency to complement the interior and it shall be securely mounted on top of the streetside wheel housing. Access to the cabinet shall be

from a lockable hinged door opening into the passenger aisle area that includes a sturdy hold-open device. The cabinet door shall have a recessed handle and a lock, keyed alike, with four keys per vehicle.

The cabinet shall provide a minimum of 46 inches of free height that accommodates four shelves of standard nineteen (19) inch electronic racks of eighteen (18) inch depth. Provisions shall be provided to receive a laptop computer while repair personnel are interfacing with the diagnostic test ports, the shelf shall prevent the laptop from falling while the bus is motion. Power provisions shall be made for the radio and Vehicle Logic Units (excluding multiplexing) inside the electronics cabinet. Circuits and wiring for each system shall be independent of one another and rated per the manufacturer's specifications. 12VDC, 24VDC supplies and a chassis ground shall be provided on three (3) independent terminal strips with a minimum of six (6) terminal mounting locations. Terminal strips shall be clearly identified. Terminal strips and associated wiring shall not interfere with shelf operation.

Diagnostic test ports and ECM interfaces for all of the vehicle's systems shall be mounted inside of the electronics locker on a single test panel. The test ports shall be clearly identified. The design of the test panel shall be reviewed during the pre-production meeting.

The cabinet shall be provided with a terminal of the VLAN system (reference Section 3.6.4). A three (3) inch inside diameter conduit shall connect the cabinet with the main bus wiring harnesses above the streetside lighting fixtures. A 2-1/4 inch inside diameter metallic conduit shall connect the control head and radio control unit with the electronics cabinet.

The electronics cabinet shall provide adequate ventilation for 750 watts of equipment operating within the range of -20^0F to $+140^0$F. The design and configuration of the cabinet shall be subject to Agency approval during the pre-production process.

Intelligent Transportation System

The Agency currently utilizes a Trapeze, Inc. Intelligent Transportation System (ITS). The ITS system encompasses Computer Aided Dispatch, (CAD), Automated Vehicle Location (AVL), Automated Vehicle Monitoring (AVM), Traffic Prioritization and Automatic Passenger Counter (APC). The contractor is responsible to provide an equivalent system from Trapeze, Inc., that is currently in use by the Agency.

The Contractor shall install a Dinex Output Interface Module G4 or approved equal compatible with the Trapeze IVLU V8 in order to complete the installation of the Trapeze ITS on the bus. This Output Interface Module is required to extract signals currently provided via the multiplexing system from the drivers LED panel. The Agency requires that ground signals be provided. All signal wires will be connected to terminal strips and the wires will be clearly labeled at each end. The terminal strip and the terminal identification decal shall be provided on the interior of the electronics cabinet door. Upon review of the driver LED panel, the Agency will request specific signals be wired from the LED panel to the electronics locker via the gateway module. An example of the requested signals will be:

a) Door Open.
b) A/C Fail.
c) Retarder OFF.
d) Low Air.
e) E-Stroke.
f) Check Engine.
g) Stop Engine.
h) Check Transmission.

i) Stop Request.
j) ABS Warning.
k) DPF Warning
l) Engine Compartment Fire

m) Hot brakes

n) Underinflated tires

o) Deployed bike rack

NOTE: Signals may be changed during the thirty (30) days design review of the pilot bus.

The contractor shall review and confirm with the Agency all integration and interface requirements with the ITS during the initial design review meetings. The fully integrated ITS shall be installed on the pilot bus for evaluation during the thirty (30) day testing and demonstration program. The Contractor shall be responsible for the integration, installation and testing of the ITS on every vehicle prior to delivery to the Agency including the interface with the existing system.

Wireless Local Area Network (WLAN):

The vehicle WLAN component is embedded in the ITS Controller™ and enables high-speed communications to and from the vehicle using the IEEE 802.11b standards. Onboard data is stored in the ITS Controller™ non-volatile memory. During vehicle power up or down sequences, a connection is made automatically with the IP-based SFTP server. Data is then uploaded from the vehicle and stored on the server for integration and summarization into the TransitMaster™ database. The contractor is responsible for the connection to the WLAN at the Agency.

WLAN is used to transfer data to and from the vehicle fleet including:

Download to Vehicle

- Route and schedule files
- Canned message updates
- ITS Controller™ software updates
- Automated annunciation system announcements
- Vehicle configuration modifications

Upload from Vehicle

- Vehicle diagnostic information
- Automatic passenger count information
- Stored operational messages

Vehicle Local Area Network

The Contractor shall install and verify the operability of a Vehicle Local Area Network (VLAN) in accordance with SAE Recommended Practice J1708, Serial Data Communications Between Microcomputer Systems in Heavy-Duty Applications, SAE Recommended Practice J1587, Joint SAE/TMC Electronic Data Interchange Between Microcomputer Systems in Heavy-Duty Vehicle Applications and SAE Recommended Practice J2496, Transport Area Network Cabling. The VLAN shall initiate from the Electronics Locker and have Device Access Boxes in strategic locations throughout the bus identified by the Agency.

The VLAN shall provide the inter connectivity of all elements of the Bus Communication System, and all other equipment on the bus with microprocessor controls. Functionally, the VLAN shall support an environment where all components, modules, and systems installed on the bus shall have built-in diagnostics capability. The diagnostic system shall be capable of checking the communications between all components of the installed systems.

Mobile Radio System

A mobile radio system shall be provided for each bus. The radio shall be a Motorola APX 4500 with Sierra Wireless MG90 model, or approved equal, to transmit data from Trapeze. The radio shall include an operator speaker, the handset described in Section TS 83.4.2 Handset, and cradle and shall be programmable with multiple channels. A location convenient to the operator shall be provided for the radio control head, speaker, handset, and cradle. The location shall conform to SAE Recommended Practice J287 "Driver Hand Control Reach."

The system shall be in conformance to the mobile radio system supplier's instructions. The Contractor shall provide all material required to install the radio system beyond the brackets and harnesses provided by the radio manufacturer. A mobile radio will be provided by the Agency for the pilot bus to allow confirmation of the communications system integration during the thirty (30) day pilot bus testing and demonstration program.

Communication Antennas

Provisions for attaching the three Bus Communication System antennas to the roof and routing antenna leads to the communication devices shall include a ¾-inch inside diameter conduit with a pull wire. The mounting for all antennas and lead terminations shall be accessible from the bus interior.

A low profile Panorama SW3-686 antenna mutually compatible with the mobile radio unit shall be installed on the roof of the bus near the front and on the roof centerline. The antenna shall function optimally in the 821/866 MHz band and shall be enclosed in a weather resistant housing of plastic or composite material. The antenna mounting and enclosure shall resist bus washing equipment and weathering throughout the life of the bus.

Low profile type antennas mutually compatible with the Sierra Wireless MG90 FirstNet compatible Modem shall be installed on the roof of the bus near the front and on the roof streetside. The antenna mounting and enclosure shall resist bus washing equipment and weathering throughout the life of the bus.

A separate GPS antenna is required and shall be installed on the roof near the front of the vehicle with an unobstructed line of sight to the sky (satellite surveillance). Commercially available GPS antennas are packaged within a rugged, protective enclosure and are not to be covered or otherwise obstructed by any other form of enclosure or baffle. Typically an RG-316RF Double Shielded Cable, or equivalent, is installed as the antenna cable and can neither be pinched nor contain sharp bends.

A third antenna is required for the WLAN system. The antenna shall be mounted at the front of the bus and be in accordance with the Siemens ITS requirements.

