REQUEST FOR PROPOSALS (RFP) 9-1836

FORTY-FOOT COMPRESSED NATURAL GAS-POWERED BUSES

ORANGE COUNTY TRANSPORTATION AUTHORITY
550 South Main Street
P.O. Box 14184
Orange, CA 92863-1584
(714) 560-6282

Key RFP Dates

Issue Date:	**January 27, 2020**
Pre-Proposal Conference Date:	**February 11, 2020**
Question Submittal Date:	**February 17, 2020**
Proposal Submittal Date:	**March 11, 2020**
Interview Date:	**April 7, 2020**

FEDERAL TRANSIT ADMINISTRATION FUNDED PROJECT

TABLE OF CONTENTS

OCTA

NOTICE OF REQUEST FOR PROPOSALS

(RFP) 9-1836: "FORTY-FOOT COMPRESSED NATURAL GAS-POWERED BUSES"

TO: ALL OFFERORS

FROM: ORANGE COUNTY TRANSPORTATION AUTHORITY

The Orange County Transportation Authority (Authority) invites proposals from qualified contractors to purchase up to 299, 40-foot compressed natural gas (CNG)-powered buses.

Proposals must be received in the Authority's office at or before 2:00 p.m. on March 11, 2020.

Proposals delivered in person or by a means other than the U.S. Postal Service shall be submitted to the following:

Orange County Transportation Authority
Contracts Administration and Materials Management
600 South Main Street, (Lobby Receptionist)
Orange, California 92868
Attention: Kristen Mason, Section Manager, Maintenance Procurement

Proposals delivered using the U.S. Postal Service shall be addressed as follows:

Orange County Transportation Authority
Contracts Administration and Materials Management
P.O. Box 14184
Orange, California 92863-1584
Attention: Kristen Mason, Section Manager, Maintenance Procurement

Proposals and amendments to proposals received after the date and time specified above will be returned to the Offerors unopened.

Firms interested in obtaining a copy of this RFP may do so by downloading the RFP from CAMM NET at https://cammnet.octa.net.

All firms interested in doing business with the Authority are required to register their business on-line at CAMM NET. The website can be found at

https://cammnet.octa.net. From the site menu click on CAMM NET to register.

To receive all further information regarding this RFP 9-1836, firms and subconsultants must be registered on CAMM NET with at least one of the following commodity codes for this solicitation selected as part of the vendor's on-line registration profile:

Category:	Commodity:
Buses; Parts, Components, Vehicles	Bus Manufacturers

A pre-proposal conference will be held on February 11, 2020, at 10:00 a.m. at the Authority's Administrative Office, 600 South Main Street, Orange, California, in Conference Room 09. All prospective Offerors are encouraged to attend the pre-proposal conference.

The Authority has established April 7, 2020, as the date to conduct interviews. All prospective Offerors will be asked to keep this date available.

Offerors are encouraged to subcontract with small businesses to the maximum extent possible.

All Offerors will be required to comply with all applicable equal opportunity laws and regulations.

The award of this contract is subject to receipt of federal, state and/or local funds adequate to carry out the provisions of the proposed agreement including the identified Scope of Work.

SECTION I: INSTRUCTIONS TO OFFERORS

SECTION I. INSTRUCTIONS TO OFFERORS

A. PRE-PROPOSAL CONFERENCE

A pre-proposal conference will be held on February 11, 2020, at 10:00 a.m. the Authority's Administrative Office, 600 South Main Street, Orange, California, in Conference Room 09. All prospective Offerors are encouraged to attend the pre-proposal conference.

B. ESTIMATED QUANTITES

This RFP is intended to procure up to 299, 40-foot CNG-powered buses to be manufactured and delivered on a continuous multi-year delivery starting after the Authority issues the notice to proceed with the pilot/First Article bus. After full acceptance of the pilot bus, Authority will issue the second notice to proceed with the remainder of the production buses.

The Authority expects to take delivery of the pilot bus/First Article, no later than forty-five (45) weeks after issuing the first notice to proceed, having an estimated time of arrival to the Authority sometime during the first half of the year 2021. Then, after evaluation and acceptance of the First Article for up to sixteen (16) weeks, the Authority will issue a second notice to proceed with the production run of up to 298 buses, requiring the buses to commence arrival to the Authority by the end of June 2022, on a continuous basis, at the rate of two (2) buses per week, or as agreed upon, to have all buses delivered by June 2025.

C. EXAMINATION OF PROPOSAL DOCUMENTS

By submitting a proposal, Offeror represents that it has thoroughly examined and become familiar with the work required under this RFP and that it is capable of performing quality work to achieve the Authority's objectives.

D. ADDENDA

Any Authority changes to the requirements will be made by written addendum to this RFP. Any written addenda issued pertaining to this RFP shall be incorporated into the terms and conditions of any resulting Agreement. The Authority will not be bound to any modifications to or deviations from the requirements set forth in this RFP as the result of oral instructions. Offerors shall acknowledge receipt of addenda in their proposals. Failure to acknowledge receipt of Addenda may cause the proposal to be deemed non-responsive to this RFP and be rejected.

E. AUTHORITY CONTACT

All communication and/or contacts with Authority staff regarding this RFP are to be directed to the following Contract Administrator:

Kristen Mason, Section Manager, Maintenance Procurement
Contracts Administration and Materials Management Department
600 South Main Street
P.O. Box 14184
Orange, CA 92863-1584
Phone: (714) 560-5842, Fax: (714) 560-5792
Email: kmason@octa.net

Commencing on the date of the issuance of this RFP and continuing until award of the contract or cancellation of this RFP, no proposer, subcontractor, lobbyist or agent hired by the proposer shall have any contact or communications regarding this RFP with any Authority's staff; member of the evaluation committee for this RFP; or any contractor or consultant involved with the procurement, other than the Contract Administrator named above or unless expressly permitted by this RFP. Contact includes face-to-face, telephone, electronic mail (e-mail) or formal written communication. Any proposer, subcontractor, lobbyist or agent hired by the proposer that engages in such prohibited communications may result in disqualification of the proposer at the sole discretion of the Authority.

F. CLARIFICATIONS

1. Examination of Documents

Should an Offeror require clarifications of this RFP, the Offeror shall notify the Authority in writing in accordance with Section F.2. below. Should it be found that the point in question is not clearly and fully set forth, the Authority will issue a written addendum clarifying the matter which will be sent to all firms registered on CAMM NET under the commodity codes specified in this RFP.

2. Submitting Requests

a. All questions, including questions that could not be specifically answered at the pre-proposal conference must be put in writing and must be received by the Authority no later than 4:00 p.m. Pacific Time, on February 17, 2020.

b. Requests for clarifications, questions, comments and approved equals must be clearly labeled, "Written Questions". The Authority is not responsible for failure to respond to a request that has not been labeled as such.

c. Any of the following methods of delivering written questions are

acceptable as long as the questions are received no later than the date and time specified above:

(1) U.S. Mail: Orange County Transportation Authority, 550 South Main Street, P.O. Box 14184, Orange, California 92863-1584.

(2) Personal Delivery: Contracts Administration and Materials Management Department, 600 South Main Street, Lobby Receptionist, Orange, California 92868.

(3) Facsimile: (714) 560-5792.

(4) Email: kmason@octa.net

3. Authority Responses

Responses from the Authority will be posted on CAMM NET, no later than March 2, 2020. Offerors may download responses from CAMM NET at *https://cammnet.octa.net*, or request responses be sent via U.S. Mail by emailing or faxing the request to Kristen Mason, Section Manager, Maintenance Procurement.

To receive email notification of Authority responses when they are posted on CAMM NET, firms and subconsultants must be registered on CAMM NET with at least one of the following commodity codes for this solicitation selected as part of the vendor's on-line registration profile:

Category:	Commodity:
Buses; Parts, Components, Vehicles	Bus Manufacturers

Inquiries received after 4:00 p.m. on February 17, 2020, will not receive a response.

G. SUBMISSION OF PROPOSALS

4. Date and Time

Proposals must be received in the Authority's office at or before 2:00 p.m. on March 11, 2020.

Proposals received after the above-specified date and time will be returned to Offerors unopened.

5. Address

Proposals delivered in person or by a means other than the U.S. Postal Service shall be submitted to the following:

Orange County Transportation Authority
Contracts Administration and Materials Management (CAMM)
600 South Main Street, (Lobby Receptionist)
Orange, California 92868
Attention: Kristen Mason, Section Manager, Maintenance Procurement

Or proposals delivered using the U.S. Postal Services shall be addressed as follows:

Orange County Transportation Authority
Contracts Administration and Materials Management (CAMM)
P.O. Box 14184
Orange, California 92863-1584
Attention: Kristen Mason, Section Manager, Maintenance Procurement

6. Identification of Proposals

Offeror shall submit an **original and 6 copies** of its proposal in a sealed package, addressed as shown above in F.2. The outer envelope must show the Offeror's name and address and clearly marked with RFP number. In addition to the above, Proposers shall also include one (1) electronic copy of their entire RFP submittal package in "PDF" format, on a CD or DVD, or flash drive.

7. Acceptance of Proposals

a. The Authority reserves the right to accept or reject any and all proposals, or any item or part thereof, or to waive any informalities or irregularities in proposals.

b. The Authority reserves the right to withdraw or cancel this RFP at any time without prior notice and the Authority makes no representations that any contract will be awarded to any Offeror responding to this RFP.

c. The Authority reserves the right to postpone proposal openings for its own convenience.

d. Submitted proposals are not to be copyrighted.

H. PRE-CONTRACTUAL EXPENSES

The Authority shall not, in any event, be liable for any pre-contractual expenses incurred by Offeror in the preparation of its proposal. Offeror shall not include any such expenses as part of its proposal.

Pre-contractual expenses are defined as expenses incurred by Offeror in:

1. Preparing its proposal in response to this RFP;
2. Submitting that proposal to the Authority;
3. Negotiating with the Authority any matter related to this proposal; or
4. Any other expenses incurred by Offeror prior to date of award, if any, of the Agreement.

I. JOINT OFFERS

Where two or more firms desire to submit a single proposal in response to this RFP, they should do so on a prime-subcontractor basis rather than as a joint venture. The Authority intends to contract with a single firm and not with multiple firms doing business as a joint venture.

J. TAXES

Unless otherwise specifically provided in this Contract, the Contract Price includes compensation for all taxes the Contractor is required to pay by Laws in effect on the date the Contractor's Proposal submission. Contractor shall pay all federal, state, and local taxes, and duties applicable to and assessable against any Work, including but not limited to retail sales and use, transportation, export, import, business, and special taxes. Contractor shall ascertain and pre-pay the taxes and add to the invoice when due. Contractor will maintain auditable Records, subject to Authority reviews, confirming that tax payments are current at all times otherwise specifically Offerors' proposals are subject to State and Local sales taxes. The Authority is exempt from the payment of Federal Excise and Transportation Taxes.

K. PROTEST PROCEDURES

The Authority has on file a set of written protest procedures applicable to this solicitation that may be obtained by contacting the Contract Administrator responsible for this procurement. Any protests filed by an Offeror in connection with this RFP must be submitted in accordance with the Authority's written procedures.

L. CONTRACT TYPE

It is anticipated that the Agreement resulting from this solicitation, if awarded, will be a firm-fixed price contract specifying firm-fixed prices for individual tasks specified in the Scope of Work, included in this RFP as Exhibit A.

M. CONFLICT OF INTEREST

All Offerors responding to this RFP must avoid organizational conflicts of interest which would restrict full and open competition in this procurement. An organizational conflict of interest means that due to other activities, relationships or contracts, an Offeror is unable, or potentially unable to render impartial assistance or advice to the Authority; an Offeror's objectivity in performing the work

identified in the Scope of Work is or might be otherwise impaired; or an Offeror has an unfair competitive advantage. Conflict of Interest issues must be fully disclosed in the Offeror's proposal.

All Offerors must disclose in their proposal and immediately throughout the course of the evaluation process if they have hired or retained an advocate to lobby Authority staff or the Board of Directors on their behalf.

Offerors hired to perform services for the Authority are prohibited from concurrently acting as an advocate for another firm who is competing for a contract with the Authority, either as a prime or subcontractor.

N. CODE OF CONDUCT

All Offerors agree to comply with the Authority's Code of Conduct as it relates to Third-Party contracts which is hereby referenced and by this reference is incorporated herein. All Offerors agree to include these requirements in all of its subcontracts.

O. PRIME AND LOWER TIER DEBARMENT

Proposers are advised that the signing of their proposal, certifies that they and their sub-consultants are not debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from covered transactions by any federal department or agency.

P. DBE REQUIREMENTS FOR TRANSIT VEHICLE CONTRACTORS

Pursuant to Title 49, Code of Federal Regulations, Part 26.49, an Offeror, as a condition of being authorized to respond to this solicitation, must certify by completing the form DBE Approval Certification, Exhibit C, that it has on file with the Federal Transit Administration (FTA) an approved or not disapproved annual Disadvantaged Business Enterprise (DBE) subcontracting participation goal.

Q. AVAILABILITY OF FUNDS

This procurement is subject to the availability of funding in the form of a grant from the Federal Government. The Authority's obligation hereunder is contingent upon the availability of appropriated funds from which payment for the Contract purposes can be made. No legal liability on the part of the Authority for any payment shall arise until funds are made available for this Contract and until the Contractor receives notice of such availability, to be confirmed in writing by the Contracting Officer. Any award of Contract hereunder will be conditioned upon said availability of funds for the Contract.

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 in advance of the due date specified in "Submitting Requests" (Section I.F.2.)

Request #: _____

Proposer:

_____

Contact Information:

_____

_____

_____

Page _____, Section _____

Questions, Clarifications or Approved Equals:

SECTION II: PROPOSAL CONTENT

SECTION II. PROPOSAL CONTENT

A. PROPOSAL FORMAT AND CONTENT

1. Format

Proposals should be typed with a standard 12-point font, double-spaced and submitted on 8½" x 11" size paper, using a single method of fastening. Charts and schedules may be included in 11" x 17" format. Proposals should not include any unnecessarily elaborate or promotional materials. Technical proposals should not exceed one-hundred (100) pages in length, excluding any appendices, cover letters, resumes, or forms.

2. Letter of Transmittal

The Letter of Transmittal shall be addressed to Kristen Mason, Section Manager, Maintenance Procurement and must, at a minimum, contain the following:

a. Identification of Offeror that will have contractual responsibility with the Authority. Identification shall include legal name of company, corporate address, telephone and fax number, and email address. Include name, title, address, email address, and telephone number of the contact person identified during period of proposal evaluation.

b. Identification of all proposed subcontractors including legal name of company, whether the firm is a Disadvantaged Business Enterprise (DBE), contact person's name and address, phone number and fax number, and email address; relationship between Offeror and subcontractors, if applicable.

c. Acknowledgement of receipt of all RFP addenda, if any.

d. A statement to the effect that the proposal shall remain valid for a period of not less than 180 days from the date of submittal.

e. Signature of a person authorized to bind Offeror to the terms of the proposal.

f. Signed statement attesting that all information submitted with the proposal is true and correct.

3. Technical Proposal

a. Technical Specifications

This section of the proposal should establish evidence that Offerors understand the Technical Specifications in detail and can comply with all requirements to the successful manufacturing of buses, with suggestions intended to improve the technical and operational aspect of the buses. Compliance with performance requirements, proposed vehicle design, proposed construction, forecasted reliability, provided warranties, past performance and experience with the proposed bus platform, type and number of requested deviations, ability to provide all requested and optional items, surveys of other transit operators, among others may be used for this criterion.

(1) Offeror shall provide a narrative addressing the Technical Specifications contained in Section IV of this RFP, which exhibits the Offeror's understanding of the Authority's needs and requirements.

(2) Offeror may also propose enhancements to the Technical Vehicle Specifications which do not materially deviate from the objectives or required content of the program.

(3) Offeror shall complete the General Bus Data Sheet, of the Technical Vehicle Specifications, Section TS 1.32, and furnish any narrative required to explain or qualify the specifications provided in the proposal.

(4) The proposal should include the gross vehicle weight on any single axle per vehicle in compliance with California's Vehicle Code, not to exceed 22,000 pounds on any single axle per vehicle, or as applicable at the time of manufacturing.

(5) Offeror shall state on the form provided in "Contractor Service and Parts Support Data", Exhibit I, the representatives responsible for assisting the Authority, as well as the location of the nearest distribution center which shall furnish a complete supply of parts and components, for the repair and maintenance of the buses to be supplied.

(6) Provide evidence that the human and physical resources are sufficient to perform the contract as specified and assure delivery of all equipment within the time specified in the Contract.

(7) Provide evidence Offeror has adequate manufacturing facilities sufficient to produce and factory-test equipment on schedule. Include a detailed description of the proposed facilities where work will be done.

(8) Propose critical path schedule for the production of the First Article and remaining vehicles as well as the methodology for controlling the schedule.

(9) Provide evidence that Offeror is qualified in accordance with Section VI: Quality Assurance

(10) Provide evidence that Proposer is qualified in accordance with Section VII: Warranty Requirements

b. Qualifications, Related Experience and Project Management

This section of the proposal should establish the ability of the Offeror to satisfactorily provide the required equipment and services by reasons of; demonstrated competence in the product and service to be provided; the nature and relevance of recently completed work; staffing capability, work load and record of meeting schedules on similar projects; strength and stability as a business concern; strength of dealer/manufacturer relationship; and supportive client references.

(1) Provide a brief profile of the firm, including the principal line of business, the year founded, form of organization (corporation, partnership, sole proprietorship), number and location of offices, licenses held, and number of employees. Identify any conditions (e.g. bankruptcy, pending litigation, planned office or plan closures, impending merger) that may impede the Offeror's ability to complete the project.

(2) Describe the firm's experience in providing like equipment to that solicited in this RFP with emphasis on experience in producing CNG vehicles, and highlight the participation in such work by the key personnel. Offeror shall provide names and brief resumes of key personnel including project/account manager and the representatives responsible for assisting the Authority.

(3) A copy of the firm's three (3) most recent financial statements. Offeror's financial statements should be prepared in accordance with United States Generally Accepted Accounting Principles (GAAP) and audited by an independent certified public accountant authorized to practice in the jurisdiction of either the Authority or the Offeror.

(4) Provide evidence of satisfactory performance and integrity on contracts in making deliveries on time, meeting specifications and warranty provisions, parts availability, and steps Offeror has taken to resolve any judgments, liens, fleet defects history, and warranty claims. Evidence shall be by client references.

(5) Identify subcontractors, if any, by company name, address, contact

person, telephone number and project function. Provide the same information for each subcontractor as requested above, and describe any experience working with each subcontractor.

(6) Offeror to provide 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. Provide past maintenance and warranty experience including qualified staff.

(7) Provide as a minimum three (3) references for the projects cited as related experience, and furnish the name, title, address, telephone number, and email address of the person(s) at the client organization who is most knowledgeable about the work performed. Offeror may also supply references from other work not cited in this section as related experience.

(8) Complete and sign all forms required in this RFP including federal certifications: Buy America Certification, Non-Collusion Affidavit, Lobbying Certification, Certificate of Compliance with Bus Testing Requirement, DBE Approval Certification, and Federal Motor Vehicle Safety Standards.

(9) Furnish brief resumes (not more than two (2) pages each) for the proposed key personnel. Resumes must feature experience most directly relevant to the work proposed for such key personnel on this project. Resumes should also describe the involvement of the key personnel in related experience and indicate length of time employed by the Offeror.

(10) Provide engineering organization chart, engineering change control procedure, field modification process, including program controls and quality controls and plans for the coordination of major suppliers and subcontractors. Provide a schedule for the production of the pilot vehicle and remaining vehicles.

(11) Provide evidence Offeror has sufficient engineering, management and services; can provide sufficient personnel and requisite disciplines, licenses, skills, experience, and equipment to complete the contract as required, and satisfy any engineering or service problems that may arise during the warranty period. Provide interface relationship between engineering manufacturing, program control, quality control and test departments

(12) Provide evidence Offeror can provide spare parts and 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.

(13) Training and Documentation

4. Cost and Price Proposal

As part of the cost and price proposal, the Offeror shall submit proposed pricing in a separate sealed package from the technical proposal.

Offer shall complete the "Price Summary Sheet" and Acknowledgement of Receipt of Addenda and Offer" forms included with this RFP (Section V), and furnish any narrative required to explain the prices quoted in the schedules. It is anticipated that the Authority will issue a firm-fixed price contract specifying firm-fixed prices for each bus.

a. Letter of Transmittal

b. Contractor shall be liable for payment of all state and local taxes applicable to the complete bus as delivered. The Authority shall furnish to the Contractor a list of applicable state and local taxes imposed by the Authority's state or local governments at the Due Date. The Authority shall be liable for any such state and local taxes applicable to the complete bus as delivered that are promulgated and become effective between the Due Date and the delivery date. Quantities listed are estimated quantities which shall be used for the purpose of evaluation.

5. Exceptions/Deviations

State any technical and/or contractual exceptions and/or deviations from the requirements of this RFP, including the Authority's technical requirements and contractual terms and conditions set forth in the Technical Specifications (Section IV) and General Terms and Conditions / Proposed Agreement (Section VIII, using the form entitled "Proposal Exceptions and/or Deviations" included in this RFP. This Proposal Exceptions and/or Deviations form must be included in the original proposal submitted by the Offeror. If no technical or contractual exceptions and/or deviations are submitted as part of the original proposal, Offerors are deemed to have accepted the Authority's technical requirements and contractual terms and conditions set forth in the Technical Specifications (Section IV) and General Terms and Conditions / Proposed Agreement (Section VIII). Offerors will not be allowed to submit the Proposal Exceptions and/or Deviations form or any technical and/or contractual exceptions after the proposal submittal date identified in the RFP. Exceptions and/or deviations submitted after the proposal submittal date will not be reviewed by Authority.

All exceptions and/or deviations will be reviewed by the Authority and will be assigned a "pass" or "fail" status. Exceptions and deviations that "pass" do not mean that the Authority has accepted the change but that it is a

potential negotiable issue. Exceptions and deviations that receive a "fail" status means that the requested change is not something that the Authority would consider a potential negotiable issue. Offerors that receive a "fail" status on their exceptions and/or deviations will be notified by the Authority and will be allowed to retract the exception and/or deviation and continue in the evaluation process. Any exceptions and/or deviation that receive a "fail" status and the Offeror cannot or does not retract the requested change may result in the firm being eliminated from further evaluation.

6. Appendices

Information considered by Offeror to be pertinent to this project and which has not been specifically solicited in any of the aforementioned sections may be placed in a separate appendix section. Offerors are cautioned, however, that this does not constitute an invitation to submit large amounts of extraneous materials. Appendices should be relevant and brief.

B. FORMS

1. Campaign Contribution Disclosure Form, Exhibit A

In conformance with the statutory requirements of the State of California Government Code Section 84308, part of the Political Reform Act and Title 2, California Code of Regulations 18438 through 18438.8, regarding campaign contributions to members of appointed Board of Directors, Offeror is required to complete and sign the Campaign Contribution Disclosure Form provided in this RFP and submit as part of the proposal.

This form **must** be completed regardless of whether a campaign contribution has been made or not and regardless of the amount of the contribution.

The prime contractor, subconsultants, lobbyists and agents are required to report all campaign contributions made from the proposal submittal date up to and until the Board of Directors makes a selection.

Offeror is required to submit only **one** copy of the completed form(s) as part of its proposal and it must be included in only the **original** proposal.

2. Status of Past and Present Contracts Form, Exhibit B

Offeror shall complete and sign the form entitled "Status of Past and Present Contracts" provided in this RFP and submit as part of its proposal. Offeror shall identify the status of past and present contracts where the firm has either provided services as a prime vendor or a subcontractor during the past five (5) years in which the contract has been the subject of or may be involved in litigation with the contracting authority. This includes, but is not

limited to, claims, settlement agreements, arbitrations, administrative proceedings, and investigations arising out of the contract. Offeror shall have an ongoing obligation to update the Authority with any changes to the identified contracts and any new litigation, claims, settlement agreements, arbitrations, administrative proceedings, or investigations that arise subsequent to the submission of Offeror's proposal.

A separate form must be completed for each identified contract. Each form must be signed by the Offeror confirming that the information provided is true and accurate. Offeror is required to submit one copy of the completed form(s) as part of its proposals and it should be included in only the original proposal.

3. Disadvantaged Business Enterprise Approval Certification Form, Exhibit C

4. Restrictions on Lobbying Form, Exhibit D

As a recipient of federal funds, the Authority is required to certify compliance with the influencing restrictions and efforts of Offeror to influence federal officials regarding specific procurements in excess of $100,000 that must be disclosed pursuant to section 1352, Title 31, U.S. Code.

This RFP includes, under Exhibit G, the following: a certification form entitled “Certification of Restrictions on Lobbying,” the office of Management and Budget (OMB) Standard Form LLL entitled “Disclosure of Lobbying Activities,” and a document entitled “Limitation on Payments to Influence Certain Federal Transactions.”

The Offeror to this solicitation will be required to complete and submit to the Authority in their proposal, the certification form entitled “Certification of Restrictions on Lobbying” whether or not any lobbying efforts took place. If the Offeror did engage in lobbying activities, then OMB Standard Form LLL “Disclosure of Lobbying Activities” must also be completed and submitted to the Authority.

5. Certification of Consultant Commission and Fees, Exhibit E

6. Buy America Certification, Exhibit F

Pursuant to 49 CFR Part 661, as amended by Section 337 of the Surface Transportation and Uniform Relocation Act of 1987, no federal funds authorized by the Urban Mass Transportation Act of 1964, as amended; 23 USC 103 (e)(4); and Section 14 of the National Capital Transportation Act of 1969 as amended; and which were obligated by the Federal Transit Administration (FTA) after January 6, 1983 shall be obligated by the

Authority unless steel and manufacturers' products used in such articles are produced in the United States.

A bidder providing articles that do not meet the above provision must submit a written request to the Authority, which may be forwarded, to FTA. FTA shall review the request for waiver and FTA may grant such a waiver if FTA determines that:

1. The application of the domestic preference requirements would be inconsistent with the public interest; Materials are not produced in the United States in sufficient and reasonably available quantities and of a satisfactory quality; or

2. The inclusion of a domestic item or domestic material will increase the cost of the contract for the item or material by more than 25 percent.

FTA may grant a waiver in the case of the procurement of buses and other rolling stock (including train control, communications and traction power equipment), if the cost of components and subcomponents of such items which are produced in the United States is more than 60 percent for contracts entered into after April 1, 1992 with any supplier or contractor or any successor in interest or assignee which complied with the requirements of Section 165(b)(3) of the Surface Transportation Assistance Act of 1982 prior to April 2, 1987.

To determine costs of components or subcomponents for compliance with the Buy America Requirements, the bidder is referred to the Federal Register, Volume 56, No. 6, Dated January 9, 1991.

In order to demonstrate compliance with the Buy America Requirements, bidder shall complete the Certificates of Compliance/Noncompliance, included in this RFP. Failure to complete the appropriate certificate shall render a bidder non-responsive to this solicitation and will result in the rejection of the bid.

7. Certificate of Compliance with Bus Testing Requirement, Exhibit G

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.

8. Federal Motor Vehicle Safety Standards (FMVSS), Exhibit H

Offeror 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.

9. Contractor Service and Parts Support Data, Exhibit I

Offeror shall state on the form provided in “Contractor Service and Parts Support Data”, the representatives responsible for assisting the Authority, as well as the location of the nearest distribution center which shall furnish a complete supply of parts and components, for the repair and maintenance of the buses to be supplied.

10. Non-Collusion Affidavit, Exhibit J

Certifies that proposers are not in collusion to restrict competition or are otherwise engaged in ani-competitive practices.

11. Proposal Exceptions and/or Deviation Form, Exhibit K

Offerors shall complete the form entitled “Proposal Exceptions and/or Deviations” provided in this RFP and submit it as part of the original proposal. For each exception and/or deviation, a new form should be used, identifying the exception and/or deviation and the rationale for requesting the change. Exceptions and/or deviations submitted after the proposal submittal date will not be reviewed nor considered by the Authority.

SECTION III: EVALUATION AND AWARD

SECTION III. EVALUATION AND AWARD

A. EVALUATION CRITERIA

The Authority will evaluate the offers received based on the following criteria:

1. Technical Requirements **50%**

Offeror's understanding of the Authority's needs and requirements; proposed enhancements to the Technical Vehicle Specifications; compliance with performance requirements; proposed vehicle design; proposed construction, forecasted reliability, provided warranties, gross vehicle weight requirement, quality assurance; past experience with the proposed bus platform; complete the General Bus Data Sheet; exceptions to or deviations from the requirements of this RFP, segregating "technical" exceptions from "contractual" exceptions; ability to meet proposed delivery dates; warranty coverage.

2. Qualifications, Related Experience and Project Management **20%**

Demonstrate competence in the product and service to be provided; the nature and relevance of recently completed work; staffing capability, work load and record of meeting schedules on similar projects; strength and stability as a business concern; strength of dealer/manufacturer relationship; and supportive client references; understanding the Authority's needs; federal compliance; the logic of the Proposer's proposed project organization as measured by lines of reporting and control; adequacy of labor resources; lead time, reasonableness of proposed schedule; training and documentation.

3. Cost and Price **30%**

Reasonableness of the total price competitiveness with other offers received; adequacy of data in support of figures quoted and completion of required documentation.

B. EVALUATION PROCEDURE

An evaluation committee will be appointed to review all proposals received for this RFP. The committee is comprised of Authority staff and may include outside personnel. The committee members will evaluate the written proposals using criteria identified in Section III A. A list of top ranked proposals, firms within a competitive range, will be developed based upon the totals of each committee members' score for each proposal.

During the evaluation period, the Authority may interview some or all of the proposing firms. The Authority has established April 7, 2020, as the date to conduct interviews. All prospective Offerors are asked to keep this date available. No other interview dates will be provided, therefore, if an Offeror is unable to attend the interview on this date, its proposal may be eliminated from further discussion. The interview may consist of a short presentation by the Offeror after which the evaluation committee will ask questions related to the firm's proposal and qualifications.

At the conclusion of the proposal evaluations, Offerors remaining within the competitive range may be asked to submit a Best and Final Offer (BAFO). In the BAFO request, the firms may be asked to provide additional information, confirm or clarify issues and submit a final cost/price offer. A deadline for submission will be stipulated.

At the conclusion of the evaluation process, the evaluation committee will recommend to the Transit Committee, the Offeror with the highest final ranking or a short list of top ranked firms within the competitive range whose proposal(s) is most advantageous to the Authority. The Board Committee will review the evaluation committee's recommendation and forward its decision to the full Board of Directors for final action.

C. AWARD

The Authority will evaluate the proposals received and will submit, with approval of the Transit Committee, the proposal considered to be the most competitive to the Authority's Board of Directors, for consideration and selection. The Authority may also negotiate contract terms with the selected Offeror prior to award, and expressly reserves the right to negotiate with several Offerors simultaneously and, thereafter, to award a contract to the Offeror offering the most favorable terms to the Authority.

The Authority reserves the right to award its total requirements to one Offeror or to apportion those requirements among several Offerors as the Authority may deem to be in its best interest. In addition, negotiations may or may not be conducted with Offerors; therefore, the proposal submitted should contain Offeror's most favorable terms and conditions, since the selection and award may be made without discussion with any Offeror.

The selected Offeror will be required to submit to the Authority's Accounting department a current IRS W-9 form prior to commencing work.

D. NOTIFICATION OF AWARD AND DEBRIEFING

Offerors who submit a proposal in response to this RFP shall be notified via CAMM NET of the contract award. Such notification shall be made within three (3) business days of the date the contract is awarded.

Offerors who were not awarded the contract may obtain a debriefing concerning the strengths and weaknesses of their proposal. Unsuccessful Offerors, who wish to be debriefed, must request the debriefing in writing or electronic mail and the Authority must receive it within three (3) business days of notification of the contract award.

E. CONTRACT EXECUTION

The Authority's intent is to enter into a contract for a first article bus only, to issue a notice to proceed for the first article bus, and upon successful approval and correction of all discrepancies to the Authority's satisfaction, noted and/or detected on the first article, validation testing of the first article including forty-hours of uninterrupted (no breakdowns) revenue-service testing, the Authority may issue a second notice to proceed for the initial order of production buses and options that may be exercised at the Authority's discretion, for possible future deliveries.

The process shall consist of the following steps:

1. Proposal, evaluation, award and written notice to proceed for the manufacturing of a first article bus and intent for first production award based upon evaluation and successful acceptance of the first article bus, which shall require extensive testing of up to sixteen weeks.

2. Upon acceptance of the first article bus, the Authority may issue a written "Notice to Proceed" for the initial production & delivery.

3. Upon acceptance of the first production run, or at the Authority's discretion, the Authority will determine whether to exercise option one for the next production of buses.

4. Upon the decision of the Authority, a written notice will be sent to the Contractor informing the Contractor of the decision to continue ("Notice to Proceed"), or not.

5. The Authority, at its sole discretion, may choose to change the delivery requirements based on its internal needs.

6. At the Authority's discretion, a second first-article bus may be required if significant changes or others are introduced throughout the yearly manufacturing processes.

F. NOTICE TO PROCEED

It is a requirement for the Contractor to secure the Authority's "Notice to Proceed" with the manufacturing of the first-article bus and the additional "Notice to Proceed" with the manufacturing of any production run. Every additional Authority exercised

option and/or first article if deemed required, shall also require the issuing of individual “Notices to Proceed”.

Contractor does not have the Authority’s approval to, on its behalf or as intended for any portion of the award, to enter into any agreements, procure materials, order components, parts, supplies, etc., and any others intended for any buses under this agreement except for the units listed on the Authority’s individual “Notice to Proceed” previously secured by the Contractor. If the Contractor fails to fulfill this requirement it is understood that the Contractor’s deviation is done at the Contractor’s own peril and risk, and the Authority and/or any of its representatives, employees and officials shall have no responsibility, of any kind, nor shall the Authority have any financial obligation as to any and all components, parts, resources, ordered by the Contractor without prior securing of the required “Notice(s) to Proceed”.

The Authority expects to take delivery of the pilot bus/First Article, no later than forty-five (45) weeks after issuing the first notice to proceed, having an estimated time of arrival to the Authority sometime during the first half of the year 2021. Then, after evaluation and acceptance of the First Article for up to sixteen (16) weeks, the Authority will issue a second notice to proceed with the production run of up to 298 buses, requiring the buses to commence arrival to the Authority by the end of June 2022, on a continuous basis, at the rate of two (2) buses per week, or as agreed upon, to have all buses delivered by June 2025.

