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SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT

Metro Rail Project

Procurement Specifications Book
Contract A650

PASSENGER VEHICLE

ADVERTISED:
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GENERAL CONSULTANT:

METRO RAIL TRANSIT CONSULTANTS
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SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT
METRO RAIL PROJECT

PROCUREMENT SPECIFICATIONS BOOK
CONTRACT A650

PASSENGER VEHICLE

The preparation of this document has been financed in part through a grant from the United States Department of Transportation, Urban Mass Transportation Administration, under the Urban Mass Transportation Act of 1964, as amended, the State of California, and the Los Angeles County Transportation Commission.

Prepared by
METRO RAIL TRANSIT CONSULTANTS
Systems Design Division

Advertised: March 1987
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SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT

METRO RAIL PROJECT

PASSENGER VEHICLE

CONTRACT A650

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SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT

METRO RAIL PROJECT

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REQUEST FOR PROPOSAL

The Southern California Rapid Transit District (District), will receive proposals to supply passenger vehicles for the Metro Rail Project.

The District has scheduled a Preproposal Conference at which the scope of the Work and the requirements of the proposal will be discussed. The Conference will be held at 10:00 A.M. local time on April 7, 1987, in the District Board Room on the 2nd floor of the District's Administration Building, 425 South Main Street, Los Angeles, California. Interested parties are invited and encouraged to attend.

The District will receive proposals between the hours of 9:00 A.M. and 2:00 P.M. local time on July 13, July 14, and July 15, 1987. Proposals will not be accepted after 2:00 P.M. July 15, 1987. Proposals shall be addressed to:

MR. T.L. JOHNSON, ASSISTANT DIRECTOR
OFFICE OF CONTRACTS, PROCUREMENT AND MATERIEL
SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT
C/O PARSONS DELEUW CATHER DILLINGHAM
600 SOUTH SPRING STREET, ROOM 1222
LOS ANGELES, CALIFORNIA 90014

Proposals must be prepared and submitted in accordance with, and subject to, the conditions contained in the Information for Proposers which is part of the Proposal Documents. There will be no public opening of proposals. The evaluation of proposals and award of the Contract will be governed by applicable California law.

Proposal Documents may be examined in the Plan Room of the General Consultants (GC), Metro Rail Transit Consultants, Suite 600, 548 South Spring Street, Los Angeles, CA 90013, and at certain public and private plan rooms. Copies of the Proposal Documents may be requested from the GC either in person or by mail addressed to the GC's Plan Room at the above address. Documents requested by mail will be packaged and sent postage paid. Requests must be accompanied by either a certified check, cashier's check, company check or postal money order drawn in favor of Southern California Rapid Transit District; monies paid for Proposal Documents will be nonrefundable.

The following is a list of Proposal Documents and their respective costs:

Passenger Vehicle Procurement Specifications Book, Contract A650 Includes: Proposal Requirements Proposal Forms Contract Forms Special Provisions General Provisions Technical Provisions Half-size Contract Drawings Half-size Reference Drawings	$100.00
Guidelines for the Preparation of Safety and System Assurance Analyses, SCRTD 5-001.	No Charge
List of Planholders (updated each Monday), each issue	$2.00

Proposer must certify that it has examined the Proposal Documents, that it is not listed on the US Comptroller General's Consolidated List of Persons or Firms Currently Debarred for Violations of Various Public Contracts; and, should it become the Contractor, that it will not prosecute the Work using facilities which have been listed on the Environmental Protection Agency's List of Violating Facilities.

Dated at Los Angeles, California, this Sixteenth day of March, 1987.

SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT

Maynard Z. Walters
Director, Office of Contracts,
Procurement and Materiel

END OF REQUEST FOR PROPOSAL

SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT

METRO RAIL PROJECT

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INFORMATION FOR PROPOSERS

Contract Scope

The District is requesting proposals for the supply of 30 passenger vehicles for use on the Minimum Operable Segment (MOS-1) of the Metro Rail Project. The technical requirements for the vehicle and support programs are contained in the Technical Provisions. In addition, the offer must provide the District the option to purchase additional vehicles and additional wayside equipment in accordance with the terms of the option specified in the Special Provisions.

Schedule and Delivery

Vehicles will be delivered to the US Department of Transportation Test Facility at Pueblo, Colorado for testing and to Los Angeles. Quantities for delivery to each site and the schedule for doing so are specified in the Special Provisions. The Special Provisions also contain schedules for support program deliverable items.

Contract Type

The passenger vehicles shall be procured under a firm fixed-price Contract. The terms and conditions for the Contract are delineated in the Special Provisions and General Provisions contained in the Proposal Documents. The Contractor's final Proposal will be incorporated into the Contract as one of the Contract Documents.

Procurement Process

The District will award the Contract by competitive negotiation. Proposals will be received at the place and time stated in the Request for Proposal (RFP) and evaluated by the District. There will be no public opening of proposals.

After evaluation of proposals, an award may be made if the evaluation determines that the best achievable and technically acceptable proposal has been received. In the absence of such a determination, the District will hold discussions with proposers whose proposals are within the competitive range. The remaining proposers will be given written notification that their non-competitive proposals are no longer eligible for award.

Following discussions, the District may request Best and Final Offers (BAFOs). After receipt and evaluation of BAFOs, the District may select an offer for the award of a Contract.

Examination

Proposers must carefully examine the Proposal Documents. Proposers will be expected to be aware of means of transportation, laws and codes, local permit requirements, local tax structure, availability of insurance, and other factors that could affect the Work.

Explanations

Prospective proposers wishing explanations or clarifications of the Proposal Documents, including information and instructions, or of other procurement procedures, must submit their inquiries in writing to:

MR. T.L. JOHNSON, ASSISTANT DIRECTOR
OFFICE OF CONTRACTS, PROCUREMENT AND MATERIEL
SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT
600 SOUTH SPRING STREET, 3RD FLOOR
LOS ANGELES, CALIFORNIA 90014

Any such request shall identify the particular portion of the Proposal Documents affected. In order to insure answers to questions, proposers should submit questions not later than May 1, 1987.

Any response that the District may choose to make will be by a written addendum to the Proposal Documents or other written information sent to all proposers in the competitive range. The District will not be bound by information, explanation, clarifications, and oral or written interpretation, by whomsoever made, that is not incorporated into an addendum to the Proposal Documents.

Communications With the District--Restrictions

Following the issuance of the RFP for Contract A650, and until the Notice of Contract Award, proposers and proposed subcontractors shall communicate with the District only as prescribed in the Proposal Documents. Any other communications regarding Contract A650, with members of the District's Board of Directors, staff or consultants, during this period shall result in disqualification of the involved proposers and proposed subcontractors.

Changes to the Proposal Documents

The District may make such changes to the Proposal Documents as it deems appropriate. All changes to the Proposal Documents will be made by written addenda.

Any prospective proposer may request a change to the Proposal Documents. Any such request shall be in writing, shall identify the particular Proposal Documents affected, shall contain the specific language required to effect the change, and shall contain a statement of justification that establishes the advantage to the District to make the change. The District has sole right to accept or reject the requested change. If it is accepted, it will be implemented by an addendum to the Proposal Documents.

Supplements to the Proposal

Proposers are expected to submit designs which are fully conforming with the requirements of the Technical Provisions, however, proposers may submit for consideration an alternate design that may not be fully conforming to the Technical Provisions. The alternate shall be presented as a supplement to the Proposal. To be considered, the alternate must accomplish the basic intent of the Technical Provisions without adversely affecting overall performance of the Metro Rail System.

The supplement shall clearly define the difference with the Proposal and shall contain a statement as to the advantage accruing to the District from the alternate design. For each alternate design included for consideration, clear instructions are required to show the changes to be made to the Proposal if the alternate is selected for incorporation.

If a proposed alternate design does not fully meet the requirements of the Technical Provisions, the Proposer shall include in the supplement, the specific wording changes needed in the Technical Provisions to allow the alternate design to conform. In submitting such an alternate, the proposer agrees to accept any consequential exposure of its alternate concept that may result if the District changes the specification to permit the alternate design.

The District has the sole right to accept or reject any supplement. Any accepted changes will be implemented as addenda to the Proposal Documents.

Codes and Standards

Substitute codes and standards shall not be used unless approved by the District. Requests for substitutions shall be submitted with the Proposal and include a paragraph-by-paragraph comparison with the specified document, an explanation of differences, and a rationale for making a substitution. All such requests must be in the English language. Unless the Proposal clearly indicates that the Proposer is offering a substitute code or standard, the Proposal shall be considered as adhering to the codes and standards referenced in the Proposal Documents.

Submittal of Proposals

Proposals shall be submitted in sealed envelopes or boxes marked on the outside "PROPOSAL FOR PASSENGER VEHICLE--CONTRACT A650." Completed Pricing Forms should be in a separate sealed envelope which can be separated, unopened, from the remainder of the Proposal package. There should be no indication of prices anywhere in the Proposal except within the Pricing Forms envelope.

The Proposal should be addressed and delivered to:

DIRECTOR, OFFICE OF CONTRACTS, PROCUREMENT AND MATERIEL

at the address specified under "Explanations."

Withdrawal of Offers

Offers may be withdrawn at any time prior to written Notice of Award of Contract by the District. Withdrawal shall be by written notice to the Director, Office of Contracts, Procurement and Materiel.

Evaluation of Proposals

The District will evaluate proposals to accomplish the following objectives:

A. Assure that proposals meet the requirements of the Proposal Documents in all respects.

B. Assure that prices quoted are realistic, fair, and reasonable for the Work being offered.

C. Evaluate the Proposer's qualifications to implement the Work if awarded the Contract.

D. Assure that the Proposer has adequate personnel resources, financial capability, and available facilities to perform the Work in the time allotted.