The antenna lead for the mobile radio shall be a rugged, heat resistant RG58\U coaxial cable operating in the 821/866 MHz band. The cable center shall be stranded, or solid pure copper and the shield shall be braided copper. The dielectric insulation material shall be made of type FEP fluorocarbon foam, and the protective jacket shall be made of solid type FEP fluorocarbon. The cable shall exhibit no greater than ten (10) decibels

of attenuation per one hundred-foot length, at 821/866 MHz Low loss, vibration and corrosion resistant radio frequency (RF) connectors, designed to mate with antenna base and transceiver unit, shall be utilized at both ends of the antenna cable.

Antenna leads for other Bus Communication System components shall be of premium construction and shall meet equipment supplier specifications.

TS 86.2 Public Address System

A public address system shall be provided on each bus for facilitating radio system and driver-originated announcements to passengers.

The Automated Voice Annunciation System (AVA)/Public Announcement (PA) shall provide automatic passenger information, including the capacity to provide automatic interior and exterior announcements and automatically display text messages on an interior sign as required by the Americans with Disabilities Act. The system shall interface with the destination sign system.

An Automated Voice Annunciation System (AVA)/Public Announcement (PA) or approved equal Talking Bus System compatible with the existing Trapeze AVL system used by the Agency and shall be provided and installed per Agency configuration. An all LED interior Variable Message sign compatible with Automated Voice Annunciator System shall be provided *Interior message signs shall be connected to the AVL system via J-1708 or similar connectivity to provide remote programming capabilities via the Trapeze AVL system.*

The PA system shall include a hands free microphone which, when activated, shall override any ongoing automated announcement. The switch shall be supplied and installed by the Contractor to permit the bus operator to trigger individual announcement whenever needed using the hands free microphone. The location of the switch and hands free microphone shall be approved by the Agency.

TS 86.2.1 Speakers

Eight (8) interior loudspeakers shall be provided, semi-flush mounted, on alternate sides of the bus passenger compartment, installed with proper phasing. Total impedance seen at the input connecting end shall be 8 ohms. Mounting shall be accomplished with riv-nuts and machine screws.

One (1) loudspeaker shall be provided and mounted outside the bus near the front door to allow communications to passengers outside the bus. A weatherproof, non-corrosive, cone type exterior speaker shall be used.

TS 86.3 Automatic Passenger Counter (APC)

An IRIS Matrix Automatic passenger system shall be installed. The APC shall be capable of providing passenger counts, both ingress and egress, for each doorway. The sensors shall be mounted overhead in brackets, not in the baseplate. The APC shall integrate and communicate with the AVL system.

TS 86.4 Radio Handset and Control System

TS 86.4.1 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 86.4.2 Handset

Contractor will install to the right side of the dash and handset, model number to be specified by the agency, or approved equal, for driver use.

TS 86.4.3 Driver Display Unit (DDU)

Contractor shall install a driver display unit as close to the driver's instrument panel as possible.

TS 86.4.4 Emergency Alarm

Contractor shall install an emergency alarm that is accessible to the driver but hidden from view.

TS 87. Event Data Recorder (EDR)

EDRs shall be installed on the bus, one at the front and the other at the rear. These units are to be installed as low as possible. The EDRs shall be able to communicate over the Jl939 CAN line and shall each be equipped with three-axis accelerometers. Settings are to be finalized with the Agency during pre-production. EDRs shall broadcast via the Jl939 data communication link severe impact events to the vehicle monitoring system and also trigger an event in the camera system. The EDR shall also tag an event from a signal received over the Jl939 CAN line from the silent alarm switch signal and the camera event button and in turn broadcast these events to the vehicle monitoring system. The EDR shall also record the following operational data: headlights on or off, turn signals and hazard lights on or off, ignition on or off, low air pressure warning, whether moving in forward or reverse or idling, and whether parking brake is on or off.

TS 88. Reserved.

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 original 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, 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 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 1.1.3 Complete Bus (All Electric)

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, 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, 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 years or 100,000 miles, whichever comes first. An Extended Warranty to a maximum of five years or 300,000 miles, whichever comes first, may be purchased at an additional cost. The propulsion system manufacturer's standard warranty, delineating items excluded from the Extended Warranty, 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 (All Electric)

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 years or 300,000 miles, whichever comes first. An optional Extended Warranty of 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.

OEM shall provide information on standard warranties and available extended warranty options

WR 1.1.7 Energy Storage System (All Electric or Hybrid)

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 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 years or 300,000 miles, whichever comes first, to remain within warrantable end of life. An optional Extended Warranty of 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.

WR 1.1.8 Emission Control System (ECS)

The Contractor warrants the emission control system for five years or 100,000 miles, whichever comes first. The ECS shall include, but is not limited to, the following components:

- complete exhaust system, including catalytic converter (if required)
- after treatment device
- components identified as emission control devices

WR 1.1.9 Subsystems

The following subsystems shall be warranted to be free from Defects and Related Defects for two 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
- Wheelchair lift and ramp system: Lift and/or ramp parts and mechanical only
- Starter
- Alternator: Alternator only; does not include the drive system.
- Charge air cooler: Charge air cooler including core, tanks and including related surrounding framework and fittings
- Fire suppression: Fire suppression system including tank and extinguishing agent dispensing system
- Hydraulic systems: Including radiator fan drive and power steering as applicable
- Propulsion system cooling systems: Radiator including core, tanks and related framework, including 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 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

OEM shall provide information on available extended warranty options

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 is not 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
- Wheelchair ramp (if applicable)

The Contractor shall provide updated serial numbers resulting from warranty campaigns. The format of the list shall be approved by the 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 the Contractor-provided maintenance manuals and with workmanship performed by adequately trained personnel in accordance with recognized standards of the industry. The warranty also shall be void if the Agency fails to conduct normal inspections and scheduled preventive maintenance procedures as recommended in the Contractor's maintenance manuals and if that omission caused the part or component failure. The 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 "Fleet Defects," below.

The Contractor shall not be required to provide warranty information for any warranty that is less than or equal to the warranty periods listed.

WR 1.3.1 Pass-Through Warranty

Should the Contractor elect to not administer warranty claims on certain components and wish to transfer this responsibility to the sub-suppliers, or to others, the Contractor shall request this waiver.

Contractor shall state in writing that the 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. 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.

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 not later than the start of production. The Superior Warranty shall not be administered by the Contractor.

WR 1.4 Fleet Defects

WR 1.4.1 Occurrence and Remedy

A Fleet Defect is defined as cumulative failures of twenty-five (25) percent of the same components in the same or similar application in a minimum fleet size of twelve (12) or more buses where such items are covered by warranty. A Fleet Defect shall apply only to the base warranty period in sections entitled "Complete Bus," "Propulsion System" and "Major Subsystems." When a Fleet Defect is declared, the remaining warranty on that item/component stops. The warranty period does not restart until the Fleet Defect is corrected.

For the purpose of Fleet Defects, each option order shall be treated as a separate bus fleet. In addition, should there be a change in a major component within either the base order or an option order, the buses containing the new major component shall become a separate bus fleet for the purposes of Fleet Defects.

The Contractor shall correct a Fleet Defect under the warranty provisions defined in "Repair Procedures." After correcting the Defect, the 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 to furnish, install and replace all defective units.