G. CONFIDENTIALITY OF PROPOSALS

Access to government records is governed by the laws of the State of California. Except as otherwise required by the laws of the State of California, the Authority will exempt from disclosure proprietary information, trade secrets and confidential commercial and financial information submitted in the proposal. Any such proprietary information, trade secrets or confidential commercial and financial information which Offeror believes should be exempted from disclosure shall be specifically identified and marked as such. Blanket-type identification by designating whole pages or sections as containing proprietary information, trade secrets or confidential commercial and financial information will not assure confidentiality. The specific proprietary information, trade secrets or confidential commercial and financial information must be clearly identified as such.

Upon a request from a third party for materials designated by an Offeror as proprietary, trade secrets and/or confidential, the Authority will promptly notify the Offeror of said request in order to provide the Offeror the ability to seek protection of such identified information by way of a protective order. Offeror shall indemnify the Authority for any and all costs associated with its refusal to produce such identified information.

H. ACCEPTANCE/REJECTION OF PROPOSALS

Authority reserves the right to reject any or all proposals for sound business reasons, to undertake discussions with one or more Offeror, and to accept that proposal or modified proposal which, in its judgment, will be most advantageous to the Authority, price and other evaluation criteria considered. Authority reserves the right to consider any specific proposal which is conditional or not prepared in accordance with the instructions and requirements of this RFP to be noncompetitive. Authority reserves the right to waive any defects, or minor informalities or irregularities in any proposal which do not materially affect the proposal or prejudice other Offerors. If there is any evidence indicating that two or more Offerors are in collusion to restrict competition or otherwise engaged in anti-competitive practices, the proposals of all such Offerors shall be rejected and such evidence may be a cause for disqualification of the participants in any future solicitations undertaken by the Authority.

I. SINGLE PROPOSAL RESPONSE

If only one proposal is received in response to this RFP and it is found by the Authority to be acceptable, a detailed price/cost proposal may be requested of the single Offeror. A price or cost analysis, or both, possibly including an audit, may be performed by or for the Authority of the detailed price/cost proposal in order to determine if the price is fair and reasonable. Offeror has agreed to such analysis by submitting a proposal in response to this RFP. A price analysis is an evaluation of a proposed price that does not involve an in-depth evaluation of all the separate cost elements and the profit factors that comprise Offeror's price proposal. It should be recognized that a price analysis through comparison to other similar procurements must be based on an established or competitive price of the elements used in the comparison. The comparison must be made to a purchase of similar quantity, involving similar specifications and in a similar time frame. Where a difference exists, a detailed analysis must be made of this difference and costs attached thereto. Where it is impossible to obtain a valid price analysis, it may be necessary to conduct a cost analysis of the proposed price. A cost analysis is a more detailed evaluation of the cost elements in the Offeror's offer to perform. It is conducted to form an opinion as to the degree to which the proposed costs represent what the Offeror's performance should cost. A cost analysis is generally conducted to determine whether the Offeror is applying sound management in proposing the application of resources to the contracted effort and whether costs are allowable, allocable and reasonable. Any such analyses and the results therefrom shall not obligate the Authority to accept such a single proposal; and the Authority may reject such proposal at its sole discretion.

SECTION IV: TECHNICAL SPECIFICATIONS

TECHNICAL SPECIFICATIONS

TECHNICAL SPECIFICATIONS

TS 1.1 General

Scope

The Orange County Transportation Authority (Authority) intends to purchase up to 299, 40FT buses to be delivered in the years 2021 through 2025.

It is the Authority's intention to purchase new low floor buses that are fully compliant with the Americans with Disabilities Act of 1990 (ADA). If ADA's requirement exceeds these specifications, then the contractor shall comply with ADA. Buses shall incorporate features essential for safe, fast, efficient, and comfortable operation by the operator to ensure excellent road and traffic visibility, as well as adequate means for safe passenger movement, under all driving conditions. Buses shall be easily maneuverable in normal and heavy traffic.

These technical specifications are intended to provide a general description of a forty-foot, low floor CNG bus designed for general service in all areas of Orange County for both suburban express service and general service on urban arterial streets in addition to potential express service into any of the neighboring Counties of Los Angeles, Riverside, San Bernardino, etc. These buses are intended for use by the widest possible spectrum of passengers, including children, adults, the elderly and handicapped. The bus shall have a minimum expected life of twelve (12) years or 500,000 miles whichever comes first

These buses shall provide maximum passenger appeal in appearance, comfort, and safety; combined with excellence in operating characteristics, economy of operation, optimum seating and conformity with state and federal bus regulations and emission standards. These buses shall incorporate a high level of subsystem integration coordinated with central diagnostic functions and single point operator interface.

These technical specifications have been prepared with emphasis on in-service reliability. The basic structure of the bus, bolted on components, including major suspension components that shall be designed to last the life of the bus without major overhaul or replacement.

The Contractor shall conform to these technical specifications and shall not omit any unit or component or both, part or detail to make these buses ready for service, even though such part or detail is not mentioned in these specifications. In absence of a specification, the Contractor shall adhere to its manufacturing standards. No changes or substitutions are permitted without the prior written consent of the Authority. This procurement will allow retirement of older buses of the revenue fleet. The Authority's overall objective for purchase, design and operation of these CNG buses shall be to satisfy the following requirements:

- Safe and Reliable in Operation
- Economic to Purchase, Operate and Maintain
- Optimized Performance, Emissions and Fuel Consumption
- Full compliance with all applicable rules, regulations and standards in place at the time of manufacturing

TS 1.2 DEFINITIONS

The following are definitions of the terminology used in this technical specification:

dBA. Decibels with reference to 0.0002 microbar as measured on the "A" scale.
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.
Standee Line. A line marked across the bus aisle to designate the forward area that passengers may not occupy when the bus is moving.
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 square feet shall be allocated for the feet of each seated passenger that protrudes into the standee area.
Curb Weight. Weight of bus, including maximum fuel, oil and coolant and all equipment required for operation and required by this specification, but without passengers or operator.
Seated Load. One hundred fifty pounds for every designed passenger seating position and for the operator.
Gross Load. One hundred fifty pounds for every designed passenger seating position, for the operator, and for each 1.5 square feet of free floor space.
SLW (Seated Load Weight). Curb weight plus seated load.
GVW (Gross Vehicle Weight). Curb weight plus gross load.
GVWR (Gross Vehicle Weight Rated). The maximum total weight as determined by the bus manufacturer, at which the bus can be operated safely and reliably for its intended purpose.
GAWR (Gross Axle Weight Rated). The maximum total weight as determined by the axle manufacturer, at which the axle can be operated safely and reliably for its intended purpose.
Heavy Heavy-Duty (Natural Gas) Engine (HHDG). Heavy heavy-duty natural gas engines have sleeved cylinder liners, are designed for multiple rebuilds, and a rated horsepower that generally exceeds 250.
Operator's Eye Range. The 95th-percentile ellipse defined in SAE Recommended Practice J941, except that the height of the ellipse shall be determined from the seat at its reference height.
Fireproof. Materials that will not burn or melt at temperatures less than 2,000° F.
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.
Human Dimensions. The human dimensions used in these technical specifications are defined in Humanscale 1/2/3, N. Diffrient, A. R. Tilley, J. C. Bardagjy, MIT Press.
HIC (Head Injury Criteria). The following equation presents the definition of head injury criteria:

$$\left[\frac{1}{t_2 - t_1}\int_{t_1}^{t_2}(a)dt\right]^{2.5}(t_2 - t_1)$$

where:

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

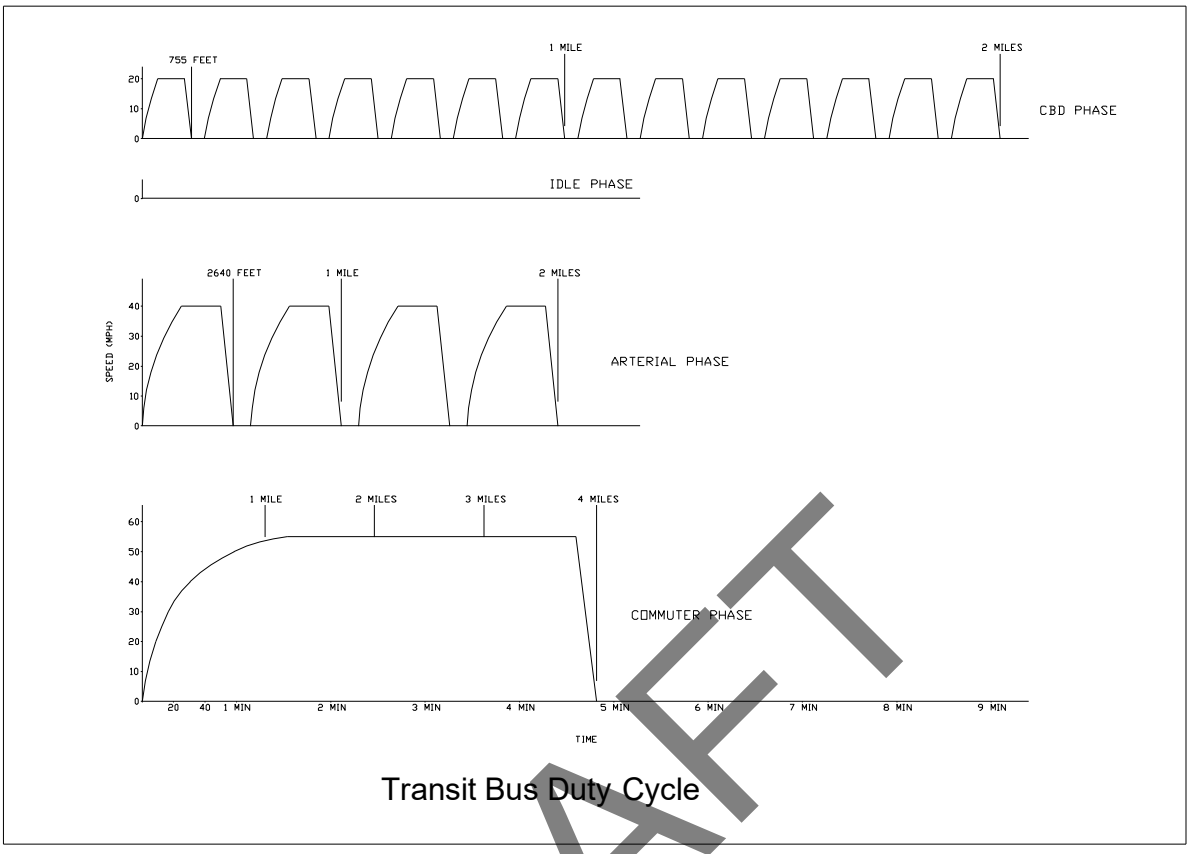
t_1 and t_2 = any two points in time during the impact.

Baseline Configuration Bus. The bus as described in these technical specifications if no alternatives are selected. Signing, colors, the destination sign reading list and other information must be provided by the Authority in attachments to these technical specifications.

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

Design Operating Profile. The operating profile for design purposes shall consist of simulated transit type service. The duty cycle is described in the figure "Transit Bus Duty Cycle." The duty cycle consists of three phases to be repeated in sequence: a central business district (CBD) phase of 2 miles with 7 stops per mile and a top speed of 20 mph, an arterial route phase of 2 miles with 2 stops per mile and a top speed of 40 mph, and a commuter phase of 4 miles with 1 stop and a maximum speed of 65 mph and a 5 minute idle phase.

Phase	Stops/ Mile	Top Speed (mph)	Miles	Accel. Dist. (ft.)	Accel. Time (s)	Cruise Dist. (ft.)	Cruise Time (s)	Decel. Rate (fpsps)	Decel. Dist. (ft.)	Decel. Time (s)	Dwell Time (s)	Cycle Time (min-s)	Total Stops
CBD	7	20	2	155	10	540	18.5	6.78	60	4.5	7	9-20	14
Idle	-	-	-	-	-	-	-	-	-	-	-	5-0	-
Arterial	2	40	2	1035	29	1350	22.5	6.78	255	9	7	4-30	4
CBD	7	20	2	155	10	510	18.5	6.78	60	4.5	7	9-20	14
Arterial	2	40	2	1035	35	1350	22.5	6.78	255	9	7	4-30	4
CBD	7	20	2	155	10	510	18.5	6.78	60	4.5	7	9-20	14
Commuter	1 stop for phase	Max. or 55	4	5500	90	2 miles + 4580 ft.	188	6.78	480	12	20	5-10	1
Total			14									47-10	51
Average Speed - 17.8 mph													



Transit Bus Duty Cycle

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

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

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

Class of Failures. Classes of failures are described below.

Class 1: Physical Safety. A failure that could lead directly to passenger or operator injury or represents a severe crash situation.

Class 2: 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.

Class 3: Bus Change. A failure that requires removal of the bus from service during its assignments. The bus is operable to a rendezvous point with a replacement bus.

Class 4: Bad Order. A failure that does not require removal of the bus from service during its assignments but does degrade bus operation. The failure shall be reported by operating personnel.

Maintenance Personnel Skill Levels. Defined below are maintenance personnel skill levels used in these Technical Specifications.
Specialist Mechanic, to include, body, electronics, machinist and upholstery
Journeyman or Class A Mechanic
Service worker, to include, runner, cleaner and fueler
In attachments to these Technical Specifications, the Authority may relate the skill levels and ratings of mechanics in its operation to the above definitions.
Note: Whenever a specific time is indicated to access components or complete a task, it is assumed the bus is in the location where the work is to be performed. All necessary equipment is in its correct position (tools, jacks, bus lifts, lighting, fluid recovery systems, etc.) and ready for use.
Standards. Standards referenced in Part 5: Technical Specifications are the latest revisions unless otherwise stated.
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 inches in width and 48 inches in length measured two inches above the ground and does not weigh more than 600 pounds when occupied.
Structure. The structure shall be defined as the basic body, including, the main frame, axle housings, axle suspension beams, component supporting cradles, sidewall/roof tube support structure, floor support structure, floor deck material and installation, load bearing external panels, structural components, axle mounting provisions and attachment points.
Low Floor Bus. A bus, which, between at least the front (entrance) and rear (exit) doors, has a floor sufficiently low, and level to remove the need for steps in the aisle between the doors and near these doors.
Discrete Signals. A signal which 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.
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.
Serial Data Signals. Serial data signals are 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.
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.
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 shall include, but is not limited to, reducer/regulator valves, fuel-metering equipment (e.g. carburetor, injectors), sensors (e.g. main throttle, wastegate).
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).
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).
Code. A legal requirement.
Defueling. The process of removing fuel from a bus.
Defueling Port. Device, which allows for, or point at which, a bus is defueled.
Destroyed. Physically made permanently unusable.
Fuel Line. The pipe, tubing, or hose on a bus, including all related fittings, through which fuel passes.
Fusible Material. A metal, alloy, or other material capable of being melted by heat.
Labeled. Equipment or materials to which has been attached a label, symbol, or other identifying mark of an organization, that is acceptable to the authority having jurisdiction and concerned with product evaluation, that maintains periodic inspection of production labeled equipment or materials, and by whose labeling the manufacturer indicates compliance with appropriate standards or performance in a specified manner.
Leakage. Release of contents through a defect or crack.
Lower Explosive Limit (LEL). 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.
Operating Pressure. The varying pressure that is developed in a container during service.
Pressure Activated Gas Relief Device. A pressure or temperature activated device, or both 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 devise is 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.
Rupture. Sudden and unstable damage propagation in the structural components of the container resulting in a loss of contents. See "Leakage."
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.
Stress Loops. The "pig-tails" commonly used to absorb flexing in piping
Sources of Ignition. Devices or equipment those, because of their modes of use or operation, can provide enough 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

TS 1.3 ABBREVIATIONS

The following is a list of abbreviations used in these Technical Specifications.

(1)	ADA	Americans with Disabilities Act
(2)	ANSI	American National Standards Institute
(3)	APTA	American Public Transportation Association
(4)	ASHRAE	American Society of Heating, Refrigerating and Air Conditioning Engineers
(5)	ASTM	American Society for Testing and Materials
(6)	CAN/CGA	Canadian Gas Association

(7)	CFR	Code of Federal Regulations
(8)	CGA	Compressed Gas Association
(9)	CHP	California Highway Patrol
(10)	CNG	Compressed Natural Gas
(11)	DOE	U.S. Department of Energy
(12)	DOT	U.S. Department of Transportation
(13)	EMI	Electromagnetic Interference
(14)	EPA	U.S. Environmental Protection Agency
(15)	FMEA	Failure Modes and Effects Analysis
(16)	FMCSR	Federal Motor Carrier Safety Regulations
(17)	FMVSS	Federal Motor Vehicle Safety Standards
(18)	FTA	U.S. Federal Transit Administration
(19)	IAS	International Approval Services
(20)	I/O	Input/output
(21)	ISO	International Organization for Standardization
(22)	JIC	Joint Industrial Council
(23)	LED	Light Emitting Diode
(24)	LEL	Lower Explosive Limit
(25)	ALTD	Armored Linear Thermal Device
(26)	MAWP	Maximum Allowable Working Pressure
(27)	MPH	Miles Per Hour
(28)	NAFTP	The National Alternative Fuel Training Program
(29)	NATEF/SAE	The National Automotive Technicians Education Foundation/ Automotive Service Excellence
(30)	NFPA	National Fire Protection Association
(31)	NGV	Natural Gas Vehicle
(32)	NHTSA	National Highway Traffic Safety Administration
(33)	OEM	Original Equipment Manufacturer
(34)	OSHA	Occupational Safety and Health Administration
(35)	PRD	Pressure Relief Device
(36)	RFI	Radio Frequency Interference
(37)	SAE	Society of Automotive Engineers
(38)	SPI	Society of the Plastics Industry
(39)	TRC	Texas Railroad Commission
(40)	UL	Underwriters Laboratories
(41)	USDOT	United States Department of Transportation

TS 1.4 REFERENCED PUBLICATIONS

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

TS 1.5 LEGAL REQUIREMENTS

The contractor shall comply with all applicable Federal, state and local regulations. Local regulations are defined as those below the state level. These shall include, but not be limited to, Federal ADA as well as state and local accessibility, safety and security requirements. The bus shall meet all applicable Federal Motor Vehicle Safety Standards and shall accommodate all applicable Federal Motor Carrier Safety Regulations in effect at the date of manufacture. The bus shall meet CA Title 13 Vehicle Code regulations. In the event of any conflict between the requirements of this specification and any applicable legal requirement, the legal requirement shall prevail. Technical requirements that exceed the legal requirements are not considered to conflict.

TS 1.6 OVERALL REQUIREMENTS

Contractor shall ensure that the application and installation of major bus sub-components and systems are compliant with all such sub-component vendors' requirements and recommendations. Components used in the bus shall be of heavy-duty design and proven in transit service. Overall, the bus shall be assembled per an inclusive design plan, to include selection, location and application of components, routing and securement of harnesses, piping, hoses, hoses, fittings, fasteners, etc. The following general guidelines shall apply unless specifically addressed otherwise:

The use/length of flexible piping should be minimized. The quantity of fittings shall be minimized (unnecessary use of bushings, adapters, etc.) and SAE O-ring / JIC flare type fittings used as available in place of NPT. NPT fittings shall not be used in any part of the fuel system prior to obtaining the Authority's written consent.

Fasteners shall not be of excessive length and critical fasteners subject to loosening shall incorporate a locking mechanism, such as, pinned, safety wire, thread locking adhesive, interference nuts, etc.

Piping and all cables shall be routed in a parallel fashion and be retained by split type mounting blocks using pinch bolts; therefore, the use of "P" clamps shall not be allowed, and the use of traditional tie straps shall not be permitted. As an alternative, Hellermann Tyton type/style of fasteners, clamps are acceptable.

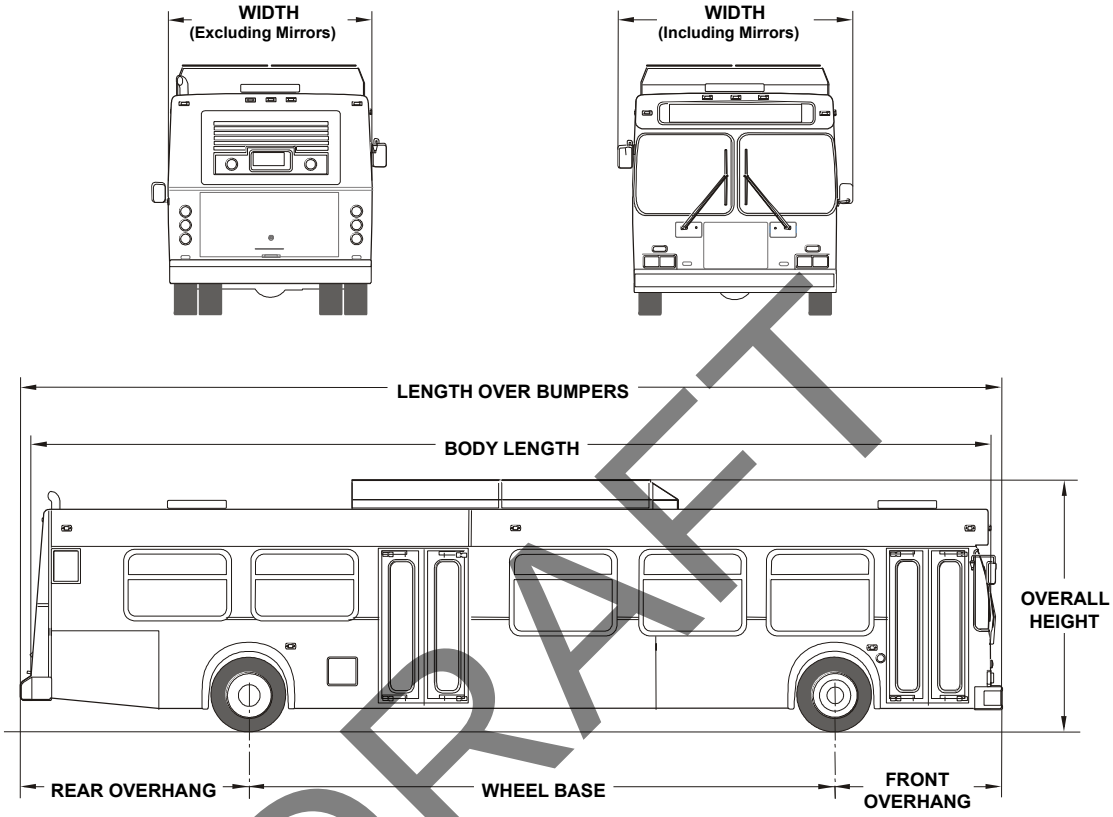
Current natural gas-powered engines in conjunction with the all-electric-cooling packages generates excessive temperatures in the engine compartments and as such, all fluid carrying hoses, plumbing, etc., that are not made of stainless steel, shall be rated to operate at a minimum of 350 degrees F or higher. This requirement shall include all components intended for placement in any such environment; e.g., electrical cables, wire harnesses, fasteners, pipes, fittings, valves, solenoids, controllers, etc.

TS 1.7 DIMENSIONS

1.7.1 Physical Size

With the exceptions of exterior mirrors, marker and signal lights, bumpers, fender skirts, washers, wipers, ad frames and rub rails, the bus shall have the following overall dimensions as shown in the figure "Transit Bus Exterior Dimensions" at static conditions and design height.

Body Length: 40 feet ± 3 inches
Body Width: 102 inches (+0, -1 inch)
Maximum Overall Height: 140 inches, includes all rigid roof mounted items such as A/C, exhaust, fuel system and cover, etc.



TRANSIT BUS EXTERIOR DIMENSIONS

1.7.2 Underbody Clearance

The bus shall maintain the minimum clearance dimensions as shown in the figure "Transit Bus Minimum Road Clearance" and defined in SAE Standard J689, regardless of load up to the gross vehicle weight rating.

Ramp Clearances. Approach angle shall be no less than 8.5 degrees. Break over angle shall be no less than 8 degrees. Departure angle shall be no less than 9 degrees.

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

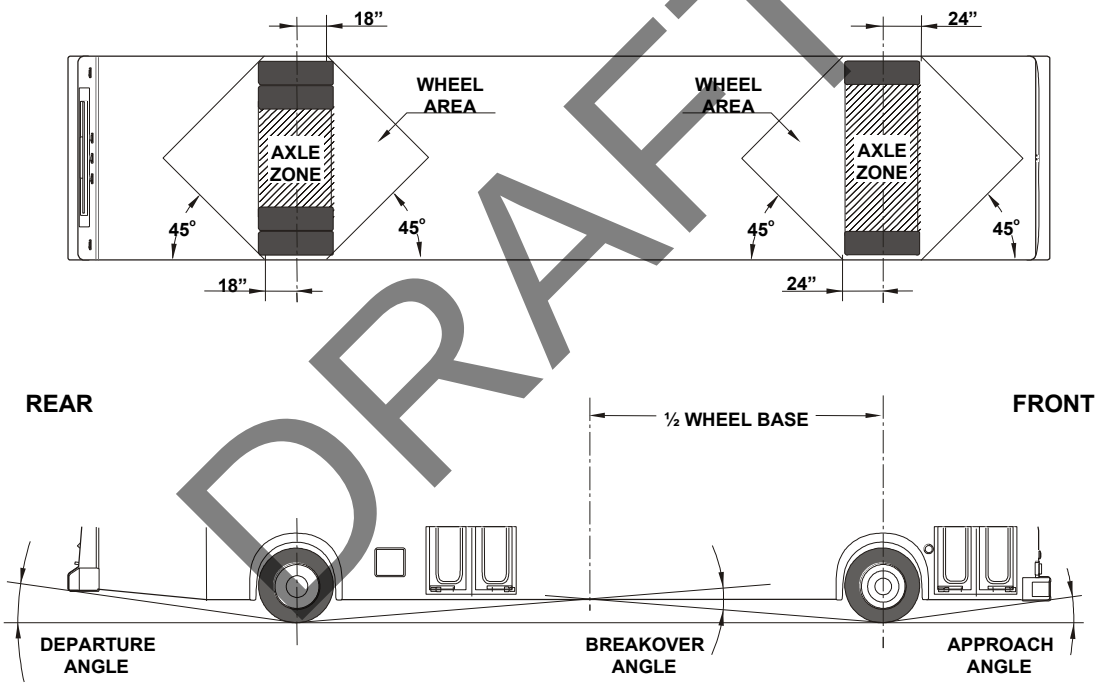
The departure angle is the angle measured between a line tangent to the rear tire static loaded radius arc and the initial point of structural interference rearward of the rear tire to the ground.

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

Ground Clearance. Ground clearance shall be no less than 10 inches, except within the axle zone and wheel area.

Axle Clearance. Axle zone clearance, which is the projected area between tires and wheels on the same axial centerline, shall be no less than 5½ inches.

Wheel Area Clearance. Wheel area clearance shall be no less than 8 inches for parts fixed to the bus body and 6 inches for parts that move vertically with the axles.



TRANSIT BUS MINIMUM ROAD CLEARANCE

1.7.3 Floor Height

Height of the floor above the street shall be no more than 15 inches measured at the centerline of the front and rear doorway. The floor may be inclined along the longitudinal axis of the bus, and the incline shall be less than 3 1/2° off the horizontal except locally at the doors where 2° slope toward the door is allowed. All floor measurements shall be with the bus at the design running height and on a level surface and with the standard tires.

1.7.4 Interior Headroom

Headroom above the aisle and at the centerline of the aisle seats shall be no less than 78 inches in the forward half of the bus tapering to no less than 74 inches forward of the rear settee. At the centerline of the window seats, headroom shall be no lower than 65 inches. Headroom at the back of the rear bench seat may be reduced to a minimum of 56 inches, 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/her head, padding shall be provided on the overhead paneling.

1.7.5 Weight

The preferred maximum curb weight of the bus is 31,000 pounds. The maximum GVWR on any one axle shall not exceed 22,000 Lbs., or as applicable by code/law at the time of manufacturing.

1.7.6 Capacity

The bus shall be designed to carry the Gross Vehicle Weight which shall not exceed the bus GVWR.

1.7.7 Service Life and Maintenance

1.7.7.1 Service Life

The bus shall be designed to operate in transit service for at least 12 years or 500,000 miles and be capable of operating at least 40,000 miles per year including the twelfth year.

1.7.7.2 Maintenance and Inspection

Scheduled maintenance or inspection tasks as specified by the Contractor shall require a skill level of journeyman mechanic or less. Scheduled maintenance tasks shall be related and shall be, in general, at intervals of 6,000 miles (along with routine daily service performed during the fueling operations).

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

Additionally, oil sample extraction fittings shall be provided as a part of the engine and transmission, as available through the Titan Oil Lab, Part #OD1014, or approved equal. The Authority shall approve the fastening and location of these fittings.

1.7.7.3 Maintainability Requirements

Following are maintenance requirements stated in mean time to fix (MTTF). Unless specified otherwise, these numbers represent the total elapsed labor time in hours and minutes required to complete the indicated maintenance tasks by one journeyman mechanic. These figures do not include time required to bring the vehicle to the shop, hoist setting, etc.

INSPECTION	
Daily Operation pre trip inspection (standard AUTHORITY bad order –BO- card	10 min.
Daily maintenance inspection	8 min.
6,000-mile inspection interval	7.5 hr.
REMOVAL AND REPLACEMENT OF	
HVAC blower motor	1 hr.
HVAC condenser motor	1 hr.
To gain access for door motor adjustment	2 min.
Batteries set	45 min.
Brake application valve	1 hr.
Brake inspection	15 min.
Electronic unit (plc module, relay, fuses, etc.)	15 min.
Exterior mirrors	5 min.
Starter motor	1.5 hr.
Lamps, passenger lights	15 min.
Alternator	1 hr.
Operator seat	30 min.
Power steering gear box assembly	2 hr.
Radiator (2 journeyman mechanics)	2 hr.
Seat insert	2 min.
Shock absorber (each)	45 min.
Wheel change, front	45 min.
Wheel change, rear	1 hr.
Window glassing passenger	15 min.
Window guard or protection, passenger and door	10 min.
Wiper motor	20 min.
Wire harness assembly (other than main body harness)	30 min.

1.7.7.4 Maintainability Demonstrations

The Contractor shall be required to demonstrate these maintenance tasks using the information contained in the service and parts manuals. The demonstration shall be conducted on the first article vehicle, may occur at the Authority facilities, and shall be certified by the Authority's Training Department. Should a failure of the demonstration occur, the Contractor shall revise the vehicle design or service manual information as necessary and re-demonstrate the procedure on the first article vehicle. The purpose of these demonstrations is to validate the maintenance manual, special tool requirements and MTTF.

1.7.7.5 Accessibility

All systems or components subject to periodic maintenance or that are subject to periodic failures shall be readily accessible for service and inspection. To the extent practicable, removal or physical movement of components unrelated to the specific maintenance or repair tasks or both involved shall be unnecessary.

As a goal, relative accessibility of components, measured in time required to gain access, shall be inversely proportional to frequency of maintenance and repair of the components.

1.7.7.6 Interchangeability

Components with identical functions shall be interchangeable to the extent practicable. These components shall include, but 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. A component shall not be used in an application for which it was neither designed nor intended.

Any one component or unit used in the construction of these buses shall be an exact duplicate in design, manufacture, and assembly for each bus in each order group in this Contract.

1.7.7.7 Operating Environment

The bus shall operate normally under all environmental conditions usually occurring in the Authority's service area. Specific conditions include ambient temperatures, which range between 30º F and 125º F, at relative humidity between 5 percent and 100 percent, and at altitudes as high as 3,000 feet above sea level.
Speed, grade ability, and acceleration performance requirements shall be met at, or corrected to, 77° F, 29.31 inches Hg, dry air per SAE J1995 including all accessories and air conditioning system.

1.7.8 Noise

1.7.8.1 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 less at any point inside the bus. These conditions shall prevail with all openings, including doors and windows, closed and with the engine and accessories switched off.

The bus-generated noise level experienced by a passenger at any seat location in the bus shall not exceed 83 dBA and the operator shall not experience a noise level of more than 75 dBA under the following test conditions. The bus shall be empty except for test personnel, not to exceed four persons, and the test equipment. All openings shall be closed, and all accessories shall be operating during the test. The bus shall accelerate at full throttle from a standstill to 35 mph on level commercial asphalt or concrete pavement in an area free of large reflecting surfaces within 50 feet of the bus path. During the test, the ambient noise level in the test area shall be at least 10 dBA lower than the bus under test. Instrumentation and other general requirements shall conform to SAE Standard J366. If the noise contains an audible discrete frequency, a penalty of 5 dBA shall be added to the sound level measured.

1.7.8.2 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 or below 35 mph at curb weight. The maximum noise level generated by the bus pulling away from a stop at full power shall not exceed 83 dBA. The bus-generated noise at curb idle shall not exceed 65 dBA. If the noise contains an audible, discrete frequency a penalty of 5 dBA shall be added to the sound level measured. All noise readings shall be taken 50 feet from and perpendicular to, the centerline of the bus with all accessories operating. Instrumentation, test sites, and other general requirements shall be in accordance with SAE Standard J366. The pull away test shall begin with the front bumper even with the microphone. The curb idle test shall be conducted with the rear bumper even with the microphone.

1.7.9 Fire Safety

The bus shall be designed and manufactured in accordance with all applicable fire safety and smoke emission regulations. These provisions shall include the use of fire-retardant/low-smoke materials, fire detection systems, fire suppression, firewalls, and facilitation of passenger evacuation. In recognition of the high exhaust temperatures experienced, the construction of areas directly surrounding the exhaust stack shall be done using fire-retardant/low-smoke materials. Design of this area shall be such that any material ejected from the exhaust stack will not cause ignition or degradation of the surfaces in the immediate vicinity surrounding the stack.

The selection of fire-retardant materials, as available, shall extend to fluids as well, such as hydraulic oil, power steering fluid, fluids used as transfer media at heat exchangers, etc. Particular attention to this requirement shall apply to fluids typically used in areas of high heat (engine compartment, exhaust piping/muffler area, turbo charger/turbine).

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, dated October 20, 1993. Materials entirely enclosed from the passenger compartment, such as insulation within the sidewalls, need not comply. In addition, smaller components and items, such as seat grab rails, switch knobs and small light lenses, shall be exempt from this requirement.

1.7.10 Elderly And Disabled Passengers

Contractor shall comply with all applicable Federal requirements defined in the Americans with Disabilities Act, 49 CFR Part 38, and all state and local regulations regarding mobility-impaired persons.

