CONTRACT AGREEMENT

between

Talgo-SYSTRA Joint Venture))))) O)	
,	
N. 27 th Street) Rebuild of Bombardier Rail Cars.	
Milwaukee, WI 53216)	
www.systra.com	
www.talgo.com)	
)	
Project Director) AWARDED	
Robert Liliac)	
1.514.654.4839	
rliliac@systra.com	
AND CONTRACT AMOUNT	
) Sixty-four million, fifteen thousand and $(564.015.017.33)$	
Southern California Regional Bail Authority Authority Project Manager(PM):	
One Gateway Plaza 12 th Floor) Michelle Stewart	
Los Angeles California 90012	
(hereinafter "Authority")	
) StewartM@scrra.net	
) Contract Administrator (CA):	
) Angelos Kastrisianakis	
) Principal Contract & Compliance Administr	ator
) 1 213 452 0215	
) Kastrisianakis∆@scrra net	

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This Contract ("Contract") is effective as of this day of May 10, 2019, by and between the Southern California Regional Rail Authority ("the Authority") and Talgo-SYSTRA ("Contractor"), jointly referred to as "the Parties".

RECITALS

WHEREAS, the Authority is a joint powers authority organized under §6500 et seq. of the California Government Code and §130255 of the California Public Utilities Code with power to contract for the services described below;

WHEREAS, the Authority desires to hire Contractor to rebuild Bombardier Rail Cars; and;

WHEREAS, the Authority has issued a Request for Proposals, along with various addenda, the provisions of which are incorporated herein; and

WHEREAS, the Contractor desires to provide services required for the Rebuild of Bombardier Rail Cars and has submitted a written proposal, the provisions of which are incorporated herein; and

NOW THEREFORE, the Parties agree as follows:

1 PERIOD OF PERFORMANCE

The term of this Contract is effective upon Notice to Proceed and continues through Contract Close-Out by the Authority, to take place after acceptance of all Rail Cars and completion of the two-year warranty period, including satisfactory resolution of all warranty claims, unless otherwise terminated or extended as provided in this Contract.

The Contractor will not commence performing Work under this Contract until it is authorized in writing by the Authority to do so by a Notice to Proceed. The Authority has the option to extend this Contract up to five years following the termination date.

2 ORDER OF PRECEDENCE

This Contract consists of the documents listed below (the "Contract Documents"), all of which are incorporated by this reference. In the event of conflicting provisions or requirements within the several parts of the Contract Documents, they will take precedence in the following order, the first stated document being of the highest precedence:

- Amendments to this Contract, including Change Orders, with the later-released having precedence over the earlier
- This Contract Agreement
- Appendices
- Attachment A (Part 2): Scope of Work
- Attachment A (Part 1): Scope of Work

- Contractor's Final Offer
- Attachment C: Price Proposal

3 SILENCE NOT APPROVAL

With respect to any time specified for the Authority to comment or grant approval of any submission by Contractor, any failure on the part of the Authority to return comments or grant approval shall not be deemed approval by the Authority.

4 TOTAL COMPENSATION AND INVOICING

- A. Manner of Payment
- (1) Base Order and Option Orders

The Base Order quantity of fifty (50) Rail Cars is awarded in the not-to-exceed contract amount of \$64,015,017.33 and shall be inclusive of all cost for non-recurring engineering, system support, manuals, teaching aids, test equipment, special tools, bonds, and insurance. In addition, the Authority has one Option for the rebuild of an additional quantity of up to 71 Rail Cars. The price for the Option is not included in the not-to-exceed Contract amount and is priced separately.

(2) Contract Pricing

The Authority will make payments to the Contractor as provided in the "*Price Proposal*" at Attachment C, in accordance with the "*Milestone Payment Schedule*" in Exhibit B. All prices are in U.S. Dollars and are inclusive of all freight cost and applicable fees to the point of delivery as specified in the Delivery Schedule.

(3) Taxes and Other Similar Charges

Prices do not include sales, use or excise taxes, special financing fees, special permits or licenses or similar charges.

(4) Milestone Invoicing and Payment Schedule

Submit invoices to the Authority according to the Milestone Payment Schedule. Milestones shall be paid as a percentage of the total price for the Base Order.

- (5) Submit no more than one invoice per month, approximately 30 days apart, unless previously approved by the Authority, and each invoice may include any number and combination of Milestone payments that have been met. No partial payments will be allowed unless prior approval is granted in writing from the Authority. Milestone invoices may be submitted out of sequence, when all conditions of any Milestone are completed and accepted. Each invoice must be submitted both electronically and in hard copy and must include:
 - a. Contract Number
 - b. Milestones reached

- c. Applicable Car Numbers
- d. Sales Tax, as applicable
- e. Amount of Payment Requested
- f. Additional documentation as may be required by the Authority's Project Manager
- (6) Invoices received that do not include the required information will be returned without payment.
- (7) Payments will be made within 30 days of approval of an approved invoice by the Authority's Project Manager. In the event that the Authority should overpay Contractor, such overpayment shall not be construed as a waiver of the Authority's right to obtain reimbursement for the overpayment. Upon discovering any overpayment, either on its own or upon notice of the Authority, Contractor shall immediately reimburse the Authority the entire overpayment. The Authority, at its discretion, may deduct any overpayment from Contractor's future invoices.
- (8) Contractor's invoice for final payment must state that all 1) material or equipment has been reviewed and accepted, 2) title has passed to the Authority as required, 3) Contractor has performed in compliance with all terms and conditions of the Contract, and 4) no claims, loss, or disputes remain unresolved. Upon receipt of payment from the Authority, Contractor releases the Authority from any further payment obligation. After final payment is made, the Authority is under no obligation to accept or review claims made against this Contract.
- B. Options
- (1) Option Exercise

The Authority may purchase, at its sole discretion, rebuild services for up to 71 additional Rail Cars. The Option will be valid for a period of five years from the NTP Date of the Contract and if exercised, will be exercised by written notice to Contractor within five years of the Base Order Notice to Proceed. There will be a minimum order quantity of five rail cars for any permissible option order. Orders will be sent at least six months before last car delivery. The Option can be exercised multiple times until the total number of vehicles within the Option have been ordered. Subject to the Authority's right to order modifications, the Option Rail Cars will have the same Scope of Work as the Base Order Rail Cars rebuilt under this Contract. All conditions, specifications, and requirements set forth in the Contract Documents apply to Rail Cars rebuilt under the Option unless otherwise specified in this Section.

(2) Option Pricing

The rebuild price for any Rail Car Option ordered within two years of Notice to Proceed shall be the same as the per-Rail Car price for Rail Cars in the Base Order. Thereafter, the rebuild price for each Rail Car in any option order will be based upon the Contractor's Option Order pricing, as modified by the following escalation methodology.

- a. Escalation
 - (i) Labor Indices Adjustment

40% adjustment of the Option Price listed above is adjusted for labor cost in accordance with the following labor indices:

- 20% (of the 40% of Price) times NAICS Code 3353 (Electrical Equipment Manufacturing)
- 5% (of the 40% of Price) times NAICS Code 3359 (Other Electrical Equipment and Component Manufacturing)
- 75% (of the 40% of Price) times NAICS Code 336 (Transportation Equipment Manufacturing)
- (ii) Material Indices Adjustment

50% adjustment of Price is adjusted for material cost in accordance with the following material indices:

- 50% (of the 50% of Price) times Metals and Metal Products Code 10 (PPI, Metals and Metal Products, Series ID WPU10
- 50% (of the 50% of Price) times Materials for Durable Manufacturing FD-ID Code ID61113
- (iii) Notes
 - 10% of the Price is not subject to adjustment.
 - Price will not be adjusted for any option exercised within the first two years of the Contract.
 - The adjusted Labor Indices and adjusted Material Indices will equal the difference between the Labor Indices and Material Indices for the last calendar quarter preceding the date of Notice to Proceed of the original Contract, and the Labor Indices and the Material Indices for the last calendar quarter preceding the date of Notice of Award of the Exercise of an Option.
 - Index data is taken from the tables entitled "not seasonally adjusted".

- (3) Other Option Provisions
- (4) Except as specifically modified by this Article, all the provisions of the Contract Documents will apply to the delivery of, and payment for, Option Rail Cars including, without limitation, the provisions regarding liquidated damages.

5 WITHHOLDING MONEY BY THE AUTHORITY

- A. In addition to deductions authorized under this Contract and retention, the Authority may deduct the following from each progress payment:
- (1) Any liquidated damages that have accrued as of the date of the application for payment.
- (2) Any sums expended by the Authority in performing any of Contractor's obligations under the Contract that Contractor has failed to perform.
- (3) Any other sums that the Authority is entitled to recover from Contractor under the terms of the Contract equity, or the law, including insurance deductibles.
- (4) Any amounts allowed under this Contract document or the Law.
- (5) Any amount as security for performance for outstanding warranty defects or, for open items.
- B. The failure of the Authority to deduct any of the above-identified sums from a progress payment shall not constitute a waiver of the Authority's right to such sums.
- C. All payments will be deemed made upon mailing to Contractor at its mailing address set forth in this Contract. Alternatively, payment to Contractor may be made electronically as agreed to by Contractor and the Authority.
- D. The parties acknowledge that the payment schedule as structured will not result in a payment which exceeds its actual costs incurred as of the invoice date together with the proportionate share of its overhead and profits attributable to those costs.

6 WITHHOLDING MONEY TO MEET THIRD PARTY CLAIMS

- A. In addition to other amounts properly withheld under any provisions of the Contract, the Authority will withhold all legally required sums for stop notices, labor and tax liens, judgements, and other third party claims filed.
- B. If at any time a claim is made with respect to matters pertaining to the Work, including claims by the Authority against Contractor, the amount of such claim or so much as may be deemed reasonable shall be retained by the Authority out of any monies then due or thereafter becoming due to Contractor under this or any other Contract with the Authority, as security for the payment of such claim. This

withholding will be in addition to the other sums authorized by the Contract to be retained. If the liability of any such claim is finally adjudicated by a judgment of a court of competent jurisdiction or such claim is admitted by Contractor to be valid, then the claim may be paid from the amount withheld or due under this or any other Contract and the balance, if any, paid to Contractor.

- C. Should any claim remain unsatisfied at the time the final payment is due Contractor, the Authority may retain out of final payment a sum in its judgment sufficient to protect the Federal Government and the Authority in regard to all unsatisfied claims. Alternatively, the Authority may require other security.
- D. If the amount retained should be insufficient to pay the amount adjudicated to be due upon such claim, Contractor shall pay the amount of the deficiency to the Authority. If Contractor fails to do so, the Authority may recover the amount from any funds due Contractor under this or any other Contract, or may sue for and recover from Contractor the amount or balance as a debt from Contractor.
- E. Notwithstanding anything in this Contract to the contrary, in the event of a claim by any person or entity other than the Authority, the Authority will not withhold money due Contractor provided the Authority receives adequate written assurance from Contractor's insurance carrier or surety on bonds required hereunder that the insurer or surety will assume all responsibility in connection with the claim including defending and indemnifying Contractor and the Authority. The Authority shall have sole discretion to determine the adequacy of the assurance furnished.

7 USE OF MONIES WITHHELD

- A. Deposits, retainage, or other monies withheld, whether in cash or securities substituted (including Letters of Credit) shall be security for the faithful performance of the Contract by Contractor. In case any default causes loss, damage or expense to the Authority, then the Authority may apply the amount necessary to restore such loss, damage or expense, including any Liquidated Damages, out of the said deposit, retainage or other funds.
- B. The Contractor shall be entitled to receive the securities withheld (to the extent not applied as above provided), or monies representing the amount due, on the date when the amount which the securities are in substitution for is due to be paid in accordance with the requirements of this Contract.

8 WITHHOLDING RELATED TO GUARANTY AND/OR WARRANTY OBLIGATIONS

A. The Project Manager, prior to withholding or deducting any monies, will give Contractor notice of the defective Work, equipment or material and the basis for the withholding or deduction.

- B. From any payments to be made subsequent to the commencement of the applicable warranty period, the Authority may withhold f such sums as may be necessary to ensure completion of warranty obligations with respect to defective Work, equipment, or materials, as identified by the Project Manager.
- C. Upon the Project Manager's certification that Contractor has fulfilled its guaranty/warranty obligations, the Authority will pay Contractor any sums of money retained.
- D. Should Contractor fail to repair or replace any item, part or component, or otherwise perform necessary or required Warranty Work in accordance with the terms of this Contract, or if the Authority's Project Manager determines that immediate repair or replacement of Work is necessary to maintain operation, the Project Manager may cause such repair or replacement to be made, as Contractor's agent, at the expense of Contractor.

9 RETAINAGE

- A. Retained Percentage
- Notwithstanding any other deductions allowed for by the Contract or as required by law, when progress payments are made, the Authority will retain five percent (5%) of each requested and approved progress payment, which will be released 45 days following Contract Close-Out, subsequent to the following conditions:
 - a. There are no open or undelivered items; and
 - b. Contractor certifies that no claims, stop notices or liens have been filed against the Work; and
 - c. Contractor certifies that all subcontractors have been paid; and
 - d. The Authority has no claims against Contractor.
- (2) Retainage for options exercised will be released separately in accordance with the details of the option exercised, also subject to the above conditions.
- (3) If there are open or undelivered items, the Authority will estimate their value and will deduct double that amount from any retainage due. In the event costs incurred by the Authority are less than the amounts deducted, the Authority will reimburse the difference to Contractor.
- B. Securities

Contractor may request, and if the Authority approves the request, at Contractor's expense the Authority will pay retentions directly to an escrow agent or into securities selected by Contractor, and Contractor will receive the interest earned on the investments upon the same terms provided for securities deposited by Contractor. Upon satisfactory completion of the Contract, Contractor shall receive from the escrow agent all securities, interest, and payments received by the escrow agent from the

Authority. The escrow contract used pursuant to this paragraph shall be substantially similar to the form set forth in the California Public Contract Code §22300. This arrangement requires approval of the Authority's Procurement Manager and Legal Counsel; its acceptance is not within the powers delegated to the Authority's Project Manager.

Securities eligible for investment under this provision include those listed in the Government Code, Certificates of Deposit from state or federally chartered banks or savings and loans, standby letters of credit, or any other security mutually agreed to by Contractor and the Authority.

10 BONDS

- A. Performance Bond
- (1) The Contractor shall furnish a payment and performance ("Performance Bond") to guaranty the faithful and timely performance of the Work in accordance with the terms and conditions of the Contract and in a manner acceptable to the Authority, in an amount equal to 20% of the Total Contract Price. The Performance Bond shall be supplied using the Authority's form and shall be issued by an admitted Surety satisfactory to the Authority and authorized to issue such bond in the State of California.
- (2) The Performance Bond shall be effective from the date of award of the Contract until the issuance of a Certificate of Final Completion. The Contractor may reduce the amount of the Performance Bond to 10% of the Total Contract Price upon Delivery and Authority's issuance of a Notice of Conditional Acceptance of the final Rail Car required by this Contract, or Contractor may substitute a Warranty Bond in a form acceptable to the Authority as discussed below.
- (3) In the event that the Authority exercises the Option pursuant to this Contract, then Contractor shall be required to maintain a Performance Bond for the Option Work in accordance with all of the requirements for a Performance Bond for the Base Order Work.
- (4) In lieu of the Performance Bond, Contractor may provide a irrevocable standby letter of credity ("Letter of Credit") in an amount equal to 20% of the Total Contract Price. The Contractor's Letter of Credit will be reduced to 10% of the Total Contract Price upon Delivery and Authority's issuance of a Notice of Conditional Acceptance of the final Rail Car required by this Contract.
- (5) The Bond requirements for the Option are the same as those for the Base Order.
- B. Warranty Bond
- (1) At the time of issuance of the first Certificate of Conditional Acceptance for the last Rail Car of the Base Order, and prior to termination of the Performance Bond

by the Authority, Contractor shall furnish, at its own expense, a Warranty Bond in a form subject to the Authority approval and equal to 10% of the Total Contract Price as a guaranty that Contractor will provide full performance of warranty and service support terms of this Contract. Said Warranty Bond shall remain in force and effect for a period of two years from the date the Authority issues the Certificate of Conditional Acceptance for the last Rail Car of the Base Order. The Authority must give its written consent to any substitution of surety and reserves the right to reject a proposed substitution.

- (2) The Warranty Bond for any Option exercised shall be in the amount of 10% of the Total Contract Price for the Option exercised.
- (3) Other Warranty Bond requirements for the Option are the same as those for the Base Order.
- C. Acceptability of Surety
- (1) Should any Surety at any time be unsatisfactory to the Authority, notice will be given to Contractor to that effect. No further payments shall be deemed due or will be made under the Contract until a new Surety shall qualify and be accepted by the Authority. The Contractor shall pay all costs of compliance with this Article.

11 LIQUIDATED DAMAGES AND RAIL CAR AVAILABILITY

- A. Liquidated Damages, General. The Parties agree that the Authority will be damaged if Contractor fails to perform within the time allowed or if Contractor's act or omission disrupts the operations of the Authority. It is impractical and/or difficult to ascertain the exact damage that the Authority will sustain in the event of such delay and the Parties have therefore made a good faith effort to estimate the damage and have agreed to the liquidated damages as set forth below. Liquidated damages may be deducted from any monies due, or which may thereafter become due, to the Contractor under this Contract, and will not be deemed a penalty. The assessment of Liquidated Damages as set forth in this section will be the Authority's sole and exclusive remedy and Contractor's sole and exclusive liability in the event of Contractor regarding Limitation of Liability.
- B. Liquidated Damages for Late Delivery. In the event of unexcused delay in the completion of the delivery of any Rail Car beyond the dates required, the Authority may assess as liquidated damages the amount of \$500 per calendar day of delay per Rail Car, up to an aggregate maximum of 2% of the price of the Rail Car for which delivery is delayed. For avoidance of doubt, no liquidated damages will be assessed so long as the two Pilot Rail Cars are delivered within

the required times, and no liquidated damages will be assessed for late delivery of remaining Rail Cars so long as Contractor complies with the delivery schedule.

- C. Availability Assessments. In addition to Liquidated Damages, the Contractor will guarantee an average minimum availability for each Rail Car at 95%. The Authority may make a financial assessment (an "Availability Assessment") for failure to meet such availability requirements.
- (1) Availability performance will be measured in availability percentage, calculated as follows:

Availability Percentage ("AP") = 100 x (T – UMT) / T

Where:

- T = total number of hours the Rail Cars could have been available during the measurement period. This number is obtained by multiplying the number of days in the Measurement Period, times 24 hours, times the number of Rail Cars that have been subject to this Contract during the measurement period.
- UMT= total number of hours that the Rail Cars were in the maintenance location for unscheduled maintenance during the measurement period, plus, in the event of a Rail Car failure which causes the annulment or cancellation of a train in revenue service, the transit time of the Rail Car to the maintenance location.

At the conclusion of each measurement period, the Contractor shall calculate the AP, rounded to the nearest 1/10 of a percent, and determine the Availability Assessment due if the AP is less than the required level of 95%. The Authority will also calculate the AP based on the Authority's records. If there are differences in the AP as calculated by each Party, the Parties will verify and adjust their respective records to reach a mutual agreement in determining the AP, which will be considered official.

- (2) The AP measurement period will begin with the first Production Rail Car (or Car No.3) delivered after the two Pilot Rail Cars (or Cars No. 1 and 2), and only after each such Rail Car enters revenue service. A Rail Car will be included in the fleet for purposes of computing any Availability Assessment beginning on the dates determined below:
 - a. First Production Rail Car delivered after the delivery of the two Pilot Rail Cars - the Measurement Period will begin on the first day of the month following sixty days after the first day of revenue service (i.e., if 60 days following the first day of revenue service falls on a date that is not the first of the month, the AP calculation will begin on the first day of the following month)

- All other Production Rail Cars delivered after the first Production Rail Car
 the measurement period will begin on the first day of the month
 following 30 days after the first day of revenue service of each applicable
 Rail Car
- c. The two Pilot Rail Cars the measurement period will begin 90 days after the first day of revenue service.
- (3) The measurement period will apply to the Rail Cars for a period of 24 months from the date each Rail Car becomes subject to the Measurement Period.
- D. The AP described will be subject to the following conditions, limitations and exclusions:
- (1) Total time due to "No Defect Found" failures will not be counted.
- (2) Any transit time to the maintenance location will not be counted. Waiting time outside the shop for legitimate failures will not be counted.
- (3) Total time due to any repeat failure of the same defect, because the defect was not fixed properly, will not be counted, unless the repair was made under the supervision or direction of, or by, the Contractor, and Contractor indicated its approval of the repair in writing.
- (4) In the event a Rail Car is annulled or cancelled from revenue service due to a failure found to be the responsibility of the Contractor after a thorough analysis, the out of service time will be counted beginning when such Rail Car was annulled or cancelled due to the problem.
- (5) If a Rail Car has a repeat failure that is the responsibility of the Contractor after a thorough analysis, the total time the train is delayed will be counted.
- (6) Poor workmanship due to work outside of the control of the Contractor will not be counted unless it is work of one of Contractor's Subcontractors, for which Contractor will be responsible.
- (7) Time delays due to parts not available will be assessed after a five-day grace period.
- (8) Time spent on scheduled services (such as 92 days, 184 days and 365 days) or maintenance intervals will not be counted.
- (9) Total time due to Maintenance/Operations/accidents/derailments/upgrades and other similar failures will not be counted.
- (10) Total time due to the failures caused by deviations from the Contractor's Maintenance Instructions or not using OEM parts will not be counted.

- (11) The Authority's specified stand-alone equipment (PTC, LDVR, Radio, etc.) will not be counted.
- (12) The AP will be based on a fleet average and any Availability Assessment will be paid out based on the following schedule, up to an aggregate maximum of two percent of the price of each Rail Car subject to the Availability Assessment.
- (13) Availability Assessment schedule:
 - a. AP between 93 and 94.9% will be assessed in the amount of (\$200 per day) x the number of days in the month being assessed
 - b. AP between 90 and 92.9% = (\$300 per day) x the number of days in the month being assessed
 - c. Below 90% = (\$500 per day) x the number o fdays in the month being assessed

12 FORCE MAJEURE

- A. The Contractor will be granted an extension of time, and will not be assessed Liquidated Damages, for any portion of a delay in completion of the Work caused by acts of God or the public enemy, wars, civil disturbances, fires, floods, earthquakes, epidemics, quarantine restrictions, freight embargoes, shipwreck, weather more severe than normal or any other cause sufficiently outside of the reasonable control of Contractor (in the discretion of the Authority) as to warrant an extension of time, providing that the:
- (1) Causes were not foreseeable and did not result from fault or negligence of the Contractor; and
- (2) Contractor has taken reasonable precautions to prevent further delays owing to such causes; and
- (3) Contractor notifies the Authority in writing of the causes for the delay within five days from the beginning of any such delay.
- B. Except under exigent circumstances caused by one of the preceding events, unavailability of personnel will not be considered an excusable delay. No claims for additional compensation or damages for the foregoing delays will be allowed to the Contractor, and the extension of time will be the sole remedy of the Contractor on account of any such delays.

13 NO WAIVER

The Authority's failure to insist upon strict adherence to any term of this Contract on any occasion is not a waiver of the Authority's rights, nor will it deprive the Authority of the right thereafter to insist upon strict adherence to that term or any other term of this Contract.

The payment of Liquidated Damages will not affect any other rights or remedies of the Authority upon default by the Contractor, except that any claim by the Authority associated with such rights or remedies will not include claims for which liquidated damages have been assessed by the Authority.

14 NO ESTOPPEL

- A. Any certification, notice, inspection, review, acceptance, approval, or payment made or given by any representative of the Authority shall be construed merely to mean that the Authority's representative was unaware of any reason, at that time, to object, and will not preclude or bar the Authority in any manner, or at any time, from asserting contrary facts, or taking a contrary position. Nor shall the Authority be estopped or precluded from showing the true and correct classification, amount, and quality of the Work done, or from deducting from future payments, or recovering from Contractor such amounts or damages as the Authority may sustain by reason of Contractor's failure to comply with the Contract.
- B. No approval by the Authority of any modification sample, schedule document, substitution, drawing or other matter shall impose any liability upon the Authority, nor shall any such approval change any of the requirements of the Contract or relieve Contractor of any responsibilities under the Contract, including without limitation, the accuracy of drawing or any obligation under any warranty provision.

15 TITLE TO EQUIPMENT

- A. Title to the Authority's Rail Cars shall remain in the Authority and shall not be divested by any remanufacturing, rebuild or overhaul made to the Rail Cars by Contractor.
- B. Title to Components and Material that are not a part of a Rail Car at Notice to Proceed, shall vest in the Authority upon Acceptance by the Authority of each Rail Car. Concurrent with or prior to its delivery of each Rail Car, the Contractor shall deliver to the Authority instruments such as a Bill of Sale and the Certificate of Origin, as may properly recite or prove the Authority's free and clear title to such Components and Materials. The Contractor will ensure that each title transferred will free and clear from all security interests, liens, or other encumbrances.
- C. Title to Components and Material from the Rail Cars identified by Contractor for salvage, and approved by the Authority in writing, shall be vested in Contractor upon Contractor's receipt of the Authority's written salvage approval.

16 **REJECTION**

- A. If on delivery of any Rail Car, the Project Manager determines that it is unfit for service, or if the Rail Car had been Conditionally Accepted but Contractor has failed to remedy the Open Items to the Authority's satisfaction within the time specified, a Notice of Rejection will be given to Contractor indicating that the Rail Car is rejected. At the Authority's option, the Rail Car may be returned to Contractor at Contractor's expense for corrective action . Rejection shall vitiate delivery for all purposes and shall subject Contractor to appropriate Contract enforcement remedies such as Liquidated Damages for Delay.
- B. The Contractor will be responsible for all expenses and costs incurred by the Authority in connection with Rejection, including, without limitation, the removal of the Rail Car from the Delivery Point, repair, reinspection, retesting, and return to the Authority.

17 RISK OF LOSS

- A. Until Delivery, or upon Notice of Rejection, the Contractor will bear all risk of loss or damage to each Rail Car under the control of the Contractor, and all risk of loss or damage to materials to be delivered pursuant to this Contract.
- B. The Contractor will not be responsible for any loss or damage arising from the negligence or willful misconduct of the Authority. The Contractor's responsibility for Risk of Loss or damage will also apply to any the Authority-furnished equipment or material in Contractor's sole care, custody and control.
- C. Contractor will bear the risk of loss or damage to any the Authority property arising from negligent actions or inactions of Contractor. In addition, Contractor will bear all risk of loss or damage with respect to all materials acquired and in its care, custody and control for the Work. The foregoing applies to any property of Contractor, Subcontractors, workers, and others performing the work, as well as third parties. Contractor will protect from damage existing property belonging to the Authority or any third parties affected by Contractor's negligent activities and will provide appropriate protection for all such property during progression of the Work.

18 PERSONAL NON-LIABILITY

None of the Directors, officers, agents, or employees of the Authority shall be charged personally by Contractor with any liability, or held personally liable to Contractor under any term or provision of this Contract, or because of its execution or attempted execution, or because of any breach, or attempted or alleged breach.

19 INDEMNITY

Contractor will indemnify, defend and hold harmless the Authority, and its member agencies, and their officers, directors, employees and agents from and against all liability, expense (including but not limited to defense costs and attorneys' fees), claims, causes of action, and

lawsuits for damages of any nature whatsoever, including bodily injury, death, personal injury or property damage (including property of Contractor) arising from or connected with any alleged act and/or omission of Contractor, its officers, directors, employees, agents, subcontractors or suppliers. This indemnity shall survive termination of this Contract and/or final payment thereunder.

20 **★INSURANCE**

Throughout the duration of the Contract, Contractor shall maintain the following insurance, not subject to self-insurance. Contractor shall not of its own initiative cause such insurance to be canceled or materially changed during the course of this Contract.

- A. Within ten days after receiving Notice of Award, Contractor shall furnish to Contract Administrator, a certificate of insurance showing the required insurance coverages for Contractor and further providing that:
- (1) The Authority and its member agencies, and their officers, directors, employees, and agents are named as an additional insured via endorsement on Commercial General Liability and Automobile Liability insurance with respect to performance hereunder.
- (2) The coverage shall be primary and noncontributory as to any other insurance with respect to liability hereunder.
- (3) Thirty days prior written notice of cancellation or of material change in coverage shall be given to the Authority by endorsement.
- B. "Occurrence," means any event or related exposure to conditions which result in bodily injury or property damage.
- C. Any deductibles or self-insured retentions (SIR) must be declared to and approved in writing by the Authority. At the option of the Authority, either the Contractor shall reduce or eliminate such deductibles or self-insured retentions with respect to the Contract to be awarded and shall procure a bond guaranteeing the amount of the deductible or self-insured retention. If the Authority agrees in writing to a deductible or self-insured retention, then in the event of any claims or suits which may arise for which the Authority seeks coverage under such policy as an additional insured, Contractor shall satisfy such deductible or self-insured retention to the extent of any loss covered by such policy arising from or connected with any alleged act or omission of Contractor, its officers, directors, employees, agents, Subcontractors, or suppliers, even if Contractor is not a named defendant in the lawsuit. Contractor's policies shall neither obligate nor prohibit the Authority or any Additional Insured, from paying any portion of any Contractor deductible or SIR.

21 MINIMUM LIMITS OF INSURANCES.

The Contractor shall maintain limits no less than:

- A. Commercial General Liability to include Products/Completed Operations, Independent Contractor, Contractual Liability, and Personal Injury Liability; with at least the following limits of liability:
- (1) Primary Bodily Injury and property damage liability limits of \$4,000,000 per occurrence.
- (2) Primary Property Damage Liability Limits of \$4,000,000 per occurrence.
- (3) Aggregate liability for both bodily injury and property damage liability of \$8,000,000.
- B. Automobile Liability with the following limits:
- (1) Primary Bodily Injury with limits of \$1,000,000 per occurrence; and
- (2) Primary Property Damage with limits of \$1,000,000 per occurrence; or
- (3) Combined single limits of Liability for Primary Bodily and Primary Property Damage of \$2,000,000 per occurrence.
- C. Workers' Compensation Insurance with the limits established and required by the State of California, or other state in which Work will be performed.
- D. Employer's Liability with limits of \$1,000,000 per occurrence.
- E. Railroad Protective Liability Insurance
- (1) Contractor shall provide, with respect to the operations they or any of their Subcontractors perform on any property of the Authority as per criteria shown in "Rules and Requirements for Construction on Railway Property," Railroad Protective Liability Insurance.
- (2) The policy shall have limits of \$4 million per occurrence, combined single limit, for coverage and for losses arising out of injury to or death of all persons, and for physical loss or damage to or destruction of property, including the loss of use thereof. A \$15 million annual aggregate shall apply.
- (3) Contractor shall include the Southern California Regional Rail Authority as insured under its Railroad Protective Liability Insurance, and the following as Additionally Insured:
 - a. Burlington Northern Santa Fe Corporation (BNSF)
 - Los Angeles County Metropolitan Transportation the Authority (MTA) National Railroad Passenger Corporation (Amtrak)

- c. Orange County Transportation the Authority (OCTA) Riverside County Transportation Commission (RCTC) San Bernardino County Transportation the Authority (SBCTA)
- d. Union Pacific Railroad Company (UPRR)
- e. Ventura County Transportation Commission (VCTC)
- f. Others at the request of the Authority

22 CONTRACT CLOSE-OUT

Contract Close Out occurs upon completion and Acceptance of all Work, which requires:

- A. A Final Completion Certification for each vehicle placed in the Car History Book;
- B. Final Acceptance of all Rail Cars;
- C. Submittal and Approval of all Contract Deliverables;
- D. Certification of no claims, stop notices or liens have been filed against the Work; and
- E. Certification that the Authority has no claims against Contractor.

23 **★**WARRANTY REQUIREMENTS

- A. Warranty Coverage
- (1) The Contractor guarantees and warrants that all materials, supplies, systems, equipment, and designs furnished by Contractor, including without limitation any Software furnished under this Contract, and all Work, will conform to the requirements outlined in the Contract and will, at a minimum:
 - a. Fulfill their design functions and be fit for the purposes for which Contractor provided them; and
 - b. Be free of all patent and latent defects in design, materials, and workmanship; and
 - c. Perform satisfactorily for a period extending two years after the date that the Car is placed into Service following Conditional Acceptance ("Warranty Period"); and
 - d. Be compatible with all the Authority equipment used in passenger service; and
 - e. Comply with all applicable Federal Railroad Administration regulations, rules and requirements.
- (2) Except where longer periods of warranty are specified, the Contractor warrants that all Work, equipment, parts, and materials provided by Contractor will be free of all defects in materials and workmanship for a period of two years after

Final Acceptance, or for any longer period specified in any warranty available from any Subcontractor or stated in this Contract. The warranty will apply whether the equipment, materials or labor were furnished by the Contractor or by any subcontractors or suppliers of any tier. Without limiting any of Contractor's obligations under this Section, the Authority shall be the beneficiary of any warranty provided by any Subcontractor.

- (3) The Contractor warrants that the title to any Deliverables covered by the Contract, when delivered to the Authority or to its successors, will be free and clear of all liens and encumbrances.
- (4) The right of inspection and Acceptance by the Authority in no way limits or modifies the warranties provided above, and the Authority is not in any manner bound by inspection or otherwise to discover any defects of any type whatsoever.
- B. Warranty Repair
- (1) All goods, equipment, designs and Work found to be defective on each Car prior to the expiration of the Warranty Period shall be repaired, remedied or replaced by the Contractor, free of all charges, including transportation of the Car to and from the Contractor's facilities.
- (2) Upon notice from the Authority of any failure or Defect in any materials or workmanship, the Contractor will diligently perform all work necessary to determine the cause thereof, and the time necessary to remedy the Defect, and will propose in writing to the Authority how and in what manner it will remedy the Defect. If the Authority determines that the proposal complies with the terms of the Scope of Work, it will authorize the Contractor to proceed to repair or replace the defective or failed items within the agreed time period.
- (3) In determining the cause of the Defect, the Contractor will perform such investigations and tests as the Authority may require to determine the cause, and to verify that repairs and replacements comply with the requirements of the Scope of Work. All costs associated with such investigation repair, replacement and testing, including the removal, replacement, and reinstallation of equipment and materials necessary to gain access to defective Units, will be borne by the Contractor. Should the Contractor fail to commence the necessary investigation repair, replacement, and test within three working days after receipt of a written notice from the Authority of a Defect, the Authority may perform or cause to be performed the same at the Contractor's expense.
- (4) The Contractor warrants all repaired or replaced Units against defective materials and workmanship for the original warranty period associated with the items, which will be no less than two years.

- (5) The Contractor and the Authority may mutually agree to have the Authority and/or its contractors carry out warranty repair, field modifications, Change Orders, and other work that is the responsibility of the Contractor, and to do so on the Authority's property at rates to be mutually agreed upon.
- Subject to the approval of the Authority, Contractor personnel may be allowed (6) to use the Authority facilities and special equipment to perform warranty Work, provided that such Work does not interfere with other the Authority activities, and is performed in accordance with the Authority policies and directions. The Authority will designate which facilities and special equipment may be used, and the schedule thereof. Contractor will reimburse the Authority for any reasonable extraordinary expenses to the Authority arising from Contractor's use of the Authority facilities and special equipment. If the Authority in its sole discretion determines that its facilities or special equipment cannot be made available, Contractor will be responsible for obtaining its own facilities and special equipment at Contractor's cost. Damages to the Authority property caused by negligence or willful misconduct of the Contractor (or its subcontractors or suppliers) while such property is in the Contractor's sole care, custody and control, will be the sole responsibility of the Contractor, and will be corrected at the Contractor's expense.
- C. Subsystems and Components.

The Contractor warrants specific Units, if provided or serviced by the Contractor, against Defects as noted in the following table from and after the date that each Rail Car is placed into revenue service.

ltem	Years
Base Warranty – Entire Rail Car	2
Rail Car body and underframe structural integrity and corrosion*	10
Truck frame and bolster structural integrity, corrosion	10
Elastomers used in trucks	4
HVAC Units	4
Paint and Graphics (no fading or deterioration)	5

*Corrosion that results from debris damage, collision damage or vandalism will not be considered a corrosion defect.

D. Extended Warranties.

In the event any subcontractor, supplier or manufacturer offers a longer warranty period beyond those specified in this Contract, the Contractor shall state the terms of such warranty or warranties in writing and shall extend same to the Authority without additional cost to the Authority if no additional cost is incurred by Contractor.

E. Other Warranties or Guarantees.

All express warranties and guarantees of subcontractors, suppliers of any tier and manufacturers are deemed to be made for the benefit of the Authority regardless of whether stated as such, and the Contractor shall enforce such warranties and guarantees for the benefit of the Authority.

F. Exceptions to Warranty.

If a Defect was caused as a result of the Authority's (a) misuse, negligence or accident, including, but not limited to, (i) using a Rail Car for purposes for which it is not designed or intended (such as use for freight purposes when such Rail Car is designed for passenger purposes, or vice versa), or (ii) using the Rail Cars under conditions other than those contemplated in the specifications, or (iii) subjecting a Rail Car to improper installation or improper operation, or (iv) not maintaining a Rail Car according to either the Contractor's maintenance instructions applicable to the Rail Cars or components, or other maintenance advices provided by Contractor to the Authority; or (b) a Unit was repaired or altered in any way by the Authority or any other party not authorized or approved by Contractor (except for any repair, alteration or modification made as a result of Contractor's failure to promptly investigate, repair or replace beyond the applicable cure period, including but not limited to damage arising from the Authority's application of non- Contractor parts, the warranty shall not apply to any such Rail Car, part or component.

In addition, warranty does not apply to any Rail Car, part or component that fails or is damaged as a result of any other component with respect to which any action under (a) or (b) was undertaken; or when Contractor's examination of the Rail Car, part or component discloses that no Defect exists.

- G. Detection of Defects.
- (1) If the Authority detects a defect within a warranty period as defined herein, it shall promptly notify the Contractor.
- (2) The warranty shall not apply to Contractor-furnished consumables, such as filters, seat cushions, or brakes shoes, unless the Defect is due to defective manufacture or workmanship of the consumable; or to items furnished by the Authority, except insofar as such an item is damaged by a Defect in a Unit for which the Contractor is responsible.
- H. Contractor Response.

- (1) Within three working days after notification, the Contractor's Representative shall either agree that the defect is in fact covered by warranty, or reserve judgment until the Unit is inspected by the Contractor's Representative or is removed from the Rail Car and examined at the Authority's property or at the Contractor's plant. At that time (or such longer period as necessary), the Contractor will provide the Authority with its initial analysis of the Defect, and the Parties will attempt to resolve the status of warranty coverage on the Unit. If Contractor's examination of the Rail Car, part or component discloses that no Defect exists, the Authority will pay for any analysis performed by Contractor.
- (2) Notwithstanding any time necessary for the Contractor to analyze and resolve warranty status, if the Contractor has not commenced repair or replacement in good faith, within three working days after the Contractor's notification, the Authority reserves the right to perform the required repairs without further notice to the Contractor and to be reimbursed for all associated costs.

24 REPAIRS BY AUTHORITY

If the Authority self-performs repairs, it will consult the Contractor prior to beginning the repair work and obtain Contractor's agreement as to the work to be performed to ensure that any existing warranty on the Unit to be repaired is not adversely affected. In such an event, the Authority shall make repairs using the Contractor specified Units supplied by the Contractor specifically for this repair. Warranty claims for repairs covered by this warranty shall be submitted by the Authority to the Contractor for reimbursement on a regular basis. The Contractor shall pay the warranty Labor Rate as mutually agreed upon by the Parties, excluding overtime, at the time of the incident for all the Authority labor required.

If, following return of a part by the Authority and upon analysis by Contractor, the Authority is found to be responsible for the failure or Defect, or if the original part is found to be free of the reported Defect, then Contractor may invoice the Authority for all charges for replacement parts and freight costs incurred by Contractor with respect to any replacement parts supplied to the Authority.

25 CONTRACTOR SUPPLIED PARTS

The Authority may request that the Contractor supply new (or remanufactured to OEM standards) Units for warranty covered repairs being performed by the Authority. These Units shall be shipped prepaid to the Authority from any source selected by the Contractor. Replacement Units shall be shipped directly to the Authority's maintenance facility. Contractor must provide an effective materials management program to ensure spare parts inventory sufficient to support the warranty. The Authority reserves the right to verify and audit the adequacy of Contractor's spare parts inventory.

26 DEFECTIVE UNIT RETURN

The Contractor, in its sole discretion, may request that defective Units covered by the warranty be returned to the manufacturing plant. The Contractor shall make such requests no later than one hundred twenty (120) days after repairs are completed. The cost of standard freight and insurance shall be paid by the Contractor. Units shall be returned in accordance with Contractor's instructions at the Contractor's cost.

27 REIMBURSEMENT OF THE AUTHORITY FOR WARRANTY REPAIR

The Contractor shall reimburse the Authority for all reasonable costs incurred by the Authority associated with performing warranty work. Following are specific requirements, but the list is not exhaustive.

- A. The Contractor shall reimburse the Authority for all labor associated with the Authority's correction of defects. The amount will be determined by multiplying the number of labor hours actually required to correct the Defect by the Authority's warranty Labor rate.
- B. The Contractor shall pay the cost of transporting a Rail Car for warranty work if such action is necessary, provided, however, that if such transport is from a location on the Authority's system to another location on the Authority's system, Contractor shall not be required to pay such cost of transportation.
- C. Should the Contractor request the Authority to transport Rail Car to a vendor/subcontractor for repairs, the Contractor shall reimburse the Authority for all expenses incurred including, but not limited to, labor, fuel, and transportation. The Contractor shall assume all liability for damage from the time Contractor assumes sole care, custody and control of the Rail Car until it is returned to the Authority's care, custody and control. Reimbursement to the Authority shall be made upon receipt of an invoice.
- D. Materials, tools, and spare parts required to effect warranty repairs and/or Failure Mode Analysis and Recovery are the responsibility of the Contractor and its subcontractors, who shall make adequate provisions of replacement parts and tools sufficient to carry out the work promptly. However, if the Contractor is unable through commercially reasonable efforts to acquire parts sufficient to perform the warranty repairs and/or Failure Mode Analysis and Recovery, the Contractor may be allowed to use the Authority's spare parts to effect warranty repairs. The Contractor shall, within 30 days of removing a part from the Authority's spare parts inventory, either replace such parts, or provide the Authority with evidence that such parts has been ordered and will be replaced as expeditiously and diligently as practicable.
- E. The Contractor's warranties shall not be voided by the Authority's procurement of equivalent spare parts from other sources when such purchases are necessitated by the Contractor's failure to deliver correct parts in a timely manner or due to the Contractor's price for spare parts.

F. If the Authority self-performs repairs the Contractor shall provide to the Authority replacements for Defective Units and for additional parts (i.e. gaskets, etc.) to correct the Defect under warranty.

28 REPLACEMENT OR REPAIRED PART WARRANTY

- A. If any Unit is repaired, rebuilt or replaced by the Contractor or by the Authority's personnel pursuant to this Contract, the Unit shall have the warranty period of the original Unit.
- B. Once any single item provided by Contractor fails for a third time for the same fault at any point during the warranty period, having been repaired by the Contractor, the item shall be designated as "Faulty 3 Times" and shall be replaced with a new item by Contractor and the replaced item shall never be returned to service in this or any other Authority Contract.

29 FLEET DEFECTS

- A. If, at any time prior to the expiration of the Warranty Period, any single failure mode of an item develops and the rate of failure reaches 20% of the total number of such items during any 12 consecutive month period, it will be deemed a Fleet Defect. The rate calculation shall start when all Rail Cars of the Base Order are accepted and continue until the expiration of the warranty applicable to that Item on the last Rail Car accepted by the Authority in the Rail Car Fleet.
- B. The Contractor shall correct Fleet Defects at the Contractor's sole cost. After correcting the Fleet Defect, the Contractor shall promptly undertake and complete, at the Contractor's sole cost, a work program reasonably designed to prevent the occurrence of the same Fleet Defect in all other Rail Cars purchased under this Contract including those for which the individual Rail Car or Unit warranty has already expired. The work program shall include inspection and repair or replacement of the defective Units in all the Rail Cars delivered or to be delivered under this Contract.
- C. The warranty on Units arising from Defects determined to be Fleet Defects shall apply to the entire fleet of Rail Cars delivered or to be delivered under this Contract, and as to Rail Cars previously accepted by the Authority shall commence on the date remediation and correction by the Contractor is completed on the entire fleet accepted up to that date ("Corrected Date"). The period of warranty for a Fleet Defect shall be the greater of the full period of the entire original warranty on the defective Unit or one year from the first Corrected Date, whichever is longer.
- D. If a failure of a single item on one Rail Car represents a higher percentage than twenty percent, that single failure shall not constitute a Fleet Defect and shall be addressed as an isolated problem.

- E. Each incident of an item failure shall count as a single Rail Car failure, even if multiple item failures are recorded on one Rail Car until such time that the first item that failed is corrected. If the failure occurs after a correction is made, it will be added to the failure count as a new failure.
- F. Fleet Defects shall be cured in accordance with a Failure Mode Analysis and Recovery Plan, which shall be agreed upon by the parties and identify the nature of the problem, analyze its cause, and designate remedial action to be taken, which may include replacement, redesign, repair and/or adjustment.
- G. The components, systems, subsystems, or circuits affected by the Failure Mode Analysis and Recovery Plan shall have their warranty extended by one year from the date of completion of the work, or until the expiration of the previously effective Warranty Period, whichever is longer, however, in any event, the warranty shall not exceed one year beyond the expiration of the original warranty of the cars.
- H. Replacement parts and materials shall be included in any Failure Mode Analysis and Recovery Plan.
- I. The "Rail Car Fleet" consists of the number of Rail Cars accepted by the Authority at the time of any notice to the Contractor of a Fleet Defect, but not less than 100% of the Base Order. For each Item reaching the 20% threshold, the Contractor and the Authority shall jointly review the failure mechanism and agree on the remedy. Remedy may consist of repair, replacement, adjustment, or redesign. In the latter case, the Contractor at its sole cost shall furnish, install and replace defective items in up to 100% of the Rail Car Fleet, including those Rail Cars yet to be delivered (option Rail Cars) and Rail Cars for which the warranty has already expired, and all identical items contained in the Authority's stock. Modified Items shall meet or exceed all performance requirements.
- J. For purposes of this section, an "item" is defined as the minimum unit on which a corrective action may be performed (repair, replacement, adjustment or redesign), either directly on the Rail Car or in the shop. The Contractor shall update, as necessary, technical support information (parts, maintenance and operators' manuals) due to changes resulting from warranty repairs.
- K. A Defect resulting in a safety hazard shall immediately upon discovery be deemed to be a Fleet Defect and the Contractor, at its sole cost, shall furnish, install and replace all defective items.
- L. The Fleet Defect provisions do not apply to Fleet Defects caused by the Authority's non-compliance with the Contractor's minimum recommended normal preventative maintenance practices and procedures contained in the maintenance manuals supplied by the Contractor to the Authority; provided, however, the Contractor, in any denial of Fleet Defect status must demonstrate

by adequate proof that the Authority did not comply, and if adequate proof is not provided the Fleet Defect provisions shall apply.

30 WARRANTY CLAIM SUBMITTAL

Warranty claim forms will be supplied and submitted by the Authority, and will contain the following information:

Identification Data:

- Warranty repair claim number
- Rail Car number
- Rail Car mileage and megawatt hours
- In service date of Rail Car, or failed part if previously replaced
- Repair date
- Claim date
- Failure description
- Repairs made

Unit and Part Information:

- Quantity
- Unit or Part number
- Unit or Part description
- Serial numbers

Labor Information:

• Labor hours

The Contractor shall respond to the warranty claim in writing. The Authority will not process warranty through a subcontractor or component manufacturer.

31 MANUFACTURER'S WARRANTIES AND GUARANTIES

The Contractor shall obtain all manufacturers' warranties and guaranties of all equipment and materials required by this Contract in the name of the Authority and shall deliver same to the Authority; provided that the delivery of such manufacturers' warranties and guaranties shall in no respect relieve Contractor of its obligation under this Contract. Unless expressly waived in writing by the Authority's Director of Contracts and Procurement, such manufacturer's warranty or guaranty shall not expire prior to the date of expiration of the warranty/guaranty provided by Contractor for such item under this Article nor shall it contain any terms substantially different than required under this Contract. The Authority, by accepting the manufacturer's warranties and guaranties provided by Contractor, in no respect waives any of its rights as against Contractor, and should there be a failure of the applicable manufacturer to honor any such guaranty or service obligation or a failure of Contractor to secure any such

rights from the manufacturer for the Authority, the Authority may, in its discretion, enforce any such rights against Contractor.

32 **★**SUBCONTRACTORS

- A. The Contractor may not subcontract any services to be performed by it under this Contract, or any materials or equipment incorporated into the Rail Cars, for an amount of \$100,000 or higher without the prior written approval of the Authority's Project Manager, provided, however, that such approval shall not be required for any subcontract to any entity that is controlled by, under common control with, or a parent company of any tier of Contractor. Any subcontractors must be engaged under written contract with Contractor with provisions allowing the Contractor to comply with all requirements of this Contract. Without limitation to the generality of the foregoing, each such written subcontract will at a minimum contain the following express provisions:
- (1) Contractor, not the Authority, is solely responsible for payment to the Subcontractor for any amounts owing and the Subcontractor will have no claim, and will take no action against the Authority, Member Agencies or officers, directors, employees, or sureties of any of them for nonpayment by Contractor.
- (2) Subcontractor agrees that the subcontract is subservient to this Contract and that it will be bound to the applicable terms and conditions of this Contract. Without limitation to the generality of the foregoing, the Subcontract will require Subcontractor to agree to terms and conditions effecting the provisions in these documents regarding liquidated damages.
- B. Consent by the Authority to any subcontracting will not relieve the Contractor of its primary responsibility for performance under this Contract. If subcontracting is approved, the Contractor agrees that all applicable FTA flow down compliance requirements will be included in such subcontracts and the Contractor shall obtain all applicable FTA-required certifications before entering into any subcontract.
- C. The Contractor shall be fully responsible to the Authority for all acts and omissions of its own employees, and of Subcontractors, Suppliers and their employees. The Contractor shall also be responsible for coordinating the Work performed by Subcontractors/Suppliers. When a portion of the subcontracted Work is not performed in accordance with the Contract, or if a Subcontractor/Supplier commits or omits any act that would constitute a breach of the Contract, the Subcontractor/Supplier shall be replaced at the request of the Authority and will not again be employed on the project.
- D. The Contractor shall be responsible for all materials and workmanship in the construction of the Rail Cars and all accessories used, whether the same are

manufactured by the Contractor, subcontracted, assigned, or purchased from a supplier. The Contractor shall be solely responsible for reimbursing any subcontractors and the Authority will have no obligation to them.

- E. Nothing contained in any of the Contract Documents, nor any course of conduct, will be construed to create any contractual relationship between the Authority and any Subcontractor.
- F. Upon request by the Authority or any government agency with jurisdiction, Contractor shall provide to the Authority an executed copy of each subcontract agreement, including any amendments.

33 CONTRACTOR'S KEY PERSONNEL

- A. The Contractor's Project Manager will be the primary point of contact for the Contractor regarding this Contract.
- B. The Contractor's Project Manager or delegated representatives shall be present at the work site at all times during performance of the Work and shall be authorized to receive and respond to orders from the Project Manager.
- C. All persons identified in the table below are deemed by the Authority to be Key Personnel. Contractor may not remove, replace, substitute, or otherwise change any Key Personnel without the prior written consent of the Authority.

Robert Liliac	Contractor's Project Manager
lgor Loginof	Contractor's QA Manager
Luc St-Laurent	Contractor's System Integrator

- D. In the event that any of Contractor's personnel become unavailable due to resignation, sickness or other factors outside of Contractor's control, Contractor shall be responsible for timely provision of adequately qualified replacements. In no event will a position remain unfilled for more than three months. Except for excusable delays due to Force Majeure, unavailability of personnel, even due to factors outside of Contractor's control, will not provide Contractor an excuse from meeting the time requirements under this Contract.
- E. If at any time the Authority, in its sole discretion, desires the removal of any individual assigned by Contractor to perform Work due to questions regarding the legal or professional fitness of the individual, or the individual's continued poor performance for which the Authority has given Contractor written notice, Contractor shall remove such person or persons immediately upon receiving written notice from the Authority.

34 THE AUTHORITY'S PROJECT MANAGER

- A. The Authority has the final approval in all matters relating to or affecting the Work. Except as expressly specified in the Contract, the Authority's Procurement Director may exercise any powers, rights, and/or privileges that have been lawfully delegated by the Authority. Nothing in the Contract should be construed to bind the Authority for acts of its Officers, employees and/or agents that exceed the delegation of authority specified herein.
- B. The Procurement Director has delegated to the Authority's Project Manager certain powers and duties in connection with the Contract. Within the scope of this delegation, and as may be additionally authorized in writing by the Authority, the Authority's Project Manager or his designee is empowered to:
- (1) Have general oversight of the Work and Contractor with the power to enforce compliance with the Contract, including giving orders to do work he determines necessary for Contractor to fulfill the requirements of the Contract. The exercise of or failure to exercise such power shall not relieve Contractor of any of its obligations under the Contract.
- (2) Suspend the Work or any part of it by giving notice to Contractor in writing.
- (3) Subject to the review and acceptance of the Authority, negotiate with Contractor all adjustments of price and time to perform the Work, however, approval of the Procurement Director or the Chief Executive Officer is required for any price adjustment once the total cumulative price adjustments to the Contract reach \$50,000, or for any modification of the deliverables required under this Contract.
- (4) Accept or reject progress payment applications for Work performed by Contractor.
- (5) Review and accept or reject Contractor's progress schedule.
- (6) Inspect and test the Work.
- (7) Determine appropriate responses to questions arising out of or related to the Work, including without limitation: questions as to the value, acceptability and fitness of the Work, and questions as to the interpretation of the Specifications and Contract Drawings.
- C. In addition to the foregoing, the Authority's Project Manager shall have those rights and powers expressly set forth elsewhere in the Contract, but the powers and rights of the Project Manager as the authorized representative of the Authority will not include any right or power specifically reserved for the Authority and/or the Procurement Director, by Contract or by Law.

35 PROMPT PAYMENT TO SUBCONTRACTORS

- A. The Contractor shall pay any Subcontractor approved by the Authority for work that has been satisfactorily performed no later than seven days from the date of the Contractor's receipt of payments by the Authority.
- B. In the event the Authority holds retainage from the Contractor, it will make prompt and regular incremental acceptances of portions of the contract work, as determined by the Authority, and pay retainage to the Contractor based on these acceptances. The Contractor shall return all monies withheld from all Subcontractors within 30 days after receiving payment for Work satisfactorily completed and accepted including incremental acceptances of portions of the Contract Work by the Authority. Any delay or postponement of payment may take place only for good cause and with the Authority's prior written approval. In the event the Contractor does not make progress payments or release retentions to the Subcontractors in accordance with the time periods in this section, the Contractor will be subject to a charge of two percent per month on the untimely or improperly withheld payment.
- C. Upon the Authority's request, the Contractor shall provide evidence that the Contractor has paid Subcontractors all amounts due in accordance with this section. This section applies to both DBE and non-DBE Subcontractors.

36 PAYMENT OF TAXES

- A. The Contractor shall pay all taxes, license, certification, permit and examination fees and excises which may be assessed on its property or operations hereunder or income therefrom, and shall make all applications, reports and returns required in connection therewith.
- Β. The Contractor shall pay all taxes and duties applicable to and assessable against any Work, equipment, materials, services, processes, and operations incidental to or involved in the Contract, including but not limited to transportation, export, import, business, and special taxes. The Contractor is responsible for ascertaining and acquainting itself with such taxes and making all necessary arrangements to pay them. In accordance with the Federal Railroad Revitalization and Regulatory Reform Act of 1976, as interpreted by the California State Board of Equalization, the Authority is exempt from California sales and use taxes for the purchase of railroad rolling stock. Therefore, Contractor certifies that no such taxes are included in the Total Contract Price. After Contract award, if it is determined that the Authority is not exempt from the California sales and use taxes or if there are any variations in taxes to be paid under this Contract, Contractor shall submit his request for change. The Total Contract Price shall include compensation for any taxes, other than sales and use taxes, Contractor is required to pay by laws and regulations in effect on the date the Cost Proposal was due to the Authority. The Contractor will maintain auditable records, subject to the Authority reviews, confirming that tax payments are current at all times.

37 FINAL COMPLETION CERTIFICATION

- A. When Contractor has completed the Work under this Contract, including all Open Items and open warranty defects, the Project Manager shall so certify in writing in the form of a Final Completion Certification in which he shall state, (i) from actual count and inspection, the whole amount and value of Work performed by Contractor, and (ii) the amount and value of such Work performed by Contractor still due and owing to Contractor under and according to the terms of this Contract.
- B. As a condition of the issuance of such Final Completion Certificate, Contractor shall submit an unconditional release of the Authority, in a form approved by the Authority, of all claims and liability to Contractor for anything done or furnished for, or in any way relating to the Work.
- C. The Project Manager, in his sole discretion, may issue a Final Completion Certification, notwithstanding that there are Rail Cars with Open Items or open warranty defects, in which event the Authority may deduct from the final payment, as security for performance, an amount equal to twice the Authority's estimated cost to correct any open warranty defects and/or Open Items.

38 FINAL PAYMENT

Final payment is made to Contractor when the Authority determines that Contractor has satisfied all of the deliverable requirements called for by the Contract, including all of the required documentation. Final payment signifies that the performance obligations of both parties to the Contract have been satisfied. Before receiving final payment, Contractor shall provide a signed release releasing the Authority from any further claims by Contractor. The Contractor shall also certify that all deliverable items have been delivered

39 FINAL PAYMENT TO ACT AS RELEASE

The acceptance by Contractor, or any person claiming under Contractor, of the final payment for the Work as audited by the Authority, whether such payment be made pursuant to any judgment or order of any court or otherwise, shall be a release to the Authority from all claim and liability to Contractor for anything theretofore done or furnished for, or relating to, the Work or for any prior act, neglect, fault or default of the Authority or of any person relating to or affecting the Work, except only the claims against the Authority submitted in accordance with this Contract.

40 **★INDEPENDENT CONTRACTOR**

The Contractor represents that it is fully experienced and properly qualified to perform the Work required for the Contract and that it is properly licensed, equipped, organized, staffed, and financed to perform the Work. The Contractor shall be an independent Contractor. The Contractor is not an agent of the Authority in the performance of the Contract, and shall maintain complete control over its employees and its Subcontractors and Suppliers of any tier.

Nothing contained in the Contract or any subcontract awarded by Contractor shall create any contractual relationship between any Subcontractor and the Authority. The Contractor shall perform the Work in accordance with its own methods and in compliance with the terms of the Contract.

41 CONTRACTORS STANDARD OF PERFORMANCE

- A. Contractor and Contractor's Project Manager shall be responsible for performance in accordance with the Contract. The Contractor shall be solely responsible for implementation of all means, methods, techniques, sequences, and procedures for any required coordination under the Contract. The Contractor shall be solely responsible for the safety of its employees and third parties.
- B. Contractor's services shall be performed in accordance with generally-accepted professional practices and principles and in a manner consistent with the level of care and skill ordinarily exercised by members of the profession currently practicing under similar conditions. All services shall be performed to the reasonable satisfaction of the Authority. The work of Contractor's Subcontractors will be deemed to be the work of Contractor.
- C. Contractor shall be responsible for the professional quality, technical accuracy, completeness, and coordination of the Contract, it being understood that the Authority will be relying upon Contractor's professional competency.
- D. The Contractor shall be bound by all determinations or orders and shall promptly obey and follow every order of the Project Manager, including the withdrawal or modification of any previous order and regardless of whether Contractor agrees with the Project Manager's determination or order. Orders shall be in writing unless not practicable, in which event any oral order must be confirmed in writing by the Project Manager as soon thereafter as practicable.
- E. Notwithstanding anything in the Contract to the contrary, it is understood by Contractor that the Scope of Work and Contract Drawings are provided by the Authority solely for the purpose of describing in general terms the performance required from the systems or equipment and do not in any way constitute a design by the Authority of such systems or equipment. It is further understood that the Authority makes no warranties whatsoever concerning such Scope of Work. It is the ultimate responsibility of Contractor to meet the performance requirements and other requirements of the Contract.

42 PARTS AVAILABILITY

The Authority shall have the right to procure additional spare parts required to maintain system components not generally available on the open market for a period commencing with NTP for this Contract and terminating twenty years after the expiration of the warranty of the last Delivered Rail Car, unless Contractor provides documentation confirming that the requested

spare parts are no longer manufactured by Contractor or the OEM. Parts which are no longer manufactured by Contractor or OEM shall be provided as described in the section of this Contract titled TECHNOLOGY AND INTELLECTUAL PROPERTY RIGHTS. The additional spare parts list, which includes the number of units and the unit prices, shall be as set forth in the Contract. The additional spare parts will be ordered using Purchase Orders, which shall be issued and funded, separately from this Contract. Each subsequent Purchase Order shall include requirements for dates of delivery of each item ordered that is consistent with the industry standard lead time for production of the item. The Authority may exercise the right described above by providing a written notice to Contractor.

43 AUTHORITY SUPPLIED MATERIAL, LABOR OR FACILITIES

- A. The Authority reserves the right to provide for incorporation into the Work, parts or components from its own inventory. If invoked, the Authority will be entitled to a credit for the value of parts or components, and with provisions for responsibility for general or special warranties with respect to such components or parts.
- B. Except as expressly specified in the Contract Documents, or as provided for above, no material, labor, equipment furnishings, parts, components, or facilities shall be furnished or supplied by the Authority for use in prosecuting and completing the Work to be performed under this Contract.

44 BRAND NAMES/SUBSTITUTION OF SPECIFIED MATERIAL

- Α. Wherever in the Technical Specification a particular brand, or make of material, or equipment is shown or specified, such material or equipment is to be regarded as a standard for the purpose of concisely indicating the requirements as to type, quality, performance, design and finish. Any material or equipment other than that specified will be acceptable if, as determined by the Authority, it is as satisfactory for the particular work for which it was intended as the material or equipment specified. Complete documentation in support of an "or equal" contention will be required. The Authority may require that a presentation be made for any proposed substitution, and reserves the right to reject any such other material or equipment offered which is not approved as being in all respects equal to the named material or equipment for the work for which it is to be used. Such rejection may be for any reason, including the Authority's determination that the evaluation would result in excessive expense or manpower. Unless there is a specific statement to the contrary, Contractor understands that requests for such approval of any alternative material or equipment shall be submitted within 20 days after Contractor knew or should have known of the necessity to make the change.
- B. The Contractor is obligated to furnish all data and information, including price comparison between specified and proposed material, as the Authority in its discretion deems necessary to establish the equivalency of the alternative
material or equipment. If Contractor seeks reconsideration of any determination with respect to equivalency, the Authority shall have discretion to reconsider the matter. In the event of any reconsideration Contractor shall be obligated to pay all the Authority expenses in connection therewith.

- C. The Authority shall be the sole judge of the acceptability of items offered equivalency to that specified and may reject any item not considered as equivalency thereto. The Contractor must submit proof satisfactory to the Authority, including a non-returnable sample if requested by the Authority, that the item Contractor offers is equivalent to the material or equipment specified in quality, performance and such other characteristics as the Authority may deem relevant.
- D. The Authority will consider as evidence of equivalency an independent laboratory certification concluding that Contractor's proposed item meets or exceeds all requirements and standards, including performance criteria, or the particular brand or make of material or equipment specified by the Authority. The laboratory must be accredited by the American Association for Laboratory Accreditation or be otherwise acceptable to the Authority. If the Authority approves a request for substitution, it will issue a Change Order for new material as necessary.

45 CHANGES IN WORK

A. General.

Oral Change Orders are not permitted. Any plan or method of work, whether suggested by Contractor or the Authority or their representatives but not specified or required in writing in either the Contract or an amendment, if adopted or followed by Contractor in whole or part will be at the risk and responsibility of Contractor, and the Authority assumes no responsibility. Any unwritten approval by an Authority's representative of any modification, sample, schedule document, substitution, drawing or other matter will not impose any liability upon the Authority or relieve Contractor of any responsibilities under the Contract, including any obligation under any warranty provision, or the responsibility to deliver Rail Cars that are compliant with regulatory requirements or the Technical Specifications.

- B. Contractor Changes.
- (1) For the purpose of indicating standards, certain materials or devices are named and certain specific workmanship is described. Unless specifically indicated to the contrary, Contractor is encouraged to use his expertise to propose improvements to those stated. The improvements may take the form of new state of the art designs, concepts, new components and new systems. Improvements proposed by Contractor may suggest the substitution of other materials, devices and Work of equal grade, design and finish provided the Authority approves such substitutions as being equally suitable. Any changes in

type, quality, design or finish from that called for shall be fully explained by descriptive specifications accompanied by such detail drawings as may be necessary to enable the Authority to determine the suitability of the changes proposed.

- (2) All Contractor-proposed change in this Contract must be submitted to the Authority for written approval prior to being implemented. Contractor initiated requests for changes must be made within 20 days after Contractor knows of the issues giving rise to the request. At the Authority's request, Contractor shall provide information giving the basis for the requested change. The Contractor is liable for all costs resulting from, and/or for satisfactorily correcting, any specification change not properly ordered by written modification to the Contract and signed by the Authority.
- C. \star Authority Changes.

The Authority may direct changes to the Contract by notifying the Contractor in writing. A Change Order must be issued and executed before any Work is started on the items covered by the Change Order. Any extra Work done without a written Change Order signed by the Authority's authorized representative will be considered as unauthorized and at the sole expense of Contractor. In the event Contractor receives direction, instruction, interpretation, or determination from any source which may cause any change in the Work, Contractor shall provide written notification to the Authority before Contractor acts on the direction, instruction, interpretation, or determination.

As soon as reasonably possible but no later than ten calendar days after receipt of the written Change Order to modify the Contract, the Contractor shall submit to the Authority's Project Manager a detailed price and schedule proposal for the work to be performed as follows:

- (1) The proposal must detail all applicable direct costs, including labor and materials if possible, with the unit price and corresponding quantity if possible. The information must be in sufficient detail for the Authority to determine if the proposed costs are fair and reasonable.
- (2) Contractor agrees that in no event will the combined profit and overhead of the suppliers/Subcontractors and Contractor with respect to any Change Order work for services or labor exceed 10% above Contractor's fully burdened cost. Calculation of profit for the Change Order will be on the costs of Contractor and any subcontracted services or labor without profit and overhead of the Contractor or suppliers/subcontractors. The Contractor agrees that it will endeavor to include a provision in each subcontract which conforms to the provisions of the preceding sentence.
- (3) Equipment costs used for the Work will be reimbursable to Contractor. All receipts, vouchers and all other supporting documentation required to

substantiate the material costs shall be available for the Authority's inspection and verification.

- D. Change Orders
- (1) Modifications to Contractor's proposed prices and schedule will be executed in writing by both Parties. Modifications that increase the price to be paid to Contractor may need to be approved by the Authority's Board of Directors or executive staff and may be beyond the authority of the Project Manager. Disagreements that cannot be resolved by negotiation will be resolved in accordance with the procedures outlined in the section on Dispute Resolution. In the event of a disagreement over a Change Order, the Authority reserves the unilateral right to direct the Contractor to perform work though a Change Order that does not need to be executed by both parties. Regardless of any disputes, the Contractor shall proceed with the Work ordered and may exercise its rights to pursue a claim.
- (2) Unless properly authorized and approved by the Authority, no Change Order shall impose any liability upon the Authority, nor shall any Change Order relieve Contractor of any responsibilities under the Contract, including without limitation, the accuracy of drawing or any obligation under any warranty provision. End result must be that the Rail Car is compliant with regulatory requirements, Contract, and Technical Specification, and the Contractor is solely responsible for fulfilling this requirement.

46 EXTENSION OF TIME

- A. As a condition precedent to the granting of an Extension of Time, Contractor shall provide written notice to the Authority within ten days after the time when Contractor knows or should have known of any cause which might under reasonable foreseeable circumstances result in delay for which he may claim an Extension of Time (including those causes for which the Authority itself is responsible or of which the Authority has knowledge), specifically stating in such notice that an extension is or may be claimed; identifying such cause and describing, as fully as practicable, at that time, the nature and expected duration of the delay and its effect on the completion of that part of the Work identified in the notice. The Contractor shall not submit written notice after the Final Completion Certificate is issued. Oral notice provided by Contractor is not an acceptable notice as required by this Article.
- B. It shall in all cases be presumed that no extension, or further Extension of Time, is due unless Contractor shall affirmatively demonstrate the extent thereof to the reasonable satisfaction of the Authority. To this end, Contractor shall maintain adequate records supporting any claim for an Extension of Time, and in the absence of such records, this presumption shall be deemed conclusive.