WR 1.4.2 Exceptions to Fleet Defect Provisions

The Fleet Defect warranty provisions shall not apply to 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 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 affected. 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 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 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 for parts that must be replaced to correct the Defect. The reimbursement shall be at the current price at the time of repair and shall include taxes where applicable, plus 15 percent 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 the 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 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 remaining time and/or miles of the original warranty, whichever is greater. This remaining warranty period shall begin on the repair/replacement date for corrected items on each bus if the repairs are completed by the Contractor or on the date the Contractor provides all parts to the 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):
    - towing
    - road calls

- labor
- materials
- parts
- handling
- 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:

600 E. 4th Street

Charlotte, NC 28202

7th Floor

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 the authority and responsibility for reliability, quality control, inspection planning, establishment of the quality control system, and acceptance/rejection of materials and manufactured articles in the production of the transit buses.

QA 1.2 Quality Assurance Organization Functions

QA 1.2.1 Minimum Functions

The quality assurance organization shall include the following minimum functions:

- **Work instructions:** The quality assurance organization shall verify inspection operation instructions to ascertain that the manufactured product meets all prescribed requirements.
- **Records maintenance:** The quality assurance organization shall maintain and use records and data essential to the effective operation of its program. These records and data shall be available for review by the resident inspectors. Inspection and test records for this procurement shall be available for a minimum of one year after inspections and tests are completed.
- **Corrective action:** The quality assurance organization shall detect and promptly ensure correction of any conditions that may result in the production of defective transit buses. These conditions may occur in designs, purchases, manufacture, tests or operations that culminate in defective supplies, services, facilities, technical data or standards.

QA 1.2.2 Basic Standards and Facilities

The following standards and facilities shall be basic in the quality assurance process:

- **Configuration control:** The Contractor shall maintain drawings, assembly procedures and other documentation that completely describe a qualified bus that meets all of the options and special requirements of this procurement. The quality assurance organization shall verify that each transit bus is manufactured in accordance with these controlled drawings, procedures and documentation.
- **Measuring and testing facilities:** The Contractor shall provide and maintain the necessary gauges and other measuring and testing devices for use by the quality assurance organization to verify that the buses conform to all specification requirements. These devices shall be calibrated at established periods against certified measurement standards that have known, valid relationships to national standards.

- **Production tooling as media of inspection:** When production jigs, fixtures, tooling masters, templates, patterns and other devices are used as media of inspection, they shall be proved for accuracy at formally established intervals and adjusted, replaced or repaired as required to maintain quality.
- **Equipment use by resident inspectors:** The Contractor's gauges and other measuring and testing devices shall be made available for use by the resident inspectors to verify that the buses conform to all specification requirements. If necessary, the Contractor's personnel shall be made available to operate the devices and to verify their condition and accuracy.

QA 1.2.3 Maintenance of Control

The Contractor shall maintain quality control of purchases:

- **Supplier control:** The Contractor shall require that each Supplier maintains a quality control program for the services and supplies that it provides. The Contractor's quality assurance organization shall inspect, and test materials provided by Suppliers for conformance to specification requirements. Materials that have been inspected, tested and approved shall be identified as acceptable to the point of use in the manufacturing or assembly processes. Controls shall be established to prevent inadvertent use of nonconforming materials.
- **Purchasing data:** The Contractor shall verify that all applicable specification requirements are properly included or referenced in purchase orders of articles to be used on transit buses.

QA 1.2.4 Manufacturing Control

- **Controlled conditions:** The Contractor shall ensure that all basic production operations, as well as all other processing and fabricating, are performed under controlled conditions. Establishment of these controlled conditions shall be based on the documented Work instructions, adequate production equipment and special working environments if necessary.
- **Completed items:** A system for final inspection and test of completed transit buses shall be provided by the quality assurance organization. It shall measure the overall quality of each completed bus.
- **Nonconforming materials:** The quality assurance organization shall monitor the Contractor's system for controlling nonconforming materials. The system shall include procedures for identification, segregation and disposition.
- **Statistical techniques:** Statistical analysis, tests and other quality control procedures may be used when appropriate in the quality assurance processes.
- **Inspection status:** A system shall be maintained by the quality assurance organization for identifying the inspection status of components and completed transit buses. Identification may include cards, tags or other normal quality control devices.

QA 1.2.5 Inspection System

The quality assurance organization shall establish, maintain and periodically audit a fully documented inspection system. The system shall prescribe inspection and test of materials, Work in process and completed articles. As a minimum, it shall include the following controls:

- **Inspection personnel:** Sufficient trained inspectors shall be used to ensure that all materials, components and assemblies are inspected for conformance with the qualified bus design.
- **Inspection records:** Acceptance, rework or rejection identification shall be attached to inspected articles. Articles that have been accepted as a result of approved materials review actions shall be identified. Articles that have been reworked to specified drawing configurations shall not require special identification. Articles rejected as unsuitable, or scrap shall be plainly marked and controlled

to prevent installation on the bus. Articles that become obsolete as a result of engineering changes or other actions shall be controlled to prevent unauthorized assembly or installation. Unusable articles shall be isolated and then scrapped. Discrepancies noted by the Contractor or resident inspectors during assembly shall be entered by the inspection personnel on a record that accompanies the major component, subassembly, assembly or bus from start of assembly through final inspection. Actions shall be taken to correct discrepancies or deficiencies in the manufacturing processes, procedures or other conditions that cause articles to be in nonconformity with the requirements of the Contract specifications. The inspection personnel shall verify the corrective actions and mark the discrepancy record. If discrepancies cannot be corrected by replacing the nonconforming materials, then the 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 the procurement. The presence of these resident inspectors in the plant shall not relieve the Contractor of its responsibility to meet all of the requirements of this procurement. The Agency shall designate a primary resident inspector, whose duties and responsibilities are delineated in "Pre-Production Meetings," "Authority" and "Pre-Delivery Tests," below. Contractor and resident inspector relations shall be governed by the guidelines included as Attachment A to this section.

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.

No less than thirty (30) days prior to the beginning of bus manufacture, the primary resident inspector may meet with the Contractor's quality assurance manager and may conduct a pre-production audit meeting. They shall review the inspection procedures and finalize inspection checklists. The resident inspectors may begin monitoring bus construction activities two weeks prior to the start of bus fabrication.

QA 2.2.3 Authority

Records and data maintained by the quality assurance organization shall be available for review by the resident inspectors. Inspection and test records for this procurement shall be available for a minimum of one year after inspections and tests are completed.

The Contractor's gauges and other measuring and testing devices shall be made available for use by the resident inspectors to verify that the buses conform to all specification requirements. If necessary, the Contractor's personnel shall be made available to operate the devices and to verify their condition and accuracy.

Discrepancies noted by the resident inspector during assembly shall be entered by the Contractor's inspection personnel on a record that accompanies the major component, subassembly, assembly or bus from start of assembly through final inspection. Actions shall be taken to correct discrepancies or deficiencies in the manufacturing processes, procedures or other conditions that cause articles to be in nonconformity with the requirements of the Contract specifications. The inspection personnel shall verify the corrective actions and mark the discrepancy record. If discrepancies cannot be corrected by replacing the nonconforming materials, then the Agency shall approve the modification, repair or method of correction to the extent that the Contract specifications are affected.

The primary resident inspector shall remain in the Contractor's plant for the duration of bus assembly Work under this Contract. Only the primary resident inspector or designee shall be authorized to release the buses for delivery. The resident inspectors shall be authorized to approve the pre-delivery acceptance tests. Upon request to the quality assurance supervisors, the resident inspectors shall have access to the Contractor's quality assurance files related to this procurement. These files shall include drawings, assembly procedures, material standards, parts lists, inspection processing and reports, and records of Defects.