1.7.11 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 generated by the Authority when maintaining the bus in accordance with the procedures contained in the manufacturer's maintenance manuals. The manufacturer shall use, whenever possible, light emitting diode, LED, lighting tubes with cleanable filters, and non-asbestos brake blocks and gaskets. In accordance with Section 6002 of the Resource Conservation and Recovery Act, the Contractor shall use, whenever possible and allowed by the specifications, recycled materials in the manufacture of the bus.

TS 1.8 PROPULSION SYSTEM

1.8.1 Bus Performance

1.8.1.1 Power Requirements

Propulsion system and drive train shall provide power to enable the bus to meet the defined acceleration, top speed, and gradeability requirements, and operate all propulsion-driven accessories. Power requirements are based on heavy heavy-duty natural gas (HHDG) engines certified by the California Air Resources Board (CARB) for use in California using actual road test results, computerized performance data or engine dynamometer. The engine shall be CARB certified based on the year of the bus' manufacturing.

1.8.1.1.1 Optional Power Requirements

The OCTA, due to upcoming regulatory and code compliance requirements for the air basin, e.g., Fleet Rule, zero emission bus regulation, near-zero emission technologies, etc., reserves the right, at its own discretion, as part of any Lot of buses intended to be ordered through this RFP, to have a future defined quantity of buses built in compliance with the potential new rules and requirements. The type and quantity of buses compliant with the new rules and regulations shall be discussed and evaluated with the successful bidder at any time during the tenure of the signed agreement. If any optional power driven buses are exercised as part of the existing award, a new first article bus may be required and all the existing approval processes and steps defined in this RFP for a "first article", testing period, acceptance inspection, notice to proceed with the first article, notice to proceed with the alternative production run and others shall apply.

1.8.1.2 Top Speed

The bus shall be capable of being at a top speed of 65 mph for an unlimited amount of time on a straight, level road at GVWR with all accessories operating.

1.8.1.3 Gradeability

Gradeability requirements shall be met on grades with a dry commercial asphalt or concrete pavement at GVWR with all accessories operating. The propulsion system and drive train shall enable the bus to achieve and maintain a speed of 40 mph on a 2-1/2 percent ascending grade and 7 mph on a 16 percent ascending grade.

1.8.1.4 Acceleration

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

MAXIMUM IDLE START ACCELERATION TIMES ON A LEVEL SURFACE
(Vehicle weight = GVWR)

SPEED (MPH)	**TIME** (SEC)
10	5.0
20	10.0
30	18.0
40	30.0
50	60.0
65	Bus Manufacturer to enter time

1.8.1.5 Operating Range

The operating range of the bus when run/operated on the transit bus duty cycle shall be at least 400 miles.

TS 1.9 DRIVETRAIN

1.9.1 Power Plant

1.9.1.1 Engine

The supplied engines shall be a 2020 or newer CARB certified Cummins, or approved equal, based upon the year of the bus manufacturing. The engine/transmission combination should require application testing and approval from the respective engine and transmission manufacturer. Engine should be capable of diagnostics, archive of failure data, adaptive learning and programming via electronic interfaces. This capability should extend to time stamping of failure data, running in a real time mode for road testing and data storage.

The engine shall be designed to operate for not less than 300,000 miles without major failure or significant deterioration. Components of the fuel management or control system or both shall be designed to operate for not less than 150,000 miles without replacement or major service. Exception: Spark plugs and wires. Mileage intervals are based upon the design operating profile.

The engine should meet all requirements when operating on CNG as certified by the engine manufacturer and specified by Authority.

The engine shall be equipped with an electronically controlled management system, compatible with 24-volt power distribution. The engine control system shall be capable of transmitting and receiving electronic inputs and data from other drive train components and transmit that data to other bus systems. 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 engine performance.

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

The engine starter shall be protected by an interlock that prevents its engagement when the engine is running, or the drive selector is not in the neutral position or both.

The engine control system shall protect the engine against progressive damage. The system shall monitor conditions critical for safe operation and automatically de-rate power or speed or both and initiate engine shutdown as needed. The on-board diagnostic system shall trigger a visual and audible alarm to the operator when the engine control unit detects a malfunction and the engine protection system is activated.

Automatic shutdown shall only occur when parameters established for the functions below are exceeded:

- Coolant Level
- Coolant Temperature
- Exhaust Temperature
- Oil Pressure

A control shall be available to the operator which, when constantly depressed, will allow the driver to delay the engine shutdown but not the Fire Suppression System activation and alarm system.
If additional warning and monitoring systems/devices are engineered into the bus, all of them shall be operating under the same parameters/specifications.

Contractor shall supply a chart, from each of the potential engines, indicating all major parameters such as:

Horsepower
Torque
Engine weight
Fuel consumption @ IDLE
Fuel consumption under PARTIAL and under MAXIMUM LOAD
Schedule of maintenance items e.g. spark plugs, throttle plates, turbocharger, valve adjustments, tune-up, ignition system, fuel metering system, oil changes, fuel filter changes, fuel pressure required, quality of fuel, type of engine oil and alternatives, type of coolant and alternatives, emission certification level, maximum engine operating temperature, use of catalytic converter, etc.

1.9.1.2 Engine Air Filtration

An air filter and ducting shall be provided. The duct inlet shall be located in a manner that will not draw air from the engine compartment, exhaust system, or from the rear wheel area. Engine air inlet duct shall be located at the minimum height of five feet above the ground. Automatic gravity water drainage shall be provided at a location before the filter housing.

1.9.1.3 Engine Starter

The engine shall be equipped with an electric starter manufactured by Delco-Remy, or approved equal, model 39MT. The engine starter shall be protected by an interlock that prevents its engagement when the engine is running. Starter shall also be interlocked to the fuel fill door to prevent starting with door opening.

1.9.1.4 Starter Inhibitor Switch

A key (*) operated starter motor inhibitor switch shall be located on the rear run box and the circuit shall be operated by a GEM, or approved equal, round key camlocks. The switch is intended to inhibit the starter motor from operating when deemed necessary during the performing of repairs or other organizational needs.
(*) Additional details shall be provided at the pre-production meeting.

1.9.1.5 Engine Control System

The engine shall be equipped with an operator-controlled fast idle (1000RPM) device. The fast-idle control shall be a two-way toggle mounted on the dash or side console. A hand operated Electronic Throttle Control Multi-Turn unit shall be mounted in the engine compartment, Morse part No 310714, or approved equal. The throttle mechanism will not be capable of raising the engine RPM unless (1) the transmission is in neutral (2) the parking brake is applied (3) the engine compartment door is open. The device will incorporate the redundant features for automatically returning to idle. This device may be used to help meet the requirements of bus cool down. The location of these controls shall be approved, in writing, by the Authority.

1.9.1.6 Engine Oil

The engine shall operate satisfactorily on the Authority's current natural gas grade engine oil. Characteristics of current oil as follows or in full compliance with Cummins Engineering Standard, CES 20092.
SAE 15w40
Low Ash

1.9.1.7 Engine Oil Filtration

The engine shall be equipped with an oil filtration system approved by the engine manufacturer and installed according to their recommendations.

1.9.1.8 Engine Oil Analysis

To establish a baseline, the Contractor shall be responsible for providing, at the time of each engine installation at the manufacturing plant, a complete engine oil analysis that shall include, at a minimum, a basic Spectrographic/ICP analysis based on testing methods which conform to the ASTM D5185 standard for the following elements:

a. Elemental Analyses to be reported as PPM, to include the following elements:
- Silicon, Sodium, Boron, Potassium, Chromium, Copper, Iron, Lead, Tin, Aluminum, Barium, Boron, Calcium, Magnesium, Molybdenum, Nickel, Phosphorus, Silver, Sodium, Titanium, Zinc.

b. The testing shall also include:
- Viscosity change at 100° C, ±1 SAE Viscosity Grade (ASTM D445)
- Total Solids, % Volume (ASTM D893)

- Fuel Dilution, % Volume (ASTM D3524, ASTM D3525 or ASTM D2887)
- Water Dilution, % Volume (D95)
- Water content (ASTM D-95)
- Total Base Number (TBN) (ASTM D-4739)
- Total Acid Number (TAN) (ASTM D664)
- Glycol Dilution, PPM (D2982); shall be reported as Pass/Fail or as PPM
- TGA Soot. %(E1131) (ASTM D5967) (E2412 provided that the method is calibrated against TGA results)
- Oxidation (ASTM E2412)
- Nitration (ASTM E2412)
- Sulfated Ash % by mass (ASTM D874-07)

A second engine oil analysis shall be performed at the time of each bus' approval for shipment to Orange County, California.

1.9.1.9 Power Plant Mounting

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

The bidders shall provide with their responses the amount of time that it will take to have the engine replaced, and the list of tools required, or recommended, to accomplish the task within the indicated timelines. Bidders also shall indicate if their proposed bus is manufactured with completely removable engine-cradles

1.9.1.10 Service

The power plant shall be arranged so that accessibility for all routine maintenance is assured. No special tools, other than dollies and hoists, shall be required to remove the power plant. Two journeyman mechanics shall be able to remove and replace the engine assembly in less than 12 total combined person-hours. The muffler, exhaust system, air cleaner, air compressor, starter, alternator, radiator, all accessories, and any other component requiring service or replacement shall be easily removable and independent of the engine. 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.

Engine oil and the radiator filler caps shall be hinged to the filler neck and closed with spring pressure or positive locks. All fluid fill locations shall be properly labeled to help ensure correct fluid is added and all fillers shall be easily accessible with standard funnels, pour spouts, and automatic dispensing equipment. All lubricant sumps shall be fitted with magnetic-type, external, hex head, drain plugs.

The engine shall be equipped with enough heavy-duty fuel and oil filters for efficient operation and to protect the engine and transmission between scheduled filter changes. To the extent practicable, the filters shall be of the spin-on, disposable type or integral with the engine and transmission. All filters shall be easily accessible, and the filter bases shall be plumbed to assure correct reinstallation. An air cleaner with a dry filter element and a graduated air filter restriction indicator shall be provided. The filter shall be removable by a specialist mechanic

in 10 minutes or less. The location of the air intake system shall be designed to minimize the entry of dust and debris and maximize the life of the air filter. The engine air duct shall be designed to minimize the entry of water into the air intake system. Drainage provisions shall be included to allow any water/moisture to drain prior to entry into air filter.

1.9.2 Cooling Systems

An all-electric cooling system shall be of sufficient size to maintain all engine and transmission fluids and engine intake air at safe, continuous operating temperatures during the most severe operations possible and in accordance with engine and transmission manufacturers' cooling system requirements. The cooling system fan controls should sense the temperatures of the operating fluids and the intake air, and if either is above safe operating conditions the cooling fan should be engaged. The fan control system shall be designed with a fail-safe mode of "fan on."

The cooling system design will provide adequate cooling of the engine and transmission during ambient operating temperature between 30- and 125-degrees F at idle with all accessories on and the transmission in gear, at the rated gross vehicle weight during prolonged maximum acceleration and deceleration. The radiator design shall facilitate ease of cleaning, to include fin profile and aligned tubes, rather than staggered.

All clamped coolant hoses shall be silicone type and shall be protected from engine heat, which may cause premature failure. All hoses shall be clamped with the coiled or Belleville sprong equipped constant torque clamps. Clamps shall be complete with extended inside sleeve and of the wide band design. Head of clamp adjusting screw shall allow for slotted screwdriver or socket wrench tightening or both.

1.9.2.1 Engine Cooling

The engine shall be cooled by a Fleetguard ES Compleat Coolant, and the system shall be a 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. All below described shut off valves intended for the cooling system shall be ¼ turn valves. 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 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 sight glass to determine satisfactory engine coolant level shall be provided and shall be accessible by opening one of the engine compartment's access doors. A spring-loaded, push button type valve to safely release pressure, or vacuum in the cooling system shall be provided and located no more than 60 inches above the ground and shall be accessible through the coolant-fill access door.

The radiator, and charge air cooler if integrated, shall be of durable corrosion-resistant construction with bolted-on removable tanks. The radiator shall be designed so a specialist mechanic can gain access to a substantial portion of the side facing the engine for cleaning the radiator in five minutes or less. All radiator solder joints shall be done with 97 % tin, 3% cooper – lead free solder. Radiator headers shall be a minimum of .06-inch yellow brass construction and shall incorporate 1/8-inch airside ring reinforcements.

No heat producing components or climate control system components shall be mounted between the engine cooling air intake aperture and the radiator. The radiator and charge air cooler shall be designed to withstand thermal fatigue and vibration associated with the installed configuration. The engine cooling system shall be equipped with a properly sized spin-on coolant filter for releasing supplemental coolant additives as needed to replenish and maintain protection properties. Shut off valves will be provided to aid in coolant filter replacement.

1.9.2.2 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 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.

1.9.2.3 Transmission Cooling

The transmission shall be cooled by a separate heat exchanger sized to maintain operating fluid within the transmission manufacturer's recommended parameters of flow, pressure, and temperature. The transmission cooling system shall be matched to retarder and engine cooling systems to ensure that all operating fluids remain within recommended temperature limits established by each component manufacturer.

1.9.3 Transmission

The transmission should be multiple speeds, automatic shift with torque converter, retarder and electronic controls and shall be manufactured by Allison, Voith, or ZF. The transmission shall permit the vehicle to operate in forward and reverse motions.

Gross input power, gross input torque and rated input speed shall be compatible with the engine. A journeyman mechanic, with optional assistance, shall be able to remove and replace the transmission assembly for service in less than 16 total combined person-hours. The transmissions shall be designed to operate for not less than 300,000 miles on the design operating profile without replacement or major service.

A complete SCAAN, or equivalent, should be included within the bidder's technical proposal. The transmission should be capable of diagnostics, archive of failure data, adaptive learning and programming via interfaces and electronic devices. This capability should extend to time stamping of failure data, running in real time mode for road testing, and data storage.

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

The operator shall require a brake pedal application of 9 to 15 psi to engage forward or reverse range from the neutral position.

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

The transmission shall be capable of satisfactorily operating at extended drain intervals (84,000 miles minimum) using Allison approved fluids. The initial transmission fluid fill at the manufacturing plant shall be a TES 295 or approved fluid, preferred Transynd or Allison's approved equal for extended drain intervals.

Transmission filtering shall be done by a sump screen and filter. Transmission oil filter replacement intervals shall be every 42,000 miles minimum. The transmission filler tube should be adequate in size and venting to allow filling the transmission with fluid, after draining, within 5 minutes at an ambient temperature of 30 degrees F.

Important: Current natural gas-powered engines in conjunction with the all-electric-cooling packages generates excessive temperatures in the engine compartments and as such, all hoses, plumbing, etc., that are not made of stainless steel, shall be rated to 350 degrees F or higher. This requirement shall include all components intended for placement in any such environment; e.g., cables, pipes, fittings, valves, solenoids, controllers, etc.

1.9.3.1 Transmission Retarder

The transmission shall be equipped with an integral hydraulic retarder designed to extend brake line service life. The application of the hydraulic retarder shall cause and smooth blending of the retarder and service brake functions without exceeding jerk requirements, as defined under "Transmission Jerk" section. Brake lights shall illuminate when the retarder activates.

The retarder application shall absorb 80 percent of the normal foundation brake energy. The retarder application should occur automatically, and the intensity of application should be determined by the application of the foundation brakes and throttle position. Retarder deactivation should occur quickly to avoid parasitic loading to the vehicle during acceleration or coasting and deactivation via ABS interface. The offeror shall provide the Authority with evidence to support retarder performance and reliability. The highest degree of retardation **(*)**, e.g. 1,600 ft-lbs., shall be used for these buses. Minimum performance should be a ratio of brake lining wear with and without the retarder of 4 to 1. Based upon historic experience, the Authority anticipates the rear brake reline interval to exceed 40,000 miles and the front brake interval to exceed 60,000 miles. (Retarder activation should be phased as 1/3 @ 0 throttle, 1/3 @ 1 psi brake, 1/3 @ 4 psi brake,) A more preferred rate of retarder application shall be linear, as compared to foundation brake application, rather than the 1/3 steps. Retarder should provide decel at least 0.15g.

(*) Due to all the potential available combinations for an operational retarder, e.g., aggressive, medium mild, etc., the Contractor shall include the provisions for Authority to test and evaluate all possible combinations during the evaluation of the first article bus.

1.9.3.2 Transmission Jerk

Jerk, the rate of change of acceleration measured at the centerline, floor level of the bus, should be minimized throughout the shift of each transmission range and retarder application and should be no greater than 0.3g/sec. for duration of a quarter-second or more.

1.9.4 Final Drive

A single heavy-duty axle at the rear shall drive the bus with a load rating sufficient for the bus loaded to GVWR shall be lubricated with long-life synthetic gear oil; minimum 72,000 miles. Transfer of gear noise to the bus interior shall be minimized. The drive axle shall be designed 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, external hex head. If a planetary gear design is employed, the oil level in the planetary gears shall be easily checked through the plug or sight gauge. The drive shaft shall be guarded to prevent it striking the floor of the coach or the ground in the event of a tube or universal joint failure.

1.9.5 Accessories

Engine-driven accessories shall be mounted for quick removal and repair. Accessory drive systems shall operate without unscheduled adjustment or belt replacement for not less than 50,000 miles on the design operating profile. These accessories shall be driven at speeds sufficient to assure adequate system performance during extended periods of idle operation and low route speed portion of the design operating profile.

1.9.6 Belt Guards

Belt guards shall be provided and painted in safety yellow and properly stripped as required for safety and shall be sturdy in design and installation and readily removable or hinged mounted for ease of access. All pulleys and rotating devices shall be protected by guards and protections. Final approval will be provided by Authority during the First Article's configuration review and acceptance process upon arrival to Authority property.

TS 1.10 HYDRAULIC SYSTEMS

The hydraulic system shall be filled with Allison TES 295 oil and shall be capable of operating within the allowable temperature range as specified by the lubricant manufacturer. The hydraulic system shall demonstrate a mean time between repairs in excess of 50,000 miles.

Hydraulic system service tasks shall be minimized and scheduled no more frequently than those of other major coach systems. All elements of the hydraulic system shall be easily accessible for service or unit replacement. Critical points in the hydraulic system shall be fitted with service ports so that portable diagnostic equipment may be connected or sensors for an off-board diagnostic system permanently attached to monitor system operation. A tamper-proof priority system shall prevent the loss of power steering during operation of the bus if other devices are also powered by the hydraulic system. Sensors in the hydraulic system, excluding those in the power steering system, shall indicate on the operator's on-board diagnostic panel conditions of low hydraulic fluid level. All sight glasses shall be in visible locations which shall be defined during the first article's review.

All pressurized circuits, to the extent practical, shall be made of stainless-steel pipes and tubing, properly secured using Swagelok, or approved equal, cushion clamps (split-blocks). All "transition" connections between rigid and non-rigid members of the bus, e.g. bus chassis to hydraulic pump, shall be made using high pressure hydraulic hoses routed and shielded with

clamped snap-tite, hose guard, HGU-Polyurethane or approved equal, heavy duty, with 500 F degrees minimum operating range, permanently clamped and secured in one end 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. This requirement, Snap-Tite sleeves, also applies to the low pressure and high flow circuits (return lines) in the hydraulic system.

All pressurized hydraulic lines/hoses, throughout the bus shall be equipped with permanently crimped, non-reusable Parker Seal-Lok, O-Ring Face Seal Fittings, or approved equal. All hydraulic hoses, pipes, flex-lines and others shall be secured by means of using Swagelok, or approved equal, cushion clamps, tube support or bolted plastic clamp supports, subjected to Orange County Transportation Authority's approval. All fitting attachments to castings, housings and hydraulic components shall be SAE straight thread with O-ring seal rather that tapered pipe thread. These requirements are also applicable to the steering system/circuit.

1.10.1 Fluid Lines

All lines and piping shall be supported to prevent chafing damage, fatigue failures, and tension strain. Lines passing through a panel, frame, or bulkhead shall be protected by grommets (or similar device) that fit snugly to both the line and the perimeter of the hole that the line passes through to prevent chafing or wear or both. Lines shall be as short as practicable and shall be routed and shielded with clamped sleeves 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 fluid lines/pipes/hoses shall be secured, in a maximum of 15-inch centers, using Swagelok, or approved equal, cushioned clamp tube support or bolted plastic clamp supports subject to the Authority approval.

1.10.2 Radiator, Piping, Hoses, and Clamps

Radiator piping shall be stainless steel or brass tubing and hose quantity/length shall be minimized. Necessary hoses shall be a premium, silicone rubber type that is impervious to all bus fluids. All hoses shall be secured with premium, stainless steel clamps that provide a complete 360° seal. The clamps shall always maintain a constant tension, expanding and contracting with the hose in response to temperature changes and aging of the hose material.

1.10.3 Oil And Hydraulic Lines, and pipes

Oil and hydraulic lines and pipes shall be compatible with the substances they carry. The lines and pipes shall be designed and intended for use in the environment, which they are installed, i.e., high temperatures in engine compartment, road salts, oils, etc. Lines and pipes shall be capable of withstanding maximum system pressures. To the extent practical, the Offeror shall use stainless steel piping on all pressurized circuits. All hydraulic hoses, high and low pressure, high flow, etc. shall be covered with Snap-Tite, or approved equal. All fluid lines shall be secured, in a maximum of 15-inch centers, using Swagelok, or approved equal, cushioned clamp tube support or bolted plastic clamp support

TS 1.11 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 exhaust manifolds and other heat sources and shielded as required to meet the temperature rise requirements of the engine manufacturer.

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

TS 1.12 CNG FUEL SYSTEM

The fuel system within this section shall include the design, hardware and installation, as needed to transfer, store and supply the fuel requirement for the engine and extend to the necessary vehicle points of support, bus systems interface and fueling station. The physical extremes of the system shall be between the fuel receptacle, fuel tanks, vent receptacle, roof vent outlet and inlet fitting to the engine's low-pressure regulator.

The following conceptual design represents an overall design goal, rather than a mandatory blueprint. If the Contractor's proposal differs, in part or all, from these set of specifications, the Contractor is responsible to provide, in writing, calculations, diagrams, drawing, fuel flow patterns, piping, layouts and any others necessary to highlight the advantage(s) and or support of its proposal(s).

A CNG fuel system consisting of fuel cylinders, filler provisions, fuel lines, pressure reduction and auxiliary equipment necessary to safely operate under all operating conditions to meet the performance requirements of this specifications shall be provided. The system shall be capable of refueling from 0 psi to 125% of working pressure in a maximum of five minutes.

1.12.1 CNG Fuel System Overall Requirements

The fuel system shall be expected to meet the following overall requirements:

1.12.2 Pressure Regulators

An IIT Conoflow, Tescom, or approved equal, primary fuel pressure regulator shall be supplied and mounted in an accessible location for servicing. Coolant lines shall be routed in a manner to prevent trapping air or draining coolant when the regulator is removed for service via equipped ¼ turn service valves on both ends of the regulator. The ¼ turn coolant shut off valves shall be located closer to the coolant source to allow the replacement of delivery hoses, and the regulator, without having the need to drain the entire cooling system.

1.12.3 Fuel Capacity

The fuel capacity shall be sufficient to meet the required operating range of 400 miles, without mid-day refueling and without exceeding the maximum allowable bus configuration/specification and/or curb weight. Contractor, with its proposal, shall provide fuel consumption calculations (engine, speed, bus weight, fuel pressure, fuel load, number of passengers, etc.) to support its claim of meeting the 400-miles required range.

1.12.4 Installation

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

Fuel cylinders shall be installed in accordance with ANSI/IAS NGV2-1998, Basic Requirements for Compressed Natural Gas Vehicles Fuel Containers, NPFA 52 Standard for Compress Natural Gas (CNG) Vehicular Fuel Systems, FMVSS 304 and 303 as applicable, Fuel System Integrity of Compressed Natural Gas Vehicles, Compressed Natural Gas Vehicular Fuel Systems Code, 1998 edition Section 303.

For low floor buses, the placement of tanks shall be limited to the roof of the bus or in the compartment above the engine.

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

The roof and above the engine mounted tanks shall be contained within a skeletal structure resembling a roll cage and contained within an enclosure. The enclosure shall incorporate a hinged clamshell type access. The access panels shall be designed to offer protection from weather and sacrificial as a means of providing an escape path to atmosphere upon rapid enclosure pressure rise.

The access panels shall require a force less than 35 lbs. to open and to close throughout its entire opening and closing cycles. The access panels shall be locked in the closed position with positive-locked devices, subjected to Authority's approval and, when in the open position, the access panels shall be positively secured by props locked at preset locations. Provisions shall be provided to securely stow away the props when not in use. The access panels shall also be interlocked via proximity sensors, such that, if other than in their fully closed/locked position, an interlock will prevent engine starter engagement, prevent selection of forward or reverse transmission and shall apply the brake interlock at speeds less than 3 MPH the latching method shall utilize quick release captive hardware that can be demonstrated to last the life of the bus. Additional shielding shall be provided surrounding end fittings and valves as needed. Shields shall be attached to the bus structure hinged in a manner that permits one journeyman mechanic to unlatch and swing the shield open for routine inspections. As practical, electrical components shall not be located within the roof enclosure and if unavoidable, they shall be intrinsically safe

1.12.5 Fuel Pressure Gauge

An oil or glycerin filled gauge shall be located in the high-pressure manifold that shall indicate fuel system pressure. The fuel gauge shall have minimum 100-PSI increments, 0 to 5,000 PSI range, and shall be visible during fueling operations.

1.12.6 Fuel Lines

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

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

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

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

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

Each assembly/bus/unit-test shall be recorded individually and copy of results, clearly signed, stamped and approved by the Manufacturer’s Engineering Department, shall be provided with each set of bus’ documentation at the time of delivery.

1.12.7 Codes, Standards and Regulations

Contractor shall be responsible for ensuring that the entire fuel system, to include, fuel containers, brackets, mounting systems, delivery lines, operating pressures, fuel pressure regulators, engine, piping, connections, gauges, breakaway connections, valves, pressure relief devices, path for the fuel flow, engine requirements and any other related to the CNG fuel system meets all applicable Federal, State and Local codes, and represent the highest state of industry practice. In the absence of applicable regulation or specification, decisions shall be based upon safety, reliability and ability to be maintained. Regulations to include, however not limited to, are (among others):

The NFPA, CA Vehicle Code, DOT, ASME, FMCSR, CGA and SAE Recommended Practice

National Fire Protection Association Standards: NFPA 52 - Compressed Natural Gas Vehicular Fuel Systems Code - 1998
SAE (Society of Automotive Engineers) Standards: SAE J1616 - Recommended Practice for Compressed Natural Gas Vehicle Fuel
ANSI (American National Standards Institute) Standards: ANSI/AGA NGV1 -1994 (with 1997 and 1998 addenda) - Compressed Natural Gas Vehicle Fueling Connection Devices
ANSI/CSA NGV2 - 2000 - Basic Requirements for Compressed Natural Gas Vehicle Fuel Containers
ANSI/AGA NGV3.1 -1995 - Fuel System Components for Natural Gas Powered Vehicles
ANSI/IAS NGV4.1 -1999 - NGV Dispensing Systems
ANSI/IAS NGV4.2 -1999 - Hoses for Natural Gas Vehicles and Dispensing Systems
ANSI/IAS NGV4.4 -1999 - Breakaway Devices for Natural Gas Dispensing Hoses and Systems
ANSI/IAS NGV4.6 - 1999 - Manually Operated Valves for Natural Gas Dispensing Systems
ANSI/IAS PRD1 - 1998 (with 1999 addendum) - Basic Requirements for Pressure Relief Devices for Natural Gas Vehicle Fuel Containers

CGA (Compressed Gas Association) Standards: CGA C-6.4-1998 - Methods for External Visual Inspection of Natural Gas Vehicle Fuel Containers and Their Installations

US Department of Transportation Standards: 49 CFR 571.304, FMVSS 304 - Compressed Natural Gas Fuel Container Integrity, 49 CFR 571.303, FMVSS 303 - Fuel System Integrity of Compressed Natural Gas Vehicles, 49 CFR 393.65, FMCSR - All Fuel Systems

1.12.8 Reliability

The fuel system shall be reliable, leak free and of the quality typically expected of a pressurized fuel system or refrigeration system. A “leak” shall be defined as observance of gas, liquid loss or bubbles at applied soap solution (Snoop) or both. Leak detection may be further supplemented by electronic or infra-red methane detection or acoustic measurements. The design, selection of hardware and workmanship shall be in support of this objective.

1.12.9 Inspectability, Maintainability and Serviceability

The fuel system shall be designed in a manner to facilitate ease and effectiveness of inspection, repair and serviceability. Examples of this objective to include, but not limited to, are isolation valves, system test ports and means of testing components inherently providing regulation via springs.

1.12.10 CNG Fuel System Performance Requirements

The following shall represent minimum levels of system performance:

1.12.11 Vehicle Performance/Operating Range

Useable fuel shall provide a range of 400 miles. The Authority will conduct a range test upon delivery of the prototype bus. The system shall be capable of meeting fuel flow/pressure/temperature requirements at engine maximum load under any condition.

1.12.12 System Functionality

The bus shall be capable of being reliably fueled to within 95 to 100 percent of the tank’s useable capacity, regardless of beginning fuel tank(s) pressure. The fuel system shall incorporate provisions for individual tank de-fueling. De-fueling shall be via reverse flow at receptacle/nozzle interface to fueling station.

1.12.13 Fuel Station Interface

The fueling port receptacle shall be via Sherex 5000 type, nozzle/receptacle, ANSI/AGA/ NFPA 52 certified receptacle. The bus shall be capable of being fueled by a nozzle. The Authority, at the pre-production meeting, shall provide detailed information about fueling nozzle. The fueling port receptacle shall be such that connection, by fueling personnel, shall be performed without physical strain or interference.

A “dust cap” shall be permanently “tethered” to the fueling port receptacle. The fueling port receptacle shall be equipped with an interlock sensor that shall disable the engine’s starting system when the access door is open, to prevent drive-aways. The interlock shall be of the type such if the sensor fails, the bus shall not start.

Due to Authority’s Fuel-Island vacuum Cyclone, the center line of the fill receptacle shall be 38 inches above grade plus or minus 2 inches and 400 inches rearward plus or minus 5 inches of the center line of the front door opening. The fill and vent receptacles shall be located within an enclosure on the right side of the bus. The access door shall be sized to allow full viewing of gauges, ease of hookups and maneuver of fuel nozzle.

The bus shall be equipped with two static ground straps mounted on the undercarriage of the bus and a static ground plug installed near the fueling receptacle for grounding during refueling operations. The fuel fill receptacle and vent receptacle attachment shall be robust and capable of routine fueling connects/disconnects without deflection or metal fatigue, and capable of

withstanding mechanical loads induced by a fueling drive away incident without attachment failure.

A Fleet Watch fuel management data transponder system shall be installed and programmed with vehicle ID number and odometer mileage. This device shall be capable of communication at the CNG fueling facilities located at all OCTA fueling facilities. Authority shall approve the final location

1.12.14 CNG De-Fueling System

The CNG de-fueling port shall be an ANSI/AGA NGV1 certified receptacle. The CNG de-fueling port shall be located on the curbside of the bus (next to the fuel fill nozzle's enclosure). Subject to the Authority's approval. The de-fueling system shall incorporate the following characteristics:

- Dust Cap permanently "tethered" to the de-fueling port
- De-fueling valve, remotely located to prevent accidental de-fueling (to be discussed during the pre-production meeting).
- Others for discussion during pre-production meetings

1.12.15 Hardware/Component Level Requirements

The fuel system shall be suitable for its intended application to include highest potential operating pressures and temperature range.

1.12.16 Tank(s)

1.12.16.1 Fuel Containers – Cylinders

Tanks shall be Type IV and rated at 5,000 psig. The tank system shall provide a minimum useable quantity of gas of 20,000 SCF, or other as required to meet a 400-mile vehicle range, and this useable quantity shall assume on-board pressure range between a fill of 3,600 psig (temperature corrected to 70 degrees F) down to 500 psig. Each tank shall be isolated via a "NC" valve and each tank shall be capable of individual isolation to allow repairs, servicing and replacement if necessary, without having to perform a complete defueling of the bus. No pressure relief devices/valves (PRD's) shall be shared among the fuel tanks.

In addition to manual activation of the fuel solenoids, CNG defueling shall be accomplished remotely, via a defueling-program, strategically located defueling switch, or by other means similar in nature. The previously described protocol(s) shall only maintain the fuel-solenoids energized during the defueling process; all other circuits shall be de-energized. Additional programing details shall be discussed during the pre-production meetings.

The tank manufacturer shall permanently mark on every fuel tank the capacity, date of manufacture, manufacturer name, and certification of compliance to FMCSR, ASME or DOT. These markings shall be clearly visible when the fuel tank's storage door is opened. DO NOT STEP ON THE CNG TANK shall be clearly, visible and permanently marked on all fuel tanks.
Additionally, every tank shall be permanently marked at every location where a securing strap or a fixed reference point is located to indicate if each fuel tank is experiencing physical displacement or rotating movement during the operation of the bus.

1.12.16.2 Design and construction

CNG fuel containers/cylinders shall be designed, constructed, manufactured, tested and mounted in accordance with all applicable rules, practices and regulations at the time of manufacturing to include, among others, all applicable state and/or local standards specifically intended for CNG fuel containers

1.12.16.3 Operating Range

The operating range of the bus in the Orange County environment shall be 400 miles with a gas settled pressure of 3,600 psi @70 °F. The Contractor, with its proposal, shall explain the benefits of using the proposed fuel containers. Scaled and clear AutoCAD drawings, with all fuel tanks dimensions, shall be provided

1.12.16.4 Service Valves

A quarter turn valve shall be accessible through the fuel door that shall isolate the high-pressure manifold and fuel storage system from the rest of the engine fuel system. The valve function and open and closed positions shall be clearly marked. An additional ¾" 2-way valve shall be provided for draining the high-pressure manifold and any fuel cylinder(s) through a service port. Type and location of the service port(s) shall be subject to the Authority's approval.

Isolation, manual valves, of packless type, shall be provided for tank isolation, gauge isolation and a means of isolation for components requiring isolation for inspection. Automated valves, of normally closed type, shall be provided at each tank fuel out line as close to the tank as practical and as necessary to shut down the engines fuel supply.

Vent valves, of packless type manual or pneumatic remote, shall be provided to vent each tank to a common poppeted vent port at the control enclosure and a common vent valve shall be provided to the common roof vent stack. The common vent stack shall serve as the vent and primary pressure relief valve exit and incorporate a means of condensate drain. The preferred vent stack shall terminate in a flapper style valve.

Pressure relief valves, primary and secondary pressure relief devices (PRDs) shall be provided at each tank and at all locations necessary for system pressure protection resulting from potential trapping. Pressure relief valves shall not be shared by CNG tanks.