- C. If the delivery of Rail Cars under this Contract should, as determined by the Authority, be unavoidably delayed, as provided herein, the Authority will extend the time for completion of the Contract for the determined number of days of unavoidable or excusable delay and will make appropriate revisions to the delivery schedule. A delay is unavoidable and therefore excusable only if (i) the delay arose from causes beyond Contractor's control and the delay was without his fault, and (ii) the cause of the delay neither was nor could have been anticipated by Contractor by reasonable investigation and in fact caused Contractor to miss the delivery date. An extension for a delay meets each of the conditions set forth in (i) and (ii), above, shall be granted only to the extent that (i) the completion of the affected Work is actually and necessarily delayed, and (ii) the effect of such cause cannot be anticipated and avoided or mitigated by the exercise of all reasonable precautions, efforts and measures (including planning, scheduling and rescheduling) whether before or after the occurrence of the cause of delay. The period of any extension of time shall be only that which is necessary to make up the time actually lost. Any extension may be rescinded or shortened if it subsequently is determined by the Authority that the delay can or could have been overcome or reduced by the exercise of reasonable precautions, efforts and measures.
- D. The following actions do not constitute a waiver of the Authority's right under this Contract:
- (1) Permitting Contractor to complete the Work or any part thereof after the time fixed for such delivery or after the date to which the time for such delivery may have been extended,
- (2) Making of payment to Contractor after any of such periods,
- (3) Issuing a Change Order after the completion date for performance of this Contract.
- E. In case Contractor shall be actually and necessarily delayed by reason of the failure of the Authority to deliver to Contractor any materials or facilities to be furnished by the Authority, which are actually needed for use in the Work, within ten days of occurrence, or by any act or omission on the part of the Authority, and such delay is confirmed by the Authority in writing, the time for completion of the Contract will be extended by the Authority by the amount of the time of such delay as determined by the Authority, provided the delay was not caused by Contractor's actions.
- F. Only the actual delay as determined by the Authority shall be grounds for extension of time. In case Contractor shall be delayed at any time or for any period by two or more of such causes, Contractor shall not be entitled to a separate extension for each one of the causes but only one period of extension shall be granted for the delay.

- G. In case Contractor shall be actually and necessarily delayed from one or more of such causes in the delivery of any portion of the Work, the extension of time to be granted to Contractor shall be only for such portion of the Work. The Contractor shall not be entitled by reason of such delay to an extension of time for the completion of the remainder of the Work. If Contractor shall be so delayed as to a portion of the Work he shall nevertheless proceed continuously and diligently with the prosecution of the remainder of the Work.
- H. The Contractor agrees to supply, as soon as such data are available, any reasonable proof that may be required by the Project Manager to make a decision with respect to any request for extension. If an injunction, strike or interference of public authority will or may delay the Work, Contractor shall give the Project Manager a copy of the injunction or other orders and of the papers upon which the same shall have been granted. The Authority shall be accorded the right to intervene or become a party to any suit or proceeding in which any such injunction shall be obtained and to move to resolve the same or otherwise, as the Authority may deem proper.
- I. The Project Manager within a reasonable time after submission by Contractor, will examine the request and any documents supplied by Contractor and will determine and advise Contractor in writing if Contractor is (i) entitled to an extension and the duration of such extension or (ii) if further information is required before the Authority is able to determine at this time whether an extension should be granted. Failure of the Project Manager to furnish Contractor with the foregoing advisement shall not, however, be deemed to waive the Authority's right to deny an Extension of Time. The Authority will issue at the completion of the Work in conjunction with issuing its Certificate of Final Completion a final determination on any Contractor request for an Extension of Time not theretofore determined. If Contractor disputes the Project Manager's decision, the provision of the section on Dispute Resolution shall apply.
- J. The Contractor shall have no right to rescind or terminate this Contract by reason of any delay, obstruction, or interference of any kind or duration whatsoever.
- K. Notwithstanding the above, Contractor's obligation to give such notice shall exist independently of whether any delay is claimed by Contractor and deemed by the Authority to be excusable.

47 ADDITIONAL WORK / WORK DIRECTIVE CHANGES

A. If it is impossible or impractical to ascertain the total cost of changes in the Work to be done before such Work is begun, or if no agreement can be reached on changes in the Work and additions to the Contract price, or if a situation involving changes in the Work which, if not processed expeditiously, might delay the project, then the Authority may issue a Work Directive Change instructing Contractor to do the Work, indicating expressly the intention to treat the items as changes in the Work, and setting forth the kind, character, and limits, of the Work as far as can be ascertained, the terms, under which changes to the Contract price will be determined, and the estimated resulting change in Contract Schedule. The Work Directive Change will be executed by the Authority and transmitted to Contractor before any Work is started on the items covered by the order. Such Work Directive Change will become the basis for a Change Order when the amount of adjustment to the Contract Price and/or Schedule can be determined. The prior approval of the Work Directive Change will be sufficient authority for the Change Order within the limits of the estimated change in Contact Price. Without additional authority, no costs exceeding the estimated amount will be paid.

- B. The Contractor shall maintain such records as the Authority deems sufficient to distinguish the direct cost of other operations and shall furnish daily, on forms approved by the Authority, reports of cost-plus or time and materials work. The reports shall itemize all costs for labor, materials, and equipment rental and give total of costs to date for the Work. For workers, the reports shall include hours worked, rates of pay, names and classifications, for equipment, the reports shall include size, type, identification number, rental rate, and hours of operation. All records and reports shall be made immediately available to the Authority's Project Manager under his request. The cost of furnishing such reports shall be included in Contractor's overhead and fee percentages.
- C. All cost reports shall be signed by Contractor or his representative and signed by the Engineer. The Authority's Project Manager will compare its records with Contractor's reports, make the necessary adjustments, and compile the costs of the Work. When such reports are agreed upon and signed by both parties, they will become the basis of payment.
- D. Materials cost shall be the cost of all materials purchased by Contractor and used in the Work and shall be the actual cost of such materials, including sales taxes, freight, and delivery charges. The Authority's Project Manager reserves the right to approve materials and sources of supply of materials furnished by Contractor, or if necessary to facilitate the progress of the Work, to furnish the materials to Contractor.
- E. Materials, equipment rental, and other costs shall be substantiated by vendors' invoices submitted with the current reports; or, if not then available, shall be submitted with a subsequent report. If vendor's invoices are not submitted within 30 days after completion of the Work, or if in the opinion of the Authority's Project Manager the cost of materials is excessive, then the cost of such items shall be deemed to be the lowest current wholesale prices at which the items are available in the quantities required, less cash or trade discounts.

- F. Labor costs shall be based on the actual wage rate for each craft or type of workman in this Contract. Cost of payroll taxes and insurance, health and welfare, pension and vacation are allowable. While no percentage will be allowed thereon for overhead or profit, Contractor's fee will be allowed on such items in any Subcontractor's proposal.
- G. Allowances not to exceed the following percentage fees for the party performing the Work based upon the cost of labor, material, and use of equipment required to perform the Work:
- (1) 10% overhead and 10% profit on the first \$20,000
- (2) 7-1/2% overhead and 71/2 % profit on the next \$30,000
- (3) 5% overhead and 5% profit on the balance over \$50,000.
- H. No percentage fee will be paid to Contractor for any material furnished by the Authority. In the event that Contractor's or Subcontractor's portions of a change involve credit items, the party performing the Work shall deduct such credits prior to calculating overhead and profit.

48 VARIABLE QUANTITIES

With respect to any unit price item as to which an estimated quantity is set forth in the Price Schedule including Option items in the Price Schedule, such unit price shall apply regardless of the actual quantity of such item ultimately utilized in, or required by, the Work; except that, if the actual quantity for a unit price of an item differs from the estimated quantity in the Price Schedule by more than 20%, then the Project Manager will review whether application of the Unit Price would cause a substantial inequity to either party, and, if so, the unit price for such item will be equitably adjusted, upward or downward, as determined by the Project Manager.

49 VALUE ENGINEERING CHANGE PROPOSALS

- A. The Contractor may submit to the Authority, in writing, Value Engineering Change Proposals (VECP) for modifying the plans, Scope of Work or other requirements of the Contract for the purpose of reducing the total cost of purchase and/or operations/maintenance and/or improving the quality of the product. The VECP shall not impair, in any manner, the essential functions or characteristic of the project, including, but not limited to safety and design standards, service life, economy of operation, ease of maintenance or desired appearance. Value Engineering Change Proposals shall not be based solely upon a change to the required quantities shown in the Contract.
- B. Value Engineering Change Proposals shall contain the following information:
- (1) Description of the existing contract requirements which are involved in the value engineering proposal.

- (2) Description and justification of the proposal.
- (3) An itemization of the contract requirements that must be changed if the proposal is adopted.
- (4) A detailed estimate of the cost of performing the Work under the existing contract and under the proposed change.
- (5) A detailed estimate of additional costs to the Project attributable to the proposal on their build, revenue operation, and maintenance of the project.
- (6) A statement of the time within which the Authority must make a decision thereon.
- (7) The contract items of Work affected by the proposed changes, including any quantity variation attributable thereto.
- C. If a VECP is accepted by the Authority, the Total Contract Price shall be adjusted based upon a sharing of the net savings by Contractor and the Authority (50% the Authority, 50% Contractor).
- (1) Net savings are defined as gross savings less Contractor's costs and less the Authority's costs.
- (2) Estimated gross savings to Contractor means the difference between the cost of performing the Work according to the existing requirements and the cost to perform the Work according to the proposed change. In each instance, Contactor's profit shall not be considered part of the cost.
- (3) Contractor costs mean reasonable costs incurred by Contractor in preparing the VECP and making the change, such as cancellation or restocking charges.
- (4) The Authority's costs means reasonable costs incurred by the Authority and its consultants for evaluating and implementing the change, such as testing, redesign, and effect on other portions of the Work.
- (5) Contractor is not entitled to share in concurrent, collateral, or future contract savings. Collateral savings are those measurable net reductions in the Authority's cost of operation that may result from the VECP, including, but not limited to, maintenance and logistics. Concurrent savings cover reductions in the cost of performance of other contracts or purchase orders Contractor is participating in for services or goods for the Authority.
- (6) Contractor's profit shall not be reduced by application of the VECP.
- D. The provisions of this section shall not be construed to require the Authority to consider any VECP which may be submitted.

- E. The Authority will not be liable to Contractor for failure to accept or act upon any value engineering proposal nor for any delays to the Work attributable to any such proposal. The Contractor shall continue to perform the Work in accordance with the requirements of the Contract until an executed Change Order, incorporating the value engineering change has been issued. If any executed Change Order has not been issued by the date upon which Contractor's VECP specifies that a decision thereon should be made, or such other date as Contractor may subsequently have specified in writing, such VECP shall be deemed rejected.
- F. The Authority shall be the sole judge of the acceptability of a VECP. The Authority reserves the right where it deems such action appropriate and to require Contractor to share in the Authority's costs of investigating a VECP submitted by Contractor as a condition of considering such proposal. Where such a condition is imposed Contractor shall indicate his acceptance in writing and such acceptance shall constitute full authority for the Authority to deduct the amount payable from any monies due or that may become due to Contractor under the Contract.
- G. If Contractor's VECP is accepted in whole or in part, such acceptance will be by a Contract Change Order, which will specifically state that it is executed pursuant to a VECP. Such Change Order will incorporate the changes in the plans and specifications which are necessary to permit the VECP or such parts of it as has been accepted to be put into effect, and will include any conditions upon which the Authority approval thereof is based if the approval of the Authority is conditional. The Change Order will also specify how any cost savings attributed to the VECP will be allocated as between Contractor and the Authority.
- H. Acceptance of the VECP and performance of the Work thereunder shall not extend the time of completion of the Contract unless specifically provided for in the Contract Change Order authorizing the use of the proposal.
- I. The amount, if any, specified to be paid to Contractor, in the Change Order, which effectuates a VECP will constitute full compensation to Contractor for the proposal and the performance of the Work thereof pursuant to the said Change Order.

50 DISPUTE RESOLUTION

- A. Contractor Claims.
- (1) The Contractor shall be solely responsible for providing timely written notice to the Authority of any claims for additional compensation and/or time in accordance with the provisions of this Contract. It is the Authority's intent to investigate and attempt to resolve any Contractor claims before the Contractor has performed any disputed work.

- Claims by the Contractor disputing the meaning and intent of this Contract or (2) arising from performance of this Contract shall be referred in writing to the Authority's Project Manager for a written decision. Except for claims that result from a disagreement over a proposed Change Order, all such claims must be filed within twenty days after Contractor knows of the issues giving rise to the claim, and must be accompanied by written documentation substantiating the reasons for which the Contractor believes additional compensation may be due, the nature of the costs involved, and the amount of the potential claim. Claims resulting from a disagreement over a proposed Change Order must be filed with twenty days of the documented failure to resolve any disagreement. The Authority's Project Manager will respond to the Contractor in writing with a decision within twenty calendar days following receipt of the Contractor's claim. Unless agreed to otherwise by the Authority, failure to provide timely notice as described in this paragraph will constitute a waiver of Contractor's claims for additional compensation and/or time.
- (3) The Contractor will not be entitled to the payment of any additional compensation for any cause, including any act, or failure to act, by the Authority, or the failure or refusal to issue a modification, or the happening of any event, thing, or occurrence, unless it has given the Authority due written notice of the claim as set forth above.
- B. Appeal of Project Manager Decision.
- If the Contractor disagrees with any determination or decision of the Authority's (1) Project Manager, the Contractor shall within 15 calendar days of the date of such determination or decision, appeal the determination or decision in writing to the Chief Executive Officer of the Authority. Such written appeal shall include all documents and other information necessary to substantiate the dispute or claim. The Chief Executive Officer of the Authority will review the dispute or claim and meet with a designated representative of Contractor. Both shall use their best efforts to settle such dispute or difference within 30 calendar days from the receipt of the dispute or claim. To this end, Chief Executive Officer of the Authority and Contractor shall consult and negotiate with each other in good faith to reach a just and equitable solution within a reasonable time, and if the dispute or difference cannot be satisfactorily so settled, it shall be resolved by alternative dispute resolution upon written request of either Party. Submission of a dispute or claim to the Chief Executive Officer of the Authority shall be a condition precedent to any alternative dispute resolution under this Contract. The Chief Executive Officer of the Authority may, at his or her discretion, extend the time period for response to the Contractor specified in this Section.
- C. Alternative Dispute Resolution.

Any claim or controversy concerning the interpretation, application, or implementation of this Contract between the Authority and Contractor which cannot be resolved

through the efforts described above, may, by specific agreement of the Parties, be submitted to alternative dispute resolution (that is, mediation or arbitration) with the parameters for such dispute resolution being agreed to by the Parties at the time. Each Party will bear the costs and expenses incurred by it in connection with such alternative dispute resolution processes. The cost of any independent decision maker will be shared equally between the Parties. If a dispute is not resolved through discussion or the Parties do not agree to alternative dispute resolution, either Party may pursue available legal remedies in a California State or Federal court of competent jurisdiction. Contractor must file a government claim pursuant to Government Code section 910 et seq. in order to initiate a civil action.

- D. Any matter that is subject to the express sole discretion of either Party to this Contract will not be subject to the dispute resolution process described in this Section.
- E. Pending final decision of a dispute the Contractor shall proceed diligently with the performance of the Contract and the question or claim will be temporarily resolved in accordance with the decision of the Chief Executive Officer of the Authority, until final resolution of the question or claim.

51 **★**SUSPENSION

- A. The Authority may at any time and for any reason within its sole discretion issue a written order to the Contractor suspending, delaying or interrupting all or any part of the Work for a specified period of time. If any suspension is a full suspension of all the Work, and such suspension reaches 30 days, Contractor may terminate this Contract upon written notice to the Authority and without Contractor incurring any liability to the Authority.
- B. The Contractor shall comply immediately with any such written order and take all reasonable steps to minimize costs allocable to the Work covered by the suspension during the period of Work stoppage. Contractor must continue the Work that is not included in the suspension and will continue such ancillary activities as are not suspended. The Contractor shall resume performance of the suspended Work upon expiration of the notice of suspension, or upon direction from the Authority.
- C. The Contractor will be allowed an equitable adjustment in the contract price and/or an extension of the Contract time, as a result of any suspension. However, no adjustment will be made under this section for any suspension, delay or interruption due to the negligence of the Contractor, or for which an equitable adjustment is otherwise provided for, or excluded under any other term or condition of the Contract. As soon as reasonably possible but no later than forty-five (45) calendar days, or any other period of time agreed to by the Parties, after receipt of the written suspension of work notice, the Contractor

shall submit to the Authority a detailed price and schedule proposal for the suspension, delay or interruption.

52 **★**CLAIMS

- A. Questions regarding the meaning and intent of the Contract or claims for cost or time impacts arising from this Contact shall be referred by Contractor in writing to the Authority's Project Manager for decision within 30 days of the date in which Contractor knows or should have known the question or claim. If Contractor believes that the act or omission by the Authority caused an increase to the cost of the Work or the time required for the Work, Contractor shall submit a detailed description of the basis for the claim and complete supporting documentation for cost and time increases to the Authority within twenty days of the initial notice of claim. This obligation applies to all claims of Contractor against the Authority, including without limitation, Contractor's pass-through claims that may arise by virtue of claims Subcontractors or Suppliers have against Contractor.
- B. Failure by Contractor to either timely file or document a claim constitutes a complete waiver of Contractor's right thereafter to pursue that claim in any forum. Pending final decision of a dispute hereunder, Contractor shall proceed diligently with the performance of the Contract and in accordance with the direction of the Authority.
- C. The Contractor shall make the obligations of this provision applicable to Contracts entered into with all of its Subcontractors and Suppliers; all Subcontractors and Suppliers of all tiers shall make the obligations of this provision applicable to all of its Subcontractors.
- D. Nothing in this Contract shall be interpreted to preclude the Authority from independently exercising all lawful remedies available to it.

53 CLAIMS OF THIRD PERSONS

- A. The Contractor shall pay all claims by subcontractors, suppliers, workers, and third persons, arising out of or in connection with Contractor's performance under this Contract, provided that such claims
- (1) Are undisputed by Contractor; or
- (2) Have been ordered by a court of competent jurisdiction.
- B. Contractor will require all subcontractors to pay all such claims, under the same circumstances.

54 **★ TERMINATION OF CONTRACT**

A. Termination for Default

- (1) If Contractor fails to perform any of the provisions of this Contract after ten days of its receipt of written notice from the Authority requiring performance, the Authority may find Contractor to be in partial or complete default. If Contractor does not cure such default within 30 days after receipt of written notification that such failure has occurred, or provide a plan to cure such default which is reasonably acceptable to the Authority within the time specified by the Authority, then the Authority may, in its discretion, terminate this Contract, in whole or in part, on the basis of Contractor's default of this Contract.
- (2) The term "default" for purposes of this Section includes, but is not limited to: the performance of the Work in violation of the terms of the Contract; abandonment, assignment or subletting of the Contract without approval of the Authority; filing a petition for bankruptcy by or against the Contractor or appointment of a receiver for Contractor's property; initiation of a federal or state proceeding for relief of debtors by or against Contractor; failure of the Contractor to perform its obligations under the Contract Documents (including but not limited to use of materials, supplies, plant, or equipment of quality or quantity below the requirements in the Contract Documents; failure to perform its obligations under the time specified therein; or the performance of the Contract in bad faith.
- (3) If the Contract is terminated in whole or in part for default, the Authority may procure, upon such terms and in such manner as the Authority may deem appropriate, services similar to those so terminated. Without in any way affecting the Authority's rights under the Performance Guaranty, the Contractor may be liable to the Authority for any reasonable costs or expenses incurred by the Authority in reprocuring elsewhere similar Rail Cars or services.
- (4) If, after notice of termination of this Contract under the provisions of this clause, it is determined for any reason that the Contractor was not in default under the provisions of this clause, or that the default was excusable under the provisions of this clause, the rights and obligations of the Parties will be the same as if the notice of termination had been issued pursuant to termination for convenience of the Authority.
- (5) All finished documents and any completed Rail Cars produced pursuant to this Contract will become the property of the Authority upon the effective date of such termination for default.
- B. Termination for Convenience.
- (1) The Authority may terminate this Contract for convenience, including for nonavailability of funds, in whole or in part, upon 30 calendar days' notice sent by certified mail, return receipt requested, to the Contractor, provided, however, that such termination may be exercised only prior to the scheduled delivery date

of any Rail Car. If the Authority terminates this Contract for convenience, the Contractor shall:

- a. Stop work under the Contract on the date and to the extent specified in the notice of termination.
- b. Place no further orders or subcontracts for materials, services, or facilities except as may be necessary for completion of such portion of the Work under the Contract as is not terminated.
- c. Terminate all orders and subcontracts to the extent that they relate to the performance of Work terminated by the notice of termination.
- d. Settle all outstanding liabilities and all claims arising out of such termination or orders and subcontracts, with the approval or ratification of the Authority, to the extent that may be required, which approval or ratification will be final for all the purposes of this Section.
- e. Use its best efforts to sell, reuse, or scrap, in the manner, at the times, to the extent, and at the prices directed or authorized by the Authority, any property of the types referred to above, provided however, that the Contractor will not be required to extend credit to any purchaser, and may acquire any such property under the conditions prescribed by and at a prices approved by the Authority. The value of any reuse or scrap, or proceeds of any such transfer or disposition will be applied in reduction of any payments to be made by the Authority to the Contractor under this Contract or will otherwise be credited to the price or cost of the work covered by this Contract or paid in such other manner as the Authority may direct.
- f. Complete performance of such part of the Work as will not have been terminated by the notice of termination.
- (2) In the event of termination for convenience, the Contractor will be paid all sums actually due and owing for all services performed and all expenses incurred up to the day written notice of termination is given, plus any costs reasonably and necessarily incurred by Contractor to effect such termination in addition to a termination fee equal to ten percent (10%) of the unpaid balance of this Contract (including the Option). Thereafter, Contractor shall not be entitled to make any claim against the Authority in connection with this Contract. All finished documents and completed Rail Cars produced pursuant to this Contract will become the property of the Authority upon the effective date of such termination for convenience.
- (3) In the event of termination for convenience, Contractor, and its Subcontractors, shall provide reasonable and good faith cooperation in any transition to other vendors or contractors as the Authority may determine necessary.

C. Contractor Responsibility for Subcontracts.

If this Contract is terminated, the Authority will have no liability or responsibility for leases or contractual agreements entered into by the Contractor for performance of the Contractor's responsibilities under this Contract, except as provided in this Section.

55 CORRESPONDENCE TRACKING

The Authority has established a method of numbering all correspondence sequentially between Contractor and the Authority. This method of numbering correspondence and maintaining corresponding tracking reports, will be provided to Contractor after the Contract Award. The reports shall indicate the status of all correspondence and shall be in a form acceptable to the Authority.

56 **★**AUDIT AND INSPECTION OF RECORDS

A. Establishment and Maintenance of Information

The Contractor agrees to establish and maintain accurate, detailed, and complete books, accounts, financial records, documentation, and other evidence pertaining to: i) the performance of the Work under this Contract, and ii) the receipt and expenditure of all funds received under this Contract. The Contractor shall also maintain the financial information and data used in preparation or support of the cost submission for any negotiated Contract amendment or Change Order under this Contract. The Contractor shall establish and maintain all such information in accordance with generally accepted accounting principles and practices and shall retain intact all such information until the latest of:

- (1) complete performance of this Contract; or
- (2) six years following the end of the term of this Contract; or
- (3) if any litigation, claim, or audit is commenced during either such period, when all such litigation, claims or audits have been resolved.
- B. Access to Data and Other Information; Audits
- (1) Upon reasonable prior notice, the Authority or its representatives, as well as representatives of the California Air Resources Board, the South Coast Air Quality Management District, and the Federal Transit Administration, shall have access to all Contractor data under this Contract and Contractor shall cooperate with the Authority's reasonable requests for access to the data for the purpose of inspection, audit, and copying. The Contractor agrees to maintain the data in convenient formats reasonably requested by the Authority and to provide reasonable facilities for access, inspection, audit, and copying. For the Authority to determine whether the Contractor has complied with the requirements under this Section, the Contractor shall, at any time when requested, submit to the Authority properly authenticated documents or other satisfactory proof as to the

Contractor's compliance with such requirements. The term "data" for the purposes of this Section includes all information and records collected, created, received, maintained, or disseminated by the Contractor in connection with this Contract and in the performance of the Work under this Contract, regardless of physical form, storage media, or conditions of use.

(2) Within 30 calendar days after completion, the Contractor shall deliver to the Authority a copy of any audit of the Contractor done by the Contractor or at its request or at the direction of any governmental agency or department which relate to the performance of the Work under this Contract.

57 CONFLICT OF INTEREST

- A. In addition to those direct conflicts of interest discussed and prohibited in the RFP, Contractor shall take all reasonable measures to preclude the existence or development of an organizational conflict of interest in connection with Work performed under this Contract. An organizational conflict of interest occurs when, due to other activities, relationships, or contracts, a firm or person is unable, or potentially unable, to render impartial assistance or advice to the Authority. Contractor shall not engage the services of any Subcontractor or consultant on any Work related to this Contract if the Subcontractor or apparent organizational conflict of interest related to Work or services contemplated under this Contract.
- B. If during the term of this Contract Contractor becomes aware of an organizational conflict of interest in connection with the Work, Contractor immediately shall provide the Authority with written notice of the facts and circumstances giving rise to this organizational conflict of interest and proposed alternatives for addressing or eliminating the organizational conflict of interest. The Authority will consider the conflict presented and the alternatives proposed and meet with the Contractor to determine an appropriate course of action. The Authority's determination will be final.
- C. During the term of this Contract, Contractor must maintain lists of its employees, and the Subcontractors and consultants used and their employees. Subject to applicable laws and confidentiality agreements that restrict disclosure, Contractor shall provide relevant information to the Authority upon request to address conflict of interest concerns.

58 **★**PUBLICITY

Contractor, it's employees, subcontractors, and agents, may not use any logos, images, or photographs of the Authority for any commercial purpose, including advertising, promotion, or public relations, without the prior written consent of the Authority, but written consent will not be required for the inclusion of the Authority's name on a customer list.

59 CONFIDENTIALITY

- A. All materials to which either Party has access or materials prepared by either Party during the course of this Contract ("Confidential Information") shall be held in confidence by the Parties, who shall exercise all reasonable precautions to prevent the disclosure of Confidential Information to anyone except the officers, employees and agents of the receiving Party as necessary to effect the purpose of this Contract.
- B. Neither Party shall release any reports, information or promotional materials prepared in connection with this Contract, whether deemed confidential or not, to any third party without the approval of the disclosing Party.
- C. Confidentiality obligations hereunder will not apply to any portion of the Confidential Information which:
- (1) has become a matter of public knowledge other than through an act or omission of the receiving Party;
- (2) has been made known to the receiving Party by a third party in accordance with such third party's legal rights without any restriction on disclosure;
- (3) was in the possession of the receiving Party prior to the disclosure of such Information by the disclosing Party and was not acquired directly or indirectly from any person or entity in a relationship of trust and confidence with the disclosing Party with respect to such Information; or
- (4) the receiving Party is required by law to disclose, however, before disclosing the information, the receiving Party will provide the disclosing party with sufficient notice to allow the disclosing party the opportunity to seek a stay of the disclosure.

60 **★**PUBLIC RECORDS ACT

- A. All records, documents, drawings, plans, specifications and other material relating to conduct of the Authority's business, including materials submitted by Contractor in its Proposal and during the course of performing the Work under this Contract, shall become the exclusive property of the Authority and may be deemed public records. Said materials may be subject to the provisions of the California Public Records Act. The Authority's use and disclosure of its records are governed by this Act.
- B. Contractor may designate material submitted to the Authority as "Trade Secret" or "Proprietary" and request that the Authority not disclose such information to the public. If the Authority agrees not to disclose such information, Contractor assumes all responsibility for any challenges resulting from the non-disclosure, and will indemnify and hold harmless the Authority from and against all damages

(including but not limited to attorneys' fees that may be awarded to the party requesting the Contractor's information), and pay all costs and expenses related to the withholding of Contractor's information. Contractor shall not make a claim, sue, or maintain any legal action against the Authority or its member agencies, directors, officers, employees, or agents concerning the withholding from disclosure of Contractor information.

61 HAZARDOUS AND NON-HAZARDOUS CHEMICALS AND WASTES

- Α. Contractor shall bear full and exclusive responsibility for any release of hazardous or non-hazardous chemicals or substances at any of Contractorowned facilities during the course of performance of this Contract except to the extent that any such releases are caused by the negligence, omission or misconduct of the Authority or any of its employees, agents, contractors, representatives, or any other party that is accountable directly to the Authority or for whom the Authority is responsible. The Contractor shall be solely responsible for all claims and expenses associated with the response to, removal and remediation of such release at any Contractor-owned facilities, including, without limit, payment of any fines or penalties levied against the Authority by any agency as a result of such release and will hold harmless, indemnify and defend the Authority from any claims arising from such release. For purposes of this Section only, the term "claims" will include (i) all notices, orders, directives, administrative or judicial proceedings, fines, penalties, fees or charges imposed by any governmental agency with jurisdiction, and (ii) any claim, cause of action, or administrative or judicial proceeding brought against the Authority, its member agencies, their directors, or employees, or for any loss, cost (including reasonable attorney's fees), damage or liability, sustained or suffered by any person or entity, including the Authority. This indemnification shall survive the termination of the Contract.
- B. If the performance of the Work outlined in the Contract Scope of Work creates any hazardous wastes at any Contractor-owned facility, those wastes shall be properly disposed of according to federal, state, and local laws, at the expense of Contractor. The Contractor shall dispose of the wastes under its own EPA Generator Number. In no event shall the Authority be identified as the generator. The Contractor shall notify the Authority of any such hazardous wastes relevant to the production of the Rail Cars.

62 *****TECHNOLOGY AND INTELLECTUAL PROPERTY RIGHTS

A. Development and Deliverables.

Contractor represents and warrants that all Contractor-developed software:

(1) has been developed or will be developed in conformance with those standard industry interfaces and protocols specified by the Authority to permit

interchangeability of Contractor-provided systems, subsystems, assemblies, subassemblies, and components;

- (2) is capable of maintenance, modification, and upgrades in accordance with conventional and industry software standards and practices; and
- (3) utilizes conventional command sequence and structure.
- B. Contractor shall not incorporate or deliver any Third Party Software in or as part of the Software without express prior written informed consent from the Authority. If Contractor wishes to incorporate or delivery any Third Party Software in or as part of the Software, Contractor shall notify the Authority of this intent along with any information appropriate, desirable, or necessary for the Authority to consider the request. Notwithstanding the foregoing, the Authority recognizes that Contractor has or may have incorporated Third Party Software into Contractor provided systems, subsystems, or components, but that successful use of such already existing Third Party Software has been proven. Such existing use of Third Party Software shall be considered as preapproved by the Authority.
- C. Contractor shall furnish to the Authority the documentation listed in this Section, in compliance with any requirements as to form, format, or media set forth in the Technical Specification, promptly as each such document reaches final form and in any event no later than delivery of the last Rail Car in the Base Order; and Contractor shall furnish to the Authority any new, modified, or updated versions of such documentation promptly as such documentation becomes available. The copies of documentation to be delivered to the Authority by Contractor are the property of the Authority. Contractor reserves ownership rights for all technology and intellectual property embodied and expressed in the documentation, and the Authority agrees to protect the confidentiality and proprietary nature of such technology and intellectual property with at least the reasonable precaution that the Authority would use to protect its own technology and intellectual property:
- (1) documentation relating to Contractor Software reasonably necessary or desirable for the Authority's Licensed Uses, including without limitation: user manuals, systems manuals, training manuals, and other such guides; logic diagrams; programmer's notes; flow-charts; algorithms; development tools and platforms, and data identifying source, functional characteristics, and performance requirements.
- (2) documentation relating to any input/output protocols and operating parameters for all microprocessor-based control systems in or used with the Rail Cars, including without limitation a complete list of all commands and operating parameters generated by electronic input devices (such as manual controls, sensors, and test equipment used with the system) and responses generated by

the controller to such devices, directives and responses sent between controllers, and the output to the controlled system; and

- (3) documentation relating to the form, fit, and function of all systems, subsystems, assemblies, subassemblies, or components thereof in or relating to the Rail Cars, including without limitation: as-built drawings; parts lists; schematics and diagrams; data relating to items, components, or processes sufficient to enable physical and functional interchangeability; data identifying source, size, configuration, mating, and attachment characteristics; and performance requirements.
- D. Notwithstanding any warranties and representations provided elsewhere in this Contract, Contractor assumes no responsibility for defects, failures, or inadequate operations of any Rail Cars caused in whole or in part by the Authority-initiated modifications.
- E. Licenses.

Contractor hereby grants to the Authority a non-exclusive, limited, royalty-free perpetual license to use the software executable delivered to the Authority with or on the Rail Cars, including, but not limited to, any embedded controls, display, or diagnostic software executable, that is stored in any format on any device or media (the "<u>Embedded Software</u>"), solely for the purpose of operation and maintenance of the Rail Cars. The Authority acknowledges that, as between the Authority and Contractor, and except as expressly stated, Contractor is the sole owner of all right, title, and interest in and to the Embedded Software, including, without limitation, all intellectual property rights related to the Embedded Software. The Authority will not, and it will ensure that no other persons or entities will, modify, decompile, reverse engineer, disassemble, rent, lease, loan, transfer, or reduce to human-readable form any of the Embedded Software.

All rights and licenses granted under or pursuant to this Contract are and will be deemed to be, for purposes of Section 365(n) of the U.S. Bankruptcy Code, licenses of rights to "intellectual property," as defined under Section 101 of the U.S. Bankruptcy Code (or any successor or amended statutory provision). The parties agree that the Authority, as a licensee of such rights under this Contract, will retain and may fully exercise all of its rights and elections under the U.S. Bankruptcy Code; however, nothing herein will be deemed to constitute a present exercise of such rights and elections.

63 SOURCE CODE

Contractor shall provide a machine-readable copy of all source code, installers, and executable files for all software Contractor develops for the Authority pursuant tothis Contract. The machine readable files provided shall contain all the data required to enable the Authority to restore, modify or delete any displays, reports, and interfaces to other systems. The Authority acknowledges and agrees that if it modifies any source code, installers, or executable files for

all Contractor Software, any such modification may void all warranties provided by Contractor under this Contract.

64 TOOLING RIGHTS

The Contractor, its Subcontractors, Suppliers and Manufacturers shall not sell destroy, or otherwise dispose of their rights to the use of, the castings, patterns, and forming or extrusion dies after their use in the manufacture of the Rail Cars without first offering them to the Authority, at a fair market price.

The terms "sell" and "sale" do not include transfer of these assets to a successor corporation or other entity which assumes the business and obligations of any Contractor, Subcontractor, Supplier, or Manufacturer herein, including obligations arising under this Contract.

Upon the Authority's refusal of Contractor's offer of any of the rights described in this Section, Contractor's obligation under this Section will cease.

65 SAFETY AND CLEANLINESS

- A. The Contractor and Contractor's employees, prior to performing Work at the Authority's facilities, shall attend the Authority's safety training program.
- B. The Contractor shall, when at the Authority's Facilities, in the furnishing of services hereunder, exercise every precaution to prevent injury to person or damage to property and avoid inconvenience to the occupants of or any visitors to the Facilities. The Contractor shall, without limiting the generality hereof, place such personnel, erect such barricades and railings, give such warnings, display such lights, signals or signs, place such cones and exercise precautions as may be necessary, proper or desirable.
- C. The Contractor shall in case of unsafe floor conditions due to construction, wetness, spillage, sickness, and all other types of hazardous conditions proceed to rope off the unsafe area and place appropriate warning signs to prevent accidents from occurring. The Contractor shall clean said area to the satisfaction of the Project Manager.
- D. The Contractor shall at all times maintain in a clean and orderly condition and appearance all facilities provided by the Authority for Contractor's operations, and all fixtures, sink closets, equipment, and other personal property of the Authority which are located in said facilities.
- E. The Contractor, when working at any the Authority facility shall conduct its operations consistent with the Authority's requirements so as not to endanger, interfere with, or delay the operations or activities of any other contractors or any other occupants. The Contractor shall use the same degree of care in performance on the premises as would be required by the policies, procedures and practices of the Authority and shall conduct operations hereunder in a courteous, efficient and safe manner.

F. The Contractor, when working at the Authority's facilities, shall provide such equipment as may be necessary to supply first aid service in case of accidents to its personnel who may be injured in the furnishing of service hereunder. The Contractor shall maintain standing arrangements for the transportation and hospital treatment of any of its personnel who may be injured.

66 TRACK AND SITEWORK COORDINATION AND ACCESS

Contractor shall coordinate, under the Authority's direction, and at all times fully cooperate with any other entity or individual performing work on the Authority property, including, but not limited to, maintenance of tracks, signals, or structures, or construction of track, signals, structures, stations, or other facilities by any of the Authority's contractors or other third party contractors authorized to work on the Authority's property. Contractor shall not seek reimbursement from the Authority for any costs incurred by Contractor to meet the requirements of this section.

The Authority will provide the Contractor the necessary access to its property as necessary for and to be used in provision of the Work.

67 **★**FEDERAL TRANSIT ADMINISTRATION REQUIREMENTS

This Contract may be subject to one or more financial assistance agreements between the Authority and the U.S. Department of Transportation, which agreements incorporate FTA Master Agreement and Circular 4220.1F, current as of the effective date of any such financial assistance agreement. Contractor and its Subcontractors shall comply with all federal laws and regulations identified in FTA Circular 4220.1F or any subsequent version of FTA Circular 4220.1F, and/or the most current version of the FTA Master Agreement. Contractor shall not perform any act, fail to perform any act, or refuse to comply with any the Authority requests that would cause the Contractor and/or the Authority to be in violation of any such federal laws or regulations and/or any of the terms and conditions of the FTA Master Agreement. Any such federal law or regulation, or term and condition of the FTA Master Agreement, shall be deemed to control in the event of a conflict with any other provision of this Agreement. Contractor will shall require lower tier Subcontractors to comply with any federal laws and regulations necessary to assure the Contractor's and/or the Authority's full compliance with any of the federal laws or regulations identified in FTA Circular 4220.1F and/or any of the terms and conditions of the FTA Master Agreement, as they apply at the time of execution of the Contract or as they may be modified from time to time. The following federal requirements will apply:

- A. Access to Records.
- (1) In accordance with 49 C. F. R. 18.36(i), the Contractor agrees to provide the Purchaser, the FTA Administrator, the Comptroller General of the United States or any of their authorized representatives access to any books, documents, papers and records of the Contractor which are directly pertinent to this contract for the purposes of making audits, examinations, excerpts and transcriptions. Contractor also agrees, pursuant to 49 C. F. R. 633.17 to provide the FTA

Administrator or his authorized representatives including any PMO Contractor access to Contractor's records and construction sites pertaining to a major capital project, defined at 49 U.S.C. 5302(a)1, which is receiving federal financial assistance through the programs described at 49 U.S.C. 5307, 5309 or 5311.

- (2) The Contractor agrees to permit any of the foregoing parties to reproduce by any means whatsoever or to copy excerpts and transcriptions as reasonably needed.
- (3) The Contractor agrees to maintain all books, records, accounts and reports required under this contract for a period of not less than three years after the date of termination or expiration of this contract, except in the event of litigation or settlement of claims arising from the performance of this contract, in which case Contractor agrees to maintain same until the Purchaser, the FTA Administrator, the Comptroller General, or any of their duly authorized representatives, have disposed of all such litigation, appeals, claims or exceptions related thereto. Reference 49 CFR 18.39(i)(11).
- B. ★ Federal Energy Conservation Requirements.

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

C. ★Civil Rights Requirements.

Civil Rights - The following requirements apply to the underlying contract:

- (1) Nondiscrimination In accordance with Title VI of the Civil Rights Act, as amended, 42 U.S.C. § 2000d, section 303 of the Age Discrimination Act of 1975, as amended, 42 U.S.C. § 6102, section 202 of the Americans with Disabilities Act of 1990, 42 U.S.C. § 12132, and Federal transit law at 49 U.S.C. § 5332, the Contractor agrees that it shall not discriminate against any employee or applicant for employment because of race, color, creed, national origin, sex, age, or disability. In addition, the Contractor agrees to comply with applicable Federal implementing regulations and other implementing requirements FTA may issue.
- (2) Equal Employment Opportunity The following equal employment opportunity requirements apply to the underlying contract:
- Race, Color, Creed, National Origin, Sex In accordance with Title VII of the Civil Rights Act, as amended, 42 U.S.C. § 2000e, and Federal transit laws at 49 U.S.C. § 5332, the Contractor agrees to comply with all applicable equal employment opportunity requirements of U.S. Department of Labor (U.S. DOL) regulations, "Office of Federal Contract Compliance Programs, Equal Employment Opportunity, Department of Labor," 41 C.F.R. Parts 60 et seq., (which implement Executive Order No. 11246, "Equal Employment Opportunity," as amended by Executive Order No. 11375, "Amending Executive Order 11246 Relating to Equal

Employment Opportunity," 42 U.S.C. § 2000e note), and with any applicable Federal statutes, executive orders, regulations, and Federal policies that may in the future affect construction activities undertaken in the course of the Project. The Contractor agrees to take affirmative action to ensure that applicants are employed, and that employees are treated during employment, without regard to their race, color, creed, national origin, sex, or age. Such action shall include, but not be limited to, the following: employment, upgrading, demotion or transfer, recruitment or recruitment advertising, layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. In addition, the Contractor agrees to comply with any implementing requirements FTA may issue.

- (4) Age. In accordance with section 4 of the Age Discrimination in Employment Act of 1967, as amended, 29 U.S.C. §§ 623 and Federal transit law at 49 U.S.C. § 5332, the Contractor agrees to refrain from discrimination against present and prospective employees for reason of age. In addition, the Contractor agrees to comply with any implementing requirements FTA may issue.
- (5) Disabilities In accordance with section 102 of the Americans with Disabilities Act, as amended, 42 U.S.C. § 12112, the Contractor agrees that it shall comply with the requirements of U.S. Equal Employment Opportunity Commission, "Regulations to Implement the Equal Employment Provisions of the Americans with Disabilities Act," 29 C.F.R. Part 1630, pertaining to employment of persons with disabilities. In addition, the Contractor agrees to comply with any implementing requirements FTA may issue.
- D. 73.4.2 The Contractor also agrees to include these requirements in each subcontract financed in whole or in part with Federal assistance provided by FTA, modified only if necessary to identify the affected parties.
- E. **★**No Government Obligation to Third Parties.
- (1) The Purchaser and Contractor acknowledge and agree that, notwithstanding any concurrence by the Federal Government in or approval of the solicitation or award of the underlying contract, absent the express written consent by the Federal Government, the Federal Government is not a party to this Contract and shall not be subject to any obligations or liabilities to the Purchaser, Contractor, or any other party (whether or not a party to that contract) pertaining to any matter resulting from the underlying contract.
- (2) The Contractor also agrees to include these requirements in each subcontract financed in whole or in part with Federal assistance provided by FTA, modified only if necessary to identify the affected parties.
- F. **★** Program Fraud and False or Fraudulent Statements or Related Acts.

- (1) 73.6.1 The Contractor acknowledges that the provisions of the Program Fraud Civil Remedies Act of 1986, as amended, 31 U.S.C. §§ 3801 et seq. and U.S. DOT regulations, "Program Fraud Civil Remedies," 49 C.F.R. Part 31, apply to its actions pertaining to this Project. Upon execution of the underlying contract, the Contractor certifies or affirms the truthfulness and accuracy of any statement it has made, it makes, it may make, or causes to be made, pertaining to the underlying contract or the FTA assisted project for which this contract Work is being performed. In addition to other penalties that may be applicable, the Contractor further acknowledges that if it makes, or causes to be made, a false, fictitious, or fraudulent claim, statement, submission, or certification, the Federal Government reserves the right to impose the penalties of the Program Fraud Civil Remedies Act of 1986 on the Contractor to the extent the Federal Government deems appropriate.
- (2) 73.6.2 The Contractor also acknowledges that if it makes, or causes to be made, a false, fictitious, or fraudulent claim, statement, submission, or certification to the Federal Government under a contract connected with a project that is financed in whole or in part with Federal assistance originally awarded by FTA under the Authority of 49 U.S.C. § 5307, the Government reserves the right to impose the penalties of 18 U.S.C. § 1001 and 49 U.S.C. § 5307(n)(1) on the Contractor, to the extent the Federal Government deems appropriate

73.6.3. The Contractor agrees to include the above two clauses in each subcontract financed in whole or in part with Federal assistance provided by FTA. It is further agreed that the clauses shall not be modified, except to identify the subcontractor who will be subject to the provisions.

- G. Suspension and Debarment.
- (1) This Contract is a covered transaction for purposes of 49 CFR Part 29. As such, the Contractor is required to verify that none of the Contractor, its principals, as defined at 49 CFR 29.995, or affiliates, as defined at 49 CFR 29.905, are excluded or disqualified as defined at 49 CFR 29.940 and 29.945.
- (2) The Contractor is required to comply with 49 CFR 29, Subpart C and must include the requirement to comply with 49 CFR 29, Subpart C in any subcontract it enters into.
 - a. The Contractor certifies as follows:
 - b. The certification in this clause is a material representation of fact relied upon by the Authority. If it is later determined that the Contractor knowingly rendered an erroneous certification, in addition to remedies available to the Authority, the Federal Government may pursue available remedies, including but not limited to suspension and/or debarment. The Contractor agrees to comply with the requirements of 49 CFR 29, Subpart

C throughout the term of this Contract. The Contractor further agrees to include a provision requiring such compliance in its lower tier covered transactions.

68 PARTICIPATION BY DISADVANTAGED BUSINESS ENTERPRISES (DBES)

The Authority receives federal financial assistance from the U.S. Department of Transportation and has established a DBE Program and an overall DBE goal. This DOT-assisted project is subject to these stipulated regulations, which are hereby incorporated in their entirety by this reference. Contractor shall not discriminate on the basis of race, color, national origin, or sex in the award and performance of subcontracts. In the event of any conflicts or inconsistencies between the Regulations and the Authority's DBE Program with respect to DOT-assisted contracts, the Regulations shall prevail.

A. DBE Goal and Race-Neutral Application

In conformance with the Authority's DBE Program the Authority has not established a contract-specific goal on this project. Although the Authority has not established a DBE contract-specific goal on this project, all race-neutral DBE participation will count toward the Authority's overall DBE goal. Contractor Is not be required to achieve a specific level of DBE participation as a condition of compliance with DBE requirements in the performance of this DOT-assisted contract.

B. Race-Neutral DBE Participation

At the time of Contract execution, the Contractor committed to utilize DBEs in the performance of this DOT-assisted Contract, and further agrees to ensure that DBE subcontractors listed on the "DBE Race-Neutral Participation Listing" form perform Work and/or supply materials in accordance with original commitments, unless otherwise directed and/or approved by the Authority prior to the Contractor effectuating any changes to its race-neutral DBE participation commitments (Refer to the Subsection entitled "Performance of DBE Subcontractors").

OR

At the time of Contract execution, the Contractor did not commit to utilize DBEs in the performance of this DOT-assisted contract. However, in the event DBEs are utilized in the performance of this Contract, the Contractor shall comply with reporting requirements delineated in the Contractor's "Race-Neutral DBE Reporting Requirements (Post-Award)" section of this Contract.

- C. Contractor's "Race-Neutral DBE Reporting Requirements (Post Award)"
- (1) SCRRA Form 103 "Monthly Race-Neutral DBE Subcontractors Paid Report Summary and Payment Verification" (Form 103)
 - a. If the Contractor is a DBE firm and/or has proposed to utilize DBE firms, the Contractor shall be required to complete and submit a Form 103 to

the Authority by the 15th of each month until completion of the contract to facilitate reporting of race-neutral DBE participation, following the first month of contract activity. The Contractor shall submit via the Authority's on-line form submittal process and/or via hard copy, as required by the Authority. The Contractor shall show the total dollar figure paid to DBEs utilized on the contract through the applicable reporting period, including the scope of work/services performed/provided and the corresponding subcontract dollar value of work. The Contractor is advised not to credit the participation of DBEs on the respective reporting form until the amount being credited has been paid to the DBE firm.

- b. The purpose of this form is to ensure Contractor DBE commitments are attained, properly reported and credited in accordance with DBE crediting provisions based on the capacity the DBE performs the scope of work. This form further serves to collect DBE utilization data required under 49 CFR Part 26.
- c. The SCRRA Form 103 Report must include the following information:
 - (i) General Contract Information Including Contract Number and Name, Prime Contractor and the following:
 - Original Contract Amount
 - Running Total of Change Order Amount
 - Current Contract Amount
 - Amount Paid to Contractor during Month
 - Amount Paid to Contractor from Inception to Date
 - Date of last progress payment
 - DBE Contract Goal
 - Total Dollar Amount of DBE Commitment
 - DBE Commitment as Percentage of Prime Current Contract Amount
 - Listed and/Proposed Contractor/Subcontractor Information For All DBE participation being claimed either Race Neutrally or Race Consciously, regardless of tier:
 - DBE Firm Name, Address, Phone Number, DBE Type of Operation, Certification, and Type and Certification Number.
 - DBE Firm Contract Value Information:
 - Original contract amount, running total of change order amount, Current contract amount, Amount paid to Contractor during month and Amount paid to Contractor to date.

- Contractor signature under penalty of perjury that it has complied with all requirements of 49 CFR, Part 26 and prompt payment requirements of the California Public Contract Code.
- (2) Contractor must sign the prompt payment assurance statement of compliance contained within the Form 103. Contractor is to further maintain and submit a detailed running tally of related invoices submitted by DBEs and Non DBEs, including dates of invoice submission, dates accepted and corresponding dates and amount of payments made on the Payment Verification Form. The Payment and Retention Reporting tally must also include:
 - a. DBEs and Non DBEs Invoice Number, Invoice Amount, Invoice Date, Prime Contractor's Invoice Number that incorporated the corresponding DBE and Non DBE invoices for billing purposes, Date of Invoice submission to Authority, date and amount Authority paid on Prime Contractor t's Invoice. The report must also reflect a breakout of retention withheld (including retention as specified in subcontract agreements and disputed invoice retention) and retention payments made, check number and date paid to DBE and Non DBE.
 - b. Contractor is advised not to report the participation of DBEs toward the Contractor's DBE attainment until the amount being claimed has been paid to the DBE. Verification of payments and/or a signed Verification of Payment by the applicable DBE or Non DBE must be submitted with Form 103 to authenticate reported payments.
- (3) DBE Subcontract Agreements

The Contractor must submit to Authority copies of executed subcontracts and/or purchase orders (PO) for all DBE firms participating on the contract within ten working days of award. The Contractor must immediately notify Authority in writing of any problems it may have in obtaining the subcontract agreements from listed DBE firms within the specified time.

- (4) "Monthly DBE Trucking Verification" Form
 - a. Prior to the 15th of each month, the Contractor must submit documentation on the "Monthly DBE Trucking Verification" Form to Authority showing the amount paid to DBE trucking companies. The Contractor must also obtain and submit documentation to Authority showing the amount paid by DBE trucking companies to all firms, including owner operators, for the leasing of trucks. If the DBE leases trucks from a non DBE, the Contactor may count only the fee or commission the DBE receives as a result of the lease arrangement.
 - b. The Contractor must also obtain and submit documentation to Authority showing the truck number, owner's name, California Highway Patrol CA

number, and if applicable, the DBE certification number of the owner of the truck for all trucks used during that month.

(5) "Final Report-Utilization of Disadvantaged Business Enterprises (DBE), First Tier Subcontractors"

Upon completion of the contract, a summary of these records must be prepared on the: "Final Report-Utilization of Disadvantaged Business Enterprises (DBE), First Tier Subcontractors" and certified correct by the Contractor or the Contractor's authorized representative, and must be furnished to the Engineer. The form must be furnished to Authority within 90 days from the date of contract acceptance. The amount of \$10,000 will be withheld from payment until a satisfactory form is submitted.

- (6) "Disadvantaged Business Enterprises (DBE) Certification Status Change"
 - a. If a DBE Subcontractor is decertified during the life of the project, the decertified Subcontractor must notify the Contractor in writing with the date of decertification. If a Subcontractor becomes a certified DBE during the life of the project, the Subcontractor must notify the Contractor in writing with the date of certification (Attach DBE certification/Decertification letter). The Contractor must furnish the written documentation to Authority.
 - b. Upon completion of the contract, the "Disadvantaged Business Enterprises (DBE) Certification Status Change" must be signed and certified correct by the Contractor indicating the DBEs' existing certification status. If there are no changes, please indicate "No Changes". The certified form must be furnished to Authority within 90 days from the date of contract acceptance.
- D. DBE Crediting Provisions

Credit for DBE participation is determined according to the following provisions:

- (1) When a DBE is proposed to participate in the Contract, either as a prime Contractor or subcontractor, only the value of the work proposed to be performed by the DBE with its own forces may be counted toward DBE participation.
- (2) If the Contractor is a DBE joint venture participant, only the DBE proportionate interest in the joint venture may be counted.
- (3) If a DBE intends to subcontract part of the work of its subcontract to a lower tier subcontractor, the value of the subcontracted work may be counted toward DBE participation only if the DBE subcontractor is a certified DBE and actually performs the work with its own forces. Services subcontracted to a non-DBE firm may not be credited toward the prime Contractor's DBE attainment.

- (4) Contractor is to calculate and credit participation by eligible DBE vendors of equipment, materials, and suppliers toward DBE attainment, as follows:
 - a. 60% of expenditures for equipment, materials, and supplies required under the Contract, obtained from a regular dealer; or
 - b. 100% of expenditures for equipment, materials, and supplies required under the Contract, obtained from a DBE manufacturer.
- (5) The following types of fees or commissions paid to DBE subcontractors, brokers, and packagers may be credited toward DBE attainment, provided that the fee or commission is reasonable, and not excessive, as compared with fees or commissions customarily allowed for similar work, including:
 - a. Fees and commissions charged for providing bona fide professional or technical services, or procurement of essential personnel, facilities, equipment, materials, or supplies required in the performance of the Contract;
 - b. Fees charged for delivery of material and supplies (excluding the cost of materials or supplies themselves) when the licensed hauler, trucker, or delivery service is not also the manufacturer of, or a regular dealer in, the material and supplies;
 - c. Fees and commissions charged for providing any insurance specifically required in the performance of the Contract.
- (6) Contractor may count the participation of DBE trucking companies toward DBE attainment, as follows:
 - a. The DBE must be responsible for the management and supervision of the entire trucking operation for which it is responsible on a particular Contract.
 - b. The DBE must itself own and operate at least one fully licensed, insured, and operational truck used on the Contract.
 - c. The DBE receives credit for the total value of the transportation services it provides on the Contract using trucks it owns, insures, and operates using drivers it employs.
 - d. The DBE may lease trucks from another DBE firm, including an owneroperator who is certified as a DBE. The DBE who leases trucks from another DBE receives credit for the total value of the transportation services the lessee DBE provides on the Contract.
 - e. The DBE may also lease trucks from a non-DBE firm, including an owneroperator. The DBE who leases trucks from a non-DBE is entitled to credit only for the fee or commission it receives as a result of the lease arrangement. The DBE does not receive credit for the total value of the

transportation services provided by the lessee, since these services are not provided by a DBE.

- f. For purposes of this paragraph, a lease must indicate that the DBE has exclusive use of and control over the truck. This does not preclude the leased truck from working for others during the term of the lease with the consent of the DBE, so long as the lease gives the DBE absolute priority for use of the leased truck. Leased trucks must display the name and identification number of the DBE.
- (7) If the Contractor listed a non-certified DBE 1st tier subcontractor to perform work on this Contract, and the non-certified DBE subcontractor subcontracts a part of its work or purchases materials and/or supplies from a lower-tier DBE certified subcontractor or Vendor, the value of work performed by the lower-tier DBE firm's own forces can be counted toward DBE participation on the Contract.
- (8) The Contractor is advised not to count the participation of DBEs toward the Contractor's DBE attainment until the amount being counted has been paid to the DBE.
- E. Performance of DBE Subcontractors

The following requirements govern the performance of DBE subcontractors:

- (1) DBEs listed by the Contractor in its "DBE Participation Listing" Form submitted with the executed Contract documents shall perform the work and supply the materials for which they are listed, unless the Contractor has received prior written authorization from Authority to perform the work with other forces or to obtain the materials from other sources.
- (2) Contractor shall provide written notification to Authority in a timely manner of any changes to its anticipated DBE participation. This notice should be provided prior to the commencement of that portion of the work.
- F. DBE Addition/Substitution/Termination Form
- (1) In the event that the Contractor identifies additional DBE subcontractors or suppliers not previously identified for DBE participation under the Contract, Contractor shall notify Authority by completing and submitting a "DBE Addition/Substitution/ Termination" form to enable Contractor to capture all DBE participation. Contractor shall also submit, for each DBE identified after Contract execution, a written confirmation from the DBE acknowledging that it is participating in the Contract for a specified value, including the corresponding scope of work (a subcontract agreement can serve in lieu of the written confirmation).
- (2) Contractor shall be required to comply with 49 CFR § 26.53 regarding DBE subcontractor terminations, including the following:

- a. Contractor may not terminate a listed DBE subcontractor without the Authority's prior written consent.
- b. Prior to the termination request, the prime Contractor must notify the DBE, in writing, of the intent to terminate, allowing for five days of response time in opposition of the rejection.
- c. A Contractor may only terminate a DBE subcontractor for "good cause," as defined in 49 CFR § 26.53.
- d. Good cause does NOT exist if the failure or refusal of the DBE subcontractor to perform its work on the subcontract results from the bad faith or discriminatory action of the Contractor (e.g., failure of the Contractor to make timely payments or the unnecessary placing of obstacles in the path of the DBE's work). Good cause also does NOT exist if the Contractor seeks to terminate a DBE so that it can self-perform the work of the terminated DBE.
- e. In the event that the Contractor needs to substitute or terminate a DBE firm and the request meets the definition of "good cause," the Contractor shall notify Authority by completing and submitting a "DBE Addition/Substitution/Termination Request" form for Authority's written approval prior to actualizing any changes.
- f. The Contractor must make a Good Faith Effort (GFE) to replace the terminated DBE with another DBE. The Contractor's GFE shall be directed at finding another DBE to perform at least the same amount of work under the contract as the DBE that was terminated, to the extent needed to meet the established DBE contract goal.
- g. Failure by the Contractor to adhere to these requirements may constitute a material breach of contract, which may result in the termination of the contract or such other remedy as Authority deems appropriate.
- G. Non-Compliance and Administrative Sanctions

A Contractor determined to be non-compliant with DBE Program requirements may be subject to administrative sanctions as outlined below:

- (1) A non-compliant Contractor may be notified by the DBELO or designee, that administrative remedies shall be imposed for failure to:
 - a. meet the Contractor's DBE commitment by contract end,
 - b. submit documentation of Good Faith Efforts,
 - c. submit required DBE utilization reports,
 - d. submit verification of prompt payment to DBE subcontractors, and/or

- e. comply with proper DBE termination procedures. The notice shall state the specific administrative remedies to be imposed.
- (2) The Contractor will be given ten working days from the date of the notice to file a written appeal to Authority's Executive Director. Failure to respond within the ten day period will constitute a waiver of appeal.
- (3) The Executive Director or his designee may schedule a hearing to gather additional facts and evidence and shall issue a final written determination on the matter within thirty working days following receipt of the written appeal. The written decision of the Executive Director or designee is final and there is no further appeal.
- (4) Administrative remedies will be determined by the DBELO and/or designee and may include, but will not be limited to:
 - a. Suspension of progress payments to the Contractor or of any monies held by Authority as retention on the contract until the Contractor is brought into compliance; and/or
 - b. Termination of the contract in part or in whole.
- H. Contractor's Assurance Clause Regarding Non-Discrimination

The Contractor must ensure that the following clause is placed in every subcontract agreement:

"The Contractor shall not discriminate on the basis of race, color, national origin, or sex in the performance of this contract. The Contractor shall carry out applicable requirements of federal law. Failure by the Contractor to carry out these requirements is a material breach of this contract, which may result in the termination of this contract or such other remedy as the Authority deems appropriate."

69 ★ CLEAN WATER REQUIREMENTS

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

70 **★**CLEAN AIR REQUIREMENTS

- A. The Contractor agrees to comply with all applicable standards, orders or regulations issued pursuant to the Clean Air Act, as amended, 42 U.S.C. §§ 7401 et seq. The Contractor agrees to report each violation to the Purchaser and understands and agrees that the Purchaser will, in turn, report each violation as required to assure notification to FTA and the appropriate EPA Regional Office.
- B. The Contractor also agrees to include these requirements in each subcontract exceeding \$100,000 financed in whole or in part with Federal assistance provided by FTA.

71 **★**COMPLIANCE WITH FEDERAL LOBBYING POLICY

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

72 BUY AMERICA PRE-AWARD AND POST DELIVERY AUDITS

The Contractor agrees to comply with 49 U.S.C. 5323(j) and FTA's implementing regulations at 49 C.F.R. Part 661.11, which provide that Federal funds may not be obligated unless rolling stock is assembled in the United States and has sixty percent (60%) domestic content. The Contractor agrees to comply with 49 U.S.C. § 5323(l) and FTA's implementing regulation at 49 C.F.R. Part 663. Contractor shall cooperate with the Authority in conducting all post-delivery audit necessary to insure compliance with the Buy America requirements.

73 **★**CARGO PREFERENCE

The Contractor agrees:

- A. to use privately owned United States Flag commercial vessels to ship at least fifty percent (50%) of the gross tonnage (computed separately for dry bulk carriers, dry cargo liners, and tankers) involved, whenever shipping any equipment, material, or commodities pursuant to this Contract by ocean vessels to the extent such vessels are available at fair and reasonable rates for United States-flag commercial vessels;
- B. to furnish within twenty working days following the date of loading for shipments originating within the United States or within 30 working days following the date of leading for shipments originating outside the United States, a legible copy of a rated, "on-board" commercial ocean bill-of-lading in English

for each shipment of cargo described in the preceding paragraph to the Division of National Cargo, Office of Market Development, Maritime Administration, Washington, DC 20590 and to the Authority (through the Contractor in the case of a Subcontractor's bill-of-lading); and

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

74 **★ FLY AMERICA**

- A. The Contractor agrees to comply with 49 U.S.C. 40118 (the "Fly America" Act) in accordance with the General Services Administration's regulations at 41 CFR Part 301-10, which provide that recipients and subrecipients of Federal funds and their contractors are required to use U.S. Flag air carriers for U.S. Government-financed international air travel and transportation of their personal effects or property, to the extent such service is available, unless travel by foreign air carrier is a matter of necessity, as defined by the Fly America Act. The Contractor shall submit, if a foreign air carrier was used, an appropriate certification or memorandum adequately explaining why service by a U.S. flag air carrier was not available or why it was necessary to use a foreign air carrier and shall, in any event, provide a certificate of compliance with the Fly America requirements. The Contractor agrees to include the requirements of this section in all subcontracts that may involve international air transportation.
- B. Contractor shall at all times comply with all applicable FTA regulations, policies, procedures and directives, including without limitation those listed directly or by reference in the Master Agreement between Purchaser and FTA, as they may be amended or promulgated from time to time during the term of this Contract. Contractor's failure to so comply shall constitute a material breach of this Contract.

75 CONTRACT WORK HOURS AND SAFETY STANDARDS ACT

- A. Contractor agrees to comply with Sections 102 and 107 of the Contract Work Hours and Safety Standards Act, as amended (40 U.S.C. §§327-333) and implementing U.S. DOL regulations at 29 CFR Part 5 and 29 CFR Part 1926.
- B. Overtime Requirements. Neither Contractor nor any subcontractor contracting for any part of the Services which may require or involve the employment of laborers or mechanics shall require or permit any such laborer or mechanic in any work week in which he or she is employed on such Services to work in excess of 40 hours in such work week unless such laborer, mechanic, watchman or guard receives compensation at a rate not less than one and one-half times the basic rate of pay for all hours worked in excess of 40 hours in such work week.

- C. Violation; Liability for Unpaid Wages; Statutory Penalties. In the event of any violation of this Section, Contractor and any subcontractor responsible for any such violation shall be liable for any unpaid wages. In addition, Contractor and such subcontractor shall be liable to the United States for statutory penalties. Such statutory penalties shall be computed with respect to each individual laborer or mechanic, including watchmen and guards, employed in violation of this Section, in the sum of \$10 for each calendar day on which such individual was required or permitted to work in excess of the standard work week of 40 hours without payment of the overtime wages required by this Section.
- D. Withholding for Unpaid Wages on Statutory Penalties. The Authority shall upon its own action or upon written request of an Authorized Representative of the Department of Labor withhold or cause to be withheld, from any monies payable on account of Services performed by Contractor or any subcontractor under any such contract or any other federal contract with the same prime Contractor, or any other federally-assisted Contractor subject to the Contract Work Hours and Safety Standards Act, which is held by the same prime Contractor, such sums as may be determined to be necessary to satisfy any liabilities of such Contractor or subcontractor for unpaid wages and statutory penalties as provided above.
- E. Safety. No laborer or mechanic shall be required to work in surroundings or under working conditions that are unsanitary, hazardous or dangerous to his or her health or safety.
- F. Subcontracts. Contractor shall insert in any subcontracts the clauses set forth in the CONTRACT WORK HOURS AND SAFETY STANDARDS ACT (40 U.S. Code 3701 et seq.) in addition to a clause requiring all subcontractors to include these clauses in any contracts with lower tier subcontractors. Contractor shall be responsible for compliance by any subcontractor or lower tier subcontractor with the clauses set forth in this Section.

76 ★AMERICANS WITH DISABILITIES ACT (ADA).

Contractor is required to comply with all applicable requirements of the Americans with Disabilities Act of 1990 (ADA), 42 USC §§ 12101, et seq.; Section 504 of the Rehabilitation Act of 1973, as amended, 29 USC § 794; and 49 USC § 5301(d), and the following regulations and any amendments thereto:

- A. U.S. Department of Transportation regulations, "Transportation Services for Individuals with Disabilities (ADA)," 49 CFR Part 37.
- B. U.S. Department of Transportation regulations, "Accessibility Specifications for Transportation Vehicles," 49 CFR Part 38.
- C. U.S. Department of Transportation regulations, "Nondiscrimination on the Basis of Handicap in Programs and Activities Receiving or Benefiting from Federal Financial Assistance," 49 CFR Part 27.
- D. U.S. Department of Justice (DOJ) regulations, "Nondiscrimination on the Basis of Disability in State and Local Federal Government Services," 28 CFR Part 35.
- E. DOJ regulations, "Nondiscrimination on the Basis of Disability by Public Accommodations and in Commercial Facilities," 28 CFR Part 36.
- F. U.S. General Services Administration regulations, "Accommodations for the Physically Handicapped," 41 CFR Subpart 101-19.
- G. U.S. Equal Employment Opportunity Commission (EEOC) "Regulations to Implement the Equal Employment Provisions of the Americans with Disabilities Act," 29 CFR Part 1630.
- U.S. Federal Communications Commission regulations, "Telecommunications Relay Services and Related Customer Premises Equipment for the Hearing and Speech Disabled," 47 CFR Part 64, Subpart F.
- I. FTA regulations, "Transportation for Elderly and Handicapped Persons," 49 CFR Part 609.
- J. Any implementing requirements that the FTA may issue.

77 ★ FEDERAL CHANGES.

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

78 **★INCORPORATION OF FEDERAL TRANSIT ADMINISTRATION (FTA) TERMS.**

The preceding provisions include, in part, certain Standard Terms and Conditions required by DOT, whether or not expressly set forth in the preceding contract provisions. All contractual provisions required by DOT, as set forth in FTA Circular 4220.1F or its successor are hereby incorporated by reference. Anything to the contrary herein notwithstanding, all FTA mandated terms shall be deemed to control in the event of a conflict with other provisions contained in this Contract. The Contractor shall not perform any act, fail to perform any act, or refuse to comply with any the Authority requests which would cause the Authority to be in violation of the FTA terms and conditions.

79 NOTIFICATION OF EMPLOYMENT OF SOUTHERN CALIFORNIA REGIONAL RAIL AUTHORITY BOARD MEMBERS/ALTERNATES AND EMPLOYEES

To ensure compliance with the Authority's Ethics Policy, Contractor shall provide written notice to the Authority disclosing the identity of any individual who Contractor desires to employ or retain under a contract, and who (1) presently serves as a Board Member/Alternate or an employee of the Authority, or (2) served as a Board Member/Alternate or an employee of the

Authority within the previous twelve months of the date of the proposed employment or retention by Contractor. Contractor's written notice shall indicate whether the individual will be an officer, principal or shareholder of the entity and/or will participate in the performance of the Contract.

80 **★**WHISTLEBLOWER REQUIREMENTS

Contractor may not adopt any rule, regulation or policy preventing an employee from disclosing information to a government or law enforcement agency, where the employee believes the information discloses violation or noncompliance with a state or Federal regulation; nor may an employer retaliate against an employee for taking such actions as set forth in the California Labor Code §1101 et seq.