E. Determine which proposers have submitted proposals within the competitive range. If discussions are deemed necessary, the District will hold discussions only with those proposers in the competitive range.

F. Determine if changes should be made to the Proposal Documents to obtain better prices or permit use of more reliable service-proved equipment.

G. Determine whether adequate price competition exists with the proposals as submitted.

Evaluation Factors

The following factors and significant subfactors will be considered in the evaluation of proposals and the source selection. The factors are listed in order of decreasing weight of importance from 1 through 4. The subfactors shown under the factors are not the only evaluation considerations, and are not necessarily arranged in order of importance.

The factors and significant subfactors include:

1. Total price including options.
   Price realism.

2. Technical design.
   Compliance with General Requirements.

3. Qualifications of Proposer and its team.
   Past performance.
   Extent of use of service-proved equipment.
   Proved engineering capability.
   Manufacturing capability.

4. Management program.
   Management approach.
   Systems assurance program.
   Test Program.
   Systems support.

Price Evaluation

The District will evaluate offers for award purposes by adding the total price for the option, Pricing Form FF, to the total price for the basic requirements, Pricing Form AA. Evaluation of the option will not obligate the District to exercise the option.

The District will consider an offer as nonconforming if it is materially unbalanced as to prices for the basic requirement and the option quantity. An offer is unbalanced when it is based on prices significantly less than cost for some work and prices which are significantly overstated for other work.

The District will evaluate the pricing information to determine whether there is sufficient price competition to assure a fair and reasonable price for the procurement. The District may also require submission of detailed cost data. Proposers will be required to certify all price and cost data submitted as to their completeness, accuracy, and currency. Such data will also be required from any subcontractor where the value of the subcontract exceeds $100,000. The District will be the sole judge of adequacy of competition and need for additional cost and pricing data.

Negotiations

Upon completion of the evaluation of proposals, if discussions are required, the District will schedule meetings for this purpose with all proposers whose proposals are in the competitive range. The meetings will be held in Los Angeles.

Best and Final Offers

When all discussions have been completed, the District will issue an addendum requesting Best and Final Offers (BAFOs). The addendum will contain any changes to requirements of the Proposal Documents and define the conditions applicable to submission of BAFOs. When BAFOs have been received and evaluated, the District will make the selection for the award. All proposers submitting BAFOs will be notified of the results at that time.

Contract Award

The District will award a contract resulting from this solicitation to the responsible proposer whose offer, conforming to the requirements of the solicitation, will be most advantageous to the District, with price and other factors specified elsewhere in this solicitation, considered.

The District may (1) reject any or all offers if such action is in the District's best interest and (2) waive informalities and minor irregularities in offers received.

The District may award a contract on the basis of initial proposals received, without discussions. Therefore, each initial proposal should contain the proposer's best terms from a price and technical standpoint.

Buy America

This procurement is subject to the Urban Mass Transportation Administration (UMTA) Buy America Requirements in 49 CFR Part 661. However, preproduction vehicles are exempt from the requirement for final assembly in the United States.

A Buy America Certification for Compliance or Non-Compliance must be completed and submitted with the Proposal in order for the Proposal to be considered for award.

Certification forms are included with the Proposal Forms.

DBE Requirements

There are requirements for participation in this procurement by Disadvantaged Business Enterprises.

Proposers shall demonstrate that they meet the requirements by completing the Transit Vehicle Manufacturer (TVM) Certification included with the Proposal Forms.

Execution of Contract

The Proposer to whom an award is made, if any, shall execute the Contract Agreement and furnish the required Performance Bond in the amount of 100 percent of the Contract Price within 10 calendar days after being given notice of award. The District may require appropriate evidence that the persons executing the Contract Agreement and the Performance Bond for both the Proposer and its surety or sureties are duly empowered to do so. The Performance Bond must be in an amount at least equal to the Contract Total and conform to the form provided with the Proposal Documents. The surety or sureties shall be a corporation or corporations authorized to act as such in the State of California and acceptable to the District.

District Rights

The District may investigate the qualifications of any proposer under consideration, require confirmation of information furnished by a proposer, and require additional evidence of qualifications to perform the Work described in this RFP. The District may also:

A. Reject any or all proposals.

B. Issue subsequent Requests for Proposal.

C. Cancel the entire Request for Proposal.

D. Remedy technical errors in the Request for Proposal process.

E. Appoint evaluation committees to review and score proposals.

F. Seek the assistance of outside technical experts in proposal evaluation.

G. Establish a short list of proposers eligible for discussions after review of proposals.

H. Approve or disapprove the use of particular subcontractors.

I. Negotiate with any, all or none of the respondents to the RFP.

J. Solicit Best and Final Offers from some, all or none of the proposers.

K. Accept any written proposal as an "offer to sell", without further negotiation and issue a Notice to Proceed.

The RFP does not commit the District to enter into a contract, nor does it obligate the District to pay for any costs incurred in preparation and submittal of proposals or in anticipation of a contract.

END OF INFORMATION FOR PROPOSERS

SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT

METRO RAIL PROJECT

PASSENGER VEHICLE

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INSTRUCTIONS FOR PREPARATION OF PROPOSALS

General

The District is desirous of obtaining proposals that explain how the proposers will meet the requirements of the procurement. Technical descriptions of the supply should be such that the District is able to relate what is being offered to equipment that has been used in revenue service on other rail transit systems. Unless specifically noted to the contrary in the Proposal, the District assumes that the Proposer will meet all requirements in the Proposal Documents. Statements telling only that the Proposer will meet specific requirements, will not suffice and are not wanted.

Unnecessarily elaborate brochures or other presentations beyond those sufficient to present a complete and effective response to this RFP are not desired. Elaborate artwork, expensive paper and bindings, and expensive visual and other presentation aids are not necessary.

The Proposer shall specify the names of the subcontractors it intends to use for supply of the major subsystems and equipment. The technical interfaces for each such subcontract shall be described in the section of the Proposal devoted to that subsystem or equipment.

The District desires to purchase Passenger Vehicles of a design fully proved in rail transit passenger service, modified only as necessary to meet the requirements of the Technical Provisions. The extent to which proposers offer service-proved systems and equipment will be a significant subfactor in the evaluation of proposals. For many sections of the Proposal, the requirements call for the Proposer to "document service experience." The following information should be provided in each such section to fulfill that requirement.

- The number of units identical to those being proposed for Metro Rail that have been in use on rail transit systems and time in service.

- Names of rail transit systems where the proposed equipment has been in service.

- Operating experience on those rail transit systems.

- Critical performance parameters in comparison with those to be experienced on the Metro Rail System.

- Manufacturer's data sheets and other experience-related data when existing equipment is being proposed.

- If the Proposer wishes to take credit for equipment that is similar but not identical, it should specify the particulars of any differences between units in operation and those being proposed. For such equipment, indicate the magnitude of the development effort, the approach to qualifying modified equipment prior to production, and the degree of risk.

The District recognizes that there may be elements of the Proposal considered proprietary. The Proposer should be aware that all records, documents, drawings, plans, specifications, and other material relating to the procurement are subject to the provisions of the California Public Records Act (Government Code Section 6250 et. seq.). The District's use and disclosure of its records are governed by this Act.

The Proposal shall identify any specific information or design details that the Proposer considers proprietary. The Proposer shall clearly and prominently mark each and every page or sheet of such materials with "PROPRIETARY", as it determines to be appropriate.

Any Proposal which includes identified proprietary information may be rejected unless the nonproprietary portion includes sufficient information for the District to evaluate the Proposal. Any Proposal submitted must include sufficient nonproprietary information to permit a competing Proposer to know the essential nature and type of products offered and to know the quantities, prices, and delivery terms. Information such as quantities, make and model identification, equipment lists, prices, and delivery terms shall, in any case, become public records.

The District will endeavor to protect such information and design details against unnecessary disclosure. Under no circumstances, however, will the District be responsible or liable to the Proposer or any other party for the disclosure of such labeled material, for any reason whatsoever.

Proposal Requirements

The requirements that follow, related to format and organization of proposals, have been purposely established to facilitate objective, timely, and efficient evaluation of same by the District. Proposers are advised to ensure that proposals comply with all such requirements.

Each Proposer shall submit only one Proposal. Eight copies of each Proposal are required. Typing should be on 8-1/2- x 11-inch paper. Proposals shall be written in the English language. 2 Dimensions shall be in the US inch/pound units. 2

Proposal Organization

The Proposal shall be organized into separate parts: A) Management and Technical Proposal, and B) Price Proposal.

A. Management and Technical Proposal

The Management and Technical Proposal (parts I through IV as defined below) shall be submitted in a three-ring loose leaf folder or equivalent. All text shall be clear of binding and all pages numbered sequentially. Index tabs shall be provided to facilitate referencing of parts and permit ready separation of sections during evaluation.

Part I:

1) Offer Letter
2) Completed Qualifications and Business References Questionnaire (also include a completed questionnaire for each major subcontractor).
3) List of Subcontractors.
4) TVM Certification.
5) Buy America Certification.
6) South Africa Certification.

Part II:

Section 1--Management Approach
Section 2--Qualifications and Experience
Sections 3 through 23--Technical descriptions of vehicle design elements and program support elements.

Part III: Drawings

Part IV: Supplements

B. Price Proposal

The completed Pricing Forms should be submitted in a sealed envelope with the Proposer's name and the wording "Pricing Forms for Contract A650" marked on the outside.