Flow and check valves shall be provided as necessary for isolation, preventing reverse flow and minimize excessive flow resulting from gross product loss. The excess flow protection may also be supplemented by remote activation of the fuel system automated shutoff valves. Excess flow valves shall satisfactorily function regardless of mixed phase fluid flow, provide positive shut-off and not be influenced by typical g force occurring during vehicle roadway operation, bumps, dips, vibrations, etc.

Pressure regulators; pressure regulating valves shall be used to regulate fuel pressure entering the engine's fuel system and may be used to manage tank pressure. These valves shall incorporate a means of inspection, adjustment and ease of isolation without system depressurization.

1.12.17 Control Panel/Instrumentation

The fuel system filling receptacle, vent receptacle, vent valves and tank-system pressure gauges shall be located within an enclosure as previously defined. Each tank shall require a pressure gauge. Pressure gauges shall be of rugged quality, liquid filled. The tank pressure gauges shall be graduated in 1/8 increments and accurate within one increment.

1.12.18 Documentation

The following documentation shall be provided in addition to the general requirements of this overall procurement specification:

1.12.19 Design Suitability/Application Approval

The overall fuel system shall be suitable for the intended application and require application approval. (Note: Components of the system will be subject to suitability at OE level.)

1.12.20 Fuel System - Manuals & Schematics

Manuals, schematics and drawings shall be comprehensive, providing the following level of detail:

Description of system operation
Preventive maintenance guideline
Diagnostic and repair guideline, at system and component level
Piping/Component schematic, to include
    System heat leak
    Flow and pressure drop
Procedure for fueling, de-fueling, venting, purging
Procedure for components requiring adjustment
OEM level specification sheets at component level to include all systems part numbers (both, manufacturers and OEM's)
Tank calculations, to include, gross volume, useable capacity, gas flow/pressure, estimated vehicle range, etc.
System FMEA and listing of applicable code/regulation compliance

Three sets of draft Service and Operational Manuals, schematics and drawings shall be delivered with the first article.

TS 1.13 EMISSIONS/EXHAUST

1.13.1 Exhaust Emissions

The engine shall meet all applicable EPA and CARB emission requirements for heavy duty natural gas engines at the time of bus manufacture.

1.13.2 Exhaust System

Exhaust gases and waste heat shall be discharged from the roadside rear corner of the roof. The exhaust pipe shall be of enough 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 with removable, re-serviceable, hard shell, metal foil insulation type blanket, Insultech insulation, www.insultech.com, or approved equal, to prevent heat damage to any bus component. All shielding shall be properly rated to operate above the engine's exhaust temperature at a minimum of 2000 degree F. The exhaust outlet shall be designed to minimize rain, snow or water generated from high-pressure washing systems from entering the exhaust pipe and causing damage to the

catalyst. The manufacturer shall consider all potential reigns of motions that the exhaust system shall be exposed/subjected to during the bus' operation and shall design a system that does not requires any periodic adjustments and/or realignments of pipes, flex tubes or other exhaust system related components. The exhaust system shall be stainless.

TS 1.14 CHASSIS

1.14.1 Suspension

1.14.1.2 General Requirements

Both the front and rear suspensions shall be pneumatic type. The basic suspension system shall last the service life of the bus without major overhaul or replacement. Normal replacement items, such as one suspension bushing, shock absorbers, or air spring shall be replaceable by a journeyman mechanic in 45 minutes or less. Air springs shall be fully independent at all wheel positions thus blocking air transfer between them thus increasing rolling stability, minimizing sway and actively maintaining ride height on uneven road conditions.

Adjustment points shall be minimized and shall not be subject to a loss of adjustment in service. Necessary adjustments shall be easily accomplished without removing or disconnecting the components.

1.14.2 Springs And Shock Absorbers

1.14.1.3 Travel

The suspension system shall permit a minimum wheel travel of 3 inches jounce-upward travel of a wheel when the bus hits a bump (higher than street surface), and 3 inches 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 ± 1/2 inch at any point from the height required to maintain normal ride height.

1.14.1.4 Damping

Hydraulic shock absorbers mounted to the suspension arms or axles and attached to an appropriate location on the chassis shall accomplish vertical damping of the suspension system. Damping shall be sufficient to control coach motion to 3 cycles or less after hitting road perturbations. Shock absorbers shall maintain their effectiveness for at least 50,000 miles of the service life of the bus. Each unit shall be replaceable by a journeyman mechanic in less than 45 minutes. The shock absorber bushing shall be made of Elastomeric material that will last the life of the shock absorber

1.14.1.5 Lubrication

All elements of steering, suspension, and drive systems requiring scheduled lubrication shall be provided with grease fittings conforming to SAE Standard J534. These fittings shall be located for ease of inspection and shall be accessible with a standard grease gun without flexible hose end from a pit or with the bus on a hoist. Each element requiring lubrication shall have its own grease fitting with a relief path. Lubricant specified shall be

standard for all elements on the bus serviced by standard fittings. Additional requirements for lubrication if any are contained in an attachment to this technical specification.

1.14.1.6 Kneeling

A kneeling system shall lower the entrance(s) of the bus a minimum of 2.5 inches during loading or unloading operations regardless of load up to GVWR, measured at the longitudinal centerline of the entrance door(s), by the driver using a three position, spring loaded to center switch:

Downward direction will lower the bus.
Release of switch at any time will completely stop lowering motion and hold height of the bus at that position.
Upward direction of the switch will allow the system to go to floor height without the driver having to hold the switch up.

Brake and Throttle interlock shall be activated and shall prevent movement when the bus is kneeled. The kneeling control shall be disabled when the bus is in motion. The bus shall kneel at a maximum rate of 1¼ inches per second at essentially a constant rate. After kneeling, the bus shall rise within 2 seconds to a height permitting the bus to resume service and shall rise to the correct operating height within 7 seconds regardless of load up to GVWR. During the lowering and raising operation, the maximum acceleration shall not exceed 0.2g and the jerk shall not exceed 0.3g/sec.

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, minimum 3-inch 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. Kneeling switches shall also be installed at the rear door's wheelchair ramp control boxes.

TS 1.15 WHEELS AND TIRES

1.15.1 Wheels

Wheels and rims shall be hub-piloted with 2-sided polished aluminum Alcoa, Dura-Flange, or approved equal and shall resist rim flange wear. All wheels shall be interchangeable and shall be removable without a puller. Wheels shall be compatible with tires in size and load-carrying capacity. Front wheels and tires shall be balanced as an assembly per SAE J1986. Front, rear and spare wheel/tire assemblies shall be alike. Each bus unit shall be equipped with one spare wheel-tire assembly mounted and balanced as previously described

1.15.2 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 of the radial type, capable of sustained speeds of 65 MPH. The Contractor shall be responsible for providing Bridgestone tires (*).

(*) Bridgestone is the current tire supplier for Authority. Due to the Authority's contracting services with tire suppliers/manufacturers, the applicable tire's brand name, if changes by the time of manufacturing, shall be provided during the pre-production meeting.

TS 1.16 STEERING

1.16.1 Front Axle

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 lubrication fittings easily accessible from a pit or hoist. The front axle shall be manufactured by MAN or approved equal.

1.16.2 Strength

Fatigue life of all steering components shall exceed 1,000,000 miles. No element of the steering system shall sustain a Class I failure when one of the tires hits a curb or strikes a severe road hazard. Inadvertent alternations of steering because of striking road hazards shall be considered steering failures.

1.16.3 Turning Radius

Outside body corner-turning radius, for a standard configuration 40-foot long bus, shall not exceed 44 feet.

1.16.4 Steering Turning Effort

The steering wheel shall be removable with a standard or universal puller. The steering column shall have full tilt and telescoping capability allowing the operator to easily adjust the location of the steering wheel and, a electrohydraulic assisted power steering shall be provided as manufactured by TRW, ZF or approved equal intended to make the bus easier to drive, reduce driver's fatigue, among others.

The steering gear shall be an integral type with flexible lines eliminated or the number and length minimized. With the bus on dry, level, commercial asphalt pavement, and tires inflated to recommended pressure and the front wheels positioned straight ahead, the torque required to turn the steering wheel 10 degrees shall be no less than 5-foot pounds and no more than 10-foot pounds. Steering torque may increase to 70-foot pounds when the wheels are approaching the steering stops, as the relief valve activates. 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. Power steering failure shall not result in loss of steering control. With the bus in operation, the steering effort shall not exceed 55 pounds at the steering wheel rim and perceived free play in the steering system shall not materially increase because of power assist failure. Gearing shall require no more than seven (7) 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.

1.16.5 Steering Wheel – General

The steering wheel diameter shall be 20 inches and equipped with two spokes; the rim diameter shall be 7/8 inch to 1¼ inches and shaped for firm grip with comfort for long periods. The steering wheel shall be removable with a standard or universal puller. Steering wheel spokes and wheel thickness should be such as to ensure that visibility is within the range of a 95-percentile range as described in SAE 1050, or current. Placement of steering column must be as far forward as possible, but either in-line or behind the instrument cluster.

1.16.6 Steering Wheel Tilt

The steering wheel shall have a rearward tilt adjustment range of no less than 40 degrees as measured from the horizontal and upright position.

1.16.7 Steering Wheel Telescopic Adjustment

Measurement – From the top of the rim of the steering wheel in the horizontal position to the cab floor at the heel point. The steering wheel shall adjust to maximum height of 35 inches and a minimum low-end adjustment of 29 inches.

The following chart is acknowledged as the standard for measurements of thigh clearance, resting elbow height, the slope of the steering wheel, and the height of the wheel, and the relationship of one to another, to assist in determining the appropriate telescopic range.

(Based on Drillis and Contini, 1966)

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

Steering Wheel Height (Measured from Bottom Portion Closest to Driver) Relative to Angle of Slope			
At Minimum Telescopic Height Adjustment (29”)		At Maximum Telescopic Height Adjustment (5”)	
Angle of Slope	Height	Angle of Slope	Height
0 degrees	**29”**	0 degrees	**35”**
15 degrees	**26.2”**	15 degrees	**30.2”**
25 degrees	**24.6”**	25 degrees	**28.6”**
35 degrees	**22.5”**	35 degrees	**26.5”**

TS 1.17 BRAKES

1.17.1 General

The entire brake system shall a have minimum overhaul or replacement life of 40,000 miles. Brakes shall be self-adjusting throughout this period. Visible stroke and wear indicators shall be provided to allow service personnel to easily identity when the brakes are not in correct adjustment.

1.17.2 Service Brake

1.17.2.1 Actuation

A compressed air system shall control and actuate service brakes. Force to activate the brake pedal control shall be an essentially linear function of the bus deceleration rate and shall not exceed 50 pounds at a point 7 inches above the heel point of the pedal to achieve maximum braking. The heel point is the location of the driver’s heel when foot is rested flat on the pedal and the heel is touching the floor or heel pad of the pedal. A microprocessor controlled Automatic Braking System (ABS) shall be provided. The microprocessor for the ABS system shall be protected and in an accessible location to allow for ease of service. The total braking effort shall be distributed between all wheels in such a ratio as to ensure equal friction material wear rate at all wheel locations.

1.17.2.2 Friction Material

The entire service brake system, including friction material, shall have a minimum overhaul or replacement life of 40,000 miles. Brakes shall be self-adjusting throughout this period. Visible stroke indicators shall be provided to allow service personnel to easily identify when the brakes are not in correct adjustment. The brake pads/linings shall be made of non-asbestos material. To aid maintenance personnel in determining extent of wear, a provision such as a scribe line or chamfer indicating the thickness at which replacement becomes necessary, shall be provided on each brake pad/lining in addition to electronic wear pad indicators with a driver's display. Each axle and each wheel shall be reported independently. The driver's display shall not broadcast the brake lining/pad thickness at any time; it shall broadcast the brake pad condition on demand.

1.17.2.3 Hubs

Replaceable wheel bearing seals shall run on replaceable wear surfaces or be of an integral wear surface sealed design. Wheel bearing and hub seals shall not leak or weep lubricant for 100,000 miles when running on the design operating profile. The brake system material and design shall be selected to absorb and dissipate heat quickly, so the heat generated during braking operation does not glaze brake pads/linings. The heat generated shall not increase the temperature of tire beads and wheel contact area to more than that allowed by the tire manufacturer.

The brake pad or lining and cam interface shall be easily viewable (direct or assisted by mirror or both) in their entirety. Therefore, restrictive backing plates or others shall not be permitted. The bus shall be capable of deceleration without secondary retardation of at least 0.8g. If equipped, the bus shall be equipped with out-board brake rotors removable without the need of hub removal.

1.17.2.4 Disc Brakes

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

1.17.3 Parking Emergency Brake

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. An emergency brake release shall be provided to release the brakes in the event of automatic emergency brake application. The parking brake valve button will pop out when air pressure drops below requirements of FMVSS 121. The driver shall be able to manually depress and hold down the emergency brake release valve to release the brakes and maneuver the bus to safety. Once the operator releases the emergency brake release valve, the brakes shall engage to hold the bus in place.

The parking brake application shall be performed via manual operation or via toggle switch located on the driver's side console at a location that is practical and in compliance with best ergonomic practices. Soft padding shall be provided on both sides of the parking brake knob to ease operator's hand/finger interface with the device.

TS 1.18 PNEUMATIC SYSTEM

1.18.1 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 as indicted on the instrument panel mounted air gauges, within 15 minutes from the point of governor cut-off.

Provision shall be made to apply shop air to the bus air systems using a standard tire inflation type valve. 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 through the main engine air cleaner system. The air system shall be protected by a pressure relief valve set at 150 psi and shall be equipped with check valve, pressure protection valves and positive hand shut-off valves to assure partial operation in case of line failures.

1.18.2 Air Compressor

The air compressor shall be sized to charge the air system from 40 psi to the governor cutoff pressure in less than 3 minutes while not exceeding the fast-idle speed setting of the engine.

1.18.3 Air Lines and Fittings

Air lines, except necessary flexible lines, shall conform to the installation and material requirements of SAE Standard J1149 for copper tubing with standard, brass, flared or ball sleeve fittings, or SAE Standard J844 for nylon tubing if not subject to temperatures over 200 degrees F. 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-foot intervals. Nylon lines may be grouped and shall be supported at 2-foot 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-foot intervals or less.

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

Important: Current natural gas-powered engines in conjunction with the all-electric-cooling packages generates excessive temperatures in the engine compartments and as such, all hoses, plumbing, etc., that are not made of stainless steel, shall be rated to 350 degrees F. This requirement shall include all components intended for placement in any such environment; e.g., cables, pipes, fittings, valves, solenoids, controllers, etc.

1.18.4 Air Reservoirs

All air reservoirs shall meet the requirements of FMVSS Standard 121 and SAE Standard J10 and each tank shall be equipped with clean-out plugs and manual and automatic 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 brass drain valves that discharge below floor level with lines routed to eliminate the possibility of water traps or freezing or both in the drain line. Automatic pressure differential drain valves, one for each air tank, Bendix or approved equal, shall be mounted on the lower section of the bus' skirt and, be equipped with manual, petcock style of valves, intended to manually drain the air tanks during servicing or, on an as-needed basis.

1.18.5 Air System Dryer

An air dryer shall prevent accumulation of moisture and oil in the air system. The air dryer system shall include a replaceable desiccant bed, electrically heated drain, and activation device. A journeyman mechanic shall replace the desiccant in less than 15 minutes. The dryer will be a Bendix AD9 or approved equal. A Bendix, part # 801731, Puraguard QC oil coalescent filter, or approved equal, shall be installed following the manufacturer's specifications for location, height and ease of draining and servicing.

TS 1.19 BODY

1.19.1 General

1.19.1.1 Design

The bus shall have a clean, smooth, simple design, primarily derived from bus performance requirements and passenger service criteria established by these technical specifications.

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, doors 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 interior of bus 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 on any window of the bus of spray and splash generated by the bus' wheels on a wet road shall be minimized.

1.19.1.2 Crashworthiness

The bus body and roof structure shall withstand a static load equal to 150 percent of the curb weight evenly distributed on the roof with no more than a 6-inch reduction in any interior dimension. Windows shall remain in place and shall not open under such a load.

The bus shall withstand a 25-mph impact by a 4,000-pound automobile at any point, excluding doorways, along either side of the bus with no more than 3 inches 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 inches from ground level shall withstand a static load of 2,000 pounds applied perpendicular to the bus by a pad no larger than 5 inches square. This load shall not result in deformation that prevents installation of new exterior panels to restore the original appearance of the bus. In addition to the above requirements, NFPA-52 and local regulations must be met.

1.19.1.3 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; add-on devices and trim, where necessary, shall be minimized and integrated into the basic design.

1.19.1.4 Corrosion

The entire bus including flooring, sides, side walls, interior walls, exterior walls, panels, enclosures, roof, structure, frames, doors, brackets, clamps, all fasteners (bolts, clamps, nuts, washers, rivets, etc.), hinges, understructure, bolted on components, non-bolted components, axle suspension components shall resist corrosion or deterioration from atmospheric conditions and/or road salts 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.

The bus shall be constructed using only inherently corrosion-resistant materials such as, stainless steel, non-metallic composites and fasteners to minimize deterioration. The structure shall not require corrosion-preventive coatings or after-treatments throughout the service life of the bus.

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 2-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. The bus manufacturer shall provide certification, in writing, that all materials and connections are in compliance with this procedure.

1.19.1.5 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.

1.19.1.6 Engine Compartment Bulkheads

The passenger and engine compartment shall be separated by fire-resistant bulkheads. The engine compartment shall include areas where the engine and exhaust system are housed. This bulkhead shall preclude or retard propagation of an engine compartment fire into the passenger compartment and shall be in accordance with the Recommended Fire Safety Practices defined in FTA Docket 90A, dated October 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. The engine's access panel locking mechanism shall be operated with a ¼-inch square key.

TS 1.20 FIRE PROTECTION – methane detection

A Kidde, or approved equal, fire detection/suppression system shall be provided, to include, control module, UPS (48-hour minimum stand-alone back-up), minimum of three (3) optical detectors, minimum 22-pound purple K agent, discharge nozzles and required harnesses, brackets, etc. The subject supplier shall also be responsible for providing installation guidelines and certification and approval by a professional registered fire protection engineer and approval of final installation/operation. The control module shall be capable of recording events (time stamp log), sensor ID and provide a standard data communication port to facilitate the computer interface for diagnostics, data retrieval and others not broadcasted via the system's interface. The fire detection system may also include a local means of thermal detection via armored linear thermal device, ALTD, in addition to the optic sensors. The ALTD element shall be capable of providing continuous operation and shall be routed, mounted, secured and attached to all high-power cables in the engine compartment, e.g., alternator, battery cables, HVAC, all cooling system, alternator, etc., in accordance with the Authority standards. The fire suppressing agent's delivery lines/plumbing, starting at the fire extinguisher container and ending at the discharge nozzles, shall all be made of stainless steel and shall be properly secured using split-blocks.

The following components, at a minimum, shall be part of the Kidde, or approved equal, fire monitoring and suppression system:

- Driver's display and Control Panel with datalogging and diagnostic capabilities
- ALTD, armored linear thermal device type sensing element
- Module for Thermal sensing element
- Installation kit for ALTD
- 22 Lbs. extinguisher bottle w/pressure sensing device
- Distribution manifolds
- Nozzles
- PM-3M Optical Sensors
- Stainless steel plumbing

1.20.1 Operator's Alarm

The operator's area at a clearly visible location shall be equipped with a Floyd Bell, or approved equal, whoop fire alarm, part # TXO-86-515-Q and TLM-87R-930-Q, that shall emit a distinctive sound and warning light to alert the driver in case of an impending or detected fire related event. The feed for this alarm shall be provided through the fire-suppression's control panel and it shall be muted upon driver's acknowledgment of the event.

1.20.2 Methane Detection

The bus shall also be equipped with an on-board methane detection system. The system shall be integrated into the above fire detection system and at a minimum consist of multiple IR type detectors located within the passenger compartment and areas most likely capable of fuel release, such as, fuel storage, engine compartment, confined areas where methane may be introduced through the venting or HVAC systems into the passenger compartment, etc. The detectors shall be suitable for the intended application and shall provide 20 and 50% LEL detection. All sensors shall be located at locations where remote viewing of display-light status is possible and servicing of the units is possible without requiring the removal of additional bus' components. All methane detectors' electrical connectors shall be waterproof and shall be properly located, secured and treated to eliminate the penetration of water, dirt, moisture and humidity. The Offeror must provide documentation supporting the location of the detectors in the passenger compartment and in areas most likely capable of a fuel release. The supporting documentation shall include certification of the system's acceptability to a registered, professional, fire protection engineer.

The methane detection system shall be equipped with a display panel, visible and accessible to the driver -while seated, constantly displaying, at the same time, each sensor, by location and status e.g. SENSOR XX is at 0% LEL, – 20% LEL, – 50% LEL.

All incidents resulting from triggering any of the methane detectors at a level of 20% LEL or higher shall be:

- Logged
- Time stamped
- Sensor or sensors that triggered the event shall be individually identified on the driver's display. Identification of activated sensors within a "loop" shall not be acceptable.
- Sensor status shall monitor and constantly displayed, in real time, on the driver's panel.
- Indication of methane level reached.
- Duration of the incident.
- Driver's acknowledgement button shall not clear historical data.
- All historical data shall be displayed, one incident at the time, using driver's display
- System shall store historical data for a minimum of thirty days.
- Historical data shall be clear only by a "password" protected procedure not accessible to the driver.
- The system shall incorporate a device, mounted on the outside of the bus, intended to provide a visible an audible warning to the driver that the system is/was in any stage of methane alarm level/mode while the bus was left unattended. This device shall be intrinsically safe, and it shall not worsen any ongoing condition/stage during its operation.

Additional operating parameters such as, sequence of events, levels of warnings, and others associated with this display shall be discussed during the pre-production meeting(s).

1.20.3 Remote warning device for presence of methane

The system shall incorporate a device, e.g., light, buzzer, blinker, etc., properly labeled, mounted on the outside of the bus and connected to the existing on-board methane detection system, intended to provide a visible and audible warning to the driver that the system is/was in any stage of methane alarm level/mode (20% LEL, 50% LEL, etc.) while the bus was left unattended. This device shall be intrinsically safe, and it shall not worsen any ongoing condition/stage during its operation. The system/device shall operate in a "latching configuration" and it shall only be resettable by maintenance personnel. Additional details shall be provided during the pre-production meetings and/or during the first article's evaluation.

TS 1.21 STRUCTURE

1.21.1 Strength and Fatigue Life

The structure of the bus shall be designed to withstand the transit service conditions typical of an urban duty cycle throughout its service life.

1.21.2 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 and service doors. Static conditions shall include the bus at rest with any one wheel or dual set of wheels on a 6-inch curb or in a 6-inch deep hole.

1.21.3 Altoona Testing

Prior to acceptance of prototype bus, the proposed structure of the bus shall have undergone appropriate structural testing or analysis or both, including FTA required Altoona testing, to ensure adequacy of design for the urban transit service. Any items that required repeated repairs or replacement must undergo the corrective action with supporting test and analysis. A copy of the Altoona test report, clearly describing and explaining the failures and corrective actions taken to ensure all such failures will not occur, shall be submitted to the Authority for review and approval.

1.21.4 Towing

1.21.4.1 Towing Devices

Towing devices and securing hooks, or applicable, shall be provided on each end of the bus. Towing devices should accommodate flat-bedding or flat-towing. Each towing device shall withstand, without permanent deformation, tension loads up to 1.2 times the curb weight of the bus within 20 degrees of the longitudinal axis of the bus. The rear towing device(s) shall not provide a toehold for unauthorized riders. The rear towing devices shall permit lifting and towing of the bus for a short distance, such as in cases of an emergency, to allow access to provisions for front towing of the bus.

The front towing devices shall allow attachment of adapters for a rigid tow bar and shall permit lifting and towing of the bus, at curb weight, until the front wheels are clear off the ground. The method of attaching the tow bar or adapter shall require the specific, in writing, approval of the Authority. Each towing device shall accommodate a crane hook with a 1-inch throat.

1.21.5 Dyno Anchors

The tow hooks shall also be used to anchor the vehicle on a chassis dynamometer. These hooks shall be required to withstand maximum loading of the vehicles propulsion system and tolerate inherent jerking of the transmission while shifting at full throttle. The manufacturer shall be responsible for determining the worst-case dynamic loading of the hooks and incorporate a practical safety factor.

1.21.6 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-inch-high run-up block not wider than a single tire.

Contractor shall be responsible for providing 12 sets of adapters (front and rear) if required.

Jacking and changing any one tire shall be completed by a journeyman mechanic in less than thirty (30) minutes from the time the bus is approached. The bus shall withstand such jacking at any one or any combination of wheel locations without permanent deformation or damage. Jacking pads shall be painted safety yellow or orange for ease of identification.

1.21.7 Hoisting

The bus axles or jacking plates shall accommodate the lifting pads of a two-post 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 bus shall be capable of being hoisted on a Rotary model post hoist by using adapters, as provided by the bus manufacturer. The adapters shall be designed/fabricated to interface with the subject hoist model and restrain bus move in the fore/aft as well as sideways directions. Contractor shall contact the Authority's Facilities Maintenance Department prior to the design, test, evaluation and manufacturing of the hoist adapters to ensure proper fitting with existing hoist-equipment installed in all Authority Bases. Contractor shall be responsible for providing 90 sets of hoist adapters (45-front and 45-rear).

1.21.8 Jack Stand Interface

The bus shall be equipped with pads suitable for placement of stationary jack stands. These pads shall be permanently located to the bus' main structure and capable of providing a stable platform when used in combination with "standard" jack stands. Further requirements of pads and standard interface, as follows:

- Pads shall be located as near the vehicle's perimeter as practical, ahead of the front axle and rearward of the rear axle.
- Pads shall be located to facilitate un-obstructed removal of the front axle, rear axle, differential carrier assembly, engine and transmission.
- Pads shall interface to a standard jack stand having a 5.5-inch clear of obstructions square platform with a center indexing pin of 1-inch diameter x 1-inch in height.
- Pads shall be painted safety yellow.
- Stickers mounted on the outside of the bus' skirt shall clearly identify the padding locations.

1.21.9 Floor

1.21.9.1 Design

The floor shall be essentially a continuous flat plane, except at the wheel housings and platforms. The floor height shall be designed to eliminate steps and facilitate boarding and de-boarding of passengers.

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 approximately 18-inches above the lower level. An increase slope shall be allowed on the upper level not to exceed 3½ degrees off the horizontal.

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 1-inch. Similarly, a molding or cove shall prevent debris accumulation between the floor and wheel housings. The bus floor in the area of the entrance and exit doors shall have a lateral slope not exceeding 2 degrees to allow for drainage.

The floor shall be constructed of exterior waterproof plywood, a minimum of ¾ inch thick or light weight material with similar strength and anti-rot properties. The floor shall be supported, fastened and sealed to maintain its integrity throughout the life of the vehicle. The floor covering should be RCA Transit Floor TR766, or approved equal, and be installed without gaps between mating joints. The entrance area and standee areas are to be separated by a yellow strip molded into the flooring. The center aisle exit door approach and rear standee area shall be covered with ribbed flooring. The entire driver's area shall be covered with Line-X or approved equal anti-skid flooring material. The Authority is interested in alternatives to the traditional plywood floor and manufacturers sharing this interest are encouraged to submit composite or alternative flooring materials, that do not corrode, during the approved equals period.

The bus' flooring shall have special markings such as yellow stripes, embedded lights or others blended with the bus' flooring material that do not create a trip hazard, intended to indicate the beginning, the top and the end of any floor humps, risers or any others that result in a change of the passengers' walking floor-plane.

1.21.9.2 Interior Floor 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. The use of adhesives to secure the floor to the structure shall be allowed only in combination with the use of bolt or screw fasteners and its effectiveness shall last throughout 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 inches from the normal plane. The floor shall withstand the application of 2.5 times gross load weight without permanent detrimental deformation. Floor, with coverings applied, shall withstand a static load of at least 150 pounds applied through the flat end of a ½-inch diameter rod, with 1/32-inch radius, without permanent visible deformation.

1.21.9.3 Construction

The floor shall consist of the subfloor and the floor covering. 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.

If plywood is used, it shall be certified at the time of manufacturing by an industry approved third-party inspection agency such as APA – The Engineered Wood Association (formerly the American Plywood Association). Plywood shall be of a thickness adequate to support the design loads, manufactured with exterior glue, satisfy the requirements of a Group I Western panel as defined in PS 1-95 (Voluntary Product Standard PS 1-95, Construction and Industrial Plywood) and be of a grade that is manufactured with a solid face and back. Plywood shall be installed with the highest-grade veneer up and will have all edges sealed. Plywood shall be pressure-treated with a preservative chemical that prevents decay and damage by insects.

Before any preservative treating, the plywood shall be certified at the time of manufacturing by an industry approved third-party inspection agency such as APA, the Engineered Wood Association (formerly the American Plywood Association). Preservative treatments shall use no EPA listed hazardous chemicals. The concentration of preservative chemical shall be equal to or greater than required for an above ground level application. Treated plywood will be certified for preservative penetration and retention by a third-party inspection agency. Pressure-preservative treated plywood shall have moisture content at or below fifteen percent. A barrier shall be installed to prevent contact by road salt with the plywood panels.

1.21.10 Platforms

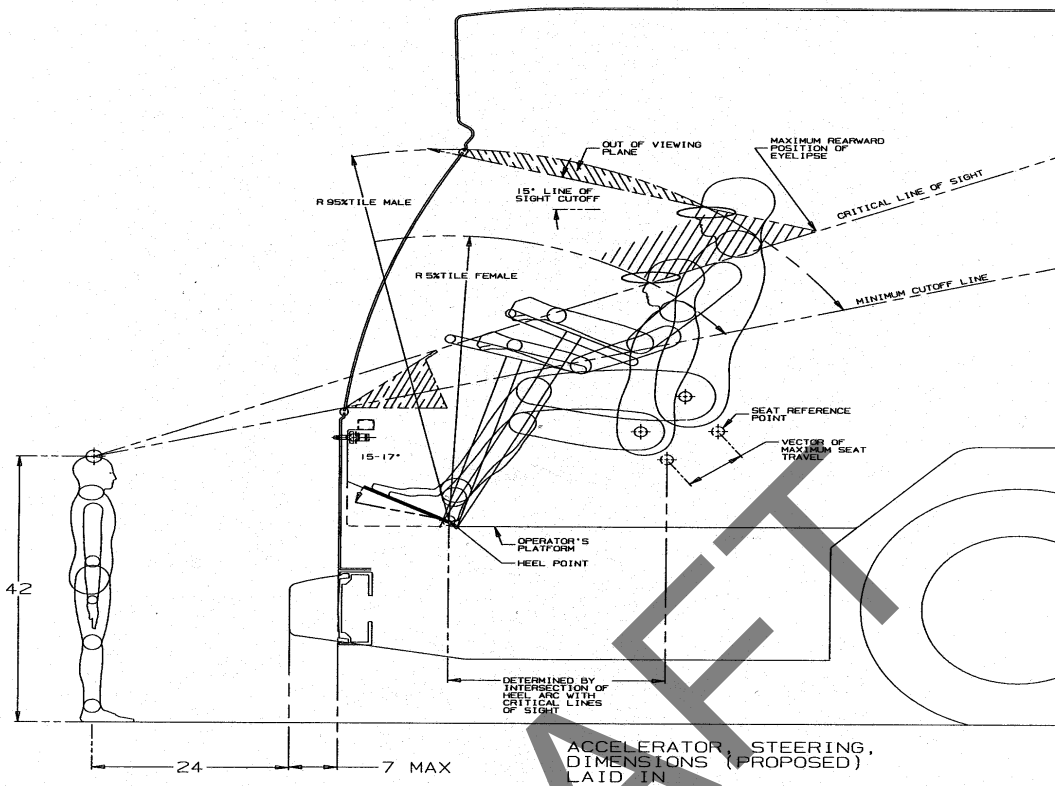
1.21.10.1 General

Platform height shall not exceed 12 inches. Trim shall be provided along top edges of platforms unless integral nosing is provided. Except where otherwise indicated, covering of platform surfaces and risers shall be same material as specified for floor covering. Trim installed along edges of platforms shall be constructed of stainless steel.

Other raised areas such as for providing space for under-floor installation of components shall be limited. Such raised areas shall be constructed in accordance to these specifications.

1.21.10.2 Operator Platform

The operator's platform shall be of a height that, in a seated position, the operator can see an object located at an elevation of 42-inches above the road surface, 24-inches from the leading edge of the bumper. Notwithstanding this requirement, the platform height shall not position the operator such that the operator's vertical upward view is less than 15 degrees. A warning decal or sign shall be provided to alert the operator to the change in floor level. The following schematic diagram illustrates a means for determining platform height using the Critical Line of Sight. Anti-skid Line-X material, or approved equal, shall be used on the driver's platform. An adhesive type of antiskid material shall not be accepted. Contractor shall apply or install a long-lasting friction enhancing coating or RCA flooring and this item shall be subjected to the Authority's approval.



1.21.10.3 Farebox Platform

If the driver's platform is higher than 12-inches, the GFI Odyssey farebox shall be mounted on a platform of suitable height to provide accessibility for the operator without compromising a passenger's access. The platform shall be sufficiently rigid to prevent swaying, bouncing and movement of the farebox. Contractor shall obtain, in writing, the Authority's approval for the design, securing, materials used, and location of this platform. The farebox's horizontal platform shall be covered with Line-X, or approved equal, safety yellow anti-skid material.

1.21.10.4 Intermediate Platform

If the bus is of a bi-level floor design, an intermediate platform shall be provided along the center aisle of the bus to facilitate passenger traffic between the upper and lower floor levels. This intermediate platform shall be cut into the rear platform and shall be approximately the aisle width, 18-inches deep and approximately one-half the height of the upper level relative to the lower level. The horizontal surface of this platform shall be covered with yellow Hypalon ribbed rubber or Line-X, or approved equal, skid-resistant material 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.

1.21.11 Wheel Housing

1.21.11.1 Design

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. 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 and ADA requirements for passenger and wheelchair circulation.

Design and construction of the front wheel housings shall allow for the installation of radio/electronic equipment's storage box/compartment that shall extend, continually, from the wheel well housing's top surface to the ceiling using the maximum available section/footprint. This storage box, and trays, are subject to the Authority's approval. The radio/electronic equipment compartment shall be keyed using a flush-mounted ¼"-turn square-key access.