81 INTEREST OF MEMBERS OF, OR DELEGATES TO, CONGRESS

No member of, or delegate to, the Congress of the United States will be admitted to a share or part of this Contract or to any benefit arising there from.

82 **★ EQUAL EMPLOYMENT OPPORTUNITY**

In the performance of this Contract, Contractor shall not discriminate in recruiting, hiring, promotion, demotion, or termination practices on the basis of race, religious creed, color, national origin, ancestry, sex, gender identity, age, or physical or mental disability and shall comply with the provisions of the California Fair Employment & Housing Act (Government Code Section 12900 et seq.), the Federal Civil Rights Act of 1964 (P.L. 1992-352) and all amendments thereto, Executive Order No. 11246 (30 Federal Register 12319), and all administrative rules and regulations issued pursuant to said Acts and Order. The Contractor shall take affirmative actions to insure that applicants are employed, and that employees are treated during their employment, without regard to their race, religious creed, color, national origin, ancestry, sex, gender identity, age, or physical or mental disability. Such actions shall include, but not be limited to, the following: employment, upgrading, demotion or transfer recruitment or recruitment advertising, layoff or termination, rates of pay or other forms of compensation; and selection for training, including apprenticeship. The Contractor further agrees to endeavor to insert a similar provision in all subcontracts, except subcontracts for standard commercial supplies or raw materials.

83 LABOR RELATIONS

Should a labor dispute directed primarily or secondarily at Contractor occur on, at, or near the Work site, Contractor shall take all necessary steps to ensure that such labor dispute does not disrupt, interfere with, hamper, interrupt and/or delay the progress of the Work. Such steps shall include, but not be limited to, seeking and obtaining legal relief from all appropriate Federal, State and/or local agencies, and from all appropriate Federal and/or State courts.

The Contractor shall be responsible for complying with all of the foregoing at its sole cost and expense, without any increase in compensation or time for performance of Work on account of

such compliance and regardless of whether such compliance would require additional labor, equipment and/or Materials not expressly provided for in the Contract Documents.

For purposes of this provision, a "labor dispute" is defined as any concerted or non-concerted activity that does or could potentially disrupt, interfere with, hamper, interrupt and/or delay the progress of the Work. Such term includes but is not limited to a refusal to work; strike; inter- or intra-union jurisdictional dispute; sympathy strike; slowdown; work stoppage; withholding of labor; honoring of picket line; picketing; hand-billing or other notice to the public that a labor dispute exists; interference with the progress of the Work of any kind for any labor-related reason; and/or boycotts for any purpose and/or reason, including a dispute between an employer and a labor organization.

84 **★ NON-DISCRIMINATION ASSURANCE**

The Contractor shall not discriminate on the basis of race, color, national origin, or sex in the performance of this Contract. The Contractor shall carry out applicable requirements of 49 CFR Part 26 in the award and administration of U.S. DOT-assisted contracts. Failure by the Contractor to carry out these requirements is a material breach of this Contract, which may result in the termination of this Contract or such other remedy as the Authority deems appropriate. The Contractor shall obtain the same assurances from its subcontractors and subconsultants by including this assurance in all subcontracts entered into under this Contract.

85 NOTICE

Notice for purposes of this Contract will be sufficient if sent by e-mail or personally delivered or sent by certified mail to the other Party at the following addresses:

<u>To the Authority</u> :	To the Contractor:
Southern California Regional Rail Authority	Talgo-SYSTRA
900 Wilshire Blvd, 15th Floor	N. 27 th Street
Los Angeles, CA 90012	Milwaukee, WI 53216
Attn: Angelos Kastrisianakis	Attn: Robert Liliac
Principal Contract & Compliance Administrator	Project Director
KastrisianakisA@scrra.net	<u>rliliac@systra.com</u>

With a copy to:

Attn: Legal Services

Any notice legally required to be given by one Party to another or otherwise required concerning the Work to be performed under this Contract shall be in writing and dated. The notice shall be signed by the Party giving such notice or by a duly authorized representative of such Party. Notices sent by certified mail will be deemed to have been given as of the day of mailing.

With a copy to:

86 NO WAIVER

A Party's failure to insist on any one or more instances upon the other Party's performance of any term or condition of the Contract will not be construed as a waiver or relinquishment of its right to such performance, or to future performance, of such term or condition, and the other Party's obligation for performance of that term or condition will continue in full force and effect.

87 POLICIES, PRACTICES, AND PROCEDURES OF AUTHORITY

The Contractor when present at the Authority's facilities shall observe and obey, and compel its Officers, employees, guests, and those doing business with it, to observe and obey, the Policies, Practices, and Procedures of the Authority.

88 COMPLIANCE WITH LAWS, RULES, AND REGULATIONS

The Contractor shall comply with all Federal, State, and local laws, rules and regulations applicable to this Contract and to the Work. Contractor shall be responsible for compliance with the provisions, and successor provisions, of all applicable regulations of FRA and other entities with regulatory authority over the rail industry as well as other applicable federal, state, and local laws regarding the condition of the Service Property as they apply to the matters that are within the scope of this Contract.

If any changes are made to the law affecting the Work as described in this Contract between the date of submission of Contractor's Proposal (including options, if exercised) and such changes have an impact on Contractor's Work, any such change shall be addressed in accordance with the provisions in this Contract regarding changes.

89 APPLICABLE LAW, JURISDICTION, AND VENUE

All matters relating to the performance of this Contract will be controlled by and determined in accordance with the laws of the State of California. Venue for all legal proceedings arising out of this Contract, or breach of this Contract, will be in the state or federal court with competent jurisdiction in Los Angeles County, California.

90 **★**ASSIGNMENT

The Contractor may not assign any interest, obligation, or benefit under or in the Contract or transfer any interest in the Contract, whether by assignment, or novation, without prior written consent of the Authority's Project Manager, provided, however, such consent shall not be required for any assignment to an entity that is under the control of, under common control, or a parent of any tier of Contractor, and as long as Contractor provides written notice thereof to the Authority. If assignment is approved, the Contract will be binding upon and inure to the benefit of the successors of the Contractor. Except as otherwise specified herein, any attempt by the Contractor to assign any responsibility or interest in the Contract without the Authority's prior written approval will be invalid.

91 ATTORNEYS' FEES

If any legal proceeding should be instituted by either of the Parties to enforce the terms of this Contract or to determine the rights of the Parties under this Contract, the prevailing Party in said proceeding may recover, in addition to all court costs, reasonable attorneys' fees as awarded by a court of competent jurisdiction.

92 NO THIRD PARTY BENEFICIARIES

This Contract is not for the benefit of any person or entity other than the Parties.

93 CONTRACTOR STATUS

Neither the Contractor nor any party contracting with the Contractor will be deemed to be an agent or employee of the Authority. The Contractor is and will be an independent contractor, and the legal relationship of any person performing services for the Contractor shall be one solely between that person and the Contractor.

94 COMPLETE CONTRACT AND SEVERABILITY

This Contract, including exhibits and other documents incorporated in this Contract or made applicable by reference, constitutes the complete and exclusive statement of the terms and conditions of the Contract between the Contractor and the Authority. This Contract supersedes all prior representations, understandings, and communications. In the event any section, paragraph, sentence, clause, or phrase contained in the Contract will be declared or adjudged invalid, illegal, unconstitutional, or otherwise unenforceable, such determination will in no manner affect the rest of the Contract, which will remain in full force and effect as if the section determined unenforceable was not originally contained in the Contract.

95 LIMITATIONS OF LIABILITY

Notwithstanding any other provisions contained in this Contract, and to the maximum extent permitted by law, the total liability to the Authority, of Contractor, its parent, affiliates, subcontractors, agents, officers, and employees arising out of the performance or nonperformance of this Contract or any of its obligations, whether based on contract, warranty, tort (including negligence), strict liability or otherwise, shall not exceed in the aggregate a sum equal to \$35,000,000.00, however, this does not include Liquidated Damages, damages recoverable under required policies of insurance, damages that arise by way of, or are based on claims of third parties.

Notwithstanding any other provisions contained in this Contract, and to the maximum extent permitted by law, neither the Authority or Contractor or their parents, affiliates, subcontractors, agents and/or employees shall be liable for any loss of use, loss of profit, losses resulting from or related to downtime of the goods, nor any special, indirect, punitive, exemplary, incidental, or consequential loss or damages of any nature, howsoever caused, and whether based on warranty, contract, tort (including negligence), strict liability, or any other theory of law, regardless of whether a Party had advance notice of the potential of any such damages. These limitations of liability shall survive expiration, cancellation or termination of this Contract, and prevail over any conflicting or inconsistent term contained in any documents comprising the Contract.

IN WITNESS WHEREOF, the parties hereto have caused this Contract to be executed on the date shown below, and effective on the date first hereinabove written.

CONTRACTOR

SYSTRA North America

Chief Executive Officer

Dave Spagnolo

SOUTHERN CALIFORNIA REGIONAL RAIL AUTHORITY

Alund

Chief Executive Officer

System

CONTRACTOR

Talgo Inc.

Antonio Perez President & Chief Executive Officer

Talgo-SYSTRA Joint Venture Tax I.D. No. <u>84–2177164</u>

APPROVED AS TO FORM:

Don O. Del Rio General Counsel

EXHIBIT A – DELIVERY SCHEDULE

Description	Days from NTP
NTP	0
Delivery of Pilot Cars (Cars 1-2)	450
Delivery of Cars 3-5	510
Delivery of Cars 6-10	630
Delivery of Cars 11-15	750
Delivery of Cars 16-20	840
Delivery of Cars 21-25	930
Delivery of Cars 26-30	1020
Delivery of Cars 31-35	1110
Delivery of Cars 36-40	1200
Delivery of Cars 41-45	1290
Delivery of Cars 46-50	1380

EXHIBIT B - MILESTONE PAYMENT SCHEDULE

For Units #1-50

MS#	Milestone	Invoice	Retained	Payment	Estimated Billing Date
1	Notice to Proceed, including proof of Bonding and Insurance and submittal of Program Management Plan.	20.0%	(1%)	19%	1/2 30 days after NTP 1/2 60 days after NTP
2	Order Parts and Materials, provide proof of purchase orders for the systems below: Trucks HVAC Doors Seats Flooring Lighting	10.0%	(.50%)	9.50%	In full 180 days after NTP
3	Pre-revenue Service Plan submittal and approval, test complete on first car.	8.0%	(.40%)	7.60%	In full 390 days after NTP
4	Conditional Acceptance, including acceptance of all documentation for each car. Milestone will be pro-rated	37.0%	(1.85%)	35.15%	1/50 (0.74%) per car as per Delivery Schedule
5	Submittal and Acceptance of Final Training Program and all Manuals	10.0%	(.50%)	9.50%	In full 360 days after NTP
6	Final Acceptance, Conditional Acceptance open issues addressed for each car. This milestone shall be pro-	10.0%	(.50%)	9.50%	1/50 (0.20%) per car upon final acceptance on each car
7	CDRL's Delivered	5.00%	(.25%)	4.75%	In full upon delivery and acceptance of all CDRLs
8	Contract Close-out Final Completion Certification Release Retainage	-	-	5.00%	In full 2130 days after NTP
	TOTAL for Units #1-50	100.0%	(5.00%)	100%	

^{*} Percentage of the total Base Order Price, including System Support, Manuals, Teaching Aids, Equipment and Special Tools, Taxes, Bonding, and Insurance.

APPENDIX 1 - DEFINITIONS

- Acceptance: Written documentation attesting to the act of an authorized representative of the Authority by which all Work or a specified portion thereof, under the Contract has been completed to the satisfaction of the Authority.
- Adhesion, coefficient of: During rolling contact, the ratio between the longitudinal tangential force at the wheel-rail interface and normal force.
- A-end: The end of the car opposite the B-end of the car; sometimes designated as the F-end of the cab car.
- **Affiliate**: Two or more firms are affiliates if a Parent owns more than fifty percent (50%) of the voting stock of each of the firms, or a common shareholder or group of shareholders owns more than fifty percent (50%) of the voting stock of each of the firms, or if the firms have a common proprietor or general partner.
- **Agency or Governmental Agency**: Any federal, state, county, city or other local agency, including but not limited to, departments, offices, public authorities and corporations that may have jurisdictional or regulatory authority with regard to the Work.
- **Agent**: Any employee of, or contractor or consultant to, the Authority that is specifically authorized, in writing, to act for or in place of the Authority
- **Approved Equal:** A proposed substitute brand or make of material, device, or equipment has been determined by the Authority to be the equal of that specified.
- **Approved or Approved Type:** Design, type of material, procedure, or method given approval by the Authority
- Availability: The percentage of the car fleet useable for revenue service at the beginning of each day's schedule. Also, on per-car basis, the percentage of time a car is useable for service (MTBF) / (MTBF + MTTR)
- Award Date: The date the Contract is awarded by the Authority.
- Base Order: The Authority's initial order of the rebuild of 28 Rail Cars.
- **Baseline Design:** The design of the car or any of its components, apparatus, systems, subsystems, or materials, which have received both drawing approval and First Article approval by the Authority.
- **B-End:** The end of the car at which the hand brake is located; the end opposite the A-end, sometimes designated the R-end.
- **Burn-in:** A 1,000-mile, trouble-free, operational test conducted by the Authority after all other tests are successfully completed; the operation of an item under stress for a specified length of time to stabilize its characteristics.

- **Cab Car:** A passenger car containing an operating cab that, when properly trainlined to a Locomotive, is capable of controlling the propulsion and braking system of the Locomotive and the train consist.
- **Calendar Days:** Consecutive calendar days including weekends and holidays. Unless otherwise provided, any generic reference to days shall be construed to mean Calendar Days.
- Car: A passenger car assembly; see Cab Car; Trailer Car; Vehicle.
- **Car Rebuild History Book:** A document specific to an individual car containing records of technical and parts data pertinent to that individual car including described rebuilt systems, subsystems and/or components for that individual car.
- **Central Maintenance Facility (CMF):** The primary the Authority facility used to support daily inspection and service, periodic and unscheduled maintenance and repair of the Authority rail vehicle fleet. The CMF facility is located at 1555 San Fernando Road, Los Angeles, California, 90065.
- **Change Order:** A written order approved by an authorized employee of the Authority and issued to Contractor amending the Contract Documents and establishing the basis for payment and program adjustments, if any, of the Work affected by the changes. The Change Order becomes a part of the Contract when executed by Contractor and the Authority.
- **Change Request:** A document issued by the Contractor to the Authority requesting that a Change Order be issued.
- **Coast:** The mode of operation of a car or train in which propulsion (positive traction) and brake (negative traction) are inactive and any acceleration or deceleration results only from the rolling resistance of the train, aerodynamic drag and the physical characteristics of the track.
- **Commissioning:** The pre-acceptance Contractor activities involved in delivering, adjusting, and testing the cars to demonstrate compliance with Scope of Work requirements.
- **Component**: Parts, devices, and structures performing a distinctive function necessary to the operation of a subsystem or system.
- **Conditional_Acceptance** the Authority's determination and notification to the Contractor in writing that the Rail Car is suitable for service even though it requires work to correct defects, exceptions, and deficiencies to meet the Contract requirements.
- **Consumable_Items**: Those parts, components and materials of a particular system that, pursuant to the manufacturer's maintenance manual, are required to properly maintain such system for a one-year period based upon the Authority's expected usage of 80,000 miles per year per Rail Car.
- **Contract Data Requirement List (CDRL):** List of items to be provided by the Contractor as defined in the Contract. Also referred to as a Contract Deliverable Requirements List.

Contract Drawings: Drawings provided by the Authority as part of the Contract Documents.

- **Contractor Software**: Any Software for which any applicable Intellectual Property Rights necessary to grant the licenses contained in this Contract are owned by Contractor (or its Subcontractors).
- **Contractor:** The person, persons, partnership, joint-venture, company or corporation entering into the Contract to perform the Work
- **Contractor's Drawings:** Items such as general arrangement drawings, detail drawings, as-built drawings, graphs, diagrams, shop drawings, and sketches that are prepared by the Contractor to detail its Work.
- **Corrosion Defect:** A defect resulting from normal use and normal exposure of a surface to the Authority operating environment.
- Days, Working: Those calendar days during which the Authority's regular business is conducted.
- Days: Unless otherwise designated, days as used in the Contract means calendar days.
- **Defect:** A patent or latent malfunction or failure in manufacture or design of any Deliverable, including without limitation any vehicle or any vehicle component, subcomponent, part or material of whatever kind or type, or any failure of any Deliverables to conform to the requirements of the Contract.
- **Deliverable**: Materials, equipment, and services required to be furnished by Contractor to the Authority under the terms of this Contract.
- **Delivery:** The transfer of the completed vehicle to the Authority property, with all in-plant testing completed and results accepted by the Authority, ready for commissioning and acceptance testing.
- **Downtime:** The elapsed time during which equipment is not capable of use in revenue service use due to maladjustment, malfunction of systems, or maintenance in progress.
- **Eastern Maintenance Facility (EMF):** The secondary the Authority facility used to support daily inspection and service, and periodic maintenance and repair of the Authority rail vehicle fleet, located at 1945 Bordwell Avenue, Colton, California, 92324.
- **Event Recorder:** A device, designed to resist tampering, that monitors and records data on train speed, direction of motion, time, distance, throttle position, brake applications and operations (including train brake, independent brake, and if so equipped, dynamic brake applications and operations) and other events required by Federal Regulations and the Authority.
- **Fail-Safe:** A characteristic of a system that insures that any malfunction affecting safety will not cause the system to achieve an unsafe state.
- **Failure Rate:** The frequency of failure, expressed as failures per hour or failures per mile, or the number of failures, usually presented as a percentage of the total amount of same items used. Failure rate is the mathematical reciprocal of MTBF or MDBF.

- Failure, Dependent: The failure of a system, subsystem, or component induced by the failure of another system, subsystem, or component.
- **Failure, Independent:** The failure of a system, subsystem, or component not induced by or the result of the failure of another system, subsystem, or component either directly or indirectly.
- **Failure:** The inability of a component, system, or subsystem to function or perform in accordance with the Scope of Work and requiring a corrective action to restore the specified function or performance.
- **Field Modification**: Any change, alteration, adjustment, or modification to the equipment or any Work not performed at the original manufacturer's plant, for the purpose of correcting deficiencies in design, workmanship and materials.
- **Final Acceptance:** Written notice by the Authority acknowledging that the Contractor has fulfilled all of its obligations under the Contract and that the Authority has accepted the Work as of the date stated on the Final Acceptance Certificate, one for each vehicle. Final Acceptance is a condition precedent to final payment.
- **First Article Approval**: Written approval by the Authority of an initial production part, major assembly, subassembly, system, subsystem, apparatus, or material, remanufactured or assembled by either Contractor or subcontractors.
- **First Article Inspection:** A formal inspection of a First Article to establish the level of quality and workmanship that will be maintained for the balance of the components produced, including observation in three dimensions by the Authority's representatives to see what could be seen only on two-dimensional drawings up to that point. If the First Article Inspection is of a component that the Contractor is purchasing, rather than manufacturing, the First Article Inspection discloses details that were not previously visible through Contractor submittals.
- **First Article:** The first unit of any production component produced in accordance with approved drawings. The Contract provides that nothing be manufactured prior to approval, so First Article shall have been made from approved drawings.
- **Fleet Defect:** Any Defect in which the rate of the Defect reaches 20% of the total number of such items during any consecutive twelve-month period.
- Flow-Down to Subcontractors: All articles, sub-articles, or obligations in the Contract noted by a single star ("★") that must be included in all subcontracts of any tier.
- **Hidden Damage**: Damage not otherwise covered by the Scope of Work and which cannot be observed by usual inspection or determined by other specified test until apparatus or material obstructing view is removed, unless removal of such is directed by the Authority.
- **Inspection Agreement:** The agreement made between the Authority and the Contractor for work that will be completed for the inspected production component in accordance with approved drawings for the fleet of cars.
- **Inspector:** The person or firm designated by the Authority as its quality assurance representative.

- Intellectual Property Rights: Inventions (whether patentable or unpatentable and whether or not reduced to practice), patent rights, copyrights, trademark or service-mark rights, trade secrets, know-how, or other intellectual-property or proprietary rights, regardless of whether any such rights have been recorded, perfected, or have been recognized in registrations or issued patents.
- **Interface:** The points at which two or more systems, subsystems, or structures meet, transfer energy, or transfer information.
- Jumper: A short piece of wire or cable with appropriate terminations on each end to permit connection to terminals within a terminal board or to an adjacent terminal strip. Also, a single or multi-conductor cable used to carry current or train line signals between coupled cars and/or locomotives.
- **Key Personnel**: The individuals identified in as such by the Contractor and the Authority, who are considered critical to the Work.
- Latent Defect: A defect not discoverable even by the exercise of ordinary and reasonable care.
- Left Hand Side: The side of the car to the left when standing at the B-end of the car and facing the Aend of the car.
- **Licensed Uses**: All uses or actions (by the Authority directly or by the Authority through its contractors, consultants, vendors, or other agents) reasonably necessary or desirable for operation of the Rail Cars in the ordinary or reasonably foreseeable aspects of the Authority's operations and services.
- Liens: A charge, hold, claim, or encumbrance upon the property of another as security for some debt or charge.
- LRU (Line Replaceable Unit): A unit/component or subsystem that is normally replaced in line, without cutting the Locomotive from the train consist.
- **LLRU (Lowest Level Replaceable Unit)**: The lowest component of a subsystem which can be replaced from an installed position by use of standard attachments.
- **Maintainability:** A measure of a car's ability to be properly maintained taking into account the ease and frequency of maintenance tasks, ability to efficiently use applied labor, and accessibility of equipment to be maintained by the Authority maintenance staff.
- Maintenance and Guaranty Bond: A promise from a Surety to secure fulfillment of all of Contractor's maintenance and guaranty obligations under this Contract.
- Maintenance, Scheduled: Inspection and repair or replacement of components at intervals measured by time or usage.
- Maintenance, Unscheduled: Repair or replacement of components as a result of failure.

- **Manufacturer**: The original builder or producer supplying materials, equipment, or apparatus for installation on the Rail Car.
- **MDBF (Mean Distance Between Failures):** The reliability of the components, systems, and cars expressed as the mean operating mileage between independent failures of the components, systems, and cars.
- **MTTR (Mean Time to Repair):** A measure of maintainability defined as the time required to restore a car system or car to proper operating condition.
- **Operating Mileage:** The total distance traveled by the car during scheduled and unscheduled movements over established routes as recorded by the Authority.
- **Mock-up**: A full-scale model used to demonstrate Specification compliance.
- **Notice of Acceptance**: A written notice, conditional or final, given by the Authority to Contractor for each Rail Car, confirming that the Rail Car is acceptable for revenue service, though in the case of conditional acceptance a list of open items may remain which Contractor is required to complete to the Authority's satisfaction prior to receiving final acceptance.
- **Notice to Proceed**: A written notification from the Authority that authorizes Contractor to proceed with the Work.
- **Open item:** an issue, action or activity that has not been completed or closed.
- **O&SHA (Operating and Support Hazard Analysis):** Analysis performed primarily to identify and evaluate hazards associated with the environmental, personnel, procedures and equipment involved throughout the operation of a particular system/element. The O&SHA may be performed on such activities such as testing, installation, modification, maintenance, support, transportation, ground servicing, storage, operations, emergency escape rescue, and training. The O&SHA may also be selectively applied to facilities acquisition projects to make sure operation and maintenance manuals properly address the safety requirements.

Operating Speed: Speed at which cars are run by the Authority during revenue service.

- **Overhaul:** The complete disassembly, cleaning, inspection, qualification and replacement or restoration of parts that are found worn in excess of the OEM serviceable tolerances. Overhaul includes testing the reassembled part or component to assure that it functions to the OEM performance specification for an identical new part. Overhaul also includes the Authority-directed work that may be considered an upgrade to the existing equipment.
- **Pilot Car:** The first of each car type which undergoes manufacturing and testing processes and, once each stage of work is approved, serves as the standard to be in manufacturing the balance of the cars.
- **Preliminary Hazard Analysis (PHA):** The initial effort in hazard analysis during the system design phase or the programming and requirements developmental phase for facilities acquisition. It may also be used on an operational system for the initial examination of the state of safety.

- **Product Data**: Written, printed, or electronic descriptions, illustrations, standard schedules, performance charts, instructions, brochures, diagrams, or other information furnished by Contractor to describe Materials to be used for some portion of the Work.
- **Project Manager:** The respective party's individual with authority for managing the subject matter of the Contract and the relationship of the parties.
- **Project Schedule:** The schedule prepared by the Contractor and accepted by the Authority setting forth the logical sequence of activities required for the Contract's orderly performance and completion of the Work in accordance with the Contract and specifically to meet the specified milestone dates.
- **Qualify:** The classification, based on evaluation of inspection or test results, of a previously applied part, component or system as fit for re-application and continued service until the next proven service interval for that part, component, or system.
- Rail Cars: The Rail Cars under this Contract.
- **Rebuild:** A capital expense associated with rolling stock that occurs at or near the end of a unit of rolling stock's useful life, and which results in an extended useful life for the unit of rolling stock consistent with the extent of the rebuilding. The FTA definition of the Scope of Work performed under this Contract.
- **Refurbish:** Disassemble, clean, repair, replace, and reassemble to achieve the specified features, functions, performance and service life as new equipment.
- **Reliability:** The probability of a component, system, or car of performing a specified function without failure and within design parameters, for the period of time intended, under normal operating conditions.
- Renew: Install identical item in new, unused condition.
- **Replace**: Install a new but different model in lieu of current configuration.
- **Right Hand Side:** The side of the car to the right when standing at the B-end (R-end) of the car and facing the A-end (F-end) of the car.
- **Shipment:** The physical departure of the car from the Contractor's facility to the Authority's designated receiving site.
- **Shop Drawings:** Drawings, diagrams, schedules, sketches or other data prepared by the Contractor, or any Subcontractor, manufacturer, supplier, or distributor to illustrate or detail some portion of the Work for use in manufacturing or other activities.
- **Slide, Wheel:** The condition that occurs when the braking force (deceleration) overcomes the available adhesion at the wheel/rail interface, resulting in the wheel rotating at a speed less than that of pure rolling contact between the tread and rail.

- **Software**: Contractor-provided computer application programs which are incorporated in any system, subsystem, assembly, subassembly or components of any Rail Cars, or any interfaces or interface system control between or among any of these, or which are used by Contractor for diagnostics on or other testing of the Rail Cars.
- **Stop, Emergency:** The stopping of a car or train by an emergency brake application.
- **Stop, Service:** The stopping of a car or train by application of service braking.
- **Subcontractor**: Any firm or person or entity under contract to Contractor, authorized by the Authority to assist in the Work.
- **Supplier**: A person, firm, contractor, corporation, or combination thereof who furnishes materials, equipment or supplies for the Work to Contractor either directly or indirectly.
- **Supplier:** Any person, firm, partnership, corporation or other entity that provides materials, including those fabricated to a special design, but usually provides no labor other than delivery.
- **System**: A combination of subsystems, components and/or parts whether or not mechanical in nature, which, when performing together or taken as a whole constitutes or provides a discrete operation, function or subdivision of a Rail Car.
- <u>Systems Support</u>: The provision of services associated with the Rail Cars, including all design, engineering, manuals, catalogs, one-time qualification-type testing, field support, training sessions, extended warranties, and other items as required in the Scope of Work.
- **Tamperproof:** Designation for fasteners selected so that they cannot be easily loosened with common tools.
- Third Party Software: Any Software that is not Contractor Software.
- **Tight (***used as a suffix***):** Designation indicating that when apparatus is. Water-tight, dust-tight," etc., it has been constructed so that the enclosing case will exclude the specified material. Not letting (something specified) in or out, i.e. "watertight", "airtight", etc.
- **Time, Down:** The elapsed time during which equipment is not capable of doing useful work because of maladjustment, malfunction, or maintenance in progress.
- **Time, Warm-up:** The elapsed time from application of power to an operable device until it is capable of performing all of its intended functions.
- Trailer Car: A passenger car for use in any orientation between end of train cab car and Locomotive.
- Train: A configuration of cars and Locomotives to be used in revenue service.
- **Unit**: A term used to either individually or collectively refer to a system, subsystem, component, assembly, subassembly or part of a Rail Car.
- Vital Circuit: Any circuit and its elements, the function of which affects the safety of vehicle or train operations or both.

- **Warranty Bond**: A promise from a third party to fulfill Contractor's warranty obligations under this Contract.
- **Waterproof:** The design, construction, and/or treatment of a device, component, apparatus, or structure that allows the device, component, apparatus, or structure to operate or function normally with its intended level of reliability for the duration of its design life without detrimental effect from the presence of moisture or water resulting from leakage or condensation in its operating or functional environment.
- Week: unless otherwise specified, seven consecutive calendar days.
- **Weight, Actual:** The measured weight of a finished empty car (AWO), ready for passenger carrying service, and with full water and biocide tanks.

Work: All the obligations of Contractor under the Contract.

APPENDIX 2 - ABBREVIATIONS

The following list of abbreviations is used in this solicitation. The list is provided as information only and may not be all-inclusive.

Α	Ampere
AAR	Association of American Railroads
AATCC	American Association of Textile Chemists & Colorists
AC	Alternating Current
ADA	Americans with Disabilities Act of 1990 (as amended)
AFBMA	Anti-Friction Bearing Manufacturer's Association
AFI	Air Filter Institute
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
AMCA	Air Moving & Conditioning Association
ANSI	American National Standards Institute
АРА	American Plywood Association
API	American Petroleum Institute
APS	Auxiliary Power Supply
АРТА	American Public Transportation Association
APU	Auxiliary Power Unit
AREA	American Railway Engineering Association
AREMA	American Railway Engineering & Maintenance-of-Way Association
ARI	Air Conditioning & Refrigeration Institute
ASC	Automatic Speed Control
ASES	Advanced Speed Enforcement System
ASHRAE Engineering	American Society of Heating, Refrigerating & Air Conditioning
ASIC	Application Specific Integrated Circuit
ASM	American Society for Metals
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing & Materials
АТС	Automatic Train Control
ATS	Automatic Train Stop

AWG	. American Wire Gauge
AWS	. American Welding Society
ВНР	. Brake Horsepower
BTE	. Bench Test Equipment
BTU	. British Thermal Test
С	. Capacitance
С	. Degree Celsius
CAD	. Computer Aided Design
CD	. Compact Disk
CDB	. Degrees Celsius Dry Bulb
CDPD	. Cellular Digital Packet Data
CDRL	. Contract Deliverable Requirement List
CDS	. Central Diagnostic System
CEM	. Crash Energy Management
CER	. Critical Engineering Review
	Computational Fluid Dynamic
CI D	
cfm	. Cubic Feet per Minute
cfm CFR	. Cubic Feet per Minute . Code of Federal Regulations
CFR CLDS	. Cubic Feet per Minute . Code of Federal Regulations . Car Level Diagnostic System
CFR CFR CLDS CMF	. Cubic Feet per Minute . Code of Federal Regulations . Car Level Diagnostic System . Central Maintenance Facility
CFR CFR CLDS CMF COT&S	. Cubic Feet per Minute . Code of Federal Regulations . Car Level Diagnostic System . Central Maintenance Facility . Clean, Oil, Test & Stencil
CFR CFR CLDS CMF COT&S CPM	. Cubic Feet per Minute . Code of Federal Regulations . Car Level Diagnostic System . Central Maintenance Facility . Clean, Oil, Test & Stencil . Critical Path Method
CFR CFR CLDS CMF COT&S CPM CPTS	. Cubic Feet per Minute . Code of Federal Regulations . Car Level Diagnostic System . Central Maintenance Facility . Clean, Oil, Test & Stencil . Critical Path Method . Commercial Off the Shelf
CFR CFR CLDS CMF COT&S CPM CPTS CPU	. Cubic Feet per Minute . Code of Federal Regulations . Car Level Diagnostic System . Central Maintenance Facility . Clean, Oil, Test & Stencil . Critical Path Method . Commercial Off the Shelf . Central Processing Unit
CFD	. Cubic Feet per Minute . Code of Federal Regulations . Car Level Diagnostic System . Central Maintenance Facility . Clean, Oil, Test & Stencil . Critical Path Method . Commercial Off the Shelf . Central Processing Unit . Cyclic Redundancy Check
CFD	 Computational Hald Dynamic Cubic Feet per Minute Code of Federal Regulations Car Level Diagnostic System Central Maintenance Facility Clean, Oil, Test & Stencil Critical Path Method Commercial Off the Shelf Central Processing Unit Cyclic Redundancy Check Critical Radiant Flux
CFD	 Computational Hald Dynamic Cubic Feet per Minute Code of Federal Regulations Car Level Diagnostic System Central Maintenance Facility Clean, Oil, Test & Stencil Critical Path Method Commercial Off the Shelf Central Processing Unit Cyclic Redundancy Check Critical Radiant Flux Communication System
CFD	 Computational Hald Dynamic Cubic Feet per Minute Code of Federal Regulations Car Level Diagnostic System Central Maintenance Facility Clean, Oil, Test & Stencil Critical Path Method Commercial Off the Shelf Central Processing Unit Cyclic Redundancy Check Critical Radiant Flux Communication System Car Level Diagnostic System
CFD	 Computational Hald Dynamic Cubic Feet per Minute Code of Federal Regulations Car Level Diagnostic System Central Maintenance Facility Clean, Oil, Test & Stencil Critical Path Method Commercial Off the Shelf Central Processing Unit Cyclic Redundancy Check Critical Radiant Flux Communication System Car Level Diagnostic System Cab Signal System
CFD	 Computational Hald Dynamic Cubic Feet per Minute Code of Federal Regulations Car Level Diagnostic System Central Maintenance Facility Clean, Oil, Test & Stencil Critical Path Method Commercial Off the Shelf Central Processing Unit Cyclic Redundancy Check Critical Radiant Flux Communication System Car Level Diagnostic System Cab Signal System Degrees Celsius Wet Bulb
CFD	 Computational Hald Dynamic Cubic Feet per Minute Code of Federal Regulations Car Level Diagnostic System Central Maintenance Facility Clean, Oil, Test & Stencil Critical Path Method Commercial Off the Shelf Central Processing Unit Cyclic Redundancy Check Critical Radiant Flux Communication System Car Level Diagnostic System Cab Signal System Degrees Celsius Wet Bulb Data Acquisition Unit

dBA	Decibel, A-Weighted Scale
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DBU Disc Brake Unit

DC..... Direct Current

DCN Data Car Network

DCS..... Door Control System

DDU..... Driver Display Unit

Ds Specific Optical Density

DTMF..... Dual-Tone Multi Frequency

DTN Data Trainline Network

DUART...... Dual Universal Asynchronous Receiver/Transmitter

E Modulus of Elasticity

ECR Engineering Change Request

ECU..... Electronic Control Unit

EEPROM Electrically Erasable Programmable Read Only Memory

EER Energy Efficient Radio

EIA Electronic Industries Association

EMC..... Electromagnetic Compatibility

EMCP..... Electro-Magnetic Compatibility Plan

EMF Eastern Maintenance Facility also see CMF

EMI Electromagnetic Interference

EPA Environmental Protection Agency

EPA Environmental Protection Agency

EPIC Electro-Pneumatic Integrated Control

EPROM Erasable Programmable Read-Only Memory

ERTIS En Route Transit Information System

F Degrees Fahrenheit

FAI First Article Inspection

FAI First Article Inspection

FAP Frequency Allocation Protocol

FAR Federal Acquisition Regulations

FCC Federal Communications Commission

FDA..... Food and Drug Administration

FDB	. Degrees Fahrenheit Dry Bulb
FEA	. Finite Element Analysis
FMECA	. Failure Mode Effects and Criticality Analysis
FPM	. Feet Per Minute
FR	. Fiberglass Reinforced Plastic
FRA	. Federal Railroad Administration
FRACAS	. Failure Reporting and Corrective Action System
FRB	. Failure Review Board
FTA	. Federal Transit Administration
FWB	. Degrees Fahrenheit Wet Bulb
g	. Gravitational Acceleration
GP	. General Purpose
GPS	. Global Positioning System
GTO	. Gate Tum-Off
HAZ	. Heat Affected Zone
HCFC	. Hydro chlorofluorocarbon
HDLC	. High Level Data Link Control
НЕР	. Head End Power
HFC	. Hydro fluorocarbon
НР	. Horsepower
HVAC	. Heating, Ventilation, & Air Conditioning
Hz	. Hertz
I/O	. Input/Output
IC	. Inter-communications System
ICEA	. Insulated Cable Engineers Association
IEC	. International Electrotechnical Commission
IEEE	. Institute of Electrical & Electronic Engineers, Inc
IEM	. Interactive Electronic Manual
IES	. Illuminating Engineering Society
IFD	. Indentation Force Deflection
IPC	. Institute of Printed Circuits
IPER	. In-Process Engineering Review

IPS	. Iron Pipe Size
ls	. Flame Spread Index
ISO	. International Standards Organization
JEDEC	Joint Electronic Device Engineering Council
kHz	. Kilohertz
kVA	. Kilo Volt Ampere
kW	. Kilowatt
LAHT	. Low Alloy High Tensile Strength (Steel)
LAN	. Local Area Network
Lb	. Pounds
Lbf	. Pounds Force
LCD	. Liquid Crystal Display
LED	. Light Emitting Diode
LLRU	. Lowest Level Replaceable Unit
LVDB	. Low Voltage Distribution Bus
LVDN	. Low Voltage Distribution Network
LVPS	. Low Voltage Power Supply
MA	. Motor Alternator
MC	. Master Controller
MDBF	. Mean Distance Between Failure
MDS	. Monitoring and Diagnostics System
MDU	. Maintenance Display Unit
MHz	. Megahertz
MIL	. Military Specification
MPH	. Miles Per Hour
MPHPS	. Miles Per Hour Per Second
MPHPSPS	. Miles Per Hour Per Second Per Second
MRB	. Material Review Board
MS	. Margin of Safety
ms	. Millisecond
MS-DOS	. Microsoft Disc Operating System
MTBF	. Mean Time Between Failure

MTTR Mean Time To Repair	
MU Multiple-Unit	
NBR Net Braking Ratio	
NBS National Bureau of Standards	
NEC National Electrical Code	
NEMA National Electrical Manufacturers' Assoc	iation
NFL No Field Lubrication	
NFPA National Fire Protection Association	
NTP Notice to Proceed	
NTP Notice to Proceed	
O&SHA Operating & Support Hazard Analysis	
OD Outside Diameter	
ODK Operator's Display Keyboard	
OEM Original Equipment Manufacturer	
OHDS Overhead Heat Duct Sensor	
OSHA Occupational Safety and Health Adminis	tration
PC Printed Circuit	
PCB Printed Circuit Board	
PCBs Polychlorinated biphenyls	
PCMCIA Personal Computer Memory Card Intern	ational Association
PCU Pneumatic Control Unit	
PDR Preliminary Design Review	
PEI Passenger Emergency Intercom	
PER Preliminary Engineering Review	
PHA Preliminary Hazard Analysis	
PIV Peak Inverse Voltage	
PLDS Passenger Load Determination System	
ppm Parts Per Million	
PROM Programmable Read-Only Memory	
PS Pressure Switch	
PSI Pounds Per Square Inch	
PSIA Pounds Per Square Inch, Absolute	

PSIG	. Pounds Per Square Inch, Gauge
РТЕ	. Portable Test Equipment, interchangeable with PTU
PTFE	. Polytetrafluorethylene
PTS	. Positive Train Separation
PTU	. Portable Test Unit, interchangeable with PTE
PWM	. Pulse Width Modulation
QA	. Quality Assurance
R-22	. Refrigerant 22
R-C	. Resistive-Capacitive
RDC	. Rail Diesel Car (Budd Company Specific)
RFI	. Radio Frequency Interference
RH	. Relative Humidity
RMS	. Root Mean Square
ROM	. Read-Only Memory
RPM	. Revolutions Per Minute
S&I	. Service & Inspection Facility
S/N	. Signal to Noise Ratio
SAE	. Society of Automotive Engineers
SCCO	. Speed Control Cutout Switch
scfm	. Standard Cubic Feet Per Minute
SCI	. Software Configuration Item
SCR	. Silicone Controlled Rectifier
SCS	. Speed Control System
SDD	. Software Design Description
SDU	. Speed Display Unit
SHR	. Sensible Heat Ratio
SIC	. Standard Industrial Code (US Department of Labor)
SPL	. Sound Pressure Level
SSP	. System Safety Program
ТВА	. To Be Addressed
TBD	. To Be Determined
TBU	. Tread Brake Unit

TDMS	Train	Data	Monitoring System
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TFE Tetrafluoroethylene

Ti Interior Temperature

TIG Tungsten Inert Gas

TIR Total Indicated Runout

TLDS Train Level Diagnostic System

TOR Top-of-Rail

Ts Ambient Temperature

TSDL Technical Specification Deliverable List

TWC Train To Wayside Communications

TXV Thermal Expansion Valve

UA-Factor Total Carbody Heat Transmission Value

UL Underwriters Laboratories Inc.

UNC Unified National Coarse (Thread)

UNF Unified National Fine (Thread)

USASI United States of America Standards Institute

USDOT United States Department of Transportation

UV Ultraviolet

VDC Volts, Direct Current

VMU Vehicle Monitoring Unit

VOM Volt/Ohm Meter

VPI Vacuum Pressure Impregnation

W Watt

WDS Wayside Diagnostic Systems

WPS Weld Procedure Specifications

WTB Wire Train Bus

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APPENDIX 3 – REFERENCE MATERIAL

Please click at the links below to download requested supplemental information:

- SI-01. Bombardier Bi-level Gen I Illustrated Parts Catalogue
- SI-02. Bombardier Bi-level Gen I Electrical Schematics Drawings
- SI-03. Example Electrical Schematics
- SI-04. SCRRA HMM Side Doors Section 4
- SI-05. SCRRA HMM Electrical System Section 5
- SI-06. SCRRA HMM Trucks Section 10
- SI-07. SCRRA HMM Communication System Section 11
- SI-08. MM_CH04_Intercar Connections_Rev.01
- SI-09. MM_CH05_Door System and Controls_Rev.01
- SI-10. MM_CH09_Auxiliary Power Supply and Apparatus_Rev.0
- SI-11. MM_CH12_Communications System_Rev_01
- SI-12. 28 Car Unit History
- SI-13. SCRRA Wheels Specification 99-001
- SI-14. Seat and Seat Cushion Drawings
- SI-15. SCRRA Trailer Car Exterior Decals
- SI-16. SCRRA Trailer Car Interior Decals
- SI-17. SCRRA Trailer Car Services General Arrangement
- SI-18. SCRRA Performance Bond Example

The schematics, drawings and specifications (collectively, the Proprietary Material) being provided by the Authority in connection with RFP EP199-19 are confidential material of the Authority and/or the equipment manufacturer, Bombardier Inc. Proposer may use the Proprietary Material only in connection with the creation of its proposal. Certain of the Proprietary Materials may also constitute Sensitive Security Information governed by 49 C.F.R. §1520 and regulations cited therein.

Proposer must treat the Proprietary Material as secret and confidential and maynot disclose or give such Proprietary Material to others except with written permission of the Authority, and may not use such Proprietary Material except to the extent reasonably necessary for the evaluation and creation of a proposal.

APPENDIX 4 - EXTERIOR COLOR SCHEME



DWG NO. 20-001-000109 (Sheet 1/2)



DWG NO. 20-001-000109 (Sheet 2/2)



DRAWING NO. 20-001-000110 (Sheet 1/2)



DWG NO. 20-001-000110 (Sheet 2/2)



ATTACHMENT A (PART 1) - SCOPE OF WORK

1 **PROJECT OVERVIEW**

The purpose of this rebuild is to improve the reliability and appearance of the Southern California Regional Rail Authority's existing Bombardier passenger rail car fleet and to update/upgrade it to comply with current standards and regulations. The scope of the rebuild includes the refurbishment, renewal, overhaul, replacement and reconditioning of existing hardware, components, equipment, systems and apparatus to extend the useful life of these passenger rail vehicles.

A. Description of Existing Fleet

The Authority currently operates and maintains a commuter rail vehicle fleet configured as follows:

- Locomotives, consisting of F59PH, F59PHI, MPI MP36PH-3C, F40PH and F125 locomotives.
- Bombardier multi-level commuter rail cars, consisting of cab control cars and trailer cars.
- Guardian/Hyundai-Rotem (H-R) multi-level commuter rail cars, consisting of cab control cars and trailer cars.

The Bombardier vehicles have a low alloy, high tensile (LAHT) steel underframe and aluminum car bodies. The vehicles were built by UTDC/Bombardier and supplied to the Authority beginning in 1992. The vehicles received regular maintenance while being operated in revenue service. The vehicles have four areas for passenger seating: upper and lower levels between the trucks and an intermediate level located over each truck. There are two side entry doorways on each side of the lower level. The vehicles are designed to operate safely at up to 100 mph. The 480 VAC, 3-phase power for operation of the vehicle electrical equipment is furnished via trainlined wiring between vehicles in the train with the appropriate jumper cables and receptacles on each vehicle.

The 121 Bombardier rail cars in the fleet were procured with three separate contracts over a period of approximately 10 years and they generally have the same configuration.

Year in Service	Cab Car	Trailer Car	Contract Number
1992	28	60	R60-CR-001
1997	5	2	PO150
2002	0	26	EP100
Total by Type	33	88	
Grand Total	12		

The vehicles are owned by the Authority and operated by Amtrak. Any of the cab control cars provided for the Work will have been downgraded to remove all train control features to

function as trailer cars. The cars procured under the Authority Contract No. R60-CR-001 rebuilt under this Contract shall be modified from 36 Volt cars to 72 Volt cars to provide equivalent, interoperable performance and to be functionally compatible with the balance of the fleet.

- B. Description of Facilities
- (1) The Authority's Central Maintenance Facility (CMF) is located at 1555 San Fernando Road in Los Angeles, California 90065. The CMF is arranged to support maintenance and inspection activities necessary to comply with FRA and California Public Utilities Commission regulations, American Public Transportation Association Standards and Recommended Practices, Association of American Railroads (AAR) Standards, and industry accepted standards and practices. The CMF is equipped to service the trains prior to their release for revenue operation and perform necessary running repairs. The facility includes a drop table to permit the removal and reinstallation of complete truck assemblies; a wheel-truing machine; shops equipped to perform running repairs and to change major components.
- (2) In addition, the Authority maintains equipment storage facilities at Lancaster, Montalvo, Moorpark, San Bernardino, and Riverside. These facilities are equipped to service the trains prior to their release for revenue operation and provide stand-bypower and compressed air. The service work performed at these locations includes daily inspections and repairs such as testing and inspecting the air brakes, performing electrical and mechanical inspections, cleaning the interior cab and passenger areas. There are toilet services at some locations.
- (3) Rebuild work scope may not be performed on Authority property.
- C. Summary of Required Services

The requirements and conditions provided for the rebuild of the vehicles are intended to represent the minimum acceptable conditions for the overhaul, design, manufacture, test and operation of the vehicle systems and the integrated vehicle. The Authority may accept and allow other proven designs, methods, and standards to be used to meet the intent of the Contract, provided the proposed alternative can be shown to the Authority's satisfaction to have a successful, documented, and a service-proven history in this or other industries. In all cases, the Authority reserves the right to disapprove a proposed design, method or standard without cause. The Contractor will provide the following minimum services:

(1) All transportation, inspection, cleaning, disassembly, qualifying, repairing, replacement, engineering, rebuilding, testing, management, labor, materials, tools, equipment, data, design services, and incidentals necessary to complete the specified Work. The Contractor is solely responsible for the repair, replacement, modification, overhaul, manufacture, systems interface and integration, reconfiguration, detailed design of all car systems and components as described and required within the Scope of Work and as determined by and during vehicle inspections.

- (2) All necessary detailed design work, analyses and investigations required to overhaul and configure the Rail Cars, including preparing all required detailed drawings, design calculations, analyses, and all other technical documentation required to perform the Work. All new equipment, apparatus and vehicle systems provided as part of the overhaul work must be the same for all vehicles and be fully interchangeable among the vehicles rebuilt under this Contract.
- (3) All required tests and test reports, certifications and other supplemental information required to demonstrate compliance with 49 CFR 238, including revision of the Authority's fire safety analysis.
- (4) Ensuring compliance in all respects with applicable laws, regulations, standards and recommended practices of the following agencies and organizations:
 - a. US Department of Transportation
 - b. Federal Railroad Administration
 - c. Federal Transportation Administration
 - d. US Public Health, Food and Drug Administration
 - e. State of California
 - f. American Public Transportation Association
 - g. Association of American Railroads
- (5) Ensuring that each Subcontractor and Supplier has a complete copy of the Scope of Work to avoid any confusion regarding the contract requirements and warranty support.
- (6) Ensuring the suitability of the systems, devices, apparatus, components and parts for the service intended, whether they are the Contractor's own or those of Subcontractors.
- (7) Meeting all requirements of the scope of Work and providing all required Deliverables to the Authority whether or not a cross-reference is provided.
- D. Compatibility Requirements.

Rebuilt cars shall be compatible with the existing fleet of locomotives and Rail Cars. To ensure compatibility between the Authority's existing cars and the rebuilt Rail Cars under this Contract, Contractor will be provided, upon request, with additional information with respect to the design of existing the Authority Rail Cars.

With respect to the requirement that the Rail Cars be compatible with the existing fleet of locomotives and cars, Contractor's liability shall be limited to its compliance with the Scope of Work and the design process. If the Rail Cars do not meet the compatibility objectives because Contractor has failed to comply with the Scope of Work and the approved design, Contractor shall be obligated, at its cost, to make all modifications necessary to the Rail Cars to fully comply with those specifications and design. If Contractor fulfills every contractual

requirement and compatibility is not achieved, Contractor shall have no responsibility or liability to the Authority. However, in such situations, Contractor and the Authority shall determine the modifications to be made to enable the Rail Cars and the existing fleet of cars to be compatible. Contractor shall implement modifications pursuant to the provisions of the Contract, except that the Change Order issued will include only Contractor's cost exclusive of profit.

E. Removal of parts

Unless specifically required by the Contract, no items, components, structure, systems, wiring, piping, etc., may be removed, repaired, reconfigured, or modified in any way unless required as part of the rebuild work. Removal and replacement of items required to facilitate the rebuild, as well as replacement of missing and damaged fasteners, electrical terminals and wire labels, is considered part of the Scope of Work.

F. Quantity of Cars to be Rebuilt

The base order is 50 cars. The remaining 71 cars shall be priced as options. The number of cars to be rebuilt may be subject to change pending available funds and occurrences out of the Authority's control. Unless otherwise directed by the Authority, the initial focus will be completing the rebuild on the Generation 1 Cars.

G. Additional Cars

Options will be exercised in groups of no less than 5 cars. Should additional cars be added, the Authority will notify the Contractor six months in advance of adding the additional cars.

2 CLARIFICATIONS

If Work is not sufficiently explained and defined or any aspect is not technically feasible or is inconsistent with the intent of the Work, the Contractor may request clarification and determination of the requirements. The Authority's Project Manager will endeavor to respond to the request for clarification within five days of receipt of the Contractor's request.

The purpose of the design review is to insure the requirements of the Scope of Work are met by the design. The design review process shall be coordinated with the drawing submittal, review and approval process. Any approval by the Authority's Project Manager shall not relieve the Contractor from the responsibility to comply with the requirements of the Contract in all aspects of Work. The Contractor's technical documentation submitted to support the design review process shall clearly define the systems and vehicle designs, production processes, testing and operational criteria, and compliance with the Contract requirements. Interfaces between the various systems, between structural elements and their sub-assemblies, and between the structural elements and the attached apparatus, equipment, wiring, piping, and hardware shall be clearly detailed in the technical documentation and design drawings.

As a minimum, two reviews, preliminary and final, shall be conducted. Each review may require several iterations to complete. All action items, outstanding issues and requests for clarification from the preliminary design review shall be satisfactorily resolved prior to commencing final design
reviews. Formal design reviews shall be scheduled no sooner than fifteen working days after receipt of said design review package by the Engineer.

All drawings shall be prepared using a CAD format, approved by the Engineer. All "as-built" drawings shall be prepared in accordance with ANSI standards and shall be submitted as electronic documents using the approved AutoCAD. All reports shall be submitted in MS Word [®] format. [CDRL 1.001]

3 REVIEW AND APPROVAL

The Authority's Project Manager will review each submittal furnished by the Contractor within thirty days of its receipt. Upon completion of the review the Authority's Project Manager shall notify the Contractor in writing of the status of the submittal with one of the following dispositions:

<u>Approved</u> – The Contractor may proceed with the work addressed in the submittal.

<u>Approval Pending</u> – The Contractor must not proceed with the Work affected by the noted comments until the Contractor has responded to the comments; the comments have been reviewed; and the status of the submittal has been changed from "Approval Pending" to "Approved."

<u>Not Approved</u> – The Contractor must not proceed with the Work. The Contractor must revise and resubmit the submittal. The revised submittal shall address to the satisfaction of the Authority's Project Manager all the comments provided in the Engineer's writing of the disposition.

Information – This disposition is provided for submittals presented to explain an "approved equal" submittal, a concept and/or an approach to the Work, and appropriate conditions. The Contractor may not proceed with the Work addressed in such submittals until the concept has been finalized and "Approved."

The Contractor shall respond in writing to comments provided by the Authority's Project Manager within fifteen days of receiving the comments. The Contractor may not release any designs for manufacture before approval of the final design by the Engineer.

4 CHANGES

Requests for changes or alternatives to required materials must be made in writing to the Project Manager. Each request must include all pertinent information to verify that the item offered is equal to or exceeds the Scope of Work requirements. Include all test requirements in the Scope of Work that pertain to an item under consideration in the request submittal package. Sample components may be submitted to the Authority's Project Manager to facilitate the evaluation of the proposed alternative item. Such samples become the property of the Authority.

The Authority's Project Manager may request the Contractor to dismantle and/or functionally test such samples to establish the equality or superiority of form, fit, and function. The Contractor shall fulfill all such requests.

CDRL #	
CDILLI	

Description

5 SYSTEMS DESIGN AND INTEGRATION

The Contractor is responsible for the proper design, integration, and functioning of all systems and their interrelation with all other parts of the cars, and at a minimum, will do all of the following:

- (1) Provide complete systems integration services during the design, overhaul, and testing phases of the Contract, coordinating all electrical and mechanical interfaces between the vehicle subsystems, the vehicle, the wayside and shop, and electrical interference control and the Authority's existing fleet.
- (2) Complete necessary design tasks to perform the work, and prepare and submit all necessary detail drawings, design calculations, other specified technical documentation and Contract required submittals. Submit such additional or revised drawings, diagrams, calculations, tests results, etc. as the Authority's Project Manager deems necessary to confirm the completeness and accuracy of Contractor's submittal.
- (3) Incorporate ergonomic/human factor guidelines in the design, the placement and maintenance access of all parts of the vehicle affected by the overhaul work. Provide sufficient clearance between components to allow testing, removal, and replacement without difficulty. Install all devices so that they are fully accessible for inspection, repair-in-place, or removal and replacement. All parts shall be installed in a manner that facilitates inspection, testing, maintenance and troubleshooting. Those items requiring routine maintenance and removal must be accessible without requiring disassembly and removal of other components.
- B. Drawings

Develop complete and comprehensive drawings for the overhaul work, including equipment assemblies their installations and arrangements, passenger area, electric and pneumatic diagrams and schematics, and exterior elevations. In the drawings, identify equipment interface and installation requirements, access points, equipment weight and center of gravity, and work space envelope requirements.

Include sufficient details in the drawings and technical documentation to convey the concept, design dimensions, maintenance, operation, overall assembly, and interfaces. Review and approve drawings and documentation submitted by subcontractors prior to submitting them to the Authority's Project Manager for review and approval of the request. [CDRL 2.001]

C. Test Procedures and Reports

Perform or arrange for the performance of all tests specified. Test procedures and reports shall cover subcontractor tests to be completed at their plant, all Contractor tests to be completed at its plant and all tests to be completed at the Authority. No tests shall be conducted prior to its approval by the Engineer. All test procedures shall be approved by the Authority's Project Manager at least thirty days prior to the scheduled test date. [CDRL 2.002]

Ensure that all test procedures and reports are reviewed and approved by the Contractor's Engineering department prior to submittal. The Pilot Cars will undergo vehicle performance qualification testing after delivery to the Authority. The vehicle performance qualification tests shall be arranged to verify and validate the features, functions and performance of each vehicle system included in the Work as integrated vehicle systems. The Contractor shall develop test procedures for each vehicle system itemizing by Technical Specification reference for the specified features, functions and performance parameters being demonstrated by the particular test. [Part of CDRL 2.002]

All test reports pertaining to routine acceptance and for equipment specific to the rebuild work shall be included in the Car History Book. A pre-revenue service acceptance testing plan in accordance with FRA 238.111 shall be developed as appropriate to the rebuild. This plan shall include the test data necessary to support the Authority's waiver for operation at 4 inches of cant deficiency and Electro Magnetic Compatibility compliance with applicable portions of the Authority's PTC RFI Interference Test Plan. [CDRL 2.003]

D. SUBMITTAL REQUIREMENTS

Each submittal must be accompanied by a transmittal letter that identifies the Contract Section the submittal addresses. Each submittal revision must be accompanied by a similar transmittal letter that references the previous submittal and dispositions.

6 **PRODUCTION FACILITIES**

Rebuild work scope may not be performed on SCRRA property. Contractor must have adequate facilities to perform all required Work. At a minimum, the production facilities must support the following activities:

- Vehicle storage during rebuild and until return to the Authority's property
- Parts warehousing
- Design drawing and control
- Production processes and control
- Primary parts cutting and assembly
- Welding operations
- Weld testing
- Painting
- Equipment installation
- Interior materials installation (insulation, interior panels, flooring, etc.)

- Wiring Installation
- Piping Installation
- Truck Assembly
- Water tightness testing
- HVAC testing
- Car functional testing
- Testing on track
- In-coming, in-process and pre-shipment inspections

Contractor's final assembly facilities must support all Buy America Requirements for final assembly facilities defined by 49 CFR 661 and FTA's Dear Colleague Letter March 18, 1997 letter number C-97-03, as either may be amended.

7 MANAGEMENT SYSTEMS

A. Program Management

The Contractor's organization must be able to properly manage this Contract and ensure ontime performance of the Work. The Contractor is responsible for ensuring that all required design, and configuration reviews are addressed, and all required deliverables are submitted as specified.

The Contractor shall develop and submit a Management Plan for Authority approval. Submit the Management Plan no later than forty-five days after the Authority issues a Notice to Proceed. [CDRL 2.004]

The Management Plan must show all design reviews, testing, inspections, and audits required by the Contract, and must include:

- (1) An organization chart including names and a definition of the responsibilities and qualifications of all personnel therein for the Contractor and major suppliers. As appropriate, staff of the Contractor and major suppliers at the local office, design, manufacturing, assembly, and the Authority project site locations shall be identified.
- (2) The internal methods, communications, correspondence coding system, and correspondence control to be used to monitor, oversee, and manage the Schedule, technical performance, changes, subcontracts, purchase orders, material procurement, in-service support, warranty, systems assurance analysis, tests, and demonstrations.
- (3) A Master Contract Schedule in Critical Path Method (CPM) format showing key milestones, events and activities.
- (4) A list of drawings and documents to be submitted during the design review phase of the Contract and a schedule for the submittal of these drawings and documents.

- (5) An updated and expanded Contract Deliverable Requirements List (CDRL) based on the Contract and on the information in each Section of the Scope of Work within 60 days after the Authority issues Notice to Proceed. The CDRL shall contain the consolidated listing of all required deliverables including specific format, quantity, frequency, and paragraph reference of submittal as required by the Technical Requirements. Submittals include, but are not limited to, schedules, plans, procedures, reports, certificates, samples, certifications, test results, and as-built drawings. The CDRL shall be in accordance with the following column headings:
 - a. Item No: Numeric identifier
 - b. Title: CDRL item
 - c. Reference Section: Location of requirement within the Contract Documents
 - d. Description: Brief description of required due dates and frequency
 - e. Quantity: Number of documents, units, or copies required
 - f. Planned submittal date
 - g. Person responsible for preparing the CDRL
- B. Systems Engineering Management

The Contractor shall treat the Rail Cars as a single system rather than as an assembly of independently engineered and manufactured elements, integrating the specified requirements for reliability, maintainability, safety, quality, testing, and human factors into the total engineering effort. The technical and performance requirements of the Contract shall be integrated into the Contractor's review process to ensure physical and functional interfaces are optimized throughout the design, rebuild and test phases.

C. Configuration Control Management

The Contractor shall maintain accurate and current configuration control records that are available to the Authority and its inspector throughout the performance of the Work and warranty period. The records shall identify the configuration to the lowest level required to ensure repeatable performance, quality and reliability.

D. Project Meetings

Project meetings shall be held initially no less than once every two weeks at a mutually agreed-to location. The Contractor shall be represented by its Project Manager or an the Authority-approved designee. The first Project Meeting will be held ten working days after NTP at a time and location designated by the Authority. At this meeting, Contractor shall introduce key personnel, including Subcontractors.

E. Monthly Progress Reports

After the Authority's approval of the Master Contract Schedule, the Contractor shall submit to the Authority a Monthly Progress Report containing data as of the end of each month for each month. [CDRL 2.005]. The Monthly Progress Reports will serve as a joint review and agreement on project progress. Monthly Progress Reports shall specifically include:

- All items listed in the Management Plan,
- Actual completion dates for activities completed during the report period,
- Actual start dates for activities started during the report period,
- Estimated remaining durations for activities in progress,
- Estimated start dates for activities scheduled to start during the six weeks following the report period,
- Changes in the durations of activities and minor logic changes,
- Workaround plans needed to make up for schedule slippage, as necessary,
- A narrative in bullet format highlighting problem areas and corrective actions being taken to resolve the actual/potential problem,
- Record of the Contractor's drawing/document status,
- Engineering Change requests Status Report,
- Change Order Log indicating pending or open Change Orders,
- Financial summary,
- Activities not previously included in the Master Contract Schedule necessary to complete the work, and
- Status of correspondence including open items.
- A summary list of actual car weights by car number, the cumulative average car weight along with a graphic comparison of cumulative average car weight with individual car weight by car number.

The Contractor shall include with the Monthly Progress Report an updated Master Contract Schedule containing data as of the end of each prior month. The Monthly Progress Report is due the fifth day of each month for the life of the project.

The Contractor shall also provide a narrative, which shall state the Work actually completed and reflect the progress in terms of days ahead of or behind the specified dates for each of the work items, as well as percent completed. During the manufacturing, assembly, and testing phases, Contractor shall supplement the narrative with color photographs (digital) to show the status and/or problem areas of the work-in-progress. The Authority may request supplemental detailed reports and/or photographs if those, provided in the Monthly Progress Report, are determined to be inadequate.

- F. Master Contract Schedule and Updating
- (1) Schedule is of paramount importance in this procurement. Contractor shall submit a time-scaled CPM schedule indicating achievement of key milestones, both design and construction, using the date of Notice to Proceed for the purposes of preparing the Baseline Master Contract Schedule. [CDRL 2.006] Accompanying this schedule shall be

a narrative describing the Contractor's approach to implementing and maintaining this schedule. With regard to the schedule submittal, Contractor shall:

- a. Indicate all activities by ID and description
- b. Indicate Early Start, Start, Early Finish, and Finish dates for all activities
- c. Indicate all activity durations
- d. Indicate logical connections between all activities
- e. Indicate float for all activities
- f. Indicate a specific date for each milestone activity
- (2) As a minimum, Contractor shall include the following activities:
 - a. Project mobilization time
 - b. Rail car shipping time
 - c. Submittal of general arrangement drawings
 - d. Each major subsystem contractor under contract
 - e. Design and mock-up review and approval
 - f. Qualification testing and first article inspection of major subsystems and components
 - g. Commence disassembly and inspection
 - h. Commence work for major assemblies
 - i. Floor Fire test
 - j. Complete first trucks
 - k. Commence user training and manual development
 - I. Commence final assembly
 - m. Equipment installation
 - n. Final truck mounting
 - o. Complete first car
 - p. Complete design qualification test
 - q. Submittal of System Safety Program Plan
 - r. Delivery of each Rail Car to SCRRRA
 - s. Acceptance of first car
 - t. Delivery schedule and the estimate acceptance schedule
 - u. Reliability Demonstration Test
- (3) The Contractor shall update the Master Contract Schedule in the following manner:

- a. Baseline schedule shall remain the same for each update.
- Actual progress shall be shown using different colored lines or lines of a different pattern from those used when preparing the initial baseline schedule. Actual progress shall be shown directly under the activity with the percentage complete indicated as of the date the report was prepared.
- c. Date of the updates shall be provided.
- d. Actual start/finish dates shall be shown for activities in progress.
- (4) If Contractor's actual progress of the Work falls ten working days behind the approved Baseline Schedule for the Contract completion date, the Contractor must prepare and submit a Recovery Schedule within five working days to explain how the Contractor intends to bring the work back on schedule. The plan for recovery must conform to all other Contract requirements. Incorporate revisions accepted by the Authority in the next Progress Schedule. Do not incorporate proposed revisions in the Progress Schedule prior to their acceptance.
- G. Progress Review Meetings

The Authority will hold Progress Review Meetings every month or as otherwise agreed. Depending on the subject matter to be covered, the Authority may opt to meet at its own facilities or those of the Contractor or a subcontractor. The Authority will endeavor to make these locations known to the Contractor at least fourteen days prior to the meetings.

The Contractor and the Authority will collaborate to prepare an approved agenda for the meetings five working days prior to the scheduled meeting date, and the appropriate Contractor personnel, based upon the approved agenda, shall attend. The following topics may be discussed:

- (1) New attendees and their areas of responsibility.
- (2) Review minutes of previous meetings.
- (3) Provide and review an updated Master Contract Schedule.
- Work accomplished since previous meetings, including: product delivery status, schedule slippages, impacts arising from proposed changes, and other circumstances which might affect progress of the work.
- (5) Critical work and the Contract Schedule and Monthly Progress Reports.
- (6) Engineering, manufacturing, and quality assurance/control activities.
- (7) Measures to maintain Contract Schedule when necessary.
- (8) Training Program and manuals.

Each of the inquiries, reports, and requests for solution of problems presented during such meetings shall be answered, if possible, during the meeting. Those not answered during the

meeting shall be answered, solved subsequent to the meeting and the resolution documented and delivered in person or mailed to the Authority's designee for comment and approval, within five working days of the close of the meeting, or longer time frame, if acceptable to the Authority. Such answers shall be communicated to the Authority in writing, or in a mutually agreed upon manner.

8 QUALITY ASSURANCE

A. General

The Contractor will establish and maintain an effective quality assurance program to exercise quality control over all phases of the rebuild and preparation for delivery. As part of the quality assurance program, the Contractor will maintain an ongoing history of customer complaints with corrective action. The program must also control the quality of subcomponent articles. The quality assurance program must have the responsibility for reliability, quality control, inspection planning, establishment of the quality control system, and acceptance/rejection of materials and manufactured articles in the rebuild of the Rail Cars.

B. Protection of Rail Cars During Transit

The Contractor shall establish and maintain procedures for implementing corrective and preventive action to prevent missing items and damage during transportation. The Contractor shall implement and record any changes to the documented procedures resulting from corrective and preventive action.

C. Repairs by Others

For specialized repairs that cannot be performed by the Contractor, the Contractor must submit the name of the specialty Subcontractor and Scope of Work to the Authority for approval. [CDRL 2.009]

Any rebuild Work beyond the scope of this Contractual Scope of Work must be authorized by the Authority.

9 INSPECTIONS, GENERAL

A. Contractor's Inspection Requirements

The Contractor shall inspect and physically and/or functionally test all items to be delivered under the terms of this Contract. Inspection and testing must occur at appropriate points in the rebuild sequence to ensure compliance with drawings, process and test specifications, quality procedures and standards. The Contractor shall ensure that inspections and tests are based on the latest approved design. All inspection procedures shall include provisions for reporting defects, exceptions, deficiencies and questionable work to the Engineer.

- B. Authority Access to Plant and Subcontractor Facilities
- (1) The Authority and its authorized representatives shall have access at all times, during working hours, to all Contractor and subcontractor facilities, whether necessary or

convenient, for inspecting the materials to be furnished and the Work to be done under the Contract. The Contractor shall extend and shall ensure that its subcontractors extend to the Authority and its representatives full cooperation and necessary facilities to permit the proper inspection and testing of materials, work and equipment supplied. Representatives of the Authority shall be admitted at any time summarily and without delay at any place where the Work is being performed, or to inspect materials at any place or stage of their rebuild, preparation, shipment, or delivery.

- (2) The Authority may station its own inspector at the Contractor's or its subcontractors' facilities during the execution of the Work. The inspector shall be authorized and allowed to inspect all Work, and materials furnished, to determine the quality of workmanship and to make periodic assessments of the Work.
- (3) The Authority has the right to conduct the most thorough and minute inspection of all Work and materials and of the preparation of materials and of the rebuild from the beginning to the final completion of the Work. The Authority may draw the attention of Contractor to all defects in workmanship, materials, and other errors or variations from the requirements of this Contract. But no omission on the part of the Authority or the Project Manager or any of their representatives or their subordinates to point out such errors, variations or defects shall in any way relieve Contractor from its obligations according to the terms of the, nor shall give Contractor any right or claim against the Authority.