Proposal Information Requirements

Management and Technical Proposal

Requirements for Part I

1. Offer Letter

   Complete the form included in the Proposal Documents. The Offer Letter must acknowledge receipt of addenda, be signed by an authorized representative of the Proposer, and include notarized authorization for signer's authority to bind Proposer's Organization.

2. Remaining Forms

   Complete as required.

Requirements for Part II

Part II of the Management and Technical Proposal shall consist of not more than 300 pages of text, plus drawings, graphs, forms, and tables as needed to clearly describe the proposed Work. The Proposal shall include sufficient information to permit thorough understanding of the Proposer's management approach to the Work, its qualifications for the Work, and its proposed vehicle, without the need for any additional information or discussion. The Proposal shall describe the proposed vehicle in sufficient detail to enable the District to evaluate its compliance with the Technical Provisions. Do not include unnecessary technical design details in the technical descriptions, which otherwise shall be provided during the course of the contract execution, unless they are specifically contrary to the requirements in the Technical Provisions.

If the Proposer submits examples of program plans, operation and maintenance manuals, or catalog cuts of components, etc., they should be as enclosures to Part II. The physical volume of material in enclosures should not exceed the volume of Part II. Sample material from plans, manuals and other such documents that show proposed scope and quality of material will be adequate for evaluation purposes. The complete documents are not needed.

Part II shall consist of 23 sections. Particular items in each section for which the District requires detailed information are stated below. Each section shall be clearly separated from other sections by index tabs, and the title and number used to identify each section must be identical to those used below.

1. Management Approach

   A. The Proposal shall describe the overall plan and schedule to manage the Work from start to finish. The plan

shall address organization, and utilization of resources. The description of the management approach shall particularly highlight how the proposed approach compares with past projects of similar magnitude and complexity and shall identify any differences or planned improvements as compared with past projects.

B. The Proposal shall include information to demonstrate that the Metro Rail procurement would not conflict with the Proposer's existing manufacturing, testing, and delivery commitments.

C. The Proposal shall include a list of the locations where the major engineering and manufacturing work on the Contract will be performed.

D. The Proposal shall describe how the Proposer plans to handle local coordination of the project.

2. Qualifications and Experience

A. The Proposal shall describe the general experience and background of the Proposer and associated firms or joint venturers and provide information to demonstrate that the Proposer has the capability in terms of financial responsibility, facilities, and personnel required to accomplish the proposed Work. This information shall be organized as follows:

1. Provide a brief description of similar projects performed during the past 10 years, with the names and addresses of the organizations for which the work was performed. Include a client list with telephone numbers. In particular, the District is interested in the Proposer's past performance in meeting schedules; maintaining reliability and quality control standards; providing spare parts, training and warranty support; and responding to customer requests, change orders, and subcontractor needs.

2. Provide a completed "Qualifications and Business References Questionnaire" for itself and each major subcontractor. Use the form included with the Proposal Forms.

3. Provide a completed "List of Subcontractors." Use the form included with the Proposal Forms. Identify the subcontractor for each major subsystem and equipment listed thereon. The District re-

serves the right to make investigations and to request additional information as it may deem necessary for evaluation of qualifications for any subcontractor listed.

B. The Proposal shall adequately describe the experience and background of Proposer's and subcontractors' personnel to demonstrate that they can satisfactorily perform the Work.

1. The Proposal shall contain the names and personal resumes of key managerial and technical personnel to be assigned to the Contract. Include key subcontractor personnel. Resumes should include information on their education, related experience, accomplishments, and other pertinent information. Particular emphasis should be placed on experience with the rapid transit industry. Identify which positions the key personnel will fill and the percentage of their time they are expected to work on the Contract.

2. A statement should be provided listing additional engineering personnel to be hired for permanent employment, on subcontract or as consultants, and the source from which they will be obtained. Provide assurance that the proposed additional personnel will be available for the Work.

5 3. The Proposal shall contain the names and resumes of 5
5 the proposed project manager and local coordinator, 5
5 if any. The Proposal shall also address their abi- 5
5 lity to communicate in English, both written and 5
5 orally. 5

3. General Requirements

A. Provide the following drawings to demonstrate that the proposed vehicle is within the dimensional allowance and is compatible with guideway interfaces for all conditions given in the Technical Provisions:

1. General arrangement/side elevation drawing, showing vehicle physical characteristics.

2. Static and dynamic outlines superimposed on the Maximum Static Outline, and Maximum Dynamic Outline Contract Drawings.

B. Provide an estimate of A-car and B-car weights. The estimate shall be detailed to at least the subsystem level. Provide justification for the equipment weights

used in the estimate. Indicate the degree of uncertainty.

C. Describe how the proposed vehicle will meet the following requirements.

1. Performance Criteria

2. Thermal Capacity

3. Acceleration

4. Deceleration.

Support the description with submittals identified in Articles 3.6 and 3.18 of the Technical Provisions, for AW2-loaded trains at PL-1, except where AWO plus 20,790 lb per vehicle is required in Technical Provision Paragraphs 3.6.3 and 3.18.6.

D. Provide description of brake and motor control signals (BRK signal and P-signal).

E. Describe how the proposed vehicle and subsystems will meet the required Noise Control and Criteria. Support description with actual noise measurements on existing vehicles and subsystems, indicating any required modifications.

F. Describe the proposed procedure for control of electromagnetic interference (EMI) and means to prevent allowable chopper harmonics from exceeding the specified envelopes. Indicate values of input filter components.

Describe how chopper frequency and integrity of the input filter shall be assured. If a step change of frequency is proposed during motoring, describe how chopper frequency transition will be assured.

G. Provide general arrangement of vehicle interior layout showing key dimensions for seating, knee space, standbacks, aisle width, door location and size of doors.

4. Interfaces

A. Describe how the Proposer will support the District in review and control of the interfaces between different Metro Rail contracts and assist with the resolution of interface problems.

B. Provide interface and installation requirements for the wayside ATC equipment. Include space requirements, connection requirements, voltage and power requirements, and mounting requirements.

5. Mock-ups and Models

Describe the design approach and materials used for building mock-ups and models. Support the description with photographs from past projects.

6. Workmanship, Processes, and Materials

A. Describe the construction materials to be used (steel, aluminum, plastics, elastomers, etc.) for the vehicle.

B. Provide an estimate of the total fire loading, with breakdown by subsystems. Describe the capability of the proposed vehicle to meet the fire safety performance requirements with particular attention to underfloor fire separations.

C. Provide workmanship and metal joining standards for:

1. Carbody skin to the frame

2. Truck casting or fabrication

D. Define subsystems having fasteners conforming to International Organization for Standardization (ISO) standards.

7. Carbody

A. Describe the approach that will be taken to ensure that the proposed vehicle will meet the requirements of structural integrity and strength.

B. Describe the proposed carbody design and provide a list of existing vehicles with similar design concepts.

C. Provide description, drawings and photographs depicting design of carbody shell, underframe, floor, underfloor equipment arrangement and mounting techniques, and side doors.

D. Document service experience in similar applications.

8. Outfittings and Furnishings

Provide interior renderings or photographs for the proposed vehicle. Provide a description of the seat construction, materials, and the method of attachment and support. Describe the proposed signs and graphics. Show proposed locations of signs and graphics on vehicle.

Document service experience with the proposed seat in a similar cantilevered application.

9. Operator Cab

Provide a description and drawings of the cab arrangement. Describe the proposed manual controller, including the deadman feature.

Document service experience with proposed manual controller and deadman arrangement.

10. Side Door Operators and Controls

Describe the proposed door control system, including:

A. Trainlining

B. Interlocking

C. Door operator, linkage and mechanical lock

D. Push-back feature.

Support the description with appropriate drawings, photographs, and schematic and block diagrams.

Document service experience with the proposed door equipment.

11. Trucks and Suspension

A. Describe truck design, including:

1. Frame construction

2. Interchangeability

3. Weight distribution and load equalization, particularly when a wheel is raised

4. Equipment mounting and arrangement

5. Primary and secondary suspension, including the natural frequencies

6. Leveling and load weight compensation.

Support the description with appropriate drawings and photographs.

B. Describe how the proposed truck will meet the specified strength requirements and ride characteristics (Reference: Section 3). Support the description with appropriate calculations, curves and data.

C. Document service experience in a similar application.

12. Coupler and Draft Gear

A. Describe how coupler and draft gear and drawbar will meet performance and strength requirements. Describe the support and centering devices, gathering range capability and emergency release.

B. Describe the proposed design for electrical, mechanical, and pneumatic coupling and uncoupling.

C. Describe the manual uncoupling mechanism.

D. Provide appropriate drawings to supplement the descriptive information.

E. Document service experience in a similar application.

13. Power Supply and Electrical Equipment

A. Describe primary power distribution arrangement. Describe the current collector assembly and its compatibility with the contact rail. Describe the method of circuit protection and transient suppression.

B. Describe proposed auxiliary power subsystem to meet requirement of Figure TP-13-1. Provide kW/kVA ratings and operating characteristics of all power sources (alternators, converters, inverters, etc.).

C. Describe the auxiliary power distribution arrangement, including operation of the load sequencing capability (if applicable), circuit protection, and ability of auxiliary power subsystem to traverse gaps.

D. Describe the low-voltage power distribution arrangement. Discuss the method of transient suppression proposed for the low-voltage circuit.

E. Support all of the above descriptions with appropriate single-line diagrams, schematic and block diagrams, and preliminary load analyses.