The exterior finish of the front wheel housings shall be scratch-resistant, meeting requirements of Interior Panels and Finishes, and complement interior finishes of the bus to minimize the visual impact of the wheel housing. If fiberglass wheel housings are provided, then they shall be color-impregnated to match interior finishes. The lower portion extending to approximately 12-inches above floor shall be equipped with additional stainless-steel trim.

Safety yellow markings, at the Authority's discretion, may be required in areas or sections of the wheel well housings that can potentially become trip hazards.

1.21.11.2 Construction

Wheel housings shall be constructed of corrosion-resistant, fire-resistant material. Wheel housing as installed, shall withstand impacts of a tire tread dislodging from the tire at a maximum vehicle speed without penetration. Wheel housings, as installed and trimmed, shall withstand impacts of a 2-inch steel ball with at least 200 pounds of energy without penetration.

1.21.12 Exterior Panels and Finishes

1.21.12.1 Pedestrian Safety

Exterior protrusions greater than ½ inch and within 80-inches of the ground shall have a radius no less than the amount of the protrusion. The exterior rearview mirrors and required lights and reflectors are exempt from the protrusion requirement. Advertising frames shall protrude no more than 7/8-inch from the body surface and shall have the exposed edges and corners rounded to the extent practicable. Grilles, doors, bumpers and other features on the sides and rear of the bus shall be designed to minimize the ability of unauthorized riders to secure toeholds or handholds.

1.21.12.2 Repair and Replacement

Exterior panels below the lower daylight opening and within 35-inches above ground level shall be divided into sections that are repairable or replaceable in less than thirty (30) minutes for a section up to five (5) feet long (excludes painting).

1.21.12.3 Rain Gutters

Rain gutters shall be provided to prevent water flowing from the roof onto the passenger doors, operator's side window, and exterior mirrors. When the bus is decelerated, the gutters shall not drain onto the windshield, or operator's side window, or into the door boarding area. Cross sections of the gutters shall be adequate for proper operation. Rain gutters shall also be provided above passenger side windows.

1.21.12.4 License Plate Provisions

Provisions, and/or housings, shall be made to mount standard size U.S. license plates perpendicular to the ground 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. License plates shall be mounted at a location not to be blocked by the bicycle rack and the device, and provided provisions, shall not allow a toehold or handhold for unauthorized riders.

Licensing and registration shall be completed by the bus manufacturer prior to or by the time of delivery. Contractor shall be responsible for installing a vehicle registration holder, Truck-lite model 97960, or approved equal, subject to the Authority approval.

1.21.12.5 Rubrails

No requirements for rubrails.

1.21.12.6 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.

1.21.12.7 Splash Aprons

Splash aprons, composed of ¼-inch-minimum composition or rubberized fabric, shall be installed behind or in front of wheels or both as needed to reduce road splash and protect underfloor components. The splash aprons shall extend downward within 4-inches of the road surface at static conditions. Apron widths shall be no less than tire widths, except for the front apron that shall extend across the width of the bus. 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. Other splash aprons shall be installed where necessary to protect bus equipment.

1.21.13 Service Compartments and Access Doors

1.21.13.1 Access Doors

Vertically hinged or pantograph hinged doors shall be used for the engine compartment and for all auxiliary equipment compartments including doors for checking the quantity and adding to the engine coolant, engine lubricant, transmission fluid and the windshield washer reservoir. The upper engine radiator/A.C. compartment door may be horizontally hinged.

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 coach. 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.

Doors with top hinges shall have safety props stored behind the door or on the doorframe. All access doors shall be retained in the open position by props or counterbalancing with over-center or gas-filled springs and shall be easily operable by one person. Springs and hinges shall be corrosion resistant.

All latch handles shall be flush with, or recessed behind, the body contour and shall be sized to provide an adequate grip for opening. At a minimum, all access doors larger in area than 100 square inches shall be equipped with corrosion resistant flush-mounted locks. All such access door locks shall be flush mount, push to open type, Southco, or approved equal, C5, sealed lever latches. Access doors that are not equipped with locks shall be remotely accessible from only the operator's area or other secured compartment via a cable release or similar device.

Access doors, when opened, shall not restrict access for servicing other components or systems. Large access doors shall hinge up (180-degree operation) and out of the way or fold flat against the coach body and shall be easily operable by one person. These doors, when opened, shall not restrict access for servicing other components or systems. Retention devices used to hold the engine compartment access doors in the open position shall be heavy duty and designed to last the service life of the coach. Access doors subject to becoming open by wind force shall be positioned such that the normal air flow influence by the bus moving in a forward direction shall bias closing the door.

1.21.13.2 Battery Compartment

The battery compartment or enclosure shall be vented and self-draining. It shall be accessible only from outside the bus. All components within the battery compartment, and the compartment itself, shall be protected from damage or corrosion from the electrolyte and gases emitted by the battery, and from snow, slush, salt spray, mud, etc. generated from environmental conditions outside the bus. Louvers, vents and others used for air circulation shall not allow the introduction of dust, dirt and/or road debris inside the battery compartment. 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.

To minimize the length and routing, throughout the bus, of battery cables, the battery compartment shall be located as close as practical to the electric generator and starter motor. The battery compartment shall be free of any component(s) that generate or produce sparks in general, no other components, devices or wirings, specifically required for battery operation, shall be located in the battery compartment or the immediate vicinity of the battery if not in a separated enclosed compartment.

Battery cables (limited to two, one positive and one ground at battery attachment) shall not be less than 4/0 gauge with a minimum of 2000 strands, shall be a premium grade cable and incorporate a redundant insulation sleeve. The preferred sleeve shall be Packard Flex Guard Loom. Cables shall be routed in a manner to prevent abrasion and pinch points during the routine sliding of the battery tray during battery service. Cable routing securement shall be accomplished using insulated split blocks with pinch bolts, (subject to the Authority's approval) "P" clamps are not permitted.

1.21.13.3 Service Area Lighting

Lights shall be provided in the engine and in all other compartments, where service may be required, to generally illuminate the area for night emergency repairs or adjustments. Sealed lamp assemblies shall be provided in the engine compartment and shall be controlled by a switch located

near the rear start controls in the engine compartment. Necessary lights, located in other service compartments, shall be provided with switches on the light fixture or convenient to the light. All lights, when available, shall be LED with a lifetime warranty.

1.21.14 Bumpers

1.21.14.1 Location

Bumpers shall provide impact protection for the front and rear of the bus with the top of the bumper being 28-inches plus or minus 2 inches 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.

1.21.14.2 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 longitudinal centerline of the bus. 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 4,000 pounds parallel to the longitudinal centerline of the bus and 5.5 mph impacts into the corners at a 30-degree angle to the longitudinal centerline of the bus. The energy absorption system of the bumper shall be independent of every power system of the bus and shall not require service or maintenance in normal operation during the service life of the bus. The bumper may increase the overall bus length by no more than 7 inches.

1.21.14.3 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-feet 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-inch high, and at accelerations up to 2-mph/sec.

The rear bumper shall protect the bus, when impacted anywhere along its width by the Common Carriage with Contoured Impact Surface defined in Figure 2 of FMVSS 301 loaded to 4,000 pounds, at 4 mph parallel to, or up to a 30-degree angle to, the longitudinal centerline of the bus. The rear bumper shall be shaped to preclude unauthorized riders standing on the bumper. The bumper shall be independent of all power systems 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-inches.

1.21.14.4 Bumper Material

Bumper material shall be corrosion-resistant and withstand repeated impacts of the specified loads without sustaining damage. Visible surfaces shall be black. These bumper qualities shall be sustained throughout the service life of the bus.

1.21.15 Finish and Color

All exterior surfaces shall be smooth and free of wrinkles and dents. Exterior surfaces to be painted shall be properly prepared as required by the paint system supplier, prior to application of paint to assure a proper bond between the basic surface and successive coats of original paint for the service life of the bus. Drilled holes and cutouts in exterior surfaces shall be made prior to cleaning, priming and painting to prevent corrosion. The bus shall be completely painted prior to installation

of exterior lights, windows, mirrors and other items that are applied to the exterior of the bus. Body filler materials may be used for surface dressing, but not for repair of damaged or improperly fitted panels.

Paint shall be applied smoothly and evenly with the finished surface free of 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.

To the degree consistent with industry standards for commercial bus finishes, painted surfaces shall have gloss and orange peel shall be minimized. All exterior finished surfaces shall be impervious to environmental exposure and commercial cleaning agents. Finished surfaces shall resist damage by controlled applications of commonly used graffiti-removing chemicals. Except for periodic cleaning, exterior surfaces of the bus shall be maintenance-free, permanently colored and not require refinish/repaint for the life of the bus. Durable, peel-resistant pressure sensitive appliqués shall be used for any striping and coloring required.

The overall exterior color of painted surfaces shall be based on the OC Bus paint scheme provided in **Attachment labeled "Branding OCBUS regular"**

Paint shall be Dupont Imron, PPG concept or Deft with a final clear coat. The Authority identity, OCBus, OCbus.com and other additional graphics, bus ID numbers (side, front, rear & large ID, 44-inch numbers at roof) and CA Carrier Number (CA 43438). The exact size, quantity and location of decals are subject to review/final acceptance by the Authority and will be conducted with the Contractor between time of award and pre-production meeting. The subject review will also include elements of subjective color coordination such as, but not limited to, exterior color approval and interior colors that have not been specifically addressed otherwise.

1.21.16 Numbering and Signing

1.21.16.1 General

Monograms, numbers and other special signing specified by the Authority shall be applied to the inside and outside of the bus as required. Signs shall be durable and fade, chip, and peel resistant. The signs may be painted signs, decals, or pressure-sensitive appliqués. All decals shall be sealed with clear, waterproof sealant around all exposed edges if required by the decal supplier. The Authority bus ID numbers will be provided at the pre-production meeting.

Signs shall be provided in compliance with the ADA requirements defined in 49 CFR Part 38, Subpart B, Section 38.27. Decals indicating on-board CNG fuel, in compliance with California Code of Regulations Title 13, and NFPA 52 shall be affixed to the bus.

1.21.16.2 Interior

Coach Interior decal layout shall consist of the following basic items:

- Information required by Federal, State and Local regulations
- International graphic symbols typical of transit buses
- Authority bus ID numbers
- Driver and Passenger information typical of the proposed bus

The Authority reserves the right of final approval upon acceptance of the prototype bus.

1.21.16.3 Exterior

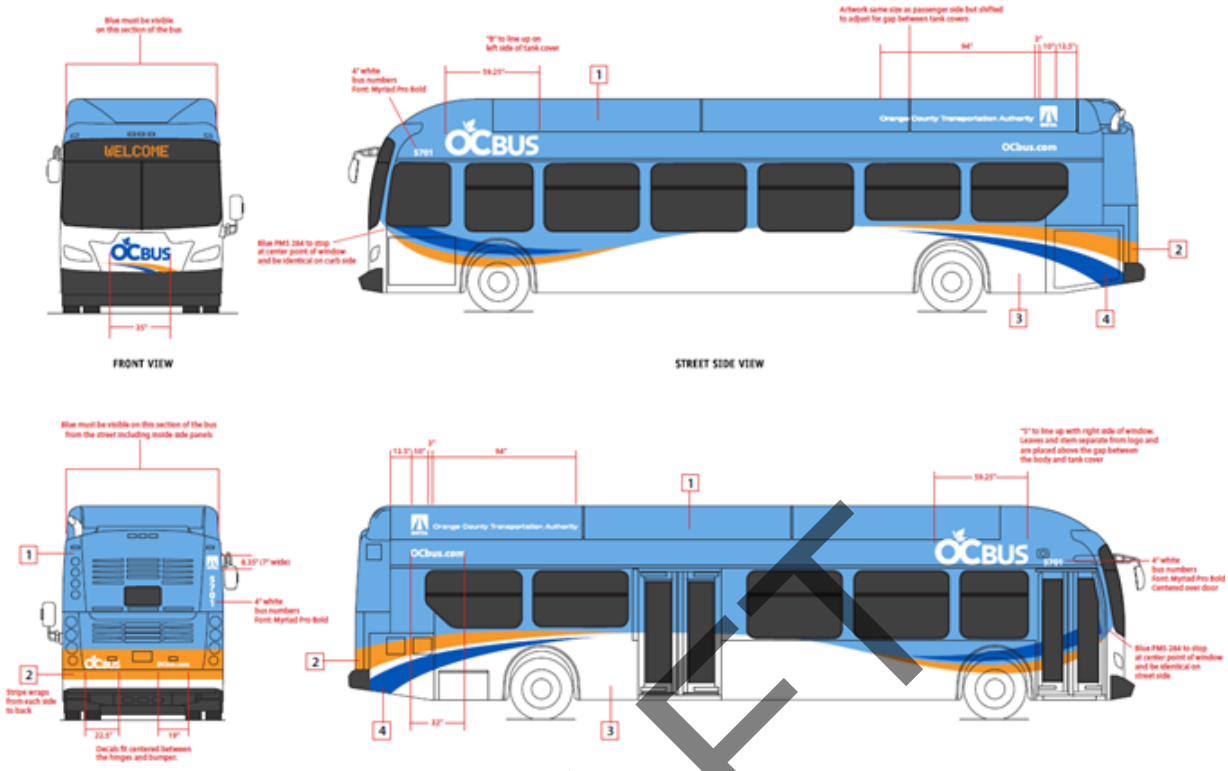
The exterior decal and paint layout shall be based on the "OCBUS" paint scheme; see **Attachment labeled "Branding OCBUS regular"**, in addition to the following basic items:

- Authority logos; OCBUS, OCbus.com", "T" logos and all others.
- Bike rack operation instructions
- Authority 4-digit bus ID numbers (front, rear, driver's side, street side, others)
- Rooftop ID numbers (48 inches high)
- CA commercial carrier number CA43438)
- Authority name
- CNG decals. Multiple CNG decals shall be installed to clearly indicate the type of fuel when the bus is approached from any, and all directions.

Decals, if applicable, shall consist of 3M Reflective 680 CR Series material with 9700 Series ink or approved equal. Authority reserves the right of final approval upon acceptance of the prototype bus.

1.21.16.4 Exterior Paint Scheme

OCTA's standard exterior paint scheme is depicted below.



1. PPG paint to match 284 C Blue
2. PPG paint to match PMS 151 C Orange
3. PPG paint to match White HSV 921472
4. PPG paint to match PMS 2935 Blue for Stripes and Logo on front of the bus
5. 3M 8991R clear surface protectant to alleviate scratches on paint from bus king advertisements and should be the last item applied (146” wide x 30” high).
6. Drawing is for reference only. Final engineering drawing shall be provided by Contractor for Authority approval.
7. All lettering is white cut out vinyl.

1.21.17 Exterior Lighting

All exterior lights shall be designed to prevent entry and accumulation of moisture or dust, and each lamp shall be replaceable in less than five (5) minutes. Commercially available LED (Light Emitting Diode) type lamps, with a lifetime warranty, shall be used at all locations.

Lights mounted on the engine compartment doors shall be protected from the impact shock of door opening and closing. 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 bus through an automatic bus washer. Lights located on the roof and sides (directionals) of the bus shall have protective shields or be of the flush mount type to protect the lens against minor impacts. As available, lamps shall operate at nominal 24 vdc and include internal voltage regulation.

Two hazards, 7-inch LED lamps with a lifetime warranty, shall be installed at the rear of the bus and shall be visible from behind when the engine service doors are opened.

Visible and audible warning shall inform following vehicles/bus or pedestrians of reverse operation. Visible reverse operation warning shall conform to SAE Standard J593. Audible reverse operation warning shall conform to SAE Recommended Practice J994 Type C or D.

Lamps at the front and rear passenger doorways shall comply with ADA requirements and shall activate only when the doors open. These lamps shall illuminate the street surface to a level of no less than 1 foot-candle for 3-feet 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.

Turn-signal lights, 7-inch lamps with a lifetime warranty, shall be provided on both sides of the bus.

1.21.17.1 Brake and Back-up Lights

Two vertically mounted 7-inch LED rear brake lights, with a lifetime warranty, shall be installed in each side of the rear section of the bus. Three rear centered mounted 7-inch LED brake lights, with a lifetime warranty, shall be provided and located as to not interfere with the placement of the rear ad frame. Two 7-inch LED back-up lights shall be vertically mounted on the rear section of the bus.

1.21.17.2 Curbside Cornering Lights

Two LED cornering lights, 4-inch diameter minimum, or applicable, shall be provided to allow the operator viewing of the curbs when making right-hand turns. Such lights shall be activated by the floor-mounted Right-Hand turn signal switch and shall be aimed at each, front and rear curbside wheels. The lights shall remain energized after the turn-signal switch is released, for an amount of time to be determined during the evaluation of the first article

1.21.18 Interior Panel and Finishes

1.21.18.1 General

Materials shall be selected based on maintenance, durability, appearance, safety, flammability, and tactile qualities. Trim and attachment details shall be kept simple and unobtrusive. Materials shall be strong enough to resist everyday abuse and vandalism; they shall be resistant to scratches and markings. Interior trim shall be secured to avoid resonant vibrations under normal operational conditions.

Interior surfaces more than 10-inches 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. The entire interior shall be cleanable with a hose, using a liquid soap attachment. Water and soap should not normally be sprayed directly on the instrument and switch panels.

1.21.19 Front End

The entire front end of the bus shall be sealed to prevent debris accumulation behind the dash and to prevent the operator's feet from kicking or fouling wiring and other equipment. The front end shall be free of protrusions that are hazardous to passengers standing or walking in the front of the bus during rapid decelerations. Paneling across the front of the bus and any trim around the operator's compartment shall be formed metal or plastic material. Formed metal dash panels shall be painted and finished or may be carpeted or vinyl covered. Plastic dash panels shall be reinforced, as necessary, vandal-resistant, and replaceable. All colored, painted, and plated parts forward of the operator's barrier shall be finished with a dull matte surface to reduce glare.

Manufacturer shall place special attention to the selection of components, materials, placement of the lights, use of filters, non-reflective materials, paints and surfaces to minimize the glare effect on the Operator.

1.21.20 Rear End

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, plastic, or carpeting and trimmed with stainless steel, aluminum, or plastic. Authority reserves the right of selecting from any of the listed materials.

1.21.21 Interior Panels

1.21.21.1 General

Interior side trim panels and operator's barrier shall be textured stainless steel, anodized aluminum, plastic, melamine-type material, or carpeting. 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. Grey carpet shall be used on top of non-corrosive material at the rear section of the bus. Untrimmed areas shall be painted and finished. All materials shall comply with the Recommended Fire Safety Practices defined in FTA Docket 90A, dated October 20, 1993. Only stainless-steel panels or materials that inherently do not permit corrosion shall be allowed on the interior of the bus unless, the Contractor obtains the Authority's approval in writing for a different type of material(s).

1.21.22 Operator's Coat Hanger

A suitable hanger shall be installed in a convenient approved location for the operator's overcoat.

1.21.23 Operator Barrier and Schedule Holder

A barrier or bulkhead between the operator 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.

Operator's Barrier shall extend continually from floor to ceiling and from the bus wall to first stanchion immediately behind the Operator to provide security to the Operator and limit passenger conversation.

- Location and shape must permit full seat travel possibilities and accommodate the shoulders of a 95th percentile male.
- Partition shall have a side return and stanchion to prevent passenger from standing behind the Operator's seat; lower area between seat and panel must be accessible to the Operator.
- Partition must be strong enough in conjunction with entire partition assembly for mounting of such equipment as flare kits, fire extinguishers (1.2kg), microcomputer, public address amplifier, etc.
- Partition shall start 25mm (1-inch) above floor
- Dark or black panels preferred ½-inch thick acrylic or similar
- Schedule holder shall be mounted, at Authority's decision, horizontally on the passenger side of the barrier or vertically, facing the passenger aisle.
- Panel should be attached with rubber grommets.

1.21.24 Operator Storage Box

An enclosed Operator storage area shall be provided with a positive latching door and key-lock UCP # 2051641; minimum approximate size: 355 mm x 355 mm x 355 mm (14" x 14" x 14"). This box shall be located at the driver's workstation area. No key shall be required if the driver's seat, or other, during normal operations, blocks the access to the Operator's storage box.

1.21.25 Modesty Panels

Sturdy, stainless steel for the lower sections and transparent melamine for the upper sections, divider panels constructed of durable, unpainted, corrosion-resistant material complementing the interior trim shall be provided to act as both a physical and visual barrier for seated passengers. Modesty panels shall be immune to vandalism or be of a design incorporating inexpensive/easily replaceable sacrificial panels, firms, etc.

Modesty panels shall be located at, when applicable, front and rear sections of doorways to protect passengers on adjacent seats, and along front edge of rear upper level. Design and installation of modesty panels located in front of forward-facing seats shall include a handhold/grab handle along its top edge. These dividers shall be mounted on the sidewall and shall project toward the aisle no farther than passenger knee projection in longitudinal seats or the aisle side of the transverse seats.

Modesty panels shall extend no higher than the lower daylight opening of the side windows and those forward of transverse seats shall extend downward to a level between 1½ and 1 inch below the floor. Panels forward of longitudinal seats shall extend to below the level of the seat cushion. Dividers positioned at the doorways shall provide no less than a 2½-inch clearance between the modesty panel and the opened door to protect passengers from being pinched. Modesty panels installed at doorways shall be equipped with yellow powder coated grab rails and, when applicable (e.g., rear doors), shall extend below the floor level to prevent door interaction with passenger's feet.

The modesty panel and its mounting shall withstand a static force of 250 pounds applied to a four-inch by four-inch area in the center of the panel without permanent visible deformation. Mounting provisions of modesty panels shall accommodate easy replacement of damaged or vandalized components and shall be secured with removable tamper-proof provisions.

Stainless steel modesty panels, or passenger barriers, shall be in front of any and all forward, or rear facing seats where a barrier does not exist. Such modesty panels shall cover the entire width of the forward or side facing seats.

1.21.26 Passenger Hand Holds

Stainless steel powder coated safety yellow passenger handholds shall be located at all seat locations where the installation or presence of a modesty panel, or passenger barrier, is not practical or, where such barrier or modesty panel, does not cover the entire forward "projected width" of a passenger seat e.g.; forward-facing seats located in the rearmost bench-seat of the bus, first row of aisle facing seats after the front wheel wells, etc. The passenger handholds shall be made of stainless steel and shall be mounted on the side, or in between of the targeted seats, and they shall be of a slim design intended to minimize protrusion, passenger interference, object catching and any other passenger traffic related interferences. The passenger handholds shall be similar in design to an "arm-rest" and shall be capable of allowing a passenger ranging in size from a 5th-percentile female to a 95th-percentile male to have a full hand grip on the device when required. Final locations shall be discussed and defined during the pre-production meetings and during the evaluation of the first article.

1.21.27 Rear Bulkhead

The rear bulkhead paneling shall be contoured to fit the ceiling, side walls, and seat backs so that any litter, such as a cigarette package or newspaper, 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. To service components located on the rear bulkhead, the panel shall be hinged or shall be able to be removed and replaced by a specialty mechanic in five (5) minutes. Grilles where access to or adjustment of equipment is required shall be heavy duty and designed to minimize damage. The panels above the rear seats shall be covered with dark color carpet material.

1.21.28 Headlining

Ceiling panels shall be a material that inherently does not corrode such as textured stainless steel, anodized aluminum, melamine-type material, carpeting, or material suitable for exterior skin painted and finished to exterior quality. 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.

1.21.29 Fastening

Interior panels shall be attached so that no exposed unfinished or rough edges or rough surfaces exist. Panels and fasteners shall not be easily removable by passengers. Interior trim fasteners, where required, shall be rivets or cross-recessed head screws. Fasteners shall be stainless steel.

1.21.30 Insulation

Any insulation material used between the inner and outer panels shall be sealed or self-sealing to minimize entry or retention of moisture or both. 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. All insulation materials shall comply with the Recommended Fire Safety Practices defined in FTA Docket 90A, dated October 20, 1993.

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 of these Technical Specifications. The bus body shall be thoroughly sealed so that the operator or passengers cannot feel drafts during normal operations with the passenger doors closed.

1.21.31 Floor Covering

The floor covering shall have a non-skid walking surface that remains effective in all weather conditions and complies with all ADA requirements. The floor covering, as well as transitions of flooring material to the main floor and to the entrance and exit area, shall be smooth and present no tripping hazards. The standee line shall be at least 2-inches wide and shall extend across the bus aisle. This line shall be the same color as the outboard edge of the entrance/exit areas. Color/pattern shall be consistent throughout the floor covering. Floor covering shall be RCA transit flooring, type TR-766.

Any areas on the floor, which are not intended for standees, such as areas "swept" during passenger door operation, shall be clearly and permanently marked. The floor in the operator's compartment shall be easily cleaned and shall be arranged to minimize debris accumulation. A one-piece center strip shall extend from the vertical wall of the rear settee between the aisle sides of transverse seats to the standee line. If the floor is of a bi-level construction, then 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 wheelchair locations shall be covered with Line-X, or approved equal, antiskid material and, the floor under the seats shall be covered with smooth antiskid surface flooring material and the center strip shall be ribbed. The floor covering shall closely fit the sidewall cove or extend to the top of the cove.

1.21.32 Passenger Interior Lightning

The interior LED lighting system, with a lifetime warranty, shall provide a minimum 15 foot-candle illumination on a 1 square foot plane at an angle of 45-degrees from horizontal, centered 33-inches above the floor and 24-inches in front of the seat back at each seat position. Allowable average light level for the rear bench seats shall be 7-foot-candles. Floor surface in the aisles shall be a minimum of 10-foot-candles, vestibule area a minimum of 4-foot-candles with the front doors open and a minimum of 2-foot-candles with the front doors closed.

The light source shall be located to minimize windshield glare with distribution of the light focused primarily on the passengers' reading plane while casting enough light onto the advertising display. LED lights/tubes shall be a maximum 6-foot length, single-pin, T-12 type (with exception granted for extinguishing or dimming fixtures). Lens material shall be clear polycarbonate. Lens shall be designed to effectively "mask" the LED individual diode's light source projection and reflection. Lens shall be sealed to inhibit incursion of dust and insects yet are easily removable for service. If threaded fasteners are used, they must be held captive in the lens. Access panels shall be provided to allow servicing of components located behind all light panels. If necessary, the entire light fixture shall be hinged.

The front entrance area and curb lights shall illuminate when the front door is open and master run switch is in the "Lights" positions. Rear exit area and curb lights shall illuminate when rear door is unlocked. Step lighting for the intermediate platform between lower and upper floor levels shall be provided and shall illuminate in all engine run positions. The step lighting shall be low-profile to minimize tripping and snagging hazard for passengers and shall be shielded as necessary to protect passengers' eyes from glare.

When the master switch is in the RUN or NITE/RUN mode, the first light module on each side of the bus shall automatically extinguish or dim when the front door is in the closed position and illuminate when the door is opened.

The light system may be designed to form part or the entire air distribution duct. A light fixture shall be mounted in the ceiling above the farebox location. The fixture shall project 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. The interior lighting configuration, glare, reflection, operation, etc. shall be reviewed and approved during the first article evaluation.

1.21.33 Fare Collection

Space shall be made for installation of the GFI Odyssey Farebox and the connecting operator control unit. Location of this equipment shall not restrict traffic in the vestibule, including wheelchairs if a front door loading device is used, and shall allow the operator to easily reach the farebox controls and to view the Operator Control Unit (OCU). The farebox and the farebox operator control unit shall not restrict access to the operator area, shall not restrict operation of operator controls and shall not, either by it or in combination with stanchions, and route destination signs, restrict operator's field of view per SAE Recommended Practice J1050. Placement of the OCU shall not prevent fully opening of the farebox top lid.

Location and mounting of the GFI Odyssey model farebox shall allow use, without restriction, by passengers. Farebox location shall permit accessibility to the vault for easy manual removal and for data probing. The floor under the fare box shall be reinforced, as necessary, to provide a sturdy mounting platform and to prevent shaking of the fare box. Farebox mounting, power cables at 24 vdc, data cables at J-1708 interface, brackets and mounting provisions for operator interface shall be provided by the bus manufacturer to accept installation of a GFI Odyssey model farebox. Contractor shall use 12-gauge wire, at a minimum, for power cables and shall consult GFI for inline fuse size. The J-1708 data cable connection at the transit interface box (TIB) must allow for multiple connection points (Y–connector or breakout box). The Authority will install the GFI Odyssey model farebox on the prototype bus after delivery, within acceptance inspection process. The floor area shall be sealed at the farebox base plate interface to prevent water from entering the farebox electrical connection area.

Additionally, Contractor shall be responsible for providing the required mounting provisions e.g., pre-drilled bar(s), bracket, holder, or other as applicable in the front entrance section of the bus to accommodate mounting Authority's "iNit" proxmobile reader/scanner. The iNit unit will be provided by Authority and is intended for Authority's web-based application/transactions. The final mounting location shall be defined during the evaluation of the first article. Existing mounting location is depicted below.

During the Pre-Production Meeting, the Offeror and Authority shall discuss how to design the operator control area to allow maximum visibility and access to the Farebox Operator Control unit, AMDT/IVU, iNit, and all others.

1.21.34 Access Panels and Doors – Interior

Panels and doors that appear to be an integral part of the interior shall provide access for maintenance and replacement of equipment. Access doors shall be hinged with gas props or over-center springs, where practical, to hold the doors out of the mechanic's way. Panel fasteners shall be standardized so that only one tool is required to service all special fasteners within the bus.

Locks shall secure access doors for the door actuator compartments and shall prevent entry of mechanism lubricant into the bus interior. The locks shall be standardized so that only one tool is required to open access doors on the bus. All fasteners that retain access panels shall be captive in the cover.

Access openings in the floor shall be sealed to prevent entry of fumes and water into the bus interior. Flooring material shall be flush with the floor and shall be edge-bound with stainless steel, or other material that is acceptable to the Authority, 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.

TS 1.22 PASSENGER ACCOMMODATIONS

1.22.1 Passenger Seating

1.22.1.1 General

Passenger seats shall be USSC Aries, American Seating Vision or approved equal, to include, stainless steel structure, vandal guard padded/fabric replaceable seat and back inserts, 980 gray color, Holdsworth Defender anti-bacterial, anti-fungal and anti-stain custom Authority fabric (sample shall be provided at the pre-production meeting) or equivalent and thermoplastic padded hand rails.

Arrangements and Seat Styles

The passenger seating arrangement in the bus shall be such that seating capacity is maximized and in compliance to the following requirements. The Authority recognizes that ramp location, foot room, hip-to-knee room, doorway type and width, seat construction, floor level type, seat spacing requirements, etc. ultimately affect seating capacity and layout.

Passenger seats shall be arranged in a transverse, forward facing configuration, except at the wheel housings 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).

The last row of passenger seats shall accommodate five passengers and the center seat shall be equipped with handholds on each side of the seat. The center seats shall securely latch in the closed position and shall be hinged to fully open for easy access to the engine compartment. A gas spring shall be provided to assist lifting to the fully open position. A prop rod, with a latch, shall be provided to securely hold the seat in the fully opened position. An engine access door shall be provided under the last row of seats in the bus. Such removable door/cover shall be noise and thermally insulated.

Passenger seating capacity with this arrangement shall be no less than 35 seats not including the operator, with the specified seating arrangement. The passenger seats shall be equipped with vandal-resistant padded inserts throughout the bus. Note that all applicable seat dimensions specified below shall be measured with the pad fully depressed. Hip-to-knee room measured from the front of one seat back horizontally across the highest part of the seat to the seat or panel immediately in front, shall be no less than 26-inches. Hip-to-knee room shall be no less than 26.5 inches at all seating positions in paired transverse seats immediately behind other seating positions.

Foot room, measured at the floor forward from a point vertically below the front of the seat cushion, shall be no less than 14 inches. Seats immediately behind the wheel housings and modesty panels may have foot room reduced, provided the wheelhouse is shaped so that it may be used as a footrest or the design of modesty panel effectively allows for foot room. Thickness of the transverse seat backs shall be minimized at the bottom to increase passenger knee room and passenger capacity. The area between the longitudinal seat backs and the attachment to the bus sidewalls shall be designed to prevent debris accumulation.

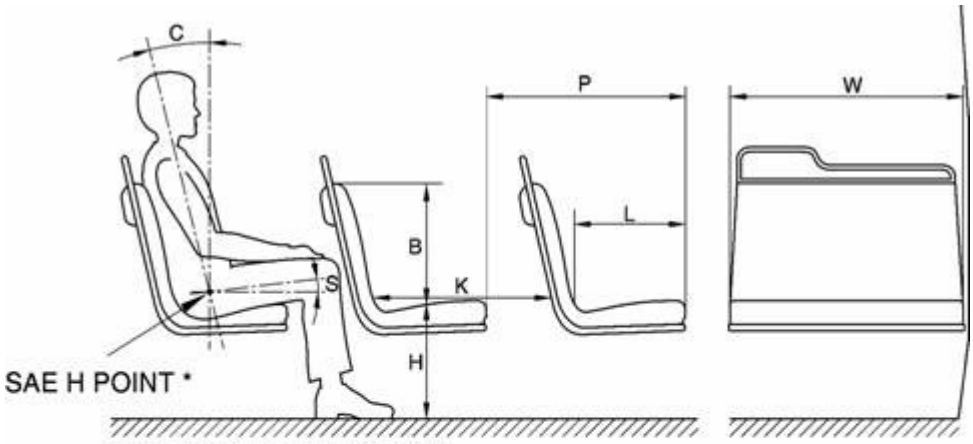
The aisle between the seats shall be no less than 20-inches wide at seated passenger hip height. Seat backs shall be shaped to increase this dimension to no less than 24-inches at standing passenger hip height. Raised platforms for passenger seats shall not be allowed without the Authority's approval. If bus is of a sloped floor design, then raised platforms for passenger seats may be provided in the rear sloped section.

Contractor shall submit in accordance to requirements under Section 1 Offeror Communications and Requests, a copy of the proposed seat layout consistent with these specifications showing hip-to-knee and foot room dimensions, stanchion layout and wheelchair maneuverability layout with proposal for the Authority's review and approval. Contractor shall also indicate on this layout the Free Floor Space available to standees and include the calculation of the Free Floor Space area.

1.22.1.2 Dimensions

Following are the seat dimensions for the various seating arrangements: (Refer to the diagram below.)

- The width, W, of the seat shall be 35 inches.
- The length, L, shall be 17 ±1 inch.
- The seat back height, B, shall be a minimum of 15 inches.
- The seat height, H, shall be 17 ± 1 inches. For the rear lounge (or settee) and longitudinal seats, and seats located above raised areas for storage of under floor components, a cushion height of up to 18 ± 2 inches will be allowed. This shall also be allowed for limited transverse seats, but only with expressed approval of the Authority.
- The seat cushion slope, S, shall be between 5° to 11°.
- The seat back slope, C, shall be between 8° to 17°.