C. Defective Work

Should the Authority inspector have evidence that defective work or defective materials have been used, the Contractor and its subcontractor, if appropriate, shall provide the facilities and labor to conduct such inspections of the Work or materials in question as may be required. The Contractor shall provide all inspection data reports showing the inspections and testing of the Work and materials conducted to date of the items under investigation. Any defective work and materials that are disclosed shall be corrected promptly. If the investigation discloses no defect, the delay caused by such investigation will be considered as beyond the Contractor's control. No omission on the part of the Authority to point out any error, variation, or defect will give the Contractor any right or claim against the Authority or relieve Contractor from its obligations and representations under the Contract.

D. Rejected Work

The Authority inspector has the right to reject any materials and/or workmanship that does not comply with the Contract requirements or with approved Contractor's and subcontractors' drawings and/or specifications.

E. Source Inspection

Components, equipment and apparatus that require inspection prior to shipment to the Contractor's facility shall be identified in the Quality Assurance Plan. The Contractor shall maintain records of these inspections with item part numbers, associated correspondence,

drawings, test data, and dates when inspections were conducted and by whom. Samples of approved materials shall be maintained throughout the Contract.

F. Uncovering Finished Work

The Project Manager's right to make inspections shall include the right to order Contractor to uncover or take down portions of finished Work. Should the Work thus exposed or examined prove to be in accordance with the Contract, the uncovering or taking down and the replacing and the restoration of the parts removed will be treated as a Work Directive Change for purpose of computing additional compensation and an extension of time; but should the Work exposed or examined prove unsatisfactory as a result of defects, exceptions, and deficiencies, such uncovering, taking down, replacing and restoration shall be at the expense of Contractor. Should defects, exceptions, or deficiencies be found during the inspection of the uncovered finished Work, the Authority reserves the right to require subsequent inspections for similar Work throughout the balance of the fleet at Contractor's expense. Such expenses shall also include repayment to the Authority for all expenses or costs incurred by it, including employees' salaries or otherwise, in connection with such uncovering, taking down, replacing.

10 FIRST ARTICLE INSPECTIONS

- A. The First Article Inspection (FAI) program will consist of pre-FAIs and FAIs for all major components and subassemblies, and the fully assembled Rail Car. Pre-FAI will be performed by Contractor and FAI will be performed jointly by the Authority and Contractor, unless directed otherwise by the Authority.
- B. The objective of the FAI is to demonstrate that the FAI articles comply with the Contract requirements, conform to design documents, and set an acceptable standard for production workmanship. At the time the FAI is conducted, or earlier if required by the Engineer, the Contractor shall present for review documentation of the physical inspection of the article and required test and inspection reports. Photographs shall be taken and included in the report to document the FAI results. The Contractor shall preserve all First Articles until all Work is completed, unless otherwise approved by the Authority. The FAI results shall be documented in a report submitted to the Authority's Project Manager for review. [CDRL 2.008]
- C. First Article Inspections are required for all Contractor and subcontractor-furnished systems, assemblies, subassemblies and components. An FAI shall be conducted by the Contractor at the point of manufacture on the first piece, component, assembly and system constructed using production tooling and approved or approval pending drawings. Drawings and procedures must be approved by the Authority's Project Manager before the FAI is scheduled. [CDRL 2.007] At a minimum, FAIs must be conducted for the following:
 - Assembled truck
 - Air suspension controls
 - Exterior paint

- Exterior decals and/or graphics
- Coupler, yoke, and draft gear
- Door operators and controls (passenger entry, end-of-car, toilet room)
- Brake equipment and controls
- Reservoirs
- All seat assemblies
- HVAC system and controls (complete including all blowers, fans, diffusers, etc.)
- Low Voltage Power Supply including battery charger
- Light fixtures each type, (interior and exterior)
- Communication system and controls (PA/IC control panels, speakers, information signs, etc.)
- Passenger Emergency Intercom (PEI) system
- Conductor emergency wireless PA announcement system
- Interior panels
- Flooring and floor coverings
- Signage, decals and/or graphics
- Door panels each type (side entry, end-of-car, toilet room, equipment compartments, etc.)
- D. Within 120 days of Notice to Proceed, Contractor shall submit a comprehensive schedule of all pre-FAIs and FAIs. As a minimum, the schedule shall identify the items to be inspected, inspection locations and inspection dates. The Contractor shall submit to the Authority the updated schedule on a monthly basis. The Contractor can schedule the pre-FAIs as it sees fit to meet the FAI schedule but Contractor shall not schedule more than two FAIs within the same week without prior approval by the Authority.
- E. The Contractor shall provide an individual notice to the Authority for each pre-FAI a minimum of 30 calendar days prior to each pre-FAI. The Contractor shall provide an individual notice and the pre-FAI results to the Authority for each FAI a minimum of 30 calendar days prior to each FAI. The Authority will decide whether to attend pre-FAI and /or FAI and notify Contractor 15 working days prior to the event
- F. The Contractor shall be solely responsible for adequate FAI preparation. The Authority shall require Contractor to reimburse the Authority for FAI related expenses if the Authority attends FAI and finds the equipment or site not ready for a meaningful inspection.
- G. Equipment shall not be shipped from the point of rebuild unless an FAI has been offered and

- (1) The Authority attended and approved the FAI results or
- (2) The Authority decided not to attend the inspection and approved the FAI results submitted by Contractor, or
- (3) The Authority waived the FAI altogether.
- H. The Contractor shall be responsible for the project delays caused by pre-FAI and/or FAI failures. If delay does occur Contractor shall present a detailed corrective action plan to address the failures and shall quantify any delays to the Program Schedule with proposed remedial actions.
- I. If the Authority waives pre-FAI and/or FAI, Contractor shall credit the Authority with savings resulting from the inspection's cancellation.
- J. The Contractor shall preserve all First Articles until production of the Rail Cars is completed, unless otherwise approved by the Authority.

11 **★INSPECTION AND ACCEPTANCE OF THE WORK**

A. Outbound Inspection.

The Contractor and the Authority will inspect the condition of each vehicle as it leaves the Authority's property and will document all items or equipment missing from each vehicle. The Contractor will identify damage and missing parts on a form approved by the Authority. A copy of this form shall accompany the vehicle as part of the outbound inspection documents; the original will be retained by the Authority.

The Authority may elect to remove certain items or equipment for maintenance use on the balance of the fleet; any such items shall be listed but not considered "missing." The Authority will supply all major assemblies to be reused on the rebuilt vehicles and found to be missing on outbound inspections.

B. Receiving Inspection.

To confirm the results of the outbound inspection, the Contractor and the Authority will inspect each car as it arrives at the Contractor's facility. Both the Contractor and the Authority representatives will sign off on the results of each such receiving inspection. The Contractor shall take digital photographs of the vehicles in the "as received" condition, specifically areas identified as damaged or missing parts, and will include these photographs in the receiving inspection report. The photos and inspection results will become part of the Car History Book. Prior to commencing Work, the Contractor shall identify and submit notification to the Authority of all discrepancies between the outbound inspection report and the receiving inspection. Equipment or items found to be missing after the completion of the outbound inspection and not included in the notification to the Authority shall be the responsibility of the Contractor.

C. Pre-Shipment Inspection.

- (1) All production work and tests are to be completed at the Contractor's or subcontractor's facility and must be accepted by the Authority prior to shipment of the car. Contractor may not commence delivery of any Rail Car until the Authority has approved all pre-delivery testing.
- (2) Upon completion of the rebuild of each Rail Car, Contractor shall provide the Authority with 2 weeks advance written notice of each Rail Car inspection to be performed by Contractor at its plant. Contractor and the Authority may jointly inspect the Rail Cars, conducting a comprehensive visual, electrical, and mechanical inspection to ensure proper assembly, and perform operational tests of the complete Rail Car to check and verify the quality of workmanship and to check for malfunctions and correct operation and performance of all Rail Car systems.
- (3) If the Authority agrees, Contractor may perform the inspection without the Authority but prior to shipping any Rail Cars, Contractor shall notify the Authority the preshipment inspection and operational tests of the Rail Cars are complete and will provide the Authority copies of the inspection and test results for review as a complete package at least five full working days in advance of the scheduled shipment date, with at least two full working days allowed for the Authority to perform its own pre-shipment inspection of each Rail Car. The Contractor shall ensure that the Rail Car is positioned over a pit with standby power and compressed air applied.
- (4) When the pre-shipment inspection at the Contractor's site, and review of all documentation has been conducted to the satisfaction of the Authority's representatives, and any defects or corrective action items discovered are fully corrected, except for those items agreed to by the Authority, the Authority shall issue to Contractor a "Notice of Approval for Shipment" to be signed by both Contractor and the Authority.
- (5) As required on a per Rail Car basis, attached to the "Notice of Approval for Shipment" will be a "Shipping Open Items Lists" that details material shortages, any open items requiring corrective action and agreed to by both the Authority and Contractor, the proposed remedial actions and the schedule for its implementation. No shipment of Rail Cars or other completed material shall be made by Contractor to the Authority without such document. The "Notice of Approval for Shipment" shall not be construed nor inferred to constitute acceptance, conditional or final, of the Rail Car by the Authority.
- (6) Upon completion of the pre-shipment inspection and acceptance of remedial actions by the Authority, Contractor shall provide the Authority's Project Manager with a written report signed by Contractor's Director of Quality Assurance and the Authority Inspector, stating that the Rail Car has been rebuilt according to the Contract requirements, has passed all required in-plant tests, and is ready for shipment. This report shall include detailed lists of all defects, exceptions and deficiencies noted that have been approved by the Authority for repair, rework and/or modification after delivery, as well as the remedial actions taken or planned to correct them, and the schedule for completion. This report shall be included in the Car History Book

D. Post Shipment

- (1) Each completed Rail Car received at the Authority receiving facility will be jointly inspected by representatives of the Authority and Contractor. Following completion of the inspection, a "Receiving Inspection Report" will be issued and signed by Contractor's representative and signed by the Authority's representative. This report shall provide an assessment of the "as received" condition of the Rail Car and note any defects or damage that occurred during shipment. Contractor will issue the report to the Authority prior to commencing any adjustments, repairs and/or replacement of damaged parts, post-delivery tests and commissioning activities.
- (2) Upon issuance of a report which indicates a material shortage or damaged item, Contractor shall promptly replace any missing or damaged equipment and material, at its cost, to prevent delay of the project. Promptly means that in stock items shall be shipped immediately while the repurchase of all other items shall be initiated without delay.
- E. Delivery
- (1) After delivery of the Rail Car to the Authority's property but prior to the Authority's Acceptance of the Rail Car, the Contractor shall perform the post-delivery tests.
- (2) The Contractor shall conduct an arrival inspection on each vehicle upon arrival of the vehicle on the Authority's property. At its sole discretion, the Authority may choose to accompany the Contractor's inspector during this inspection. Subject to the Authority Operations availability and schedule, the Authority will provide the facilities and crew required to operate the car for these tests. The Contractor shall provide the test personnel and test equipment required to properly conduct these tests. The results of the inspection shall be documented and included in the Car History Book. All discrepancies identified as having occurred during the shipping process shall be corrected according to approved procedures.
- (3) Unless explicitly agreed by the Authority, each Rail Car shipped by Contractor to the delivery site shall be complete and in compliance with all provisions of the Contract. All parts, except those identified by the Authority to be shipped separately, must be removed to permit shipment shall be securely packaged and shipped with the Rail Car to which they belong. The Rail Car shall be secured against unauthorized entry during transit by sealing closed all doors and exterior compartments. Any special temporary fittings and locking devices required for shipment of the Rail Car shall be provided and removed by Contractor at its expense.
- (4) After issuance of the "Receiving Inspection Report" but in no event later than five working days following arrival at the Authority receiving facility, the Authority's representative shall provide to Contractor's representative a "Certificate of Delivery." Such certificate shall state the date of the certificate and shall include a copy of the "Receiving Inspection Report", noting all damages and defects which require correction by Contractor.

- (5) To be considered Delivered, each Rail Car shall be in sound, whole, ready-to-run condition, and evaluated to determine whether it is ready for entry into post-delivery tests and commissioning activities. Should the Authority agree to allow shipping with in-plant testing, repairs, reworks and/or retrofits to be performed at the delivery site, the Rail Cars shall not be considered Delivered until Contractor has completed all such Work to the satisfaction of the Authority.
- F. Inspection Reports

Contractor will provide the Authority's Project Manager a written report of checks, tests, and inspections, as well as any defects, exceptions and deficiencies noted during the rebuilding process and their remedial actions. The report will be included in the Car History Book.

The Contractor shall be responsible for preparing the inspection forms for the outbound, inbound, and pre-shipment inspections and shall submit the forms to the Authority for review and approval. [CDRL 2.010]

12 STORAGE OF RAIL CARS

If the Authority authorizes Contractor to deliver and store Rail Cars on the Authority's property, Contractor shall obtain prior approval from the Authority to ship the Rail Cars and will solely bear all risk of loss related to stored Rail Cars while they are on the Authority property until such time as they are Accepted or Conditionally Accepted in accordance with the Contract.

13 ADDITIONAL WORK

- A. Inspection Discrepancies
- (1) Any discrepancy or damage that was not documented during the outbound or receiving inspection but becomes apparent while performing the Work shall be documented and brought to the attention of the Authority within 24 hours of discovery. Request for approval to perform supplemental repair Work shall be thoroughly documented with procedures required to perform the Work, number of hours required to complete the supplemental repair Work, and inspection sheets to be used to record the Work performed and the quality achieved. Approval of supplemental repairs must be provided by the Authority prior to commencing the affected portion of the Work.
- (2) If after pre-shipment inspection, Rail Cars are found to be in conformance with the Contract Documents, the Authority will issue a signed "Notice of Approval for Shipment" which will identify each Rail Car by serial number and road number.
- (3) If a Rail Car is found to be non-compliant with the Contract Documents, the Authority will issue a "Notice of Rejection" stating the defects, exceptions and deficiencies, and Contractor shall take all necessary remedial actions to correct the defects, exceptions, and deficiencies.

- (4) Upon completion of the remedial action Contractor will submit to the Authority a report that details the remedial action taken. If the Authority deems these remedial actions acceptable, the Authority will perform a re-inspection to verify the adequacy of the repair, rework, or modification to remedy the defects, exceptions, and deficiencies. The Contractor shall reimburse the Authority for the costs of any such reinspection and be responsible for the delay, if any.
- B. Out of Scope Work
- (1) If a defective or damaged Unit is found which is not specifically with the Scope of Work, the Contractor shall notify the Authority within 48 hours of discovering it, identifying the defect or damage and indicating whether, in the opinion of the Contractor, not repairing the defect will compromise the safety of the car. The Contractor and Authority will inspect the affected car within 72 hours of the Contractor's notice or as otherwise may be agreed by the parties.
- (2) If the Authority's Project Manager agrees that the additional work is necessary, the Contractor will submit a proposal for the work setting forth the specific additional tasks to be undertaken, any additional time needed to complete the Work on the car, and the price of each additional task, as well as all related costs. If the price is within the approval authority of the Authority's Project Manager, the Authority's Project Manager may approve the additional work. If the price of the proposed additional work, either on its own or when added to all other additional work and changes to date will result in exceeding the approval authority of the Authority's Project Manager, and the Authority agrees that the work is necessary, the Authority will issue an amendment to the Contract or Task Order. Should Contractor perform work for in advance of issuance of a fully executed Amendment or Task Order for such work, Contractor shall be performing the work as an unpaid helper for the Authority.
- (3) If the Authority's Project Manager does not believe that the additional work is necessary, as may be the case for purely cosmetic work, the Project Manager will document the reason for rejecting the work in a written letter to the Contractor, and other than the time needed for inspection, no additional time or compensation will be made to the Contractor.
- (4) The Contractor may appeal the decision to the Authority's Chief Executive Officer.

14 TESTING

- A. All tests required to be performed by Contractor shall be done as set forth in the Scope of Work at the expense of Contractor. The Project Manager shall be apprised of all such tests sufficiently in advance to be able to witness any such tests.
- B. All Systems, subsystems and components required or proposed to be incorporated into the Work are subject to the testing requirements described and may anot be incorporated into the Work until the Project Manager has been satisfied that they have successfully passed all applicable tests. All tests must be in accordance with the approved test procedures and/or plan and in the event of a failure of any test,

Contractor shall be responsible for any necessary corrective action and retesting until the applicable certified test results have been approved by the Project Manager.

- C. All tests required to show that all equipment and Work including materials are in accordance with the requirements of the Contract shall be made by and at the expense of Contractor in the presence of the Authority's representative. If the tests require the presence of an engineer, the Authority's engineer will be present. The Project Manager reserves the right to determine what tests are necessary. The necessary testing instruments and apparatus, and all labor and the facilities for the transportation of testing apparatus shall be furnished by Contractor.
- D. The Authority may waive a test provided that:
- (1) At the first Project Meeting, Contractor presents the list of tests it would like the Authority to waive, explaining any differences between the tested and proposed systems hardware and software, and providing the estimated credit to the Authority once the Authority approves a waiver; and
- (2) Contractor successfully tested similar system hardware and software in the last two years prior to receiving Notice of Award; and
- (3) Sixty days after receiving from the Authority an agreement to the list, Contractor presents the test procedures and reports for each of the waived test for the Authority review and approval.
- E. Once the Authority grants a waiver, it will issue a Change Order for a waiver and a credit due to the Authority. The Authority shall be the sole judge of the acceptability of Contractor's request.

15 POSSESSION OF RAIL CARS PRIOR TO FINAL ACCEPTANCE

The Authority shall have the right to take possession of or use any completed or partially completed parts of the Work. Such possession or use will not be deemed an acceptance of Work not completed in accordance with the Contract. While the Authority is in such possession, Contractor will be relieved of the responsibility for loss or damages to the Work other than that resulting from Contractor's fault, negligence, or breach of warranty. If such prior possession or use by the Authority delays the progress of the Work or causes additional expenses to Contractor, an equitable adjustment in the Contract Price or the time of completion will be made and the Contract will be modified in writing accordingly, subsequent to the issuance of a Notice of Conditional Acceptance.

16 ACCEPTANCE

Rail Car acceptance by the Authority will come in two phases, conditional and final, as defined below.

A. Conditional Acceptance

- (1) After issuance of a "Certificate of Delivery," each Rail Car will be subjected to a series of post-delivery tests and inspections and commissioning tasks, witnessed by the Authority's Project Manager or a designated the Authority representative.
- (2) If, during acceptance testing and inspection, the Authority determines that the Rail Car is suitable for operation in revenue service, but that it is not totally responsive to the Scope of Work and that substantial delay might be incurred in implementing required corrective actions, the Authority may, at its discretion, issue a "Certificate of Conditional Acceptance" for the affected Rail Cars for mutual execution by the Authority and Contractor. Such conditionally accepted Rail Cars shall then be available for the Authority to place in revenue service until such time as Contractor is able to initiate and execute the necessary corrective actions. At the time of conditional acceptance into revenue service, the warranty period will commence on all parts, except those requiring corrective action. Warranty period for parts requiring corrective action shall commence upon acceptance of corrective actions by the Authority.
- (3) Upon acceptance of each Rail Car, the title shall transfer to the Authority and Contractor will be relieved of responsibility for loss or damages to the Work other than that resulting from Contractor's fault, negligence, breach of warranty and/or defects in design, workmanship and material. The Certificate of Conditional Acceptance will include a list of the defects, exceptions, and deficiencies identified by the Authority. The Contractor will remedy the identified items within 14 days of issuance of the Certificate of Conditional Acceptance, or within such period as mutually agreed.
- (4) The Contractor may requsest additional time to remedy the items, if the additional time is substantiated by confirmation of the delay. If the identified items are not remedied within 14 days of issuance of the Certificate of Conditional Acceptance, or within such period mutually agreed, the amount of the following invoice payment to Contractor shall be reduced by the amount estimated by the Authority as necessary to remedy the identified items. The Authority estimate will be based on the Authority's evaluation of its cost to perform the corrective actions.
- (5) The Authority may draw upon the estimated amount withheld to remedy the identified items if within the prescribed period Contractor fails to remedy the identified items to the satisfaction of the Authority. The amount drawn from the estimated amount held will be used to cover the Authority's or its third party contractor's costs of performing the corrective actions. In the event any corrections made by the Authority cost less than the amount drawn, the Authority shall reimburse the difference to Contractor. The Authority reserves the right to utilize the Rail Car for revenue service during this corrective action period with a mutually agreed upon time for corrective action to be accomplished.
- B. Final Acceptance

Upon successful completion of the post-delivery tests and inspections and commissioning tasks, and any associated corrective actions, Contractor shall present the Rail Car and its documentation to the Authority's Project Manager for Final Inspection. Acceptance will occur when all post-delivery tests, inspections and commissioning activities have been completed and approved by the Authority, and all defects, exceptions, and deficiencies noted during testing and inspections have been remedied and approved by the Authority, and all open issues have been resolved to the Authority's satisfaction, all CDRLs have been approved, and the Rail Car is deemed by the Authority, in its sole discretion, capable of operating reliably. The Authority will issue a Notice of Final Acceptance of the Rail Car. The Authority will not provide Final Acceptance of Rail Cars that do not meet all Contract requirements and specifications, even if the Contractor assures the Authority that any deficiencies will be handled under the warranty process.

- (1) The Authority will notify Contractor in writing of acceptance or rejection, and in the case of rejection, the Authority will issue a "Notice of Rejection" stating the reasons for rejection.
- (2) Within ten days of approval by the Authority of all completed corrective actions and retrofits (if any) and receipt and acceptance of the Car History Book by the Authority, and when the Rail Car is considered by the Authority to be in full compliance with the Contract, the "Final Acceptance Certificate" will be executed by Contractor and the Authority. At this time, Contractor shall submit invoices for the corresponding milestone and payment shall be made in accordance with payment.
- (3) Should the Authority experience delays in the Rail Car acceptance program attributable to Contractor because of noncompliance to the Contract requirements, and/or because of defective workmanship, materials and/or design, Contractor shall not be permitted to store unaccepted Rail Cars on the Authority property pending resolution of the problems. Notwithstanding the foregoing, no more than two unaccepted Rail Cars will be permitted to be stored by Contractor on the Authority property at one time unless agreed to by the Authority.
- (4) Spare parts and other materials, including those parts that are easily stolen such as keys, brake handles, radios, emergency tools, fire extinguishers, etc., shall be delivered separate from the Rail Car to the Receiving Department at the Authority's maintenance facility, CMF. Along with Contractor, the Receiving Department shall prepare and sign a Receiving Report, describing any missing parts or damage that may have occurred during shipment and that is otherwise visible after a cursory inspection.
- (5) Where the Authority performs work to remedy any Open Items, the Authority shall be deemed to be performing such repair or remedial work as agent of Contractor, and Contractor shall be required to reimburse the Authority for the cost involved. If the work was performed by the Authority employees or agents, all labor or materials will be billed to Contractor in accordance with the Authority's then current Schedule for Rates for such work. Any such costs may be deducted by the Authority from any payment due or to become due to Contractor.

(6) When all tests are completed, the required reports are received and approved, and no corrective actions are required, and the Car Rebuild History Books are received and approved, the cars will be accepted by the Authority. [CDRL 2.011]

17 DELIVERY

- A. Delivery not Acceptance.
- (1) Delivery does not constitute Acceptance of any Rail Car, although delivery constitutes a transfer of any Risk of Loss or Damage, and transfer of title, from Contractor to the Authority, subject to any security interest retained by Contractor.
- (2) Delivery of each Rail Car will be considered complete when the post-delivery inspection is satisfactorily completed and acknowledged by a receipt signed by the Authority's Project Manager at the point of delivery.
- B. Delivery Location

All Rail Cars and materials are to be delivered by the Contractor FOB to the Authority's Central Maintenance Facility, located at 1555 N. San Fernando Road, Los Angeles, CA. Delivery means complete delivery as defined in these documents.

Delivery of Pilot Rail Cars in Base Order	No later than 450 Days after NTP (See attached schedule)
Delivery of Remaining Rail Cars – Production Rail Cars	See attached schedule.
Delivery of test equipment and special tools	No later than 30 days prior to delivery of the seventh Rail Car.
Delivery of draft of all manuals and training materials	No later than 30 days prior to delivery of the first Rail Car
Completion of all required training	Must commence prior to delivery of the first Rail Car. Completion of all required training is a requirement of Rail Car Acceptance (Conditional Acceptance) of the first Rail Car.

18 PILOT RAIL CARS

A. The Contractor will make delivery of the two Pilot Rail Cars according to the mutually agreed-upon schedule (the "Pilot Rail Cars Delivery"). The Pilot Rail Cars may be placed into revenue service by the Authority and Contractor may monitor the Pilot Rail Cars, at no additional charge to the Authority, until the last Rail Car (including the last option Rail Car, if applicable) is delivered to the Authority in accordance with the agreed-upon delivery schedule. The Authority will provide Contractor access to the Pilot Rail Cars during this monitoring period. At the conclusion of the monitoring

period, Contractor shall schedule the upgrade of such Pilot Rail Cars, if required, as mutually agreed between the Contractor and the Authority, at no cost to the Authority. Any component upgraded will be subject to a re-commencement of the warranty period that is applicable to such component.

- B. All Rail Cars are to be delivered during the period Monday through Friday. No Rail Cars may be delivered on Saturdays, Sundays, or Authority holidays. Hours of delivery are 8:00 a.m. through 3:00 p.m. PST. Contractor will give the Authority ten calendar days advance notice before each delivery is made and will prepare all materials and equipment in such a manner as to protect them from damage in transit and at the delivery site. The Rail Cars may only be delivered by a qualified, properly insured, and experienced common or contract carrier.
- C. Should an event occur which will delay deliver of any Rail Car beyond the delivery date specified in the Delivery Schedule, the Contractor will notify the Authority's Project Manager in writing as soon as the Contractor has knowledge that the event has occurred. If the Contractor believes the delay in delivery is justified, within five days it may request an extension of the delivery date, providing the reasons for the request. The Contractor agrees to supply, as soon as such data is available, reasonable proof required by the Authority's Project Manager to make a decision on such a request for extension. The Authority's Project Manager will examine the request and any documents supplied by the Contractor, will determine whether an extension will be granted, and will notify the Contractor how long the extension will be. It is expressly understood and agreed that the Contractor will not be entitled to damages or additional compensation, and will not be reimbursed for any losses, due to delays resulting from any cause under this provision. If any delay is caused by a Force Majeure event, the extension of the delivery date shall be as described in the Contract section regarding Force Majeure.
- D. The delivery schedule for Rail Cars ordered by the Authority by exercise of its Option will be mutually agreed upon by the Parties at the time the Authority exercises the Option.

19 MANUALS, TRAINING, SPECIAL TOOLS AND TEST EQUIPMENT

The manuals and training program must comply with the requirements of 49 CFR 243, and 49 CFR 238.109 and must be compatible with the Authority's inspection, testing, and maintenance plan. The Contractor will be required to supply all the following:

- A. Manuals
- One electronic copy in a format approved by the Authority, and one master cameraready hard copy of all maintenance manuals for the rebuilt cars. All master hard copy materials must be printed on durable sheets as approved by the Authority. [CDRL 2.012]

- (2) An Illustrated Parts Catalog that includes sufficient detail, as solely defined by the Authority, for the Authority to procure parts to service, maintain and trouble-shoot, and repair the rebuilt cars.
- (3) A maintenance manual that includes information required for the Authority to inspect, service, test, and maintain the car and its systems, and that addresses requirements for lubrication, maintenance, adjustments, heavy maintenance, troubleshooting and problem diagnosis.
- (4) Updates to the manuals every three months during car production, or official notification that no changes were made during the update period. Updates are required through the end of the warranty period.
- B. Training Program and Support Material

One electronic copy in a software format approved by the Authority, and one master cameraready hard copy of all training program materials for the systems provided for a car that are different than the original component, system, or subsystem for the car. A training plan must be developed by the Contractor and approved by the Authority. The training program materials must include instructor's guide/manual, student handbook, overhead transparencies, videos, training aids, mock-ups (if applicable) and student tests. The program may assume spare parts from the Authority's inventory are available to be used to support the training program requirements.

C. Special Tools and Operating Instructions

A list of special tools, jigs, and fixtures required for maintenance testing and trouble-shooting of the rebuilt cars. Include instructions for the proper use and periodic inspections and tests of the tools, jigs and fixtures in the maintenance manuals and training program. As appropriate, each tool shall be accompanied by diagrams, schematics, maintenance and calibration instructions for the device itself. The Contractor shall make any modifications to existing tools that are required because of changes and modifications made to the rebuilt vehicle or any of its systems.

Any items not manufactured by the Contractor shall be identified by the original equipment manufacturer and the equipment manufacturer's catalog/part number.

D. Test Equipment and Instructions

A list of test equipment required for the testing, servicing, maintenance, trouble-shooting and repair of the cars as required for the rebuilt systems. The instructions for the proper use and periodic inspections and tests of the test equipment shall be included in the maintenance manuals and training program. The test equipment must be accompanied by test procedures, maintenance and trouble-shooting procedures for the associated car borne system and equipment. As appropriate for the specific piece, each piece of test equipment shall be accompanied by diagrams, schematics, maintenance and calibration instructions for the device itself. The Contractor shall make any modifications to existing test equipment that are required because of changes and modifications made to the vehicle or any of its systems as a result of the vehicle rebuild. Any items not manufactured by the Contractor shall be identified by the original equipment manufacturer and the manufacturer's catalog/part number.

20 SPARE PARTS AVAILABILITY

Provide a complete spare parts list that includes spare parts and consumables. Any spare parts supplied by a company consisting of several divisions/departments must be identified on by part number from the original manufacturer division. All electronic components shall be available from recognized electronic distributor sources in the United States. Spare parts must be available for 20 years after delivery of the last rebuilt car.

21 CAR REBUILD HISTORY BOOK

Thirty days after Notice to Proceed, submit a sample copy of the Car Rebuild History Book to the Authority for review and approval. The sample copy must show the format, media type, contents, and other sections as required in the Contract. On approval of the sample by the Authority, provide a Car Rebuild History Book following that model for each rebuilt Rail Car. [CDRL 2.013] At a minimum, each history book must contain the following information:

- Car Number
- Any the Authority approved engineering changes, deviations and/or modifications incorporated into the car which are not incorporated into all cars.
- Manufacturer, model, revision level, and serial numbers of all serialized components replaced and/or installed as a result of the rebuild. This information shall be recorded for components removed as well as new components installed.
- The complete test history while the unit is in testing, including all readings taken in testing procedures.
- List of defects noted and the disposition of each.
- Weight of the vehicle upon arrival empty and weight of the vehicle at completion, documenting each wheel weight and total vehicle weight.
- Measurements for car height and lean shall be recorded after all work is completed and shall meet the requirements as stated in "Running Maintenance Manual".
- Measurements for coupler height shall be recorded and compliant with the requirements as listed in the "Running Maintenance Manual".
- All wheel, bearing and axle information to include all pertinent component ID numbers and measurements consistent with the applicable AAR regulations. Include each component position in the passenger Rail Car.
- Copies of the completed worksheets and/or checklists.
- Quality Control inspection results and actions taken, if any.
- Provisions for recording malfunctions, inspection, servicing, and major overhaul

- A list of drawings and revision numbers for redesigned items; as-built drawings
- Preliminary Acceptance Certificate of Compliance
- Final Acceptance Certificate
- Any other information required by the Technical Specification to be in the Car History Book.
- Other documents as may be required by the Authority.

CDRL #	Description
2.001	Drawings
2.002	Test Procedures and Reports
2.003	Pre-Revenue Service Acceptance Test Plan
2.004	Management Plan
2.005	Master Contract Schedule update and Progress Report (monthly)
2.006	Initial Master Contract Schedule
2.007	First Article Inspection Procedures
2.008	First Article Inspection Reports
2.009	Specialized Repairs
2.010	Post-Shipment Inspection Forms
2.011	Delivery and Acceptance
2.012	Manuals
2.013	Car Rebuild History Books

22 CARBODY - EXTERIOR

- A. General
- (1) The carbody must be reconditioned and all necessary repairs made to correct damage and defects and to provide an appearance consistent with the color scheme specified by the Authority.
- (2) Vehicles must be de-trucked and the carbody exterior thoroughly inspected for damage, cracks and corrosion.
- (3) The Contractor shall perform a thorough inspection of each vehicle structure for locations requiring repair due to debris strikes, collision, or vandalism and submit the findings to the Authority for review. As part of this inspection, vehicles will receive a water tightness test to determine the extent of work required, with special attention given to those areas exhibiting prior leakage, such as window openings. [CDRL 3.001] The Contractor will perform repairs as determined by joint review with the Authority.
- (4) Side frame damage which is not the result of exterior damage or other visible abnormality that is not anticipated will be considered as extra work and treated through the replacement item list.
- (5) The roof shall be inspected and reconditioned and any corroded or damaged side sheet, end sheet and roof rivets shall be replaced.
- (6) As part of the water tightness test, all roof insulation must be removed to expose the underside of the roof sheets at the locations repairs have been made.
- (7) All repairs to previously damaged areas shall be removed, and all old and new leak areas and debris distorted areas shall be repaired using a cover plate of matching configuration with a continuous weld to the roof sheet.
- (8) A second water test shall be performed to test all roof repairs. All roof thermal insulation shall be replaced at the locations repairs have been made. All roof hatches shall be inspected and reconditioned and non-slip walkways around the roof hatches shall be replaced.
- B. Exterior Carbody
- (1) The carbody damage shall be properly repaired and exterior surface prepared prior to painting. Each vehicle shall be completely painted in accordance with the Authority's latest passenger vehicle exterior paint scheme including logos, vehicle numberings and other exterior lettering. All exterior signage and markings shall be properly applied and legible in compliance with requirements of 49 CFR 238, 49 CFR 239 and APTA PR-PS-S-002-98, Rev.3.
- (2) The Contractor may submit an exterior wrap scheme for review by the Authority. The submittal package shall provide documentation and test data demonstrating that the wrapping provides the same durability and appearance as with the paint.

- (3) The portion of the vehicle body or any of its components, receiving paint shall be painted as required by the Scope of Work and in accordance with the specified color scheme. The color of the under frame paint shall match Sico Paint Systems alkyd semigloss black No. 517-195. The Contractor shall submit color samples for approval. [CDRL 3.002] The exterior finish shall have a gloss level greater than 85 as measured with 60 degrees Gloss-meter. Orange peel shall be allowed on exterior wet coatings if it is a level 7 or greater when evaluated in accordance with ACT Laboratories "Orange Peel Visual Standards."
- Painting shall be performed by experienced labor, using proper equipment under competent supervision. All painting shall be performed using documented Contractor's procedures consistent with the manufacturer's recommendations.

C. Hardness:

Pencil Hardness tests shall be performed according to ASTM D3363. The range of acceptance shall be between H and 2H and shall be the average of ten readings taken from typical surface locations. This is a destructive test and shall require the tested surfaces to be repaired.

D. Adhesion:

Adhesion shall be tested per ASTM D4541 and achieve a minimum rating as provided by the paint manufacturer. This is a destructive test and shall require the tested surfaces to be repaired.

E. Thickness:

The minimum and maximum dry film thicknesses must be provided by the paint supplier. Dry film thicknesses beyond the manufacturer's recommendations will not be accepted. Nondestructive testing will be performed to verify final dry film thickness.

F. Paint Cure:

- (1) A solvent rub test shall be performed per ASTM D5402. The test procedure requires no less than fifty double finger rubs with a cloth wetted in acetone or methyl isobutyl ketone to the painted surface. No paint color should transfer to the cloth. After 72 hours the painted surface must retain all original characteristics such as gloss and hardness.
- (2) All carbon and LAHT steel portions of the vehicle shall be painted unless prohibited by other specifications. Seams and overlaps shall be painted using the same system as the exterior of the vehicle on all surfaces.
- (3) Disassembly will be made as required or as requested by the Authority to ensure that hidden areas are completely painted; components may be painted before installation as an alternate way of ensuring complete coverage. Any austenitic stainless steel portions of the carbody shall not be painted, unless otherwise specified by the Authority for cosmetic reasons.

- (4) The final painted surface shall be tested on the first car and presented for review by the Authority. [CDRL 3.003]
- G. Underframe
- (1) All exposed areas of the underframe, including the end underframe weldments, center sections of the underframe, draft gear and coupler pockets, and truck bays, shall be thoroughly cleaned by grit blasting, inspected and reconditioned. Joint inspections will be performed, as required. The procedure used for cleaning shall be submitted to the Authority for review and approval. [CDRL 3.004]
- (2) All connections between steel and aluminum components shall be carefully inspected, and all metal corrosion or deterioration of isolating material shall be repaired.
- (3) Corroded or damaged undercar pans shall be replaced with new under-pans. The method of sealing and attachment shall be submitted in advance for review and approval by the Authority. [CDRL 3.005]
- (4) Any areas of structural members showing evidence of exposure to excessive heat shall be sandblasted, inspected and reinforced with cover plates. Cover plate material shall be compatible with existing structural materials. Design and attachment of cover plates shall be submitted to the Authority for review and approval. [CDRL 3.006]
- (5) Completely repaired underframe shall be primed, two coats of enamel paint applied and fully undercoated with Tectil or approved equivalent.
- H. Bolster Anchor Brackets
- (1) The existing bolster anchor brackets and fasteners shall be cleaned, inspected and repaired, as required, or replaced if necessary. Suspected cracks or separations shall be examined by dye penetrate testing (NDT method).
- (2) Where damage or weld repairs compromise the structural integrity of the bolster anchor brackets, the bolster anchor brackets shall be replaced in kind or with a design approved, in advance, by the Authority. [CDRL 3.007]
- I. Undercar Boxes
- (1) All undercar boxes and enclosures shall be cleaned, inspected and reconditioned.
- (2) All weather stripping, gaskets and seals shall be renewed.
- (3) Mounting brackets shall be reconditioned and new mounting bolts applied and torqued.
- (4) Reconditioning of the battery box shall include new rollers and wood components, repair and painting metal components.
- (5) If modifications are required for any boxes and enclosures, the modification shall be submitted in advance for approval to the Authority. [CDRL 3.008]

- J. Sides and Ends
- (1) The sidewalls and ends shall be inspected and reconditioned. Any corroded or damaged rivets shall be replaced. Suspected cracks or separations shall be examined by dye penetrate testing (NDT method).
- (2) The door frames and the side trim shall be inspected and reconditioned if required. Any damaged or missing hardware shall be renewed.
- (3) Corner gutters shall be inspected and reconditioned, or renewed if missing or damaged.
- (4) Minor dents, scratches, gouges, etc. shall be repaired by grinding, filling with approved epoxy filler and ground smooth. This includes superfluous, small mounting holes.
- (5) Particular attention shall be given to repair areas around door, to insure proper weather seal of reassembled components.
- (6) Two destination sign enclosures shall be re-engineered to accommodate new signs to be supplied by the Contractor. There is one enclosure on each side of the car. LCD signs with information provided by the existing system will be furnished, two per car replacing existing destination sign assemblies on the cars.
- K. Side Passenger Windows Replace
- (1) Windows shall be removed, and the window openings shall be inspected for damage and repaired to an approved procedure. Particular attention shall be given to repair areas around window openings, to insure proper weather seal of reassembled components. The window openings shall be painted to the approved paint procedure and inspected prior to reinstallation.
- (2) Windows that require replacing must be replaced with new double-glazed FRA type II window unit. The replacement window unit shall have a ¼ inch thick, gray tinted, tempered glass exterior pane and shall have a 3/8 inch thick, clear safety glass interior pane. The window assembly shall include 3/8 inch sealed dead space between each pane. To protect against vandalism, the window assembly must include an anti-graffiti film on the interior lite on the passenger compartment side only.
- (3) The window assemblies shall be arranged in the current car configuration and shall comply with the requirements of 49 CFR238. Window assembly types shall be replaceable from the interior of the car. The window assembly design and installation arrangement shall be submitted to the Authority for approval [CDRL 3.009]
- (4) Window seals shall be replaced with new seals.
- L. Collision Posts and Walkway

- (1) The collision posts and adjacent structure shall be thoroughly cleaned and inspected for corrosion, cracks and weld separations and repaired. The repair must retain the strength of the original construction.
- (2) All corroded areas of the posts and supporting structure shall be sandblasted and repaired as required.
- (3) Ultrasonic testing of all collision post welds shall be performed and results submitted to the Authority's Project Manager for review and acceptance. Documents of the results shall be included in the car history book.
- (4) All collision post welds shall be photographed, documented and dated, both prior to and after all repairs have been completed. A set of photographs shall be provided in the car history books.
- (5) The drain hose and fittings shall be renewed.
- (6) Procedures for cleaning, inspections and repair shall be submitted in advance to the Authority's Project Manager for review and approval. [CDRL 3.010]
- M. Diaphragms Replace
- (1) The end of the car is equipped with a diaphragm assembly arranged to provide a complete peripheral seal around the passageway formed between two cars coupled together. The diaphragm assembly functions to provide protection to passengers moving from car to car. When cars are coupled together both diaphragms are under compression.
- (2) The Contractor shall remove and discard the existing diaphragm assembly. The Contractor shall remove all sealant, clean and inspect mounting surface. Mounting studs shall be inspected for damage and wear. Any surface damage and damaged studs shall be repaired. When installing the replacement diaphragm assembly, the Contractor shall apply proper sealant to the mating surfaces and the perimeter to ensure a water tight joint.
- (3) The replacement diaphragm assembly shall meet all current regulations. The assembly and details of the design and installation shall be submitted to the Authority for review and approval. [CDRL 3.012]
- N. Buffers
- (1) The cars are equipped with sliding buffer assemblies supported by spring-loaded side stems. These buffer assemblies shall be rebuilt. All buffer parts, including those which remain with the car structure, shall be dismantled, inspected and renewed or restored as necessary. All pins, bushings, wear plates, and elastomeric parts shall be renewed.
- (2) The hinged walkway plate shall be straightened and shall operate freely. A nonmetallic wear plate shall be added to the bottom of the walkway plate.

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- (3) After reassembly, buffers shall move freely and without binding through their full travel.
- O. End of Car Gate
- (1) A swing up, hinged safety bar is installed at the inter-car walkways between the collision posts at each end of the car mounted approximately 42 inches above the car floor. When not in use, the bar is secured in the down position using a spring clip attached to the web of the collision post. The spring clip is arranged to ensure the bar does not rattle in the stored position.
- (2) The end of car gate assembly shall be inspected and refurbished including renewing all damaged and missing removable fastener and spring retaining clip.
- P. Safety Curtains
- (1) A vestibule curtain is mounted vertically outside each end door. The vestibule curtain assembly consists of the curtain, hold open handle/clip, enclosure and mounting rollers. The curtain assembly is fitted with an adjustable tension spring. On the side of the doorway opposite of the curtain mounting, there is a retaining hook such that when cars are coupled, the vestibule curtain on each car is opened and hooked to the adjacent car.
- (2) The vestibule curtain assembly shall be replaced with a new curtain assembly including renewing all damaged and missing removable fastener and hold open handle/clip.
- Q. Side Skirts
- (1) The side skirts shall be cleaned, inspected and repaired as required.
- (2) The hinges shall be inspected and reconditioned or renewed as required.
- (3) The latches shall be inspected and reconditioned or renewed as required.
- (4) The dissimilar material barrier between the shirts and hinges shall be renewed.
- R. Side Steps
- (1) The existing side step assembly and related structure shall be cleaned, inspected and repaired or renewed as required. Any corrosion shall be repaired or renewed as required.
- (2) Visual alert warning strips shall be inspected and installed on the step ledge and the lower guide track of the door, compliant with ADA requirements.
- (3) The warning strip shall consist of a cast and cured in place high performance, polymer based slip resistant formulation containing no less than 45 percent virgin grain aluminum oxide granules and resin content of not less than 19 percent by weight, as

manufactured by American Safety Technologies or functionally similar material, color Safety Yellow.

- S. Handholds and Safety Bars
- (1) The exterior horizontal hand-holds shall be removed, reconditioned and reapplied in compliance with FRA requirements.
- (2) The vertical hand-hold design and installation shall meet requirements of FRA 49 CFR 238.
- (3) All handholds, horizontal and vertical, must be of a contrasting color to the side of the car where they are applied.
- (4) The sill steps shall be inspected and shall meet the requirements of FRA 49 CFR 238.

CDRL #	Description
3.001	General Carbody Inspection
3.002	Exterior Paint Samples
3.003	Exterior Carbody Paint Testing.
3.004	Underframe Cleaning Procedure
3.005	Underpan Sealing and Attachment
3.006	Coverplate Design and Attachment
3.007	Bolster Anchor Bracket Replacement Design
3.008	Undercar Box and Enclosure Modification Design
3.009	Window Assembly Design and Installation Arrangement
3.010	Collision Posts and Walkway Cleaning, Inspection and Repair Procedures
3.011	Diaphragm Repair Procedures
3.012	Diaphragm Replacement Design and Installation

23 CARBODY - INTERIOR

- A. General Flooring
- (1) Existing flooring covering shall be removed and discarded. Structure and floor panel installation shall be inspected for damage and corrosion and refurbished as required.
- (2) The sub-floor shall be inspected and, as required, sealed to close off air leaks for car pressurization, and flammability requirements.
- B. Floor Panel
- (1) The floor on all levels must be inspected for damage and refurbished.
- (2) Tapping points for seat mounting and appropriate mounting plates for tables shall be incorporated into the floor system. Individual tapping plates will not be permitted.
- (3) The panels shall be comprised of pieces as large as possible which shall extend from the side walls to the aisle. The ship-lap transverse joints shall be located over structural members. As an alternative, butt transverse joints may be used in lieu of ship-lap transverse joints if the floor panels are properly reinforced and applied in accordance with the manufacturer's recommended procedure. There shall not be any joints in the top or bottom face skins of the panel. The panels shall be insulated from the metallic structure by an elastomeric tape. All exposed edges of the panels, including interior holes through, cutouts for ducts and conduits, and joints between panels, shall have an edge machined smooth and free of sharp edges and burrs. The floor material shall be non-vermin supporting and shall not rot, corrode or absorb water. The passenger compartment floor shall be flat and level throughout and shall not exhibit visible buckles or waviness. No transverse joints shall be used in the entrance ways.
- (4) The floor panels shall be attached to the floor structure and tapping points for the seats using approved flat head stainless steel fasteners in countersunk holes in the floor panels. Reinforcements and steel tapping plates for above floor attachments (other than the seat pedestals) shall be provided in the car structure.
- (5) The original seat base mounting design shall be used with new hardware. The seat tapping design, arrangement, and installation shall be submitted to the Authority's Project Manager for review and approval. [CDRL 4.001]
- Before applying the floor covering, all voids, fastener heads, and cracks between floor panels shall be filled and the floor made smooth and true within 0.0625 inches over 3 feet in any direction with an approved leveling compound. [CDRL 4.002]
- (7) If the lower level and intermediate level floor designs change from the original design or materials, they shall be tested to meet fire requirements prior to the Contractor's procurement of production material.
- C. Strength Requirements

- (1) The floor deck shall not deflect more than 1/250 of the shortest span between supports from a load equal to the sum of dead loads plus a uniformly arranged AW3 passenger load.
- (2) The panel used in the floor shall conform to the strength requirements specified in these documents.
- (3) The seams between floor panel and vertical structure shall have an approved sealant applied to prevent moisture ingress. Sealant shall be applied prior to installation of floor covering.
- D. Floor Covering
- (1) General
 - All floors including vestibule areas, stairways, restroom, electrical and storage closets shall be rubber Norament[®] 825 C, square pastille, Article 1871, square tile flooring or approved equal. The floor tiles shall be a minimum of 0.118 inches thick and of an approved size.
 - b. The color of the floor tiles shall be arranged to match the Rotem cars. Coloring shall be uniform and shall be distributed completely through the material.
 - For steps and floors, the static coefficient of friction shall be minimum 0.6 under dry and wet conditions. The floors shall be slip resistant in all conditions. The coefficient of friction of the floor shall be tested in accordance with ASTM D 2047.
 - d. Contractor shall provide two sets of samples of selected floor covering materials for review and approval by the Authority's Project Manager prior to ordering materials. [CDRL 4.003]
 - e. The back of the floor covering sheet shall be prepared before it is laid as per manufacturer's recommendation, and then securely bonded to the composite panels with an approved adhesive. The process shall be approved by both the floor panel and the floor covering suppliers. The floor covering shall be installed such that the covering in the aisles can be replaced without disturbing the covering under the seats or removing any seats.
 - f. All floor covering shall be laid in conformity with the best practices of the industry and the manufacturer's procedures with proper allowance for expansion. Color and marbleization shall run completely through the thickness of the floor covering material.
 - g. Samples of each floor covering with supporting technical data sheets and details of the floor covering installation system shall be submitted to the Authority's Project Manager for approval. The floor covering, shall be demonstrated by the Contractor to be replaceable either for local repair or complete removal. The interior arrangement of the floor covering shall be submitted to the Authority's Project Manager for approval. [CDRL 4.004]

(2) Adhesive

- a. The type of adhesive used to bond the floor covering to the floor panels shall be as recommended by the floor covering manufacturer and installed as required by the manufacturer of the floor covering. Floor covering shall be firmly secured to the floor surface using the approved adhesive as recommend by the manufacturer.
- b. Nora[®] 310 PU two-part polyurethane adhesive system shall be used to bond floor tiles to floor panels. All seams between floor tiles shall be cold welded in accordance with the manufacturers recommend procedure.

(3) Application

- a. Floor covering shall be applied throughout the vehicle over a clean and level floor. The floor covering shall be installed in conformity with the best practices of the industry and with proper allowance for expansion.
- Special care shall be taken to bond and seal the covering along all joints to ensure the covering does not buckle because of ingress of water accumulation during inclement weather and cleaning operations. All cutouts shall be collared and all penetrations shall be ferruled.
- c. The back of the floor covering sheet shall be sanded before laying and then securely bonded to the floor panels.
- d. The floor covering in the aisle shall be applied so that it can be replaced without disturbing the covering under the seats.
- e. Matching sanitary corner pressings shall be properly fitted and secured at all corners for ease of maintenance and cleaning. The cove shall prevent liquids on the floor from entering any cavities behind the walls and heater guards.

(4) End Finish

- a. Where the floor covering reaches the end walls and partitions of the carbody, it shall be finished with a suitable sanitary cove of stainless steel. Matching sanitary corner pressings shall be properly fitted and secured at all corners for ease of maintenance and cleaning. Corner pressings shall be designed with a liberal radius between intersecting adjacent surfaces - specifically at all inside radii. A stainless steel retaining angle shall be applied over the floor covering at the outboard edge of the floor to prevent the floor covering from "turning up" away from the floor at the sidewalls. The suitable sanitary cover shall be incorporated into the heater guard enclosure. The Contractor may propose an alternative arrangement where this clamping function of the floor covering to the floor panels may be incorporated into the heater guard floor bracket for review and approval by the Engineer. [CDRL 4.005]
- b. At all door openings the floor covering shall watertight seal with the threshold plates.
- c. At all door openings, the floor covering shall connect properly to eliminate potential tripping hazards and shall join with and form an approved, positively clamped watertight seal with the threshold plates.
- d. The stair nosing shall be such that it has anti-skid or anti-slip built in. The stair nosing along with any locations with change in elevation, the surface shall have sufficient contrast to alert the passengers.
- E. Seats
- (1) The Bombardier cab cars will be used only as coach cars in passenger service therefore the existing seating arrangements shall remain the same. The existing seating arrangements in the coach cars shall remain the same. Some of the coach cars are converted to "Bicycle" and "Hybrid" cars, where seats are removed from the lower level and bicycle racks are installed for accommodating bicyclists. The seating arrangement on these cars shall remain the same.
- (2) Any change to the seating arrangements for improving passenger safety shall be substantiated through formal analysis and approved by the Authority. [CDRL 4.006]
- (3) Existing seat cushions, foam and upholstery, shall be removed, discarded and replaced with new. All seat frames, arm rests, shrouds, and shells shall be cleaned, inspected for damage and corrosion. Any damage or corrosion shall be repaired if possible, or replaced if not possible. Repair procedures shall be submitted for approval by the Authority prior to commencing the repair work. [CDRL 4.007]
- (4) Seat Frames
 - a. All seat frames are to be thoroughly cleaned and visually inspected for any damage or corrosion. Any frames found to be damaged shall be repaired or renewed. The seat attachments to the floor shall be renewed and shall bear fully on the floor panels.
 - b. The flip-up and fold-up seat attachment hardware at the sidewall shall be renewed, and shall be firmly secured to the walls.
 - c. Fasteners between seat frame and pedestal shall be renewed.
 - d. Seat armrests, shrouds and shells shall be thoroughly cleaned and inspected for any damage. Damaged shells shall be repaired or replaced with new shells of the same OEM design.
- (5) Seat Cushions and Upholstery
 - a. All seat cushions, foams and upholstery are to be removed, discarded and replaced.
 - b. If different from the existing fleet, the contours of the seat cushions shall be supported with ergonomic analysis report. [CDRL 4.008] The seat cushion assemblies shall be to the extent possible similar to those on the Authority's existing fleet, but compatible with existing seat frame and cowling.

- c. The seat bottom, seat back, head rest, arm rest and crash pad cushions shall be constructed of a fire retardant foam such as Chestnut Ridge XL or approved equal.
- d. All cushions shall be covered with approved rail passenger transportation grade vinyl upholstery such as Uniroyal Naugahyde or approved equal material. Seat covers shall be vinyl materials that meet the requirements of 49 CFR 238. The material color scheme presentation shall be made to resemble the current the Authority color scheme on the Rotem fleet as close as possible.
- e. The new seat cushion assemblies shall be easily removable from the seat frame without special tools.
- f. Alternative seat and seat cushion constructions shall be subject to the approved equal process. In addition, the Contractor shall provide sufficiently detailed information to prove that the construction for the proposed alternatives is equivalent to the specified construction in terms of strength, performance, comfort, maintainability and durability.
- g. The seat cushion construction and materials shall meet the flammability, smoke emissions and toxicity requirements and all applicable standards and regulations.

24 FRANGIBLE TABLE

- A. The Contractor shall replace or repair work tables, as needed in the Bombardier Rail Cars with frangible tables per the latest APTA SS-C&S-018-12, Standard for Fixed Workstation Tables in Passenger Rail Cars. The frangible tables shall be the same as the frangible tables on the Authority's fleet. The reused tables when installed on the new flooring structure shall be in compliance with APTA SS-C&S-018-12
- B. The tables shall be installed in face-to-face seating locations on the upper level and the two intermediate levels only in coach cars. The table locations shall be the same with existing frangible tables in the current passenger car fleet with electrical outlets location for passenger convenience.
- C. If different design or vendor for frangible tables is used, the frangible tables shall be designed in such a manner to provide an aesthetically pleasing, cleanable, stable work surface for writing, retaining computers or food.
- D. The edge treatment shall be a flat resilient material wider than the table and shall provide a marine edge to retain fluid spills. The frangible tables shall comply with all aspects of the latest 49 CFR 238.233 and be tested in conjunction with the seating per latest APTA SS-C&S-016-99.
- E. Energy absorption features shall be built into the Work Table and/or its attachments such that Human Injury Limits for 50th percentile male ATD are not exceeded during dynamic sled testing as per latest APTA SS-C&S-016-99, Section 5.2.1 modified for testing seating with a frangible table installed. The design and mounting arrangement of the work tables shall be approved by the Engineer. [CDRL 4.009]

25 INTERIOR PANELS

- A. The Contractor shall replace, in kind, all windscreen and partition solid panels in Bombardier Rail Cars with new panels of the same or similar construction as approved by the engineer. Current windscreen/partition panels are constructed of 0.75 plywood with bonded melamine faces and melamine and/or aluminum edge close out. All materials shall comply with applicable Scope of Work requirements. Materials, construction and finish of panels along with a sample of the proposed finished panel shall be submitted and approved by the engineer.
- B. The Contractor shall resurface exposed faces of end walls with melamine sheet. Melamine sheet shall be Wilsonart Type 107 HGS grade or as approved by the engineer. Melamine sheet shall be bonded to existing panels in situ. Any defects or damage to existing surface shall be repaired and surface prepared for bonding. Melamine shall be bonded using appropriate epoxy or polyurethane adhesive as approved by the engineer. Finished Installation shall be flat without raised areas or unbonded areas. Edges shall be finished unless hidden from view. Reference the section of these documents regarding Bonding. Contractor shall submit detailed resurfacing plan to include materials, surface preparation, adhesive bonding and fixturing details to the Authority's Project Manager for approval. Alternative to resurfacing, such as complete replacement of end walls will be considered by the engineer.
- C. Existing wall side panels and window masks are constructed of thermoplastic sheet and shall be refurbished by the Contractor to like new condition. Contractor shall submit a plan for refurbishing side wall panels, window masks and associated trim. Plan shall include cleaning exposed surface via dry ice blasting, replacement and/or repair of cracked, broken or defaced panels and reinstallation with new fasteners and anti-squeak tape on faying surfaces. Refurbishment plan is subject to approval by the engineer. [CDRL 4.010]

CDRL #	Description
4.001	Seat Tapping Design, Arrangement and Installation
4.002	Floor Levelling Compound
4.003	Floor Covering Material Samples
4.004	Floor Covering Interior Arrangement
4.005	Alternative Arrangement for Clamping Flooring
4.006	Seat Arrangement Analysis
4.007	Seat Frame Repair Procedures
4.008	Seat Cushion Design and Ergonomic Analysis Report
4.009	Frangible Table Design and Mounting Procedure
4.010	Interior Panels Design, Arrangement and Installation

26 DOORS

- A. General Requirements
- (1) The existing door system shall be converted to be totally interoperable with the Authority H-R fleet. A necessity of the conversion shall require the change of the door control system from 36 VAC system to 74 VDC system. The rebuild work shall include verification and validation of all features, functions and performance parameters to ensure safe operation of the door system from any vehicle to the-consist regardless of type of vehicle.
- (2) The design, operation, installation, arrangement of the door system, and the associated signage shall comply with applicable FRA regulations, ADA requirements and APTA Standards and Recommended Practices for Rail Passenger Equipment.
- (3) The door system shall be arranged such that no single point failure in the door system internal to the car shall cause:
 - a. Any door to unlock or open,
 - b. A door open command to be transmitted or responded to when train is in motion,
 - c. A "door closed" indication to be transmitted when any door is unlocked or open,
 - d. A "door closed" indication to be transmitted when an unlocked or opening command is stored anywhere in the system/train.
- B. Door Leaves

The current door opening configuration consists of two opposed sliding leaves which, when opened, withdraw into door pockets. The existing door leaves and door hangars are to be removed, thoroughly cleaned and inspected and refurbished. The leaves shall be reinstalled in a manner such that there is no scuffing against seals, insulation, or the door operator mechanisms and to be free of rattles and squeaks at all speeds.

As part of the rebuild all window glass, glazing and seals are to be removed discarded and renewed.

- C. Door Operators
- (1) The existing door operator mechanisms for the side doors are to be removed, discarded and replaced. The new door operator shall be similar to existing the Authority H-R vehicles or approved equal.
- (2) All solenoids, switches and sensors shall be powered by the 74 VDC distribution.
- (3) Door operating mechanisms shall include positive over center locking of the doors when they are in the fully closed position to ensure that the doors will not open in the absence of a command or upon loss of power.

- (4) When in the closed position, the door panel shall be fully closed and latched to prevent an uncommanded door opening. Detection shall be provided at each side door panel to indicate when the door is fully closed and mechanically latched. The detection shall be part of the door summary circuit.
- (5) When power is removed from the door operator and the latch is released, door panel friction, including seals and hangars, shall allow the doors to be opened or closed manually with as low force as practicable.
- (6) Existing emergency door release mechanisms shall be removed and replaced with a system that meets the requirements of Section 28 F Passenger Emergency Release .
- (7) A direct acting, differential force, pneumatic door operator, or equal, shall operate each leaf of each door. The door operators shall be so arranged that the door leaves open when the air solenoid valves are electrically energized. Each door operator shall have a two-position air shutoff valve. Valve position: open shall be normal with closed as a vented off position to isolate the operator from the air supply and vent air from the operator. This shall allow the door to be manually moved to and locked in the closed position as an emergency in service measure. The trainline signal buzzer shall be mounted on the rear face of the control panel.
- (8) The operating compressed air from the main reservoir system shall have the necessary pressure regulator valve and a shut off valve readily accessible inside the carbody in one of the door pockets. Moisture traps and/or filters shall be provided as required in the door operator compressed air system to prevent ingress of dirt or moisture in door engines. Materials used in the door operators or air system shall not be affected by either moisture or methyl hydrate which may be present in the air system.
- (9) The door system shall be arranged to permit the door panel to travel in the closing direction without injury to a passenger between a pair of door panels. The door drive arm shall be equipped with a spring mechanism and arranged to ensure that the closing force shall not exceed 30 pounds in mid-travel. The spring mechanism shall allow the door leaf to be pushed back not less than 3 inches and no more than 4 inches in case of entrapment between the edges of a closing door. The force required to move the door leaf back towards its door pocket shall be 20 to 30 pounds.
- (10) The motion of the doors shall approximate simple, harmonic motion and shall, thereby, provide cushioning in both opening and closing. The speed of door movement shall be such that from the moment of actuating the appropriate door control button until the completion of the operation, the following times shall be obtained:
 - a. Opening: 1.6 to 2.0 seconds (from initial movement to fully open)
 - b. Closing: 2.0 to 2.6 seconds (from initial movement to fully closed)

- (11) These times shall be independently adjustable. The method of adjusting times shall be submitted for review and approval [CDRL 5.001].
- (12) All limit switches and/or proximity sensors shall be precision units that are positively and precisely located so that they may be replaced without the need for mechanism readjustment. All mechanism, limit switch, and proximity sensor adjustments shall be by positive means such as interlocking serrated flat clamped surfaces or axial adjustment of threaded items with locking nuts, locking tabs, or similar securement method that cannot drift or loosen. Reliance only on friction between clamped surfaces is not acceptable.
- (13) Adjustments shall be provided on door operator mounts and mechanisms to eliminate scuffing of either face of the door panels. Door Operator mechanical adjustments shall be by secure means, threaded studs with lock nuts or serrated clamped plates. Items, such as wiring, that are located in the door pockets shall be installed to prevent fouling of the door mechanisms.

27 DOOR CONTROLS AND SIGNAL SYSTEM

- A. Door Controls
- (1) The door controls on the Bombardier cars to be rebuilt currently operate at 36VDC. The door controls are to be removed and replaced with a 74VDC system to achieve interoperability with the existing Rotem fleet. The rebuilt cars shall be interoperable with the fleet, such that, when operating in a mixed consist, all doors can be opened or closed from either type of car. The zero speed trainline signal will continue to operate on 36VDC.
- (2) The door controls shall be trainlined to permit remote operation from control stations in each car. Remote operation of door opening and door closing shall be provided by two panels, one on each side, at the lower level B-end side doors in all cars. These controls shall be trainlined and shall control the doors on each side of the train, in all the cars in any train size. Switches and pushbuttons used for these controls shall be of heavy-duty, industrial, momentary contact type, suitable for the application. Samples of all switches and pushbuttons selected shall be submitted to the Authority's Project Manager for review and approval.
- (3) There are currently two Door Control and Communication Stations (DCCS) located on the right and left sides at the B end of the car. The DCCSs contain the following components.
 - a. Buzzer Buzzer activated from locomotive or DCCS.
 - b. Buzzer Pushbutton Black pushbutton to activate the buzzer.
 - c. Key Lock Uses crew key to prevent unauthorized use of the DCCS. Turning the key in a clockwise direction manually unlocks the Door Key Switch.

- d. Door Key Switch Switch used to activate the DCCS. Turning the Door Key Switch electrically activates the DCCS and rotates a cam which moves a sliding plate to uncover operating pushbuttons.
- e. Slide Plate A plate mechanically connected by a cam to the Door Key Switch, which only allows the pushbutton controls to be exposed when Door Key Switch is in the active position.
- f. Door Open Pushbuttons There are two red pushbuttons to open doors on the side of the train the DCCS is located. One opens all doors forward of the DCCS, the second all doors aft of the DCCS.
- g. Door Close Pushbuttons There are two green pushbuttons to close doors on the side of the train the DCCS is located. One closes all doors forward of the DCCS, the second all doors aft of the DCCS.
- h. Crew Door Open Pushbutton There is 1 blue pushbutton which opens only the adjacent door leaf to the activated DCCS. The zero sped signal shall not be required for this switch to open the adjacent door leaf.
- i. Door Closed Indicator Lights There are two green indicator lights to indicate when all doors in the train are closed.
- j. Interior Staff Key Switch Uses the crew key to open and close the adjacent leaf. Zero speed and air pressure must be present to use this switch.
- k. Communication System Pushbutton White button used for the communication system.
- I. IC/PA Indicators Two red lights used to indicate when the internal communication and public address are activated by plugging in a portable handset into the receptacles below them.
- m. IC/PA Receptacles Two ITT-Canon receptacles used by train crew to connect to the internal communication and PA systems with a portable handset.
- (4) As part of the rebuild, an additional pushbutton shall be added to the DCCS to activate the external PA (See Section 35 B Wireless PA Installation). All existing components shall be removed, cleaned, inspected and replaced as necessary. All existing components shall retain current function after the DCCS has been modified. The Contractor shall submit the modified DCCS design for review and approval [CDRL 5.002].
- (5) At the B-end only, on both sides of each car, located on the vertical grab handle adjacent to the door control panel, a pushbutton switch to hold open the single door leaf nearest to the activated control station for the use by the train crew only. This CREW HOLD OPEN pushbutton switch shall be enabled only when the adjacent door panel is activated. The crew door is held open only while the CREW HOLD OPEN switch is depressed and will irrevocably close if the CREW HOLD OPEN is released even briefly.

- (6) At the crew switch locations, opening of the side door at the B-end, each side, from both the interior and the exterior of the car using a crew key shall be possible. Crew key operation of the door leaf shall only be possible if the zero speed trainline signals is present and shall open the door interlock circuit when activated. The outside crew switch shall have a hinged, spring loaded, weatherproof cover.
- (7) Operation of the master control drum switch shall "short circuit," connect to battery negative, the open trainline for the opposite side of the train to prevent simultaneous actuation of doors on both sides of the train.
- (8) With a key inserted and the master control train switch actuated, the door open trainlines on the selected side of the train shall be short circuited, connected to battery negative, until the open pushbutton control switches are actuated.
- (9) Suitable safeguards shall be integrated with the door controls to prevent the doors from opening while the train is in motion (zero speed system) and to prevent the train from moving (locomotive traction achieved) if any side door on the train is open (door interlock system).
- (10) Unless the zero speed system is activated or bypassed, it shall not be possible to open any side door from any door control station or any staff switch. The zero speed system shall only be activated when its trainline wire is energized at 36 +/-4 VDC, if zero speed is detected on the locomotive. Should the train move at a speed above the threshold of the zero speed detector on the locomotive, the zero speed trainline shall be de-energized and all open doors shall close. When train motion is detected, opening of all doors in the train, with the exception of the crew doors, shall be prevented.
- (11) A "No-Motion Bypass" shall be included to allow for opening of the doors in the event of a zero speed detection system failure. The bypass switch shall have provisions for sealing in the normal position by safety wire, key lock or other approved design, and shall have an indicator to indicate when the train is operating in bypass.
- (12) Suitable door leaf position interlock switches on each door leaf which shall detect when each door is fully closed and locked. The switch shall close when the door edges, as the doors are closing, are within 0.50 inch (plus 0.25 inch, minus zero) of each other measured at the height of the switch actuator and door lock is active. The switch shall open when the edges of the doors are greater than 0.50 inch apart as the door leaves are moving in the opening direction. The switch shall be actuated by the door leaf or an attachment to it, not by any part of the actuating mechanism. All switches shall be connected in series and all switches must be closed or bypassed by the cutout switch in order to energize the car door interlock relay.
- (13) Suitable cutout switches for each door leaf to isolate the doors and controls from the trainline shall be provided. The cutout switches shall disconnect the pneumatic solenoid valves from the control circuits and shall bypass the door leaf position detection switches so as to cause the car door interlock relay to indicate a door's

closed condition. The switches shall be located in the door pockets near the door operator and shall be clearly labeled as to their function and switch positions.