QA 2.2.4 Support Provisions

The Contractor shall provide office space for the resident inspectors in close proximity to the final assembly area. This office space shall be equipped with desks, outside and interplant telephones, Internet access, file cabinet 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, 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 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 thirty (30) days' notice so that they may be witnessed by the resident inspectors, who may accept or reject the results of the tests. The results of pre-delivery tests, and any other tests, shall be filed with the assembly inspection records for each bus. The underfloor equipment shall be available for inspection by the resident inspectors, using a pit or bus hoist provided by the Contractor. A hoist, scaffold or elevated platform shall be provided by the Contractor to easily and safely inspect bus roofs. Delivery of each bus shall require written authorization of the primary resident inspector. Authorization forms for the release of each bus for delivery shall be provided by the Contractor. An executed copy of the authorization shall accompany the delivery of each bus.

QA 3.2.1 Visual and Measured Inspections

Visual and measured inspections shall be conducted with the bus in a static condition. The purpose of the inspection testing includes verification of overall dimension and weight requirements, that required components are included and are ready for operation, and that components and subsystems designed to operate with the bus in a static condition do function as designed.

QA 3.2.2 Total Bus Operation

Total bus operation shall be evaluated during road tests. The purpose of the road tests is to observe and verify the operation of the bus as a system and to verify the functional operation of the subsystems that can be operated only while the bus is in motion.

Each bus shall be driven for a minimum of fifteen (15) miles during the road tests. If requested, computerized diagnostic printouts 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 4. Agency-Specific Requirements

QA 4.1.1 Buy America

Prior to the beginning of the bus manufacture and continuing throughout the scheduled production, the Contractor shall assist the Resident Inspector in verifying the bus complies with Buy America domestic content requirements as specified in 49 CFR Part 661. At minimum, the Resident Inspector shall:

Review actual component content to ensure that the bus is manufactured with the components and

materials identified in the pre-award audit; and, Check that the final assembly location is in the United States and the manufacturer's final assembly activities meet the requirements as outlined in the FTA's Pre-Award review, as specified in Section 3.1.5.1, Buy America Certification, and as approved by the Agency prior to award. The Resident Inspector must verify that the actual manufacturing processes are consistent with the information provided by the manufacturer and approved by the Agency.

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 offsite 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

- Agree 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: 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 OEM'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 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 non-acceptance. The Agency shall record details of all defects on the appropriate test forms and shall notify the Contractor of acceptance or non-acceptance 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)
- Wheelchair 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.

Resident Inspection Process for Serial Production

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 power plant build-up and wire harness production, and 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, sub-assemblies 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 could be used. If it is decided to use multiple inspectors, then the inspectors could 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 be 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 typically are placed for the inspection of underbody structure, body framing, electrical panels and harnesses, air and hydraulic line routings, installation of insulation, power plant 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 the bus 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
- Wheelchair 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
- Wheelchair securement and ramp systems
- Fire suppression system
- Electrical installations (multiplex, tell-tale 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, airline 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.

Wheelchair Ramp Inspection

The wheelchair 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.

Communications

The lines of communications, 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 signoff

- 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
    - Wheelchair 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 & 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 non-acceptance. The Agency shall record details of all defects on the appropriate test forms and shall notify the Contractor of acceptance or non-acceptance 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 non-acceptance.

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 non-acceptance and work with the OEM to develop a timeline of addressing the problem for a 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 Bus Procurement Project

Package 1: Technical Proposal

- ☐ 1. Letter of Transmittal
- ☐ 2. Technical Proposal
- ☐ 3. Acknowledgement of Addenda
- ☐ 4. Form for Proposal Deviation
- ☐ 5. Vehicle Questionnaire
- ☐ 6. References and non-priced information (if provided by 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. Proposal Form
- ☐ 5. All Federal Certifications:
  - □ Buy America
  - □ Debarment & Suspension (Prime)
  - □ Debarment & Suspension (Subs)
  - □ Non-Collusion
  - □ Anti-Lobbying
  - □ Bus Testing
  - □ DBE Approval
  - □ FMVS Standards

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."

Submit form by email (preferred) to todd.holcomb@charlottenc.gov or in writing to:
RFP# 269-2023-1402, Bus Procurement Project
ATTN: Todd Holcomb
Charlotte Area Transit System
600 East Fourth Street, 3rd Floor
Charlotte, NC 28202

Request #: **Proposer:** **RFP Section:** **Page:**		
Questions/clarification or approved equal:		
Agency action:	□ Approved □ See addendum	□ Denied □ See response below
Agency response:		

CER 3. Acknowledgement of Addenda

Failure to acknowledge receipt of all addenda may cause the Proposal to be considered nonresponsive to the Solicitation. Acknowledged receipt of each addendum must be clearly established and included with the Proposal.

The undersigned acknowledges receipt of the following addenda to the documents:	
Addendum No.:	Dated:
Addendum No.:	Dated:
Addendum No.:	Dated:
Addendum No.:	Dated:
Proposer: **Name:** **Title:** **Phone:** **Street address:** **City, state, ZIP:**	
_____	
Authorized signature	Date

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."

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Deviation No.:	**Contractor:**	**RFP section:**	**Page:**
Complete description of Deviation:			
Rationale (pros and cons):			

CER 6. Pricing Schedule

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		All prices are to be in United States dollars	
	Unit Price 1-5	**Unit Price 6-10**	**Unit Price Lump Sum**
Per bus cost 30 foot Local Hybrid			
Per bus cost 30 foot Local Electric			
Per bus cost 40 foot Local Hybrid			
Per bus cost 40 foot Local Electric			
Per bus cost 40 foot Commuter Electric			
Per bus cost 40 foot Commuter Hybrid			
Manuals			Lump Sum
Training			Lump Sum
Spare parts package			
Test equipment and special tools			
Extended Warranty [Bus)			
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: This form is to be completed and included in the Qualification Package. Attach additional pages if required.

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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 demonstrates 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 demonstrates your technical proficiency, each with the name of the contracting party and number and they type of buses completed within the last 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** 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.

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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 Proposer for contract value over $25,000.

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Choose one alternative:

☐ The Proposer, [insert 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 [insert 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.

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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

CER 8.4 Non-Collusion Affidavit

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 his or her individual name at the end, not a partnership or corporation name, and swear to this affidavit before a notary public, who must attach his or her seal.

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State of _____, County of _____

I, _____, being first duly sworn, do hereby state that
(Name of Affiant)

I am _____ of _____
Capacity) (Name of Firm, Partnership or Corporation)

whose business is

_____

and who resides at

_____

and that

_____
(Give names of all persons, firms, or corporations interested in the bid)

is/are the only person(s) with me in the profits of the herein contained Contract; that the Contract is made without any connection or interest in the profits thereof with any persons making any bid or Proposal for said Work; that the said Contract is on my part, in all respects, fair and without collusion or fraud, and also that no members of the Board of Trustees, head of any department or bureau, or employee therein, or any employee of the Authority, is directly or indirectly interested therein.

_____
Signature of Affiant Date

Sworn to before me this _____ day of _____, 20_____. _____ Notary public My commission expires	Seal

CER 8.5 Lobbying Certification

This form is to be submitted with an offer exceeding $100,000.

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The Proposer certifies, to the best 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

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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 DOT Programs, and that its goals have not been disapproved by the Federal Transit Administration.

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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.

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Company name:
Name of signer:
Title:

_____

Authorized signature Date

CER 9. Other Certifications

CER 9.1 Proposal Form

Proposer shall complete the following form and include it in the price Proposal.

PROPOSAL

By execution below by a duly authorized representative(s) of the Proposer, the Proposer hereby offers to furnish equipment and services as specified in its Proposal submitted to Charlotte Area Transit System – City of Charlotte in response to Request for Proposal No. 269-2023-1402 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: This form is included as an example. Standard industry practice is to execute a separate Contract as provided as an example in Appendix E.