F. Describe methods for grounding and shielding.

G. Document service experience in rail transit applications.

5 H. Identify which mode of auxiliary power supply is used. 5
5 i.e., ac, or ac and dc, or regulated high-voltage dc, 5
5 or direct primary power. If direct primary power is 5
5 used, describe how the subsystem equipment will be pro- 5
5 tected from 450 to 900 V dc and during transients. 5

I. Identify whether LVPS and battery are provided on a per vehicle or per dependent pair basis. Provide their ratings of the LVPS and battery.

14. Propulsion Subsystem

A. Identify the specific traction motor, gear reducer, and coupling designs to be used on the proposed vehicle.

Provide traction motor rating. Provide traction motor curves of speed, tractive effort and efficiency versus current for worn and new wheels. Show operating points on the characteristics for a AW2 loaded train operating at PL-1 for 650 V dc line operation and also for 750 and 900 V dc line operations. Provide curves of torque, armature current, motor voltage and line current against speed in motoring and braking for an AW2 loaded train with new wheels operating at PL-1 with a line voltage of 750 V dc and a fully receptive line.

B. Describe the operation of the spin/slide correction feature. Identify whether an integrated system or two separate spin/slide systems will be provided.

C. Describe the propulsion chopper control subsystem, including the protective devices and interlocks. Support the description with single-line schematic and block diagrams.

D. Describe the type of control logic to be used (discrete circuit or microprocessor-based). The discussion shall include the proposed fault isolation and diagnostic capability.

E. Describe the mounting arrangement for the speed sensor and its method of installation without requiring any adjustments.

F. Describe the type, size, and method of mounting the brake resistors. Describe the method used for cooling.

G. Deleted.

H. Document service experience in a similar application.

15. Friction Brake Subsystem

A. Describe the control and operation of the friction brake subsystem, including spin/slide correction features.

Support the description with appropriate block diagrams, schematic piping diagrams, and electrical control diagrams. Identify whether a tread brake or disc type brake subsystem is offered. Identify whether electronic control unit is part of friction brake subsystem or propulsion subsystem.

B. Provide analyses to show that the subsystem will meet the requirements for:

1. Reservoir storage capacity.

2. Compressor capacity and duty cycle.

3. Emergency braking propagation and recharge times.

C. Describe the proposed parking brake.

D. Describe the air compressor unit.

E. Describe the control and operation of the emergency brake including initiation by a trip assembly (cock or switch).

F. Describe operation and functioning of any spin/slide features.

G. Document service experience with the proposed subsystem.

16. Automatic Train Operation

A. Describe automatic speed regulation, programmed station stopping, and berthing verification equipment.

B. Describe unintentional movement protection equipment.

C. Document service experience with the proposed ATO equipment.

D. Identify block boundary information required from ATP.

17. Communications

A. Describe communications subsystem and characteristics for the CCU, IC, PA, speakers, and microphones.

B. Document service experience with the proposed communications equipment.

18. Heating, Ventilating, and Air Conditioning (HVAC)

A. Describe the HVAC subsystem. Describe proposed compressor, condenser, and evaporator equipment.

B. Provide an analysis to justify the air conditioning capacity and airflow proposed for vehicle cooling. 5

C. Provide an analysis to justify the capacity of heating being proposed.

D. Provide an analysis to verify ability to meet positive pressurization and ventilation requirements.

E. Document service experience with the proposed HVAC equipment.

19. Systems Assurance Program

A. Describe the overall approach to meeting the requirements of the Systems Assurance Program. Description shall address organization, schedule, interface management and utilization of resources separately for each program of safety, reliability, maintainability and quality assurance. Provide excerpts from existing documentation and indicate major areas of modification for this project.

B. Describe the approach to meeting Guidelines for the Preparation of Safety and System Assurance Analyses, SCRTD 5-001, and support the description with examples from past experience in this area.

C. Describe the microprocessor software quality assurance program. Description shall address software development procedures, software test, validation and verification procedures, and software configuration management plans that are being used on similar programs.

D. Discuss the proposed maintenance approach to microprocessor hardware and software, including software documentation standards, fault tolerance features, fault isolation provisions, management of software changes, and software maintenance automated design tools.

20. Management Program

A. Provide an organization chart for undertaking the Work, supplemented with a definition of the responsibilities of all parties shown thereon.

B. Provide a master program schedule, with key Contract milestones emphasized. Describe the Proposer's method of critical path network planning, with special emphasis on Contract Data Requirements, control of systems engi-

neering and design, and planning for the integrated test program. This should be brief, but with sufficient detail to facilitate an understanding of the Proposer's approach to fulfillment of the Contract requirements.

C. The Proposal shall include an engineering plan for the Work. Include plans for major subcontractors' engineering. Specify key engineering milestone dates, including requirements for District actions relative to review and approval.

Where proved equipment and systems are proposed to be modified for use on Metro Rail, the development plans to qualify changes should be discussed in detail. In particular, discuss any technical or schedule risk associated with the development.

Provide a month-by-month engineering manpower resource loading plan from the time of Notice to Proceed until completion of production drawing release for all subsystems.

D. Describe the process to be used to identify and manage multiparty interfaces and those between major subsystems and components of the Work. The Proposer shall clearly describe its role and detail the interfaces with all potential major suppliers.

E. Provide excerpts from the configuration management plan the Proposer is currently using. Describe briefly any proposed changes to the plan for use on the Metro Rail Project.

21. Test Program

Describe the proposed test program including organization, interfaces, schedules, logistics, and test descriptions for:

A. Component and subsystem qualification tests.

B. Vehicle factory acceptance tests.

C. Vehicle performance tests at the test center.

D. Vehicle performance tests on District property.

E. System integration tests.

F. Reliability and maintainability demonstration tests.

G. Supplemental tests.

Use of block diagrams and brief narratives will be acceptable.

22. System Support

Describe the overall approach to providing system support. The description shall address organization, schedule and utilization of resources separately for each area of technical support, manuals preparation, microprocessor-based products, training programs, diagnostic and test equipment, special tools, and spare parts. Description should be supported by excerpts from representative documents used on past programs.

5 Deleted. 5

23. Contract Data Requirements List

Confirm compliance with the requirements.

Requirements for Part III

Part III of the Proposal shall include all drawings required to support the description of the vehicle design elements contained
5 in Part II. The drawings shall be numbered to facilitate referencing. A Drawings Index, including references to the written text, shall also be provided. The drawings shall be bound in the Proposal, and those larger in size than 8-1/2 x 11 inches shall be properly folded. Drawings shall be dimensioned in the English inch/pound system, and be of sufficient quality to enable a meaningful evaluation of the vehicle design elements. Proposals may contain half-size or reduced-size drawings. 5

5 Deleted. 5

Requirements for Part IV

Part IV of the Proposal shall include the information on any alternate designs proposed for District consideration.

Supplements

Each Supplement shall contain the description and drawings of a proposed alternate design that may not fully conform to the requirements of the Technical Provisions. To facilitate evaluation, the Supplement format shall be identical to the design element description format contained in Part II of the Proposal, except as follows:

- Difference(s) with the Proposal and the advantage(s) accruing to the District from the alternate design shall be clearly stated at the beginning of the Supplement.

- Any recommended specific wording changes needed in the Technical Provisions to allow the alternate design to conform shall be stated in the conclusion to the Supplement.

Price Proposal

Provide all pricing information required by the Pricing Forms included in the Proposal Documents. Any proposal that fails to provide all of the pricing details required in the Pricing Forms will be considered nonresponsive and will not be eligible for award.

END OF INSTRUCTIONS FOR PREPARATION OF PROPOSALS

SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT

METRO RAIL PROJECT

PASSENGER VEHICLE

CONTRACT A650

II. BEST AND FINAL OFFER FORMS

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THIS FORM ADDED BY ADDENDUM NO. A650-5

SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT

METRO RAIL PROJECT

PASSENGER VEHICLE

CONTRACT A650

Request for Best and Final Offer Dated 1/28/88

Proposer BREDA C.F.

OFFER LETTER

In response to the above-referenced Request for Best and Final Offer (BAFO), the undersigned hereby proposes to the Southern California Rapid Transit District (District) to:

> Furnish all plant, labor, technical and professional services, supervision, materials, and equipment, and to perform all operations necessary and required to perform the Work in accordance with provisions of the Proposal Documents and any addenda thereto, and at the prices stated opposite the respective items set forth in the Schedule of Prices--Pricing Forms attached hereto, and incorporated by reference herein.

The undersigned agrees that this BAFO constitutes a firm offer until a contract for the Work is fully executed by the District, unless it is withdrawn by written notification from the undersigned to the District.

The undersigned certifies that it has examined and is familiar with all provisions of the Proposal Documents and any addenda thereto; that it has carefully checked all of the words and figures shown in its Pricing Forms; that it has carefully reviewed the accuracy of all statements in this BAFO and attachments hereto; and that it has, by careful examination of the Proposal Documents and any addenda thereto, satisfied itself as to the nature and location of the Work, the general conditions to be encountered in the performance of the Work, the requirements of the Contract, and all other matters which can in any way affect the Work or the cost thereof.

THIS FORM ADDED BY ADDENDUM NO. A650-5

The undersigned further certifies that the only persons or firms interested in this Proposal as principals are those listed as such in the Qualifications and Business References Questionnaire; that this BAFO is made without collusion with any other person, firm, corporation, or other party; that neither the undersigned proposer nor any principal is included on the United States Comptroller General's Consolidated List of Persons or Firms Currently Debarred for Violations of Various Public Contracts; and that it will not prosecute the Work using facilities which have been listed on the Environmental Protection Agency's List of Violating Facilities.

If awarded a Contract, the undersigned agrees to execute the Contract and deliver it to the District within 10 calendar days after notice of award of the Contract, with the necessary certificates and Performance Bond, and to proceed with the Work upon receipt of a Notice To Proceed, in accordance with the General Provisions of this Contract.