FOR ILLUSTRATIVE PURPOSES ONLY

W	WIDTH	35 inches minimum
L	LENGTH	17 ± 1 inches
B	BACK HEIGHT	15 inches minimum
H	SEAT HEIGHT	Transverse seats 17 ± 1 inches Longitudinal seats and rear settee 18 ± 2 inches
S	SEAT CUSHION SLOPE	5 - 11 degrees
C	SEAT BACK SLOPE	9 - 17 degrees
K	HIP TO KNEE ROOM	26 inches minimum
P	PITCH	Reference only

* Reference SAE J826

SEATING DIMENSIONS

1.22.1.3 Structure and Design

The passenger seat frame and its supporting structure shall be corrosion resistant, constructed and mounted to maximize that space to increase wheelchair maneuvering room and is completely free of obstructions to facilitate cleaning. The transverse seat structure shall be fully cantilevered from the sidewall with enough strength for the intended service. The lowest part of the seat assembly that is within 12-inches of the aisle shall be at least 10-inches above the floor. Folding seats used in wheelchair securement areas, as well as, transverse seats mounted in locations at which cantilevered installation is precluded by design or structure, or both, need not be cantilevered. All seat support structures shall be free of sharp edges.

The underside of the seat and the sidewall shall be configured to prevent debris accumulation and the transition from the seat underside to the bus sidewall to the floor cove radius shall be smooth. All transverse objects, including seat backs, modesty panels, and longitudinal seats, in front of forward-facing seats shall not impart a compressive load in excess of 1,000 pounds 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 .05 ± .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-inches, measured at the aisle side of the seat frame at height H. Seat back should not deflect more than 14-inches, 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 pounds applied to the top of the seat cushion in each seating position with less than ¼-inch permanent deformation in the seat or its mountings. The seat assembly shall withstand static horizontal forces of 500 pounds evenly distributed along the top of the seat back with less than ¼-inch 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-pound 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-inch pendulum and shall strike the seat back 10,000 times each from distances of 6, 8, 10, and 12 inches. Seats at both seating positions shall withstand 4,000 vertical drops of a 40-pound sandbag without visible deterioration. The sandbag shall be dropped 1,000 times each from heights of 6, 8, 10, and 12 inches. Seat cushions shall withstand 100,000 randomly positioned 3½-inch drops of a squirming, 150-pound, smooth-surfaced, buttocks-shape 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 7/8-inch 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 inches 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 or constructed of energy absorbing materials or both. During a 10g deceleration of the bus, the HIC number (as defined by SAE Standard J211a) shall not exceed 400 for passengers ranging in size from a 5th percentile female through a 95th percentile male. The seat back handhold may be deleted from seats that do not have another transverse seat directly behind and where vertical assist is provided. Armrests shall not be included in the design of transverse seats.

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 operator's barrier, or a modesty panel and 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 1-1/2 to 3-1/2-inches of the end of the seat cushion. Armrests shall be located from 7 to 9-inches 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 inch 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 pounds applied anywhere along their length with less than ¼-inch permanent deformation. Seat back handhold and armrests shall withstand 25,000 impacts in each direction of a horizontal force of 125 pounds with less than ¼-inch permanent deformation and without visible deterioration.

Contractor shall provide a test report at the Authority's request fully documenting compliance with all the requirements defined above upon request. The test report shall contain a record

of all testing activities, test diagrams, testing equipment, as well as test data related to loads, deflections and permanent deformation of the seat assembly. The report shall include a statement of compliance with the requirements of this section of the Technical Specifications.

1.22.1.4 Construction and Materials

Seats shall be constructed with materials that comply with the physical test. Selected materials shall minimize damage from vandalism and shall reduce cleaning time. The seats shall be attached to the frame with tamperproof fasteners. Coloring shall be consistent throughout the seat material, with no visually exposed portion painted. All visually exposed metal of the standard seat structure including mounting brackets and other components shall be aluminum or 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-inch. Seat covering materials shall be selected based on durability, ease of maintenance, and pleasing texture and appearance. The seat back and seat back handhold immediately forward of transverse seats shall be constructed of energy absorbing materials to provide passenger protection and, in a severe crash, allow the passenger to deform the seating materials in the impact areas in accordance with the Knee Impact and Head Impact Criteria requirements. Complete seat assemblies shall be interchangeable to the extent practicable.

1.22.2 Passenger Assists

1.22.2.1 General

Passenger assists in the form of full grip, vertical stanchions or handholds shall be provided for the safety of standees and for ingress/egress. Passenger assists shall be convenient in location, shape, and size for both the 95th-percentile male and the 5th-percentile female standee. Starting from the entrance door and moving anywhere in the bus and out the exit door, a vertical assist shall be provided either as the vertical portion of seat back assist or as a separate item so that a 5th-percentile female passenger may easily move from one assist to another using one hand and the other without losing support. All handholds, stanchions and passenger assists shall be stainless steel.

Excluding those mounted on the seats and doors, the assists shall have a cross-sectional diameter between 1¼ and 1½-inches or shall provide an equivalent gripping surface with no corner radii less than ¼ inch.

All vertical stanchions and horizontals identified by the Authority's Risk Management or Health, Safety & Environmental Compliance Departments or both shall be covered by a rubber like energy absorbing sleeves (padding) secured in place with adhesive that shall be applied to tubing and sleeve. All passenger assists shall permit a full hand grip with no less than 1½-inches of knuckle clearance around the assist. Passenger assists shall be designed to minimize catching or snagging of clothes or personal items and shall pass 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. Passenger assists shall

be designed to minimize glare in the Operator's area to the extent possible. Except for seat and door handholds, all areas of the passenger assist that are handled by passengers including functional components used as passenger assists shall be of anodized aluminum or stainless steel. Seat handholds may be of the same construction and finish as the seat frame. Front and rear door mounted passenger assists shall be of anodized aluminum, stainless steel, or powder coated metal in yellow color. Connecting tees and angles may be powder coated metal castings. Assists shall withstand a force of 300 pounds applied over a 12-inch lineal dimension in any direction normal to the assist without permanent visible deformation. All passenger assists 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. All passenger stanchions located by the entrance and exit's doors shall be painted in powder coated safety yellow color.

1.22.2.2 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-inches from the outside edge of the entrance step and shall be easily grasped by a 5th-percentile female boarding from street level. Door assists shall be functionally continuous with the horizontal front passenger assist and the vertical assist and the assists on the wheel housing or on the front modesty panel.

1.22.2.3 Vestibule

The aisle side of the operator'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-inches 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. Passengers shall be able to lean against the assist for security while paying fares. The assist shall be no less than 36-inches 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 operator's barrier, wheel housings, or front modesty panel.

1.22.2.4 Rear Doorway

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 no less than ¾-inch in width and shall provide at least 1½-inches 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-inches from the outside edge of the rear doorway.

1.22.2.5 Overhead

Except forward of the standee line and at the rear door, a continuous, full grip, overhead assist shall be provided. This assist shall be convenient to standees anywhere in the bus and shall be located over the center of the aisle seating position of the transverse seats. The assist shall be no less than 70-inches above the floor. All vertical stanchions and horizontals identified by the Authority's Risk Management or Health, Safety & Environmental Compliance Departments or both shall be covered by a rubber like energy absorbing sleeve (adhesive will be applied to tubing and sleeve).

Passenger hand straps of webbing design, permanently mounted on the selected locations, shall be provided for sections where vertical assists are not available and for the use by passengers that cannot reach to 70-inches and the quantity must be equal to the allowable number of standees. One per standee overhead assists shall be provided and those shall simultaneously support 150 pounds on any 12-inch length. No more than 5 percent of the full grip feature shall be lost due to assist supports. Final hand-strap configuration/location shall be reviewed during the first article's presentation to Authority.

1.22.2.6 Longitudinal Seats

Longitudinal seats shall have vertical assists located between every other designated seating position, except for seats that fold/flip up to accommodate wheelchair securement. All flip-up seats' locking/latching mechanisms shall be located on the right-hand side of the seats. 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 inches apart or functionally continuous for a 5th percentile female passenger.

1.22.2.7 Wheel Housing Barriers/Assists

Unless passenger seating is provided on top of a wheel housing, passenger assists shall be mounted around the exposed sides of the wheel housings (and propulsion compartments if applicable) which shall also be designed to prevent passengers from sitting on wheel housings.

TS 1.23 PASSENGER DOORS

1.23.1 General

Two doorways shall be provided on the curbside of the bus for passenger ingress and egress. The front doorway shall be forward of the front wheels and located so that the operator will be able to collect or monitor the collection of fares. Passenger doors and doorways shall comply with ADA requirements. To maximize ADA accommodations, center aisle spacing, passenger circulation, the centerline of the rear doorway shall be located, approximately, twenty feet rearward of the front door's centerline and/or, as close as possible to beginning of the upper deck of the bus.

The door style for the front door shall be slide glide with yellow hand bars.
The door style for the rear door shall be slide glide with yellow hand bars.

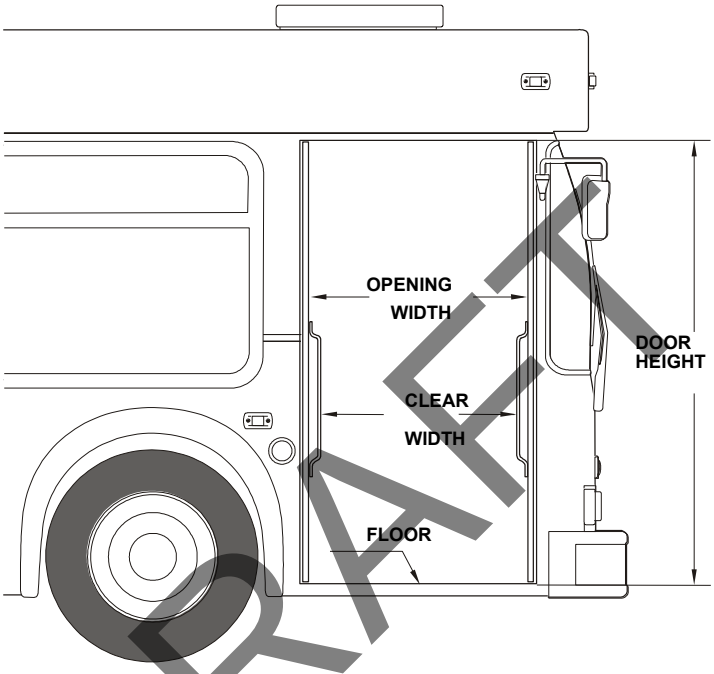
1.23.2 Materials and Construction

Door structures, 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. The doors, when fully opened, shall provide

a firm support and shall not be damaged if used as an assist by passengers during ingress or egress. The front leaves of the passenger doors shall overlap the rear leaves.

1.23.3 Dimensions

Front door width shall be no less than 34-inches and rear door width no less than 40-inches with the doors fully opened. When open, the doors shall leave an opening no less than 76-inches in height.



TRANSIT BUS MINIMUM DOOR OPENING

1.23.4 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. The front door panel glazing material shall have a nominal one-quarter (¼) inch or 6 mm thick laminated safety glass conforming to 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 the same material, thickness and color as the side windows.

1.23.5 Door Projection

The exterior projection of the front doors beyond the side of the bus shall be minimized and shall not block the line of sight of the rear exit door via the curb side mirror when the doors are fully open. The exterior projection of both doors shall be minimized and shall not exceed 13-inches during the opening or closing cycles or when doors are fully opened. Projection inside the bus shall not exceed 21-inches. The closing edge of each door panel shall have no less than 2-inches of soft weather stripping. The doors, when closed, shall be effectively sealed and the hard surfaces of the doors shall be at least 4-inches apart. The combined weather seal and window glazing elements of the

front door shall not exceed 10 degrees of binocular obstruction of the operator's view through the closed door.

1.23.6 Door Height Above Pavement

It shall be possible to open and close either passenger door when the bus, loaded to GVWR, is not knelt and parked with the tires touching an 8-inch-high curb on a street sloping toward the curb so that the street side wheels are 5-inches higher than the right side wheels.

1.23.7 Door Actuators

The bus shall be equipped with a single electric 24 VDC nominal Vapor, or approved equal, electric door operator/actuator incorporating a non-back drivable feature which shall hold the doors in the closed position without the need or application of electrical power. The actuators shall be lubed with grease not with oil.

The door operator and the complex door mechanism shall be in the overhead door compartment and concealed from passengers but shall be easily accessible for servicing. This door operator shall be mechanically synchronizing both doors and shall not rely on software or simple door timing for proper door panel sequencing. The doors, when exposed to a force in excess of 300 pounds applied to the center of the door panel leading edges, the door operator, without the use of auxiliary locking devices shall prevent the doors from opening. If a higher force is applied causing the doors to be opened there shall be no damage to the door operator itself or door panels, any damage shall be limited to minor door components that are easily accessible and replaceable. Whether or not the obstruction system is present or functional, it shall be possible to withdraw a 1-inch diameter smooth cylinder from between the closed-door panels with a force no greater than 35 pounds and the electric door operators shall be rebuildable. The 4-way hazard flashers shall be activated any time that any door is in the open position.

1.23.8 Closing Door Speed –

Closing door edge speed shall not exceed 2.5 to 3.5 seconds. Power close rear doors shall be equipped with a sensitive edge or other obstruction sensing system such that if an obstruction is struck by a closing door edge, the doors will stop or reverse direction or both prior to imparting a 10-pound force on 1 square inch of that obstruction. The Vapor, or approved equal, pressure wave sensors shall be optical type, solid state with a tamper proof housing, visible LED status light indicator intended to aid in the diagnostic and operation of the device.

1.23.9 Door Actuator – Sensing Obstructions

During the closing-door cycle, the electric door actuator's electrical current shall be constantly monitored by the door or bus' control systems and when, or if the normal actuator's operating current threshold is exceeded, then the door control system shall consider that as a "passenger obstruction" and it shall stop the doors from continuing its closing cycle.

1.23.10 Remote Switch

An exterior door switch shall be provided at a location discussed and defined during the pre-production meeting and the manufacturing and presentation of the first article to Authority, to open and close the door when entering or leaving the bus.

1.23.11 Door Motor Control

The door operator shall be driven by a dedicated electrical controller that shall provide the capability of auto set up determining full open, full closed and proper door preload. This controller shall have password protected Bluetooth capabilities for programming and diagnostics and shall be J1939

compatible capable of communicating with the master vehicle network (PLC, I/O, Vansco, etc.). The door controller shall provide diagnostic capability as well as storage and time/date stamping of any door related faults. There shall be an integral cycle counter as part of the embedded software in the controller. Door speed and cushioning shall be accessible through the diagnostic program. Diagnostics and programming shall be an MS Windows based format accessible by a PC laptop device.

1.23.12 Passenger Contact-Less Acoustic Sensor System

The buses shall be equipped with a rear-door mounted contact-less acoustic sensor system (CLASS ultra) as manufactured by Vapor or approved equal. The CLASS system shall be designed to allow passengers to initiate the opening of the doors and exit the vehicle and detect the presence of passenger(s) in the defined zones of detection. The rear door shall be equipped with waterproof or weatherproof touch-tape switches and an “on/off” CLASS-system-switch located in the driver’s overhead compartment. That switch shall be labeled and, when in the “off” position, the rear door system shall maintain full door operational functionality (tape switches, sensitive edges, driver’s door control, etc.)

1.23.13 Emergency Operation

The door operator shall provide a manual release which when actuated by one single motion with the application of a force no greater than 20 pounds allows manual opening of the doors. The manual release shall not allow disengagement of any of the major operating components, linkages or meshing gears and shall be internal to the gear motor mechanism. Reset of the manual release shall be accomplished with one single motion without the use of tools regardless of door panel position.

The respective door emergency unlocking device shall be accessible from the entrance and exit areas. The emergency release activation mechanisms shall be located within hinged enclosures and the intent for passenger use shall require breaking an etched clear lens. Additionally, the enclosures shall be hinged, and shall remain in the closed position by means of magnets thus allowing ease access of use for maintenance and servicing.

When the rear door emergency device is actuated, the door interlock throttle system shall return the engine to idle and the door interlock brake system shall apply to stop the bus. When the front door emergency device is actuated, only the door interlock throttle system shall be actuated. Locked doors shall require a force of more than 300 pounds 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, engines, and complex mechanism. Application of the brake interlock shall be dependent upon the bus being at near zero speed (less than 2 MPH).

TS 1.24 ACCESSIBILITY PROVISIONS

1.24.1 General

Contractor shall design and construct the bus in accordance with all requirements defined in 49 CFR, Part 38, Subpart B: ADA Accessibility Specifications for Transportation Vehicles – Buses, Vans and Systems. Contractor shall provide space and body structural provisions at the rear door of the bus to accommodate the wheelchair loading system. Prior to submission of bid, the Contractor shall provide a plan, including layout drawings for entry, maneuvering, parking, and exiting of wheelchair passengers, to show compliance with ADA regulations.

1.24.2 Loading System

An automatically-controlled, power-operated ramp, 1 to 6 ratio (rise over run relationship), 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. Contractor shall provide the ADA ramp at the rear door location. When the system is not in use, the passageway shall appear normal. In the stored position of the ramp, no tripping hazards shall be present, and any resulting gaps shall be minimized. The controls shall be simple to operate with no complex phasing operations required, and the loading system operation shall be under the surveillance and complete control of the operator.

The controls for the loading system shall be located near the rear door in which the system is located. The key "on" switch, using key UCP #205164, shall be located at the driver's console/dashboard panel. The ramp and kneeling controls shall also be incorporated in a secondary key-locked metal enclosure using key UCP #205164 located by the door, as to not obstruct passage through the doorway or aisle. The location and shape of the enclosure shall be discussed at the pre-production meeting and will be subject to the Authority approval at that time. A switch shall be provided in the operator's area to disable the loading system using key-lock UCP # 205164. The bus shall be prevented from moving during the loading or unloading cycle by a shifter, throttle and brake interlock system.

The control panel shall be labeled RAMP (STOW, FLOAT, DEPLOY), KNEELING (RAISE, KNEELING) and ENABLE.

The wheelchair loading system shall not present a hazard, nor inconvenience any passenger. The loading system shall be inhibited from retracting or folding when a passenger is on the ramp/platform. A passenger departing or boarding via the ramp shall be able to easily obtain support by grasping the passenger assist located on the doors or other assists provided for this purpose. The platform shall be designed to protect the ramp from damage and persons on the sidewalk from injury during the extension/retraction or lowering/raising phases of operation.

The loading platform shall be covered with Line-X, or approved equal, nonskid material and shall be fitted with devices to prevent the wheelchair from rolling off the sides during loading or unloading. Deployment or storage of the ramp shall require no more than 15 seconds. The device shall function without failure or adjustment for 500 cycles or 5,000 miles in all weather conditions on the design operating profile when activated once during the idle phase. A manual override system shall permit unloading a wheelchair and storing the device in the event of a primary power failure. The manual operation of the ramp shall not require more than 20 pounds of force. The ramp assembly components shall be replaceable within 30 minutes by a journeyman mechanic.

The unit shall be equipped with a "non-zeroing" historical counter controlled, recorded and operated within the PLC. The data shall be time stamped and downloadable into a spread-sheet format for analysis (intended to evaluate activity; daily, monthly, time of the day, day of the week, etc.)

1.24.3 Wheelchair Accommodations

Two forward-facing locations, as close to the wheelchair loading system as practical, shall provide parking space, individual barriers and securement system compliant with ADA requirements for a passenger in a wheelchair. Additional equipment, including passenger restraint seat belts, shoulder harnesses and wheelchair securement devices shall be provided for each wheelchair passenger. All belt assemblies and securements shall be capable of remote activation, must stow up and out

of the way when not in use and provisions shall be provided to eliminate having them laying on the ground floor by means of, e.g., magnetic plates, stow-away devices, hooks, etc.

Antiskid Line-X, or approved equal, flooring material, subject to the Authority's approval, is required at all wheelchair locations.

LED lights shall be provided above the doorway equipped with the wheelchair lift/ramp system to floodlight the loading area. The lamps shall illuminate when the lift system is in operation and shall illuminate the street surface to a level of no less than 1 foot-candle for three-feet square outward from the lowest step tread edge.

The basic securement system shall be USSC 4-ONE or American Seating Q-POD, or approved equal, to include a three-point securement system, stabilizing bumper, scooter ring provisions, multiple scooter straps for two ADA positions, integrated shoulder belt thus eliminating window brackets, electrical release with back-up provisions with audible alarm, integrated wheelchair securements, stainless steel paneling's to minimize vandalism, belting system for conventional wheelchairs as well as three wheel scooters. All flip-up seats' locking/latching mechanisms shall be located on the right-hand side of the seats.

1.24.4 Interior Circulation

Maneuvering room inside the bus shall accommodate easy travel for a passenger in a wheelchair from the loading device through the bus to the designated parking area and back out. It shall be designed so that no portion of the wheelchair or its occupant shall protrude into the normal aisle of the bus when parked in the designated parking space(s). As a guide, no width dimension should be less than 34-inches. Areas requiring 90-degree turns of wheelchairs should have a clearance arc dimension no less than 45-inches and in the parking area where 180-degree turns are expected, space should be clear in a full 60-inch-diameter circle. A vertical clearance of 12-inches above the floor surface should be provided on the outside of turning areas for wheelchair footrest.

The bus shall be equipped with a rear mounted wheelchair ramp. Contractor shall submit a scaled drawing with clear and complete dimensions indicating potential seating layouts intended to maximize seated capacity, wheelchair turning radius, wheelchairs in parked position, wheelchair accommodations for rear mounted wheelchair ramps. An ADA compliance envelope of 30 x 48-inches shall be included in the drawings showcasing that the physical layouts proposed are in compliance with the ADA requirements.

1.24.5 Passenger Information

ADA priority seating signs as required and defined by 49 CFR, Part 38.27 shall be provided to identify the seats designated for passengers with disabilities. Additional signage and passenger information requirements are outlined within the following sections of these technical specifications:

Public Address System
Destination Signs
Passenger Stop Request
Voice Annunciation System

1.24.6 Bike Rack

The bus shall have a front bumper mounted 3-position bike rack, as manufactured by Byk Rack, Sports Works or approved equal. The bicycle rack dimensions shall comply with the California Vehicle Code. The bike rack shall be made of stainless steel, powder coated flat black and include a solid-state proximity-sensing device. The sensing device shall be incorporated into the operator's

indicator panel, alerting the operator of bike rack position when not in its fully stowed position. In addition, a convex mirror mounted around the driver's workstation shall be used for viewing of deployed bike-rack.

Two (2) additional low-beam style of lights, intended to illuminate the roadway when the rack is loaded with bicycles, shall be mounted on a practical location on the rack, bumper, bracket or other attachment(s) not subjected to vibrations that will hinder the low-beam aiming direction. These additional lights shall only be energized only when the 3-position bicycle rack is deployed.

Clearly posted instructions to operate the rack shall be posted on the front of the bus, visible by any patron during loading and unloading of bicycles.

TS 1.25 OPERATOR PROVISIONS

1.25.1 Operator's Area

1.25.1.1 General

The operator's work area shall be designed to minimize glare to the extent possible and dashboard lights and indicators shall be equipped with additional shading provisions, e.g., dashboard visor, antireflective/antiglare sunshade or others as applicable. 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 operator's area shall be avoided. Such objects include dash panels, switches and controls, cowlings, windshield wipers and arms, barriers and modesty panels, fare stanchions, access panels and doors, fasteners, flooring, ventilation and heating ducting, window and door frames, and visors. Interior lighting located ahead of the standee line shall be controlled by the operator. In general, when designing the operator's area, SAE Recommended Practice, J833, Human Physical Dimensions, shall be used.

1.25.1.2 Visors

Adjustable sun visor(s) shall be provided for the windshield and the operator's side window. Visors shall be shaped to minimize light leakage between the visor and windshield pillars and cover the full width of the window. 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 operator's field of view at angles more than 5-degrees above the horizontal. Contractor shall supply the Authority with different options of front and side visors for approval.

1.25.1.3 Fire Extinguishers

A general-purpose 5-pound ABC extinguisher and mounting bracket shall be provided. Preliminary mounting location shall be on the front, curbside, wheel well, inside the safety equipment storage box (*). Authority will determine location at the pre-production meeting. (*) Safety triangles shall also be mounted and secured inside the safety equipment storage box.

1.25.1.4 Operator's Controls

All switches and controls necessary for the safe operation of the bus shall be conveniently located in the operator's area and shall provide for ease of operation. Switches and controls shall be divided into basic groups and assigned to specific areas, in conformance with SAE Recommended Practice J680, Revised 1988, Location and Operation of Instruments and Controls in Motor Truck Cabs and be essentially within the hand reach envelope described in SAE Recommended Practice, J287, Driver Hand Control Reach.

Operational controls, instrumentation, switches, and other system controls shall not be mixed with ventilation diffusers and non-operational controls or readouts. Controls shall be located so that boarding passengers may not easily tamper with control settings.

Ergonomically designed operator controls, especially those used with a higher degree of frequency are required; e.g., driver's door control, parking brake valve, foot controls, etc.

The door control, kneel control, windshield wiper/washer controls, and run switch shall be in the most convenient operator locations. They shall be identifiable by shape, touch, and permanent markings. Doors shall be operated by a single control, conveniently located and operable in a horizontal plane by the operator's left hand. The setting of this control shall be easily determined by position and touch.

All panel-mounted switches and controls shall be marked with easily read identifiers. Text designating position (on/off) shall be a minimum of 9 points, identifying legends shall be a minimum of 11 points. Extremely condensed or italic type fonts shall not be used. Graphical symbols shall conform to SAE Recommended Practice J2402, Road Vehicles – symbols For Controls, Indicators, and Tell Tales, where available and applicable. Color of switches and controls shall be dark with contrasting typography or symbols. Red type on a black or gray field (or vice versa) shall not be used. Mechanical switches and controls shall be replaceable, and the wiring at these controls shall be serviceable from the vestibule or the operator's seat. Switches, controls, and instruments shall be dust and water resistant.

The following list for Normal Bus Operations identifies bus controls used to operate the bus safely and efficiently. These controls are frequently used, or they are critical to the operation of the bus. They should be located within easy reach of the operator. The operator should not be required to stand or turn his/her body to view or to actuate these controls unless specified otherwise. Final approval to the Operator's Controls locations shall be approved by Authority's Health, Safety and Environmental Compliance department during the presentation of the first article.

The following chart summarizes controls typical of operator interface and all controls electrical in nature shall be assumed to be input signals to the PLC system. PLC input signals shall be positive "high" for activation and PLC outputs shall be positive "high" for load device activation. The PLC based upon rung instruction may directly or indirectly activate device loads, unless the control function is defined as "critical" per the following chart. Critical devices shall require redundant in series confirmation of operator intended activation by passing the output current through the control switch for the subject load device.

Control Device	Control Type	Control Location	Function of Control Activation	"Critical"
Master Run Switch	Rotary, 4 position detent	Side Console	Master control for bus, off, day run, night run and clearance ID lights	No
Engine Start, Front	Push button, n.o. momentary	Side Console	Activates engine starter motor	Yes
Engine Start, Rear	Push button, n.o. momentary	Engine Compartment	Activates engine starter motor	Yes
Engine Run, Rear	3 position toggle switch	Engine Compartment	Permits running engine from rear start & normal front run position & off	Yes
Drive Selector	Touch panel switch	Side Console	Provides selection of propulsion, forward, reverse and neutral	No
HVAC	Rotary, 5 position detent	Side Console	Permits selection of passenger ventilation, off, cool, heat, low fan, high fan	No
Driver's Ventilation	Rotary, 3 position detent	Side Console	Permits supplemental ventilation fan, off, low, high	No
Defroster Fan	Rotary, 3 position detent	Side Console	Permits defroster fan, off, low, high	No
Defroster Temperature	Variable position	Side Console	Adjusts defroster water flow / temperature	No
Windshield Wiper	Variable rotary position (2 required)	Dash left wing	Variable speed control of left / right windshield wipers	No
Windshield Washer	Push button	Dash left wing	Activates windshield washers	No
Dash Panel Lights	Rotary Rheostat	Dash left wing	Provides adjustment for light intensity in night run position	No
Interior Lights	3 position toggle switch	Side Console	Selects mode of passenger compartment lighting, off, on, normal	No
Fast Idle	2 position toggle switch	Side Console	Selects high idle speed of engine	No
WC Ramp / Kneel Enable	2 position keyed (*) switch	Dash right wing	Permits operation of ramp and kneel operations at each door remote panel	Yes
Front Door Ramp/Kneel Enable	2 position keyed (*) switch	Front door remote	Permits ramp and kneel activation from front door area (*) key required	Yes
Front Door Ramp	3 position toggle switch momentary	Front door remote	Permits deploy and stow of front ramp	Yes
Front Kneel	3 position toggle switch detent	Front door remote	Permits kneeling activation and raise and normal at front door remote location	Yes
Rear Door Ramp/Kneel Enable	2 position keyed (*) switch	Rear door remote	Permits ramp and kneel activation from rear door area (*) key required	Yes

Control Device	Control Type	Control Location	Function of Control Activation	"Critical"
Rear Door Ramp	3 position toggle switch momentary	Rear door remote	Permits deploy and stow of rear ramp	Yes
Rear Kneel	3 position toggle switch detent	Rear door remote	Permits kneeling activation and raise and normal at rear door remote location	Yes
Silent Alarm	Recessed Push button, n.c. momentary	Side Console	Activates emergency radio alarm at dispatch & permits covert microphone	No
Left Remote Mirror	4 position toggle type	Side Console	Permits 2 axis adjustment of left exterior mirror	No
Right Remote Mirror	4 position toggle type	Side Console	Permits 2 axis adjustment of right exterior mirror	No
Passenger Door Control	5 position handle type detent	Side Console, Forward	Permits open / close control of front and rear passenger doors	Yes
Rear Door Override	2 position momentary toggle	Side Console, Forward	Allows driver to override activation of rear door passenger tape switches	Yes
Engine Shutdown Override	2 position momentary toggle	Side Console	Permits driver to override auto engine shutdown	No
Hazard Flashers	2 position toggle detent	Side Console	Activates emergency flashers	No
Fire Suppression	Square D red push button w/protective cover	Dash left wing	Permits driver to override and manually discharge fire suppression system	N/A
Mobile Data Terminal	Conduent driver interface panel	Above right dash wing	Facilitates driver interaction with Communication system & master logon	N/A
Farebox Interface	GFI driver interface panel	Near farebox	Facilitates driver interaction with Farebox system	N/A
Sign Interface	Luminator interface panel	Above windshield	Facilitates driver interaction with destination sign system, manual entry	N/A
Turn Signals	Momentary push button (2 required)	Left foot panel	Activates left and right turn signals	No
RIGHT Turn Signal	Momentary push button	Left Foot Pedal	Activates rear wheel exterior flood turning light	No
PA Manual	Momentary push button	Left foot panel	Permits driver to manually activate PA microphone	No
Low Profile Microphone	Low profile discrete Mounting	Steering column	Permits driver to make announcements with both hands on the wheel and focusing on road conditions	No
High Beam	Detent push button	Left foot panel	Permits driver to toggle between low and high beam	No
Parking Brake	Pneumatic PPV	Side Console	Permits driver to apply and release parking brake	N/A

Control Device	Control Type	Control Location	Function of Control Activation	"Critical"
Remote Engine Speed	Rotary Rheostat	Engine Compartment	Permits technician to raise and lower engine RPM from engine compartment	N/A
Master Door / Interlock	Multi-pole toggle, detent	In sign compartment	Permits driver override to disable door and brake/throttle interlock	Yes
Retarder Disable	Multi-pole toggle, detent	Side Console	Permits driver override to disable brake retardation/regeneration	No
Alarm Acknowledge	Push button momentary, n.c. (2 required)	Dash center panel	Permits driver to acknowledge alarm condition and reset sentry system	No
Indicator / Alarm Test Button	Push button*	Dash center panel	Permits driver to activate test of sentry, indicators, and audible alarms	No
Radio Power	2 position toggle switch	Side Console	Permits turning radio power on and off	No

(*): All indicators shall have a method of momentarily testing operation. Wherever possible, sensors shall be of the closed-circuit type so that failure of the circuit or sensor or both shall activate the malfunction indicator. Audible alarms shall be loud enough for the operator to hear and to be inclined to discontinue operation of the bus.

Critical systems or components monitored by onboard diagnostics system shall be displayed in clear view of the operator. This display shall have visual or audible indicators or both. 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 back lighting.

Space shall be provided on the panel for future additions of no less than five spare indicators as the capability of onboard diagnostic systems improves. Blank spaces shall contain bulbs (or LED's).

All overriding switches, e.g. retarder, class, door master, ABS, Kidde, etc., shall be located inside the destination sign compartment.

1.25.1.5 Master Run Switch

The run switch shall be a four-position rotary switch with the following functions:

OFF - All electrical systems off, except power available for the passenger interior lighting, stoplights, turn lights, hazard lights, radio, silent alarm, horn, fare box, fire detection equipment, engine compartment lights, methane detection if provided and electronic equipment that require continuous energizing. If the bus is not operated for a period of 48 hours, the total electric load due to devices that require continuous energizing shall not cause the battery to be discharged below the level necessary to start the engine. Electrical loads resulting from the Authority's devices, such as, fare box, GPS or applicable, radio, etc., shall not exceed 1.5 amps with the master run switch in the OFF position.

CL/ID - All electrical systems off, except those listed in OFF and power to destination signs, interior lights and marker lights.

RUN - All electrical systems and engine on, except the headlights, parking lights and marker lights. Daytime running lights (DRL), if provided, shall be on.

NITE/RUN - All electrical systems and engine on.

1.25.1.6 Door Control

The bus shall be equipped with a Vapor, or approved equal, ergonomic door position selector knob, digital door controller equipped with RAISE and KNEEL easy to read, backlighted switch icons/buttons.

Doors shall open or close completely in not more than 2.5 to 3.5 seconds from the time of control actuation and shall be subject to closing force requirements and adjustment requirements. The door control shall be located on the street side of the operator's area within the hand reach envelope described in SAE Recommended Practice, J287, Driver Hand Control Reach. The front door shall remain in commanded state position even if power is removed or lost.

To preclude movement of the bus while the rear door is open, an accelerator interlock shall lock the accelerator in the closed position and a brake interlock shall engage the service brake system when the rear door control is activated. The interlock system shall also energize the emergency four-way flasher system.