By execution below, Charlotte Area Transit System – City of Charlotte 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 Sep 2011) J366_201109		
SAE J382	Windshield Defrosting Systems Performance Requirements--Trucks, Buses, and Multipurpose Vehicles (Cancelled Sep 2000) J382_200009		
SAE J534	Lubrication FittingsJ534_201508		
SAE J537	Storage Batteries J537_201604		
SAE J541	Voltage Drop for Starting Motor Circuits(Cancelled Jul 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 Jul 2012) J686_201207		
SAE J689	Curbstone Clearance, Approach, Departure, and Ramp Breakover Angles—Passenger Car and Light Truck (Cancelled Aug 2009) J689_200908		
SAE J833	Human Physical Dimensions		
SAE J844	Nonmetallic Air Brake System Tubing (STABILIZED Dec 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		

Standard	Title	Compliance	If “partial” or “N/A,” please describe
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		
SAE J1128	Low Voltage Primary Cable J1128_201512		
SAE J1149	Metallic Air Brake System Tubing and Pipe (STABILIZED Oct 2015) J1149_201510		
SAE J1292	Automobile and Motor Coach Wiring(STABILIZED Apr 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 Jan 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 Sep 2016) J1708_201609		
SAE J1763	A Conceptual Its Architecture: An Atis Perspective (Cancelled 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 Jul 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		

Standard	Title	Compliance	If “partial” or “N/A,” please describe
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		
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/ASHRAE 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		

Standard	Title	Compliance	If "partial" or "N/A," please describe
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		
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

This form must be completed and included in the Technical Proposal.

GENERAL DATA SHEET

BUS TYPE :

☐ **30 ' Low-Floor Urban Transit**	☐ **Electric**	☐ **Hybrid**
☐ **40 ' Low-Floor Urban Transit**	☐ **Electric**	☐ **Hybrid**
☐ **40 ' to 45' Commuter Coach**	☐ **Electric**	☐ **Hybrid**

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

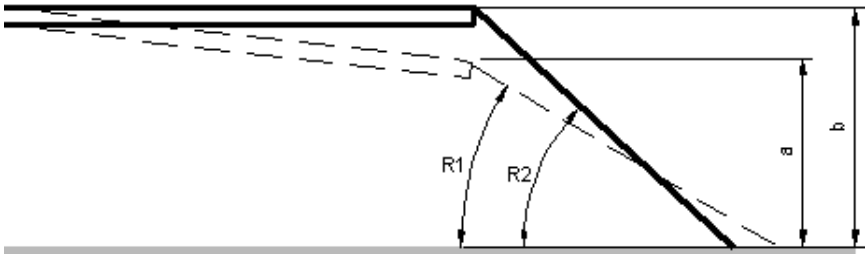
Overall length	Over bumpers		ft		in.
	Over body		ft		in.
Overall width	Over body excluding mirrors		ft		in.
	Over body including mirrors–driving position		ft		in.
	Over tires front axles		ft		in.
	Over tires center axle		ft		in.
	Over tires rear axles		ft		in.
Overall height (maximum)			ft		in.

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 head room (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.

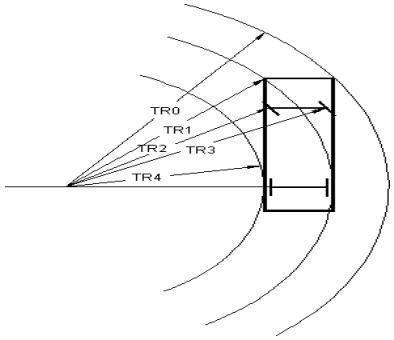
At rear door [ ] in.

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)	[ ] sq ft		
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		cu in.		
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	

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		sq. in.
Second		sq. in.
Third		sq. in.

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		cu in.
Primary reservoir		cu in.
Secondary reservoir		cu in.
Packing reservoir		cu in.
Accessory reservoir		cu in.

Other reservoir type		cu in.

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		
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	

Wheelchair 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	

Wheelchair 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)		lbs.
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	

NOTE: All information above is accurate to the timeframe upon submission. The Agency reserves the right to update above data if changes occur, upon consultation with the customer.

Appendix D: Sample Contract

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. Final 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)

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 [insert 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.

INCORPORATE FINAL 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 (NTP). The Contractor shall commence work after the effective date of the Contract, upon receipt of the NTP.

The base Contract will contain orders for [insert 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 [insert 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. Inspection, Testing and Acceptance

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 the materials and the 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" of the RFP;

and they may be witnessed by the resident inspector. When a bus passes these tests and inspections, the resident inspector shall authorize release of the bus.

Within fifteen (15) calendar days after arrival at the designated point of delivery, the bus shall undergo the Agency tests defined in "Post-Delivery Tests." If the bus passes these tests or if the Agency does not notify the Contractor of non-acceptance within 15 calendar days after delivery, then acceptance of the bus by the Agency occurs on the 15th day after delivery. If the bus fails these tests, it shall not be accepted until the repair procedures defined in "Repairs after Non-Acceptance" 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.

4.2 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 being required, and the document shall become part of the official record of the Pre-Production Meeting.

4.3 Risk of Loss

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

4.4 Post-Delivery Tests

The Agency will conduct acceptance tests on each delivered bus. These tests shall be completed within fifteen (15) days after bus delivery and shall be conducted in accordance with written test plans. The purpose of these tests is to identify Defects that have become apparent between the time of bus release and delivery to the 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 non-acceptance. The Agency shall record details of all Defects on the appropriate test forms and shall notify the Contractor of acceptance or non-acceptance of each bus according to "Inspection, Testing and Acceptance" after completion of the tests. The Defects detected during these tests shall be repaired according to the procedures defined in "Repairs after Non-Acceptance."

4.5 Repairs after Non-Acceptance

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

4.6 Repair Performance

4.6.1 Repairs by Contractor

After non-acceptance 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 repair schedule.

The Contractor shall provide, at its own expense, all spare parts, tools and space 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.

4.6.2 Repairs by the Agency

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

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

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

iii. **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.

iv. **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, 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.

v. **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 fifteen (15) percent handling costs.

5. Deliveries

5.1 Bus Deliveries

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

5.2 Delivery Schedule

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

5.3 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. The amount of said damages, being difficult if not impossible of definite ascertainment and proof, it is hereby agreed that the amount of such damages due to the Agency shall be fixed at [insert dollar amount] per calendar day per bus not delivered in substantially good condition as inspected by the Agency at the time released for shipment.

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 arising at any time from the failure of the Contractor to fulfill the obligations referenced in this clause in a timely manner.

6. Title and Warranty of Title

Adequate documents for registering the bus in the State of North Carolina shall be provided to the Agency not fewer than 10 business days before delivery to the Agency. Upon acceptance of each bus, the Contractor warrants that the title shall pass to the Agency free and clear of all encumbrances.

7. 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, or replace same with non-infringing equipment, or modify it so 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.

8. Data Rights

8.1 Proprietary Rights/Rights in Data

The term "subject data" used in this clause means recorded information, whether or not copyrighted, that is delivered or specified to be delivered under the Contract. It includes the proprietary rights of the following:

- Shop drawings and working drawings
- Technical data including manuals or instruction materials, computer or microprocessor software
- Patented materials, equipment, devices or processes
- License requirements

The Agency shall protect proprietary information provided by the Contractor to the fullest extent of the law. The Contractor shall grant a non-exclusive license to allow the Agency to utilize such information in order to maintain the vehicles. In the event that the Contractor no longer provides the information, the Agency has the right to reverse-engineer patented parts and software.