- (14) Unless the door interlock system is activated or bypassed, it shall not be possible for the locomotive Generator Field Circuit to be closed and the train to move. The door interlock system shall only be activated when all side doors on each car in the train are closed (or individual doors bypassed by its cutout switch) energizing each car interlock system and, in turn, energizing the 72 VDC door interlock trainline to the locomotive. A sealable "Door Interlock Bypass" switch and indicator is provided in each the Authority cab car and locomotive for use by the operator in the event of a door interlock system malfunction which cannot be corrected by use of the individual cutout switches.
- (15) The locomotive traction (Generator Field Circuit) shall be interlocked with the door circuit so that traction cannot be achieved unless continuity within the door interlock system is reached (doors are closed or failed door system is bypassed).
- (16) Failure mode of all apparatus shall be such that, in the event of a failure, doors remain closed. Door controls shall be protected against transient and spurious signals and shall be filtered in an approved manner to provide electric noise immunity.
- B. Door Control Relay Panel
- (1) The existing door control relays shall be removed, discarded and replaced with a system capable of operating with the 74 VDC power distribution.
- (2) All door control relays, including the zero speed and the door interlock relays, shall be mounted on one common panel and all wiring shall be brought to terminal blocks with screw terminals that shall accept ring tongue lugs. All relays shall be fully enclosed in dust tight enclosures with screw terminals.
- (3) The door control relays shall be mounted in an approved location in the intermediate level electrical locker. Door control, power, and signal circuits for each side of the car shall be separate and distinct from those for the other side of the car. There shall be no shared components, except for the "door closed" light in the Operator's compartment and the door indicator light in each vestibule. The door system shall be designed such that, when operating in a consist which includes existing the Authority vehicles and/or North San Diego County Transit District (NCTD) Vehicles, all doors on each side of the train can be operated from any vehicle in the train, regardless of the location and orientation of any vehicle in the consist.
- (4) Details of the door controls shall be submitted to the Authority's Project Manager for approval [CDRL 5.003].
- C. Door Obstruction Detection
- (1) The door system shall be equipped with an obstruction detection system for passenger protection during the door closing cycle. The door system shall be capable

of detecting an obstruction in the path of the closing door. When an obstruction is detected, the door system shall not permit a door closed indication. If an obstruction is sensed by the panel, that panel shall recycle to the fully open position and immediately re-close. Recycling shall continue as long as an obstruction is detected

- (2) The Contractor shall submit to the Authority for review and approval a design analysis and test validation report that demonstrates compliance with the performance and functional requirements. The report shall include measurements results of for all parameters required to demonstrate compliance. [CDRL 5.004]
- (3) Activation Force: The force exerted on an obstacle required to trigger the detection of an obstruction shall not exceed the following when the door is powered to close:

Peak force (Fp):68 lbf

Effective force (Fe): .45 lbf

Refer to APTA PR-M-S-18-10 Appendix A for definition of the force values, test equipment and test methodology that shall be used to verify the performance requirements.

- (4) Sensitivity: The sensitivity of the obstruction detection system shall be demonstrated as defined by the following test procedure when a door is commanded to close:
 - The system shall detect a rigid flat bar, ¼ in. wide and 3 in. high, held between and perpendicular to the door panels or between and perpendicular to the panel and doorframe (for a single panel door opening). This sensitivity shall be required along the length of the panel except the uppermost 3 in. and the lowermost 1 in. of the door leading edges.
 - The system shall detect a rigid rod, ¾ in. in diameter, held between and perpendicular to the door panels or between and perpendicular to the panel and the doorframe (for a single panel door opening) at all locations along the length of the door leading edges, except the uppermost 3 in. and lowermost 1 in. of the seal.
 - The test specimens for the above requirements shall be of sufficient length to span the door seals.
- D. Audible Door Alarm and Warning Light

Audible and visual warnings shall be provided at each doorway. The warnings shall be activated upon initiation of the door close command and shall continue until the doors are closed and locked. The operational frequencies for the audible and visual warnings shall be independently adjustable. Each warning signal shall operate on a 50 percent duty cycle, with a minimum adjustable cycle period of from 0.5 to 1.2 seconds. The audible output shall also be adjustable to the desired loudness with a minimum range of 68 to 80 dBA and audible to passengers inside and outside the car. The visual warning shall be provided by white, LED-illuminated fixtures visible to passengers inside and outside the car. The details of the location, design,

operation and testing of the audible door alarm and warning lights shall be submitted to the Authority's Project Manager for review and approval.

E. Employee Access

The current Bombardier cars currently have 2 interior and 2 exterior staff key switches to open the B-end doors on either side of the car. The interior are located on the DCCS (see section 28 A Door Controls and Signal System). The exterior are located adjacent to the door panel toward the center of the car at both B-end doorways.

These switches are to be removed, thoroughly cleaned, inspected and refurbished or replaced if necessary.

The staff key switches shall maintain their current operation. When turned to the right, doors shall open under power. When turned to the left, doors shall close under power.

F. Passenger Emergency Release

Passenger Emergency release mechanisms shall be removed and replaced with mechanisms which comply with the latest requirements of APTA PR-M-S-18-10 and 49 CFR 238 and 239.

The current emergency release system on the Bombardier fleet opens a single door leaf when the release mechanism is pulled. This shall be upgraded such that a single emergency release mechanism at each doorway shall allow both door leaves in the adjacent doorway to be opened.

When activated, the emergency release shall cut power to the adjacent doorway, release the locking mechanism for both door panels, and move doors toward the open position such that there is a minimum 1.5 inch gap between the panels. The door shall then be able to be manually opened to provide a minimum opening of 30 inches horizontally and 74 inches vertically.

The force to activate the interior emergency release shall not exceed 20 lbf. The exterior shall not exceed 30 lbf. using a lever type mechanism or 50 lbf. using a "T" handle type mechanism.

The emergency releases shall require manual reset. The doors shall close under power when reset.

The passenger emergency release devices shall be covered by a transparent, breakable cover, which can be opened without requiring the use of any tool or other implement.

All doorways equipped for emergency egress shall have all required signage and markings in accordance with APTA PR-PS-S-002-98.

G. Door Position Indicator Lights

A bi-directional, exterior door status indicator shall be provided on each side of each car. The indicator shall be visible in daylight and nighttime conditions and shall be illuminated on both sides of the car with a red aspect under all conditions except when the door is fully closed.

The warning lights serve to indicate individual door leaf status as an aid in trouble shooting. Persistence of the flashing shall indicate a door that has not fully closed and locked. Flash patterns distinctly different from the 50 percent on-off warning may be utilized to indicate other local door malfunctions.

H. Door Signal System

A suitable trainlined electric buzzer, intercom signal system shall be available between any activated door control position and a locomotive or cab car. The signal shall also be audible at all door control positions throughout the train if the master control drum switch is actuated at a control station. The electric buzzer signal system shall have a distinctively different tone from the private communication signal buzzer utilized between any car and locomotive. It shall operate from the low voltage DC system.

The signal system shall comply with applicable radio interference regulations.

- I. Side (Vestibule) Doors
- (1) Side doors shall be removed from the cars, thoroughly cleaned, repaired as required, and reinstalled.
- (2) Dented areas may be repaired by welding a skin patch the width of the door, finished to match original construction, or other method proposed by the Contractor and approved in advance by the Engineer.
- (3) The existing door pockets, lower tracks, drains and inside walls shall be cleaned, repaired, or replaced as required.
- (4) All existing hardware and seals shall be renewed. This includes the door nosing rubber, weather seals and Teflon guides.
- (5) Side door hangers shall be reconditioned and adjusted as required to provide smooth, noise free operation.
- (6) Glazing and mounting rubber shall be renewed.
- (7) All doors shall have fixed glazing, compliant with FRA requirements.
- (8) Mounting rubber shall be compliant with FRA requirements.
- (9) The door pocket heater system shall be removed.
- J. End Doors
- (1) End doors shall be removed from the car, inspected and the door panels and frame reconditioned as required.
- (2) Door seals and wipers, rubber bumpers, and return springs shall be inspected and renewed as required.

- (3) Upper guides, sills, Levers, arms and bases shall be inspected and reconditioned as required.
- (4) Cushioning cylinders shall be inspected and reconditioned as required.
- (5) Door lock assemblies shall be inspected and renewed.
- (6) On Cab car which will be converted to coach service, end door locks must be such that they function procedurally as a coach car end door and allow the operator to lock the car in accordance with FRA's Unattended Equipment guidelines and afford quick egress in the event of an emergency. The three dog leg locks must be such that they are in the unlatched position during service (or removed completely).

CDRL #	Description
5.001	Door Operator Timing Adjustment Procedures
5.002	Door Control and Communication Station Design Details
5.003	Door Control Design Details
5.004	Door Obstruction System Design Analysis and Test Validation Report

HEATING, VENTILATION AND AIR CONDITIONING (HVAC)

28 HVAC - GENERAL

The HVAC System includes all of the heating apparatus, ductwork, ventilation, cooling systems and their controls. The existing Heating, Ventilating, and Air Conditioning system consists of two unitized air conditioning units, a four-zone perimeter baseboard convective heating system, and forced air duct heating system.

The HVAC units are installed in the ceiling compartment on the intermediate level at each end of the car. Each vehicle has two independent, self-contained, modular, HVAC units. Each unit includes an evaporator, supply air fan, compressor, condenser and associated fan, refrigeration control unit, and terminal board box. HVAC units are removable through roof hatches. Routine service operations are largely performed through hinged ceiling panels accessible from the intermediate level inside of the car. The Authority has a program for overhauling and converting HVAC units to R-143a refrigerant. The Contractor's scope of work may be adjusted if a car is provided with converted HVAC units on it.

The entire HVAC system also contains fresh air fan located at the fresh air intake on the car roof, electric heaters located in the supply air duct, thermostat assemblies for fresh, return and supply air temperatures, and fresh and return air filters.

For the purposes of HVAC control, the car interior is divided into two independent zones. Zone 1 includes the A-end intermediate level, lower level right side, and upper level right side. Zone 2 includes the B-end intermediate level, lower level left side, and upper level left side. There is one control panel located in the equipment locker at B-end for both HVAC units. The HVAC system monitors exterior and interior temperatures and provides the required operating modes based on the temperature control chart. The control chart, in turn, varies between the normal and layover operation. There is also a winter/summer switch, which precludes the cooling equipment operation in winter mode. Objectionable drafts and hot spots shall not exist at any point in the carbody.

Temperature sensors/thermostats are provided in each intermediate level, upper level and lower level seating areas, return air plenum, air distribution ducts, and a layover thermostat on the lower level. The system is arranged such that except in the area of the side doors and vestibule, the HVAC system maintains a temperature variation not exceeding +/-3 degrees F throughout the car from 4 inches above the floor to 43 inches above the floor.

Ventilation is provided from blowers located within the unitized air conditioning units and fresh air is drawn from the outside through exterior grilles and mixed with interior return air in the return air plenum. The fresh air unit uses a two-speed fan motor that operates at reduced speed when outside ambient temperature is below 200 F, and is off when passenger entry doors are open.

For the rebuilt cars, power for the controls shall be nominal 72 VDC; power for the ventilation fans is 120 VAC; power for the heating elements and compressor shall be presently 480 VAC, 3-phase, 60 Hz.

The principle component of the HVAC system included in the rebuild work consist of:

- Air conditioning units,
- Overhead heaters,

- Baseboard heaters,
- Door pocket heaters, door threshold heaters, door track heaters,
- Under seat heaters,
- Temperature control panel, temperature sensors, thermostats,
- Air distribution ducts.

ASHRAE Standard 55-2004, Thermal Environmental Conditions for Occupancy and ASHRAE Guidelines 23-2016, Guideline for Design and Application of Heating, Ventilation and Air Conditioning Equipment for Rail Passenger Vehicles, shall be used as a guide in determining system capacities and the necessary work to rebuild the system.

Design Criteria for the HVAC system shall be as following:

- <u>Ambient Temperature (Summer)</u>: 103°F Dry Bulb (DB), 70 °F Wet Bulb (WB)
- <u>Ambient Temperature (Winter)</u>: 22°F Dry Bulb
- Passenger Load: 225 (not less than 450 Btu/h per person with 55% SHR)
- Interior Design Conditions: 75°F DB and 55% RH (Cooling) 70°F DB (Heating)
- Fresh Air: 1500 cfm (Minimum) per car
- <u>Total Air Flow</u>: Sufficient to meet the internal temperature, humidity and car pressurization requirements of the Scope of Work (5400 cfm minimum) per car
- <u>Carbody Heat Transmission</u>: In accordance with the Contractor's carbody and Insulation designed to meet the requirements of the Scope of Work
- <u>Lighting Load</u>: Total wattage of interior lights considering ballast efficiency
- <u>Solar Load</u>: In accordance with ASHRAE data and calculation methods

All system components shall be service-proven and supported by design and test data adequate to demonstrate compliance with the specified requirements and shall comply with the latest requirements of APTA SS-C&S-034 and 49 CFR 238 for equipment attachment. Details of the system capacity and performance calculation, design, arrangement, installation, and operation of the HVAC system shall be submitted to the Authority's Project Manager for review and approval. [CDRL 6.001]

The rebuilt HVAC system shall have the heating capacity of not less than 40 K W (not including the forced air cab heater) and the refrigeration capacity of not less than 240,000 BTU/h per car.

The Contractor shall conduct qualification testing to verify that the units provide the required features, functions and performance for heating and cooling capacity. [CDRL 6.002]

Only HVAC system control circuit breakers shall be accessible to the operating crew. Power circuit breakers, controls and relays shall be inaccessible to the operating crew and passengers.

Incremental repairs not specifically mentioned in this rebuild procedure will be considered beyond the work scope and must be authorized by the Authority before proceeding.

29 AIR CONDITIONING

- A. The refurbished air conditioning units shall consist of a hermetic or semi-hermetic refrigerant compressor driven by a 480 VAC, 3-phase motors, condenser and evaporator coils with associated blowers, two-stages of electric heater coils and associated refrigeration apparatus. The rebuild work for HVAC includes refurbishing the system to accommodate the new refrigerant, as well as to upgrade the system due to new and/or obsolete components or subsystems. The systems shall be updated to use the R-407C refrigerant or approved equivalent. A fully-hermetic HVAC unit without full accessibility for maintenance, troubleshooting and repair on the car will not be considered an approved equal.
- B. The air flow switch, one for each blower fan, that prevents the overhead heating and cooling systems from operating unless the fan is operating, shall be inspected for proper operation and renewed or replaced if required.
- C. The refurbished units shall be capable of being removed and replaced with the use of an overhead crane with a capacity of 2½ tons. Separation of the unit from the car shall be facilitated by the use of efficient disconnection of air ducts, electrical cables and removal of mounting attachments. The units shall be removable without the disassembling of refrigerant piping. The refurbished units shall be identical and interchangeable among all cars in this Contract and between ends.
- D. Taper guide pins mounted to the carbody are provided for ease of precisely locating the unit. The units shall be furnished with provisions for lifting. Time required to remove and replace the HVAC unit on the car shall not exceed 2 hours for two workers.
- E. If a lifting jig is required to safely remove the unit, four such jigs and their associated manufacturing drawings shall be provided to the Authority for review and approval.
 [CDRL 6.003]
- F. All electrical connections to the units, with the exception of the grounding strap, shall be by means of separate quick disconnects for each voltage level. The units shall be secured to the car structure using a maximum of eight (8) threaded fasteners. The mounting system shall be such that the air-conditioning unit shall be safely retained to the vehicle even in the event of failure of up to 25 percent of the fasteners. A ground strap shall be provided between the unit frame and the carbody.
- G. The removed R-22 and new R-407C refrigerants shall be handled according to the EPA regulations currently in effect, including qualification and certification of the technical personnel.
- H. The unit's frame and housing shall be constructed of stainless steel except as approved by the Authority. The minimum level of work that shall be performed on the air conditioning portion of the HVAC system is provided below.
- (1) Main Frame
 - a. Remove all components, equipment and insulation from the frame.

- b. Inspect frame structural members and panels. Repair cracks and damage. All welding must be performed by an AWS certified welders. If a bottom panel is cracked, replace with a new panel.
- c. Thoroughly clean unit of dirt, rust, oil, etc. If needed, use grit blast to remove rust or contamination to bare metal.
- d. Prime areas, as required. Paint the unit and components in original color.
- e. After repainting, apply new foil faced, moisture proof thermal insulation, or approved equivalent, using holding pins.
- f. Renew or replace, as applicable, damaged or defective latches, including those that are not of the approved stainless steel ¼-turn latches.
- g. Renew panel seals. Refrigeration control and terminal box enclosures shall have gaskets installed made from approved self-adhesive neoprene seal material.
- h. Renew sealant on top closure panels.
- i. Install new vibration isolating mounts and cushions for mounting the HVAC unit to the carbody. The preload spacer and steel sleeves can be qualified for reuse. Renew mounting bolts.
- j. Replace elastomeric tubing supports.
- (2) Evaporator Section
 - a. Chemically wash, rinse and clean evaporator coil. Straighten the fins. Inspect for damage and repair as required.
 - b. Pressure test evaporator coil to 600 psig.
 - c. Clean drain pan and replace the rubber-insulating material on the outside surface of the pan. Renew kazoo valves.
 - d. Disassemble and inspect evaporator blower assembly. Renew if required.
 - e. Clean and paint fan and housing assembly.
 - f. Inspect blower fan shaft. Renew if required.
 - g. Renew bearings.
 - Replace evaporator blower motor with a new or rebuilt OEM or approved alternative 3 H.P. motor. A rebuild should include: new bearings, dipped and baked stator. It shall be hi-potted at 2 kV dc for one minute, with measuring and recording insulation resistance value before and after the hi-pot.
 - i. Install and balance a new pulley on the motor.
 - j. Check the balance of fan assembly and check alignment of motor and fan pulleys. Alignment of motor and fan pulleys to be on the same plane.
 - k. Install new "V" belt and adjust tension.

- I. Renew air flow switch, including new bracket if renewed.
- m. Replace air flow switch tubing.
- n. Renew flexible duct material.
- (3) Condenser Section
 - a. Chemically wash, rinse and clean condenser coil. Straighten the fins. Inspect for damage and repair as required.
 - b. Pressure test condenser coil to 600 psig.
 - c. Replace condenser fan motor with a new or rebuilt OEM or approved alternative 3 H.P. motor. A rebuild shall include: new bearings, dipped and baked stator. It shall be hi-potted at 2 kV dc for one minute, with measuring and recording insulation resistance value before and after the hi-pot.
 - d. Inspect and replace condenser fan if damaged.
 - e. Reassemble fan and motor. Ensure proper alignment and balance. Replace split-tapered bushing and secure hub.
- (4) Compressor
 - a. If the same type of compressor is used, it shall be completely rebuilt by the compressor manufacturer or its authorized rebuilder. Alternatively, new hermetic scroll compressors may be used with the modified piping as required.
 - b. For rebuilt semi-hermetic compressor, renew the unloaders with a suction cutoff type.
 - c. For the rebuilt semi-hermetic compressor, renew crankcase heater with a 75 W, 72 Vdc type. For scroll compressors, install crankcase heaters around the compressor with a type and capacity suggested by the compressor manufacturer, powered from 72 Vdc.
 - d. Clean and repair the compressor mounting base, as applicable.
 - e. Renew vibration mounts.
 - f. The rebuilt semi-hermetic compressor is to have an oil drain plug on the base of the crankcase.
- (5) Other Components
 - a. Damaged or defective components shall be renewed including replacing the liquid receiver with a new receiver complete with sight glasses and three new removable service valves. Receiver shall be pressure tested to OEM specification.
 - b. Replace the filter-dryer.
 - c. Renew moisture indicator sight glass.
- (6) Piping and Valves

- Renew piping/tubing which is damaged, kinked, showing signs of leak, etc.
 Replacement material shall be seamless copper tubing per ASTM Standard
 B280. All non-threaded connections shall be brazed with inert gas flow
 through the joint while brazing, and cleaned. All threaded connections shall
 use "pipe dope" or equivalent. Teflon tape shall not be used.
- b. Inspect all brazed joints for indications of leakage and corrosion. Repair all defects found.
- c. Recondition service valves by repacking, replacing defective components, and testing. Damaged valves shall be replaced.
- d. Renew all Schrader valves.
- e. Discharge check valve shall be reconditioned by installing a new piston with Teflon seat, new spring, and new body sealing gasket.
- f. Inspect and insure that all service valves have caps in place. Tighten caps as required.
- g. Solenoid valves shall be restored to new working condition by installing a rebuilt kit consisting of a new diaphragm, plunger, and a body sealing "O" ring.
 Renew solenoid electrical coils if necessary.
- Renew thermal inspection valves. Position the sensing bulb at 4 or 8 o'clock on the suction line. Remove corrosion and dirt from suction line before installing the sensing bulb. Insure that the bulbs have a good thermal contact with the suction lines. Replace defective thermal inspection valves.
- i. Insulate the thermal bulb and adjacent piping.
- j. 10. Renew insulation on the suction line piping using Rubetex, or approved equal insulation, secured with tie wraps or suitable approved adhesive.
- (7) Refrigeration Control Box and Terminal Box
 - a. Renew all pressure switches.
 - b. Renew capillary tubes for pressure switches.
 - c. Renew service switch.
 - d. Inspect and clean terminal blocks. Renew if required.
 - e. Inspect the interior of each box. Remove corrosion and repaint box.
- (8) Wiring
 - a. Inspect all wiring for damage, discoloration, abrasion, chafing, etc. Replace as required.
 - b. Inspect all wire terminations. Only insulated ring lugs are to be used.
 - c. All wiring shall be identified using heat shrink type labels or approved equivalent.

- d. Wire harnesses must be adequately secured using tie wraps, screw down clamps or other approved means.
- e. Wiring which may be subjected to abrasion must be suitably protected.
- f. Ground straps shall be inspected and replaced if required.
- (9) Labels and Decals
 - a. Renew all decals.
 - b. Install a label on the HVAC unit to identify facility and address performing the rebuild, and the rebuild date.
 - c. Identify all pressure switches, electric switches, contactors, and service ports.
 - d. Apply decal indicating blower fan and condenser fan rotation direction.
 - e. "Danger High Voltage" decal and carbody ground location decals are to be renewed and plainly visible.
 - f. All terminal blocks shall be labeled.
- (10) Pressure Testing, Evacuation and Charging
 - a. Pressure test HVAC unit. Test pressure should be 415 +/- 10 psig throughout the entire unit, except compressor which should be isolated at the pressure suggested by the compressor manufacturer.
 - b. Check entire system for leak using a leak detector. Repair leaks as necessary and re-test.
 - c. Evacuate the system to a maximum 300 microns pressure from both suction and discharge sides with all service valves open and solenoid valves energized.
 - d. With the pump isolated, wait for 30 minutes for the system to attain equilibrium before the final vacuum is read. The final reading must be below 700 microns. Reading of the final pressure above 700 microns may indicate a system leak, in which case the leaks shall be found and repaired, and evacuation test repeated.
 - e. Charge the system by weight with liquid refrigerant only through the system liquid side.
- (11) Operation and Test Procedures
 - a. Check for proper phasing and proper fans rotation direction.
 - b. Check insulation of the blower and condenser motor circuits. Insulation values should be not lower than 10 MOhm.
 - c. Check insulation of the control circuits.
 - d. Hi-pot the high voltage circuits at 1720 V for one minute.
 - e. Hi-pot control circuits at 1250 V for one minute.

- f. Following the hi-pots, again check the insulation of the circuits. The insulation resistance should not diminish.
- g. Check continuity of compressor crankcase heater. Measure and record resistance.
- h. Check and record the compressor, evaporator blower and condenser fan motor currents.
- The following checks shall be performed after HVAC unit has been run for at least one hour and stabilized in operation at suction pressure of approximately 70 psig and discharge pressure of 275 psig minimum. Thermal loads shall be used if required to achieve these operating pressures.
 - (i) Check/adjust evaporator blower fan to run at 1606 rpm.
 - (ii) Check expansion valves superheat to be 10 degrees +/- 3 degrees F.
 - (iii) For rebuilt semi-hermetic compressor, check/adjust the compressor unloader valves as follows:

Valve	Load	. Unload
Junction Box side	63	. 51
Discharge Line Side	69	. 56.5
Tolerance is =/- 2 psi for all se	ettings.	

(iv) Check pressure switch settings to be as follows:

Switch	.Open	Close
High Pressure	.425 +/- 10 psig	. 320 +/- 25 psig
Low Pressure	.20 +/- 4 psig	. 35 +/- 4 psig
Modulation Pressure	.390 +/- 10 psig	. 330 +/- 10 psig

- j. The system shall run for an additional three hours after satisfactory completion of the previous tests. The following parameters shall be checked and recorded:
 - (i) Compressor oil level (if applicable)
 - (ii) Unusual vibrations or noise
 - (iii) Sight glass moisture indicator to indicate dry system
 - (iv) Refrigerant leaks
 - (v) Compressor oil leaks (if applicable).

30 HEATING

The minimum level of work to be performed on the heating portion of the HVAC system is provided below. All heaters shall be tested, cleaned and sanitized.

- A. Floor Heaters
- (1) All floor heater covers shall be inspected and reconditioned or renewed as required.
- (2) Cover hardware shall be inspected and reconditioned or renewed, as required.
- (3) All back-liner assemblies shall be inspected and reconditioned or renewed, as required.
- (4) Terminal blocks, insulator strips, cover strips, and associated hardware shall be renewed.
- (5) Wiring and lugs between heating elements shall be renewed and shall be rated for 150°C operation minimum.
- (6) All insulating washers shall be replaced.
- B. Under-Seat (forced flow) Heaters
- (1) Under-seat (forced flow) heater covers shall be inspected and reconditioned or renewed as required.
- (2) Cover hardware shall be renewed.
- (3) Box assemblies shall be inspected and reconditioned or renewed as required.
- (4) Grommets, wire guards and fasteners shall be renewed.
- (5) Terminal blocks, insulator strips, cover strips and associated hardware shall be renewed.
- (6) Wiring and lugs between heating elements shall be renewed and shall be rated for 150°C operation minimum.
- (7) All insulating washers shall be replaced with an asbestos-free type.
- (8) Element attaching hardware shall be renewed.
- C. Overhead Heaters
- (1) Overhead heater assemblies shall be inspected and reconditioned or renewed, as required.
- (2) The thermo-fuse assembly shall be replaced.
- (3) All heaters wiring insulation shall be rated at 150°C.
- (4) Element attaching hardware shall be renewed.
- (5) Mounting hardware shall be renewed.

31 VENTILATION AND DISTRIBUTION DUCT WORK

- A. Distribution and return air ducts, including dampers and restricting plates shall be cleaned and sanitized. All flexible ducts shall be replaced.
- B. Airflow
- (1) Airflow shall be adjusted to the following values:
 - a. Outside Air 750 cfm
 - b. Return Air 2000 cfm
 - c. Total Air 2750 cfm per air conditioning unit.
- (2) Airflow shall be evenly distributed throughout each car Setting parameters for each car showing the configuration of each damper, restrictor and diffuser shall be included with the car rebuild history books. Airflows shall be measured and documented at various locations throughout the car.
- (3) The Contractor shall completely test and balance airflow with an approved flow hood or equivalent measuring device.
- C. Ventilation Ducts and Grills
- (1) All ventilation ducts, plenums and diffusers shall be thoroughly cleaned, sanitized and disinfected.
- (2) Fasteners securing upper level flexible (FRP) fiberglass HVAC ducts are coming loose in service and are inaccessible and difficult to tighten. The Contractor shall provide an improved method of securing the ducts using captive fasteners that shall be submitted to the Authority for review and approval.

32 HVAC CONTROLS

- A. The HVAC control system shall be replaced with a commercially available Direct Digital Control (DDC) "off-the-shelf" system that is non-proprietary.
- B. The HVAC control system shall use commercially available temperature sensors or thermistors. Contractor shall be qualified to install, check, test and perform a system start-up.
- C. The system shall be fully automated, programmable to maintain temperature within a specific temperature range and automatically switch between heating and cooling as needed. System shall also control overhead heating, floor heating and compressor/system capacity staging.
- D. System design to consider option for 30 minutes of ventilation while under emergency power. The control system design shall be submitted to the Authority for approval. [CDRL 6.004]

E. HVAC relay and contactor panels shall be cleaned, inspected and repaired. All contactors shall be replaced with a service proven, off the shelf contractor. Contactors and relays to be approved by the Authority before installation. [CDRL 6.005]

CDRL #	Description
6.001	HVAC System Capacity and Performance Calculation, Design, Arrangement, Installation and Operation
6.002	HVAC Unit Qualification Report
6.003	Lifting Rig Design
6.004	HVAC Control System Design
6.005	HVAC Relays and Contactors Data and Service History

LED LIGHTING SYSTEM

33 LED LIGHTING SYSTEM

A. Lighting System - General

All existing interior lighting fixtures and ballasts shall be removed and replaced using LED modules, neutral white in color. The lighting shall operate from the 120 VAC and 72 VDC power supplies. The lighting shall be as uniform as practical throughout the car. Lighting shall be by means of an approved arrangement of lighting fixtures and shall be coordinated with the vehicle color scheme and arrangement. [Part of CDRL 7.001]

The vehicle lighting shall include the following:

- Upper and Lower Level Passenger area lights
- Vestibule lights
- Marker lights, portable unit stored in door pocket locker
- Emergency lights (both battery powered and self-contained)
- Platform illumination lights
- Stairway Light
- Toilet Room Light

The Authority has updated some cars with new LED lighting. Reuse components on cars with existing LED lighting systems. Document the change of scope in the Car Rebuild History Book, indicating the difference from installation in a car without LED lighting. The lighting shall function as an integrated system and shall provide normal lighting, standby lighting and emergency lighting. The lighting system design, features, functions, and performance shall comply with 49 CFR 38, 238, and 239 and minimum performance requirements of APTA Standards and Recommended Practices APTA PR-E-S-013-99, Rev. 1 and APTA PR-E-RP-012-99 for passenger car lighting. Where a conflict exists, the most restrictive condition shall apply.

The lighting design and arrangement shall incorporate the minimum quantity of unique fixtures. To the extent possible, replaceable and repairable components of the lighting shall be interchangeable among fixtures and shall be available from U.S. sources.

The lighting system shall neither produce an objectionable glare nor show single LED dots in the light fixture. LED lights shall not deteriorate rapidly in effectiveness due to LED ageing or due to the collection of dirt on fixtures. Fixtures shall permit easy cleaning and renewal of LED lights. All light fixtures and shall be free of rattles and not generate noise during normal operation. Cleaning, maintenance, and parts replacement shall be accomplished without disassembly of interior panels.

Intelligent LED light fixtures shall include brightness control based on ambient light conditions or time of the day. The brightness control parameters shall be adjustable by the Authority and submitted to the Authority for approval. [Part of CDRL 7.001]

LED light fixtures shall not have exposed contacts when changing a light assembly.

Vestibule lights, platform lights, outside indicator lights, marker lights, and emergency lights shall operate from the battery circuit (72VDC). Lights shall not be wired in series. All other

Location	Method of Measurement	Intensity
Passenger Seats	At an elevation of 33 inches above the floor and on the upper surface of a 45 degree reading plane	30 footcandles (All seats except those in the vestibule which will be 10 footcandles
Passenger Aisles	At the floor	5 foot candles
Entrances and Exits	At the floor within 20 inches from the door, inside the car	5 foot candles
Stairways	At center of tread	5 foot candles

lights shall operate from the 120 VAC power supply. The system providing power for emergency lights shall be capable of operation in accordance with the requirements of APTA PR-E-S-013-99, Rev. 1.

Indirect lighting shall be provided for the passenger seating areas. Light fixtures shall be integrated into the car interior to provide the light at the reading plane, to the specified intensity, while also illuminating adjacent ceiling panels to assist in diffusing the light and in increasing the overall brightness level of the interior of the car. The Contractor shall submit details of the lighting system design, arrangement, installation, and operation to the Authority for review and approval. [CDRL 7.001]

B. Intensity

The intensity of normal illumination with nominal voltage available at the light fixtures must satisfy the following criteria:

The intensity of illumination in other areas of the car shall be in accordance with the requirements of 49 CFR 238, APTA RP-E-RP-012-99 for normal lighting and APTA PR-E- S-013-99, Rev.1 for emergency lighting. Lighting shall be uniform throughout the reading plane in the passenger seating area of the car and shall provide adequate illumination of surfaces such as aisles, doors and advertising cards. Illumination must be directed downward to minimize glare.

C. Lighting and Fixture Arrangement

The lighting fixtures in the main passenger areas shall be mounted in existing locations, in two parallel rows extending through in the lower, upper, and intermediate levels to provide indirect light. Alternative arrangements of the light fixtures may be proposed, if required to

satisfy the specified feature, function and performance requirements. The lighting fixture arrangement shall be approved by the Authority. [CDRL 7.002]

As a minimum, the fixtures in the main passenger area shall be divided electrically into three circuits. The fixtures on each of the circuits shall be connected in a manner to produce, as nearly as possible, uniform distribution of light throughout the car when only one or two circuits are activated. Adjacent fixtures shall not be on the same circuit.

LED modules and accessories shall have a reported L70 rating based on IES TM-21-11, Projected Long Term Lumen Maintenance of LED Light Sources. An LED lighting circuit, with individual thermal protection or approved equivalent, shall be used. The over-temperature feature shall remove the power when over-temperature is reached and automatically reset when the temperature drops to acceptable levels.

Each driver module shall be able to individually adjust the intensity of the LEDs with a pulse width modulated output. Safety grounding of the driver and fixture shall be isolated from the power return. Reversing polarity on the driver module shall not result in damage to the module.

In the event that an LED board is replaced with a new board, the LED board shall include a feature to adjust the LEDs for aging such that the intensity and color shall blend with the adjacent boards.

The design shall limit LED junction temperature rise to no greater than 68°F (20°C) over ambient temperature. The LEDs shall have a Correlated Color Temperature (CCT) range within 4,200 to 5,700 degrees Kelvin. The transmitted light shall be neutral white and there shall be no visible difference in illumination between LED modules and fixtures.

Mixing LEDs in light fixtures from multiple CCT/color bins is not permitted. All LEDs in a fixture shall be from a single CCT/color bin. Mixing LEDs from various suppliers is not permitted. All LEDs shall be from a single supplier such as NICHIA, OSRAM or an approved equal.

The power supplies shall be incorporated with the LED boards. No threaded fasteners shall be required to attach the LED boards to the fixtures. The driving of the LEDs by the use of multiplexing is not permitted. Failure of up to three LEDs in a single fixture shall not turn off the LED fixture. The removal or service of LED boards shall not require any special tools.

Control of LED currents shall not cause any noticeable light flickering. The fixture of a single LED shall not turn off the LED board/cluster and shall not reduce the life expectancy of the LED board/cluster.

LED module reliability shall be 500,000 hours MTBF minimum. The ballasts LED module shall also include reverse polarity and high and low voltage protection.

LED fixtures shall have a reported L70 rating based on IES TM-21-11, *Projecting Long Term Lumen Maintenance of LED Light Sources*. The Contractor shall provide evidence that sample LED fixtures have been tested per IES LM-80-08, *IES Approved Method for Measuring Lumen Maintenance of LED Light Sources* over a minimum of 6000 hours of operation. The minimum TM-21-11-based reported L70 rating shall be the lesser of six times the duration of testing or

50,000 hours. An LM-80 Test Report shall be obtained documenting these tests and lumen maintenance calculations.

The Contractor shall provide evidence that LM-80-type tests performed over at least 6000 hours of operation at high ambient temperatures up to the maximum operation temperature do not cause the TM-21-11 reported L70 rating to diminish below 95% of a reported L70 rating based on normal temperature conditions. Additionally, the correlated color temperature and chromaticity coordinates shall be measured and reported over the high temperature testing period. Measurements shall be made at least once every 1000 hours over the high temperature testing period. The results of this testing shall be provided to the Authority. [Part of CDRL 7.003] Alternative testing schemes that demonstrate the performance of the LED fixtures at high ambient temperatures may be submitted to the Authority for consideration.

LED module electromagnetic emissions shall not exceed the levels specified above, nor interfere in the operating frequencies of the car communication system and crew radios.

The design, life expectancy and reliability data for all fixtures shall be submitted to the Authority for approval during design review process. [CDRL 7.003]

D. Fixture Construction

LED fixture sockets, if used, shall be of an approved heavy-duty spring type with an approved connector and configuration and if any contacts are used for individual lamps, contacts and shall be designed to provide support to the end of the lamp. If provided in a tubular configuration, supplementary support for the lamps shall be provided by two spring-metal clamps (one at each end of each lamp) attached to the underside of the reflector or approved equivalent. Sockets shall not be visible when viewing the fixture from seated positions. Integral electronic control module, conveniently located on the fixture, shall be provided. Alternate controller schemes of appropriate types may be considered, as approved by the Authority. Easily accessible AMP MATE-N-Lok connectors shall be provided on lighting fixtures for connection of wiring so that the fixture may be electrically isolated for maintenance. The back of the fixture may be an aluminum extrusion. Continuous wire-ways, separate from the fixture or an arrangement of thin wall steel conduit and junction boxes, shall be provided to route wiring to each fixture. The access panel of the fixture shall be made with a concealed hinged extrusion and a closing screw extrusion. No wire splice shall be permitted in conduits or fittings connected to the lighting fixtures. The lighting fixtures shall provide indirect light in the passenger areas and shall be integrated into the interior arrangement such that the fixtures are not visible to seated passengers. The fixtures shall be arranged to be compatible with the color, pattern, and texture of the interior materials and provide the specified light intensity. Alternative fixtures may be proposed based on the requirements of the interior arrangement.

The lighting system shall not use the fixture housing or socket as a ground return. All conductive portions of fixtures exposed to passengers or maintenance staff shall be grounded. Under all conditions, lighting fixture surfaces which the passengers and crew may contact shall not have a surface temperature in excess of 125 F (52 C).

Lenses shall be uniform in color. All fixtures shall have UV-stabilized polycarbonate lenses and shall be arranged for re-lamping from the front. Fixtures shall be dust and moisture resistant using suitably designed solid neoprene rubber seals between the lens and fixture.

E. Toilet Room Lighting

To the extent possible, the toilet room lighting shall match that of the Authority H-R fleet. The toilet room shall use two LED lamps, one powered from 120 VAC power supply for operation during normal service and one powered from the 72 VDC circuit with a selfcontained battery back-up for operation during normal, and emergency services. The fixtures shall be service proven for railway service.

F. Stairway Lighting

LED fixtures shall be recessed in the stairway walls and directed downward to illuminate the stair tread. The fixtures shall be powered from the 72 VDC supply to provide the required illumination for normal and emergency functions. The fixtures shall be service proven for railway service.

G. Emergency Lights

Each car shall be provided with emergency lights in four passenger areas (two intermediate, one upper, and one lower), in the stairways, in between car passageway, and in the toilet room. The emergency lights shall be powered from the car battery system upon loss of HEP trainline power. The emergency lights shall be enclosed within the LED lighting fixtures and powered from one long life, DC inverter with status and test capability. The emergency lighting system shall comply with the minimum function and performance requirements of APTA-PR-E-RP-013-99, Rev 1 and 49 CFR 238 and 239 and shall coordinate with emergency signage and low location exit path marking requirements.

Emergency lights shall be coordinated with the load shedding function to ensure a smooth changeover of the lighting without loss of illumination. The control scheme shall function such that when the normal lighting power is interrupted, the emergency lights shall be managed in the following manner:

- Upon interruption of the normal lighting power, (loss of HEP, or 120VAC or LVPS), the passenger emergency lighting shall be powered at normal lighting levels by the car battery.
- While in the emergency lighting mode, the car battery shall provide power for essential equipment including the emergency lighting for at least 90 minutes or longer. When the battery voltage falls below 50VDC, the emergency lighting shall automatically switch to a separate independent power source. When operating from the independent power source, the emergency lighting level shall be maintained.
- Emergency lighting from the independent power source shall remain operational for a period of 90 minutes. The light system shall include an emergency lighting manual reset function that shall, when operated, allow the initiation of another 90 minute period at any time. One momentary activated

switch shall be provided on each car to reset the 90 minute timer. The switch with operating instructions shall be installed in an approved location accessible to the crew. The system shall allow for repeated use of the manual reset function.

- The independent power source for emergency lighting shall consists of a 72 VDC current limited/ trickle charger with a lithium ion battery pack, or super capacitor arrangement for lighting during periods of total loss of AC and DC power on the car. The self-contained emergency light unit shall have sufficient capacity to provide a minimum of 90 minutes of operation from its own independent source.
- The self-contained emergency light unit shall be automatically recharged after the 72 VDC power is restored. The self-contained emergency light package shall be integrated into the general lighting scheme such that no differences in performance are noted when operating in the non-emergency mode. The emergency lighting shall be arranged such that a self-test can be performed by use of a manual reset switch. Each emergency light shall incorporate an LED indicator that indicates the condition and operation of the independent power source.
- Operation in the emergency lighting mode shall not degrade the life of the module.
- The quantity and location of the emergency lights, emergency lighting arrangement, and emergency lighting system features, functions and performance shall be submitted to the Authority for review and approval and demonstrated on the Pilot Cars. [CDRL 7.004]

H. Low Location Exit Path Marking

Each car shall be equipped with a passive illumination, low location, and exit path marking system that complies with the requirements of 49 CFR 238 and 239, APTA PR-PS-S-004-99, Rev. 2,. To the extent possible, the low location exit path markings shall be arranged to match the markings and arrangement of the fleet. The low location exit path marking system shall be coordinated with the emergency lighting and emergency signage requirements. The Contractor shall submit details of the material, installation and arrangement of the low location exit path markings to the Authority for review and approval. [CDRL 7.005]

The system shall use an approved HPPL marking material. The system shall be arranged to provide visual guidance for evacuation of the car when overhead lighting and the emergency lighting system has failed or has been obscured. The low location exit path marking system shall clearly identify the primary path to be followed for exiting the car under emergency situations. The primary exit path shall be designed to evacuate the passengers to the next car and not onto the right-of-way. Standard test method in accordance with ASTM E2073-02 shall be used. The system shall be approved by the Authority and demonstrated on the Pilot Cars. [CDRL 7.006]

I. Service Area Lights

Existing service area lights shall be replaced. Any location requiring access by maintenance and crew personnel shall have LED 72VDC lights installed to aid in the maintenance and servicing of equipment. Lighting control shall be performed via micro switching engaged by the locker door or ceiling panel allowing the light to operate when the door/panel is open and automatically extinguish when closed. Rattling of door shall not cause the lighting to cycle between ON and OFF. Location of these lights shall be submitted for review and approval by the Authority. [CDRL 7.007]

J. Portable Marker Lights

One red portable marker lights shall be stored in the B-end door pocket locker next to the Passenger Emergency Brake pull handle A receptacle and mounting device for a portable marker light shall be provided at the A and B-ends of the cars. One portable marker light shall be provided with each car. The marker light and luminosity shall comply with 49 CFR 221 requirements for marking devices. The light mounting arrangement and storage shall be subject to the approval by the Authority. [CDRL 7.008]

The LED shall produce an equivalent luminous intensity to a PAR 46 universal red LED at 72 VDC. A tab on the lamp mates with a notch on the mounting plate to keep the lamp from rotating. The lamp shall contain two LEDs in parallel. The marker light fixture shall use a long life LED array rated at 100,000 hours at 40-95 volts clear bulb.

- K. Exterior Indicator Lights
- (1) One exterior status indicator assembly is mounted on both sides of each car with three indicators: amber Brake Applied indicator, white Emergency Brake indicator, and red Door Open indicator. This assembly shall be removed and replaced with an exterior status indicator assembly similar to that on the Authority's existing H-R fleet.
- (2) All system signal and indicator lights shall use long life, high intensity LED array lamps having a rated life of at least 100,000 operating hours at 30 to 95 VDC. The LED array shall be arranged such that the failure of a single LED in the array does not affect the life of the remaining LEDs.
- (3) The lights shall be visible from front or rear of the train, at a distance of 12 car lengths when lit in bright sunlight. The lenses shall be shaded to aid in meeting the visibility requirements.
- (4) The assembly shall be in a low clearance, corrosion resistant housing located within the car clearance line and of a design which shall not be damaged by car washing machines.
- (5) The exterior indicator light location shall be similar to existing the Authority H-R vehicles. The lights indicate the following:
 - a. Door Open Indicator Light illuminates on any car on which a door is open or which does not have a door closed status.
 - b. Brake Applied Indicator Light illuminates when the brake applied trainline is energized or on any car on which brake cylinder pressure exceeds 10 psi.

- c. Emergency Brake Indicator Light illuminates when a B-3-B emergency brake valve handle is pulled; in addition, illuminates on any car that has door control and communication station key switch enabled.
- L. Light Control
- (1) All lighting circuits shall be protected by circuit breakers. The main passenger area lighting and the platform lights shall be controlled by switches located in the switch locker. The emergency lights shall be automatically controlled.
- (2) The end vestibule lights and marker lights shall be controlled by switches located in the locker.
- (3) The light control arrangement and switch locations shall be submitted to the Authority for review and approval. [CDRL 7.009]

CDRL #	Description
7.001	Lighting System Design, Arrangement, Installation and Operation
7.002	Lighting and Fixture Arrangement
7.003	Lighting Design, Life Expectancy and Reliability Data
7.004	Emergency Lights Design Package
7.005	Low Location Exit Path Marking Design Package
7.006	Low Location Exit Path Marking Pilot Car Demonstration
7.007	Service Area Lights Arrangement
7.008	Portable Marker Lights Mounting Arrangement and Storage
7.009	Light Control Arrangement and Switch Locations

ELECTRICAL SYSTEM (VOLTAGE, BATTERY, 120 VAC POWER, TRAINLINES)

34 LVPS/ BATTERY CHARGER - GENERAL REQUIREMENTS

- A. To achieve interoperability with existing H-R cars, the low voltage system will be changed from 36 VDC to 72 VDC, except for the trainlined zero speed circuit and its bypass. The design and interface of the new 72 VDC system with all low voltage systems shall be provided. [CDRL 8.001] The zero speed circuit shall be powered by a 72/36V DC/DC converter. The arrangement shall be such that this circuit can be easily converted to 72V in the future. [CDRL 8.002]
- B. The existing LVPS/Battery charger system shall be removed and discarded. A new LVPS/Battery Charger shall be installed which shall be able to provide all necessary 72 VDC power to the cars.
- C. The replacement LVPS/Battery charger system shall be designed for maximum load including 25% spare capacity.
- D. The LVPS/BC shall be designed and tested according to IEC 61287, with all optional tests being performed. Electronic circuits within the LVPS shall be designed and tested according to IEC 60571.
- E. The LVPS and battery charging unit shall be functionally separate systems with separate current limit and circuit breaker protection. The modules for the LVPS and battery charger shall be interchangeable.
- F. The maximum charging current must be limited to the capacity of the LVPS/BC unit and the temperature limits of the battery cells. The capacity of the charger shall reflect the ability to charge a totally discharged battery within 2 hours to a level that shall meet 49 CFR 238.115 requirements.
- G. LVPS/Battery Charger system technical data shall be submitted to the Authority for review and approval including the following details: [CDRL 8.003]
- (1) Operating characteristics of auxiliary system power supply components;
- (2) Low-voltage power supply/battery charger operating characteristics;
- (3) Over-temperature protection compensation scheme;
- (4) Battery charging requirements;
- (5) Tabulation of all low voltage DC loads (with assistance of the Authority)
- H. The unit shall be weatherproofed and protected from shock and vibration by shock mounting of the enclosure or the internal components. The unit shall be state of the art technology using IGBTs, with transient protection and surge suppression necessary to produce reliable performance in the commuter rail environment.
- I. The LVPS/Battery Charger shall be capable of operation with a nominal input of 480 VAC, 3-phase with a tolerance of +/- 10 percent with an input frequency range of 57-

63 Hz, 3-phase. The input power factor, including all frequency harmonics of the current, should exceed 0.9 at the rated load. The output voltage shall have a ripple not to exceed 2.0 V peak-to-peak (0.7 V rms) under all operating conditions.

- J. The DC outputs are to be isolated from the AC input and properly regulated at 72 +/-1 VDC for all operating loads. The input loads shall be balanced and distributed between the phases. Open phase protection shall be provided and indicated on the car monitoring system.
- K. The LVPS shall be designed to operate without damage or degraded performance with phase imbalances of +/- 10%.
- L. A battery temperature sensor shall be mounted to a battery terminal and shall translate the battery temperature to an electrical input signal to the LVPS. The LVPS battery charger channel shall be designed to provide the recommended charging current as a function of battery temperature, as recommended by the battery supplier.
- (1) Current limit shall be provided and shall be time limited to differentiate a temporary load characteristics from system faults.
- (2) Self-test features shall be included to verify the operation of the LVPS/BC as well as operation of the protective circuitry.
- (3) The LVPS/BC unit shall operate in the range of 50 VDC to 90 VDC. Load shedding shall occur when the battery voltage drops below 50Vdc.
- Overvoltage and undervoltage events shall be declared when the high limit of 528
 VAC and low limit of 432 VAC are exceeded. Overvoltage and undervoltage activation shall be announced in the car by the LVPS/BC monitoring and diagnostic system.
- (5) Reverse polarity protection shall be provided. The operation of the reverse polarity features shall not result in any defective components.
- (6) Automatic change over to battery backup shall occur in case of a 480 VAC power failure or LVPS failure. The non-essential loads will be dropped during the changeover. The LVPS/Battery Charging unit EMC design and testing shall comply with IEC 62236.

M. Battery System

The cars are currently equipped nickel-cadmium battery set. The battery sets provide low voltage power in the event of head end power (HEP) loss. The battery is contained in two battery compartments located under each side of the car at the B-end. The battery charger section of the LVPS/BC system monitors and maintains the charge on the battery set. Battery power is available to the car with the battery switch in the closed position.

The Contractor shall replace the existing battery set with a nickel-cadmium battery having sufficient capacity to support all 72 VDC vehicle loads within the voltage range of 50 to 90Vdc, including the emergency loads identified below.

(1) Operation

The replacement battery system shall be a 48-cell NiCad battery for railway applications. Each of the two battery boxes shall accommodate 24 cells which then are connected in series. The car battery system shall be dimensioned to provide emergency power for the following equipment for at least 180 minutes.

- Door Controls and ADA audio/visual system (cycle doors on one side of the car open for 40 seconds every 5 minutes),
- PA and Intercom Systems (operate PA for 20 seconds every 5 minutes from hand held radio),
- Passenger Emergency Intercommunication System
- Conductor Signal (operate for 5 seconds every 5 minutes),
- Wheel Slide Controller (activated every 5 minutes),
- Destination Sign (continuous),
- Air Brake and Door Indicating Lights (continuous),
- Temperature control (if LVPS shuts down but 480Vac is available)
- Standby Lighting (refer to lighting section for details) continuous for 90 min powered by vehicle battery, followed by self-powered Emergency Lighting for an additional 90 min, as required in 49 CFR 238.115.
- HVAC ventilation for 30 min.

While operating these emergency loads, the output voltage must not drop below 50 VDC.

If the battery voltage drops below 50VDC, all emergency loads shall be shed other than the Radio and the PA system. The load shedding voltage shall have a sufficient large hysteresis to avoid cycling between emergency power and load shedding.

Details of the design, arrangement, and installation of the Battery System shall be submitted to the Authority for review and approval [CDRL 8.004].

- (2) Battery Arrangement
 - a. The battery construction, identification, test methods, and battery connectors shall comply with APTA PR-E-RP-007-98, 49 CFR 238, and NFPA 130.
 - b. The cells in each individual tray assembly shall be connected in series using inter-cell connectors. The inter-cell connectors shall be covered with an FRP protective cover. The individual tray assemblies shall be connected in series using inter-tray cables, providing forty-eight cells in series. Each cell shall be equipped with one flame-arresting flip-top vent and fill cap.
 - c. Lines marked MIN and MAX to identify the minimum and maximum electrolyte levels shall be visible on both sides of the cell. The cell manufacturing date code shall appear on the top near the positive terminal.
 - d. Each cell shall be marked on two sides with the model and serial number label and a bar code.
- e. Terminal markings shall be molded into the cover near the terminals. Red (positive) and blue (negative) plastic washers under the terminal nuts shall identify the polarity of the connections.
- f. The battery system shall have a nominal capacity of at least 160 Ah to comply with the emergency load requirement. A capacity calculation shall be provide to the Authority for review. [CDRL 8.005]
- (3) Battery Compartment
 - a. The battery specified shall fit into the existing battery compartments. The Contractor shall modify these compartment, as required, to accommodate a new battery on all cars.
 - b. All battery boxes shall be reconditioned. Reconditioning shall include repairs, new rollers, modifications as needed, and painting of metal components. The inside of the battery compartment shall be painted with no less than two coats of white insulating paint.
 - c. Means shall be provided within the compartment to prevent battery movement. If needed, NFPA 130 compliant material shall be used for either the battery blocking or lining. The compartment shall include means to drain liquids through drain hole to the ground. The design shall ensure that the batteries are accessible from the exterior of the car and that servicing can be performed without the use of tools.
 - d. The battery box shall be ventilated adequately to meet the requirements of Standard BS EN50272-2:2001. The Contractor shall submit a design report to the Authority for any modifications to the existing battery compartment including calculations for strength, mounting, and venting; identifying safety factors used, and including an analysis comparing actual design with requirements of Standard BS EN50272-2. [CDRL 8.006]

(4) Battery Cells

- a. The battery shall be composed of cells connected in series. In compliance with NFPA 130, fire-retardant, transparent material shall be used for the casing and lid.
- b. The positive and negative electrodes shall consist of a nickel fiber structure with graphite-free active material. There shall be no need for electrolyte replacement during the battery's lifetime.
- c. The positive electrodes shall be enveloped in micro-porous separators. The separators shall be designed to ensure that the electrodes are properly separated and shall have low internal resistance corresponding to the applicable level of stress.
- d. The cells shall be designed for the following operation conditions:
 - (i) Operation temperature range: -40 °F to 140 °F (-40 °C to +60 °C)

- (ii) Altitude: maximum 1,600 ft.(500 m)
- (iii) Maximum Humidity (at 68 °F [20°C]): 5% 100%, non-condensing
- (5) Battery Temperature Sensor
 - a. In each battery box, an over-temperature protection system shall disconnect the battery in the event of battery over temperature in compliance with NFPA 130. An condition shall be displayed locally as well as on the remote display unit. The over temperature protection shall be independent of the temperature compensation circuitry used by the LVPS, so as to provide independent operation of the two circuits.
 - b. The sensor shall prevent overheating of the battery whenever the battery temperature exceeds the temperature specified by the battery supplier, but in no case greater than 160° F (71° C).
 - c. The battery protection system shall be approved by the Authority. [CDRL 8.007]

N. 120 VAC POWER

120 VAC (60 Hz) for lighting and convenience outlets shall be provided by existing 480VAC to 120VAC transformers. The transformers shall be rated at 1.25% of the maximum power requirement. All independent auxiliary ac load circuits shall be protected by circuit breakers.

(1) Space for New Transformer

A new 480 VAC to 120 VAC transformer shall be installed to provide power to the new passenger Convenience Outlets.

- (2) Convenience Outlets
 - a. The existing maintenance receptacles and convenience receptacles shall be removed and discarded. They shall be replaced with new receptacles of the same type.
 - b. Six duplex, twist lock maintenance receptacles shall be installed at existing locations in the passenger area; one on each intermediate level, two on the upper level, and two on the lower level. The twist lock maintenance receptacles shall be GFCI protected 120 VAC, 15 amperes outlets with self-closing covers.
 - c. One additional regular 120 VAC maintenance receptacle shall be installed in each intermediate level overhead equipment compartment. These maintenance receptacles shall be GFCI protected, 120 VAC, 15 amperes outlets.
 - Maintenance outlets are used by maintenance personnel to provide power for cleaning, servicing, maintenance, testing and troubleshooting tasks. The power for the maintenance outlets shall be distributed using two separate circuit breaker protected circuits.

- b. The Contractor shall install a wall mounted GFCI protected, 120 VAC duplex convenience outlets adjacent to wheelchair location, each table location, at each knee to knee seat location and at each row of knee to back seat location for the use by passengers with laptops or similar electronic equipment. Outlets in the passenger area shall be limited to a maximum current of 2A per outlet to discourage recharging batteries for high-power applications. Automatic reset shall occur when the overload is removed.
- c. The power for the passenger convenience outlets shall be distributed using at least four separate protected circuits. The Contractor shall submit details of the installations for each type of outlet and the power distribution to the Authority for review and approval. [CDRL 8.008]
- O. Trainlines
- (1) All trainline jumpers, 480 VAC cables and receptacles shall be removed to junction box connections. Rewire all junction boxes with new wire to original configuration.
- (2) Provide 480 VAC parallel control pin configuration as a design option for the Authority's review. [CDRL 8.009]
- (3) Install new trainline jumpers, 480 VAC cables and receptacles. All trainlines should be rung out end to end with signals measured and documented under the test program and included in the Car Rebuild History Book. [CDRL 8.010]

CDRL #	Description
8.001	72 VDC System Design and Interface
8.002	Provisions for 72VDC Zero Speed Circuit Conversion
8.003	LVPS/Battery Charger Technical Data
8.004	Battery System Design, Arrangement and Installation
8.005	Battery Capacity Calculations
8.006	Battery Box/Compartment Design Report
8.007	Battery Protection System Design
8.008	Convenience Outlet Installation and Power Distribution
8.009	480 VAC Parallel Control Pin Configuration Design
8.010	Trainline Signal Report

35 COMMUNICATION

- A. PEI System Installation
- (1) PEI Answered at ICCU's Only
 - a. Contractor shall provide a complete and functional Passenger Emergency Intercom (PEI) System on each rebuilt car to allow two-way communication between passengers and train crew in case of an emergency. The system shall be integrated into the car communications system and shall be an integrative trainline function.
 - b. The PEI System shall comply with 49 CFR238.121 and shall be interoperable with the PEI system installed in the Authority H-R Rail Cars and existing locomotive fleets. The marking and operating instructions for the PEI System shall comply with the requirements of APTA PR-PS-002-96, Rev.3.
 - c. Three PEI stations shall be installed in the passenger compartment of each rebuilt car. Unless otherwise approved by the Authority, the locations of the PEI shall be:
 - (i) B-end, lower level, right hand side doorway on door pocket panel,
 - (ii) A-end/F-end, left hand side doorway on door pocket panel;
 - (iii) Toilet Room interior.
 - d. The PEI panel assembly shall incorporate a microphone, speaker and pushbutton with LED indicator.
 - e. Activation of a PEI call by a passenger shall be indicated by a lit red LED and an activated buzzer from the PEI panel, and the car number and location of the activated PEI panel shall be displayed on the Integrated Communication

Control Unit (ICCU). Further operation on the part of the passenger shall be hands-free and shall remain under the control of the crew member. The crew member shall control the conversation via the ICCU Push to Talk (PTT) switch.

- f. Passenger pressing the "EMERGENCY CALL" pushbutton shall notify the crew member in the cab car or locomotive, both audibly via an alarm on the ICCU and a PEI annunciation message and visually via a flashing PEI pushbutton light on the ICCU. The notifications shall remain active until the PEI call is acknowledged by a crew member by pressing the PEI pushbutton on an ICCU. Voice communication shall not be activated until the crew member presses the ICCU PEI pushbutton switch. This shall cause the light on the ICCU PEI pushbutton and on the PEI panel to stop flashing and light steadily.
- g. The crew member shall be able to listen to the passenger when the ICCU PTT switch is released and shall be able to talk to the passenger by depressing the ICCU PTT switch. Pressing the ICCU PEI pushbutton shall activate the visual annunciator on the originating PEI panel by causing the flashing LED to go to steady green. The visual annunciator and voice communications shall remain activated until the crew member terminates the call by either pressing the ICCU PEI pushbutton again or by placing the ICCU enable switch in the "OFF" position.
- h. If the crew member selects another ICCU function, the PEI call shall be placed on hold. If additional PEI calls are made while a PEI call is in progress, the additional calls shall be queued. The crew member shall be able to answer each of them in the order received. The earlier PEI call must be terminated before the subsequent PEI can be answered by a crew member.
- i. The PEI annunciation message shall be programmable by the Authority. It shall be possible to program any or all of the following into this message: a unique chime, car number, PEI location, and another audio message. The PEI annunciation message shall be played only once for any PEI request, regardless of the number of times that button is pressed, until the call is acknowledged and call is terminated.
- j. Details of the design, arrangement, and installation of the PEI System shall be submitted to the Authority's Project Manager for review and approval [CDRL 9.001].
- (2) PEI Calls Answered at ICCU and ICS
 - a. Contractor shall provide a complete and functional Passenger Emergency Intercom (PEI) System on each rebuilt car to allow two-way communication between passengers and train crew in case of an emergency. The system shall be integrated into the car communications system and shall be an integrative trainline function.
 - b. The PEI System shall comply with 49 CFR238.121 and shall be interoperable with the PEI System installed in the Authority H-R Rail Cars and existing

locomotive fleets. The PEI System shall include an audio detection feature and function in a manner similar to the modified TOA Engineering Corp. system installed on the H-R fleet. The marking and operating instructions for the PEI shall comply with the requirements of APTA PR-PS-002-96, Rev.3.

- c. Three PEI stations shall be installed in the passenger compartment of each rebuilt car. Unless otherwise approved by the Authority, the locations of the PEI shall be:
 - (i) B-end, lower level, right hand side doorway on door pocket panel,
 - (ii) A-end/F-end, left hand side doorway on door pocket panel;
 - (iii) Toilet Room interior.
- d. The PEI panel assembly shall incorporate a microphone, speaker and pushbutton with LED indicator.
- (3) Activation of a PEI call by a passenger shall be indicated by a lit red LED and an activated buzzer from the PEI panel, and the car number and location of the activated PEI panel shall be displayed on the Integrated Communication Control Unit (ICCU). The system shall broadcast an automatic announcement over the PA system identifying the location of the activated PEI panel. The automatic message shall be cancelled when a crew member presses the Push to Talk (PTT) push button on the ICCU or the Inter-Communication Station (ICS) handset. The PEI annunciation message shall be programmable by the Authority.
- (4) After the system is manually activated by a passenger, further operation on the part of the passenger shall be hands-free and shall remain under the control of the crew member. The crew member shall control the conversation via the ICCU PTT pushbutton or at the ICS by plugging the ICS handset into the Inter-Communication (IC) socket and activating the PTT pushbutton. The communication direction shall be from the activated PEI panel to the active ICCU/ICS until the crew member presses the PTT pushbutton. The crew members shall be able to listen to the passenger when the ICCU or ICS PTT pushbutton is released and shall be able to talk to the passenger by depressing the ICCU PTT pushbutton. Crew members shall be capable of responding to PEI calls from multiple locations. With the PTT pushbutton depressed the communication shall be from ICCU or ICS to the PEI panel and the voice communication from the active PEI panel shall not be heard until all PTT pushbuttons are released. All ICCU and ICS involved in the PEI call shall be placed in stand-by mode to terminate the PEI call.
- (5) If additional PEI calls are made while a PEI call is in progress, the additional calls shall be queued. The crew member shall be able to answer each of them in the order received. The automatic audio announcements for subsequent PEI calls shall be broadcast after the previous announcement has ended. The earlier PEI call must be terminated by all responding ICCUs and ICSs before the subsequent PEI can be answered.

- (6) The system shall be arranged such that when the ICCU responds to an emergency call earlier than the ICS handset, only the ICCU is able to terminate the call, and when the ICS responds to an emergency call earlier than the ICCU, only the ICS is able to terminate the call. When the ICS handset responds to a PEI call prior to the ICCU, the LCD screen on the ICCU shall be changed automatically to stand-by status. The system shall function to allow multiple ICCUs and ICSs to join the current conversation by responding to the PEI call.
- (7) Details of the design, arrangement, and installation of the PEI System shall be submitted to the Authority's Project Manager for review and approval [CDRL 9.002].
- B. Wireless PA Installation
- (1) Contractor shall provide a complete and functional Wireless Public Address (PA) System on each rebuilt car to allow train crew to make announcements and to page passengers and other crew members through speakers in the passenger area and through exterior speakers using wireless crew handheld radios in normal operation and in case of an emergency.
- (2) The Wireless PA System shall comply with 49 CFR238.121 and shall be interoperable with the Wireless PA System installed in the Authority H-R Rail Cars and existing locomotive fleets. The Wireless PA System shall include a control amplifier and required antenna to interface with the wireless crew handheld radios. The system shall function in a manner similar to the TOA Engineering Corp. system installed on the H-R fleet or an the Authority approved alternative manner that ensures interoperability. The crew radio shall be used as the receiver on the car for the PA messages. The on-board crew radio shall be powered from the 72 VDC system which shall provide power under normal operation and emergency conditions.
- (3) The system shall be arranged to allow crew members to make PA announcements through the use of crew handheld radios. The system shall be integrated into the car communications system and shall transmit along the communication trainlines under normal operation. In emergency situations when the trainlines are not complete, the system shall transmit to each individual car in a train.
- (4) The crew handheld radio shall be programmed to receive and transmit only on FAP 89 or 161.445 MHz on each channel. To establish differentiation between the channel traffic and ultimately the individual train sets, each channel shall be programmed with a unique and distinctive private-line code. The resulting received audio product should be directly connected to a feedback termination device. It is recommended that all RF power out of the radios be adjusted to no greater than one watt of radiated power. To assure the availability of maintenance spare radios, all crew radios utilized for this application shall be programmed identically.
- (5) Real-time links between the input and output of an audio system have the potential to create a feedback loop which can produce undesirable audio to the passengers. To overcome this potential, a feedback termination device, Bogan Communications

Digital Feedback Terminator Model DFT120 or approved equal, shall be included in the proposed audio pathway. This device shall record and playback at user selectable intervals between one and ten seconds of delay.

- (6) The system shall function such that an announcement can be made with the handheld radios using the following steps: The push-to-talk button of the wireless crew handheld radios is depressed, the announcement is made and recorded on the control amplifier. When the push-to-talk button of the wireless crew handheld radios equipment is released, the announcement is performed on the "play status contact" leads on the audio output connections of the feedback termination unit. This action transitions the public address preamplifier to an active state. After a message is recorded or the time delay duration has been exceeded, the message is transmitted through the PA system.
- (7) Upon initial installation, radio channel selections shall be organized into groups that will minimize common assignments to trains traveling over territories with overlapping service schedules. During the vehicle level communication system testing, the random assignment process shall be examined to ensure a minimum of potential crosstalk between nearby trainsets. It may become necessary to extend the random nature of the channel assignments as operational activities become apparent.
- (8) The crew radio control of the Wireless PA System shall be included in the communications system design review package and the communication system test program. Details of the design, arrangement, and installation of the Wireless PA System shall be submitted to the Authority's Project Manager for review and approval [CDRL 9.003].
- C. Destination Sign System
- (1) Contractor shall remove and discard the existing Destination Sign System. An electronic destination sign system, compatible with the destination sign system of the existing the Authority Hyundai Rotem (H-R) commuter rail passenger cars, or approved equal, shall be installed on each rebuilt car. The system shall comply with all requirements of 49 CFR 238, IEEE P1477, and Standard for Passenger Information System for Rail Transit Vehicles or latest revision and referenced IEEE Standards.
- (2) All cars shall have two LED side destination signs for viewing from the exterior of the cars. All exterior destination signs shall be identical and interchangeable with all cars in the fleet, including H-R cars. The externally viewed side destination signs shall be located as approved by the Authority; one on the right side and one on the left side of each car. Housing with a hinged cover, compatible with the interior design, shall be provided on the interior of the car. Approved fasteners shall be provided to secure the access door. The hinged cover shall be large enough to allow troubleshooting and removal of the sign assembly without disturbing or removing of the glazing assembly.
- (3) The minimum character height shall be 3 inches. The display area shall have approximate dimensions of 7.5 inches height by 45.5 inches width.

- (4) Each sign shall be capable of being programmed to display one or two lines of text. When operating in the one line of text mode, the text shall be fixed. When operating in the two lines of text mode, the system shall be capable of displaying text as fixed or scrolling. The text shall scroll from right to left.
- (5) The system shall be arranged to allow for selection of destination sign messages and for downloading of the new text messages for the destination signs via a trainline and locally on a per car basis for all vehicles rebuilt under this Contract, regardless of the make-up of the operating consist. When operating in mixed consist, the sign message selected and/or new text messages downloaded via the trainline shall be displayed on all cars of the consist.
- (6) The destination sign system shall be arranged to display to and from destination information; train number information; and special messages. New text messages shall be created in the Portable Test Equipment (PTE) and downloaded into the destination sign system memory. The destination sign text messages shall be programmable by the Authority.
- (7) Pre-recorded audio messages shall be coordinated with destination sign and stored in a digital format in the communication and/or destination sign systems. Through a sound card, the audio messages shall be directed to the dedicated PA/IC trainlines.
- (8) It is preferable that the Sign Control Unit (SCU) shall be installed in the same locker as used for the original destination sign system control unit, or in a location as approved by the Authority. The door on the locker shall be provided with a key lock to allow authorized personnel to access the keyboard for programming, troubleshooting, or removal. A similar SCU with an approved operator's display keypad shall be located in the rear wall of the Operator's cab to allow the Operator to select and send audio and text messages. The terminal shall be placed at a suitable height for easy operation. A window shall be placed in the access door to allow viewing of the keyboard screen with the door closed.
- (9) A connector shall be provided adjacent to the SCU and behind the access door, to facilitate the connection of a portable memory transfer unit. The connector shall be Shell Part Number AMP 206043-1, Contact Part Number AMP 66101-3.
- (10) All components and wiring shall meet the requirements of all applicable standards. Where required to prevent interference, shielded, twisted pairs of wires shall be used. The power supply shall be capable of operating within the voltage range specified by manufacturer.
- (11) The design of the Destination Sign System, including the operation, shall be submitted to the Authority's Project Manager for review and approval [CDRL 9.004].