Operation of, and power to, the front passenger doors shall be completely controlled by the operator. Power to rear doors shall be controlled by operator. The opening of rear doors shall be controlled by passenger via touch-tapes, or by the operator using a bypass switch. An alarm shall sound whenever the rear door is opened or attempted to be opened when rear doors are not powered.

A control or valve in the operator's compartment shall shut off the power to, or dump the power from, the front door mechanism or both to permit manual operation of the front door with the bus shut down. A master door switch that is not within reach of the seated operator when set in the "Off" position shall close the doors, deactivate the door control system, release the interlocks, and permit only manual operation of the doors.

1.25.1.7 Step Well Lamp

Front and rear step well areas shall be lighted by two-step well LED lights in each step well, suitable mounted so that the entire step well and a portion of the ground area immediately outside the bus is sufficiently illuminated. These lights shall be shielded to protect passengers' eyes from glare. The front step well lights shall be on with front door open and off when the front door is closed. The rear step well lights shall always be on except when the master switch is in the off position.

1.25.1.8 Operator Interior Lights

The operator's area shall have a light to provide general illumination, and it shall illuminate the half of the steering wheel nearest the operator to a level of 10 to 15 foot-candles. This LED light shall be operator controlled by a toggle switch located on the operator's control panel or other approved location.

A three-position toggle switch, labeled "Interior Lights; On (at top), Off, Normal" shall control the lights.

"On" turns on all lights in any Master Switch position
"Off" turns off all lights
"Normal" turns on all lights in "Night Run" and "Night Park" except as noted below.

The first light on each side (behind the Operator 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 when the toggle switch is in the "On" position

To help eliminate windshield reflection on suburban roads, where street lighting is at a low level, the second light on each side, when "Night Run" or "Night Park" is selected, shall be controlled by the toggle switch; off in "Off" and on in "Normal." (These LED lights shall be turned on when the toggle switch is in the "On" position.)

All interior lighting shall be turned off whenever the transmission selector is in the reverse and engine run switch is in the "On" position. Authority shall approve the interior lighting design.

1.25.1.9 Operator Foot Controls

Authority's Health, Safety & Environmental Compliance department shall approve all foot controls, pedal angles, actuation and recovery forces as well as locations throughout the bus during the presentation and review of the first article bus.

1.25.1.10 Adjustable Throttle and Brake Pedals

The bus shall be equipped with Teleflex, or approved equal, adjustable foot controls including brake and throttle pedals.

1.25.1.11 Accelerator

1.25.1.11.1 Accelerator Pedal Angle

The angle of the accelerator pedal shall be determined from a horizontal plane regardless of the slope of the cab floor. The accelerator pedal shall be positioned at an angle of 27-35 degrees at the point of initiation of contact and extend downward to an angle of 10-18 degrees at full throttle. Authority's Health, Safety & Environmental Compliance department shall approve the accelerator pedal angle, actuation and recovery force as well as location.

1.25.1.11.2 Accelerator Pedal Dimensions

The floor mounted accelerator pedal shall be 10-inches to 12-inches long and 3-inches to 4-inches wide.

1.25.1.11.3 Accelerator Pedal Force

The force to depress the accelerator pedal shall be measured at the midpoint of the accelerator. The accelerator force shall be no less than 7-foot pounds and no more than 9-foot pounds.

1.25.1.11.4 Accelerator Interlock

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 when the rear door control is activated. The braking effort shall be adjustable with hand tools. Rear doors shall not open until bus speed is at 0 mph and brake interlock shall not activate until bus speed is at 0 mph.

1.25.1.12 Brake

1.25.1.12.1 Brake Pedal Angle

The brake pedal angle shall be determined from a horizontal plane regardless of the slope of the cab floor. The brake pedal shall be positioned at an angle of 27 to 35-degrees at the point of initiation of contact and extend downward to an angle of 20 to 28-degrees at full depression. Authority's Health, Safety & Environmental Compliance department shall approve the brake pedal angle, actuation and recovery force as well as location.

1.25.1.12.2 Brake Pedal Dimensions

The floor mounted brake pedal shall be 10-inches to 12-inches long and 3-inches to 4-inches wide.

1.25.1.12.3 Brake Force

The force to depress the brake pedal shall be measured at the midpoint of the brake pedal. The brake pedal force shall be no less than 10-foot pounds and no more than 50-foot pounds.

1.25.1.12.4 Relative Position Between Accelerator and Brake Pedals

The accelerator and brake pedals shall be positioned such that the spacing between them, measured at the heel of the pedals, is between 1-inch and 2-inches. The Authority's Health, Safety & Environmental Compliance department shall approve the relative position between accelerator and brake pedals.

1.25.1.12.5 Accelerator and Brake Pedal Location and Lateral Angle

Contractor shall determine the location of the brake and accelerator pedals based upon space needs, visibility, lower edge of windshield, and vertical H-point. The brake pedal shall have a 0-degree lateral angle. The accelerator shall have a 12-degree lateral angle to coincide with the position of the operator's leg as it moves outward to operate the accelerator pedal.

1.25.1.13 Turn Signal Platform

The angle of the turn signal platform shall be determined from a horizontal plane, regardless of the slope of the cab floor. The turn signal platform shall be angled at a minimum of 10-degrees and a maximum of 21-degrees. It shall be located no closer to the seat-front than the heel point of the accelerator pedal. The Authority shall provide a sample floor plate with switches to the Contractor after the pre-production meeting. All turn signal lights, when available, shall be LED with a lifetime warranty.

1.25.1.14 Turn Signal Controls

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

1.25.2 Instrumentation

1.25.2.1 Reverse Motion and Rear Door Camera – Display

The bus manufacturer shall be responsible for providing a rear-door viewing camera, Apollo camera RR-CTMIRA, and monitor, Rear View Safety-7709900, with an impact rating of 5G or greater, 7-inch x 5-inch x 1-inch LCD color monitor located on the driver's vicinity intended to monitor the passenger traffic at the rear door of the bus including reverse motion. The LCD color monitor shall be equipped with features that automatically adjust intensity and contrast to provide clear views under all ambient light conditions. Camera's field of view and additional operating display and functionality features shall be discussed at the pre-production meeting and during the first article's evaluation. Sunshade or antireflection devices maybe required for both, the camera and driver's monitor/display.

1.25.2.2 Instruments

The speedometer, air pressure gauge(s), and certain indicator lights shall be in the Instrument Panel immediately ahead of the steering wheel. The steering wheel spokes or rim shall not obstruct the operator's vision of the instruments when the steering wheel is in the straight-ahead position. Illumination of the instruments shall be simultaneous with the marker lamps. Glare or reflection from the windshield, side window, or front door windows from the instruments, indicators, or other controls shall be minimized. Instruments shall be easily readable in direct sunlight or shielded in such a manner that sunlight does not adversely affect legibility. Instrument covers shall be non-reflective, without electrostatic qualities that attract and hold dust, and shall be resistant to scratching or hazing as a result of cleaning.

Text shall be a minimum of 11 points. Extremely condensed or italic type fonts shall not be used. The color of the display field shall be dark with contrasting typography. Indicator lights or illuminated symbols or typography immediately in front of the operator shall be restricted to those concerned with the operation of the bus, as identified in the following table.

The instrument panel shall include an electronic speedometer indicating no more than 80 mph and calibrated in maximum increments of 5 mph. The speedometer shall be a rotating pointer type, with a dial deflection of 220 to 270-degrees and 40 mph near the top of the dial. The speedometer shall be sized and accurate in accordance with SAE Recommended Practice J678.

The bus shall be equipped with a combination bus mileage/fluid management system transponder such as Fleet Watch, equivalent or approved equal. The Authority shall provide the specific brand/type/model of this device during the pre-production meeting.
The device shall be installed and configured to store bus information, fluid specifications, and collect cumulative bus mileage. The device shall be capable of communications via antenna. The antenna shall be located beneath the bus, centered in the front doorway, centered widthwise of the bus, a maximum of 18-inches from ground level. The Authority shall approve the location of the Fleetwatch antenna.

The instrument panel shall also include air brake reservoir pressure gauge(s) with indicators for primary and secondary air tanks and voltmeter(s) to indicate the operating voltage across the bus batteries. The instrument panel and wiring shall be easily accessible for service from the operator's seat or top of the panel. The diagnostic 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.

1.25.2.3 Visual and Audible Alarms

The bus shall be equipped with visual and audible alarms linked to an on-board diagnostic system that will indicate conditions that require immediate action by the operator to avoid an unsafe condition or prevent further damage to the bus. The indicator display shall be located on the instrument panel. The intensity of visual indicators shall permit easy determination of on/off status in bright sunlight or shielded in such a manner that sunlight does not adversely affect legibility. Indicator illumination shall not cause a visibility problem at night. All indicators shall have a method of momentarily testing their operation. The audible alarm shall be tampering resistant and shall have an outlet level between 80 and 83 dBA when measured at the location of the operator's ear. Wherever possible, sensors shall be of the closed-circuit type, so that failure of the circuit or sensor or both shall activate the malfunction indicator.

To avoid unnecessary confusion and anxiety on the part of the operator, on-board displays visible to the operator shall be limited to indicating the status of those functions described herein that are necessary for the safe operation of the bus and protection of assets. All other indicators needed for diagnostics and their related interface hardware shall be concealed and protected from unauthorized access. The following chart represents instruments and alarms. The intent of the overall physical layout of the indicators shall be in a logical grouping of systems and severity nature of fault.

1.25.2.4 Visual and Audible Alarms – Sentry System

The sentry indicator strategy is to provide a simple method of consolidating individual indicators into a central easily viewed layout for the operator to determine that all systems are ok or at some stage of fault/failure. Activation of the sentry system shall require the operator to depress an acknowledgement reset button to extinguish/mute the alarm.

The sentry system, as well as the individual source of alarm shall be managed/recorded within the PLC or central on-board computer or both in a fashion to time stamp events and allow event data to be moved from an active to an inactive historic file. The inactive file shall not be capable of deletion by operator or technician.

Instrument / Indicator	Visual	Audible	Location	Resultant Action of Activation
Speedometer	X		Dash center	Visual indication of speed / distance traveled
Air Pressure Gauge	X		Dash center	Visual indication of primary / secondary air systems
Mobile Data Terminal	X		Dash center	Visual communication status and text messages
High Beam	Blue		Dash center	Indication of high beams on
Left Turn Signal	Flashing Green		Dash center	Indication of left turn and/or hazard lights on
Right Turn Signal	Flashing Green		Dash center	Indication of right turn and/or hazard lights
Sentry System	X		Dash center	Visual indication of all monitored systems ok
Sentry System	Flashing Yellow		Dash center	Visual indication of non-critical failure of monitored systems (requires acknowledge to reset)
Sentry System	Flashing Red	Buzzer	Dash center	Visual indication of critical failure of monitored systems requires acknowledge to reset)
Fire Detection	Red	Bell	Dash center	Indication of fire detection activation
Door Obstruction	Red	Buzzer	Dash center	Indication of rear door sensitive edge activation
Door Ajar	Red	Buzzer	Dash center	Indication of rear door not properly closed
Low System Air Pressure	Red	Buzzer	Dash center	Indication of low air system pressure
Methane Detection	Red		Dash center	Indication of system failure
Methane Detection	Red Flashing		Dash center	Indication of 20% LEL methane
Methane Detection	Red Flashing	Buzzer	Dash center	Indication of 50% LEL methane
Engine	Yellow		Dash center	Indication of low engine coolant
Engine	Red		Dash center	Indication of overheated engine, time delay shutdown
Engine	Red		Dash center	Indication of low engine oil pressure, time delay shutdown
ABS Fault	Yellow		Dash center	Indication of ABS and/or ATC fault
HVAC fault	Yellow		Dash center	Indication of HVAC fault
24 vdc charging fault	Yellow		Dash center	Indication of low, high or in-balance
Bike Rack Deployed	Yellow		Dash center	Indication of bike rack not being in fully stowed position
Fuel Tank Pressure	Yellow		Dash Center	Indication of fuel tank pressure approaching set point of primary PRD

1.25.3 Windshield Wipers

The bus shall be equipped with a variable speed windshield wiper for each half of the windshield. The windshield wiper shall be synchronized; separate controls for each side shall not be allowed. A variable intermittent feature shall be provided to allow adjustment of wiper speed for each side

between approximately 5 to 25 cycles per minutes. If powered by compressed air, exhaust from the wiper motors shall be muffled or piped under the floor of the bus. No part of the windshield wiper mechanism shall be damaged by manual manipulation of the arms. At 60 mph, no more than 10 percent of the wiped area shall be lost due to windshield wiper lift. Both wipers shall park along the edges of the windshield glass. Windshield wiper motors and mechanisms shall be easily accessible for repairs or service and shall be removable as complete units. The fastener that secures the wiper arm to the drive mechanism shall be corrosion resistant.

1.25.3.1 Windshield Washers

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

The windshield washer system shall have a minimum 3-gallon reservoir, located for easy refilling from outside of the bus and protected from freezing. Reservoir pumps, lines, and fittings shall be corrosion-resistant, and the reservoir itself shall be translucent for easy determination of fluid level.

1.25.4 Operator's Seat

1.25.4.1 General

Contractor shall provide and install the USSC Q90 seat or approved equal. The seat shall accommodate operators from the fifth percentile female to 95th percentile male, and include the following items:

- PNEUMATIC FULL STROKE SUSPENSION: Eliminates torque during suspension movement and provides five (5) inches of vertical height adjustment.
- QUICK DUMP: Air valve shall incorporate quick dump feature for easy entry and egress. Air valve will have roll pin stop, not snap ring. Air valve will be mounted on the left-hand side of the seat cushion, close to the front of the seat.
- BILATERAL DAMPERS: Suspension system shall be damped by two (2) shock absorbers to eliminate torque in the suspension system. Dampers to attach to the scissors system.
- SECONDARY ANTI-BOTTOM-OUT SYSTEM: Two (2) half-circle rubber bumpers that prevent the suspension from bottoming out shall prevent Spine shock.
- THREE (3) POSITION SUSPENSION LOCKOUT: Seat shall be provided with a three (3) position suspension lockout located on the left rear side of the seat frame. The outward position allows full suspension travel; the middle position limits suspension range; the inside position locks out the suspension completely for use during maintenance and for shipping purposes.
- PROTECTIVE BELLOWS: Seat shall be provided with protective bellows that prevent dust and debris from fouling the suspension system and keep fingers and other body parts clear of the scissors system.

- PROTECTIVE BELLOWS: Seat shall be provided with a heavy-duty protective back-shell

- PENDULUM SCISSORS SYSTEM: Scissors are to be solid bar stock with outside scissors 12.5-inch width.

- SEAT PAN: Suspension shall incorporate a secondary leaf spring suspension that facilitates keeping the spine straight up and down.

- AIR SLIDE RELEASE: Seat shall be equipped with air activated fore and aft slide release, (United States Patent No. 5,613,733), air pressure shall be required to release the fore/aft slides from the locked position. Design shall ensure that seat remains locked in position should there be loss of air pressure. There shall be a manual override.

- BILATERAL ADJUSTMENTS: All seat adjustments shall activate both sides of the seat to prevent torque and increase durability.

- BACK RECLINE: Recline system shall engage on both sides of the backrest. Operators shall be able to adjust the backrest recline from knobs on either side of the back. Recline shall be adjustable from 45 to 105-degrees.

- SEAT TILT: Two (2) knobs shall manually operate eight (8)-degrees of stepless seat tilt, one on either side of the seat. Seat tilt knob on one side is unacceptable. Seat tilt shall operate independently of the seat height adjustment, allowing full tilt at all heights. Bilateral tilt is necessary to eliminate torque in the suspension system.

- FORE/AFT ADJUSTMENT: The entire seat shall adjust fore/aft a minimum of 11.80-inches. Slides shall be double locking, roller bearing design. Slides shall be located below the suspension.

- LUMBAR SUPPORT: Three (3) air bladders shall be in the lumbar region of the back frame. Independent switches located on the right front side of seat frame shall activate lumbar bags. Lumbar systems shall operate off the vehicle air pressure, without pumps or motors.

- SECUREMENT OF UPHOLSTERY TO FOAM: Foam shall have Velcro molded into the foam. Velcro shall be used to secure the upholstery material in place allowing quick, easy reupholstering of the operator's seat without having to remove it from the vehicle. Foam shall be self-skinning polyurethane.

- SOLID STEEL BACK: Seat shall be equipped with solid steel back that prevents break-through.

- INTEGRATED LAP BELT: Seat shall be provided with ALR (Automatic Locking Retractor) 2-point lap belt. Seat shall have integral tether straps that allow seat to meet FMVSS 207/210-pull test. Seat systems shall allow operator to move seat front to back without having to loosen lap belts. Seat belt shall be adjustable to fit up to 54-inches in length.

- RISER: Seat shall be provided with an appropriate mild steel heavy-duty riser. Height shall be determined during the first article evaluation.

- SEAT CUSHION: Air circulation/venting provisions with minimum 19-inch width; minimum 18.5-inch length; 16 to 21-inches from uncompressed seat cushion to the floor

- UPHOLSTERY: Seat shall be upholstered with Holdsworth DEFENDER, or approved equal, A72OCW with the Authority "T" logos fabric upholstery Fabric inserts with vinyl boxing.

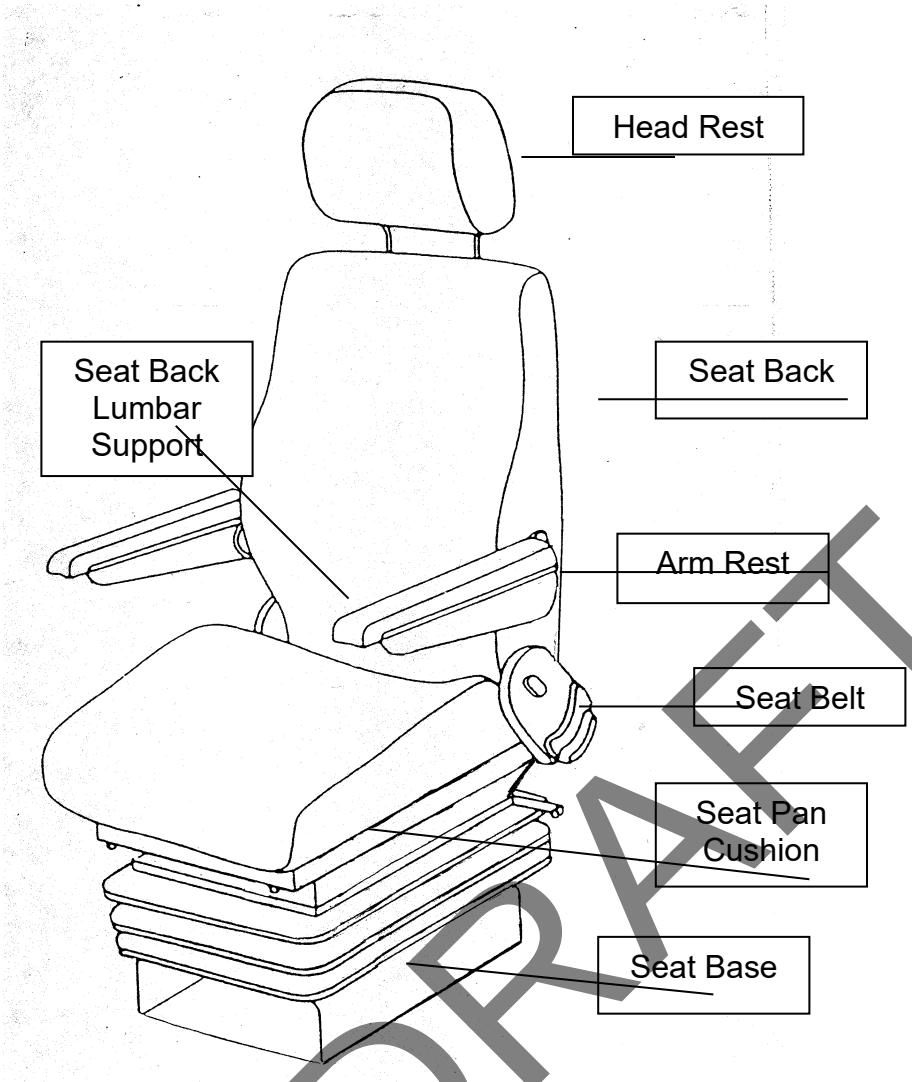
- WIDE BACKREST: Air circulation/venting provisions with width adjustable from 19 to 21-inches; 23-inches from uncompressed seat cushion to top of backrest

- 4-Way adjustable head rest

Contractor shall provide a minimum three-year warranty, 100-percent parts and labor, on the driver seat, components and installation

1.25.4.2 Dimensions

The operator's seat shall be comfortable and adjustable so that persons ranging in size from the 95th-percentile male to the 5th-percentile female may operate the bus. While seated, the operator 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. Graphical symbols shall conform to SAE Recommended Practice (Proposed) J1458, Universal Symbols for Seat and Suspension Adjustments.


Head Rest
Seat Back Lumbar Support
Seat Back
Arm Rest
Seat Belt
Seat Pan Cushion
Seat Base

1.25.4.3 Seat Belt Adjustment

A Type I seat belt shall attach at a point that moves with the assembly, so that the operator may adjust the seat without resetting the seat belt. Seat belts shall be stored in automatic retractors. Seat belts shall be extended to a length of 54-inches. Seat belt lock shall be located on the right side of driver's seat.

1.25.4.4 Seat Structure and Materials

The operator's seat shall be contoured to provide maximum comfort for extended periods of time. Cushions shall be fully padded with at least 3-inches of closed-cell polyurethane foam or material with equal properties, in the seating areas at the bottom and back. Upholstery shall be ventilated, transportation grade material. All visually exposed metal on the operator's seat, including the pedestal, shall be unpainted aluminum or stainless steel.

The seat and seatbelt assemblies, as installed in the bus, shall withstand static horizontal forces as required in FMVSS 207 and 210. The seat shall withstand 10,000 impacts of a 40-pound sandbag dropped from a height of 12-inches without visible deterioration. The seat shall be tested in the lowest vertical position and repeated with the seat in the top vertical position. The 40-pound sandbag shall be suspended on a 36-inch pendulum and shall strike the seat back 10,000 times from distances of 6, 8, 10, and 12 inches. Seat cushion shall withstand 100,000 randomly positioned 3½-inch drops of a squirming, 150-pound, smooth-surfaced, buttocks-shape striker with only minimal wear on the seat covering.

At the request of the Authority, the Contractor shall provide a certified test report fully documenting compliance with all the above defined requirements. The test report shall contain a record of all testing activities, test diagrams, testing equipment, as well as test data related to loads, deflections and permanent deformation of the seat assembly. The report shall include a statement of compliance with the requirements of this section of these Technical Specifications.

1.25.5 Mirrors

1.25.5.1 Exterior Mirrors

Contractor shall equip the bus with corrosion-resistant, outside top-mounted rearview mirrors on each side of the bus. Mirrors shall permit the operator to view the roadway along both sides of the bus, including the rear wheels. The curbside rearview mirror shall be top-mounted so that its lower edge is no less than 80-inches above the street surface. The bus shall be equipped with 2 outside mirrors of unit magnification (flat), each with not less than 50 square inches of reflective surface and include turn signal indicators, mounted on the mirror housing, not on the mirror glass itself.

The mirrors shall be corrosion-resistant and be installed with stable supports on each side of the bus. The mirrors shall be located to provide the operator a view to the rear along both sides of the bus and, the mirror glass, as well as the mirror housing shall be adjustable in the horizontal and vertical directions to view the rearward scene. The curbside rearview mirror shall be top-mounted so that its lower edge is no less than 80-inches above the street surface. The roadside rearview mirror shall be mounted lower on the bus body so that the operator's line of sight is not obstructed. In addition, a convex mirror mounted around the driver's workstation shall be used for viewing of a deployed bike-rack.

The operator shall be able to adjust the curbside and street side mirrors remotely while seated in the driving position. The control for remote positioning of the mirror shall be a single switch or device. Mirrors shall be firmly attached to the bus to minimize vibration and prevent loss of adjustment, but not so firmly attached that the bus or its structure is damaged when the mirror is struck in an accident. Mirrors shall retract or fold sufficiently to allow bus washing operations. Interior Mirrors shall be provided for the operator to observe passengers throughout the bus without leaving the operator's seat and without shoulder movement. The operator shall be able to observe passengers in the front/entrance and rear/exit areas, anywhere in the aisle, and in the rear seats. Location and type of mirrors shall be approved by Authority's Health, Safety & Environmental Compliance department.

1.25.5.2 Interior Mirrors

Mirrors shall be provided for the operator to observe passengers throughout the bus without leaving operator's seat and without shoulder movement. With a full standee-load, including standees in the vestibule, the operator can observe passengers in the front and by the rear door, anywhere in the aisle and in the rear seats. Inside mirrors shall not be in the line of sight to the right outside mirror.

1.25.6 Windows

1.25.6.1 Windshield

The windshield shall permit an operator's field of view as referenced in SAE Recommended Practice J1050. The vertically upward view shall be a minimum of 15-degrees, measured above the horizontal and excluding any shaded band. The vertically downward view shall permit detection of an object 3½-feet high no more than 2-feet in front of the bus. The horizontal view shall be a minimum of 90 degrees above the line of sight. Any binocular obscuration due to a center divider may be ignored when determining the 90-degree requirement, provided that the divider does not exceed a 3-degree angle in the operator's field of view. Windshield pillars shall not exceed 10-degrees of binocular obscuration. The windshield shall be designed and installed to minimize external glare as well as reflections from inside the bus. The upper portion of the front windshield(s) shall be tinted as dark as permissible by both Federal, and State regulations.

The windshield shall be easily replaceable by removing zip-locks from the windshield retaining moldings. Bonded-in-place windshield shall not be used. The windshield glazing material shall have a ¼-inch or 6-mm nominal thickness laminated safety glass conforming to the requirements of ANSI Z26.1 Test Grouping 1A and the Recommended Practices defined in SAE J673. The glazing material shall have single density tint. The upper portion of the windshield above the operator's field of view shall have a dark, shaded band with a minimum luminous transmittance of 6-percent when tested in accordance to ASTM D-1003.

1.25.6.2 Operator's Side Window

The operator's side window shall be the sliding type, requiring only the rear half of sash to latch upon closing and shall open sufficiently to permit the seated operator to easily adjust the street side outside rearview mirror. When in an open position, the window shall not rattle or close during braking. The entire assembly shall be hinged and have a single release for emergency egress. 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. Light

transmittance shall be 75-percent on the glass area below 53-inches from the operator platform floor.

IMPORTANT: Authority encourages Offerors to propose enhanced sun blocking protections for the driver by means of films and/or window materials intended, in compliance with code, to minimize exposure to the sun's radiation and heat transmissivity.

The operator's view, perpendicular through operator's side window glazing, should extend a minimum of 840 mm (33-inches) 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 560 mm (26-inches) above the operator's floor to ensure visibility of an under-mounted convex mirror. Operator's window construction shall maximize ability for full opening of the window.

The operator's side window glazing material shall have a ¼-inch nominal thickness laminated safety glass conforming to the requirements of ANSI Z26.1, as stated in 49 CFR Section 571.205, Test Grouping 2 and the Recommended Practices defined in SAE J673.

1.25.6.3 Side Windows

1.25.6.3.1 Configuration

All side windows, except windows in passenger doors and those smaller than 500 square inches, shall have window panels that passengers can open. Window panels that passengers can open shall be equipped with latches that secure the window in the fully open and fully closed positions. Each side window that passengers can open shall incorporate an upper transom portion. The transom shall be between 25 and 35 percent of the total window area. The lower portion of the window shall be fixed. The transom portion shall be hinged along the lower edge and open inward.

If a hazardous condition is created by the tip-in windows (transom) when operated on the upper deck of the bus then, the windows at such locations shall be fixed top/bottom, maintaining the same widow frame configuration as in the rest of bus.

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. The windows shall be designed and constructed to enable removal and replacement in less than 15 minutes.

All side windows shall be ¼-inch thick tempered glass without window guard and, at the time of delivery, the buses shall be equipped with 3M, or approved equal, anti-graffiti film as described in "Materials".

1.25.6.3.2 Materials

Side windows glazing material shall have a ¼-inch nominal thickness laminated safety glass. The material shall conform to the requirements of ANSI Z26.1 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 E-424, and the luminous transmittance shall be no less than 16-percent as measured by ASTM D-1003. Windows over the destination signs shall not be tinted.

All windows, excluding driver's side, and front door(s), on the interior side, shall be equipped with 3M Scotchgard™ Multi-Layer, 3M-8991 RW, or approved equal. All windows including destination sign glass and doors, on the outside, shall be equipped with 3M Scotchcal, 8991 RW, or approved equal, clear protection film.

1.25.6.3.3 Rear Window

No requirement for rear window

TS 1.26 HEATING VENTILATING AND AIR CONDITIONING

1.26.1 General

The Heating, Ventilation and Air Conditioning (HVAC) unit may either be roof or rear mounted. Fuel tank location will affect the location of the HVAC unit. Accessibility and serviceability of components shall be provided without requiring maintenance personnel to climb-up on the roof of the bus. The system shall be equipped with a screw type of compressor.

1.26.2 Capacity and Performance

The HVAC climate control system shall maintain the interior of the bus at the temperature and humidity levels defined in the following paragraphs:

With the bus running, at the design operating profile with corresponding door opening cycle and carrying a number of passengers equal to 150-percent of the seated load, the HVAC system shall control the average passenger compartment temperature within a range between 65F 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 115 to 95°F and at any ambient relative humidity levels between 5 and 50-percent.

When the bus is operated in outside ambient temperatures of 95°F to 115°F, the interior temperature of the bus shall be permitted to rise one degree for each degree of exterior temperature in excess of 95°F. System capacity testing, including pull-down/warm-up, stabilization and profile, shall be conducted in accordance to the APTA Recommended Instrumentation and Performance Testing for Transit Bus Air Conditioning System.

Temperature measurements shall be made in accordance to this document with the following modifications:

- The three primary locations used for temperature probes are:
    - 12-inches aft of front wheel housing, centered between the two axles and 6-inches aft of rear wheel housing.
- At each primary location, the nine (9) temperature sensing devices shall be:
    - 72 inches above floor level, 6-inches above top surface of seat cushion and 6-inches above floor.

The recommended locations of temperature probes are only guidelines and may require slight modifications to address actual bus design. Contractor must take care 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.

The air conditioning portion of the HVAC system shall be capable of reducing the passenger compartment temperature from 110° to 90°F in less than 20 minutes after engine start-up. Engine temperature shall be within the normal operating range at the time of start-up of the cool-down test and the engine speed shall be limited to fast idle that may be activated by an operator-controlled device. During the cool-down period the refrigerant pressure shall not exceed safe high-side pressures and the condenser discharge air temperature, measured 6-inches from the surface of the coil, shall be less than 45°F above the condenser inlet air temperature. The appropriate solar load as recommended in the APTA "Recommended Instrumentation and Performance Testing for Transit Bus Air Conditioning System," representing 4 P.M. on August 21, shall be used. No passengers shall be on board, and the doors and windows shall be closed during the test.

The air conditioning system shall meet these performance requirements using R407c refrigerant. All fans within the HVAC and defroster system shall be brushless. The climate control blower motors and fan shall be designed such that their operation complies with all interior noise level requirements.

1.26.3 Controls and Temperature Uniformity

The HVAC system, excluding the operator's heater/defroster, shall be centrally controlled with an advanced electronic/diagnostic control system with provisions for extracting/reading data. After manual selection or activation or both of climate control system operation mode, and all interior climate control system requirements for the selected mode shall be attained automatically to within ±2°F of specified temperature control set-point.

The operator shall have full electric control over the defroster and operator's heater. The use of cable operated controls shall not be allowed. The operator shall be able to adjust the temperature in the operator'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 or cold spots or both. After stabilization with doors closed, the temperatures between any two points in the passenger compartment in the same vertical plane, and 6-inches to 72-inches 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 to APTA Recommended Instrumentation and Performance Testing for Transit Bus Air Conditioning System. Variations of greater than ± 5-degree F will be allowed for limited, localized areas provided most of the measured temperatures fall within the specified requirement.

1.26.4 Air Flow

1.26.4.1 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. This level is based

upon 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 feet 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 assure at least 70°F air outlet temperature. The heating air outlet temperature shall not exceed 120°F under any normal operating conditions. The air shall be composed of no less than 20-percent outside air.

1.26.4.2 Operator's Area

Contractor shall provide separate heating, ventilation, and defroster system for the operator's area and the operator shall control the system. The system shall meet the following requirements:

The heater and defroster system shall provide heating for the operator and heated air to completely defrost and defog the windshield, operator's side window, and the front door glasses in all operating conditions. Fan(s) shall draw air from the bus body interior or the exterior or both through a control device and pass it through the heater core to the defroster system and over the operator's feet. A minimum capacity of 100 cfm shall be provided. The operator shall have complete control of the heat and fresh airflow for their area.

Contractor shall locate defroster supply outlets at the lower edge of the windshield. These outlets shall be unbreakable and shall be free of sharp edges that can catch clothes during normal daily cleaning. The system shall be designed so that foreign objects, such as coins or tickets, cannot fall into the defroster air outlets. Adjustable ball vents shall be provided at the left of the operator's position to allow direction of air onto the side windows. Two additional ball vents shall be located on the vertical front dash panel adjacent to the front door to allow direction of air onto the door windows or entrance area or both.

Contractor shall provide a ventilation system to ensure operator comfort and shall be capable of providing fresh air in both the foot and head areas. Vents shall be controllable by the operator from the normal driving position. Decals shall be provided indicating "operating instructions" and "open" and "closed" positions as well. When closed, vents shall be sealed to prevent the migration of water or air into the bus.

1.26.5 Controls for the Climate Control System (CCS)

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

A separate switch shall control the heat/defrost system fan 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 Authority approves the fans, an "On-Off" switch shall be located to the right of or near the main Defroster switch. No fan, motor or other shall remain energized when the master switch is in the “off” or “night-park” position.

A manually operated control valve shall control the coolant flow through the heater core. If a cable operated manual control valve is used, 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 written approval of the Authority.

1.26.6 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. Shut-off valves may be provided in lieu of self-sealing couplings.

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

1.26.7 Air Filtration

Air shall be filtered before discharge into the passenger compartment. The filter shall meet the ANSI/ASHRAE 52.1 requirement for 5-percent or better atmospheric dust spot efficiency, 50-percent weight arrestance, and a minimum dust holding capacity of 120 gram per 1,000 cfm cell. More efficient air filtration may be provided to maintain efficient heater and/or evaporator operation. Air filters shall be easily removable for service. Air filters shall be cleanable.