The Agency reserves a royalty-free, non-exclusive and irrevocable license to reproduce, publish or otherwise use, and to authorize others to use, the following subject data for its purposes: (1) any subject data required to be developed and first produced in the performance of the Contract and specifically paid for as such under the Contract, whether or not a copyright has been obtained; and (2) any rights of copyright to which the Contractor, Subcontractor or Supplier purchases ownership for the purpose of performance of the Contract and specifically paid for as such under the Contract. 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.

9. Changes

9.1 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.

9.2 Agency Changes

The Agency may obtain changes to the Contract by notifying the Contractor in writing. As soon as reasonably possible but no later than thirty (30) calendar days after receipt of the written change order to modify the Contract, 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. At that time, a detailed modification shall be executed in writing by both parties. 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.

10. Indemnification

The Company shall indemnify, defend and hold harmless the City and the City's officers, agents and employees from and against any and all claims, losses, damages, obligations, liabilities and expenses, including but not limited to attorneys' fees (collectively, "Liabilities"), arising out of or resulting from or alleged to arise out of or result from, Company's performance under this Contract or Company's actual or alleged breach of any representation, warranty or covenant hereunder, except to the extent that the Liabilities are caused by the negligence of the City, or the City's officers, agents and employees. Such Liabilities shall include those arising from a violation of any federal, state or local law, regulation or ordinance by the Company or any of its subcontractors. In any case in which Company provides a defense to the City pursuant to this indemnity, the defense will be provided by attorneys reasonably acceptable to the City. This provision shall survive the expiration or early termination of the Contract.

11. Suspension of Work

11.1 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.

11.2 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. 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.

11.3 The Contractor shall be allowed an equitable adjustment in the Contract price (excluding profit) 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 any other 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.

12 Excusable Delays/Force Majeure

12.1 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 acts of God; earthquake, flood and any other natural disaster; civil disturbance, strikes and labor disputes; fires and explosions; war and other hostilities; embargo; or failure of third parties, including Suppliers or Subcontractors, to perform their obligations to the Contractor;
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 10.3.4 below.

A delay in meeting all the conditions of this section shall be deemed an excusable delay. Any concurrent delay that does not constitute an excusable delay shall not be the sole basis for denying a request hereunder.

12.2 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, or subsequent to the occurrence of an excusable delay.

12.3 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.

12.4 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 and 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) calendar days after receipt of the application.

13. Termination

13.1 Termination for Convenience

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 affected by delivery to the Contractor of a notice of termination specifying the extent to which performance of Work under the Contract is 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 such portion of the Work under the Contract as 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, in its discretion, to settle or pay any or all claims arising out of the termination of such orders and subcontracts.
- Settle all outstanding liabilities and all claims arising out of such termination of orders and subcontracts, with the approval or ratification of the Contracting Officer, to the extent he or she may require, 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 other material produced as part of, or acquired in connection with the performance of, the Work terminated, and 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 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 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 the Contractor. 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.

13.2 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 to perform the services within the time specified herein or any extension thereof; or if the Contractor fails to perform any of the other material provisions of the Contract, or so fails to make progress as to endanger performance of this Contract in accordance with its terms, and 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.

14. Disputes

If a current or prospective legal matter that may affect the city or the federal government emerges, the company must notify the city. The company must include a similar notification requirement in each of its subcontracts for twenty-five thousand dollars ($25,000) or more.

A. Legal disputes that require notification under this provision include, but are not limited to, a major dispute, breach, default, litigation, or naming the city or naming the federal government as a party to litigation or a legal disagreement in any forum for any reason.

B. Matters that may affect the federal government (and thereby the city) include, but are not limited to, the or the federal government's interests in the award, the accompanying underlying agreement, and any amendments thereto, or the federal government's administration or enforcement of federal laws, regulations, and requirements.

C. Additional notice to U.S. DOT Inspector General. The Company must promptly notify the U.S. DOT Inspector General in addition to the FTA chief counsel or regional counsel for FTA region 4, if the company has knowledge of potential fraud, waste, or abuse occurring on a project receiving assistance from FTA. The notification provision applies if a person has or may have submitted a false claim under the false claims act, 31 U.S.C. § 3729, et seq., or has or may have committed a criminal or civil violation of law pertaining to such matters as fraud, conflict of interest, bid rigging, misappropriation or embezzlement, bribery, gratuity, or similar misconduct involving federal assistance. This responsibility occurs whether the project is the subject of this contract, another contract funded by the FTA, or an agreement involving a principal, officer, employee, or agent of the company. It also applies to subcontractors at any tier. Knowledge, as used in this paragraph, includes, but is not limited to, knowledge of a criminal or civil investigation by a federal, state, or local law enforcement or other investigative agency, a criminal indictment or civil complaint, or probable cause that could support a criminal indictment, or any other credible information in the possession of the company. In this paragraph, "promptly" means to refer information without delay and without change.

15. Confidential Information

"CONFIDENTIAL INFORMATION" means any information, in any medium, whether written, oral or electronic, obtained or accessed in connection with the Contract that is not subject to mandatory disclosure as a public record under North Carolina law, including without limitation the following:

- Trade secrets of the City and its suppliers, contractors and licensors, including software and technical materials.

- *Information marked "Confidential" or "Proprietary"*
- *Computer security information of the City, including passwords, codes, configurations, security standards and protocols, and other network, device and system security features*
- *Building plans of City-owned buildings and structures*
- *Plans to prevent or respond to terrorist activity, including vulnerability and risk assessments, potential targets, specific tactics or specific security or emergency procedures, the disclosure of which would jeopardize the safety of government personnel or the general public or the security of any governmental facility, structure or information storage system(s).*
- *Information contained in the City's personnel files, as defined by N.C. Gen. Stat. 160A-168 (which includes all information gathered by the City about employees, except information which is a matter of public record under North Carolina law)*
- *Personal identifying information of individuals, such as social security numbers, bank account numbers, credit and debit card numbers, birth dates, PIN numbers and passwords*
- *Billing information of customers maintained in connection with the City providing utility services*
- *Attorney / client privileged information disclosed by either party*
- *Names and address of individuals who have received a rehabilitation grant to repair their homes.*
- *Information relating to criminal investigations conducted by the City, and records of criminal intelligence information compiled by the City*

The Confidential Information listed in italics above is "Highly Restricted Information," which subject to additional restrictions as set forth herein. Confidential Information includes information disclosed prior to execution of this Contract as well as information disclosed after execution.

16. General Nondiscrimination Clause

The Contractor agrees to comply with the Non-Discrimination Policy set forth in Chapter 2, Article V of the Charlotte City Code, which is available for review at http://library.municode.com/index.aspx?clientId=19970 and incorporated herein by reference. The Contractor consents to be bound by the award of any arbitration conducted thereunder."

17. 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.

18. 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.

19. REMEDIES.

19.1. Right to Withhold Payment. At the non-breaching party's election, Company and the City are each entitled to setoff and deduct from any amounts owed to the other party under this Contract all damages and expenses incurred due to the other party's breach. If Company breaches any provision of this Contract, the City may elect to withhold a portion of or all payments due until the breach has been fully cured. The City may obtain performance of the Work elsewhere.

19.2. Misappropriation or Infringement Breach. In the event of a violation, misappropriation or infringement of any copyright, trademark, patent, trade secrete or other proprietary rights with respect to the Work provided under this Contract, in addition to the indemnification obligation under the Contract, Company shall (i) procure the right for the City to use the infringing product or service; or (ii) repair or replace the infringing product or service so that it is no longer infringing so long as such modification does not adversely affect the Contract.