The undersigned represents that the following person(s) are authorized to negotiate on its behalf with the District in connection with the RFP:

(Name)	(Title)	(Telephone)
MANNUCCI C.	Sales and Marketing Director	573 370243
CARIFI C.	Sales Manager	573 370290

THIS FORM ADDED BY ADDENDUM NO. A650-5

The undersigned acknowledges receipt, understanding, and full consideration of the following addenda to the Proposal Documents:

Addendum No.	1	Date	APRIL 17 87
Addendum No.	2	Date	MAY 22 87
Addendum No.	3	Date	JUNE 12 87
Addendum No.	4	Date	JUNE 22 87
Addendum No.	5	Date	JANUARY 28 88
Addendum No.	6	Date	MARCH 4 88

Proposer BREDA C.F.

Signature [signature]

Roberto Cai - General Manager
Printed Name and Title

Date March 3, 1988

Via Ciliegiole 110/B
Proposer's Business Address

51100 PISTOIA - ITALY

State of Incorporation ITALY

NOTE: Signature must be notarized. Use appropriate attached certificate. Per Instructions to Proposers, where person executes Offer Letter on behalf of Proposers, include proof of authority to act on behalf of Proposer.

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OPTIONAL FORM 175
(FORMERLY FS-88)
MARCH 1975
DEPT. OF STATE
50175-101

Certificate of Acknowledgment of Execution of an Instrument

(Country)
Republic of Italy
(County and/or other political division)
SS.
(County and/or other political division)
(Name of foreign service office)

SS:

I, Virginia Morris Consul

of the United States of America at Florence, Italy

duly commissioned and qualified, do hereby certify that on this 3rd

day of March 1988 (DATE), before me personally appeared

= ROBERTO CAI =

x x x x x x x x x x

to me personally known, and known to me to be the individual--described in, whose name was subscribed to, and who executed the annexed instrument, and being informed by me of the contents of said instrument he duly acknowledged to me that he executed the same freely and voluntarily for the uses and purposes therein mentioned.

[SEAL]

In witness whereof I have hereunto set my hand and official seal the day and year last above written.

Virginia Morris
Consul
_____ of the United States of America

NOTE.—Wherever practicable all signatures to a document should be included in one certificate.

☆U.S.GPO:1980-0-311-153/5279

BREDA COSTRUZIONI FERROVIARIE

ATTACHMENT TO OFFER LETTER

PROOF OF AUTHORITY

REPUBLIC OF ITALY)
PROVINCE OF FLORENCE)
CITY OF FLORENCE)
CONSULATE GENERAL OF)SS.
THE UNITED STATES OF)
AMERICA,)

I hereby solemnly declare:

That my name is Isobel Febe WILKE

That I reside at Via Cosimo Trinci 22, Pistoia, Italy

That I am thoroughly acquainted with the Englisn and Italian languages:

That I have made the translation of the attached document and that th s translation true and correct rendering into English of the Italian Text.

√ Isobel Febe WILKE

Subscribed and sworn to before me this 24th day of February 88
at FLORENCE, Italy.

Virginia Morris
Consul of the United States
of America

WP-0033M - 9/87

The Court of Pistoia

The undersigned clerk of the Court

certifies that

- The Corporate Company "BREDA COSTRUZIONI FERROVIARIE S.p.A." with main office in Pistoia Via Ciliegiole, 110/b and subsidiary office in Rome, Via Giorgione, 163, with company capital of Lit. 120.000,000,000 =, fully paid up, duration establisned as up to 31 December 2020, having as purpose the manufacture, repair, assembly and sale of rolling stock, both tractive and trailer, for the transportation of persons and things on separate right-of-way and on rail or road, as well as metal structural work and mechanical work in general is inscribed in the Registry of Companies of this Court under number 2867;

- that said Company according to its own bylaws is managed by a sole administrator or by a Board of Directors comprised of from four to eight members whose term of office is three years and who can be reappointed;

- tnat the administrative body has the widest powers for ordinary and special administration of tne Company which are not by law reserved to shareholders;

- the legal representatives of the Company for all matters concerning third parties and in Courts of Law is the sole Chairman of the Board of Directors;

- tne current Chairman is Capuano Giuseppe, born at Barletta

on June 4, 1921, residing in Pistoia, Via Ciliegiole 110/b, for the term of office;

- the Board of Directors has unanimously conferred upon the Chairman of the Board itself, in the report dated July 15, 1987, all powers of ordinary and special administration, apart from those not delegable by law, to be exercised with his sole signature;

- Mr. Capuano, with the document notarized by Gualtiero Cappellini Notary, on September, 21 1983, rep. N. 117291/ 12970 here registered, exercising the powers conferred upon him by the Board of Directors, conferred upon Mr. Corrado Fici, Board Member and General Manager, born in Florence on June 2, 1934, and Roberto Cai, General Manager of the Company, born in Pistoia on August 13, 1937, the following powers to be exercised with individual signature :

1) rent and take in rental real estate for a duration not exceeding nine years;

2) purchase equipment, machinery and their accessories, equipment, raw materials, consumable materials, furniture, furnishings and all else needed for the Company's activity, sell them and exchange them;

3) sell and exchange goods and products, hire and confer services, supplies, purveyances and supply contracts of any kind, as regards either private or public administrations, stipulating the relative contracts and specifications, re-

present the Company in all import and export operations;

4) concur in the establishment of Consortiums, Associations and/or Joint Ventures;

5) hire the laborers and office staff needed for running the Company, establish their salaries and wages, suspend or dismiss personnel, represent the Company with trade union organizations, stipulate consultant's contracts establishing compensation and terms;

6) nominate and terminate contracts with agents, franchisees and representatives, establish their powers and compensations, give and receive fees;

7) participate in public and private auctions, tenders, bids, signing the relevant contracts and specifications;

8) stipulate insurance contracts of any kind and nature;

9) arrange for payments to be made and issue orders to pay and draw cheques on Banks accounts, also those in deficit, from financial institutions in Italy and abroad, and from public agencies, juridical persons or collective organizations;

10) exact payment of credits of any amount due the Company, make and withdraw deposits of sums and securities at any public or private Bank;

11) casn postal and telegraphic money orders, pay orders and cheques of any kind, including pay orders to the treasuries of the State, the Regions, the Provinces, the Municipalities

and any other juridical person, public or private, issuing receipts;

12) endorse, exact and receive promissory notes, bank money orders and drafts, bank cheques, as well as issue drafts also for cashing and discount;

13) request banks, financial institutions, insurance companies and other organizations, bonds in favour of Public Administrations and private agencies, taking on all relative obligations;

14) settle any isssue in wnich the Company may be involved, making compromises, accepting or rejecting proposals for settlement, proceeding to readjust and pay off counts and payables and receivables;

15) promote and sustain legal action for any purpose and at any level of jurisdiction, including Courts of Appeal and Supreme Court and arbitrational proceedings in any form; promote bankruptcy procedures and represent the Company in them, claim credits in bankruptcy procedures, attend bankruptcy procedures; nominate lawyers and attorneys for litigations and confer upon them the necessary powers, nominate Arbitrators, also as "aimable compositeurs";

16) represent the Company before the competent judge and Authorities, promote and sustaining petitions, appeals and claims before same, for any purpose, also as preventive or executive remedies, with the power of delegating others to

represent the Company in disputes with employees and laborers, and confer upon them all the necessary powers as per art. 420 of the Civil Law Code, including those of settling and conciliating;

17) attend deliveries and tests of materials and/or finisned products with the power of delegating others to represent the Company;

18) receive registered mail and insured letters, postal packages and packages of any kind, carry out any transaction with postal, railway and customs offices, transport and navigation Companies, delegate others to carry out such transactions, exonerate said agencies and the administrations in general from any and all responsibilities;

19) issue certificates and declarations for income tax returns, except from pay-rolls and statements concerning personnel for social security, insurance and health and welfare agencies, as well as for other agencies and private concerns;

20) sign correspondence inherent to the delegated powers;

21) issue and terminate, within the limits of the conferred powers, proxy "ad negotia";

- said Company is not in liquidation and that there are no pending suits for bankruptcy, composition before bankruptcy or controlled administration before this Court of Law, and that such proceedings have not taken place in the past five

years.

TRIBUNALE DI PISTOIA

Il sottoscritto Cancelliere

certifica

che al n. 2867 registro delle Società esistente presso questa Cancelleria Commerciale risulta iscritta la Società per azioni denominata "BREDA COSTRUZIONI FERROVIARIE SPA" con sede in Pistoia, Via Ciliegiole 110B, sede secondaria in Roma, Via Giorgione, 163 capitale sociale di lire 120.000.000.000, interamente versato, durata fissata fino al 31 dicembre 2020, avente per oggetto la costruzione, la riparazione, il montaggio in opera e il commercio di materiale mobile trainante e trainato per trasporto di persone e di cose su sede propria e su rotaie o su strada, nonchè di carpenterie metalliche e lavorazioni meccaniche in genere;

che detta società a norma del suo statuto sociale, è amministrata da un amministratore unico o da un consiglio di amministrazione composto da quattro ad otto membri i quali durano in carica tre esercizi sociali e sono rieleggibili;

che all'organo amministrativo spettano i più ampi poteri per la gestione ordinaria e straordinaria della società, che non siano per legge riservati inderogabilmente all'assemblea dei soci;

che la rappresentanza della società di fronte ai terzi ed

IL SEGRETARIO
Brunella Fiorini

- 5 AGO. 1997

DIRITTI CANCELLERIA
BOLLETTA N. 15576
£ 1.000(T)

MARCA COMUNE DI LIRE 5000 FIGLIA

in giudizio spetta al Presidente del Consiglio di Amministrazione;

che attualmente riveste la carica di Presidente del Consiglio di amministrazione il Sig. CAPUANO Dr. Ing. GIUSEPPE, nato a Barletta il 4/6/1921, domiciliato per la carica a Pistoia, Via Ciliegiole, 110B;

che il Consiglio di Amministrazione con verbale in data 15 luglio 1987, all'unanimità ha conferito al Presidente del Consiglio stesso, ad eccezione di quelli non delegabili per legge, tutti i poteri di ordinaria e straordinaria amministrazione da esercitare con firma singola;

che l'ing. Giuseppe Capuano in virtù dei poteri a lui conferiti ha delegato in data 21 settembre 1983 con atto rogito notaio Cappellini Gualtiero rep. n.117291/12970 regolarmente depositato a norma di legge, all'Amministratore e Direttore Generale della Società ing. CORRADO FICI nato a Firenze il 2 giugno 1934, ed all'ing. ROBERTO CAI, Direttore Generale della Società, nato a Pistoia il 13 agosto 1937 i seguenti poteri da esercitare con firma singola:

1) Locare ed assumere in locazione beni immobili per durata non superiore a nove anni.