CDRL #	Description
9.001	PEI Answered at ICCU's Only - Design, Arrangement and Installation
9.002	PEI Calls Answered at ICCU and ICS - Design, Arrangement and Installation
9.003	Wireless PA Installation - Design, Arrangement and Installation
9.004	Destination Sign- Design, Arrangement, Installation and Operation

36 TRUCKS

A. General

The truck consists of a frame assembly, bolster assembly, truck/bolster anchor assemblies (tie rod/drag rod), side bearer pads, traction pads, wheel/axle assemblies, primary suspension, secondary suspension, dampers (lateral and vertical), pneumatic piping, and electrical wiring. Each truck is equipped with four tread brake units, two disc brake units and one truck for each car is arranged as the handbrake unit.

Each vehicle is equipped with two trucks and incorporates a three point leveling system, with the B-end truck has provision for two leveling valves with a compensating valve and the A-end truck has provision one leveling valve. Leveling valves are carbody mounted.

- (1) The following parts shall be removed and refurbished or renewed as required:
 - a. Wheel/axle assemblies
 - b. Air Springs
 - c. Chevron Springs
 - d. Bumpers
 - e. Side Bearers
 - f. Traction Pads
 - g. Vertical Dampers
 - h. Lateral Damper
 - i. Snubbers (or yaw dampers shall be replaced)
 - j. Ground Straps
 - k. Spherelastic Bearings (truck/bolster anchor assemblies)
 - I. Speed sensors and cabling
 - m. All Mounting Hardware and Fasteners (new)
 - n. Brake System Components for compliance with COTS per 49 CFR 238.309
- (2) All parts of the trucks and related assemblies shall be thoroughly cleaned and repaired or renewed as required. All components being repaired and refurbished, except wheel/axle assemblies and elastomeric components, shall be cleaned, primed and painted. Replacement parts shall be equal to or superior to the original parts. All new components shall be interchangeable with existing components. Piping shall be cleaned and thoroughly inspected. Damaged piping shall be renewed.
- (3) All truck casting shall be thoroughly cleaned and inspected for cracks and other visible damage. All truck frames and bolsters shall be magnetic particle tested using the wet method.

- (4) Rebuilt trucks shall be complete with all equipment, including repair and replacement of all damaged and/or missing parts.
- (5) All work performed on and material applied to, rebuilt trucks shall be in compliance with the OEM Heavy Maintenance Manual requirements, the most recent release of the AAR Wheel and Axle Manual, and the AAR Roller Bearing manual, including amendments.
- B. Disassembly and Cleaning
- (1) The truck and all components shall be completely disassembled. The truck frame and bolster shall be immersed in an alkaline solution cleaning tank, followed by a hot water rinse. Particular care shall be taken to remove all components that may be damaged by the cleaning process.
- (2) Other cleaning methods that are now used by the contractor or approved subcontractor shall be submitted for approval by the Authority. [CRDL 10.001]
- (3) All parts removed during disassembly of the truck shall be inspected and qualified for re-use, unless otherwise specified as renewed, refurbished, or replaced. All parts to be re-used shall be neatly stored and protected from moisture or dirt or other contamination and physical damage.
- C. Truck Frame and Bolster
- (1) The truck frames and bolsters shall be sandblasted then visually inspected for evidence of structural defects, wear, and physical damage, and shall be magnetically particle inspected using the wet method. Cracks shall be repaired by drilling stop holes, grooving, welding, and grinding smooth, followed by magnetic particle testing of the repaired area. All weld repairs of cast steel shall be in accordance with the AWS applicable codes. Any cracks shall be repaired per procedures approved by the Authority. [CDRL 10.002]
- (2) Frames shall be trammed for proper alignment. Tram marks were located on each pedestal at time of manufacture. The Contractor shall confirm that all tram marks are visible. All OEM dimensional tolerances will be maintained. If tram marks are distorted or not visible, the Contractor shall establish new marks using an approved procedure. The truck frame shall be inspected to OEM parameters for the following:
 - a. Coplanearity of bottom of pedestal legs
 - b. Perpendicularity of pedestal legs
 - c. Transverse pedestal spacing
 - d. Lateral alignment of pedestals
 - e. Tramming
 - f. Wheel base

- g. Longitudinal pedestal opening
- h. Lateral pedestal distance
- (3) Proper alignment is defined as the diagonal measurements being less than 1/16 inch. Incorrect tram shall be corrected using industry accepted methods. The Contractor shall submit the procedure for inspection and correction of out of tolerance conditions to the Authority for review and approval and results of inspection and applicable refurbishment shall be included Car Rebuild History Book. [CDRL 10.003]
- (4) Mounting holes shall be cleaned, inspected and repaired as required. Pedestal tie bar counter bores and other mounting holes requiring repair shall be built up with weld, holes reamed, and seats restored.
- (5) Surfaces of pedestals to which tie bars are applied shall be ground smooth.
- (6) Detailed procedures for all inspections, repairs, welds and subsequent stress relieving of the truck frame or bolster shall be submitted for review and approval by the Authority. [CDRL 10.004]
- D. Suspension
- (1) The Chevron springs (8 per truck) shall be inspected and renewed. The Chevron adapter brackets shall be inspected and refurbished or renewed, if required.
- (2) The air spring assemblies (2 per truck) shall be inspected, refurbished or renewed, if required.
- (3) The vertical dampers (2 per truck) shall be inspected, refurbished and renewed, if required.
- (4) The lateral damper (1 per truck) shall be inspected, refurbished and renewed, if required.
- (5) The snubbers (yaw dampers, 2 per truck) shall be replaced with hydraulic snubbers.
- (6) The bumpers (2 per truck) shall be inspected and renewed. The lateral bumper brackets shall be inspected and refurbished.
- (7) The side bearers (4 per truck) shall be inspected and renewed. The side bearer wedges shall be inspected and renewed as required.
- (8) The traction pads (2 per trucks) shall be inspected and renewed. The traction pad brackets shall be inspected and refurbished, as required.
- (9) Existing leveling valves shall be cleaned, inspected, and refurbished or renewed, as required. The current arrangement is (1) leveling valve at the No. 2 truck (A-end) and two at the No. 1 truck (B-end).
- (10) A compensating valve shall be cleaned, inspected, and refurbished, or renewed, as required for application on the B-end truck.

- E. Journal Bearings and Boxes
- (1) All journal bearings shall be inspected, refurbished, or renewed or replaced, if required. All journal bearings refurbished in the rebuild program shall be dismantled, cleaned, inspected, refurbished and requalified in accordance with manufacturer's maintenance recommendations by a contractor qualified by the bearing manufacturer for such work. All work shall be performed in an AAR-approved shop specifically designed for bearing repair, equipped with adequate tooling and providing a clean sanitary environment. All bearings shall be marked in an approved manner as to date and place repaired or applied new. New bearings shall be AP, Class F, 6¹/₂" x 12" roller journal bearings manufactured by Timken Co. or an the Authority approved equivalent.
- (2) The Contractor shall prepare and submitted to the Authority a report identifying patterns, trends or unusual wear or damage.
- (3) Bearings, and all appurtenances shall be installed in accordance with the bearing manufacturers' requirements.
- F. Wheels and Axles
- All wheel/axle sets shall conform fully to AAR Manual of Standards and Recommended Practices for Wheels and Axles Manual, Section GII and Section AAR Roller Bearing Manual Section HII.
- (2) All wheels shall be renewed with wheels that accommodate disc brake rotors presently utilized on the fleet.
- (3) Wheels shall be 33 inches in diameter, multiple wear type, class "A" in accordance with AAR specification M-107. The profile shall be AAR-1B narrow Flange contour.
- (4) The wheels shall be marked with hub stamping. Rim stamping shall not be permitted or accepted.
- (5) The Contractor shall order sufficient wheels with undersize bores to permit maximum re- use of existing axles.
- (6) New wheels shall be grouped and applied in car sets with new brake disc rotor installed. All wheel pressure graphs and wheel and axle inspection records shall be supplied in the Car Rebuild History Book.
- G. Wheel Matching Size
- (1) Wheels mounted on the same axle shall be the same tape size and include the same tape size marking. Within one truck, there shall be no more than two tape size difference between the wheel pairs. Within one car, there shall be no more than a six tape size difference between the wheel pairs.

- (2) Axles shall be inspected in accordance with requirements of AAR Manual of Standards and Recommended Practices for Wheels and Axles Manual, Section GII with results of dimension measurements recorded for inclusion in Car Rebuild History Book, refurbished, or renewed, as required. All axles proposed for refurbishing shall be radial ultrasonic tested per requirements of Manual of Standards and Recommended Practices Section G, Specification M 101.
- (3) Roller bearing axle journal repairs may be made by the electro-chemical disposition process if done within the scope of paragraph 2A5 of the AAR Wheel and Axle Manual.
- (4) Rejected axles shall be replaced with new axles that are presently utilized on the fleet. Rejected axles shall be stored and protected until released by the Authority.
- (5) A permanent record shall be kept of all wheel pressings, pressing charts, serial numbers, axle stampings, tape sizes and all other dimensions taken including run-out readings. These
- (6) records shall be made available to the Authority on request and shall be included in the Car Rebuild History Book.
- H. Conduit and Piping
- (1) Existing conduit, junction boxes, and fittings shall be inspected and refurbished, repaired or replaced, as required. New gaskets and new fittings shall be installed on all junction boxes.
- (2) The wheel slide sensor cable arrangement and speed transducer assemblies shall be inspected, and replaced.
- (3) New cable clamps shall be installed to securely retain the cable arrangements on the truck frame.
- (4) Cable clamps and cable routing shall be arranged to permit the full range of truck rotation relative to the carbody and maximum dynamic vertical displacement of the journal boxes relative to the truck frame.
- (5) The proposed installation shall be submitted in advance to the Authority for review and approval. [CDRL 10.005]
- (6) Existing piping to the tread brake disc brake units shall be cleaned and inspected. Kinks, rust or thread damaged piping shall be replaced. All piping shall be tested for air leakage at twice the maximum brake cylinder pressure of 100 psig. All flexible hoses shall be replaced with new hose assemblies that comply with current AAR and APTA standards and recommended practices.
- I. Other Truck Components

- (1) Pedestal tie bars shall be inspected and refurbished including straightening, building up and reaming of bolt holes and grinding smooth those surfaces where the bar mates to the pedestal or replaced, as required.
- (2) Damaged or missing tie bars shall be renewed, as required.
- (3) The truck bolster anchor assembly (tie rod/drag rod) shall be inspected and refurbished or replaced, as required. Spherelastic bearings shall be renewed.
- (4) The brake and snubber brackets shall be inspected, refurbished or renewed, as required.
- (5) Bushing shall be renewed.
- (6) All existing bolts, nuts, cotter pins, wear plates, shims, and bushing shall be renewed
- J. Tread and Disc Brake Units
- (1) The existing GM-5-1/2 and GM-H-5-1/2 brake units shall be refurbished to the OEM specifications.
- (2) Refurbishment shall incorporate all OEM upgrades for these model numbers.
- Refurbishment shall be performed in accordance with a specification prepared by the Contractor and reviewed and approved by the Authority prior to start of work. [CDRL 10.006]
- (4) New tread brake shoes, WABCO or approved equivalent shall be installed.
- (5) New brake shoe keys shall be installed.
- (6) Existing disc brake heads shall be refurbished or renewed as required.
- (7) The brake disc rotors shall be renewed.
- (8) When installing the tread brake units and disc brakes, the bolts shall be torque in sequence in accordance with OEM recommendations.

37 BRAKE SYSTEM COMPONENTS

- A. Hand Brake
- (1) Existing hand brake lever units shall be inspected and refurbished, as required. Hand brake brackets shall be inspected and refurbished, as required. All pins, bushings, nuts, cotter pins, and wear pads and plates shall be renewed.
- (2) Existing carbody mounted hand brake rigging shall be cleaned, inspected, refurbished and lubricated, as required. All pins, bushings, nuts, cotter pins, and wear pads and plates shall be renewed.
- (3) Cable assemblies shall be renewed.

- B. COT&S Brake System Components
 - (1) All components related to the air brake system, car and truck mounted, shall be serviced and refurbished as required by 49 CFR 238.309.
 - (2) All reservoirs shall be inspected with a borescope and replaced as needed. Inspection results, including photographs shall be provided to Authority. Telltale holes shall be added to reservoirs if not already present. [CDRL 10.007]
 - (3) All brake valves and apparatus shall be thoroughly cleaned, inspected and tested, with parts renewed as needed.

38 ELECTRICAL GROUNDING

- A. Flexible ground straps shall be refurbished or renewed and/or added as required.
- B. Ground strap mounting hardware shall be renewed.

39 PAINTING

A. Before assembly of truck, one coat of approved metal primer to all individual metal parts shall be applied.

CDRL #	Description
10.001	Truck Frame and Bolster Cleaning Procedures
10.002	Truck Frame and Bolster Casting Weld Repair Procedures
10.003	Truck Frame and Bolster Results of Inspection and Applicable Refurbishment
10.004	Truck Frame and Bolster Procedures for All Inspections, Repairs, Welds and Stress Relieving
10.005	Conduit and Piping Installation Design
10.006	Tread and Disc Brake Units Refurbishment Procedures
10.007	Reservoir Inspection Results and Photographs
10.008	Painting Procedures

- B. Before installation under the car, the truck shall be cleaned of all dirt, dust, and other foreign matter by approved methods. A final coat of black approved oil base paint shall be applied.
- C. Wheels, axles and exposed rubber may not be painted. Any existing wheel number plates or other identification plates shall be protected and/or masked off until after final paint is completed. The Contractor's paint procedure shall be reviewed and approved by the Authority prior to start of work.

COUPLERS

40 COUPLERS – REPLACE

Each end of each vehicle shall be equipped with APTA-type "H" short shank, tight lock knuckle couplers with associated double acting twin cushion draft gears, radial connection, yoke, coupler carrier and uncoupling mechanism. The Contractor shall be responsible to ensure the proper pre-load is achieved with the coupler, yoke and draft gear installed.

The couplers shall be removed and replaced. Replacement couplers shall meet the 100,000 lbs. (445 kn) vertical sheer strength required by 49 CFR Part 238.

The couplers shall be single rotary operating type, with "H" type tight lock heads and shanks shall be provided on each vehicle. The couplers shall have sufficient lateral swing to allow the vehicle to negotiate a 26-degree curve and all track conditions without damage to truck, draft gear, carbody, diaphragms, air hoses and car to car connections, while coupled to another vehicle or locomotive. The coupler height shall be adjusted to 34 1/2" from top of rail to centerline of coupler before leaving the Contractor's plant. Coupler height shall be adjusted with the trucks leveled and adjusted. No paint shall be applied to the coupler.

- A. Material
- (1) The coupler shall be Grade AAR M-201 Grade E, annealed cast, high tensile steel or better and shall comply with the requirements of APTA RP-M-RP-003-98.
- (2) The Contractor shall submit certification to the Authority that includes a statement that the material has been manufactured, sampled, tested and inspected in accordance with, and meets the requirements of all applicable provisions of APTA PR-M-RP-003-98.
- (3) Each certification furnished shall be signed by an authorized agent of the supplier or manufacturer. A copy of the certification shall be included in each Car History Book.
- (4) The Contractor shall ensure that the manufacturer maintains records for 15 years of the mechanical, chemical and hardenability test reports, covering the heats representing the purchased castings. These records shall be made available to the purchaser upon request by the Authority.
- (5) All completely assembled couplers shall be carefully tested for operation. The knuckles and other operating parts must perform their functions in an entirely satisfactory manner.
- (6) Coupler knuckle shall throw to the open position by a continuous rotary force applied by hand through the operating rod from rod handle.

- (7) Coupler knuckle shall rotate to the fully closed position to permit drop of the lock to the locked position by a continuous steady force applied by hand on the knuckle nose.
- (8) Coupler lock shall automatically drop to the locked position when the knuckle is closed.
- B. Yokes and Draft Gear Renew
- (1) Disassemble, clean, inspect and remove carrier assemblies.
- (2) Notify the Authority in advance of required repairs and alert the Authority to patterns or trends of observed damage and wear.
- (3) Each vehicle shall be equipped with two Waughmat, double-acting, twin cushion draft gears or approved equal that use separate sets of rubber pads for draft and for buff. Yokes shall be complete with bushings and yoke pin. No paint shall be applied to the yoke, bushing, or pin.
- (4) The yoke shall be Grade AAR M-201 Grade E, annealed cast, high tensile steel or better and shall comply with the requirements of APTA RP-M-RP -003-98.
- (5) They shall be designed for 22-3/16" pockets, type WM-5-6, including followers, for use with "H" head, "H" shank couplers. The Draft Gear shall be designed to provide reliable service and be capable, within reasonable margins of safety, of withstanding loads in accordance with AAR, APTA, and FRA requirements.
- (6) The inner and outer coils springs and stems shall be removed and renewed. Wear plates and guide liners shall be renewed, and assemblies shall be reassembled and adjusted as per OEM.
- C. Carrier Renew
- (1) The coupler carrier shall comply with the vertical force requirements of 49 CFR 238.205 and 238.207.
- (2) The coupler carrier shall adequately and consistently support the coupler through its full range of vertical and horizontal movement. The coupler carrier shall be held captive in the carrier pocket regardless of coupler movement. The coupler carrier for the "H" tight lock type coupler shall be a spring suspended type, with a non-metallic wear plate and with side and end pads and rubber stop blocks designed to prevent metal-to-metal contact. Means shall be included to allow removal and replacement of wear plates, carrier springs and carrier stops.
- (3) The coupler carrier shall provide for adjustment of coupler height in either vertical direction. The coupler carrier design shall comply with the AAR and APTA recommended practices for vertical and horizontal movement of the coupler head.
- D. Centering Devices Renew

There shall be no centering device. Lateral rubber stop blocks shall be applied to the coupler pockets to limit the coupler swing to either side of centerline and to protect the pocket wings from damage.

- E. Uncoupling Levers Renew
- An uncoupling arrangement shall be provided at each end of the vehicle in conformance with APTA Standard PR-M-S-016-06. It shall be a standard APTA type No.
 6 operating mechanism
- (2) arranged for operation from the left side of each vehicle end when viewed at the corresponding end of the vehicle. Minimum clearance of 2 inches shall be maintained between uncoupling mechanism and all other components on the end of the vehicle when either coupled or uncoupled. The uncoupling arrangement shall be submitted to the Authority for approval. [CDRL 11.003]

CDRL #	Description
11.001	Repair Notification
11.002	Operational and Functional Testing
11.003	Uncoupling Arrangement

41 TOILET ROOM

A. General Requirements

The toilet room must have the features described in this section. Components shall be refurbished or renewed to achieve the features described. It shall have a lockable door. The required accessibility and accommodation provisions of the toilet room shall comply with all current ADA requirements. As a minimum, the following equipment shall be included in each toilet room:

- (1) Stainless steel hopper preferably coated with a non-stick surface enclosed in a fiberglass shroud that is the same color and finish as toilet room interior, with seat and cover that are black in color.
- (2) Vanity assembly which shall include:
 - a. Stainless steel wash basin.
 - b. Provisions shall be included for the Authority to install a dispenser for liquid soap Celeste Industries Part No.: 4154 with a 2 inch diameter base or approved equal. As a minimum, these provisions shall include a properly sized and located mounting hole.
 - c. Tilted tempered glass mirror for wheelchair passengers.
 - d. Stainless steel paper towel dispenser.
 - e. Spring loaded faucet with a palm operated stem valve.
- (3) Waste container with spring loaded cover minimum size of 9 inches width by 4 inches depth by 24 inches length.
- (4) Disposable seat cover dispenser.
- (5) Two-roll type toilet paper holder or two separate holders, one-roll type each.
- (6) Sanitary napkin waste container with spring loaded cover minimum size of 7 inches width by 3 inches depth by 9 inches length.
- (7) Flush mounted retractable coat hook.
- (8) Tempered glass mirror for standing passengers.
- (9) Exhaust fan and grille.
- (10) LED ceiling light powered by the emergency lighting circuit.
- (11) Stainless steel wall mounted handholds around the toilet seat.
- (12) Illuminated toilet occupied status sign on the toilet room exterior wall.
- (13) Lockable cupboard in toilet compartment corridor wall for storing supplies.

- (14) PA speaker mounted behind a grille in the ceiling.
- (15) Red toilet flush push button.
- (16) HVAC system outlet.
- (17) PEI Station
- B. Signage associated with the toilet room shall be per "the Authority Trailer Car Interior Decals" or approved equal. Details of the design, integration, and installation of the complete toilet room/water system shall be approved by the Engineer. [CDRL 12.001]
- C. Toilet Room Construction
- (1) The toilet room shall be modular in design to facilitate easy and complete removal. The module shall be completely self-contained, including interior and exterior walls, floor, ceiling, trim and telescoping sliding entrance door. Except for the door, the module shall be constructed of fiberglass-reinforced plastic (FRP). The module shall be constructed with as few components as possible. The floor and lower walls shall be manufactured as a one-piece pan extending at least 9 inches up the wall. The upper walls and ceiling shall be constructed of as few pieces as possible. A minimum 3 inch radius shall be provided in all corners to prevent accumulation of dirt and debris. The interior walls of the toilet room shall have a high gloss, gel coat finish measuring a minimum of 80 on a 60 gloss meter. The exterior walls (passenger compartment) shall be fabricated from a Tedlar covered composite laminate, or approved equal.
- (2) The module floor shall be designed to withstand the combined loading from a wheelchair and occupant weighing 600 pounds and an assistant weighing 250 pounds. The toilet room floor surface shall be within 0.25 inch of the same plane as the finished floor surface in the passenger compartment. The floor covering material shall conform to the requirements. The floor material shall extend at least 9 inches up from the floor. The edge of the floor covering shall be sealed to be permanently waterproof.
- (3) Air, water, and drain line fittings shall be kept to a minimum. All fittings shall be hidden from passenger view, yet readily accessible for maintenance through access doors. All access panels shall use recessed or concealed hinges and shall be equipped with an the Authority approved lock. Fittings and valves shall be easily identified and serviceable from the access doors. Fittings shall be readily separated with the proper tools. All fittings that pass through the module wall shall be sealed by a neoprene grommet or compression gasket. All fittings shall be heavy duty brass or stainless steel construction. All fittings used in the waste system shall be stainless steel. It shall be possible to remove the stainless steel hopper with minimum disassembly of the module.
- (4) A floor drain shall be provided, piped through the floor, and routed so that liquids are not discharged onto any part of the truck or other undercar equipment. The drain shall be capable of being opened and closed from outside of the vehicle near the

Waste Dump Outlet on the Right Hand Side of the vehicle, and the drain outlet shall be vermin infestation proof. The drain shall be designed to be opened by an electric valve inside of the toilet room. The floor of the module shall be sloped so that the cleaning solution and any liquids shall flow to the drain.

(5) The floor heater guard shall be recessed into the wall to the extent practical and otherwise packaged to minimize the intrusion of the fender and grille into the toilet compartment.

D. Toilet Room Entrance Door

The ADA compliant toilet door shall be comprised of two sliding panels. Each panel shall be constructed of 0.75 inch thick aluminum honeycomb parts. Each panel shall be hung from the top on a linear ball bearing slide arrangement, similar to the existing Bombardier bathroom entrance door. The two sliding panels shall be synchronized with telescoping movement and have a smooth operation during opening or closing of the door. A latch shall be provided to hold door in the open position. The door shall normally be held closed by a lock set, which can be locked and unlocked manually from the inside, and which can also be locked and unlocked from the outside with a staff key. The operating force for any portion of the Toilet Room, such as locking, door sliding or stopping, shall not exceed 5 pounds force". The door handle or the door operation shall not create a pinch or any other hazard during operation.

E. Water and Waste System

Each car shall have a water supply and waste system. With the exception of the undercar water fill lines, and the toilet retention tank, all of the components associated with this system shall be located in a utility compartment behind the toilet compartment rear wall and shall be accessible through a hinged door. Illumination of the utility compartment shall be provided by a wall mounted service light. Water rising shall be by compressed air. An approved pressure reducing valve shall be connected to the main reservoir and shall provide an output pressure of 15 psig which shall be used to pressurize the water system.

Grey water shall be discharged directly to the roadbed; however, the holding tank shall incorporate the appropriate fitting to permit the future installation for the grey water to drain into the holding tank. The tank shall be supplied with the appropriate plug installed in this fitting.

F. Water Tank

Water storage capacity is provided by one stainless steel tank mounted in the B end vestibule area next to the partition bulkhead. The water storage tank shall comply with the latest edition of the ASME "Unfired Pressure Vessel Code". The tank shall be insulated and provided with antifreeze heaters.

The water system shall be designed for potable water and shall have a minimum usable onboard capacity of 60 US gallons. The onboard water shall be used for drinking, hand washing, and toilet flushing. To prevent drinking water contamination, an FDA approved backflow preventer shall be installed between the drinking water supply and the other parts of the water system.

G. Water Fill Arrangement

Wayside water fill nozzles with overflow outlets are installed on both sides of the car. The water filling system permits the wayside water supply pressure to overcome the car water raising pressure. A completely filled system shall be indicated by a steady flow of water from separate water flow outlets located adjacent to the water fill nozzles.

H. Piping

A properly sized network of copper lines shall be installed to connect the water tanks to the water filling equipment, wash basin, toilet and water cooler, and to provide a means for draining the system to the roadbed. Shut off valves with identification tags shall be provided at major equipment locations. A main drain valve shall be provided under the floor, accessible from below the car. Automatic thermostatic drain valves shall be installed. The drain valves shall automatically empty the water system when the utility compartment interior temperature falls below 34°F. Piping shall be installed in a manner that shall prevent the formation of air or water pockets when the system is drained.

I. Water Cooler

A water cooler shall be located in the utility compartment. The water cooler shall be OASIS Corporation model RLFIS or approved equal. The unit shall provide 50°F drinking water with an Air Conditioning and Refrigeration Institute Standard Rating Condition 80°F inlet water temperature, and a 90°F ambient air temperature. The rated capacity of the unit under these conditions shall be 1 gallon per hour. The water cooler shall provide chilled water to a remotely located water fountain spigot mounted in the toilet compartment corridor wall. A cup dispenser shall be provided for dispensing a 100 count of 5 ounce pleated water cups. The water spigot shall be readily accessible to wheelchair passengers.

J. Waste System

- (1) Waste sanitation shall be provided by a flushing arrangement. Air assisted (vacuum) systems may be used such as Microphor Microflush LF-510/520 with a stainless steel hopper or Approved Equal. When the toilet is flushed, a measured amount of gravity fed biocide solution shall be introduced into the toilet hopper flush water by a separate nozzle mounted in the toilet hopper. The toilet hopper shall be coated with a non-stick surface. Toilet flushing shall be initiated by a pushbutton located on the side wall of the toilet room.
- (2) The biocide storage tank shall be mounted above the ceiling and shall have a minimum usable capacity of 20 US gallons. Swagelok, or approved equal, stem and body fill nozzles shall be installed on both sides of the car.
- (3) The waste retention tank shall have a minimum usable capacity of 55 US gallons and shall be protected against freezing. It shall be possible to remove the retention tank without removal of any of the interior components of the toilet room module. The use of automatic drain valves is strictly prohibited. A 3-inch cam and groove waste tank drain fitting with quarter turn shut off valve and dust cap shall be mounted in an approved location on the Right Hand Side of the car. The waste retention tank shall be

fitted with an internal water washing arrangement that shall use the yard water supply for tank cleaning. A cleanout plate shall be located on the tank to facilitate a thorough cleaning of the tank. The tank shall have a non-stick surface on the interior, be sloped towards the waste tank drain and have rounded corners (no right angles).

- (4) Alternative waste handling systems will be considered if the Contractor can demonstrate that the alternative system will be reliable, maintainable, and will fit within the maintenance practices of the Authority.
- K. EXHAUST FAN

The exhaust fan to be furnished shall be an industrial grade, meeting NEMA requirements for industrial units. The exhaust fan shall be designed to withstand the condition encountered in transit service. It shall meet the ventilation requirements.

CDRL #	Description
12.001	Toilet Room Systems Design, Integration, and Installation

SYSTEM PROVISIONS

42 WI-FI PROVISIONS

The Contractor shall provide provisions for the future installation of a complete passenger Wi-Fi System. [CDRL 13.001] The provisions shall allow for the future installation without modification to the car other than installing the equipment and interconnecting wiring. The Contractor shall create an Interface Control Document that the Authority can use with potential suppliers of such a system. [CDRL 13.002] The provisions shall include the following:

- A. Roof-mounted antenna location, including mounting hard points and conduit for cable routing;
- B. Space envelope and hard mounting points for interior IEEE 802.11x antennas;
- C. Space envelope and hard mounting points for router system;
- D. Space envelope and hard mounting points for uninterruptible power supply;
- E. Installation of 74 Vdc circuit breaker, ready for connection of loads;
- F. Installation of conduit for cable runs, ready for cable to be pulled;
- G. System analysis to demonstrate that there is sufficient power for future installation without the need for changes to the system;
- H. Weight allocation to determine mounting hard points are suitable for equipment.

CDRL #	Description
13.001	Wi-Fi Provisions Design
13.002	Wi-Fi Interface Control Document

For items E. and F. above, the work identified as provisions shall include the actual physical installation of the circuit breaker and conduits on the car by the Contractor.

43 PASSENGER SURVEILLANCE CAMERA PROVISIONS

- A. General Requirements
- (1) The Contractor shall provide provisions for each vehicle to include a Closed Circuit Television (CCTV) system consisting of color Internet Protocal (IP) cameras, Network Video Recorder (NVR), CCTV controller and other ancillary equipment, including supporting the cellular download of surveillance data, as required. The Contractor shall propose video recorder locations and video camera quantity and mounting locations. [CDRL 14.001]

- (2) The Contractor shall provide provisions for a digital video recording system that will record video surveillance from all on-board cameras. Audio shall not be recorded.
- (3) All cameras provisioned shall be connected to a digital network video recorder using the Communications Ethernet network. The CCTV network configuration shall use a mesh topology, wherein a single point network failure shall not cause the system to fail. Camera power shall be provided by Power over Ethernet (PoE). All wiring shall be marked and capped to prevent damage.
- (4) Passenger area Close Circuit Video Recording (CCVR) system will not be required to interface with the existing outward facing and inward facing cab area video recording system.
- (5) The provisions shall allow for the future installation without modification to the car other than installing the equipment and interconnecting wiring. The Contractor shall create an Interface Control Document that the Authority can use with potential suppliers of such a system. [CDRL 14.002]
- (6) Mounting space, bracketry, vehicle wiring, system power, and wireless link capabilities (via the NVR) shall be provisioned for sufficient interior video cameras to surveil all on-board activities, except inside the toilet.
- (7) The camera mounting bracketry, space, and wiring shall be based on a heavy duty inceiling mounted camera, or rail-proven low profile dome type cameras. The provisions shall include the following:
 - a. Installation of conduit for cable runs
 - b. Space envelope and hard mounting points for NVR;
 - c. Space envelope and hard mounting points for CCTV Controller;
 - d. Space envelope and hard mounting points for color IP cameras;
 - e. Space envelope and hard mounting points for any ancillary equipment;
 - f. Installation of 74 Vdc circuit breaker, ready for connection of loads;
 - g. Installation of conduit for future cable runs, wi-fi hotspots, and cellular modems.
 - h. System analysis to demonstrate that there is sufficient power for future installation without the need for changes to the system;
 - i. Weight allocation to determine mounting hard points are suitable for equipment.
- (8) For items e. and f. above, the work identified as provisions shall include the actual physical installation of the circuit breaker and conduits on the car by the Contractor.
- B. Video Cameras

- (1) Each vehicle shall be provisioned with a sufficient number of interior color surveillance IP cameras mounted to provide complete coverage of the passenger area, including all door openings looking out to the platform. The number of cameras provisioned shall be sufficient to provide full coverage of the entire passenger compartment including all door openings, stairs and PEI locations except inside the toilet module
- (2) Cameras are expected to be to latest available technology. Each camera shall record video, having a minimum resolution of 1.3 megapixels (1280×1024), 16.7 million colors, and use H.264 or similar high definition video compression. The camera shall have at a minimum, frame rate of 24 frames per second (fps). The recorded frame rate for each camera shall be controllable, using the CCTV controller and initially set to 15 fps. Camera sensitivity shall be sufficient for any possible combination of ambient and vehicle interior or exterior lighting levels, including vehicle emergency lighting.
- C. Video Recorder
- (1) Provisions for a Network Video Recorder (NVR) and associated power supply shall be provided in each car. The used/unused capacity of the NVR shall be viewable, using the CCTV controller, by maintenance personnel and the train crew.
- (2) The NVR provisioned shall overwrite the oldest recording if it runs out of capacity. One NVR per car shall be able to store 360 hours (approximately 15 days) worth of CCTV recorded video.
- (3) The recording method shall include an approved authentication process to detect any alteration of the data after recording

CDRL #	Description
14.001	CCTV Provisions Design
14.002	CCTV Interface Control Document

- (4) The NVR provisioned shall have hot-swappable, non-volatile memory storage (hard-disk), with a simple plug-in arrangement for playback on a standard laptop PC.
 Recording shall be active whenever the vehicle auxiliaries are turned on.
- (5) To comply with California Law requiring off-vehicle storage of video recordings taken by on-board cameras, video information must start uploading automatically when the train reaches the CMF and/or EMF. The Contractor shall calculate how many Wi-Fi access points are needed for daily upload of the videos of all cars in the yard in a reasonable time. A secondary system using cellular communication must be part of the design.
- (6) The NVR provisioned shall include a date and time stamp for all recordings that is synchronized to the same date and time stamp used by the Event Recorder so that video events can be synchronized to the Event Recorder data recording.

ATTACHMENT A (PART 2) SCOPE OF WORK - MATERIALS AND WORKMANSHIP

This Section provides guidance to the Contractor for the work to be completed on the cars, particularly the types of materials and the manner in which they are to be applied. If specific guidance is not given in the individual sections, the requirements of this Section will govern. When a material or method is specified in an individual section, those requirements will be applicable.

Contractor's services shall be performed in accordance with generally-accepted professional practices and principles and in a manner consistent with the level of care and skill ordinarily exercised by members of the profession currently practicing under similar conditions. All services are to be performed to the reasonable satisfaction of the Authority. Contractor will correct all errors or omissions identified in the Contractor's Work upon written notification by the Authority, and no additional payment will be made for those corrections, nor will corrections limit enforcement of any other provision of the Contract.

44 MATERIALS AND WORKMANSHIP - GENERAL

- A. Quality
- (1) Material and workmanship shall be in accordance with the requirements of this Contract, unless otherwise approved by the Authority. Apparent silence or omissions regarding a detailed description of the materials or services to be provided is to be interpreted to mean that only the best practices are to prevail and that only materials and workmanship of the first quality is to be used.
- (2) Inclusion of a material or method in this Section does not indicate approval for application or use in a specific situation.
- B. Material Safety Data Sheet Book
- (1) Material Safety Data Sheet Books shall be furnished by the Contractor in hard copy (one laminated set suitable for use in a shop environment) and electronic media. The books shall be indexed and contain Material Safety Data Sheets as defined by CFR, Title 29 – Labor, Part 1910 – Occupational Safety and Health Standards.
- (2) Items to be addressed shall include, but not be limited to, lubricants, sealants, insulation (thermal and acoustical), plastics, fiberglass, seat cushioning and covering material, and paint. The books shall include a cross reference for suppliers' trade names to part numbers and shall be available prior to delivery of the pre-production cars. Information shall be in a form compliant with ANSI Z400.1-1993.
- C. Marking

The Contractor's Quality Assurance Program shall assure that all aspects of the Contract are in conformance with the design, materials and workmanship requirements provided in the Scope of Work.

D. Cleaning Agents

A list of recommended cleaning agents shall be provided to the Authority for all materials exposed to normal cleaning operations. This information shall also be included in the maintenance documentation for the vehicle.

E. Prohibited Materials

The following materials are prohibited on the cars:

- (1) PVC
- (2) Asbestos
- (3) Cadmium (except for battery)
- (4) Lead (except for battery)
- (5) PCBs
- (6) Carcinogenic materials
- (7) Materials listed in 29 CFR Sec. 1910.19

45 STANDARDS

A. National Codes and Standards

All materials and manufacturing techniques shall meet the latest revision, at the time of Contract award, of the appropriate APTA, AAR, ANSI, AISI, and ASTM Specifications and Standards, and FRA regulations, unless otherwise specified and approved.

B. State of California Requirements

All materials and manufacturing techniques shall meet the latest revision, at the time of manufacture, of State of California regulations. All repair techniques and materials reasonably expected to require repair shall be compatible with State of California requirements.

C. The Authority Requirements

The Authority requirements are contained in the Scope of Work and the references thereto. All repair techniques and all materials furnished under this Contract shall comply with these requirements.

D. Equivalent Standards

The use of equivalent foreign standards shall be avoided. When other or foreign standards are proposed by the Contractor, the Contractor shall submit documentation for the Authority review and approval, demonstrating the proposed standards are the equivalent of the foregoing standards. Proposed substitute standards shall be submitted in both English and the language of the country of origin. The Contractor shall be responsible for assuring that the English translation is correct.

If equivalent standards are used, all referenced or subsidiary standards shall be from the same country/body's system and the same requirements from the preceding paragraph shall apply.

46 JOINING AND FASTENING

A. General Joining

Certain combinations of materials require particular care in joining to avoid the possibility of corrosion. The Contractor shall design the vehicles to minimize the number of such combinations, and to minimize the accumulation of water, cleaning chemicals, and chemicals present in the environment, at or near combination joints. Isolating and moisture-proofing materials, appropriate to the materials being joined, shall be used at all times where these combinations exist. The Contractor shall provide a detailed plan for installation of dissimilar materials in accordance with these sections and applicable industry practice. This plan shall be submitted for approval by the Authority prior to beginning the rebuild of the first car.

B. Joint Fitting

Joints shall be properly fitted, whether exposed or concealed. When not otherwise specified in Contractor drawings or specifications, gaps between joints shall be held to a dimension not greater than 10 percent of the thinner material being joined, or 0.002 inch, whichever is greater. Gaps shall be uniform in width across 100 percent of the surface. The edges of panels shall have a smooth, finished appearance.

Where excessive gaps (greater than those permitted by approved drawings or standards) are found to exist at the faying surfaces of structural bolted or riveted connections, metal shims of the same material as that of the deficient part may be used, but only with the written permission of the Authority. Shims, if used, shall be permanently fastened to one of the base parts being joined. The use of epoxy or other plastic filler at such locations is expressly prohibited.

C. Metal-to-Metal Connections

Where metals contact each other, the contact surfaces shall be free of dirt, grease, rust, and scale. Unless specified otherwise, the contact surfaces shall be coated with a metal based primer which conforms to Society for Protective Coatings, Specification SSPC-Paint 25. Metal primer may be omitted for austenitic stainless steel to austenitic stainless steel joints.

D. Wood-to-Metal Connections

Where wood and ferrous metal surfaces are placed together, the wood shall be coated with aluminum paint conforming to Federal Specification TT-P-38, and the metal shall be coated with a primer which conforms to Society for Protective Coatings, Specification SSPC-25.

All bolts or rods passing through wood shall be coated with aluminum paint conforming to Federal Specification TT-P-38.

E. Wood-to-Wood Connections

Where wood and wood are placed together, both abutting surfaces shall be coated with aluminum paint conforming to Federal Specification TT-P-38.

47 FASTENERS

A. Fasteners, General

The Contractor and suppliers are responsible for selecting fastener types, sizes, styles, lengths, materials, grades, and finishes that shall meet the requirements of the Scope of Work. The Contractor shall minimize the number of different sizes and styles of fasteners used. The use of inch standard fasteners is preferred but ISO Metric fasteners may be used with approval by the Authority.

All fasteners used on this vehicle can be classified under one of four categories: critical; general purpose; decorative; or electrical and electronic. The criteria for classification are expressed below. All fasteners must meet the general requirements for design and material in addition to any requirements contained in the section specific to the particular category.

- (1) Critical fasteners include, but are not limited to, all fasteners applied to carbody structure, trucks, bolsters, truck-mounted brake equipment, couplers, and power collection devices. Additionally, any fastener is considered critical if failures cannot be tolerated, that is, if even a single fastener fails there is a possibility of unsafe condition, brake failure, derailment, or accident. In the event of a dispute, the Authority shall be the final arbitrator on which fasteners are classified as critical.
- (2) Fasteners used to attach interior lining or trim and exposed to passenger view are specified under Decorative Fasteners.
- (3) Fasteners used to secure wire terminations to an electrical or electronic device are considered Electrical and Electronic, and are specified in appropriate Materials and Workmanship subsections for electrical devices and wiring.
- (4) Fasteners not falling into one of the other three categories are classified as General Purpose.
- B. Threaded Fastener Standards
- (1) Inch-Standard Fasteners

All inch-standard threaded fasteners shall conform to ASME B1.1 Standard, Unified Inch Screw Threads, (UN and UNR Thread Form) or Industrial Fasteners Institute "Inch Fastener Standards".

(2) Metric Fasteners

Upon approval, specific Line Replacement Units (LRUs) that are provided by a supplier or sub-supplier to the Contractor may be supplied with metric fasteners to ANSI B1.13M (ISO-metric) Standards. In these cases, all internal fasteners and threaded components of the approved unit shall have ISO-metric threads. Internal to components there shall be no mixing of metric and inch threaded fasteners. External mounting fasteners and threaded connecting components shall have ISO-inch threads to ASME B1.1 Standards. Each unit, component, or group containing ISO-metric threads shall be indelibly identified, in an approved manner and in a conspicuous approved location, to signify that the unit contains metric threaded fasteners. All repair and maintenance manuals shall be conspicuously marked on each page where metric threaded fasteners were used within the unit. Replacement, repair, or maintenance parts supplied under the Scope of Work shall contain all necessary replacement fasteners of the correct size and grade.

Metric fasteners shall be marked as required in "Metric Fastener Standards", Industrial Fasteners Institute latest edition.

- C. Fastener Materials and Coatings
- (1) When making connections to heat producing apparatus, thermal expansion of the components shall be taken into consideration for selection of fastener materials. If the joined components are high expansion alloys such as copper or austenitic stainless steel, austenitic stainless steel fasteners shall be used. If the joined components are low expansion materials such as carbon steel or ferritic stainless steel, zinc plated carbon steel fasteners of minimum Grade 5 shall be used.
- (2) All carbon, alloy, and martensitic stainless steel fasteners shall be plated with zinc, unless specifically waived by the Engineer. Cadmium plated fasteners are not permitted. Grade 8 or metric grade 10.9, or stronger, fasteners shall not be plated if the OEM finish is other than plating. The zinc plating shall conform to ASTM B633 SC2 Type II, SC3 Type II, or SC4 Type II, or ASTM B695, Class 8, Type II.
- (3) Alternate fastener coatings are permissible if qualified by testing per ASTM B117 with no red rust or visible corrosion products after 96 hours of exposure. The Contractor shall submit qualification results for each process used at each subcontractor applying the proposed coating.
- (4) In order to use an alternate coating, the vendor shall submit 1) coating manufacturer's product data including required thickness, 2) ASTM B117 test results from an accredited third party laboratory, 3) documentation of torque/tension characteristics, and 4) a statement from the coating manufacturer regarding the propensity for the coating process to cause hydrogen embrittlement of the fastener during coating. Regardless of the coating's propensity for hydrogen embrittlement, each lot of high strength fasteners, including OEM plated zinc or yellow bolts (Grade 5 or Metric Grade 8.8 or higher) shall be tested for hydrogen embrittlement. Each lot of lower strength fasteners shall be tested for hydrogen embrittlement if the coating has the possibility of causing hydrogen embrittlement.
- (5) If the proposed coating results in a change in the K-value for the plated fastener to outside the range of 0.13-0.15, as defined by Industrial Fasteners Institute Standard IFI-543, the vendor shall use the alternate coating on all fasteners within the particular LRU. The LRU shall contain an indelible label identifying the coating type used within the LRU and the required torque values for each size fastener used

therein. Fasteners internal to a subcomponent within an LRU may use the standard coating system if they are not subject to removal during Owner's maintenance activities.

- D. Requirements for Nuts
- (1) Unless otherwise required by a specific application, all nuts shall be regular height, nylon insert, self-locking stop nuts (ESNA or approved equal), conforming to Military Standard MS-21044 and Military Specification MIL-N-25027. Where nylon-insert self-locking stop nuts cannot be used, self-locking bolts and screws conforming to MIL-DTL-18240 Type L may be used. Nylon insert lock nuts, bolts, or screws shall not be used near heat sources that shall exceed the manufacturer's recommended operating temperature or 200°F, whichever is lower.
- (2) All-metal prevailing-torque type locknuts shall only be used where there is insufficient clearance to install ESNA type locknuts, or where the locknut is exposed to temperatures above 200°F.
- (3) Clip nuts shall not be used.
- (4) All carbon, alloy, and martensitic stainless steel nuts shall be plated with zinc, unless specifically waived by the Engineer. Grade 8, or metric grade 10.9, or stronger, nuts shall not be plated if the OEM finish is other than plating. The zinc plating shall conform to ASTM B633, SC2 Type II, SC3 Type II, or SC4 Type II, or ASTM B695, Class 8, Type II.
- E. Washers and Retention Devices
- (1) Washers, of a grade and strength compatible with the fastener, shall be used under the heads of all bolts and under all nuts. Washers shall conform to ANSI B18.22.1 or ANSI B18.22M, latest revision, as is appropriate for the application. Where high strength fasteners are applied, washers shall be hardened and comply with IFI Fastener Standards.
- (2) Lock washers shall not be used for fatigue applications where the fastener must be torqued and marked. The use of lock washers is discouraged throughout the vehicle and all systems. Other types of washers, including Belleville washers, may be used for special applications with the Authority's approval. Lock washers, when applied, shall conform to IFI Fastener Standards.
- F. Joint Design
- (1) All screws or bolts used to secure access panels to the interior, undercar, or roof equipment shall be made captive to the panel in which they are used. All fasteners used to secure access covers, doors, or panels to equipment boxes or interior panels shall be made captive to the panel in which they are used. Where access for service is expected more often than every five years, access panels shall be equipped with quarter-turn fasteners. Quarter-turn fasteners shall have a minimum shank diameter
of 0.25 inch, be of adequate strength, and as manufactured by Southco, or approved equal.

- (2) Unless otherwise approved by the Authority, threaded fasteners shall not be threaded directly into non-metallic materials. Metal thread inserts shall be used when a threaded fastener is secured to a non-metallic material.
- (3) When bolts are used to secure apparatus where the bolt head is not accessible, a reusable mechanical locking device shall be used to prevent the bolt head from turning when the nut is being turned.
- (4) At least 1-½ screw threads shall be visible beyond all nuts. When used without elastic stop nuts, bolts shall not project more than 1-½ threads plus 0.25 inch for bolts 0.25 inch diameter or less and shall not project more than 8 threads for larger diameter bolts, unless otherwise approved. With elastic stop nuts, bolt threads shall not project more than 0.25 inch, regardless of bolt size.
- (5) Undercar equipment shall not be supported by bolts in tension.
- (6) All critical fasteners and general purpose fasteners used to secure equipment to the carbody, including truck and brake equipment bolts and all fasteners exposed to fatigue loads, shall be torqued to a minimum preload equal to 75 percent of their proof load and "torque sealed" or "torque striped" after torqueing by paint or other approved means. All other fasteners shall be torqued to a value appropriate to the application, so that they do not loosen in service.
- (7) Fastener installation torque for standard oiled or waxed bolts with standard or heavy hex nuts may be calculated from Industrial Fasteners Institute, Fastener Standards, equations using values for "K" of 0.18 for unplated and 0.15 for plated threads. Locknuts shall be torqued in accordance with their manufacturer's recommendations or the Contractor may conduct tests to determine installation torque. For those nuts or bolts requiring "torque striping", the Authority may require bolt torque-tension tests to verify that installed preload is equivalent to 75 percent of proof loads.
- G. Critical Fasteners
- (1) All critical fasteners shall have documentation identifying manufacturer and purchase specifications available for examination by the Authority at the Contractor's QA department. This documentation shall include the fastener material or grade, and finish including plating material and specifications, when applicable. Whether the buyer is a sub-contractor, supplier, or the Contractor, the Contractor shall obtain and hold this documentation for a period of not less than termination of the last car's warranty period. After this period, all documentation shall be provided to the Authority.
- All critical fasteners shall either a) be manufactured, tested, and distributed in accordance with ASME FAP-1-1990, Quality Assurance Program Requirements for Fastener Manufacturers, Distributors and Testing Laboratories, including the

requirements of ASME accreditation or b) have a representative sample of each production lot of fasteners tested for conformance to purchase specifications by an independent laboratory accredited by the American Association of Laboratory Accreditation (AALA), or approved equal. A production lot is defined as one size of fastener, from one manufacturer, produced during one continuous production run. Fasteners not meeting this definition of production lot shall be treated as separate lots. Testing shall be performed using sample quantities as proposed by the Contractor and approved by the Authority. Tests conducted shall confirm that fastener material meets specified chemistry and strength requirements. The buyer shall obtain certified test results from the testing laboratory and hold the documents for a period of not less than the termination of the warranty period of the last car. After this period, all documentation shall be provided to the Authority.

- (3) All critical fasteners that are plated or chemically cleaned shall have certifications showing freedom from hydrogen embrittlement. Testing shall be done by the Contractor or a supplier following ASTM F519 procedures. An ASTM F606 wedge test sample may be used in place of the F519 standard samples. Test loads shall be a minimum of 80 percent of yield strength or proof load and held for a minimum of 168 hours. Any failures shall reject the entire lot.
- H. General Purpose Fasteners
- Mounting and attachment bolts shall be sized to the design strengths for Grade 2 bolts and Class A nuts, however in no case shall the fastener diameter be less than 0.375 inch. Grade 5 bolts and Class A nuts shall be used for installation of all equipment and/or structures.
- (2) Fasteners used within equipment shall meet all requirements of this Section other than the requirements specifically listed for critical fasteners or decorative fasteners, and shall be sized as appropriate for the application.
- (3) All general purpose fasteners shall have documentation that identifies the manufacturer, base material, plating or finish if applied, and the fastener type. The Contractor or supplier shall maintain this documentation on file for the Authority to review for a period of not less than the expiration of the warranty on the last car delivered. After this period, all documentation shall be provided to the Authority.
- I. Decorative and Appearance Fasteners
- (1) All interior fasteners exposed to passengers shall be either bright or finished to match the surfaces being joined, and installed such that the fastener head is flush with the mating surface. Bright finished fasteners used for stanchions shall be austenitic grade stainless steel. Bright finished interior fasteners may be either austenitic or plated martensitic stainless steel. Self-tapping screws are only permitted where they shall not be removed for normal maintenance more frequently than once in five years and shall be plated martensitic stainless steel.

- (2) All exterior fasteners visible to passengers shall be austenitic stainless steel for steel, LAHT steel, and stainless steel car bodies. Exterior aluminum shall be joined by austenitic stainless steel or aluminum alloy fasteners, as appropriate to the design and appearance requirements. Fasteners used on the side sill to attach equipment brackets are considered either critical or general-purpose fasteners, as appropriate for the application.
- (3) Fasteners on access panels, plates, covers, or other components accessible by passengers shall be of a single style tamperproof type approved by the Authority.
- (4) All decorative and appearance fasteners shall have documentation that identifies the manufacturer, base material, plating or finish if applied, and the fastener type. The Contractor or supplier shall maintain this documentation on file for the Authority to review for a period of not less than the expiration of the warranty on the last car delivered. After this period, all documentation shall be provided to the Authority.

48 BONDING

- A. The joining of elastomeric pieces shall be conducted by the hot vulcanization process. Adhesive bonding of elastomers shall not be allowed.
- B. All adhesive applications shall be approved by the manufacturer of the adhesive system and suitable for the materials being joined and the environmental exposure to be expected. Where adhesives are in contact with painted surfaces, suitable bond strength to both the paint and substrate shall be verified by test. The Contractor shall submit manufacturer's data for all proposed adhesive applications prior to first use of the adhesive system. After this period, all documents shall be provided to the Authority.

49 WELDING AND BRAZING

A. General

The Contractor shall be responsible for the quality of its welding and brazing as well as that of its suppliers and subcontractors. Cleaning prior to welding shall be in accordance with applicable parts of Section 2, MIL-HDBK-132, "Cleaning Materials and Processes."

B. Structural

All structural welding practices shall be according to requirements of the AWS D1.1, "Structural Welding Code-Steel;" AWS D1.2, "Structural Welding Code - Aluminum;" AWS D1.3, "Structural Welding Code - Sheet Steel;" AWS D1.6, "Structural Welding Code- Stainless Steel;" AWS D15.1 "Railroad Welding Code", and the AWS Welding Handbook. Requirements for dynamically loaded structures shall be applied. Cast steel welding shall be according to ASTM A488/A488M, "Steel Castings, Welding, Qualification of Procedures and Personnel." Resistance welding shall be in accordance with AMS-W-6858B. AWS D1.1 shall apply to steel of 0.125 inch and greater thickness. AWS D1.3 shall apply to steel less than 0.125 inch thickness. Canadian Welding Bureau (CWB) Standard W59, "Welded Steel Construction," may be used in lieu of AWS D1.1 and CWB Standard W59.2, "Welded Aluminum Construction," may be used in lieu of AWS D1.2. In the case of the use of CWB standards, AWS standards shall be used for all materials and thicknesses where CWB standards do not apply.

Structural welding of ferritic and austenitic stainless steel shall primarily be governed by AWS D1.6. ASME Section IX and ASME Section VIII, Part UHA shall apply where appropriate. 201L (UNS 20103) and 301LN (UNS 30153) stainless steels shall be treated as P-No. 8, Group-No. 3, category for reference to ASME requirements. Ferrite number for welds made with austenitic stainless filler materials shall be between WRC4 and WRC10, or as proposed by the Contractor and approved by the Engineer. Weld heat-affected zones (HAZ) and weld metal shall be limited to maximum allowable stress values in ASME Section VIII, Table UHA-23, for UNS S20100 stainless steel and Table UW-12 rating of welds. Fatigue allowable stresses shall not exceed the lesser of fatigue limits in AWS D1.1, Section 2.20.6, or 50 percent of the joint strength level calculated from ASME maximum allowable stress values. Higher values shall only be used if qualified by Contractor tests.

Regardless of the governing codes, all Welding Procedure Specifications (WPS) shall be fully qualified by test by the Contractor. Qualification shall be documented by Procedure Qualification Records (PQR). WPS and PQR shall be prepared by the Contractor and reviewed and accepted by the Authority's Project Manager and a Certified Welding Inspector. The use of AWS-B2.1 guidelines for qualification shall not be permitted and shall not be included or referenced in WPS and PQR. The use of any WPS purchased from an outside agency shall not be permitted without separate qualification by the Contractor.

C. Welder Qualification

Welders shall make only those welds for which they have been qualified according to the requirements of the AWS, ASME Section IX, ASTM A488/A488M, or other approved qualifying procedures. AWS B2.1 "Standard for Welding Procedure and Performance Qualification", may not be used for welder qualification. Records of welder qualification tests shall be made available for review.

D. Inspection of Welds

The Contractor shall visually inspect all structural welds in accordance with AWS D1.1 requirements.

In addition to the visual inspection specified for all welds, nondestructive surface inspection (dye penetrant or magnetic particle methods, as appropriate) shall also be used to inspect all first-production welds. The Contractor shall specify a sample nondestructive inspection rate for all subsequent welds. If ring welds are used, on the first structure all ring welds shall be nondestructively inspected by magnetic particle or dye penetrant methods. The Contractor shall submit a random sampling plan for additional metallographic examinations of ring welds for approval. The minimum acceptable sampling plan shall require inspection of one ring weld sample for every 300 production ring welds. A record of all NDT inspections shall be included in the Car History Book.

On the first structure, all <u>full penetration</u> welds shall be nondestructively, volumetrically inspected (ultrasonic or radiographic methods) according to AWS D1.1 requirements. The Contractor shall specify a random sampling plan for volumetric inspection of subsequent, full-

penetration welds for approval. The minimum acceptable inspection plan shall require inspection of one portion of a full penetration weld for every 200 production welds. The proposed test welds shall be selected from among welds that are most critically loaded as determined by calculation or load test. With approval, destructive sectioning and metallurgical examination may be substituted for some or all of the required volumetric inspection requirements for production welds.

E. Post-Weld Cleaning Requirements

All welds visible to passengers or on sliding contact surfaces of truck frames and bolsters shall be completely cleaned of spatter.

F. Contractor Documentation

All welding procedures and documents, including Welding Procedure Specifications, Procedure Qualification Records, and Resistance Spot Welding Schedules, shall be submitted for approval before application. Specifications for purchase of welding electrodes, welding wires, and cover gases shall be submitted for approval before their application.

- G. Dissimilar Metal Welding
- (1) Procedures and qualification records for structural welding of stainless steel to LAHT shall be submitted for approval. As part of the qualification of all dissimilar metal welds, sample welds shall be sectioned and examined metallographically to determine HAZ hardness. The HAZ hardness shall not exceed 400 HV (Vickers Hardness).
- (2) Austenitic stainless steel electrodes or wire shall be used to join carbon or LAHT steels to stainless steels.
- (3) Galvanized steel shall not be welded to stainless steel.
- H. Resistance Welding
- (1) Resistance welding of stainless or carbon steels shall be according to AMS-W-6858B, Class B for structural applications and Class C for non-structural applications. All resistance welding procedures shall be qualified per AMS-W-6858B; procedures and qualification records shall be submitted for review and approval. Contractor-proposed deviations from AMS-W-6858B, including, but not limited to, weld nugget diameter, tension shear strength, and minimum spacing, shall be submitted and approved before application in production.
- (2) Design strengths higher than standard certification and production strength requirements shall be qualified according to AMS-W-6858B, Figure 11b, for one thickness combination. This shall require a test lot size of 180 spot welds. Additional thickness combinations with the same increased strength ratio may be qualified by twenty-five (25) spot weld shear tests plus three macro-sections. Twenty of the twenty-five (25) shear test specimens may be recorded from production witness tests taken from twenty consecutive production days (not calendar days). The Contractor

shall submit records of the settings, ultimate shear strength, weld diameter, and weld penetration for approval.

- (3) Surface indentation shall not exceed 20 percent of material thickness (t) or 0.01 inch, whichever is greater. However, for exterior resistance-welded areas exposed to passenger view, indentation shall not exceed 10 percent of t or 0.005 inch, whichever is greater. For exposed welds, the Contractor shall vary welding parameters and conditions within their acceptable ranges to minimize indentations. Surface burn and discoloration shall be removed by chemical cleaning, or an approved equal method, and sanding or polishing to match the surrounding surface.
- (4) Production witness welds shall be made and tested once each day and, in addition, whenever otherwise necessary such as by change in any of the following:
 - a. Operator
 - b. Material, material thickness, or combination of thicknesses
 - c. Electrodes
 - d. Settings
- I. Resistance Spot Weld and Intermittent Weld Spacing
- (1) Spacing of resistance and spot welds shall be according to approved structural drawings. Spacing of welds contributing to carbody stiffness shall not exceed 2 inches plus twice the weld nugget diameter for any structural application, including carbody side sheets, roof sheets, and corrugation. For any application to corrugations, if the pitch of the corrugation nodes does not allow the above weld spacing, there shall be two spot welds between each node.
- (2) For intermittent fusion-welds contributing to carbody stiffness, spacing pitch shall not exceed 5 inches for 2 inch (minimum) weld lengths (forty {40} percent minimum of length welded).
- (3) For structural members not contributing to carbody stiffness, the intermittent welds joining structural members contributing to the stiffness of other members must conform to the spacing criteria above. All other intermittent welds shall be designed and qualified in accordance with the appropriate welding code requirements.
- J. Toughness of Welded Assemblies
- (1) The Contractor shall prove that all welded steel structures are above the ductilebrittle transition temperature for the specified environmental exposure. Specifically, the weld heat-affected zone (HAZ) and base metal shall resist service impact loads at the lowest specified operating temperature without brittle failure. In the absence of prior operating history, and if the Contractor's approved design does not require greater toughness, the minimum impact value for Charpy V-notch specimens shall be 15 foot-pounds of absorbed energy at -20°F.

(2) The Authority's Project Manager shall have the right to require impact tests to verify the specified toughness. If tests are required, verification of HAZ toughness shall be done on a test sample welded according to PQR parameters. Base metal toughness shall be certified on a heat basis by the steel manufacturer or steel supplier; if these data are not available, the Contractor shall perform tests on each heat of as-received base metal.

K. Torch Brazing

All brazing, defined as heating above 840° F without base metal melting, shall follow the recommendations of the AWS Welding Handbook, Volume 2, latest issue. Procedures and personnel who perform brazing work shall be qualified in accordance with AWS B2.2, "Standard for Brazing Procedure and Performance Qualification". Records of brazing procedure and performance qualification shall be submitted for approval.

L. Torch Soldering

All structural (not electrical) soldering, defined as heating below 840°F, shall follow the recommendations of the AWS Welding Handbook, Volume 2, latest issue. Procedures and personnel who perform torch soldering shall be qualified through the preparation and testing of samples of production torch soldering. Test samples shall be prepared and submitted for approval before production torch soldering.

50 STAINLESS STEEL

A. General

Permitted uses of structural stainless steels are specified throughout the Scope of Work. Ferritic stainless steels shall be painted where exposed to passengers or the weather. Austenitic stainless steels may be unpainted. Unpainted stainless steels exposed to passengers shall be a single grade of austenitic stainless steel in which both the color and surface finish of abutting pieces shall match, except where the design specifically calls for contrasting appearance.

B. Austenitic Stainless Steel

Structural austenitic stainless steel components assembled by fusion or resistance welding shall be of AISI type 201L (UNS S20103), 301L (UNS S30103), 301LN (S30153) or JIS SUS301L (with Nitrogen) and shall conform to the requirements of ASTM A666 except that the carbon content shall not exceed 0.03 percent and type 301LN and SUS301L (with Nitrogen) shall not exceed 0.25 percent nitrogen. Other stainless steels conforming to ASTM A666 are acceptable for non-welded applications.

Stainless steel used in structural applications covered by the Scope of Work shall also conform to the latest APTA SS-C&S-004-98 Standard for Austenitic Stainless Steel for Railroad Passenger Equipment.

General requirements for delivery of stainless steel shall be as required by the Certification Provisions of ASTM A666. Stainless steel to be used in structural applications shall be tested for susceptibility to intergranular corrosion in accordance with ASTM A262, latest revision. Practice A of ASTM A262 can be used to accept material only; Practice E is required for final determination of acceptance or rejection of material that is not acceptable by Practice A.

- C. Ferritic Stainless Steel
- (1) When specified, ferritic stainless steel conforming to ASTM A176 may be used for sheeting up to 0.2 inch thickness. Ferritic stainless steel sheet shall have a ductile-tobrittle transition temperature (DBTT) or nil-ductility temperature (NDT) below 0°F. Weld heat-affected-zones shall also have a DBTT or NDT below 0°F. Ferritic stainless steel sheet shall have a balanced composition (low carbon and/or suitable titanium content) that shall, for all conditions of fabrication and assembly into the carbody, inhibit formation of martensite and limit chromium depletion in weld-heat-affected zones so that material shall meet ASTM A763 requirements for resistance to intergranular corrosion.
- (2) General requirements for delivery of ferritic stainless steel shall be as required by ASTM A480.
- (3) Where ferritic stainless steels are welded to other structural steels, the less-noble steel shall be painted with weld-through primer.
- D. Testing

The Contractor shall prepare (or have prepared), submit, and receive approval of a test and inspection plan for acceptance of all stainless steel to be used in welded applications prior to purchasing any such material. The tests and inspections shall verify that the stainless steel conforms to specified requirements. For austenitic stainless steels, the test and inspection plan shall include frequency of submittal of certifications in accordance with Certification Provision of ASTM A666 and frequency of submittal of checks for susceptibility to intergranular corrosion in accordance with ASTM A262. For ferritic stainless steels, the test and inspection plan shall include frequency of submittal of checks for susceptibility to intergranular corrosion in accordance with ASTM A263.

51 LOW-ALLOY, HIGH-TENSILE STEEL

- A. General
- (1) Low-alloy high-tensile (LAHT) steel structural shapes, plates, and bars shall, as a minimum, conform to the requirements of ASTM A588, where available. Plate steel may alternatively conform to ASTM A710, Grade A, Class 1, 2 or 3. Where not available in A588, hot rolled or formed structural shapes conforming to ASTM A36 may be used for limited applications including equipment supports and jack pads. General requirements for delivery of LAHT shapes, plates, and bars shall be as required by ASTM A6.
- (2) Cold and hot rolled LAHT sheet and strip shall, as a minimum, conform to the requirements of ASTM A606, Type 4. General requirements for delivery of these products shall be as required by ASTM A568.

- (3) Other low-alloy, high-tensile steels which meet or exceed the above minimum requirements may be used, provided their detailed specifications are submitted and approved as equivalent, or better material, for the proposed applications. All LAHT steels shall be applied according to their specification properties.
- (4) Welded LAHT steel shall develop 15 foot-pounds Charpy V Notch impact strength in the CGHAZ (Coarse grain heat affected zone) 0.03937 inches from the fusion area at -20°F.
- B. Testing

The Contractor shall prepare (or have prepared), submit, and receive approval of a test and inspection plan for acceptance of all structural steels in accordance with the requirements of this Section before purchasing any such material. The test and inspection plan shall include provisions for submission of reports and certification to the Authority for each shipment in accordance with the applicable requirements of Purchase Specification and specified CGHAZ impact tests.

52 STEEL CASTINGS

A. General

The Contractor shall be responsible for selecting casting grade, composition, strength, and finishing. Steel castings used in the carbody structure and truck assemblies shall meet AAR Specification M-201 latest revision, Grade "B", plus 2 percent nickel, minimum. These castings shall be heat treated to develop a minimum tensile strength of 75,000 psi, with minimum yield strength of 48,000 psi, elongation of not less than 25 percent in 2 inches, and reduction of area of not less than 50 percent. Steel castings used for coupler, drawbars, and anchors, shall meet AAR Specification M-201, latest revision, Grade C or E, quenched and tempered.

Where cast steel of superior properties is required for a specific application, the Contractor may propose such castings for the Authority's review and approval.

- B. Design Qualification of Structural Castings
- One casting, selected by the Authority from the first lot of production castings, shall be subjected to a qualification test of the casting design by the Contractor. Qualification tests shall include radiographic examination for material soundness using reference radiographs to ASTM E446 and any mechanical testing.
- (2) Acceptance levels for the design qualification radiographic examinations shall be selected by the Contractor as appropriate for the service intended, subject to the approval by the Authority before any castings are produced. Radiographs shall meet the requirements of ANSI/ASTM E94 and E142, and the quality level in the area of inspection shall be at least 2 percent (2-2T).
- (3) A qualification test report shall be prepared and submitted for the Engineer's approval. The production of any castings before receipt of the Engineer's approval of

this report shall be at the Contractor's risk. All radiographs that resulted from the qualification test shall be made available to the Authority for review. In case the casting selected for qualification fails to qualify, a plan of action including details of how failed material shall be handled shall be included in the qualification test report. Once a design is qualified and accepted by the Authority, no changes shall be made in the casting pattern, technique, heat treatment, or material composition without requalification in accordance with the requirements of this Section.

C. Quality of Structural Castings in Production

All structural castings supplied shall be equal to or better than the design qualification castings in all respects. The casting supplier or Contractor shall test, inspect and accept castings in accordance with procedures described in AAR Specification M-201. In addition, the inspections below shall be performed and a written report of the results of the tests and inspections shall be furnished for each lot of castings produced.

D. Magnetic Particle Inspection

Magnetic particle inspections of all surfaces of each casting visible to the naked eye or with inspection mirrors shall be conducted according to ASTM E709, by personnel certified to MIL-STD-410. With respect to structural castings, including coupler castings, the maximum permissible magnetic particle indications shall be 0.25 inch in the direction transverse to the usual direction of loading, and 0.75 inch in the direction parallel to the usual direction of loading.

E. Radiographic Inspection

Radiographic inspection shall be conducted according to the requirements of ASTM Standards E94 and E142 using reference radiographs to ASTM E446. A sampling frequency shall be proposed by the Contractor and submitted for the Authority approval. Structural castings shall not exceed severity level 3 of ASTM E446 in all critical areas of such castings and shall not exceed level 5 in all other areas of the castings. During demonstration that the stated severity level requirements of ASTM E446 have been met, successively-produced castings shall be re-inspected by radiography in the defective areas shown in the prior radiographic inspection. After such severity levels have been proved, the sampling frequency for structural castings shall be one casting out of each ten produced. If no castings are rejected by radiographic inspection, this frequency may be extended to one casting in 25.