19.3. Other Remedies. The election of one remedy does not waive other legal or equitable remedies that a party may pursue. The remedies enumerated herein are in addition to any other remedy available at law or in equity, such as the right to cover.

19.4. Liquidated Damages. The City is entitled to assess liquidated damages for non-performance when authorized by this Contract. The City may setoff and deduct from any amounts owed to the other party under this Contract any amounts which represent liquidated damages calculated in response to the other party's breach. The Company acknowledges and agrees that with regard to non-performance: (a) the City may be damaged by such failures, including loss of goodwill and administrative costs; and that (b) the costs that the City might reasonably be anticipated to accrue as a result of such failures are difficult to ascertain due to their indefiniteness and uncertainty. Accordingly, the Company agrees to pay liquidated damages as they may be calculated in this Contract.

19.5. Right to Cover. If the Contractor fails to comply with any term or condition of the Contract or the Contractor's response to the RFP, the City may take any of the following actions with or without terminating the Contract, and in addition to and without limiting any other remedies it may have: Employ such means as it may deem advisable and appropriate to obtain the applicable Products and/or Services (or reasonable substitutes) from a third party; and Recover from the Contractor the difference between what the City paid for such Products and/or Services on the open market and the price of such Products and/or Services under the Contract or the Contractor's response to the RFP.

19.6. 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.

20. REPRESENTATIONS AND WARRANTIES. Contractor represents, warrants, and covenants that: (a) The Products and Services shall comply with all requirements set forth in this Contract,

including but not limited to the Attachments; (b) All work performed by the Contractor and/or its subcontractors pursuant to this Contract shall meet industry accepted standards, and shall be performed in a professional and workmanlike manner by staff with the necessary skills, experience and knowledge; (c) Neither the Products, nor any Services provided by the Contractor under this Contract will infringe or misappropriate any patent, copyright, trademark or trade secret rights of any third party; (d) Contractor and each of its subcontractors have complied and shall comply in all material respects with all applicable federal, state and local laws, regulations and guidelines relating to the performance of this Contract or to the products and services delivered hereunder, including but not limited to E-Verify, and shall obtain all applicable verifications, permits, and licenses; (e) Contractor is a duly organized and validly existing entity of the type set forth in the first paragraph of this Contract, is in good standing under the laws of the state specified in the first paragraph of this Contract, and is registered to do business in North Carolina; (f) Contractor has the requisite power and authority to execute and perform this Contract; and (g) neither the execution nor the performance of this Contract will violate any third party contractual rights. Contractor and each person signing this Contract for Contractor represents and warrants that the execution, delivery, and performance of this Contract have been duly authorized by Contractor. Additional warranties may be set forth in the Attachments.

21. 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.

22. 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.

23. 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:

- “Intellectual Property Warranty”
- “Data Rights”
- “Indemnification”
- “Governing Law and Choice of Forum”
- “Disputes”
- “Confidential Information”
- “Parts Availability Guarantee”
- “Access to Records”
- “Training”

24. 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.

24.1 Payment Terms

Payment upon Delivery

All payments shall be made as provided herein, less any additional amount withheld as provided below and less any amounts for liquidated damages in accordance with "Liquidated Damages for Late Delivery of the Bus."

24.2 Payment of Taxes

Unless otherwise provided in this Contract, the Contractor shall pay all federal, state and local taxes, and duties applicable to and assessable against any Work, goods, services, processes and operations incidental to or involved in the Contract, including but 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. The Contractor will maintain auditable records, subject to the Agency reviews, confirming that tax payments are current at all times.

25. Insurance

The Company, and all its subcontractors, shall provide and maintain at its expense during the term of this Contract the following program(s) of insurance covering its operations. Such insurance shall be provided by insurer(s) qualified to do business in North Carolina, have a rating at least "A-" by A.M. Best, and be satisfactory to the City as approved by the City's Risk Management Division. Evidence of such programs satisfactory to the City shall be delivered to the City on or before the effective date of this Contract and prior to commencing any work hereunder. Such policy shall list "City of Charlotte, 600 East Fourth St. Charlotte, NC 28202" as an additional insured for operations or services, rendered under this Contract. City is to be given written notice within thirty (30) days of any termination of any program of insurance.

(i) The Company's insurance shall be primary of any self-funding and/or insurance otherwise carried by the City for all loss or damages arising from the Company's operations under this Contract. If any of the coverage conditions are met by a program of self-insurance, the Company must submit evidence of the right to self-insure as provided by the State of North Carolina.

(ii) The Company and each of its subcontractors shall and does waive all rights of subrogation against the City and each of its indemnified parties. The City

shall be exempt from, and in no way liable or responsible for any sums of money that may represent a deductible or self-insured retention in any insurance policy of the Company or its subcontractors.

(iii)The following insurance is required under this Contract:

a. Automobile Liability. Evidence of current automobile insurance (attach copy of automobile policy declaration page(s) or submit a current certificate of insurance, showing the vehicles covered and coverage amounts as the appropriate one of the following:

(iv)If the Company owns or leases commercial vehicles to provide goods or perform a service under this Contract, Automobile Liability must be provided at a limit of not less than $1,000,000 per occurrence/aggregate, combined single limit, each occurrence, for bodily injury and property damage liability covering all owned, non-owned, and hired vehicles.

(v) If the Company does not own or lease any vehicles, but is using their personal vehicles to perform a service under this Contract, primary Personal Automobile Liability may be provided at limits not less than $100,000 each person, $300,000 each accident and property damage liability of $50,000.

(vi) If Company does not own or lease any vehicles, but has employees using their vehicles to provide goods or perform a service under this Agreement, Company must provide hired/non-owned automobile liability coverage at a limit of not less than $1,000,000 per occurrence aggregate.

(vii) If the Company is trucking fuel or hauling potential pollutants, the Automobile Liability coverage shall be broadened to include pollution coverage on covered autos, and a copy of endorsement CA 99 48 shall be provided to the City. Company must also supply the City with evidence of motor carrier endorsement MCS-90 as required by the Federal Motor Carrier Safety Administration's Motor Carrier Act.

b. General Liability. Insurance with a limit not less than $**1,000,000.00** per occurrence/aggregate including coverage for bodily injury, property damage, products and completed operations, personal/advertising injury liability and contractual liability.

c. Worker's Compensation and Employers Liability. Insurance meeting the statutory requirements of the State of North Carolina and any applicable Federal laws; and Employers' Liability - $100,000 per accident limit, $300,000 disease per policy limit, $100,000 disease each employee limit. If the Company does not employ more than 2 full time employees, Company must attest this fact on company letterhead and include such letter in this Contract.

26. Audit. The City, or an agent of the City, may audit all Company books, records, and facilities used by Company in the furtherance of the City's Contract and scope of work. Any audit would evaluate Company's compliance with the terms and conditions of the Contract or the City's payment obligations. The City's right to audit commences on the date the Contract is executed and expires three (3) years after the Contract's termination or expiration. Prior written notice shall be provided

by the City before an audit may commence and any audit should occur during normal business hours of the Company. The City shall pay its own expenses for any audit and is not responsible for any expenses or additional costs of the Company. The Company shall reimburse the City for the City's audit expenses if the audit finds the Company was non-compliant with the contract and the amount of the non-compliance is in excess of five thousand ($5,000).

27. 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]

28. Required by State Law

a. E-Verify. Contractor shall comply with the requirements of Article 2 of Chapter 64 of the North Carolina General Statutes, and shall ensure that each of its subcontractors also do so.

b. NC Prohibition on Contracts with Companies that Invest in Iran or Boycott Israel. Contractor represents and warrants that it is eligible to contract with the City because it is not identified as an ineligible company on the State Treasurer's list created pursuant to G.S. 147-86.58 or identified as a restricted company for purposes of the Israel Boycott. Company also agrees to immediately notify the City if it is identified as an ineligible company on either list at any time during the term of this Contract.