2) Acquistare impianti, macchinari e loro accessori, attrezzature, materie prime, merci, materiali di consumo, mobili, arredi, e quant'altro necessario per l'attività

aziendale, venderli e permutarli.

3) Vendere e permutare merci e prodotti, assumere e conferire servizi, forniture, somministrazioni ed appalti di qualsiasi specie, sia nei riguardi di privati sia di pubbliche amministrazioni, stipulando i relativi contratti e capitolati, rappresentare la società nello svolgimento di tutte le pratiche di importazione ed esportazione.

4) Concorrere alla costituzione di consorzi, associazioni e/o raggruppamenti di aziende.

5) Assumere il personale operaio ed impiegatizio occorrente per la gestione dell'azienda, fissarle le relative attribuzioni, sospenderlo e revocarlo, rappresentare la società presso le organizzazioni di categoria e sindacali; stipulare contratti di consulenza fissandone compensi e modalità.

6) Nominare e revocare agenti, concessionari e rappresentanti fissarne le attribuzioni ed i compensi, dare e ricevere commissioni.

7) Adire ad aste ed incanti pubblici e privati, gare, licitazioni, appalti concorso, firmando i relativi contratti e capitolati.

8) Stipulare contratti di assicurazione di qualsiasi genere e natura.

9) Dare disposizioni per l'esecuzione di pagamenti ed emettere mandati ed assegni sui conti correnti, anche

passivi, della Società, presso qualunque Istituto di credito in Italia ed all'Estero, presso Enti pubblici, persone giuridiche od Enti collettivi.

10) Esigere crediti e qualunque somma dovuta alla società; fare e ritirare depositi di somme e valori presso qualunque cassa pubblica e privata.

11) Riscuotere vaglia postali e telegrafici, mandati ed assegni di qualsiasi specie, compresi i mandati sulle Tesorerie dello Stato, le Regioni, le Provincie, i Comuni e qualsiasi altra persona giuridica pubblica o privata, rilasciando scarichi e liberazioni.

12) Girare, esigere e quietanzare cambiali, vaglia bancari e cambiari, assegni bancari nonchè emettere tratte anche per l'incasso e lo sconto.

13) Richiedere a Banche, Istituti di Credito, Compagnie di Assicurazioni ed altri Enti, fidejussioni a favore di Amministrazioni pubbliche ed Enti Privati assumento le corrispondenti obbligazioni.

14) Transigere qualsiasi questione nella quale la società possa essere interessata, fare compromessi, accettare o respingere proposte di concordato, procedere a revisioni e liquidazioni di conti e di partite attive e passive.

15) Promuovere e sostenere azioni giudiziarie per qualunque oggetto ed in qualunque grado di giurisdizione, compresi i giudizi di revocazione e cassazione e procedimenti

arbitrali rituali ed irrituali. Promuovere procedure fallimentari e rappresentare in esse la Società, fare insinuazioni di crediti, assistere alle adunanze dei creditori. Nominare avvocati e procuratori alle liti e conferire loro gli occorrenti poteri, nominare arbitri anche come amichevoli compositori.

16) Rappresentare la società avanti le competenti giurisdizioni ed autorità, promuovere e sostenere istanze, ricorsi e reclami avanti le stesse per qualunque oggetto, anche in via di preventiva cautela o di esecuzione, con facoltà di delegare altri a rappresentare la società stessa nelle vertenze con il personale impiegatizio e salariato e conferire all'uopo tutti i poteri di cui all'art. 420 codice procedura civile, compresi quelli di transigere e conciliare.

17) Assistere a consegne e collaudi di materiali e/o prodotti finiti, con la facoltà di delegare altri a rappresentare la società.

18) Ritirare lettere raccomandate ed assicurate, pacchi postali e pieghi di qualunque specie, compiere qualsiasi operazione presso gli uffici postali, ferroviari, doganali, imprese di trasporto e di navigazione: delegare altri a compiere le operazioni stesse. Esonerare gli Enti stessi e le Amministrazioni in genere da ogni e qualsiasi responsabilità.

19) Rilasciare certificati e dichiarazioni per la denuncia dei redditi, estratti dei libri paga ed attestazioni riguardanti il personale sia per gli Enti previdenziali, assicurativi e mutualistici, che per altri Enti e Privati;

20) Firmare la corrispondenza inerente ai poteri delegati.

21) Rilasciare e revocare nei limiti dei poteri conferiti procure "ad negotia".

che detta società non risulta in liquidazione e che a carico della stessa non risultano pendenti presso questo Tribunale procedure di fallimento, concordato preventivo o di amministrazione controllata;

che dette procedure non si sono verificate nel quinquennio precedente la data odierna.

Pistoia, 5 AGO. 1987

IL DIRETTORE DI CANCELLERIA
(Vittorio Baccolini)

TRIBUNALE CIVILE E PENALE - PISTOIA

THIS FORM ADDED BY ADDENDUM NO. A650-5

Attachment I:

Certificate of acknowledgement; corporation.

State of _____,
SS. County of _____

On this ____ day of _____, in the year ____, before me the undersigned, a Notary Public in and for said State, personally appeared _____, personally known to me (or proven to me on the basis of satisfactory evidence) to be the person who executed the within instrument as president (or secretary) or on behalf of the corporation therein named and acknowledged to me that the corporation executed it.

(SEAL)

_____
Signature of Notary Public

Attachment II:

Certificate of acknowledgement; partnership.

State of _____,
SS. County of _____

On this ____ day of _____, in the year _____, before me the undersigned, a Notary Public in and for said State, personally appeared _____, personally known to me (or proven to me on the basis of satisfactory evidence (to be the person that executed this instrument, on behalf of the partnership and acknowledged to me that the partnership executed it.

(SEAL)

_____
Signature of Notary Public

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THIS FORM ADDED BY ADDENDUM NO. A650-5

Attachment III:

Certificate of acknowledgement; joint venture.

State of _____,
SS. County of _____

On this _____ day of _____, in the year _____, before me the undersigned, a Notary Public in and for said State, personally appeared _____, personally known to me (or proven to me on the basis of satisfactory evidence) to be the person who executed this instrument, or on behalf of the joint venture and acknowledged to me that the joint venture executed it.

(SEAL)

_____
Signature of Notary Public

Attachment IV:

Certificate of acknowledgement; individual.

State of _____,
SS. County of _____

On this _____ day of _____, in the year _____, before me the undersigned, a Notary Public in and for said State, personally appeared _____, personally known to me (or proven to me on the basis of satisfactory evidence) to be the person that executed this instrument, on behalf of the partnership and acknowledged to me that he (she or they) executed it.

(SEAL)

_____
Signature of Notary Public

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THIS FORM ADDED BY ADDENDUM NO. A650-5

SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT

METRO RAIL PROJECT

PASSENGER VEHICLE

CONTRACT A650

Request for Best and Final Offer Dated 1/28/88

Proposer BREDA C.F.

SCHEDULE OF PRICES--PRICING FORMS

The District intends to enter into a firm fixed-price contract for the scope of Work described in the Proposal Documents. The price (including profit) proposed for the Work should be on that basis. The District has the right to award a contract at the quoted price without further discussions.

The Proposer shall complete the forms in the spaces provided. Payment of the amounts shown on the Pricing Forms shall constitute full compensation for the Work described in the Contract. Prices of work shown or indicated in the Contract, but not separately stated as items on the Pricing Forms, shall be included in the most appropriate item on the Pricing Forms. Be sure to have a properly authorized representative of the Proposer's organization sign Pricing Form AA.

The completed forms shall be placed in an envelope separate from the rest of the BAFO, sealed, and marked in accordance with the Request for BAFO. The Pricing Data shall be submitted with the BAFO.

The Proposer must provide all pricing information required by the Pricing Forms included with the Proposal Documents. Failure to do so will cause the BAFO to be eliminated from consideration for award.

The price factor which will be evaluated as part of the BAFO evaluation process is the Adjusted Contract Price on Pricing Form AA and the Option Total Price on Pricing Form FF.

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THIS FORM ADDED BY ADDENDUM NO. A650-5

SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT

METRO RAIL PROJECT

PASSENGER VEHICLE

CONTRACT A650

Request for Best and Final Offer Dated 1/28/88

Proposer BREDA C.F.