F. Repair Welding and Cast-Weld Designs

Repair welding of castings is permitted, provided the casting supplier performs all repair welds according to the structural welding requirements. Castings requiring repair or modification by welding after completion of heat treatment may be stress relieved locally by using electrically controlled heating not greater than 1150° F and slow cooling. Manual torch stress relief shall not be permitted, except for cosmetic welds and only then after the procedures have been submitted to the Authority's Project Manager for review and approval.

For cast-weld designs, the entire length of all assembly welds on any welded assembly of several separate castings selected for design qualification shall be radio-graphically inspected

to ANSI/ASTM E94 and E142, using reference radiographs from the International Institute of Welding "Collection of Reference Radiographs of Welds," quality level Green. Portions of assembly welds stressed in tension by service loads shall meet quality level Blue.

G. Disposal of Non-Conforming Castings

If castings are found to be non-conforming to requirements determined by the design qualification castings, the material shall be repaired, retested, and re-inspected, or it shall be destroyed at the Contractor's expense.

53 ALUMINUM

A. General

Aluminum alloy mill products shall be identified by Unified Numbering System designations and shall conform to The Aluminum Association specifications contained in the Association's publication "Aluminum Standards and Data". Aluminum alloy castings shall conform to ASTM B26, B85, or B108 for, respectively, sand, die, or permanent mold castings. Aluminum alloy forgings shall conform to ASTM B247. Copies of all test reports for sheet, extrusion, and forgings used in the car structure shall be submitted to the Authority for review.

B. Design Stresses

All aluminum structural members shall be designed so that calculated stresses under the specified AW3 passenger load do not exceed the allowable stresses per latest APTA SS-C&S-015-99, Standard for Aluminum and Aluminum Alloys for Passenger Equipment Carbody Construction. Proper allowance shall be made for the effects of fatigue, for column and plate stability effects, and for strength reduction at welded regions.

Permissible fatigue stresses under the loads specified in Section 3.3.1.6 shall be established, with approval based on available relevant research data or on prototype testing under the variable load patterns expected to occur in service.

C. Fabrication and Fastening

The forming of aluminum parts; joining of parts by bolting, riveting, and welding; and the protection of contact surfaces shall, as a minimum, conform to the requirements of the Aluminum Company of America's Technical Report No. 524, 'Specification Covering Use of Aluminum in Passenger Carrying Railway Vehicles", except as otherwise specified herein.

Fabrication techniques shall be such that the strength and corrosion resistance of the aluminum shall not be impaired nor the surface finish permanently marred or discolored during construction.

- D. Protection of Contact Surfaces
- (1) The specific measures to be taken by the Contractor to prevent the risk of direct metal-to-metal contact and resultant possible electrolytic corrosion shall be approved and shall depend upon the determination of the most suitable method which can be adapted to the design involved. The following instructions shall be the minimum protection.

- (2) Aluminum alloy surfaces shall not be secured to or make direct contact with the surfaces of copper, copper bearing aluminum alloy, brass, bronze, silver, nickel, nickel alloys, nickel plated parts, lead, tin, or wood.
- (3) The contact surfaces of aluminum alloy with aluminum alloy shall be painted with zinc chromate primer or approved equal before securing.
- (4) The surfaces of aluminum alloy parts secured to steel parts, where exposed to weathering or harsh environments, shall be protected with a one-part polysulphide sealant, zinc chromate paste, mica insulation joint material, or an approved equivalent material which completely covers the faying surfaces. The insulating material shall be non-hygroscopic and, if fibrous, shall be impregnated with bitumen or an approved, non-corrosive, water and moisture-repellant substance. After driving, fasteners shall be primed and painted with red oxide or aluminum paint.
- (5) Stainless steel and carbon steel fasteners plated with zinc shall be coated with zinc chromate paste or approved equal before installation. Where possible, only the head and the shank of the bolt shall be in contact with the aluminum part when secured in place. Suitable bushings may be used in place of the zinc-chromate paste.
- E. Interior Trim

Where unpainted aluminum is exposed to contact by passengers, it shall have a clear (natural) anodic finish. The finish process shall be the Aluminum Company of America's "Alumilite 204" with a minimum coating thickness of 0.0004 inch and a minimum coating weight of 21 milligrams per square inch, or approved equal process.

54 PIPING AND TUBING

- A. General
- (1) All piping, valves, fittings, installation methods, and testing shall be in accordance with the Code for Pressure Piping, ANSI B31.1. All joints shall be easily accessible.
- (2) Following installation, all piping systems shall be cleaned to remove dirt, metal chips, oily contamination, and moisture. After cleaning, all piping systems shall be pressure tested in accordance with the latest edition of ANSI B31.1. All leaks shall be repaired and the system re-cleaned and retested until leak-free.
- (3) Pipes must be supported throughout their length and at all connections to prevent vibration or noise and to limit stresses in the pipe to less than 50 percent of the pipe's fatigue endurance limit. Pipes and their connections shall not interfere with the removal of other components. Pipe routing and support shall be planned and accomplished in an efficient, organized manner to keep the total length and number of fittings and bends to an absolute minimum. All changes in direction shall be accomplished by bending the pipe to a radius of not less than specified by AAR Specification No. 2518, Standard S-400. Direction-change fittings are not permitted in the trainlined brake pipe or in the brake cylinder pipe. Support and clearances

provided between adjacent pipes and between pipes and surrounding structure, equipment or other appurtenances

- (4) shall be sufficient to prevent chafing or contact due to any combination of car loading and deflection, car dynamics, and thermally induced movement. The minimum clearance shall be 0.125 inch.
- (5) At all locations where pipe or tubing passes through holes in the floor, bulkheads, structure, or any fixed member, it shall be rigidly clamped to protect against possible damage or noise due to bearing, abrasion, or car dynamics-induced rattling. Clamps shall not be welded, brazed or otherwise permanently fastened to any pipe or tubing.
- (6) Pipe and tubing interfaces with clamps shall be insulated with an elastomeric or woven non-asbestos mineral fabric tape material to protect and sound-insulate the pipe or tubing.
- (7) Wherever carbody piping interfaces with vibration-isolated rotating equipment, such as the air compressor and air conditioning compressor-condenser unit; approved flexible vibration eliminators shall be used. The pipe connection at either end of the flexible elements shall be rigidly clamped no farther than 2 inches from the flexible elements. All pipe clamps shall be inherently rigid and shall be firmly attached to car structure. Cantilevered clamps or clamp supports that are weaker than service-proven designs shall not be accepted. All clamps shall be of a suitable material for the application.
- B. Air Piping, Tubing, and Fittings
- (1) The main reservoir pipe and brake pipe shall conform to ASTM A53 or ASTM A106, Schedule 80 seamless pipe. Where ASTM A53 or ASTM A106 piping is provided, its application shall also comply in all respects to AAR Specification No. 2518, Standard 400, latest revision.
- (2) Type "K" annealed copper tube per ASTM B88, latest revision, may also be used, provided it is installed no lower than 2 inches below the floor sheet or structural member and is protected by means of equipment or approved steel guards from any potential impact damage from rail debris, especially in the truck and outboard of the bolster areas. Approved copper tube shall also comply with any relevant requirements of AAR Specification No. 2518. Where suitable protection in damage-prone areas is not possible or practical, approved steel or stainless steel piping sections shall be provided. All joints for copper tubing shall utilize fittings of wrought copper or non-porous cast brass in accordance with ANSI B16.22 and B16.18.
- (3) All air hoses shall conform to the requirements of AAR Specification M-618 with AAR approved reusable fittings meeting AAR Specification M-927.
- (4) All air piping must comply in all respects with the air brake supplier's design and installation requirements. The diameter of the main reservoir pipe and brake pipes shall meet the brake supplier's requirements; however, in no case shall these pipes be

less than 0.875 inch Outside Diameter. All air pipes shall be sized in accordance with the function intended and may be either ASTM A53 or ASTM A106 schedule 80 pipe or seamless copper tubing as described previously.

- (5) Within one hundred-eighty (180) days of Contract Award and prior to rebuild of cars, the Contractor shall provide the Authority with a report containing written approval from the air brake supplier of the Contractor's air brake piping fabrication, installation, and design concept. The following information shall be contained in the report:
 - a. All critical line sizes and materials including the main reservoir pipe, the emergency brake pipe, and the brake cylinder piping.
 - b. The installation details of the above critical lines including routing, total length and volume, elevation and slopes, and major joint and direction change locations. A list of all proposed bend radii shall also be provided.
- (6) Pipe processing details including welding, brazing, cleaning, and fabrication methods are provided in the Specification.
- (7) Locations of all major air brake control, relay, and emergency venting devices, and the proposed location and volume of all reservoirs.
- (8) An air consumption analysis that justifies the proposed air storage system design.
- (9) All air piping shall be installed in a manner to provide drainage away from devices, or branch pipes leading to devices, when the function of those devices could be impaired by the accumulation of water or ice.
- (10) All cut-out cocks shall be of the vented type, except where function prohibits. All cutout cock handles and their arrangements shall be as described in the Specification.
- (11) Air piping on the trucks shall be 0.50 inch ASTM A53 or A106, Schedule 80, or approved equal. Low spots (traps) are strictly prohibited on the trucks. Truck piping shall not be run on the bottom of truck side frames, transom, or bolster, unless approved by the Authority.
- (12) Where steel piping is used, all connections and joints where disassembly for service may be required shall utilize swivel type butt-welded flange fittings with an "O" ring type seal. The use of threaded fittings is expressly prohibited. Approval may be granted for the use of threaded fittings in extreme cases where adequate proof is provided that flanged fittings cannot be used.
- C. Air Conditioning System Piping, Tubing, and Fittings
- (1) Air conditioning refrigerant lines shall be of seamless copper tubing, ASTM B88 type "K" or type "L" or ASTM B280, with wrought copper sweat type fittings. Refrigerant lines below the upper surface of the floor or subject to damage during operation shall be ASTM B88, type "K" only. Condensate drain lines shall be seamless copper tubing, type "K" or seamless stainless steel tubing.

- (2) Joints shall be kept to a minimum and all inaccessible runs of tubing shall be without joints. Finned tubing in evaporators and condensers shall be copper. Instead of elbows, tubing may be bent utilizing a bending tool designed specifically for bending of the tubing to be used.
- (3) Suction lines shall be designed and installed without traps. The suction line shall be sized for 3 psi (gauge) maximum system pressure drop and the liquid line shall be sized adequately to prevent flashing due to pressure drop.
- (4) Lines subject to condensation shall be insulated with an approved insulation, applied with an approved contact cement. The liquid line shall be insulated in all areas where required to provide additional mechanical or thermal protection. Insulation at all joints and fittings shall be mitered and sealed with an approved material. The insulation, adhesive, and sealant shall meet the Specification requirements for thermal, smoke emission, and flammability performance.
- (5) All piping and pipe subassemblies shall be deburred, cleaned, dried, and capped with tight fitting plastic caps, or approved equal on all openings after fabrication. Caps shall remain in place until immediately prior to incorporation into the final assembly.
- (6) Vibration eliminators shall be used in piping connections to the compressor unless deemed unnecessary by the Authority. Tubing installations shall be designed so that ease of maintenance can be achieved, as approved by the Authority.
- D. Brazing and Soldering of Piping, Tubing, and Fittings
- (1) All brazing and soldering shall comply with the applicable parts of Section 15.5, and the following requirements. All refrigerant piping and air system copper tubing shall be joined using silver solder conforming to Federal Specification QQ-B-654A, BAg-5, BCuP-5, or for copper to copper connections only BCuP-3. Refrigeration piping and tubing shall be internally swept with a continuous flow of a non-oxidizing gas such as dry nitrogen during brazing.
- (2) Condensate drain tubing shall be joined using 95-5 solder or Silver Solder as above.
- (3) Solder joints shall be wiped and have flux cleaned from tubing and fittings after soldering. After fabrication, the refrigeration and air systems shall each be cleared of all dirt and foreign matter, flushed with a degreasing agent and dried, all according to a written procedure prepared for each by the Contractor and approved by the Authority.

55 PRESSURE VESSELS

All pressure vessels shall conform to the latest revision of Section VIII of the ASME Boiler and Pressure Vessel Code for Unfired Pressure Vessels. Test reports shall be furnished for each pressure vessel, and each pressure vessel shall be stamped to document the test.

56 ELASTOMERS, SEALS, AND GASKETS

A. General

- (1) Elastomers shall be compounded and cured to perform as intended in the Authority environment specified in the Scope of Work. Elastomers shall have high resistance to ultraviolet and other solar radiation, weather and to all the Authority car-washing and cleaning fluids. All elastomeric parts shall be resistant to ozone, oxidation, heat, oil, grease and acid, and shall have the longest possible life, consistent with the other characteristics specified.
- (2) The following elastomeric parts shall be of neoprene unless otherwise specified or approved:
 - a. Glazing Rubber,
 - b. Door Seals,
 - c. Door Nosing,
 - d. Other parts exposed to the outdoor ambient environment, except where otherwise specified.
- (3) The following elastomeric parts shall be of natural rubber, (synthetic rubber compounds are not permitted) unless otherwise specified or approved:
 - a. All resilient mounts,
 - b. Elastomeric truck components.
- (4) Elastomers used within pneumatic or hydraulic equipment shall be as necessary to meet the performance requirements of the Scope of Work for the pneumatic or hydraulic device.
- B. Life Expectancy

For all parts made by vulcanizing an elastomer to metal, any premature failure (less than six years) between metal and the elastomer or in the elastomer, occurring when the parts are used in normal service and according to the provisions of the Scope of Work, shall be considered as having been caused by defect of materials or workmanship.

C. Metal Parts

Metal parts to which elastomeric material is vulcanized shall be made of SAE 1020 or 1045 hot-rolled steel.

D. Truck Parts

Truck bumpers, snubbers, and the exterior surfaces of air springs shall be made of natural rubber or approved equal. They shall be compounded to be resistant to abrasion, oil, grease, and acid.

E. Seals

- (1) Glazing strips shall be of neoprene conforming to ASTM C542, or approved equal material.
- (2) All door mating edges, door and window seals, and glazing strips shall be of neoprene material. The durometer hardness measured with a Shore Type "A" durometer at a temperature between 70°F to 90°F shall be 70 ±5 except for the side door mating edges where it shall be 80 ± 5.
- F. Bonding

The joining of elastomeric pieces shall be conducted by the hot vulcanization process. Bonding of elastomers by other processes shall not be allowed unless the Contractor submits the application, bonding procedure and bonding agent technical data for approval prior to the purchase of any materials.

- G. Tests
- (1) All tests shall be conducted according to the latest revisions of the specified ASTM test procedures, unless otherwise specified. All resilient, natural rubber mounts and elastomeric truck suspension components shall be tested in accordance with the procedures outlined for elastomers in the Scope of Work; the results of the testing shall be submitted to the Authority for review.
- (2) The test specimens shall be cut out from the extruded material, and at least one tensile strength and elongation test and one accelerated aging test shall be made on the material used for each order. If the compound or cure, or both, are changed during the production of material for one order, at least one test of each type shall be made for each different batch.
- (3) When testing the 6 inch by 0.50 inch ASTM "dumb bell" type test specimen (or smaller size if the size of the part necessitates) by the methods specified in ASTM D3182, D3183, D3190, and D412, the tensile strength shall not be less than 1,500 psi and elongation shall be a minimum 350 percent. The tensile strength of the elastomer shall not be reduced more than 25 percent when subjected to accelerated aging by the methods specified in ASTM D573, for a period of 96 hours in an air oven at 158°F.
- (4) The ozone resistance of the elastomer shall be tested in accordance with ASTM D1149 using an ozone concentration of 100 pphm, an exposure time of 100 hours at 100°F, and a specimen elongation of 20 percent. The elastomer shall not exhibit any cracks during the test period.

57 GLAZING MATERIALS

- A. Safety Glass, General
- (1) Safety glass shall meet the requirements under Item 1, Table 1 of ANSI Z26.1, "American National Standard for Safety Glazing Materials for Glazing Motor Vehicles

and Motor Vehicle Equipment Operating on Land Highways - Safety Code" and FRA 49 CFR 223 and 238 Type I or II test as appropriate for the application.

- (2) All safety glass shall be of the laminated type.
- B. Size and Configuration
- (1) Flatness

When an individual light of glass is laid on a truly flat surface, such as a surface plate, the glass shall not indicate a bow of more than 0.030 inch per linear foot.

(2) Dimension Tolerance

The overall dimensions of individual lights as supplied shall be held within 0.60 inch of the dimensions ordered.

(3) Overlap Tolerance

The overlap of one laminate of the light with respect to the other at an edge shall not exceed 0.03125 inch. Corners and burrs shall be ground smooth and all edges shall be treated in accordance with ANSI Z26.1, Section 6.

- C. Optical Characteristics
- (1) Color The color of the glass shall be as required by the Scope of Work. When new, there shall be no more than ±4 percent variation in the color of individual lights of laminated sheet glass when examined over a white background. Visible light transmission through safety glass shall be a minimum of 85 percent.
- (2) Haze All the laminates of the safety glass shall be so nearly free from haze that the glass shall have approximately the same clarity as a light of the same nominal thickness of plate glass when viewed against a north light.
- D. Workmanship
- (1) Specks and Scratches

Occasional specks of foreign material and scratches are permissible, provided such specks do not exceed 0.020 inch in greatest dimension and scratches do not exceed a total of 3 inches in length and neither are within the central three-quarters area of the light. The Authority reserves the right to determine which lights are to be rejected.

(2) Bond Separation

The bond between two sheets of glass and the membrane shall be of such quality that when the glass is broken by twisting or by direct impact, there shall be no separation between the glass sheets.

E. Quality Assurance

The Contractor shall be responsible for the performance of all inspection and test requirements. Except as otherwise specified, the Contractor may utilize the facilities of its supplier or any approved commercial laboratory.

F. Shipping

The material shall be carefully prepared for shipping and shall be properly protected to prevent damage. If a pressure sensitive masking is used, it shall be easily stripped from the material and not leave a gummy or sticky residue.

G. Identification

Each light shall be marked for identification in accordance with the requirements of ANSI Z26.1, Section 7 and 49 CFR 223 by the supplier in legible letters 0.1 inch high in the lower right hand corner as viewed from the inside of the vehicle. This identification shall be no closer than 0.75 inch to the edge. The identification shall give the product name, the manufacturer, month and year of manufacture, and FRA Type I or II designation. Marking shall be legible and permanent for this application and shall be applied in such a manner so as not to reduce the integrity of the coating. The light shall be installed so that the marking can be read from the inside.

H. Documentation

The Contractor shall certify that the shipped material complies with the requirements in the Scope of Work.

58 AIR FILTERS

A. HVAC and Equipment Ventilation Filters

Filters shall be selected in accordance with manufacturer's recommendations for the specific equipment involved. All filters shall have an integral frame. Filters shall be the throw-away type, except reusable filters may be approved for specific applications where throw-away filters are not available. Filters shall be designed to meet the performance requirements of each installation, and shall be approved. All filters shall be freely accessible for maintenance. Filters shall meet the requirements of UL 900, Class 2.

B. High Pressure Air Filters

Air filter assemblies with replaceable filter elements shall be provided in the air line that connects each subsystem to the air supply system. The air filter filtering capability, flow rate capability, and overall size shall be appropriate for the application so that the filter replacement interval is greater than one year. It shall be possible to gain access to the filter element for replacement without requiring any pipe fittings to be disconnected or loosened. Filters shall be provided for each of the following systems and any others operated from the air supply system:

- (1) Each air brake control assembly,
- (2) Input and output of each height control valve,

- (3) Coupler controls,
- (4) Door controls, and
- (5) Horn.
- C. Low Pressure Air Filters

Replaceable media type filters shall use resin-bound, spun-glass fiber materials having an uncompressed thickness not less than 3.50 inches. It shall be non-absorptive of fluids and gases, shall be processed in such a manner that material density increases progressively from air inlet to air exit side, and shall be coated with not less than 24 grams per square foot of a dust-retaining, viscous adhesive film. This film shall be stable at temperatures up to 150°F. The filter medium shall be cut not less than 0.50 inch oversize to ensure adequate sealing between the edge of pad and its integral frame.

59 SEAT CUSHIONS AND UPHOLSTERY

A. Seat Cushions, General

Seat cushion fill material shall be low-smoke flexible foam constructed of inherently fireretardant materials. The thickness shall be approved during design review. The material shall have a polymerized or vulcanized homogeneous (free from foreign material), cellular structure with a porous surface and open cells. The cells shall be interconnecting and uniform in size. Cellular material may be molded in one piece or may be assembled by laminating to achieve the required thickness. Laminated cushions shall be bonded together. Cushion material shall be properly cured to prevent any objectionable odor.

B. Physical Properties

Flexible foam shall meet the following physical property criteria when tested without upholstery material to the latest version of the following ASTM methods:

Test No	. Description	Criteria
D-3574 Test E	.Tensile Strength	.5.0 lbf/psi min.
D-3574 Test E	.Elongation	.70 percent min.
D-3574 Test E	.Compression Set at 50 %	.15 % max.
D-1055	.Flex Fatigue	.Thickness less 5 % max.
D-3574	.Tear Strength	.2.0 lbs/psi min.

- C. Upholstery
- (1) Cloth Fabrics, General

Cloth fabrics used for seat upholstery shall be made of woven, transportation grade fabrics of wool, wool/nylon blend (90/10), or an approved flame resistant polyester. The maximum fabric shrinkage shall be 2 percent in either the warp or fill direction.

(2) Physical Properties

Seat upholstery material shall be subjected to the physical tests of textile products required by the latest revision of the following ASTM methods, and the results shall not be less than the following values:

Test No.	Description	Criteria - Wool and Wool/Nylon Blends	Criteria - Bold
D-3776	Fabric Weight	15.5 oz/sq yd without back coating	12 oz/sq yd without back coating
D-3775	Fabric Count	Warp – (ends) 88 epi Fill - (picks) 40 to 72 ppi	Warp – (ends) 88 epi Fill - (picks) 40 to 72 ppi
D-5034	Breaking Strength and	Warp – 200 lbs. Fill – 200 lbs	Warp – 270 lbs. Fill – 200 lbs
D-2261	Tear Strength (Tongue)	Warp – 20 lbs. Fill – 20 lbs.	Warp – 20 lbs. Fill – 20 lbs.
D-4034	Yarn Slippage	Warp – 30 lbs. Fill – 40 lbs	Warp – 75 lbs. Fill – 65 lbs
D-3597	Color Fastness	Water – Class 4 min. Solvent – Class 4 min. Crocking – Class 4 min.	Water – Class 4 min. Solvent – Class 4 min. Crocking – Class 4 min.
		Light - Class 4 min	Light - Class 4 min

upholstery shall be made of woven transportation grade fabric-backed vinyl with a weight of 24 ounces per square yard.

 Physical Properties - Fabric-backed vinyl used for seat upholstery shall be subjected to the physical tests of textile products required by the FED-STD-191, latest revision, and the results shall not be less than the following values:

Test No	. Description	Criteria
5106	.Tensile Strength	.Warp – 110 lbs. Fill – 100 lbs.
5110	.Seam Strength	.85 lbs.
5134	.Tear Strength (Tongue)	.Warp – 10 lbs. Fill – 12 lbs.
5136	.Tear Strength (Trapezoid)	.Warp – 36 lbs. Fill – 42 lbs.
5660	.Colorfastness – 200 hrs	.No change
5970	.Adhesion of Coating	.10 lbs.

60 RUBBER FLOOR COVERING

A. General

Rubber floor covering shall contain 38 percent (nominal, by weight of compound) Butadiene Styrene rubber, shall be non-staining, non-discoloring, and 100 percent non-oil extended. Only high quality, fine, hard clay shall be used as filler. No whitening (limestone) shall be used in the compound. The rubber tile shall be free from reground rubber, natural rubber or coarse fillers.

At 68° F, the rubber flooring shall bend 180 degrees around a 0.75 inch diameter mandrel without breaking, cracking, crazing, or showing any change in color. The rubber flooring material shall be fully homogeneous throughout and shall meet the requirements of ASTM F1344.

B. Inspection Criteria

The Authority shall not allow defects in the flooring. Defect items discovered during inspection shall require the Contractor to replace the flooring material. Common defects are described below:

- (1) Thin-Skinned Blister A thin-skinned blister is a blister which, when finger-pushed, shall collapse upon itself.
- (2) Thick-Skinned Blister A thick-skinned blister is a blister which, when finger-pushed, shall collapse and then returns to its original condition.
- (3) Lump A lump is a blister without a void, consisting of solid material.
- (4) Hole A hole is a defect which is 50 percent through the material.
- (5) Thin Area A thin area is a defect where the sheet is of reduced thickness locally.
- (6) Color and Speckle Distribution Color and speckle distribution is an appearance judgment and shall be subject to the approval of the Authority. If the base coloring is not within 5 percent between production runs, or the speckling is not consistent over the entire surface, the roll shall be rejected.

61 FIBERGLASS-REINFORCED PLASTIC

- A. General
- (1) Fiberglass-reinforced plastic (FRP) shall be a laminated material, composed of a gel coated surface, fiberglass reinforcement, and an approved resin. FRP shall withstand, without any physical deformation or structural damage, the environmental conditions specified and be resistant to acids, alkalies, and cleaning solutions recommended by the Contractor.
- (2) FRP shall be manufactured by an open molding or matched die molding process. Production techniques shall ensure that the glass fiber reinforcement is uniformly distributed throughout the final product in such a manner as to avoid resin-rich or resin-starved sections. An analysis shall be performed to confirm that the construction method chosen is adequate for its intended purpose and meets the strength requirements within the Scope of Work. Finished gel coated surfaces

exposed to passenger view shall have a minimum gloss value of 85 when measured with a 60 degree gloss-meter. All finished gel coated surfaces shall exhibit no print through of the reinforcements or have any appreciable orange peel. Where fiberglass reinforced plastic is used in the car interior and exposed, it shall have Tedlar© applied using in mold process unless specifically approved by the Engineer.

(3) FRP parts shall have a greater thickness at attachment points and edges, unless otherwise approved by the Engineer. If fasteners are used to attach and/or assemble FRP parts, the parts shall be reinforced in a manner approved by the Authority's Project Manager to preclude the development of cracks. Exposed sharp edges shall not be allowed on any parts.

62 CONSTRUCTION

A. Resin

The resin shall be of good commercial grade, thermosetting, polyester, phenolic, vinyl-ester or acrylic material selected to meet the physical, flammability and smoke emissions properties of the Scope of Work and molding process requirements.

B. Reinforcement

The fiberglass reinforcement shall be mat, fabric woven roving, continuous roving, or swirl mat as required to meet the physical properties of the Scope of Work and the molding process requirements. The glass content shall be a minimum of 20 percent by weight.

C. Gel Coat

The gel coat shall be resistant to scuffing, fire, weather, water absorption and cleaning agents. The gel coat shall have a minimum thickness of 0.016 inches and a maximum thickness of 0.032 inches. If the surface of the FRP panel is to be painted, a primer gel coat shall be used. If the FRP panel does not receive paint, then the gel coat shall be pigmented to match the color scheme selected by the Authority.

D. Additives

Additives, fillers, monomers, catalysts, activators, pigments, fire retardants, and smoke inhibitors shall be added to the resin mixes to obtain finished products with the required physical characteristics, and the flammability requirements of this Section. Antimony Trioxide shall not be used.

Mineral filler shall not exceed 28 percent of the finished weight for any preformed matched die molding process.

- E. Strength Requirements
- (1) Independent laboratory tests shall be performed on test coupons that are trimmed from production parts.

Independent laboratory test certificates shall be provided stating that the production reinforced plastic material complies with the requirements of the following standards. Test specimens shall be conditioned in accordance with ASTM D618.

Minimum Requirement			
Mechanical Property	ASTM Test	Open Moldings	Matched Die Moldings
Tensile Strength	D 638	10,000 psi	18,000 psi
Compressive Strength	D 695	18,000 psi	24,000 psi
Flexural Strength	D 790	15,000 psi	30,000 psi
Impact Strength	D 256	6 ft-lb per inch of notch	8 ft-lb per inch of notch
Hardness	-	45 Barcol	arcol

63 WOOD AND PANELS

A. Lumber

Lumber shall be sugar or black maple, sweet or yellow birch, only. Lumber shall be thoroughly air seasoned or kiln dried before using, so as not to have a moisture content of greater than 12 percent. Lumber shall be dressed on all surfaces to full dimensions. Lumber shall be straight-grained, free from dry rot, knots, checks, and other defects which may impair its strength and durability or mar its appearance.

B. Plymetal

Plymetal may not be used for flooring. The term "plymetal" as used hear means metal-faced plywood. All plymetal panels shall conform to the following requirements:

Mechanical Properties Minimum Metal to Wood Average Shear Value or 80 Percent Wood Failure

Dry shear	.250 lbf/in2	
Boil shear, 3 hr. boil, tested wet at room temperature	.150 lbf/in2	
Soak shear, 48 hr. soak wet at room temperature	.150 lbf/in2	
Creep or cold flow, under static load for 48 hrs., at room temp	erature	250 lbf/in2

The metal face of the plymetal panel that is faced with melamine shall be constructed in accordance with this Section prior to the melamine-faced metal panel being laminated to the plywood core.

C. Plywood

All plywood shall be manufactured to conform to the requirements of Grade - Structural I of the National Bureau of Standards Voluntary Product Standard (American Plywood Association) PS 1-95, and then stored under cover. Scarf or finger jointed panels are not allowed. All plywood shall be sealed with two coats of epoxy paint on all edges and cutouts as soon as possible after fabrication. All exposed edges of the panels, joints between panels, fastener heads, and openings of panels used in areas accessible to moisture shall be water-proofed and sealed with an approved coating prior to installation in the car.

- D. Honeycomb Panels
- (1) The term "honeycomb panels" as used in the Scope of Work refers to an assembly of honeycomb material bonded to melamine-faced metal panels or to metal panels.
- (2) Aluminum honeycomb material shall be commercial grade meeting the requirements of the latest MIL-C-7438G. Bonding shall be sufficient to develop the full strength of the honeycomb material.
- (3) Stainless steel faced, stainless steel honeycomb panels shall be constructed in accordance with the requirements of MIL-A-9067. The adhesive bond strength of the honeycomb core to the stainless steel face shall not be less than fifteen (15)-lb/inch climbing drum strength when tested in accordance with MIL-STD-401. The adhesive

bond strength of the integral stainless frame to stainless steel face shall not be less than 30-lb/inch climbing drum strength when tested in accordance with MIL-STD-401.

(4) Stainless steel honeycomb panels shall be tested in accordance with MIL-STD-401B to demonstrate the following requirements:

Mechanical Properties	Minimum Requirement
Core shear yield at 200 ^o F	250 lbf/in ²
Flat wise tension at 200 ^o F	250 lbf/in ²
Beam flexure at 200º F	75,000 lbf/in ²
Core shear fatigue at R.T.	150 lbf/in ² @ 10 ⁶ cycles
Flat wise tension at R.T.	250 lbf/in ² @ 10 ⁶ cycles
Beam flexure at R.T.	50,000 lbf/in ² @ 10 ⁶ cycles

No other honeycomb materials are permitted.

64 MELAMINE-FACED ALUMINUM

Melamine-faced aluminum panels shall be constructed by laminating melamine to aluminum sheets. The melamine-impregnated papers shall be directly molded to the aluminum sheets at temperatures of no less than 270°F and pressure no less than 1000 psi. The surface characteristics, after manufacture, shall be no less than that required of type GP (General Purpose) in the NEMA Standards Publication No. LD-3, latest revision. The melamine and the required binder sheets shall be 0.015±0.005 inches thick. The aluminum sheets shall not be less than 0.025 inch in thickness when used as a facing on plywood. The aluminum sheets shall not be less than 0.081 inch in thickness when not laminated to a substrate such as plywood. Aluminum sheets shall be properly cleaned by etching, sanding, or other approved process to ensure full, permanent, adhesion.

- A. The use of contact adhesives to bond the melamine sheets to the aluminum backing is not acceptable.
- B. The bond between the melamine and aluminum sheets shall, as a minimum, meet the following requirements:

Mechanical Property	Minimum
Internal bond (ASTM D952):	2,600 lbf/in ²
Flexural strength - s (ASTM D790)	

Mechanical Property	Minimum
with grain:cross grain:	26,500 lbf/in2 25,300 lbf/in2
Modulus of elasticity - (E) (ASTM D790)	
with grain:cross grain:	2.8 x 10 ⁶ lbf/in ² 3.1 x 10 ⁶ lbf/in ²
Tensile strength (ASTM D638)	
with grain:cross grain:	22,300 lbf/in ² 20,300 lbf/in ²

- C. Phenolic Composite Floor Panels
- (1) Phenolic composite floor panels consisting of a balsa core and phenolic outer skin are preferred for the car flooring.
- (2) Phenolic composite floor panels shall be designed to withstand the following physical requirements with no visible or audible indications of de-lamination of the panel skin from the core. Permanent deformation of the top surface shall be less than 0.010 inch unless otherwise specified. There shall be no puncture or damage to fibers of the top surface. There shall be no separation of any internal core from the top or bottom skin. There shall be no fracture of the balsa core. All test results are required to be submitted to the Authority's Project Manager for approval.
 - a. Indentation Resistance The floor panel shall withstand a concentrated load of 300 pounds applied to a test dowel that has an overall 0.375 square inch surface area, with a 0.0625 inch radius on bottom edge of test dowel.
 - b. Static Load Test Average Loading A representative sample section of the flooring (without rubber floor covering attached) shall be supported on beams spaced at the maximum spacing used on the car using production bonding and fastening techniques. A uniformly distributed load in accordance with the crush loading requirements of Section 2 shall be applied to both sides of the joint (butt and/or shiplap). There shall be less than 0.088 inch deflection.
 - c. Static Load Test Maximum Loading Using the identical floor panelmounting configuration as described above, a uniformly distributed load of 200 lb /ft2 shall be applied to both sides of the joint (butt or shiplap).
 - d. Small Area Static Load Test Using the identical floor panel mounting configuration as described above, a 300 pound load shall be applied to a 1.0 inch x 3.0 inch contact area directly over the midspan, 6 inches from the outer carbody sidewall edge. The footprint shall be machined flat within 0.010 inch and the edges shall have a radius of not more than 0.125 inch. There shall be less than 0.200 inch deflection as a result of the load applied.

- e. Small Object Impact Test Using the identical floor panel mounting configuration as described above, a 16 pound standard bowling ball shall be raised directly over the mid-span, 24 inches from the edge of the panel and dropped from height of 60 inches. Permanent deformation of the top surface shall be less than 0.063 inch.
- f. Large Object Impact Test Using the identical floor panel mounting configuration as described above, a 150 pound load shall be dropped upon a 3.0 inch x 8.0 inch contact "footprint" pad located directly over the midspan, 24 inches from the edge of the panel and dropped from a height of 12 inches. The "footprint" pad shall have a rubber pad on the downside surface with a Shore D 70 minimum, at a 1 inch thickness machined flat within 0.060 inch with edges having a radius of not more than 0.030 inch. Permanent deformation of the top surface shall be less than 0.030 inch. Some damage to the top phenolic composite skin is allowed.
- g. Rolling Load Test Using the identical floor panel mounting configuration as described above, a 4 wheeled cart with a load of 200 pounds per wheel shall be rolled on the panels laterally, longitudinally and in a circular path with a 2.0 foot radius. The wheels shall be 3 inches in diameter, 1 inch wide.

D. Panel Contour Tolerance

Surfaces exposed to passengers shall not deviate from the specified contour by more than inch in any 36 inch distance. The slope of any such deviation shall not exceed inch in 12 inches.

65 THERMOPLASTIC SHEET

- A. General
- (1) Thermoplastic sheet used in the construction of this vehicle shall not contain PVC vinyl and shall withstand, without any physical deformation or structural damage, the environmental conditions described in the Scope of Work and shall be resistant to the Authority cleaning solutions. Thermoplastic sheet shall be used as extruded or vacuum-formed.
- (2) Thermoplastic sheet shall be homogeneous and extruded from virgin stock which does not include any regrind of vacuum formed parts. The exposed surface of this material shall conform to the color, texture, and gloss specified in the Scope of Work. Only UV stabilized pigments shall be used to create the specified color of the thermoplastic sheet. The color and surface finish of parts manufactured from this material shall be approved by the Authority's Project Manager prior to the production run of any parts.
- B. Quality

The finished parts shall be free of waves and quilting on both sides. Degraded polymer in the sheet shall not be allowed, and if present, shall be cause for rejection of the piece. Voids,

lumps, and contamination shall also be cause for rejection of parts if the defects are larger than 0.010 inch and the population of these defects is greater than one defect in 4 square feet.

C. Strength Requirements

Independent laboratory test certificates shall be provided stating that the thermoplastic sheet complies with the requirements of the following standards. Extruded sheet in the surface finish specified shall be used for testing.

Mechanical Properties	. ASTM Method Value
Specific Gravity	. D 7921.20 to 1.45
Tensile Strength	. D 6385,500 lbf/in2 minimum
Elongation	. D 63850 percent minimum
Flexural Strength	. D 7908,000 lbf/in2 minimum
Flexural Modulus	. D 7903.3 x 105 lbf/in2
Hardness Rockwell "R" Scale	. D 78590 to 110
Heat Shrinkage 15 minutes at 350°F	
Heat Deflection (annealed) @ 264 lbf/in2	2 D 648165°F minimum
Impact Strength Fabricated Parts:	
Gardener Dart Drop 0.5 inch dia. ball	. D 3029
At 73°F	320 in-lb minimum
At 20°F	80 in-lb minimum

66 WIRE AND CABLE

A. General Requirements

- (1) The Contractor's design and construction shall ensure that the minimum number of wire types and sizes shall be used in the vehicle.
- (2) Selection of wire sizes and insulations shall be based on the current carrying capacity, voltage drop, mechanical strength, temperature and flexibility requirements in accordance with applicable APTA, AAR, ICEA, ASTM, NEC, and MIL Specifications. However, in no case shall the properties of the wire and cable be less than those properties delineated in the Scope of Work. Extra-fine wire stranding shall be utilized on applications subject to repetitive motion.
- (3) All applications of shielded cable shall be subject to the approval of the Authority.
- (4) The Contractor and each manufacturer of equipment through the Contractor shall submit to the Authority's Project Manager for approval samples at least 12 inches

long, specifications, and 3 copies of certified qualification test documentation of each size and type of wire and cable specified before utilizing said wire and cable.

- B. Conductors
- (1) Conductors for wire AWG No. 12 and smaller shall be soft, annealed nickel-plated copper constructed in accordance with MIL-W-22759/6B. Conductors of all sizes insulated with irradiated, cross-linked polyolefin wire shall be soft, annealed tinned copper, in accordance with ASTM B33. Minimum stranding shall conform to AAR Standard S501, S502 (No. 589), or ASTM B-172 Class K, or ICEA S-66-524/NEMA WC7, Table L-7, Class K for AWG No. 10 or larger, as appropriate for the application.
- (2) Stranding and conductor construction for wire sizes AWG No. 12 to AWG No. 16 shall be in accordance with AAR Recommended Practice RP-585, ASTM B-174, Class K, or ICEA S-66-524/NEMA WC7, Table L-8, Class M, as appropriate for the application.
- (3) Stranding and conductor construction for wire sizes AWG No. 18 and smaller shall be in accordance with ASTM B-174 Class L or ICEA S-19-81/NEMA WC3, Table L-8, Class M, or shall be nineteen (19) strand construction as appropriate for the wire size.
- (4) The use of solid wire shall not be permitted except for approved wire wrap applications.
- (5) Wiring must be sized for the intended load, voltage drop, installation method, and applicable codes. Calculations of wire sizes shall be in accordance with the latest APTA-RP-E-009-98, "Recommended Practice for Wire used on Passenger Equipment." When the free air rating is used, the Contractor shall furnish data to show that the cables shall not exceed their rated temperature at the rated current. Wire ampacities shall be de-rated to meet the temperature requirements of all devices to which the wire connects. When short time ratings, short time overload temperatures, and thermal time constants are used to determine cable size, the parameters used shall be submitted for approval.
- (6) In no case may wire smaller than the following sizes be used:
 - a. Wire which is pulled through conduits or wire ways AWG No. 14.
 - b. Wire on electronic units, cards, and card racks AWG No. 28.
 - c. Wire within control compartments AWG No. 18.
 - d. Multi-conductor cables where current is not a factor in wire size selection AWG No. 18.
 - e. All other wire, including that which is not pulled through wire ways and conduits AWG No. 16.
- (7) The Authority's Project Manager may approve smaller wire sizes for selected applications upon submission of appropriate applicable data for justification.
- C. Insulation General Wiring Insulation

- (1) Teflon, mineral filled, abrasion resistant insulation may be used on wire sizes AWG No. 12 to AWG No. 28. Otherwise, for all general carbody wiring, the insulation shall be a flame retardant, flexible, irradiated cross-linked polyolefin material having a continuous temperature rating of 230° F. The insulation shall be rated at 2,000 VAC and VDC, in the case of wires carrying a nominal voltage greater than 150 VAC or VDC, and rated at 600 VAC and VDC, in the case of wires carrying a nominal voltage of 150 VAC or VDC or less. For wire sizes AWG No. 6 and larger, the insulation material shall be formulated for extra flexibility.
- (2) Insulation shall meet the following flammability requirements:
 - a. Cross-linked polyolefin shall be tested in accordance with test method ICEA S-66-524/NEMA WC7, Paragraph 6.12.5. After five applications of fifteen (15) seconds each, with a three second rest period between applications, flame shall extinguish in ten seconds or less.
 - b. Other insulation materials shall be tested in accordance with IEEE-383.
- (3) Cross-Linked Polyolefin Wire Insulation

The irradiated cross-linked polyolefin wire insulation shall be constructed and tested in accordance with the following requirements:

- D. Flexibility Tests for Cables
- (1) Flexibility tests for cable sizes up to AWG No. 2/0 shall be performed in accordance with AAR Recommended Practice RP-585, paragraph 5.9.7.1, for the appropriate wire size.
- (2) Flexibility tests for cable sizes AWG No. 2/0 and larger shall be performed in accordance with AAR Recommended Practice RP-585, paragraph 5.9.7.
- E. Single Conductor Thermal Overload Test

A continuous current of 115 Amperes shall be applied to an 18 foot length of AWG No. 10 test wire in 77° \Box F still air. A 3000C VDC potential shall be maintained between the test wire and an AWG No. 18 bare copper wire wrapped snugly around the outer insulation surface of the test wire. Failure shall occur when a short circuit is established between the bare copper wire and the test wire. Minimum time to failure shall be 3 minutes.

F. Bundle Overload

A bundle overload test using a 7 wire bundle shall be performed in accordance with AAR Standard RP585.

- (1) Temperature Cycling Tests
 - a. This test shall be performed on an 8 foot length of AWG No. 10 wire with 2 kV insulation.

- b. Thermocouples shall be attached to the outer jacket surface, and on the conductor, under a small incision in the insulation approximately 12 inches from one end of the sample. Both ends of the sample shall be securely clamped using hose clamps.
- c. Prior to temperature cycling, the sample shall be conditioned for 2 hours at a temperature of 302°F.
- d. The sample shall then be temperature cycled between ambient of 257 °and -22°F by transferring the sample between an air-circulating oven, set at 257°F and an air-circulating cold box set at -22°F. The time during which the sample stays in each chamber shall be sufficient to allow both thermocouples on the sample to read the same temperature as the environment.
- e. One cycle shall be defined as an approved dwell time at both 257°F and -22°F. The sample shall be subjected to a total of 250 cycles, with a visual observation at the end of each cycle for cracks and other damage. After 250 cycles, the sample shall be immersed in water for 6 hours with both ends out of the water, and then subjected to a dielectric test of 5 kVAC for 5 minutes and also examined by microscope to verify that no cracks exist.
- f. Flame-retardant, flexible, irradiated, cross-linked polyolefin insulation rated at 257°F may be used, provided that it meets the requirements of all the above tests and standards, modified to reflect the temperature rating related characteristics. The revised values, and the use of such wire, must be approved by the Engineer. Cross-linked polyolefin insulation shall not be permitted for use on wires connected to heater elements or any other high-temperature device.
- G. Other Wire Insulation

All insulation other than irradiated, cross-linked polyolefin shall meet the following test requirements, based on MIL-W-22759, and using the following parameters:

(1) Dielectric

Test per MIL-W-22759/10B (for 1,000 V wire with tests at 9.5 kV impulses) or MIL-W-22759/6B (for 600 V wires with tests at 8 kV impulses).

(2) Insulation Resistance

Test per ASTM D-470. Minimum accepted value shall be 1,000 megaohms per 1,000 feet, using a 1,000 VDC megohmmeter.

(3) Spark test

One hundred percent of all single conductor cables and all single conductor cables being used in a multi-conductor cable shall be inspected by Impulse Dielectric Test or by chain electrode Spark Test. Spark Test Apparatus and Procedure shall be in accordance with MIL-W-22759. Spark Test voltages shall be equivalent to impulse test voltages by corresponding RMS value at 3 kHz. Impulse Test Voltage kV Peak...... 3 kHz Test Voltage kV RMS

8	5.7
9.5	6.7
10	7.1

(4) Air aging

Test per ASTM D-638. Age sample for seven (7) days at 302°F in an air oven. Minimum tensile strength and elongation shall not be less than 85percent of the unaged values. Also test per IEEE STD 383-1974 and ASTM D-573 for extended life.

(5) Cold Bend

Test per NEMA WC3, except test temperature shall be -58ºF.

(6) Weight Loss

Weight loss of the insulation material shall not exceed one percent when subjected to an oven temperature of 266°F for 500 hours.

(7) Chemical Resistance

An appropriate length sample shall be measured for insulation diameter and total weight to record initial values. The wire shall be immersed to within 3 inches of each end in the test fluid for 24 hours at 149° F. During the immersion stage, the minimum bend radius of the wire shall be ten times the diameter of the wire being tested. Upon removal from the test fluid, the specimen shall be cooled to room temperature for 1 hour and the diameter gauged and reweighed for comparison with the original values. The maximum diameter and weight increase shall not exceed 30 percent. Typical fluids for this test include:

- a. Humble No. 2214 Railroad Diesel Lubricating Oil and lubricants (100 percent solution);
- b. Humble Diesel 260 or Railroad T fuel oil (100 percent solution);
- c. Mineral oil (100 percent solution);
- d. Hydrochloric acid, nitric acid, sodium hydroxide, sulfuric acid (0.1 percent solution);
- e. Potassium hydroxide (0.1 percent solution);
- f. Petroleum distillates and other graffiti removers and cleaning compounds;
- g. Kerosene solvents (100 percent solution);
- h. Trisodium phosphate solution (50 percent solution);
- i. Skydrol 500 B hydraulic fluid (100 percent solution); and

Water.

(8) Temperature Cycling Testing

- a. The test shall be performed on an 8 foot length sample of AWG No. 12 wire.
- b. Thermocouples shall be attached to the outer jacket surface and on the conductor under a small incision in the insulation about 12 inches from one end of the sample. Both ends of the sample shall be securely clamped using hose clamps.
- c. The sample shall be conditioned for 2 hours at a temperature of 302°F. The sample shall then be temperature cycled between ambient of 257°F and -22°F by transferring the sample between an air-circulating oven, set at 257°F and an air-circulating cold box set at -22°F. The time during which the sample stays in each chamber shall be sufficient to allow both thermocouples on the sample to read the same temperature as the environment.
- d. One cycle shall be defined as an approved dwell time at both 257°F and -22°F. The sample shall be subjected to a total of 250 cycles, with visual observation at the end of each cycle for cracks and other damage. After 250 cycles, the sample shall be immersed in water for 6 hours with both ends out of the water, and then subjected to a dielectric test of five kVAC for 5 minutes and also examined by microscope to verify that no cracks exist.
- (9) Single Conductor Thermal Overload Test

A continuous current of 115 amperes shall be applied to an 18 inch length of AWG No. 12 test wire in 77 F still air. A 1,000-VDC potential shall be maintained between the test wire and an AWG No. 18 bare copper wire wrapped snugly around the outer insulating surface of the test wire. Failure shall occur when a short circuit is established between the copper wire and the test wire. Minimum time to failure shall be 3 minutes.

- (10) Seven-Wire Bundle Thermal Overload Test
 - a. A 7 wire cable bundle shall be formed by twisting 6 insulated AWG No. 12 conductors around a center insulated AWG No. 12 conductor.
 - b. A 120 Ampere current shall be passed through the center conductor for 7 minutes. After the test period, the cable bundle shall be examined for visible damage to the outer 6 conductors. Failure shall occur if any of the outer conductors split, rupture, or melt and adhere to the center conductor insulation.
- (11) Qualification and Production Tests
 - a. The tests required for the Scope of Work concerning Qualification and Production shall be in accordance with tests in MIL-W-22759 for all lots produced.
 - b. All test reports covering Production and Qualification tests shall be submitted to the Authority's Project Manager for approval with samples prior to any shipment of materials.
- (12) Wire Insulation for High Temperature Applications

- a. High temperature insulation shall be used where connected to heatgenerating apparatus, where the ambient temperature can exceed 257°F, or where Teflon is specified as a requirement. The insulation shall be rated at 1,000 VAC and VDC in the case of wires carrying a nominal voltage greater than 150 VAC or VDC, and rated at 600 VAC and VDC in the case of wires carrying a nominal voltage equal to or less than 150 VAC or VDC. The insulation shall have a continuous temperature rating of 257°C or above and be in accordance with the following requirements:
 - (i) For wire sizes AWG No. 16 and larger, abrasion resistant Teflon
 (Polytetrafluorethylene PTFE) meeting MIL-W-22759/6B or 10B, as appropriate for the voltage level used, or silicone rubber meeting AAR Standard RP-587C.
 - (ii) For wire sizes AWG No. 18 and smaller, abrasion resistant Teflon (PTFE) meeting MIL-W-22759/6B or 10B, as appropriate. When used for interconnecting pieces of apparatus, this type wire shall be in bundles with a protective covering of high temperature rated, low smoke generating insulation.
 - (iii) The Contractor may propose other insulated wire specifications for approval in a specific high temperature application, specifying the design ambient temperature, routing, RMS ampere value, worst-case ampere value, worst-case temperature rise, stranding, and insulation material specification.
 - (iv) No high temperature insulated wire may be used in conduit or raceways without specific approval. The Contractor shall submit all applications of high temperature wire insulation for approval by the Engineer.

(13) Wire Insulation within Equipment

Insulation on wiring within replaceable modular units, electronic apparatus such as cards and card racks, and other equipment, as approved, shall be Tefzel (Ethylenetetrafluoroethylene - ETFE) per ASTM D3159 and insulation construction per Military Specification MIL-W-22759/16 (AS), irradiated cross-linked polyolefin per Section 15.20.3.1, or Teflon (Polytetrafluorethylene - PTFE) type EE per Military Specification MIL-W-16878/5.

(14) Wire Insulation at Crowded Locations

Wire for connections to the control console, or in any other locations where there are equally crowded concentrations of low voltage control wiring, may be insulated with Tefzel (ETFE) per ASTM D3159 and insulation construction per Military Specification MIL-W-22759/16 (AS), except the wall thickness shall be 0.025 inches. When used for this application, these type wires shall be bundled with a protective covering of irradiated cross-linked modified polyolefin or similar, approved, high temperature rated, low smoke generating insulation.

H. Multi-Conductor Cables

(1) General

Multi-conductor cables, where approved, shall be constructed using wiring as described in this Section. For high temperature applications, the cable shall conform to MIL-C-27072, with Type V connectors, Style 4 sheaths, Class D jackets, if needed, and shields, if needed. All conductors in multi-conductor cables shall be color coded or otherwise permanently identified as approved. Materials used in the construction of multi-conductor cables shall meet the requirements below. In applications where current is not a factor in wire size selection, such as LED indicator lights or status displays, AWG No. 16 may be used between repeater devices and displays. For Multi-Conductor cables carrying low-voltage, high-speed, serial data, exceptions to the wiring requirements may be submitted for approval, based upon availability of wire to meet the application requirements.

(2) Fillers

Where required to obtain a circular cross-section, fillers shall be made of nonhygroscopic materials compatible with the wire insulation and jacket, and shall be of the same or of a higher temperature rating than the wire insulation.

(3) Tape

A binder tape shall be employed over the assembly of conductors in multi-conductor cables if needed to assist in cable manufacture, or as required to permit the cable to function as intended in its application. The binder tape material shall be non-hygroscopic and shall be of the same (or better) temperature class as the wire insulation, and shall be of a compatible material.

(4) Shield

The shield, if required, shall consist of either tin plated copper braid (concentrically served) or aluminum/polyester tape with a drain wire, as is appropriate for the application. Tape shields shall be permitted for fixed installations only. The shields shall have the following minimum properties:

- a. Copper shield shall be made of either tinned, coated copper strands which conform to ASTM B33, or silver-coated copper strands which conform to ASTM B298, as is appropriate for the wire insulation. Shield coverage shall not be less than 85 percent. Shield strand size and application shall be as recommended by the cable manufacturer for the particular application, but shall not be smaller than AWG No. 38.
- Aluminum/polyester tape shields shall consist of a helical wrap of aluminum/polyester tape with a nominal thickness of 0.0004 inch aluminum on a backing of 0.001 inch polyester. The tape shall have a minimum overlap of 10 percent of the tape width to ensure complete coverage. In contact with the aluminum side of the shielding tape shall be a AWG No. 22 7/30 tinned copper drain wire conforming to ASTM B33 and B174.
(5) Jackets

The overall jacket of Multi-Conductor cables shall be of flame retardant, irradiated, cross-linked, modified polyolefin; Tefzel (ETFE); or Teflon (PTFE) to be fully compatible with the wire insulation and application as approved. The coupler cable shall have a jacket of low temperature arctic grade neoprene per MIL-C-13777, with a wall thickness suitable for 600 VAC. The jacket shall be extruded and vulcanized over the cabled conductors, and shall be centered, with a smooth appearance without objectionable roughness or irregularities, consistent with good industry practice. The nominal jacket thickness for polyolefin, Teflon, Tefzel and Neoprene shall be that shown below, with the minimum wall not less than 80 percent nominal value.

Cable Diameter Under Jacket	Modified Polyolefin	Teflon or Tefzel	Neoprene
0.000-0.250	0.045	0.010	0.072
0.251-0.500	0.045	0.015	0.087
0.501-0.750	0.060	0.021	0.1
0.751-1.000	0.080	0.021	0.1
1.000-1.500	0.080	0.025	0.115
1.501-2.000	0.11	-	0.135
2.001-2.500	0.13	-	0.152
2.501-3.000	0.14	-	0.195

I. Wire Wrap

- (1) Wire wrap connections may be used in selected electronic applications, where approved. Where used, the following standards, as a minimum, shall be followed:
 - a. Only soft or annealed oxygen-free solid copper conductor shall be used.
 - b. Wire size shall be AWG No. 28.
 - c. A silver conductor coating, with a minimum coating thickness of 40 microinches, shall be applied to the wire.

- d. Wire shall have "MIL-ENE" insulation, or approved equal manufactured to MIL-W-81822/1A. The insulation shall have a minimum 300 VAC/VDC voltage rating and shall allow a 275°F maximum conductor temperature.
- (2) Wrapping shall be "modified" wrap, nominal 7-1/2 turns, including 1-1/2 turns for strain-relief.

67 INSULATION SMOKE TEST

A. General

This test method describes the equipment and the procedure for preparing insulated wire samples from which the specific optical density (D_s) of smoke generated can be determined in the Aminco-NBS Smoke Chamber. This method is used for wire sizes up to and including AWG No. 12. For wire sizes above AWG No. 12, the standard procedure outlined in ASTM E662 shall be used.

Equipment calibration, standardization, and operation are to be in accordance with ASTM E662, Standard Test Method for Specific Optical Density of Smoke Generated by Solid Materials. The performance criteria shall be Ds (4.0) </= 200 (flaming) and Ds </= 75 (non-flaming).

- B. Apparatus
- (1) Aminco NBS Smoke Chamber and Recorder.
- (2) Aminco 6 tube, 90 degree burner assembly for flaming mode testing. Burners are all directed in one plane at the sample.
- (3) Notchless wire frame (Aminco AWG No. 20 wire frame with notches machined off).
- (4) Aminco wire specimen holder assembly.
- (5) Air oven.
- (6) Humidification chamber.
- (7) Heavy duty aluminum foil 0.001 ± 0.0005 inch.
- (8) Razor blade.
- (9) Tape measure.
- C. Procedure
- (1) Determine the length of insulated wire required for testing. The individual sample length shall be calculated to produce a sample area of 35 square inches. Calculate the sample length as follows:



- (2) Cut and identify a minimum of three samples of the required length.
- Condition samples prior to testing by pre-drying in an air oven for 24 hours at 140°F ±5°F followed by humidification at 73°F ±5°F, and a relative humidity of 50 percent ±5 percent, for a minimum of 24 hours.
- (4) After conditioning, wind a sample uniformly around the wire frame so that the frame opening is uniformly covered.
- (5) Cover the wire-wrapped frame with aluminum foil across the back, along the edges, and over the front surface's periphery with a single sheet of aluminum foil, with the dull side in contact with the wire.
- (6) Place the foil-wrapped wire in a trough less sample holder such that the wire is vertically oriented. Insert millboard backing, spring, and retaining clip.
- (7) Carefully trim the aluminum foil from the front opening of the sample holder.
- (8) Adjust wire turns, if necessary, to assure that the sample holder opening is uniformly covered.
- (9) Perform smoke testing in accordance with ASTM E662, noting any unusual behavior that occurs during the test; for example, self-ignition of the sample in the non-flaming test mode or any extinguishment of a burner triplet during the test.
- (10) Report the sample orientation, test conditions, results, and observations made during the test.

68 WIRING, TERMINALS, AND CONNECTIONS

- A. General
- All car wiring shall be in conformance with the latest APTA RP-E-002-98,
 "Recommended Practice for Wiring of Passenger Equipment," and the AAR Manual of Standards, Section F S-538, "Wiring Practice and Rolling Stock Standard", except

where otherwise specified, and except that all wire shall be as required in the Scope of Work. Circuit protection shall be in conformance with Chapter 2 of NFPA 70, Article 240.

- (2) All equipment enclosures and junction boxes, except primary power circuits, shall be fitted with terminal boards or connectors. Primary power circuits shall be fitted with compression terminals and knuckle joint connectors as described herein.
- (3) All wire passages into equipment enclosures junction boxes, equipment boxes shall be protected and support to prevent any damage from chaffing and rubbing on surfaces.
- (4) The Contractor shall submit the proposed design and product line for all connections for approval. Terminal boards with M4 or Number 6 or smaller screws and quickdisconnect terminals, other than those stated herein, shall only be permitted with approval by the Engineer.
- B. Wire Handling
- (1) All wiring shall be performed by qualified, experienced wiring personnel using appropriate tools for stripping insulation, cutting, tinning, soldering, harness making, attaching terminals, and other wire fabrication tasks. All wiring tools and equipment shall be used as recommended by the tool and equipment manufacturer.
- (2) Wire shall be protected from damage during all phases of equipment manufacture. Wire shall not be walked on, dragged across sharp or abrasive objects, kinked or twisted, or otherwise mishandled. The ends of wire shall not be permitted to lay on wet floors or other damp areas where moisture may be absorbed into the conductors.
- When removing insulation, wire strands shall not be nicked or broken in excess of the requirements of FAA Specification No. AC 43.13-1A, Section 449, "Stripping Insulation". Additionally, the following criteria apply:

Wire Size	Maximum Number of Nicked Strands*
Wires smaller than No. 10	None
No. 10 through 1/0	7.4 percent
Above 1/0 through 1600/24	4.4 percent
Above 1600/24	graduated scale

(4) * Definitions:

- a. A cutoff strand shall count as two nicked strands.
- b. A nick is defined as 25 percent or more of the strand area damaged, or cut more than 33 percent of its diameter.

Longitudinal scratches in a copper strand are not considered cause for rejection.

- C. Wiring Layout and Installation
- (1) Wire Harness
 - a. The layout of wiring, for both car and equipment, shall be designed in advance of its installation and in cooperation with the suppliers of the related equipment. Wiring shall be pre-fabricated into standard harnesses, wrapped or tied with spiral wrap or tie wraps. Harnesses shall be installed with identical arrangement and location in each car having similar equipment. Separate harnesses shall be provided for major circuit groups or types, or as required for specified circuit separation. All circuits and branches shall be separated by means of terminal boards to isolate portions from others for troubleshooting and searching for undesired grounds. All circuits subject to periodic high potential tests shall be so arranged that they can be conveniently set up for the tests.
 - b. Alternative methods for fabricating and installing wiring, which are standard Contractor practice, shall be considered for approval by the Authority.
 - c. Harnessed wires shall not be installed in conduit. Wires from different conduits or other openings shall not be harnessed together with wires running within the box or entering the box through another entrance point. Each harness or group of wires between equipment enclosures shall contain a minimum of 10 percent spares, but no less than one spare for each wire size whichever is greater.
- (2) Circuit Separation
 - a. Circuits shall be physically separated to reduce the possibility of unsafe conditions, interference, or equipment damage.
 - b. The following major circuit groups shall not be harnessed or bundled together, shall not run in the same conduit, and shall be physically separated and secured in enclosures, wire ducts, junction boxes, or other wire routing devices:
 - (i) High voltage circuits,
 - (ii) AC circuits,
 - (iii) Communication circuits,
 - (iv) Battery voltage level circuits,
 - (v) Semiconductor gating voltage level circuits, and
 - (vi) Conductors carrying in excess of 100 Amperes.

- c. Wires which are connected in circuits with potentials differing by 50 Volts or more shall be separated by a physical barrier. The wires shall not be cabled together and shall not be placed in the same conduit, junction box, or enclosure. Where a raceway, duct, junction box or enclosure is divided into two or more distinct areas by metallic partitions, each area may be considered separately in the application of this rule.
- d. Where it is impossible to avoid having wires at different voltages in the same equipment enclosure, the wires shall be physically separated, bundled, and secured separately such that contact between wiring is not possible. All wiring within an enclosure shall be insulated for the highest voltage in the enclosure, unless approved otherwise. All wiring connected to a piece of apparatus shall be insulated for the highest voltage connected. Wiring connected to transient-generating apparatus, such as unsuppressed contactor coils, shall not be run adjacent to wiring carrying signals to, from, or between semiconductor circuits, logic circuits, vital no-motion circuits, or communication circuits. In cases in which adequate physical separation is impossible, shielded wire shall be used for all conductors involved.
- (3) Wire and Cable Runs
 - a. Wire runs shall be continuous and unbroken between connection points, shall be supported at no greater than 2 foot spacing, and be protected at each support point against mechanical crushing and abrasion. A watertight bushing and drip loop shall be provided on all exposed cable entries. All cable bundles and wires shall be routed a minimum of 1 inch above the bottom of equipment enclosures.
 - All undercar wiring smaller than AWG No. 6 shall be run in closed wire ducts, conduits, or open wire mesh wire ways in an approved by the Authority's Project Manager manner. Wire and cable shall be secured within ducts or open wire ways, including each entrance and exit point, to prevent chafing movement. Wire ducts and conduits shall be of waterproof construction. Permanently retained watertight strain relief bushings, with insulated throat liners, of an approved design, shall be used at locations where wires, cables or harnesses enter or exit conduit, ducts, apparatus and equipment enclosures. In addition, strain relief bushings on equipment enclosures shall include a permanently retained O-ring type seal.
 - c. Lead wires to resiliently-mounted electrical apparatus shall be carried in conduit to a point as close to the apparatus as possible. The length of the leads between the end of the conduit and each piece of apparatus shall be as approved. Short runs of cables or harnesses entering or leaving conduit and apparatus shall have an approved guard mounted to the carbody to protect the wires from mechanical damage. Lead wires to solidly-mounted, electrical apparatus and equipment enclosures shall run in conduit connected to the apparatus or enclosure.

- d. All wiring routed from enclosed areas of the carbody to areas exposed to the elements (including underframe and roof areas) or between interior levels shall be run in ducts or conduit. Wiring, even if enclosed in loom, must not be run through partitions without suitable bushings being provided at such points of passage.
- e. Cables shall be laid in place with sufficient slack at the bends so that cables shall clear the inside bend surface of the wire way/wire duct.
- f. All wire and cable shall be free of kinks, insulation damage, insulation abrasions, and nicked strands. Wire installation shall not be subject to accumulations of water, oil, or other foreign matter.
- g. Wires or cables shall not pass through or over the battery compartment and shall not pass over heat generating equipment such as braking resistors, even if the wires or cables are in conduit.
- Exposed harnesses, short cable runs or harness entering or leaving exposed raceways shall have approved, fire-resistant flexible dielectric sleeving over the raceway edges and grommet-type insulation of any penetration holes. Wiring shall be retained to the sleeving with tie-wraps.
- (4) Cable Cleating and Support
 - a. All cable and wiring exiting wire ways/wire ducts, or that which is not installed in conduit, shall be cleated using split-block cleats of molded neoprene rubber, fabricated plastic or fiberglass with neoprene cushion inserts. In no case shall nylon wire ties be used as the means of supporting the weight of wire bundles and cables. Cables shall be cleated and bushed when passing through bulkheads and structural members. The cushioning material shall be nonconductive, fire retardant insulating material with a durometer of 50 to 60 meeting the requirements of this Section. Each cleat shall have a stiffener of at least 10 gage material on the side away from the mounting bracket which shall act to spread the bolt clamping force over the entire length of the cleat. Bolts shall have lock nuts. The Contractor shall minimize the quantity of different configuration cable cleats.
 - b. AWG No. 6 or larger insulated wire may be cleated in place without conduit, duct or open wire way. However, in the areas over the truck, in the wheel wash and not protected by underfloor-mounted equipment, the wire shall be mechanically protected by an open mesh, expanded metal or other type of approved guard. The guard may be attached to the bottom of each cleat with the cleat clamping bolts or other approved arrangement.
 - c. Cleats shall be designed to grip each cable individually and firmly, but without causing any damage to cable insulation, including cold flow of the insulation.
 Each cable in the cleat shall have its own cutout sized to the correct wire diameter. Cleated cables shall be routed and supported such that they cannot,

under any combination of forces and car movement, touch each other or any other part of the car, except the cleat cushioning material.

- d. Wire and cable runs shall be continuous and unbroken between terminations and shall be supported at not greater than 24 inch intervals in ducts, open wire ways or when cleated. The wire shall be protected at each support point against mechanical crushing and abrasion.
- e. Wire splices shall not be permitted, except with express written approval and in accordance with the wire splicing requirements of this Section.
- f. Concealed wires, such as within conduits and wire ducts, shall be such that wires may be replaced or added to without the removal of other than access panels. It shall not be necessary to disconnect or disassemble conduit to accomplish this task.
- g. Wiring run in loom shall not be carried over a potential chafing hazard. Wires entering any removable box shall be harnessed and secured to facilitate removal of the box.
- All wires and cables shall be fully protected against any contact with any surface other than that designed specifically to support or protect them. This applies to all current carrying wires, cables or buses on the vehicle.
- (5) Wire Securement and Termination
 - a. All wiring shall be secured and protected against movement, chafing, and any contact with conductive, sharp, or abrasive objects including the inside surfaces of wire runs.
 - b. All wiring shall be located and secured such that normal equipment motions, maintenance access, heat sources, and the environment do not damage or reduce the life of the wiring.
 - c. Junction boxes, with terminal boards, shall be used, as required, for wire terminations. Harness connections to the boxes, as well as internal wiring to terminal boards, shall be as specified in this Section. Exterior junction boxes shall be weather tight.
 - d. In cases where it is necessary to anchor wires or cables to metallic parts of the car, cleats or approved stainless steel bottle clamps shall be used. Wires and cables shall not be allowed to chafe or rub against any part of the car or each other under any circumstances.
 - e. Wire and cable dress shall allow for sufficient slack at equipment terminals to provide for movements induced by shock and vibration, equipment shifting, alignment, cover removal and component replacement. Sufficient lengths shall be provided at points of termination for additional reterminations without applying tension to the wire and without splicing the wire, as follows:
 - (i) AWG No. 10 and smaller Three reterminations

- (ii) AWG No. 8 and larger Two reterminations
- f. A drip loop shall be provided on all exposed wires and cables to prevent fluid runoff into connected equipment.
- g. Spare wires, which are part of a wire harness, shall be bundled separately inside of the equipment box to which the harness is being terminated. Spare wires shall have enough length to reach any location within the box, including sufficient slack for the required number of reterminations. The spare wire "break-out" bundle may be ty-wrapped to the main harness, but shall be easily removed from the main harness without disassembling it. The ends of the spare wires shall be insulated against inadvertent contact with any nearby conductive surfaces or terminals.
- h. Wire tying devices shall be of such material and construction that they shall adequately retain the wires for the life of the wiring and shall be resistant to ozone and ultraviolet light. Wire and cable ties shall be trimmed and located to eliminate any hazard to personnel from sharp edges. Wire tying devices shall be snug, but shall not be so tight as to cause indentation and cold flow damage to the insulation. Wire tying devices shall be mechanically fastened to a permanent structure. Adhesive-installed mounting bases shall not be used for ties or for cable support.
- All wire bundles and cables within an enclosure shall be supported by the use of tape rails, shall be spaced away from the equipment box structure, metal edges, bolt heads, and other interference points, and shall have electrical clearance from the covers, regardless of the insulation properties of covers. Wire bundles shall be located above or alongside the apparatus rather than at the bottom of the box wherever possible. In all cases, wire shall be a minimum of 1 inch above the bottom of the box, unless otherwise approved by the Authority. Wire entry into control or junction boxes shall not be permitted through the bottom of the box.
- j. Truck wiring shall be designed to ensure sufficient slack, and shall be provided with clamp supports and abrasion protection. T-splices shall not be permitted.
- k. All jumpers, jumper heads, and jumper receptacles shall be sealed in an approved manner to prevent the entry of water at any operational speed of the car.
- I. Any wiring needed to calibrate and test car functions shall be a part of the permanent car wiring to enable the Authority to conveniently maintain the equipment. This wiring shall terminate in approved connectors in the respective control groups and cabinets.
- m. The Authority desires to have wiring and cabling readily accessible for inspection and maintenance. Extensive wiring and cabling in the vehicle interior is contrary to accessibility, even though access panels, false floors, and other portals may be provided. To control this, the Contractor shall submit a complete wiring plan for approval by the Engineer.