29. NON-APPROPRIATION OF FUNDS. If City Council does not appropriate the funding needed by the City to make payments under this Contract for a given fiscal year, the City will not be obligated to pay amounts due beyond the end of the last fiscal year for which funds were appropriated. In such event, the City will promptly notify Contractor of the non-appropriation and this Contract will be terminated at the end of the last fiscal year for which funds were appropriated. No act or omission by the City that is attributable to non-appropriation of funds shall constitute a breach of or default under this Contract.

30. GOVERNING LAW AND VENUE. North Carolina law will govern all matters relating to this Contract (without regard to North Carolina conflicts of law principles). Any legal actions or

proceedings relating to this Contract shall be brought in a state or federal court sitting in Mecklenburg County, North Carolina, other than actions to enforce a judgment.

31. ASSIGNMENT/SUBCONTRACTING. Neither party may assign or subcontract any of its rights or obligations under this Contract without prior written consent of the other party. Unauthorized assignments shall be void.

32. DELAY / CONSEQUENTIAL DAMAGES. The City will not be liable to Contractor, its agents or any subcontractor for or any delay in performance by the City, or for any consequential, indirect, or special damages or lost profits related to this Contract.

33. PUBLICITY. Contractor may not identify or reference the City or this Contract in any advertising, sales promotion, or other materials without the City's prior written consent of the City except: (i) Contractor may list the City as a reference, and (ii) Contractor may identify the City as a customer in presentations to potential customers.

34. TAXES. Contractor will pay all applicable federal, state, and local taxes that may be chargeable against the performance of the Services.

35. CONSTRUCTION OF TERMS. Both parties have carefully considered the particular language used in this Contract. The general rule of law that ambiguities are construed against the drafter will not apply.

36. DAYS. Unless specifically stated otherwise, all references to days in this Contract refer to calendar days rather than business days. Any references to "business days" shall mean the days that the City's main office at 600 East Fourth Street, Charlotte, NC, is open for the public to transact business.

37. CONFLICTS OF INTEREST. Contractor will not take any action that is or is likely to be perceived as conflict of interest under this Contract. Contractor has not made and will not make any gifts to City employees or officials in connection with this Contract.

38 Pre-Audit. No pre-audit certificate is required under N.C. Gen. Stat. 159-28(a) because this Contract is for an indefinite quantity with no minimum purchase requirement. Notwithstanding anything contained herein to the contrary, this Contract does not require the City to purchase a single product or service, and a decision by the City to not make any purchase hereunder will violate neither this Contract nor any implied duty of good faith and fair dealing. The City has no financial

obligation under this Contract absent the City's execution of a valid and binding purchase order or contract addendum containing a pre-audit certificate."

39. 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.

By signing below, the parties accept and agree to the terms set forth in this Contract.

[Vendor Legal Name]

Signature _____

Print Name _____

Title _____ Date _____

City of Charlotte

Signature _____

Print Name _____

Title _____ Date _____

Abbreviation and Acronyms

A/C	air conditioning
ABS	antilock braking system
AC	alternating current
ACQ	alkaline copper quaternary
ADA	Americans with Disabilities Act
ADB	advanced design bus
Ah	amp hour
ALR	auto-locking retractor
APA	The Engineered Wood Association, formerly the American Plywood Association
APC	automatic passenger counter
APTA	American Public Transportation Association
ASTM	ASTM International, formerly the American Society for Testing and Materials
ATC	automatic traction control
AVL	automatic vehicle location
AWG	American Wire Gauge
BAFO	Best and Final Offer
BMS	Battery Management System
BRT	bus rapid transit
CARB	California Air Resources Board
CCS	climate control system
CCTV	closed-circuit television
cfm	cubic feet per minute
CGA	Compressed Gas Association
CNG	compressed natural gas
dB	decibel
DBE	disadvantaged business enterprise
DC	direct current
DDU	driver display unit
DEF	diesel exhaust fluid
DOT	Department of Transportation
DPF	diesel particulate filter
EDR	event data recorder
ECM	Engine Control and Monitoring
ECS	emission control system
ELR	emergency locking retractor
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
HDS	hybrid drive system
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
kJ	kilojoule
LEL	LED emergency light
LFL	lower flammability limit
LV	low voltage
mA	milliampere
MDT	mobile data terminal
MPa	mega-Pascal
NC	normally closed
NFPA	National Fire Protection Association
NGV	natural gas vehicle
NOx	nitrogen oxide
NO	normally open
NTP	notice to proceed
OEM	original equipment manufacturer
OSI	Open Systems Interconnect
PA	public address
PMO	project management oversight
PPV	price per vehicle
PRD	pressure relief device
psi	pounds per square inch
RF	radio frequency
RFI	radio frequency interference
RTC	real-time clock
SAE	SAE International, formerly the Society of Automotive Engineers
scf	standard cubic feet
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

USCA	United States Code Annotated
V DC	volts of direct current
WEOL	warrantable end of life
Wh	watt-hours
VIN	vehicle information number
ZEV	zero-emission vehicle

Summary of document changes

- Document was revised with new language for battery electric bus procurements.
  - Section 6 Technical Specifications:
    - New entries to Section TS 2 Definitions to reference battery bus elements
    - In Section TS 5, Operating Environment, Noise, Fire Safety, and Fire Suppression updated to be inclusive of battery buses and to specifically reference different propulsion systems.
    - In TS 7 Vehicle Performance, new language added for battery buses and other language specified for other propulsion system relating to power requirements, acceleration
    - In TS 8 Fuel Economy/Range – language added to specify requirements for various propulsions systems including battery bus. Agency Operating Profile for battery bus added.
    - In TS 9 Engine - language added to specify requirements for various propulsions systems including battery bus including new Energy Storage section.
    - In TS 10 Cooling Systems – language significantly updated to reflect conditions of various propulsion systems
    - In TS 19 Emission and Exhaust, language added for battery buses
    - TS 31.1.1 Regenerative Braking for Hybrid or Electric added
    - TS 42 General Electrical Requirements – added language relating to high voltage batteries and low voltage batteries for battery buses
    - TS 54 Heat, Ventilating and Air Conditioning – added language specific to various propulsion systems including battery.
    - TS 55 Controls and Temperature Uniformity – added Alternatives for Battery or Fuel Cell Bus
  - Section 7 Warranty Requirements:
    - Language added for Complete Bus Warranty for electric buses
    - Language added for Propulsion System Warranty for electric bus
    - Language added for Energy Storage System for electric bus
  - CER 10 Vehicle Technical Information – new language added for electric bus
  - Other major language updates not specific to battery buses include:
    - TS 3 Referenced Publications – more detailed language
    - TS 5 - Language related to vehicle weight and maintenance inspections
    - TS 16 Radiator – updated language and alternative added
    - TS 75.19 – Farebox – added new alternatives and specified types of transit vehicles applicable
    - New section: Certification of Compliance with Standards, Certifications and Regulations
    - Language added to CER 10 Vehicle Technical Information
  - Appendix H: Added “Guidelines for Selecting Electric Bus Specifications”

- Appendix I: Added "Sample technical specifications for charging equipment: plug-in, overhead conductive and wireless charging"

Document history

Document Version	Working Group Vote	Public Comment/ Technical Oversight	CEO Approval	Policy & Planning Approval	Publish Date
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