SCHEDULE OF PRICES

Pricing Form AA
Base Buy

CONTRACT PRICE--TOTAL

Full compensation to Contractor for full and complete performance of all Work as specified in the Proposal Documents, compliance with all terms and conditions of the Contract, and payment by the Proposer (Contractor) for all obligations incurred in or applicable to the Proposer's (Contractor's) performance of the Work shall be the CONTRACT TOTAL (sum of priced items 1 through 7), which includes delivery costs and applicable taxes:

Item	Description	Unit	Quantity	Unit Price	Extension	Total Price
1	Passenger Vehicles					
	Vehicle--A-Car	each	15	$ 1'584'656	$ 23'769'840	
	Vehicle--B-Car	each	15	$ 1'547'546	$ 23'213'190	
	Passenger Vehicle Total Price					$ 46'983'030
2	Performance Bond	Lump Sum				$ 584'700
3	System Support per Pricing Form BB	Lump Sum				$ 1'352'646
	Contract Subtotal					$ 48'920'376
4	Diagnostic and Test Equipment per Pricing Form CC	Lump Sum				$ 1'154'269
5	Wayside Station Stop Equipment	each	5	$ 31'413		$ 157'065

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THIS FORM ADDED BY ADDENDUM NO. A650-5

Item	Description	Unit	Quantity	Unit Price	Total Price
6	Spare Parts per Pricing Form DD	Lump Sum			$ 3'239'041
7	Miscellaneous Items per Pricing Form EE	Lump Sum			$ 414'249
CONTRACT TOTAL - (Sum of Items 1 through 7)					$ 53'885'000

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DISTRICT'S TRAVEL AND LIVING EXPENSE ADJUSTMENT

This adjustment will be added to the CONTRACT TOTAL, since the District's costs during contract implementation will be affected by the location of the contractor's facilities.

A. Air Travel: Allowance for standard coach air fare for 40 round trips between Los Angeles and the Contractor's facilities in

City: PISTOIA Country: ITALY $ 54 400

B. Living Allowance: 400 days at $90 per day. For locations outside of the United States, this amount must be multiplied by the appropriate index ratio as listed in the U.S. Department of State Indexes of Living Costs Abroad and Quarters Allowances, published by the U.S. Department of Labor, Bureau of Labor Statistics, latest revision, for the city nearest the contractor's principal place of assembly for the vehicle purchased under this contract.

City: FLORENCE Index: 131 $ 47 160

ADJUSTED CONTRACT PRICE (CONTRACT TOTAL + A + B) $ 53 986 560

Proposer BREDA C.F.

Signature [signature]

Roberto Cai, General Manager
Printed Name and Title

Date March 2, 1988

5 END OF PRICING FORM AA 5

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SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT

METRO RAIL PROJECT

PASSENGER VEHICLE

CONTRACT A650

Request for Best and Final Offer Dated 1/28/88

Proposer BREDA C.F.

SCHEDULE OF PRICES

Pricing Form BB
Base Buy

SYSTEM SUPPORT

This Form includes System Support planning, services, and equipment. Technical Support, Diagnostic and Test Equipment and Spare Parts (Reference: Technical Provisions, Article 22.2, 22.6 and 22.8 respectively), is not included. All other support item prices are to be listed on this Pricing Form.

Item	Description	Price
BB1	Preparation of System Support Plan	$ 5,668
BB2	Manuals	$ 1,069,281
BB3	Microprocessor-based Product Assistance	$ 6,007
BB4	Training	$ 243,208
BB5	Special maintenance tools	$ 28,482
	TOTAL FOR SYSTEM SUPPORT Enter into Pricing Form AA, Item 3	$ 1,352,646

END OF PRICING FORM BB

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SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT

METRO RAIL PROJECT

PASSENGER VEHICLE

CONTRACT A650

Request for Best and Final Offer Dated 1/28/88

Proposer BREDA C.F.

SCHEDULE OF PRICES

Pricing Form CC

DIAGNOSTIC AND TEST EQUIPMENT
Complete This Pricing Form for the items listed.

Item	Description		Quantity	Unit Price	Total Price
	Subsystem	DTE			
CC1	Side Door Operators and Controls	Door Control (Portable)	2	$ 3,322	$ 6,644
CC2	HVAC	HVAC Control (Portable)	2	$ 24,322	$ 48,644
CC3	HVAC	HVAC (Shop)	1	$ 67,335	$ 67,335
CC4	HVAC	Flushing (Shop)	1	$ 3,378	$ 3,378
CC5	Power Supply and Electrical Equipment	LVPS (Portable)	2	$ NA	$ NA
CC6	Power Supply and Electrical Equipment	LVPS (Shop)	2	$ NA	$ NA
CC7	Power Supply and Electrical Equipment	Auxiliary Power Supply (Portable)	2	$ NA	$ NA
CC8	Power Supply and Electrical Equipment	Auxiliary Power Supply (Shop)	2	$ NA	$ NA

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THIS FORM ADDED BY ADDENDUM NO. A650-5

SCHEDULE OF PRICES -- DIAGNOSTIC AND TEST EQUIPMENT

Pricing Form CC

Item	Description		Quantity	Unit Price	Total Price
	Subsystem	DTE			
CC9	Propulsion	Power Modulation Control (Portable)	4	$ 73,844	$295,376
CC10	Propulsion	Traction Power (Shop)	2	$226,198	$452,396
CC11	Friction Brake	Friction Braking (Shop)	2	$ 70,544	$141,088
CC12	Communications	PA/IC (Portable)	2	$ 1,773	$ 3,546
CC13	Communications	PA Amplifier (Shop)	2	$ 788	$ 1,576
CC14	Communications	IC (Shop)	2	$ 1,329	$ 2,658
CC15	ATO	Carborne and Wayside Equipment (Portable)	2	$ 17,355	$ 34,710
CC16	ATO	Carborne and Wayside Equipment (Shop)	2	$ 48,459	$ 96,918
	TOTAL FOR DIAGNOSTIC AND TEST EQUIPMENT Enter into Pricing Form AA, Item 5				$1,154,269

END OF PRICING FORM CC

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SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT

METRO RAIL PROJECT

PASSENGER VEHICLE

CONTRACT A650

Request for Best and Final Offer Dated 1/28/88

Proposer BREDA C.F.

SCHEDULE OF PRICES--SPARE PARTS REQUIREMENTS

Pricing Form DD

SPARE PARTS

Provide prices for all items applicable for proposed Passenger Vehicle. The District may order increased or decreased quantities of the parts listed. The District may not order all parts at the time the Contract is awarded, but may place additional orders as the design and logistic support plan is developed. Unit prices shall be quoted and shall be firm for at least 12 months from the date of Contract. A longer time is desirable and will be considered in the Price Proposal evaluation.

Item No.	Description	Unit	Quantity	Unit Price	Total Price
	Carbody (Exterior)				
1.	Cab exterior shell	each	3	5030	15090
2.	R-End shell	each	2	5690	11380
3.	Head light assembly*	car set	4	293	1172
4.	Tail light assembly	car set	4	220	880
5.	Side indicator light assembly	car set	3	612	1836
6.	Air intake grille	car set	2	1094	2188
7.	Exterior graphics (excluding car number)	car set	2	1142	2284

SCHEDULE OF PRICES--SPARE PARTS REQUIREMENTS

Pricing Form DD

Item No.	Description	Unit	Quantity	Unit Price	Total Price
8.	Crew grab handle and step	car set	2	276	552
9.	Lamps, all types	car set	5	119	595
10	Taillight lens	car set	4	168	672
11.	Side indicator light lens	car set	3	112	336
	Carbody (Interior)				
12.	Handrail and stanchion	car set	2	2065	4130
13.	Interior liner (all, including cab)	car set	2	18088	36176
14.	Windscreen, complete	car set	2	4756	9512
15.	Floor covering	car set	2	2194	4388
16.	Interior graphics (excluding car numbers)	car set	2	285	570
17.	Seat assembly transverse, left hand, excluding cushions	each	4	632	2528
18.	Seat assembly transverse, right hand, excluding cushions	each	4	632	2528
19.	Seat assembly longitudinal one seater excluding cushions	each	4	394	1576
20.	Seat cushions - bottom and back	each	100	85	8500
21.	Seat handgrip	car set	2	1706	3412
22.	Back to back seat assembly (if different from transverse assembly)	each	4	1158	4632
23.	Back to back seat hinge & lock mechanism (if used)	each	4	N.A.	
24.	Fluorescent light fixture with lens and air diffuser	car set	1	11994	11994
25.	Fluorescent light ballast	car set	4	1001	4004
26.	Fluorescent lamp holder	car set	4	927	3708
27.	Fluorescent tube	car set	10	114	1140
28.	Lamps, all type (including annunciators)	car set	5	348	1740
29.	Lens (each type)	car set	2	4313	8626
30.	HVAC return air grille	car set	2	333	666
31.	Equipment cabinet lock	car set	2	106	212