1.26.8 Roof Ventilators

Contractor shall provide two roof ventilators in the roof of the bus, one approximately over or just forward of the front axle and the other, approximately over the rear axle.

Each ventilator shall be easily opened and closed manually by a 50th percentile female. If roof ventilator(s) cannot be reached by a 50th percentile female, then a tool shall be provided to facilitate this action. When open with the bus in motion, this ventilator shall provide fresh air inside the bus. Each ventilator shall cover an opening area no less than 425 square inches and shall be capable of being positioned as a scoop with either the leading or trailing edge open no less than 4-inches, or with all four edges raised simultaneously to a height of no less than 3½- inches.

Contractor shall incorporate an escape hatch into the roof ventilator. Roof ventilator(s) shall be sealed to prevent entry of water when closed.

1.26.9 Entrance/Exit Area Heating

No requirements for entrance/exit area heating.

1.26.10 Floor Level Heating

No requirements for floor level heating

1.26.11 Fan, Motors and Pumps

All HVAC electric motors shall be brushless, and each motor shall be serviced by a solid-state controller. All electric boost pumps shall be brushless and sealless.

TS 1.27 SIGNAGE AND COMMUNICATION

1.27.1 Destination Signs

The sign system shall be Luminator, Hanover. I/O Controls, or approved equal, 100-percent LED matrix configuration of 16 x 160, or approved equal, consisting of a front, side, rear, run number sign, route/run number display and Operator Display Keyboard (ODK) to include the following signs:

Front, 16 x 160
Side, 8 x 96
Rear 16 x 48
Interior 144 x 19 (one & two row sign)

Interior and route/run number display 12 rows x 40 columns or as large as practical dependent upon the bus' physical constraints.

Sign system control shall be capable of accepting logon and route entry via wireless interface to Conduent communication as well as manual entries.

The destination sign compartments shall be designed to meet the following minimum requirements:

Prevent condensation and entry of moisture and dirt.
Prevent fogging of both compartment window and glazing on unit itself.
Access shall be provided to allow cleaning of inside compartment window and unit glazing.
Front window shall have an exterior display area of no less than 8.5-inches high by 56-inches wide.

The route/run display shall be located at the lower right windshield corner.

1.27.2 Destination Sign System Capabilities

The sign system capability shall include the following features:

- Console operation from the driver's workstation, to include display, keypad and programming receptacle
- Capacity of 10,000 message lines at 12 characters per line
- Illumination of night visibility
- Pre-selection of two destination messages and one public relation message
- Auto blanking
- Front and side sign shall be hinged to facilitate glass cleaning.
- Capable of updating messages via Wi-Fi, USB flash drive.

1.27.3 Destination Sign Expansion Capability

The sign system shall be capable of expansion, to include pre-wiring for operating an interior sign and interior/exterior automated voice with GPS or applicable interface.

1.27.4 Interior Sign and Annunciation System

A fully automated interior sign and annunciation system shall be provided as manufactured by Conduent and interfaced to the existing destination sign system. The integrated system shall be capable of automatic stop announcement, GPS or applicable, PA system and be programmed to the Authority's fixed route assignment.

1.27.5 Passenger Information and Advertising

1.27.5.1 Interior Displays

Provisions shall be made on the rear, or aisle side, of the operator's barrier for a frame to retain information such as routes and schedules. Advertising media 11-inches high and 0.09-inches 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 LED light system.

1.27.5.2 Exterior Displays

There are no requirements for exterior displays

1.27.6 Passenger Stop Request/Exit 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. It shall be easily accessible to all passengers, seated or standing. Pull cable(s) shall activate a solid state or magnetic proximity switch(es). Additionally, on each stanchion pole located at each side of the exit door, a thumb operated stop request switch shall be integrated on each pole. These switches shall be positioned and mounted at a location in compliance with hand and reach standards and not to interfere with passenger traffic.

At each wheelchair parking position and priority seating positions additional provisions shall be included to allow a passenger in a mobility aid to easily activate "Stop Requested" signal.

A single "Stop Requested" chime shall sound when the system is first activated. A double chime shall sound when the system is first activated from wheelchair passenger areas. With a voice annunciation system activated, an announcement of a stop request or lift request or both will occur. Exit signals located in the wheelchair parking area shall be no higher than 4-feet above the floor. Instructions shall be provided to clearly indicate function and operation of these signals.

The operator shall be able to deactivate the signal system from the operator's area.

1.27.7 Public Address System

1.27.7.1 General

Contractor should provide and install all necessary equipment for the public-address system. The Public-Address system shall include an advanced technology Digital Signal Processor (DSP) or equivalent system that can reduce background noise. A highly sensitive unidirectional microphone shall provide clear announcement without the need of handling or positioning of a microphone by the coach operator. The stationary "hands free" PA system shall have no visible cabling or conduit - only a discrete, low profile, unbreakable, exposed microphone housing. The system shall be completely solid state, designed to SAE J1455 environmental specifications, and shall have no scheduled maintenance requirements.

1.27.7.2 Public Address System Microphone

The system shall include a low-profile stealth microphone that the operator can activate at the steering column clever devices P/N 901-1500-200 or applicable. This microphone allows for a hands-free operation. An input jack shall be provided in the operator's area for a hand-held microphone.

1.27.7.3 Public Address System Amplifier

If not included with the Conduent components, radio, IVU, Orbstar, the Contractor shall provide the voice annunciation system's required amplifiers.

1.27.7.4 Public Address System Speakers

Eight internal and one external low-profile speakers with baffles, mobile/page part #603/6FB, or approved equal (that can handle digital voice/annunciation). They shall be installed at locations in the ceiling of the vehicle with all connecting wires available in a wire loom for easy replacement and protection. Speakers wired in series shall incorporate shunt resistors to prevent an open circuit in the event of a speaker failure.

1.27.7.5 Public Address System Switch

A foot operated momentary switch mounted to the floor to the left of the steering column shall activate the PA amplifier. This switch, along with the turn signal and headlight dimmer, shall be located on an inclined platform. Authority shall provide a standard sample at the pre-production meeting.

1.27.8 RADIO/ITMS/AVL/Announcement Passenger Counter Equipment

All other items required for a fully functional RADIO/ITMS/Voice/Passenger Counter/ AVL, etc., radio communication equipment shall be provided as manufactured or supplied by Conduent and this equipment shall be compatible with the Authority's existing communication system. Hardware location shall be determined at the pre-production meeting and may require refinement during the evaluation of the prototype bus. The radio handset shall be located within reach of the coach operator and not interfere with the operator's feet or walkway (for safety reasons) with proper length of the cord.

Contractor shall be responsible for contacting Conduent and securing an accurate and updated parts list to match the Authority configuration and the manufacturer's bus platform/model.

The following list of Conduent's ITMS Radio/Voice/Passenger Counter and other items provided for the most recent Authority bus delivery is provided only as a reference. Contractor shall be responsible for contacting Conduent to secure the most up-to-date configuration build for the Authority's, 40-foot bus platform.

Conduent - Contact Information
Michael Smith
mike.smith6@xerox.com
(443) 259-7156
7160 Riverwood Drive
Columbia, Maryland 21046

	CONDUENT AUTHORITY OEM BOM FOR THE IVU-4000 SYSTEM
CONDUENT PART #	**DESCRIPTON**
TBD	ANTENNA, GPS or applicable/WLAN
120004-5	HANDSET
120041-3	INTERNAL AGC MIC
131482-1	Bracket, Handset Dash Mount, GILLIG, San Diego
131623-1	Gasket, External AGC Microphone
140394-300	Cable Assembly, IVU to WLAN Antenna, w/SMA, W21
410001A	ASSY MDT-4000
410006A	ASSY IVU-4000 /TIB EQUIPMENT TRAY (INCLUDES IVU AND TIB)
420000-24	EXTERNAL AGC MIC
440007-72	Cable Assembly, IVU-4000 LAN Cable
440040-60	Cable Assembly, APC Analyzer, J1708 Van, Power, Door Open
440041-312	Cable Assembly, IVU-4000 TIB - Fare Box J1708, Term Strip
440043-48	Cable Assembly, Vehicle Power to IVU-4000 TIB
440044-36	Cable Assembly, Vehicle Power to IVU-4000
440047-18	Cable Assembly, External AGC Pigtail
440048-216	Cable Assembly, External AGC Pre-AMP - Audio Interface, TIB
440055-180	Cable Assembly, AGC Microphone to IVU4000 TIB Audio
440056-144	Cable Assembly, IVU-4000 to Destination Sign
440071-216	Cable Assembly, Handset to IVU-40000 TIB
440072-180	Cable Assembly, AVA LED Sign to J1708_TR, IVU-4000 TIB
4400XXX-18	Cable Assembly, Radio Tray Power, W14,
440XXX-144	Cable Assembly, Destination Sign to TIB
440XXX-240	CABLE MDT TERMINAL TO IVU-4000
440XXX-300	CABLE ASSY, GPS ANTENNA, IVU-4000 to GPS ANT
440XXX-48	Cable Assembly, Discrete Connections, IVU-4000 TIB
TBD	ANTENNA CELL ROUTER
TBD	IRMA MATRIX APC SYSTEM 2 DOOR
TMS-006042	NMO Mount (Tessco 23538)
TMS-006291	DB25 Male to Female 12"
TMS-006292	DB26 Male to Female 12"
TMS-006293	DB44 Male to Female 12"
TMS-006294	DB50 Male to Female 12"
TMS-006298	Mounting Base with Ball Vesa Base 3.625 sq
TMS-006299	Mounting Base Square 100 and 75 hole 4.75 sq
TMS-006300	Socket Arm Assembly, DBL Ball,
N/A	HANOVER Interior 2-Line Stop Request

1.27.9 Mobile Router

a. Contractor shall provide and install a Cradlepoint, or approved equal, router, model number IBR1700, modular modem MC400 plus five (5) year Advance licensing and a Cradlepoint 170654-000 five-way antenna for each bus. The router shall be mounted within the electronics cabinet using 3.5-inches of 1-inch wide 3M Dual Lock SJ3560 applied according to the manufacturer's directions along the mounting holes edge of each side of the mobile router. The antenna shall be mounted at a location approved by Authority's project manager. Power, ground, and ignition signal shall be sourced from the same points as the 12 Volts of the ITMS radio power source.

b. In addition, each mobile router shall be pre-paid and added to Authority's Cradlepoint ECM Prime account and Authority's CradleCare account for a period of five (5) years. Cradlepoint ECM shall be at Prime service level and CradleCare shall be at full-service level to include:

   i. Twenty-four (24) hours per day, seven (7) days per week qualified phone support and twelve (12) hours per day, five (5) days per week portal/chat support for Cradlepoint routers, NCM and NetCloud Gateway
   ii. Next business day replacement
   iii. Service level targets
   iv. Knowledge Base access
   v. NetCloud OS upgrades
   vi. Extended router warranty for term of CradleCare license

c. **Cloud Services** – Cloud Services for management of the mobile routers for a period of five (5) years shall be provided. At minimum, the cloud services shall meet the following features, functionality, and specifications:

   i. Open API such that third-party applications can interphase with the cloud service to provide added value functionality.
   ii. Manage user access at multiple levels.
   iii. Single point management of all mobile routers in Authority's fleet
   iv. Fleet configurations that provide the ability to set-up and save a single router, then copy that configuration to another router, group, or fleet.
   v. Group configurations that provide the ability to designate groups of routers with individual configurations to be managed together.
   vi. Remote firmware management that provides the ability to download and apply firmware to a single router, group, or fleet.
   vii. GPS based location services.
   viii. Command line interface to individual routers in real-time.
   ix. Historical storage of data for a minimum of ninety (90) days.

d. **Alert System** – Provides the ability for the router to alert the system administrator of critical issues with the router. The system shall be capable of alerting via the cloud interface, through SNMP trapping, and email. Alerts shall be configurable for the following:

   i. Down time
   ii. Security
   iii. Data usage
   iv. Hardware failure
   v. Geo-fencing

e. **Support** – Technical support for the mobile routers for a period of five (5) years shall be provided. At minimum technical support shall meet the following features, functionality and specifications:

i. Unlimited twenty-four (24) hours per day, seven days per week phone support
ii. Carrier specific support
iii. Dedicated assigned technical engineer
iv. Complete access to technical training on the router, networking and cloud services
v. Unlimited access to firmware, software, feature upgrades, and patches
vi. Priority consideration for advanced access to features and beta testing

1.27.10 Fluid Management System

a. Bus shall be equipped with a Fleetwatch combination bus mileage/fluid management system transponder that shall be installed and programmed with the Authority's vehicle's ID number and odometer mileage. The system shall be capable of communication at the fuel island, or other location to be determined. Use of this device will not impact or be impacted by other devices operating in the vehicle, or vehicles, on a CAN-bus network and/or platform.

b. Authority shall approve the location of the Fleetwatch datalogger/module/device during the presentation/evaluation of the first article bus. Contractor must contact Fleetwatch to obtain the latest transponder/interface required for the Authority's existing configuration.

c. S&A Systems Inc., Rockwall, Texas, phone (972) 722-1009.

Mailing Address
S&A Systems, Inc.
P.O. Box 1928
Rockwall, Texas 75087

Shipping Address
S&A Systems, Inc.
992 Sids Road
Rockwall, Texas 75032

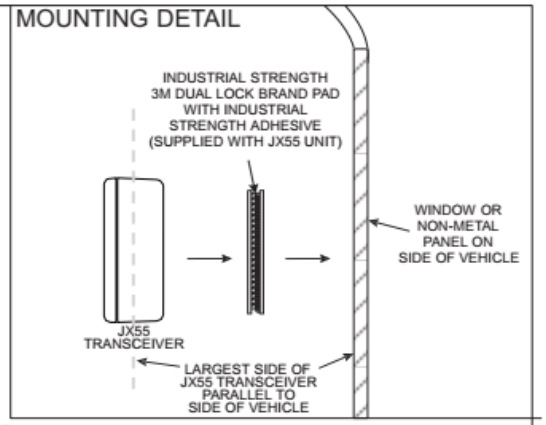
Contact
Terry Walsh
(972) 722-1009
terry.walsh@fleetwatch.com

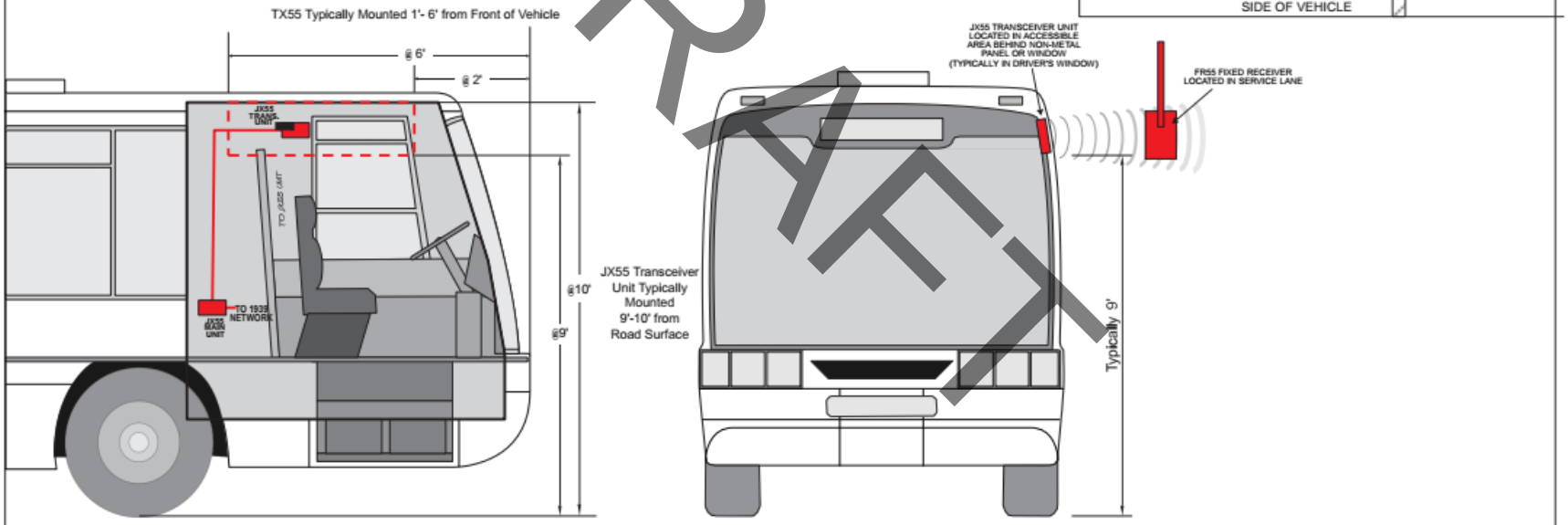
d. As a reference only, **see Exhibit below labeled "Fleetwatch Technical".**

e. **JX75 module/transceiver is required. Please note that all references to JX55 transceiver are obsolete**

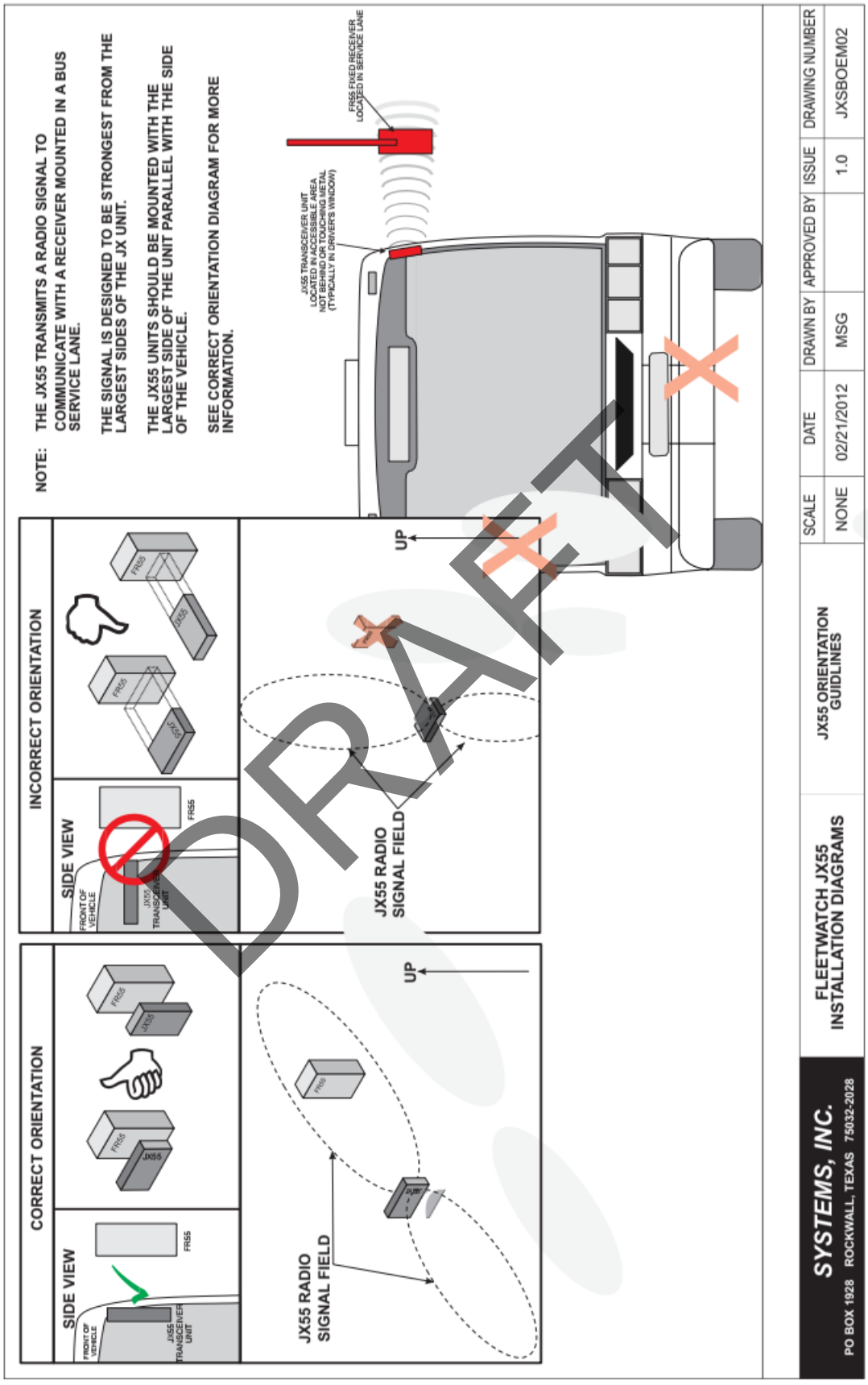
NOTES:

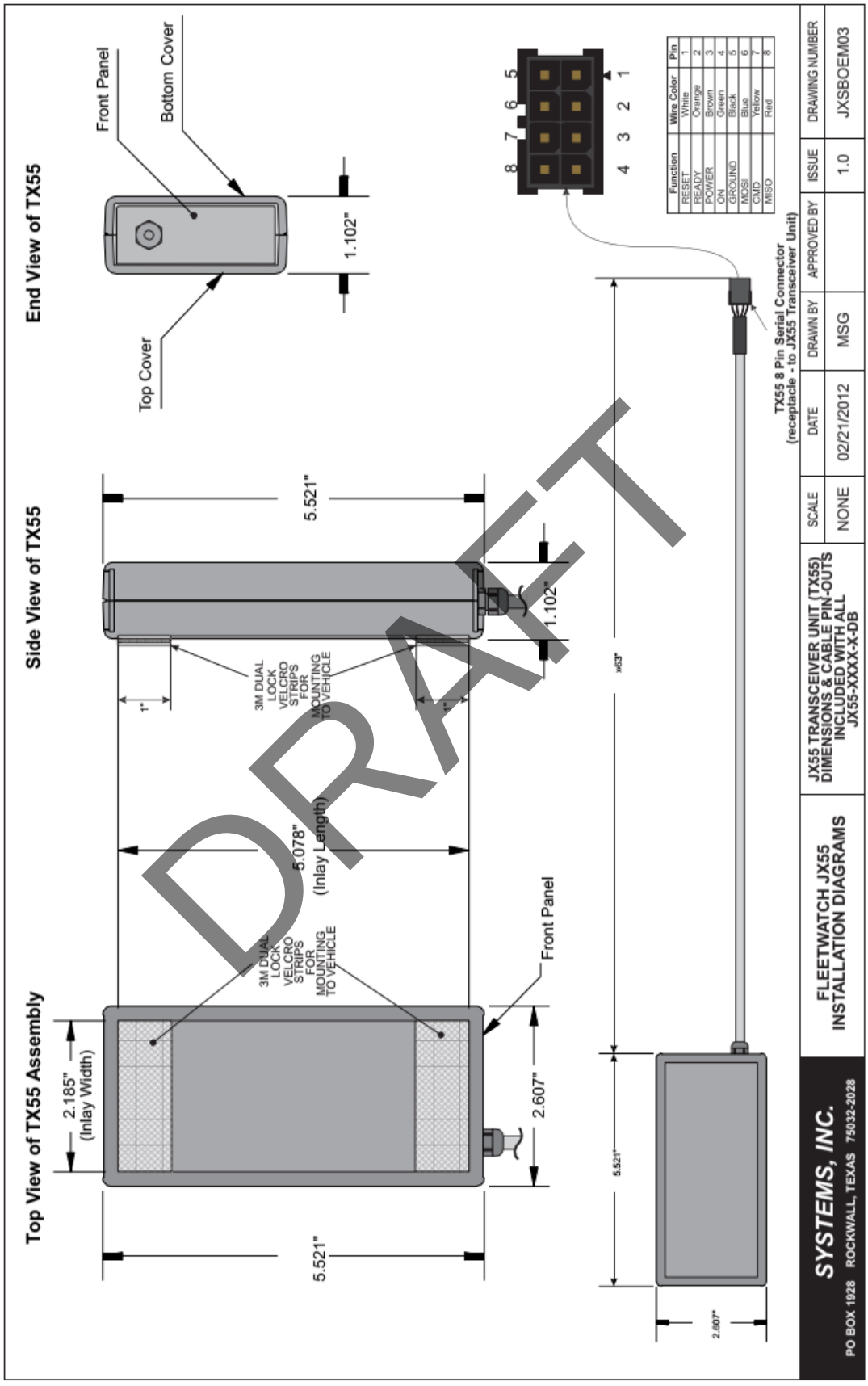
1. THE JX55 TRANSCEIVER UNIT (TX55) MAY BE MOUNTED WITH THE SUPPLIED INDUSTRIAL STRENGTH 3M DUAL LOCK PADS, OR WITH USER SUPPLIED FASTENERS IF DESIRED. FASTENERS SHOULD *NOT* PENETRATE THE JX55 TRANSCEIVER UNIT BOX OR DAMAGE TO THE INTERNAL ELECTRONICS MAY RESULT.
2. THE JX55 TRANSCEIVER UNITS SHOULD BE MOUNTED WITH THE LARGEST SIDE OF THE UNIT PARALLEL WITH THE SIDE OF THE VEHICLE.
3. THE JX55 TRANSCEIVER UNIT SHOULD *NEVER* BE MOUNTED WITH ANY METAL (OR OTHER RADIO BLOCKING MATERIAL) BETWEEN THE TRANSCEIVER UNIT AND THE OUTSIDE OF THE VEHICLE. THE TX55 TRANSCEIVER UNIT MUST BE ABLE TO TRANSMIT FROM ITS INSTALLED LOCATION THROUGH THE SIDE OF THE VEHICLE TO A WAYSIDE RECEIVER.
4. THE JX55 TRANSCEIVER UNIT SHOULD *NEVER* BE MOUNTED IN THE PASSENGER AREA. ACCEPTABLE LOCATIONS ARE ONLY IN THE OPERATOR AREA.
5. THE JX55 MAIN UNIT MAY BE MOUNTED IN ANY LOCATION THAT HAS ACCESS TO A FACTORY J1708/1939 NETWORK PLUG.

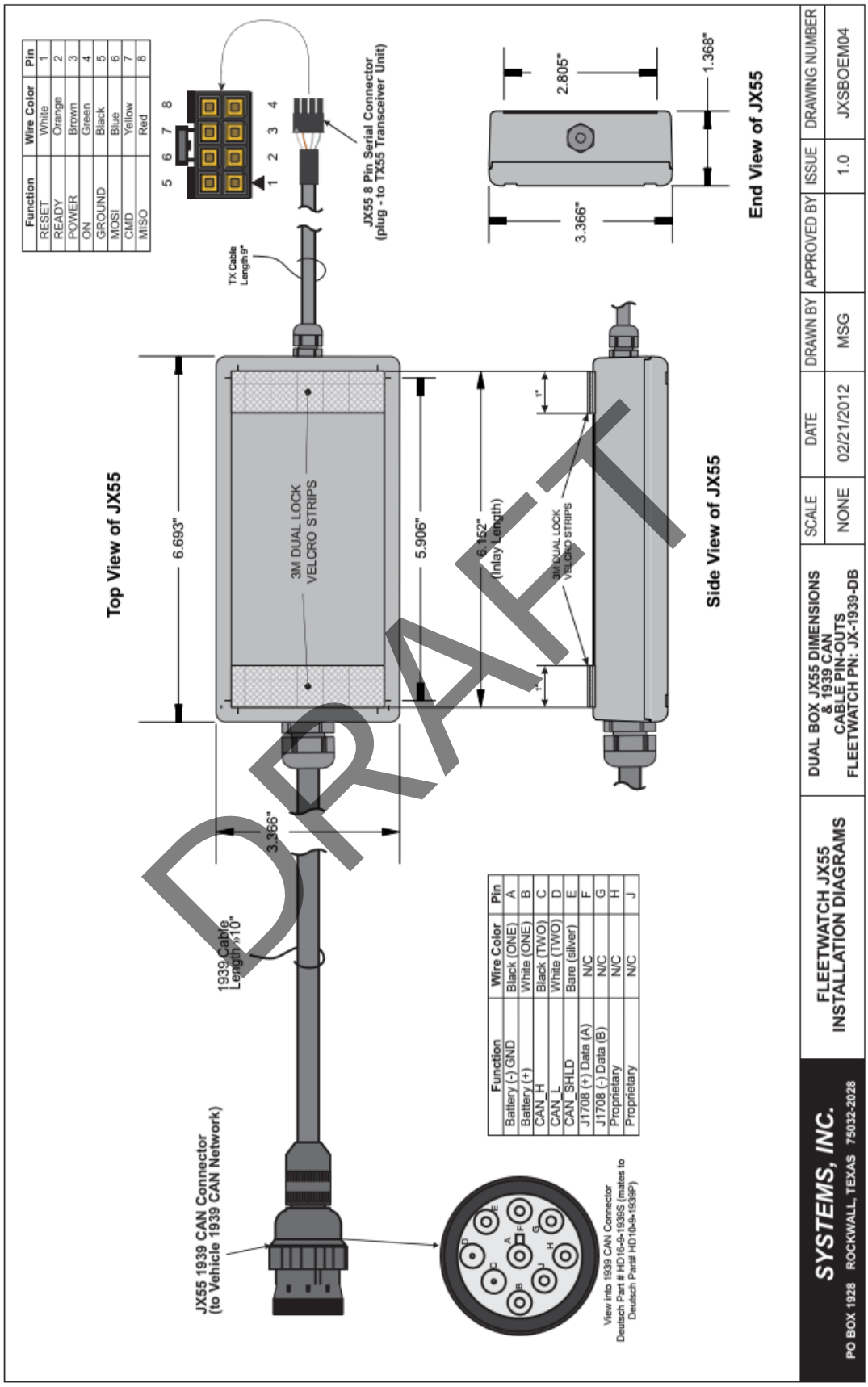




SA SYSTEMS, INC. PO BOX 1928 ROCKWALL, TEXAS 75032-2028	FLEETWATCH JX55 INSTALLATION DIAGRAMS	JX55 DUAL BOX MOUNTING INSTRUCTIONS & LOCATION GUIDELINES	SCALE	DATE	DRAWN BY	APPROVED BY	ISSUE	DRAWING NUMBER
			NONE	02/21/2012	MSG		1.0	JXSBOEM01


NOTE: THE JX55 TRANSMITS A RADIO SIGNAL TO COMMUNICATE WITH A RECEIVER MOUNTED IN A BUS SERVICE LANE.
THE SIGNAL IS DESIGNED TO BE STRONGEST FROM THE LARGEST SIDES OF THE JX UNIT.
THE JX55 UNITS SHOULD BE MOUNTED WITH THE LARGEST SIDE OF THE UNIT PARALLEL WITH THE SIDE OF THE VEHICLE.
SEE CORRECT ORIENTATION DIAGRAM FOR MORE INFORMATION.
CORRECT ORIENTATION
INCORRECT ORIENTATION
SIDE VIEW
FRONT OF VEHICLE
JX55 TRANSCEIVER UNIT
FR55
JX55
JX55 RADIO SIGNAL FIELD
UP
JX55 TRANSCEIVER UNIT LOCATED IN ACCESSIBLE AREA NOT BEHIND OR TOUCHING METAL (TYPICALLY IN DRIVER'S WINDOW)
FR55 FIXED RECEIVER LOCATED IN SERVICE LANE
SYSTEMS, INC.
PO BOX 1928 ROCKWALL, TEXAS 75032-2028
FLEETWATCH JX55 INSTALLATION DIAGRAMS
JX55 ORIENTATION GUIDLINES
SCALE NONE
DATE 02/21/2012
DRAWN BY MSG
APPROVED BY
ISSUE 1.0
DRAWING NUMBER JXSBOEM02
DRAFT


End View of TX55
Front Panel
Bottom Cover
Top Cover
1.102"
Side View of TX55
5.521"
1.102"
3M DUAL LOCK VELCRO STRIPS FOR MOUNTING TO VEHICLE
1"
5.078" (Inlay Length)
Top View of TX55 Assembly
2.185" (Inlay Width)
Front Panel
2.607"
5.521"
TX55 8 Pin Serial Connector (receptacle - to JX55 Transceiver Unit)
Function | Wire Color | Pin
RESET | White | 1
READY | Orange | 2
POWER | Brown | 3
ON | Green | 4
GROUND | Black | 5
MOSI | Blue | 6
CMD | Yellow | 7
MISO | Red | 8
DRAFT
SYSTEMS, INC.
PO BOX 1928 ROCKWALL, TEXAS 75032-2028
FLEETWATCH JX55 INSTALLATION DIAGRAMS
JX55 TRANSCEIVER UNIT (TX55) DIMENSIONS & CABLE PIN-OUTS INCLUDED WITH ALL JX55-XXXX-X-DB
SCALE NONE
DATE 02/21/2012
DRAWN BY MSG
APPROVED BY
ISSUE 1.0
DRAWING NUMBER JXSBOEM03


Function | Wire Color | Pin
RESET | White | 1
READY | Orange | 2
POWER | Brown | 3
ON | Green | 4
GROUND | Black | 5
MOSI | Blue | 6
CMD | Yellow | 7
MISO | Red | 8
5 6 7 8
1 2 3 4
JX55 8 Pin Serial Connector (plug - to TX55 Transceiver Unit)
TX Cable Length 9"
Top View of JX55
6.693"
3M DUAL LOCK VELCRO STRIPS
5.906"
6.162" (Inlay Length)
1"
1"
3M DUAL LOCK VELCRO STRIPS
Side View of JX55
2.805"
3.366"
1.368"
End View of JX55
3.366"
1939 Cable Length 10"
JX55 1939 CAN Connector (to Vehicle 1939 CAN Network)
Function | Wire Color | Pin
Battery (-) GND | Black (ONE) | A
Battery (+) | White (ONE) | B
CAN_H | Black (TWO) | C
CAN_L | White (TWO) | D
CAN_SHLD | Bare (silver) | E
J1708 (+) Data (A) | N/C | F
J1708 (-) Data (B) | N/C | G
Propnetary | N/C | H
Propnetary | N/C | J
View into 1939 CAN Connector
Deutsch Part # HD16-9-1939S (mates to Deutsch Part# HD10-9-1939P)
SYSTEMS, INC.
PO BOX 1928 ROCKWALL, TEXAS 75032-2028
FLEETWATCH JX55 INSTALLATION DIAGRAMS
DUAL BOX JX55 DIMENSIONS & 1939 CAN CABLE PIN-OUTS
FLEETWATCH PN: JX-1939-DB
SCALE NONE
DATE 02/21/2012
DRAWN BY MSG
APPROVED BY
ISSUE 1.0
DRAWING NUMBER JXSBOEM04
DRAFT