- n. Wire and cables that are subject to high currents in fault conditions or normal operation must be secured against secondary damage due to the high magnetic forces that are developed. Propulsion inverter circuits are a typical example. This includes damage to bus bars or devices to which the cables terminate.
- D. Circuit Shielding
- (1) Wire shields used in trainline circuits shall be continuous up to the car's electrical coupler contacts, including contacts of the jumper cable connector at the intermediate couplers. The wire shields shall be connected through all applicable connectors and junction boxes. Circuits shall be categorized. Shields contained in one circuit category shall not be interconnected with shields contained in another category. Shields used to protect against interference shall not carry signal current.
- (2) Shields on low-level signal wires shall not be interconnected with shields on high-level signal wires in the same category. Each group of shields (other than at the electric couplers, including the jumper cable connectors at the intermediate coupler) shall be carried through on a connector pin or pins, or on terminal strips which shall be in the immediate proximity of the categorized group of circuits. Loops due to interconnections of shields shall not be permitted.
- (3) Coaxial cables used as constant impedance transmission lines shall be terminated as dictated by the circuit termination design and shall not be considered to be shielded conductors. Triaxial cables may be used as coaxial impedance transmission lines with the outer conductor employed as an RF shield.
- (4) The following three items shall be considered as guidelines and are not absolute requirements:
 - a. Shields used to suppress electromagnetic interference (EMI) at all frequencies shall be terminated only at the low potential side of the interference circuit, at the termination which exhibits maximum susceptibility.
 - b. Shields used to protect against the effect of, or to exclude, EMI at frequencies below 150 kHz, shall be terminated either to the low potential side or at the balance point of the protected circuit at the termination which exhibits maximum susceptibility.
 - c. Cables requiring both audio frequency (AF) and radio frequency (RF) shields shall be electrically isolated from each other. The resistance between these circuits shall be at least 500 megaohms when 500 VDC is applied. Double shielding shall be required on circuits that are both AF-susceptible and RFsusceptible.
- E. Marking and Designation
- (1) The Contractor shall devise, and submit for approval, a wire and terminal marking and designation system that shall coordinate all electrical circuits in the car into a unified

system. The system shall identify all wiring, including circuit return wiring, and terminals according to their respective circuit functions and shall accurately correlate these designations with the car schematic diagrams. Each circuit shall be individually designated from point to point. Common designations for return circuits are not permitted.

- (2) Each wire and cable shall have printed on the outer surface, the manufacturer's identification, conductor size, temperature rating, and voltage rating. For wire size 1/0 and larger, stranding shall be given in addition to the other parameters.
- (3) Except for spares, TFE Teflon insulated wires and wires entirely within an equipment enclosure, each wire #8 AWG and smaller shall be permanently and legibly marked along its entire length. Wires larger than #8 AWG and TFE Teflon insulated wires may have wire markers applied at each end of the wire. Blank spaces between markings shall measure approximately 1.5 inches. Spare wires and wiring entirely within an equipment enclosure may have a single wire marker at each end, subject to approval by the Authority in lieu of continuous marking. Wires shall be marked with their alpha-numeric circuit designation. A circuit designation shall change only when it goes through an active or passive component such as a relay coil or relay contact, fuse or circuit breakers, lamp, motor or resistor. A circuit designation shall remain unchanged when it goes through a terminal strip or junction box stud regardless of how many wires of that circuit are common to that point. There shall be no duplication of wire codes in unrelated circuits throughout the car. Where there are more than one of a particular assembly per car, each assembly shall be wired identically to the others and wire marking of harnesses shall be identical in each assembly.
- (4) For pre-manufactured Multi-Conductor cables and for cases where individual circuit identification markers may be approved, the following requirements apply:
- (5) All wires and terminals shall be clearly identified. Wires attached to terminal studs shall also have a marker indicating the terminal stud to which it is attached.
- (6) Identification of wires and terminals shall be by white or yellow permanent markers, with black printing or by continuous wire marking printed on the wire. All wires shall be marked 6 inches from of the end of the wire (both ends) and every 24 inches over the remainder of the wire. Wire markers shall be stamped in two places, approximately 180 degrees apart, to facilitate readability of the marking. Wires in multiple-conductor cables shall be color-coded.
- (7) Wire markers shall meet the adherence and solvent resistance requirements as specified by MIL-M-81531 Sections 3.4.2 and 3.4.3, latest revision, and shall withstand all combinations of ambient and equipment temperatures. Hand printing is prohibited.
- (8) For cable identification, the Contractor shall use a basic identification system in conformance with ANSI/IEEE 200 and shall submit the system selected for review by the Engineer.

F. Pulling Compound

Pulling compound shall be non-conductive, non-hygroscopic, non-odorous, shall not support bacterial activity, and shall not attract vermin.

G. Solder

Solder shall be in accordance with ASTM B32, Grade Sn60. A flux of non-corrosive type shall be applied immediately before soldering.

H. Tape

Electrical tape shall be in accordance with AAR Standard S-540 of Section F of the AAR Manual Standards and Recommended Practices, or equivalent approved railway practice. Electrical tape shall meet or exceed the voltage rating of wire where the tape is applied.

- I. Terminal Boards and Terminal Points
- (1) Electrical terminal points and terminal boards shall have brass studs and connections, each of which shall be locked using a single brass nut with brass flat washer and a plated spring-type lock washer. Studs, nuts, and washers may also be made of corrosion-resistant, plated steel, where approved. Each board or connector shall have the necessary number of terminations plus a minimum of 10 percent spares, but not less than one spare unless approved. Binding head, screw type terminal boards shall be permitted only where approved. Terminal boards of this type shall be in accordance with Military Specification MIL-T-55164A.
- (2) Threaded studs shall have a minimum of 2-1/2 threads exposed beyond the final nuts. Adequate space shall be provided to permit connecting wire terminals with standard tools. All terminals shall be properly torqued to assure sound connections. Spacers shall not be used.
- (3) A maximum of two terminals shall be connected to any one binding screw. A maximum of four terminals shall be connected to any one threaded stud, provided that there is no interference between terminal barrels. On terminal boards, the wiring shall be arranged so that no more than two terminals are connected to a stud, from each side of the terminal boards.
- (4) Molded case, modular terminal blocks which utilize a spring clamp to hold the wire may be used for low voltage circuits. Each terminal block shall be properly identified with a permanent marking and each assembly shall be secured to the mounting (DIN) rail by end clamps which incorporate metallic hardware. All wires AWG 12 and smaller shall receive a ferrule. Plug-in style (split) terminal blocks will only be permitted if, as part of the design, these plugs will be used as a connector when performing maintenance, testing or replacement of a Line Replaceable Unit. All molded case, modular terminal blocks are subject to review and approval by the Engineer.
- (5) Jumpers between terminal board points shall be brass or plated steel. Wire jumpers between adjacent terminals of terminal boards shall not be permitted.

- (6) An approved permanent marking strip on each terminal board shall be provided and attached adjacent to the wire junction point to identify the wires attached thereto and/or the wires connected to terminal boards shall have the terminal point location printed on the wire.
- J. Wire Terminations
- (1) Terminals and connections used throughout the car shall be the mechanical, solderless, crimp type made by AMP Incorporated or other approved manufacturer with a comprehensive line of terminals, connector pins, and application tools available. All terminals for the same wire size shall be crimped with the same model tool. The Contractor shall minimize the total number of crimping tool types needed for all crimp connections. Terminals fitting wire sizes AWG No. 10-22 shall require no more than three tool models to provide certified crimp connections. The Contractor shall be tested to Military Specification MIL-T-16366F for temperature rise, voltage drop, vibration, current overload, and corrosion. Test results shall be submitted for approval by the Authority's Project Manager on a part by part number basis.
- (2) Terminals and connections shall be attached to the wiring with proper crimping tools and dies as recommended by the manufacturer. The terminals used on conductors of size AWG No. 10 or smaller shall be of the type which securely grips and holds the insulation of the conductor, unless approved. Terminals shall be ring lugs in accordance with Military Standard MS-25036. For components that do not accept ring tongue terminals, appropriate alternate terminations such as ferrules, locking forks or quick disconnects may be used subject to approval by the Engineer. Corrosion protection shall be provided for all base materials.
- (3) Conductors subject to motion relative to the terminal shall be protected by suitable means to prevent breakage of the conductor at or near the terminal. Sufficient slack shall be provided in all wires and cables to prevent breaking or pulling out of bushings and terminals. A maximum of one wire shall be crimped in any one terminal.
- (4) Wherever several wires are connected to terminals of a terminal strip on a device which is removable from the car for maintenance, the wires shall be terminated, with double ring terminations which shall be screwed to an insulating fanning strip which shall serve to keep the terminations in the correct relative locations while removed from the device, unless otherwise approved by the Engineer.
- K. Power Cable Terminations

Power cables shall be terminated with an approved compression terminal. Sufficient cable slack shall be provided to preclude breaking or pull-out from bushings or terminals and to allow two terminal changes. Cable conductors shall be clean prior to installation of terminals. Compression terminals shall be applied using tools and procedures recommended by the terminal manufacturer for that purpose. Swaging tools shall be of a type that ensures complete swaging in every case.

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L. Cable Connectors

- (1) All cable connectors shall conform to MIL-C-5015, or an equivalent standard as approved by the Authority. They shall employ removable crimp contacts of the correct size for the wire being terminated. Except as noted below, the connector contact area shall be plated with a minimum of 0.000030 inch of gold over a minimum of 0.000050 inch of low stress nickel. For high current applications, the connector contact area shall be plated with a minimum of 0.00010 inch of silver. Adjacent contact area shall be plated with a minimum of 0.00010 inch of silver. Adjacent connectors shall either use different inserts or different insert orientations to prevent erroneous connections. The receptacle half of all cable connectors shall be rigidly mounted.
- (2) All cable connectors used in exterior locations shall be of the environmental watertight variety. Cable connectors shall be equipped with sealing gaskets on the front mating surface and on the back where the cable enters. The cable jacket shall be held by a clamp within the connector body. Unused connector pin positions shall be sealed with either connector contacts or plastic sealing plugs designed for that purpose.
- (3) Plastic bodied connectors shall not be used in exterior locations. Quarter turn, bayonet-lock, quick-disconnect type connectors shall not be used on trainline jumper cables.
- (4) Except as specified above all cable connectors in exterior locations, shall be quarter turn, bayonet-lock, quick disconnect type CIR connectors as made by Litton-Veam SPA, or approved equal. Quarter turn, bayonet-lock connectors shall conform to all provisions in MIL-C-5015, or an approved standard, except for the screw coupling requirement.
- (5) Connectors in high vibration or high motion areas, such as speed sensors and trainline jumpers, shall have the wire connections soldered and potted and shall have a watertight jacket molded over the cable and connector to form a unitized assembly. Trainline jumper connectors used shall be as made by Pyle-National, or approved equal. The Contractor shall conduct an approved vibration test on these unitized assemblies.
- (6) Non-metallic body, non-environmentally sealed connectors are limited for use on non-vital, interior applications, such as lighting and speaker connections. These connectors must be threaded or include a positive locking mechanism. All such connectors must include a suitable means of strain relief for the wires. If a springclamp is used to terminate the wire within the connector body, a properly sized ferrule must be applied to the wire. The receptacle half of each connector assembly shall be rigidly mounted. Proposed connectors shall have a minimum of 2 years of successful service in similar applications and are subject to approval by the Engineer.
- M. Quick-Disconnect Terminals

Approved quick-disconnect terminals must be used to facilitate maintenance and inspection, WAGO or approved equal. The terminals must provide positive terminal engagement and be shock and vibration proof. All terminals shall be provided with insulation equal to that of the wire. No "Push-to-fit" (FASTON) type terminals shall be permitted unless specifically approved by the Engineer.

- N. Grounding Return Connections
- (1) Grounding
 - a. Grounding connections to the carbody and equipment shall be made through copper pads of an adequate area, silver soldered or brazed. Alternative ground pad material may be permitted in certain cases as approved by the Authority. Transition (base) plates if used, shall be made from the same alloy group as the respective carbody and piece of equipment. The base plate shall be welded to the carbody or equipment. Grounding connections shall not be made to aluminum alloy members. All ground pads shall be visible and accessible for inspection and troubleshooting. The ground connections shall be attached by a bolt, washer, and nut designed for the purpose. An anticorrosive grease shall be applied over the connection.
 - b. All equipment enclosures and shock-mounted equipment, except the operator cab lights, shall be grounded with flexible, grounding leads bolted between a carbody grounding pad and the equipment's grounding pad. Braided, straptype leads shall be used where there is relative motion between the two items being connected. The ground strap termination method shall apply uniform pressure to the conductive surface and the current density shall not exceed the bonding requirements of this Section.
 - c. The Contractor shall design a complete grounding scheme, which shall indicate the means by which it is proposed to prevent currents from passing through journal and truck-center bearings. Refer to other sections of the Scope of Work for ground brush and related requirements. Low voltage and high voltage circuits shall not be grounded to the same ground.
- (2) Bonding

All grounding and bonding jumpers and straps shall be sized to handle fault current and lightning discharge current, for which the voltage drop shall not exceed 25 Volts. The bonding method employed shall not produce a DC resistance in excess of 0.0025 Ohms, or more than 0.025 Ohms at 150 kHz for any applied AC voltage. Grounding and bonding jumpers, and brazed shunt straps shall be "extra-flexible".

(3) Wire Splicing

Splicing of conductors shall be avoided and shall be permitted only with approval on a case-by-case basis by the Authority. Splicing of conductors in conduit shall not be permitted. In the event a splice is approved, it shall be in a junction box and the spliced joint shall be mechanically as strong and have the same conductivity as any other part

of the conductor. The splice shall be an insulated permanent crimp splice in accordance with Military Specification MIL-T-7928G, Type II, Class I, and shall be installed with the crimping tool and die of the splice manufacturer. All splices shall be insulated with a self-sealing, weather-tight, seamless shrink tubing. The outside diameter of the spliced portion of the cable after the insulation is applied shall not exceed the outside diameter of the unspliced portion by more than 40 percent. Splices shall be identified in the integrated schematic.

69 WIREWAYS, CONDUIT, JUNCTION BOXES AND FITTINGS

A. General

The conduit, conduit fittings, and junction boxes for car wiring shall be as manufactured by the Contractor or by a supplier of a comprehensive line of parts. The Contractor shall submit the proposed product line for approval by the Engineer. All conduit fittings and junction boxes shall be provided with gasketed covers as described in this Section. All conduits and their connections to electrical equipment shall be installed to make a continuous ground.

B. Conduit Types

- (1) All conduit and conduit couplings shall be of an ANSI-approved type. All conduits shall be standard weight, galvanized steel with threaded fittings. All conduit ends shall be deburred inside and out to remove sharp edges and all pieces shall be blown out with compressed air and cleaned before installation to remove filings and other foreign material.
- (2) Steel conduit shall be mild steel in standard lengths with threaded ends and hotdipped zinc-coated exterior and interior surfaces. It shall be free of burrs and projections, circular in cross-section, of uniform wall thickness and shall conform to the requirements of ANSI Standard C-80.1. The threads per inch and length of threading shall conform to ANSI Standard B-2.1 on Pipe Threads.
- (3) Steel fittings shall be used to assemble steel conduit. Elbows, nipples, and couplings shall be made of the same grade of steel as that employed in the conduit. All fittings shall be treated, coated, and threaded according to the requirements for zinc-coated, rigid steel conduit and shall conform to UL 6.
- (4) Thin-walled, Electrical Metallic Tubing (EMT) or aluminum conduit shall be permitted for interior use only. All applications of such conduits shall utilize compression-style connectors and couplings.
- (5) Flexible conduit, if used, shall be watertight and interlocking aluminum such as
 Anaconda seal tite or steel strip-protected, with an approved rust resistive coating.
 Flexible covering on conduit shall not contain polyurethane or PVC vinyl.
- (6) Liquid tight flexible nonmetallic conduit, if required for special applications, may be used with the Authority's approval. Liquid tight flexible nonmetallic conduit shall not be used where subject to physical damage or in lengths longer than 6 feet.

- (7) Conduit shall be color-coded: red for those carrying circuits above 100 Volts and yellow for under 100 Volts.
- C. Junction Boxes

All exterior junction boxes shall be fabricated of minimum 14 gauge steel or aluminum. All exterior junction boxes shall be weatherproof and shall be connected in such a way that drainage from equipment groups shall not pass through conduit into the junction boxes. Interiors of all junction boxes shall be primed and then protected with a white, insulating coating.

D. Covers

All junction box covers shall be dust proof, retained by compressive spring-type latches, or captive screws as approved on a location-by-location basis. All fasteners used in junction boxes shall be stainless steel. All covers shall be designed to accept or mate with a bulb-type clamp-on seal.

- E. Wireways
- (1) Wireways shall be permitted in approved exterior and ceiling locations only. They shall not be permitted in the carbody sidewall area. Only conduit shall be permitted in the carbody.
- (2) All wireways shall be of rigid, stainless steel construction. Wireways shall be color-coded; red for those carrying circuits above 100 Volts and yellow for fewer than 100 Volts. The trays shall be adequately supported throughout their entire length in an approved manner. The trays shall be completely de-burred, leaving absolutely no sharp edges, before installation on the vehicles. Grommet clamps shall be provided at all locations where cables or wires enter or leave the wireways. Under no circumstances shall leads be draped over the edge of the wireways, with or without wireway edge protection. Heads of screws or bolts inside the raceways shall be flush with the metal surface. Metal wireways, elbows, couplings and similar fittings shall be flush with the interior of wireways. Removable wireway covers shall be secured with captive fasteners.
- (3) Wireways shall be designed to prohibit the collection of dirt and debris, and shall be perforated, without compromising their requisite strength, to permit ventilation and drainage. They shall preclude water entrapment.
- F. Conduit Interface

The open ends of conduit shall be provided with strain relief type fittings with extended rubber bushings, bell-mouth fittings, or insulated throat box connections as approved. All conduit entries into removable equipment boxes shall be secured by means of a bolt-on watertight access panel.

G. Size and Fill

- (1) Conductor area, including wire, insulation, and jacket may not exceed 40 percent of the interior cross-sectional area of the conduit unless approved by the Authority, but in no case may exceed 60 percent. Where conduit having a length not exceeding 24 inches without bends of more than 15 degrees is used between enclosures, a maximum fill of 60 percent is permitted.
- (2) Wireways shall not contain more than 30 current-carrying (i.e., power source as opposed to signaling) conductors at any cross-section. Conductor area, including wire, insulation, and jacket shall not exceed 40 percent of the interior cross-sectional area of the wireway unless approved by the Authority, but in no case should exceed 60 percent.
- H. Installation
- (1) Conduit
 - A run of conduit between junction boxes and/or pulling outlets shall not contain more than the equivalent of four quarter bends, 360 degrees total, including the outlet fittings. Bend radii at the inner surface of the bend shall be no less than eight times the nominal inside diameter of the conduit.
 - b. All conduit bends and offsets used shall be made by the use of special forms or tools and shall have the largest radius possible so that wires can be pulled without the use of tackle or power.
 - c. Conduit shall be securely clamped with all runs electrically grounded to make a continuous ground. Conduit installation shall not create situations of dissimilar metals.
 - d. All conduit shall be arranged to prevent moisture traps and shall drain toward control boxes, except that all open-ended conduits shall be installed in such a manner as to ensure gravity drainage out the end. The conduit arrangement and installation shall be subject to approval by the Engineer.
- I. Wireways
- (1) Wireways shall be located to provide access to the harnesses contained within for maintenance action. They shall be provided with approved covers which may be interrupted wherever desired for entry and exit of wires and cables. Edges of such interruptions shall be completely covered with protective bushings.
- (2) The wireways shall be routed such that they avoid:
 - a. Sources of heat such as propulsion and dynamic brake grid resistors;
 - b. Wheel splash areas; and
 - c. Areas along the vehicle where the trays may be subject to foreign object damage.

- (3) Metal raceways and the elbows, couplings, and similar fittings shall be electrically and mechanically coupled while protecting wires from abrasion and shall make a continuous ground with the car structure.
- (4) Bends in wireways shall be avoided; however, if they are required, approved protection shall be provided to avoid insulation chafing at the bends.
- (5) All wire and cable shall be securely fastened within wireways to eliminate movement and resultant chafing.

70 FLAMMABILITY AND SMOKE EMISSION REQUIREMENTS

- A. General
- (1) All combustible material used in the construction of the car shall satisfy the flammability, smoke emission, and toxicity requirements of this Section, 49 CFR 238.103, and NFPA 130, latest version. In case of conflict, the most restrictive requirement shall prevail. The Contractor shall comply with all provisions of 49 CFR 238.103 Fire Safety Analysis, and latest APTA RP-PS-005-00, "Fire Safety Analysis of Existing Passenger Rail Equipment" and shall be responsible for up-dating the Authority's existing fire safety analysis to reflect the rebuild work.
- (2) All combustible materials shall be tested at the Authority approved, independent laboratories. Test reports indicating successful compliance with these requirements are required for all materials. Testing must be conducted within the Contract duration period and preferably on a production batch of material. Each laboratory must have tested a standard test sample no greater than 30 days prior to performing the tests which shall be submitted to the Authority. The Contractor shall be responsible for complete conformance with these standards for itself and its subcontractors and suppliers. The Authority may, at its discretion, require that the current batch of material being provided for this contract be retested for conformance with these standards.
- (3) A matrix showing the total weight of all materials, where used, flammability and smoke emission test identity, test facility, test requirements, test results, and nature and quantity of the products of combustion shall be submitted by the Contractor during detailed design review.
- B. Combustible Content

The design of the vehicle shall minimize the total combustible material content of the vehicle. Each combustible material shall be specifically identified by supplier's name and type, use in the vehicle, total weight, and heating value in Btu/lb and Btu/hour. The combustible content data may be included in the combustible material matrix.

- C. Flammability and Smoke Emission
- (1) Materials used in passenger vehicles shall be tested to demonstrate compliance with the requirements set forth in this Section.

- (2) The Contractor shall test the floor assembly in accordance with ASTM E119 to demonstrate a 30-minute endurance rating. The test procedure, test facility, and test results shall be approved by the Authority prior to the Contractor's procurement of any flooring material necessary for vehicle production.
- (3) The test specimen shall be a full width vehicle section including side sills or that portion of the wall which extends below the floor. Specimen shall have a minimum exposed area of 100 square feet. If approved, the exposed area may be reduced to meet a length limitation imposed by the size of the test furnace, but the length shall not be less than 11 feet. No fewer than two typical penetrations, spaced at a distance from each other no greater than that which shall exist in actual construction, shall be included in the test specimen floor splice configurations, any penetrations through the floor including but not limited to ventilation ducts, conduits, etc, and any areas of the floor that are thinner than the standard floor section. The specimen shall include typical floor splice configurations. Test specimen shall be loaded to simulate "crush" passenger loading conditions. The Concentrated loads shall be applied to simulate underfloor equipment. The Test specimen shall include at least three typical transverse supports. The Test specimen shall represent the actual construction utilized in production. This includes the floor covering, floor boards, floor structure, thermal and acoustical insulation, and floor pans.
- (4) The Conditions of acceptance for this test shall be those required for unrestrained assembly.
- D. Toxicity
- (1) Those materials and products generally recognized to have highly toxic products of combustion shall not be used.
- (2) All materials used in the car construction, except for materials used in small parts (such as knobs, rollers, fasteners, clips, grommets, and small electrical parts) that would not contribute significantly to fire propagation or to smoke or toxic gas generation, shall be tested for toxicity using Boeing Specification Support Standard BSS-7239. Materials shall meet the following maximum toxic gas release limits (ppm) as determined per BSS-7239:

Carbon Monoxide (CO)	3500 ppm	
Hydrogen Fluoride (HF)	200 ppm	
Nitrogen Dioxide (NO ₂)	100 ppm	
Hydrogen Chloride (HCL)	500 ppm	
Hydrogen Cyanide (HCN)	150 ppm	

- (3) The tests are to be run in the flaming mode after 240 seconds using the NBS Smoke Density Chamber for sample combustion. The gas sampling may be conducted during the smoke density test. The test report shall indicate the maximum concentration (PPM) for each of the above gases at the specified sampling time.
- E. Electrical Fire Safety

Electrical equipment shall conform to NFPA 130 (latest edition), except where more restrictive requirements are imposed by the Scope of Work.

71 ELECTRICAL DEVICES AND HARDWARE

A. General

All electrical devices shall be rail transit industry-proven.

B. Contactors and Relays

All contactors and relays shall meet or exceed the requirements of MIL-R-6106 and MIL-R-5757 respectively, with the following qualifications:

- (1) Devices shall be tested for proper functioning in orientations up to 30 degrees from the orientation in which they are mounted in the vehicle, in each of the three possible rotations: pitch, yaw, and roll.
- (2) If adequate documentation exists demonstrating that during functional and operational testing of the vehicle the contactors underwent normal duty cycle tests, it shall be considered as an acceptable alternative to a burn-in.
- (3) In selected applications, contactors and relays shall comply with the requirements of MIL-R-6106 (for ratings of 10 Amperes or greater) and MIL-R-5757 (for ratings of less than 10 A) but need not be qualified to these documents if all of the following requirements are met:
 - a. The device is service proven in the exact same application.
 - b. The device is service proven in transit service.
 - c. All other requirements of the Scope of Work are met.
 - d. The Authority approves of this application.
- (4) All devices shall be constructed and utilized in a fail-safe manner; that is, all failures shall be in a direction so that neither the passengers, the crew nor the equipment are placed in jeopardy.
- (5) All devices shall be installed so that they are fully accessible for inspection, repair-inplace, or removal and replacement. All contactor terminals shall be fully accessible for

trouble shooting purposes. Contactors and relays shall incorporate means of visually determining whether they are picked up or dropped out. Relays on printed circuit boards or within electronic assemblies may be exempted from the requirement for a visual indication, as approved by the Engineer.

- (6) There shall be a maximum of two wire terminations on any one contact of the device.
- (7) The coils of all devices shall be suppressed to protect the low-voltage network from generated transients.
- (8) Under no circumstances shall either the main or auxiliary contact tips of the devices be placed in parallel for the purpose of carrying a current load at or above the manufacturer's contact tip rating.
- (9) Contact tip ratings shall be stated for the worst condition of reduced surface contact which may result from tip misalignment during normal operation of the device.
- (10) Contactor installation shall be such that the arc spray is directed by an arc chute away from ground and any other electrical devices proximate to the contactor.
- (11) Devices shall be constructed in a very heavy-duty fashion suitable for use in railroad service. The Authority reserves the right to review and approve the design and selection of all contactors and relays.
- (12) Contactor tip replacement shall not exceed 10 percent of the total number of tips at 90 day intervals.
- (13) All contactors shall be constructed so that the main contact tips make and break with a motion (wipe) that prevents deposits and pitting.
- (14) All DC contactors shall be built with series-fed blowout coils. The Contractor shall demonstrate the ability of each contactor type to reliably interrupt current over the full design operating range.
- (15) All devices shall be readily identifiable by means of a permanent, durable marking strip giving the device circuit designation. No identifications shall be obscured, or partially obscured, by wire routing. The identification strip shall be mounted adjacent to the mounting of said device.
- (16) Bifurcated contacts shall be used in low voltage applications, whenever necessary due to dry contacts or low current switching requirements.
- (17) All time delay relays shall be of the R-C delay or solid state type. No mechanical or pneumatic time delay devices shall be permitted.
- (18) Where plug-in relays are approved, the relay shall be positively retained by means of a retaining clip or bar. This device shall be captive, of rugged construction and shall be easily positioned for relay installation and removal without the need for special tools. When the relay is removed, the retainer shall itself be retained so that it cannot come

in contact with devices which may have exposed energized electrical circuits, and it shall not interfere with the operation of any other device when in this position.

- (19) Adequate gap and creepage distances shall be maintained from high voltage contactor tips and low voltage coil and auxiliary contacts to prevent entry of high voltage arcs or transients into the low voltage circuits. The same applies to grounded mounting surfaces.
- (20) Relays shall not be affected by the accumulation of airborne dust.
- C. Switches
- (1) Under no circumstances shall poles of switches be placed in parallel in order to carry currents in excess of the contact pole rating given by the manufacturer.
- (2) Switches shall be provided with a "keying" feature so that after installation, the body of the switch is constrained from mechanical rotation.
- (3) All switches provided shall be of the highest quality procurable and shall be fully suitable for the rigors of the Authority's service environment. All control switches which are subject to water splash, which is defined to mean any switches mounted near windows or doors, or mounted on the Train Operator's control console, shall be environmentally sealed. Toggle and push button switches shall be per MIL-S-3950, MIL-S-8805, MIL-S-83731, or equal. All safety-critical switches, such as those that can cause door openings, shall be designed to withstand a high potential test of 1,500 Volts for 1 second, in a clean, dry condition, without false conduction. The design and selection of all switches shall be subject to review and approval.
- (4) There shall be a maximum of two wires connected to each terminal of the device.
- (5) Switches shall be individually replaceable without disconnecting or removing anything other than the mounting fasteners and electrical connections of the switch to be replaced.
- (6) In addition to the above requirements, all switches and pushbuttons shall meet the following requirements:
 - a. Contact resistance shall be less than 0.1 Ohm at 3 VDC and a 10 milliampere load.
 - b. Open circuit resistance shall be 50 mega Ohms minimum.
 - c. Resistance to case shall be 1000 mega Ohms minimum at 500 VDC.
- D. Circuit Breakers, General
- (1) All circuit breakers provided shall be extremely rugged and fully suitable for the service intended.
- (2) They shall be of the highest quality procurable. Design and selection of all circuit breakers shall be subject to review and approval by the Engineer.

- (3) All circuit breakers of the same rating shall be of the same manufacture and model throughout the vehicle.
- (4) The "ON", "OFF", and "TRIPPED" positions of all circuit breakers shall be permanently marked on the handle or the case of the circuit breaker. The circuit breaker, when tripped, shall assume a distinct position between the "ON" and "OFF" positions to permit determination of the fact that it has been tripped by either its over-current or shunt trip elements. All circuit breakers shall be mounted in the vertical direction with the "ON" position up.
- (5) Circuit breakers shall be individually replaceable without disconnecting or removing anything other than the mounting fasteners and electrical connections of the breaker to be replaced.
- (6) Electrical connections to circuit breakers shall either be threaded to accept machine screws or use a threaded stud. Wires to circuit breakers shall use ring terminals.
- (7) Circuit breaker terminals shall not be used as junction points.
- (8) Each and every input power circuit shall be protected by an individual circuit breaker. Separate circuit breakers shall be provided for major assemblies or functions. No circuit breaker shall protect more than one circuit, nor shall any one circuit be protected by more than one circuit breaker.
- (9) All circuit breakers shall be sized by current rating and tripping time to protect both the associated equipment and the minimum size wire used for power distribution within the protected circuit without causing nuisance tripping.
- (10) High voltage circuit breaker poles may be connected in series if necessary to achieve the stated voltage interruption requirements.
- (11) Each circuit breaker pole shall be equipped with adequate means of arc extinction to prevent flashover.
- (12) The continuous current rating of thermal-magnetic trip circuit breakers shall be selected in accordance with ANSI C37.16 for the load and type of service specified.
- (13) All thermal-magnetic trip circuit breakers shall conform to the requirements of ANSI C37.13 and ANSI C37.14.
- (14) Circuit breaker current rating shall be clearly and permanently marked and shall be completely visible after installation.
- (15) Electrically operated circuit breakers shall be arranged for operation from the low voltage dc supply.
- E. High-Voltage Circuit Breakers
- (1) All high voltage circuit breakers shall be devices with not less than 3 poles connected in series.

- (2) All distribution-type, high voltage circuit breakers shall be Westinghouse Series C, FDB frame, Heinemann type GH, or approved equal.
- (3) The trip elements shall be thermal-magnetic, or magnetic, connected in series.
- (4) The circuit breaker handle shall protrude from the circuit breaker panel cover sufficiently to be manipulated in all positions.
- F. Low-Voltage Circuit Breakers

Low voltage circuit breakers shall be either one-pole or two-pole devices depending on the intended function. Trip elements shall be thermal-magnetic, or magnetic, as is appropriate for the application.

All low voltage circuit breakers shall be:

- (1) General Use Westinghouse Series C, Quicklag C frame, Heinemann Series AM or approved equal, front connection or approved access arrangement, and approved labeling.
- (2) Fast Operation Airpax type IMLK, dust sealed, magnetic breaker, or Airpax type UP, hermetically sealed, magnetic breaker, or an approved equal.
- G. Fuses
- Fuses shall be used only where specifically called for in the Scope of Work or where the use of circuit breakers is not technically feasible, and only with specific approval. Fuses may be considered in applications as follows:
- (2) To protect solid state equipment from catastrophic damage, and
- (3) Where current or voltage levels prohibit circuit breakers.
- (4) Fuses shall be permanently identified adjacent to the fuse. The rating of each fuse shall be permanently and clearly marked directly on each fuse.
- (5) Fuses shall be readily accessible. All fuses mounted in exterior equipment boxes shall be accessible without going under the vehicle.
- (6) Fuse holders shall contain fuse retention devices at both ends.
- (7) Air gap and creepage distances shall be as approved. Fuses used in nominal 600 VDC circuits shall be rated for no less than 1,000 VDC.
- (8) High voltage fuses shall be mounted in totally enclosed, dead front fuseholders, with no exposed high voltage connections. The fuse shall be extracted from the circuit when the fuse holder is opened and the exposed fuse shall be safely isolated from any circuit connection.
- (9) Where circuits use multiple fuses or fuses and circuit breakers, the coordination between the protective devices shall be discussed in design review.

H. Bus Bars

- Bus bars are to be fabricated from OFE (Oxygen Free Electronic CDA C10100) or ETP (Electrolytic Tough Pitch CDA C11000) copper. The bus bar conductivity shall be 100 percent IACS. All bus bar joints shall be silver or tin plated.
- (2) Current densities, other than at joints, shall not exceed 1,000 Ampere per square inch, and in any case shall not exceed a value which would cause a bus bar temperature rise greater than 96°F. Current densities in joints shall not exceed 150 Ampere per square inch.
- (3) Bus bars shall be properly brazed together at joints unless bolted connections are found to be absolutely necessary for maintenance purposes and are approved. The overlap at bus bar joints shall be no less than 10 times the thickness of the bus material. Bus bar connection bolts shall be torqued to obtain a uniform bus bar connection pressure of 200 psi. Bolting hardware shall be plated steel with belleville washers to maintain connection pressure.
- Except for connection areas, bus bars shall be safety-insulated, using a high-dielectric powder coating, heat shrink tubing or other approved means. Tape is not acceptable.
 Bus bars that are behind insulating panels are exempt from this requirement.
- I. Capacitors and Resistors
- (1) Hermetically sealed, dry tantalum capacitors, in metal cases, shall be used in place of aluminum electrolytics, except for very high values which are not commercially practical or available, in which case long life grade aluminum electrolytics shall be used.
- Commutating capacitors shall be a paper or plastic film type, shall incorporate a non-toxic impregnant, and shall be chosen to give a service life of at least twenty years.
 Filter capacitors shall have high ripple current rating for long life.
- (3) Capacitors shall be derated 20 percent for voltage based on the nominal supply voltage and maximum case temperature. If filter capacitors are exposed to low ripple voltages, lesser values of derating may be accepted if it can be shown that reduced operating temperatures can be achieved due to lower dissipation; however, the sum of the DC and AC ripple voltages shall always be less than the capacitor's voltage rating at a maximum case temperature of 185°F.
- (4) Except for braking power resistors, all resistors shall be derated 50 percent for power dissipation. Other power resistor applications may be submitted for approval of lower derating, on a case-by-case basis.
- J. Transformers and Inductors

Transformers and inductors shall be derated 10 percent for current. Transformers must meet the following requirements:

- (1) Have vacuum-impregnated windings.
- (2) Be rated to withstand at least twice the maximum peak-to-peak voltage that they shall be subjected to in operation.
- (3) Not emit audible noise in excess of 60 dB referenced to 20 micropascals at a distance of 2 feet while operating at rated voltage and load.
- (4) Be designed to minimize radiated and induced EMI.
- (5) Have location, orientation, mounting, cable connections and cable routing in accordance to the overall EMI/EMC control plan for the vehicle.
- K. Switch, Circuit Breaker, and Fuse Panels
- (1) All switch, circuit breaker and fuse panels shall be dead front types mounted in the specified equipment enclosures.
- (2) Each switch and circuit breaker panel shall carry the necessary apparatus, arranged to be easily accessible to connections and designed to prevent operating or maintenance personnel from coming in contact with live parts when operating the switches or circuit breakers. Furthermore, all live portions of the protected circuitry shall be completely concealed so that no danger of electrocution or shock exists from the touching of the panel or any appurtenances or devices mounted thereto.
- (3) All switches, breakers, fuses, and indicating lights shall be provided with a nameplate of raised or recessed lettering on the dead front, clearly identifying the circuit which each controls and its circuit designation. The dead front panel shall conform to NFPA 70, Article 384. The dead fronts shall be made of moisture-proof, electrically insulating, laminated phenolic or fiberglass, of approved quality suitable for switchboards. Asbestos shall not be used.
- (4) A wiring gutter shall be provided along the top, sides, and bottom, for the routing of high voltage leads to their designated circuit breakers.
- (5) The panel shall be secured by approved, captive fasteners and shall be configured for easy removal so that maintenance and repair action is not impeded.
- (6) Power distribution to circuit breakers and switches shall be from a bus bar or bus circuit. Distributing power by successive or "daisy-chained" connections between device terminals shall not be permitted.
- L. Battery Backup Circuits

Backup batteries are not permitted, unless specifically approved by the Engineer.

72 ELECTRICAL AND ELECTRONIC DESIGNS

A. General

Except as otherwise noted herein, electronic equipment shall conform to IEC 60571, Electronic Equipment Used on Rail Vehicles, Class TX, unless otherwise approved by the Authority.

- B. Reliability Standards
- (1) A standardized MIL-HDBK-217F reliability part stress prediction shall be performed on all electrical and electronic control systems. This reliability prediction shall be based on the "ground Mobile" environment. Use of alternative reliability database information may be permitted for parts not contained in MIL-HDBK-217F, subject to the Authority approval. Submittal of the reliability prediction shall be identified in the Reliability Program Plan. The prediction shall be used during design and development to compare competing designs, perform design tradeoffs, detect overstressed parts and identify high failure rate items.
- (2) A documented closed-looped Failure Reporting and Corrective Action System (FRACAS) (per Reliability Toolkit: Commercial Practices Edition) shall be established and maintained to provide for the identification, tracking, and repair of all product/process failures. Early elimination of failure causes or trends shall contribute significantly to reliability growth and continuous process improvement.
- (3) All semiconductor devices shall be derated to operate within the acceptable region for electrical and temperature stress as specified in "Reliability Toolkit: Commercial Practices Edition". If there is a conflict between guidelines given elsewhere in the Scope of Work and the Reliability Toolkit, the more restrictive condition shall govern. Other service-proven devices may be submitted for approval.
- All electronic assemblies shall undergo Environmental Stress Screening (ESS). The (4) temperature cycling regimen shall be in accordance with table 7.5-2, unit column, of the Reliability Design Toolkit: Commercial Practices Edition, from the Reliability Analysis center, except as indicated below. The temperature extremes may be limited to -13° F to + 158°F, at the discretion of the supplier. A minimum of 20 complete temperature cycles shall be conducted. The ESS shall be performed with the equipment operational, powered, and oriented as per the ultimate application. Input signals and output loads to simulate the maximum power dissipating condition in the equipment shall be applied during the rising temperature and maximum temperature portions of the temperature cycle. The equipment shall be given a full functional test before and after the ESS, and monitored for failure throughout the ESS. In the event of equipment failure, the repaired equipment shall be given another complete ESS test. Alternatives to this baseline ESS may be acceptable at the discretion of the Authority. Assemblies consisting exclusively of components rated at 50Amperes or greater are exempt from this requirement.
- C. Ability to Repair
- (1) All electrical assemblies, where practical, including such items as PC boards, shall be designed for repair by the Authority, in their electronics workshop.

(2) Assemblies shall not be sealed, potted, or constructed to prohibit repair by the Authority. Assemblies that must be potted or sealed by design shall have a minimum ten year warranty.

D. Hardware

Refer to this Section for general hardware requirements. All hardware associated with electronic and electrical control systems shall be protected against moisture, oxidation, and common airborne contaminants. Hinges and latches shall be of stainless steel.

- E. Enclosures/Racks
- (1) All circuit boards that are rack-mounted shall plug into racks containing the mating half of the circuit board connector. The circuit board rack shall mount in an enclosure conforming to requirements in this document. The rack, circuit board, and circuit board hardware shall be designed as an integrated system.
- (2) The rack and enclosure shall provide environmental and EMI shielding as required to meet the requirements of this document.
- (3) Printed circuit boards shall be positively retained by means of keeper bars or other approved method. The enclosure or rack cover shall not be used to retain the circuit boards, unless specifically designed to do so.
- (4) Each circuit board shall be fitted with an ejector or hand grip to assist in board removal. The rack and the edge of each board, or the card ejector, shall be labeled with corresponding numbers to identify board location within the enclosure. A brief functional designation shall also be included on each label.
- (5) The enclosure/rack shall not be connected to the power supply return or signal circuit, unless approved by the Engineer.
- (6) Where it is necessary to use printed circuit boards that are not plug-in and not mounted in an enclosure, the following additional requirements apply:
 - a. The PC board must be protected from mechanical damage and hostile environments such as arc discharge or contact with high voltage.
 - b. If the PC board is part of a high voltage circuit, special caution shall be used in its design with regard to strike distance and creepage in the transit vehicle environment. This includes between PC board components and with respect to any grounded mounting surfaces.
 - c. Any test points required in routine testing or fault isolation to the user replaceable level shall be easily accessible with no disassembly or tools.
 - d. If replacement of the PC board is required (as part of secondary maintenance), no special tools or soldering shall be required.
- (7) Each PC board use and application of this type is subject to approval by the Engineer.

F. Optical Fibers

Any application of optical fibers shall be approved by the Authority's Project Manager prior to implementation. This approval is not intended to discourage the use of optical fibers. Rather, it is to verify reliability and maintainability of the proposed application. In no case shall the on-car repair of an optical fiber require sophisticated or complex polishing and alignment. The connections between optical fibers and car-replaceable units shall be via approved "quick disconnects".

73 MICROPROCESSOR BASED SYSTEMS

- A. General
- (1) Microprocessor based control systems shall be based on an established family of microprocessors in wide use in the control system industry. They shall be supported by a full range of software development languages and diagnostic programs similar to those available for the Motorola or Intel family of devices.
- (2) Program code and fixed data shall be stored in PROM's or EPROM's. Either static or dynamic RAM or EEPROM may be used for temporary data storage. All EPROM windows shall be covered with labels that are opaque at the UV erasing wavelengths.
- (3) Battery-backed RAM shall be used only to store fault information. Batteries shall be sized to retain data for at least six months without charging and shall be located such that leakage cannot damage any control system components. Battery life shall be no less than five years, regardless of type. All batteries must be approved by the Engineer.
- (4) At least 50 percent additional memory space shall be installed and available for future modifications to program code, fixed data space, and temporary data space.
- (5) Flash memory may be proposed for the Engineer's approval.
- B. Isolation and Interfacing
- (1) The control system shall be powered by dedicated transformer-isolated power supplies driven from the vehicle battery circuit.
- All control system input and output signals shall be through isolation buffers. High voltage inputs and outputs shall be isolated external to the microcomputer card rack. Low voltage (battery and logic voltage level) inputs and outputs shall be isolated via buffer cards in or external to the microcomputer card rack. The isolation buffers shall:
 - a. Protect and isolate the control system from damage due to overvoltage, undervoltage, transients, shorts, and opens.
 - b. Perform necessary voltage translations.
 - c. Remove noise and undesired signals.

- (3) Limit or otherwise pre-process those signals that would otherwise require excessive processor time.
- (4) Consist of optical isolators, transformer isolators, and other circuits appropriate to the application.
- C. Software

Software shall perform the following basic functions:

- (1) Implement the desired control scheme such that the specified performance is achieved.
- (2) Monitor all inputs for unsafe, erroneous, or unknown conditions or combinations of conditions, take appropriate actions to preserve proper functioning, and capture appropriate information to facilitate root cause analysis and repair when necessary.
- (3) Sample all input conditions at rates sufficient to detect and remedy all unsafe or damaging conditions in the shortest possible time. Sampling rates and program execution times shall be such that the control system is not the limiting factor in response to unsafe or damaging conditions.
- (4) Limit all output commands to safe levels regardless of any combination of input conditions.
- (5) Perform self-diagnostic routines and respond promptly, safely, and predictably to detected faults.
- (6) Provide the functions required for the Monitoring and Diagnostics System.
- (7) Report Software Version ID's and CRC values for all Application Software Items. CRC values shall be based on CRC-16 calculations on the stored software.
- (8) Respond safely and predictably when powering up or recovering from power interruptions. All power interruptions likely to have corrupted temporary storage shall be detected and cause the system to re-initialize all affected routines and temporary data. Detection of power interruptions may be by hardware.
- (9) Permit thorough interrogation of all input, output, and internal conditions by external diagnostic equipment.
- D. Software Categories
- (1) Software shall be divided into two classifications subject to the Engineer's approval. The first classification shall be programs which are Commercial off the Shelf (COTS) Software Items. These are general market software items typically supplied to a wide range of users for a range of applications. The second classification, Application Software Items, shall include all non-COTS items.

- (2) For an item to be considered, COTS approval by the Authority's Project Manager is required; however, COTS Software Items typically include the following:
 - a. Purchased real-time operating systems,
 - b. Network interface software from a networking supplier,
 - c. General purpose commercial database management software.
- (3) The Application Software Items shall include all other software such as the vehicle logic, subsystem integration, and fault and diagnostic routines. These programs are usually tailored to meet the requirements of the Scope of Work, although they may include Software Items used on other projects. The development and documentation of these programs shall be subject to the requirements of this Section. The Contractor shall accept that the Authority may, at a future date, need to change elements of these programs and shall provide the Authority with sufficient information to alter this software without the Contractor's or Supplier's assistance.
- (4) The processors used to execute Application Software Items shall have at least 30 percent available processing time for future software changes. They also shall have available additional I/O of each type used in that application to allow for future changes.
- (5) The Application Software Items shall be programmed in a high level language, such as C, Java, or PL/M, as approved by the Engineer. Compilation of the application dependent programs shall be performed on an IBM-compatible computer. The source code and all necessary files for the linking, locating, and conversion to loadable files shall be supplied to the Authority on CD ROM, or other form as approved by the Engineer. The compiler and other development tools used shall be commercially available with all interfaces in English.
- E. Software Quality Assurance and Documentation
- (1) The Contractor and each Supplier shall perform planning, analysis, and high level design early in the project before the Preliminary Design Review. The results of these activities shall be documented and submitted for approval by the Engineer.
- (2) The Contractor shall submit, for approval, a Software Quality Assurance Plan in accordance with ANSI/IEEE Standard 730-1998 and a Software Verification and Validation Plan in accordance with ANSI/IEEE Standard 1012-1998. These two plans shall be approved by the Engineer. These documents shall describe the Quality Assurance and the Verification and Validation activities to be performed by the Contractor. These documents shall be approved before the first PDR and updated for the CDR.
- (3) In addition to the above documents submitted Commutating capacitors shall be a paper or plastic film type, shall incorporate a non-toxic impregnant, and shall be chosen to give a service life of at least twenty years. Filter capacitors shall have high ripple current rating for long life.

- a. A Software Project Management Plan (SPMP) in accordance with IEEE Standard 1058- 1998.
- b. A Software Quality Assurance Plan (SQAP) in accordance with IEEE Standard 730-1998.
- c. A Software Verification and Validation Plan (SVVP) in accordance with IEEE Standard 1012-1998.
- d. A Software Configuration Management Plan (SCMP) in accordance with IEEE Standard 828-1998.
- e. For each subsystem, a System Functional Description (SFD) defining the subsystem requirements and design. It shall define all hardware and software components, partition the requirements amongst the components, and define the external and internal interfaces. It shall include a context diagram showing the external interfaces and a decomposition diagram showing the internal components and their interfaces. Each SFD shall include a Software Configuration Item Table providing information for each Software Configuration Item (SCI). The table shall provide the Item name, classification as COTS or Application Software, names and document ID's of the SRS and SDD, and method for loading the software item. For COTS items, the requirements may be identified in a section of the SFD along with references to the COTS item provider's documentation that states the requirements are provided. These SFD sections may then be referenced in the Software Configuration Item Table in lieu of the SRS and SDD references.
- f. A Software Verification and Validation Report (SVVR) in accordance with IEEE Standard 1012-1998 and in accordance with the SVVP.
- g. For each Application Software Item, a Software Requirements Specification (SRS) in accordance with ANSI/IEEE Standard 830-1998, and a Software Design Description (SDD) in accordance with ANSI/IEEE Standard 1016-1998. Each of the specific individual requirements must be identified in the SRS with a project specific unique identifier. Timing requirements must be given and specific allowable ranges for parameters.
- (4) For each supplier, items a) through e) together shall constitute one submittal for approval, all the SRS documents a separate approval item, the SVVR another approval item, and all the SDD and SRTM documents (items g) and h)) an approval item. Items a) through e) and the SRS documents shall be submitted and approved before the PDR for the associated system. Revisions of these documents and the other remaining documents shall be submitted and approved by the Authority's Project Manager before the CDRL for the corresponding system.
- (5) The source code for all Application Software Items shall be clearly documented and must be well structured, providing easy tracing from source code to the design in the Software Design Descriptions. The comments shall also include explanations of all

significant memory addresses such as interrupt vectors, I/O addresses, addresses for RAM or ROM memory, and other device addresses.

- (6) The Authority may participate in the Supplier's internal Software Requirements Reviews, as defined by ANSI/IEEE Standard 730-1998. These reviews must precede the submittal, for approval, of the Software Requirements Specifications.
- (7) Following approval by the Engineer, all subsequent changes to these documents shall also be submitted and approved by the Authority's Project Manager prior to implementation in the source code.
- F. Software Escrow

The Contractor and Suppliers may request that the design details and Source code files for certain specific Application Software Items be placed in an escrow account in lieu of submittal to the Authority. Such requests shall be subject to approval by the Engineer.

If approved, sufficient information shall be provided for review to enable the Authority to evaluate overall system performance and future changeability.

A demonstration shall be performed and witnessed by the Authority's Project Manager for all software to be in escrow. This test shall verify that all software and developmental tools have been included to generate loadable software from the source code and that the files generated are identical to the files used in final tests of the corresponding system.

The materials in escrow shall be made available to the Authority for its own use for any of the following reasons:

- (1) If the Contractor or any Supplier is no longer in business or no longer supports the product and has not transferred the rights to another entity that supports the product.
- (2) If, based on an independent third party assessment, the Contractor or Supplier no longer supports the product at a reasonable cost.

74 SEMICONDUCTOR STANDARDS

A. General

Semiconductors shall be selected to withstand all continuous and transient voltage and power demands present in the circuit application without damage or reduction in life. All circuit designs shall provide for the presence of high current switching equipment on the vehicle and the resultant induced voltages and currents in electrical equipment.

- B. Ratings
- (1) Semiconductors, except diodes (see below), operated from the battery supply, or those connected to trainlines, shall have minimum breakdown ratings of four times the maximum achievable circuit voltage. Suppression devices shall be provided as necessary to protect the devices and limit the circuit voltage.

- (2) Diodes operated from the battery supply, used as suppression devices, or connected to trainlines shall have a minimum breakdown rating (PIV) of 1,000 Volt. Diodes with less than 1,000 Volt PIV rating may be used if adequate circuit transient protection is also provided.
- (3) All discrete semiconductors operated from inverters or other isolating devices shall have a minimum breakdown rating of two times the maximum circuit voltage, except where specifically detailed otherwise. Suppression devices shall be provided as necessary to protect the devices and limit the circuit voltage.
- (4) All semiconductor junction temperatures shall be limited to 257°F (or to the maximum rated temperature for the device, whichever is less) or less at maximum ambient temperature and at maximum rated output power.
- (5) All semiconductors shall be operated at less than 50 percent of the maximum continuous current rating or 50 percent of the maximum continuous power rating, whichever is more restrictive. High power/current devices may be exempt from this requirement with prior approval, on a case-by-case basis. The Contractor shall submit complete device information, including all manufacturer's application recommendations, and calculated current and power demands with all waiver requests. If approved, such waivers do not reduce other requirements, including reliability.
- (6) Integrated circuits operated from the battery supply through inverters or other isolating devices shall be operated within the voltage and current ratings specified by the manufacturer, de-rated to less than 50 percent of the maximum stress level at the maximum operating temperature of the device as specified by the manufacturer.
- Where the supplies to integrated circuits are regulated and surge protected, the voltage rating shall be 15 percent below the manufacturer's recommended maximum. In addition, the maximum power shall be limited to 50 percent of the manufacturer's specified maximum at the maximum operating temperature.
- (8) Silicon semiconductors shall be rated for operation over the temperature range of -40°F to 185°F, and shall be hermetically sealed to the extent required by the application.
- (9) All Gallium Arsenide and similar optical semi-conductors shall be rated for operation over the temperature range of -40°F to 185°F.
- C. Availability and Identification
- (1) All semiconductors shall be available from at least two manufacturers and available from U.S. distributors. Single source devices, such as high voltage power devices, microprocessors, ASICs, and related support chips may be used only if approved by the Engineer. Such devices shall be essential to the proposed equipment, shall meet the proven service requirements, and shall be supplied by veteran manufacturers likely to support the device.

- (2) Each device shall be labeled to identify both the manufacturer and the complete part number. Operational characteristics of the device shall be published and available to the Authority.
- D. Other Prohibitions
- (1) Electronic equipment shall utilize stock components and shall function properly with the component manufacture's full range of tolerances such that after-purchase screening or testing of components shall not be required.
- (2) Matching of components is permitted only if the components are normally available from the manufacturer in matched sets.
- (3) Germanium semiconductors shall not be used.

75 PRINTED CIRCUIT BOARD STANDARDS

- A. General
- (1) Printed circuit boards shall be designed, constructed and inspected to ANSI/IPC-D-275, latest revision, except where more stringent requirements are noted here. Within ANSI/IPC-D-275, printed circuit board classes are designated. Printed circuit boards supplied under the Scope of Work shall be Class 2, minimum, with the exception of wayside computers that are not utilized in vehicle operation. Class 3 requirements shall apply to all vital equipment.
- (2) Circuit board material shall be per NEMA Standard LI 1, Type FR-4 (MIL-P-13949, Type GF), for boards which have no components whose power dissipation is greater than 2 Watts and when said board is not mounted adjacent to components dissipating greater than two watts. Otherwise, circuit board material shall be per NEMA Standard LI 1, Type FR-5 (MIL-P-13949, Type GH).
- Printed circuit boards shall have a minimum thickness of 0.0625 inch base material.
 All conductor material shall be copper and shall be firmly attached to the board and shall be resistant to blistering and peeling when heated with a soldering iron.
- (4) All printed circuit boards shall be designed for ease of testability per ANSI/IPS-D-275, "Testability design check list".
- (5) Traces shall be made as wide as practical, with the minimum width being based on a 18°F temperature rise.
- (6) Components with pins shall be mounted only on one side. Connections shall be made to the other side or internal layers via plated through holes. SMT devices may be mounted on both sides if part of an approved existing design.
- (7) All circuit boards shall be inherently stiff or shall be reinforced to prevent damage due to vibration or handling. Circuit boards larger than 100 square inches shall be centrally stiffened unless otherwise approved.
- (8) All printed circuit boards with the same function shall be interchangeable between equipment groups without additional adjustment.
- (9) All printed circuit boards shall be of the "plug-in" type, with positive support against vibration. Single board applications, where approved by the Authority, may be of a "non-plug-in" type.
- (10) Printed circuit boards shall be designed for insertion and removal with power applied, except where power is removed by a switch adjacent to the card rack and except where the mechanical construction would generally prohibit removal and insertion with power applied. Where a switch is used, it shall be labeled with a warning regarding its proper use.
- B. Marking
- (1) All circuit boards shall be permanently labeled with a part number, serial number, Revision level and descriptive nomenclature. There will be space on the board for marking the software revision.
- (2) All components shall be labeled on the board with component drawing references and such other information as may be required to repair and troubleshoot the board, except as approved by the Engineer. The component and wiring sides of the board shall each be marked to indicate capacitor and diode polarity, and at least two leads or one lead and a graphic symbol indicating orientation of all transistors and thyristors.
- (3) Integrated circuits and other multi-terminal devices shall have an index mark on the component side of the board, visible with the component inserted, to indicate proper keying and insertion; additionally the first pin on all IC packages shall be identified on the wiring side of the board. The labels used to identify components on the printed circuit board shall match those used in the schematic drawings for that particular component.
- C. Component Mounting

Components shall be fastened to the board in such a manner as to withstand repeated exposure to shock and vibration. Large components shall be supported in addition to the solder connections. Power resistors shall be mounted on standoffs so that the resistor bodies do not contact the board, spaced far enough away from the board so that resistor produced heat shall not discolor or damage the board.

- D. IC and Device Sockets
- (1) IC and device sockets are prohibited except for components that must be removed for reprogramming or initial calibration procedures or devices that are available only in mounting in sockets. All socket applications are subject to Engineer's approval. All other components shall be soldered in place.

- (2) Where approved, IC sockets shall comply with approved standards such as MIL-S-83502 and MIL-S-83734, as is applicable for the device, and shall be made of the following materials:
- (3) The bodies shall be molded from diallyl phthalate, PTFE Teflon, or approved equal.
- (4) The contacts shall be fabricated from beryllium copper and shall be plated with a minimum of 0.000030 inch of gold over a minimum of 0.000050 inch of low stress nickel in the area of contact with IC pins.
- E. Conformal Coating
- (1) Both sides of the assembled printed circuit boards shall be coated with a clear insulating and protective coating material conforming to MIL-I-46058 latest revision, or approved equal.
- (2) The coating shall be easily removed with a brush-applied solvent or penetrated by a hot soldering iron when a component must be unsoldered. The coating solvent shall not adversely affect board-mounted components.
- (3) All IC sockets, connectors, and test points shall be masked when the coating is applied.
- F. Keying

All printed-circuit boards shall be mechanically "keyed" to prevent insertion into the wrong slot or in the wrong orientation. Further, circuit boards in safety related control systems, such as friction brakes, cab signal, ATC, ATS, and systems which can cause damage or unsafe train operation if the vehicle is operated with a card removed, shall be connected through a safety circuit to disable the vehicle if a circuit board is removed.

- G. Circuit Board Connectors
- (1) Printed circuit board connectors shall be heavy duty, high reliability, two-part type with a history of successful service in rail applications and shall be approved by the Authority's Project Manager prior to commencing design.
- (2) Connectors which comply with MIL-C-55302 or DIN 41612 Level 1 or 2, and which have plated contacts as described below, are considered to comply with the requirements of this section.
- (3) The connector contact area shall be plated with a minimum of 0.000030 inch of gold over a minimum of 0.000050 inch of low stress nickel.
- (4) Card edge connectors are prohibited.
- H. Testing
- (1) Sufficient clearance shall be provided between components to allow testing, removal, and replacement without difficulty due to lack of space.

- (2) Test points shall be provided in appropriate locations on modules and printed circuit boards. A negative return test point shall also be provided. The test points for manual testing shall either accept and hold a standard 0.080 inch diameter tip plug or shall be a turret lug similar to Cambion No. 160-1026-01-05, or approved equal, with sufficient clearance to permit it to accept a standard oscilloscope probe clip, and shall be identified by appropriate markings.
- I. Extenders

Printed circuit board extenders shall be provided by the Contractor for test purposes. At least two extenders of each type shall be available for use and evaluation throughout the design conformance and acceptance test programs and shall be delivered to the Authority upon the acceptance of the BTE. The interfaces between extender and enclosure and PC board must be positive and secure and must prevent malfunction and falling out during testing. Mechanical locking means shall be considered on large PC boards.

ATTACHMENT C - PRICE PROPOSAL FORMS

proposer:

Talgo-SYSTRA Joint Venture

RFP EP199-19 • REBUILD OF BOMBARDIER RAIL CARS· PRICING FORM							
BASE ORDER - PRICE PER CAR							
ITEM	DESCRIPTION	Materials Cost Per Car	Labor Costs	Total Unit price	Qty	Extended Price	
1	HVAC Overhaul (upgrade to R-407C)	65,608.10	20,084.61	85,692.70	50	4,284,635.07	
2	Control voltage conversion 32 to 74 volts	22,379.88	23,541.39	45,921.27	50	2,296,063.63	
3	Complete electrical systems rewire	11,454.18	27,050.71	38,504.89	50	1,925,244.68	
4	Replace door operator system with next gen	47,302.26	20,816.64	68,118.90	50	3,405,945.11	
5	Battery Changeout	18,014.88	18,732.78	36,747.67	50	1,837,383.29	
6	Wireless PA installation	13,511.16	13,528.23	27,039.39	50	1,351,969.52	
7	Truck Overhaul (new air bags and wheels)	138,511.89	18,862.19	157,374.08	50	7,868,704.01	
8	PEI System Installation	27,022.33	14,248.72	41,271.05	50	2,063,552.43	
9	Destination Sign Installation	13,511.16	17,813.55	31,324.71	50	1,566,235.61	
10	Window Gasket Replacement	3,220.00	14,671.78	17,891.78	50	894,588.92	
11	Lighting System Replacement with LED	28,666.21	21,371.84	50,038.05	50	2,501,902.48	
12	Install Composite Subfloors	8,899.74	15,852.38	24,752.12	50	1,237,605.92	
13	Install rubber floors	9,201.53	15,852.38	25,053.90	50	1,252,695.21	
14	Refurbish Seat Frames (Assume 20 seat frames and shells will be replaced.)	3,871.09	13,022.60	16,893.69	50	844,684.32	
15	Replace foam and install vinyl seat covering	57,200.92	12,180.38	69,381.29	50	3,469,064.69	
16	Replace interior panels with Rotem color match	637.00	15,969.07	16,606.07	50	830,303.42	
17	Replace Toilet Module	108,021.85	23,180.75	131,202.61	50	6,560,130.35	
18	Repair Carbody, paint and new exterior graphics (Assume 25% exterior panels replaced.)	8,066.00	34,072.23	42,138.23	50	2,106,911.69	
19	Replace all glass windows with new (Assume 25% of windows replaced.)	25,869.75	14,671.78	40,541.53	50	2,027,076.26	
20	Install 120v outlets through seating area	3,818.06	14,934.01	18,752.07	50	937,603.49	
21	New Diaphragms	14,890.44	16,841.54	31,731.98	50	1,586,599.00	
22	Pre-wire car for Wi-Fi	1,272.69	11,369.18	12,641.87	50	632,093.45	
23	Pre-wire car for passenger surveillance cameras assuming 10 cameras will be used	1,272.69	11,369.18	12,641.87	50	632,093.45	
24	Replace couplers	11,425.00	13,627.61	25,052.61	50	1,252,630.71	
26	New Signage Installation	1,962.06	18,022.00	19,984.06	50	999,203.06	
26	Door Obstruction Detection	-	-	-	50	-	
27	Vehicle Shipping	19,063.19	158.29	19,221.49	50	961,074.38	
28	TOTAL BASE ORDER PRICE	664,674.06	441,845.83	1,106,519.88	50	65,325,994 .14	
a.	System Support					6,285,476.36	
b.	Manuals, Teaching Aids, Equipment and Special Tools					761,363.30	
с.	Taxes					-	
d.	Bonding					283,513.26	
e.	Insurance					1,358,670.26	

TOTAL BASE ORDER PRICE INCLUDING a.			64 015 017 33
through e.			04,013,017.33

Proposer:

Talgo-SYSTRA Joint Venture

RFP EP199-19 - REBUILD OF BOMBARDIER RAIL CARS - PRICING FORM							
OPTION - PRICE PER CAR							
ITEM	DESCRIPTION	Materials Cost Per Car	Labor Costs	Total Unit price	Qty	Extended Price	
1	HVAC Overhaul (upgrade to R-407C)	60,028.25	18,169.04	78,197.29	71	5,552,007.87	
2	Control voltage conversion 32 to 74 volts	20,100.50	21,401.61	41,502.11	71	2,946,649.52	
3	Complete electrical systems rewire	11,708.72	24,923.93	36,632.65	71	2,600,918.12	
4	Replace door operator system with next gen	44,770.01	18,693.42	63,463.43	71	4,505,903.28	
5	Battery Changeout	17,250.00	17,200.69	34,450.69	71	2,445,998.91	
6	Wireless PA installation	8,555.00	11,959.77	20,514.78	71	1,456,549.04	
7	Truck Overhaul (new air bags and wheels)	138,511.89	17,041.26	155,553.15	71	11,044,273.99	
8	PEI System installation	17,110.00	12,980.13	30,090.14	71	2,136,399.71	
9	Destination Sign Installation	8,555.00	16,290.09	24,845.09	71	1,764,001.73	
10	Window Gasket Replacement	3,220.00	13,535.30	16,755.30	71	1,189,626.61	
11	Lighting System Replacement with LED	27,211.32	19,091.13	46,302.45	71	3,287,473.66	
12	install Composite Subfloors	8,592.55	14,633.13	23,225.67	71	1,649,022.68	
13	Install rubber floors	9,436.97	14,633.13	24,070.10	71	1,708,977.06	
14	Refurbish Seat Frames (Assume 20 seat frames and shells will be replaced.)	3,871.09	11,849.70	15,720.79	71	1,116,176.07	
15	Replace foam and install vinyl seat covering	57,200.92	11,246.39	68,447.31	71	4,859,759.07	
16	Replace interior panels with Rotem color match	637.00	14,464.59	15,101.59	71	1,072,212.91	
17	Replace Toilet Module	97,480.19	20,386.90	117,867.09	71	8,368,563.09	
18	Repair Carbody, paint and new exterior graphics (Assume 25% exterior panels replaced.)	8,066.00	30,205.77	38,271.77	71	2,717,295.73	
19	Replace all glass windows with new (Assume 25% of windows replaced.)	25,487.94	13,535.30	39,023.25	71	2,770,650.40	
20	Install 120v outlets through seating area	3,818.06	13,723.15	17,541.21	71	1,245,425.81	
21	New Diaphragms	14,635.90	15,593.82	30,229.72	71	2,146,309.91	
22	Pre-wire car for Wi-Fi	1,272.69	10,413.19	11,685.87	71	829,697.10	
23	Pre-wire car for passenger surveillance cameras assuming 10 cameras will be used	1,272.69	10,413.19	11,685.87	71	829,697.10	
24	Replace couplers	11,425.00	12,535.22	23,960.22	71	1,701,175.31	
25	New Signage Installation	1,909.03	16,691.54	18,600.57	71	1,320,640.36	
26	Door Obstruction Detection	-	-	-	71	-	
27	Vehicle Shipping	19,063.19	113.39	19,176.58	71	1,361,537.47	
28	TOTAL OPTION PRICE	621,189.92	401,724.77	1,022,914.68	71	72,626,942.52	
a.	Taxes					-	
b.	Bonding					402,588.83	
c.	Insurance					1,929,311.77	
	TOTAL OPTION PRICE INCLUDING a. through c.					74,958,843.12	
1				1	1		

Proposer:

Talgo-SYSTRA JointVenture

RFP EP199-19 - REBUILD OF BOMBARDIER RAIL CARS - PRICING FORM				
SUMMARY OF PRICING FORMS				
DESCRIPTION	PRICE			
Base Order	\$ 64,015,017.33			
Option	\$ 74,958,843.12			
TOTAL PROPOSAL PRICE	\$ 138,973,860.45			