THIS FORM ADDED BY ADDENDUM NO. A650-5

SCHEDULE OF PRICES--SPARE PARTS REQUIREMENTS

Pricing Form DD

Item No.	Description	Unit	Quantity	Unit Price	Total Price
	Operator's Cab				
32.	Manual controller assembly	each	4	3487	13948
33.	Operator console assembly	each	2	10427	20854
34.	Auxiliary control and switch panel assembly	each	2	1367	2734
35.	Auxiliary annunciator panel assembly	each	2	1294	2588
36.	Low-voltage circuit breaker panel assembly	each	2	3832	7664
37.	Air pressure gauge	each	6	219	1314
38.	Side door control panel	car set	2	1012	2024
39.	Couple/uncouple, auxiliary power control panel	each	2	689	1378
40.	Lighting/windshield device control panel	each	2	843	1686
41.	Hour meter	car set	2	562	1124
42.	Cab seat assembly	each	2	517	1034
43.	Cab seat cushion and back	each	2	59	118
44.	Cab seat adjustment knob	each	4	16	64
45.	Sun visor assembly	each	2	238	476
46.	Defogger assembly	each	4	1293	5172
47.	Defogger blower motor	each	4	168	672
48.	Console and panel switch, indicator and relay	car set	2	2587	5174
49.	Cab overhead light assembly	car set	2	398	796
50.	Cab area equipment enclosure (all types)	car set	2	2094	4188
51.	Circuit breaker	car set	3	787	2361
52.	Emergency ladder	each	6	202	1212
53.	Air diffuser, spot type	each	2	95	190
54.	Key (all types)	car set	50	90	4500
55.	Lamp for lighted indicators and pushbuttons	car set	5	101	505
56.	Light emitting diode (LED)	car set	2	562	1124
57.	Console panel assembly	car set	2	7312	14624
58.	Control printed circuit board	car set	3	3262	9786
59.	Coat hook	each	4	168	672
60.	Sun visor	each	4	95	380

SCHEDULE OF PRICES--SPARE PARTS REQUIREMENTS

Pricing Form DD

Item No.	Description	Unit	Quantity	Unit Price	Total Price
61.	Lens for all indicators and switches	car set	2	1091	2182
62.	Lead seal for sealed switches	each	50	95	4750
63.	Contact pins for all panels	car set	1	1125	1125
64.	Windshield wiper control valve	each	4	67	268
	Windows				
65.	Windshield	car set	4	1804	7216
66.	Sliding window, frame and lock assembly	car set	4	1666	6664
67.	R-end end windows, with frame assembly	car set	2	314	628
68.	Passenger side window	each	15	509	7635
69.	Side door window	car set	4	1904	7616
70.	End door window, F-end	each	4	257	1028
71.	End door window, R-end	each	4	204	816
72.	Window, destination sign, if applicable	each	4	123	492
73.	Glass, - cab partition and cab door	car set	2	761	1522
74.	Glazing rubber (each type) sufficient length to reglaze one vehicle	car set	3	2522	7566
	Miscellaneous				
75.	Horn	each	3	506	1518
76.	Pneumatic horn diaphragms	each	10	67	670
77.	Horn valve	each	3	225	675
78.	Windshield wiper arm assembly	each	4	73	292
79.	Windshield wiper motor assembly	each	4	196	784
80.	Windshield wiper blade	each	20	5	100
81.	Propulsion equipment blower fan motor (if used)	car set	4	N.A.	
82.	Trainline junction box assembly (if used)	each	2	25323	50646
83.	Access cover, lock & latch for all equipment boxes, assemblies underfloor and inside car	car set	4	2250	9000
84.	Collector shoe lifting paddle	car set	4	2812	11248

THIS FORM ADDED BY ADDENDUM NO. A650-5

SCHEDULE OF PRICES--SPARE PARTS REQUIREMENTS

Pricing Form DD

Item No.	Description	Unit	Quantity	Unit Price	Total Price
	Coupler				
85.	F-end mechanical coupler	each	4	31539	126156
86.	Electric coupler components	car set	4	11221	44884
87.	Intercar jumper cable	car set	3	8381	25143
88.	Uncoupling cylinder	each	4	213	852
89.	Centering device	each	2	253	506
90.	Coupler emergency release bolt	car set	10	216	2160
91.	Uncoupling valve	car set	3	191	573
92.	Drawbar assembly	each	2	7256	14512
93.	Electric coupler	each	4	5028	20112
	Doors				
94.	Door operating mechanism, complete	car set	2	24300	48600
95.	Bottom door track and threshold plate assembly	car set	1	2380	2380
96.	Door control relay panel assembly	car set	2	2711	5422
97.	Side door leaf	car set	1	15930	15930
98.	Side door hanger assembly	car set	1	included in ITEM 94	
99.	F-end door	each	2	1972	3944
100.	R-end door	each	2	1795	3590
101.	End door hinge	car set	2	142	284
102.	Cab door lock	each	4	241	964
103.	Cab door	each	2	666	1332
104.	Crew key switch	car set	4	1332	5328
105.	Door limit switch, resistor, and relay	car set	6	1125	6750
106.	Door seal and edge for one complete side door (both leafs)	each	12	275	3300
107.	Door signal light assembly, exterior, with lens	car set	2	513	1026
108.	Side door mechanical lock mechanism	car set	2	236	472
109.	Weatherstrip (all types) for end doors	car set	2	380	760
110.	End door stop assembly	each	4	281	1124

SCHEDULE OF PRICES--SPARE PARTS REQUIREMENTS

Pricing Form DD

Item No.	Description	Unit	Quantity	Unit Price	Total Price
111.	Cab door stop assembly	each	4	168	672
112.	Side door stop assembly	each	12	506	6072
113.	End door closer	car set	2	562	1124
	Heating, Ventilating, & Cooling				
114.	Compressor assembly with motor	each	3	11587	34761
115.	Condenser unit, complete	each	3	2868	8604
116.	Evaporator unit, complete	each	3	1519	4557
117.	Condenser fan	car set	2	181	362
118.	Evaporator fan	car set	2	220	440
119.	Refrigerant valve (each type)	car set	3	904	2712
120.	Vibration mount	car set	2	99	198
121.	HVAC control assembly	each	2	17044	34088
122.	Heater element, overhead (each type)	each	2	1599	3198
123.	Temperature control (relays, contactors, resistors, rectifiers, and thermostats)	car set	6	906	5436
124.	Protective switch	car set	2	528	1056
125.	Drain pan and drain line	car set	2	331	662
126.	Disposable filter (each type)	each	60	33	1980
127.	Filter-drier core element	each	5	43	215
128.	Strainer (each type)	each	5	included in ITEM 116	
129.	Air diffuser, passenger area	car set	2	9000	18000
130.	Refrigerant receiver	each	2	433	866
131.	Pressure control switch	car set	4	254	1016
132.	Condenser coil	each	4	2868	11472
133.	Oil filter screen assembly	each	2	92	184
134.	Bottom cover plate gasket	each	6	25	150
135.	Capacity control valve	each	4	280	1120
136.	Condenser fan motor	each	4	4443	17772
137.	Evaporator coil	each	4	1519	6076
138.	Expansion valve	each	6	99	594

THIS FORM ADDED BY ADDENDUM NO. A650-5

SCHEDULE OF PRICES--SPARE PARTS REQUIREMENTS

Pricing Form DD

Item No.	Description	Unit	Quantity	Unit Price	Total Price
139.	Air flow switch	each	4	284	1136
140.	Fuse link	each	6	11	66
141.	Compressor motor	each	2	8617	17234
142.	Evaporator fan motor	each	4	4950	19800
	Auxiliary Electrical				
143.	Low-voltage power supply	each	2	14094	28188
144.	Battery charger	each	2	N.A.	
145.	Battery cell and connecting bar	each	50	238	11900
146.	Battery box	each	2	3589	7178
147.	Motor starter & control	car set	2	5793	11586
148.	Auxiliary circuit breaker, all types	car set	2	9281	18562
149.	Motor-alternator set, convertor, inverter, or voltage limiting chopper, as applicable	car set	4	N.A.	
150.	Dc motor brush (all dc motors other than traction)	car set	20	191	3820
151.	Control printed circuit board	car set	4	6075	24300
152.	Terminal strip, (all types)	car set	1	1215	1215
153.	High voltage circuit breaker	car set	1	7312	7312
	Trucks				
154.	Truck, assembly complete (ready for exchange with an installed truck and operation in revenue service without any additional parts)	car set	3	301635	904905
155.	Wheel, separate, rough bored	each	30	689	20670
156.	Wheel/axle assembly, complete	each	8	3937	31496
157.	Current collector assembly	car set	2	5090	10180
158.	Air spring assembly	each	10	571	5710
159.	Leveling valve assembly	each	4	590	2360

SCHEDULE OF PRICES--SPARE PARTS REQUIREMENTS

Pricing Form DD

Item No.	Description	Unit	Quantity	Unit Price	Total Price
160.	Axle bearing	car set	2	1856	3712
161.	Current collector shoe	each	100	28	2800
162.	Current collector shoe fuse	each	50	236	11800
163.	Shim, wheel wear (if used)	each	30	N.A.	
164.	Contact rail shoe fuse box	each	2	157	314
165.	Shock absorber	car set	2	690	1380
166.	Trip cock or trip switch	car set	2	1046	2092
167.	ATC antenna bracket	car set	4	180	720
168.	Primary spring assembly	car set	2	3260	6520
169.	Center bearing wear plate	each	4	333	1332
170.	Lateral stop	each	8	142	1136
171.	Current collector shunt	each	24	393	9432
	Propulsion				
172.	Traction motor - unattached, separate	each	6	25110	150660
173.	Gear drive - unattached, separate	each	4	15163	60652
174.	Line switch assembly	each	4	4131	16524
175.	Propulsion control logic assembly	car set	3	486	1458
176.	Printed circuit card for propulsion control system (complete set)	car set	6	37422	224532
177.	Motor control relay and contactor	car set	4	12150	48600
178.	Main chopper thyristor, diode and commutating capacitor tray for both armature and field circuits	car set	4	4131	16524
179.	P- and BRK signal generators for ATO and MTO (if not part of other assemblies)	car set	3	3039	9117
180.	Main fuse	each	10	121	1210
181.	Voltage and current sensor	car set	4	1215	4860
182.	Ground brush holder	car set	6	5103	30618
183.	Motor/gear reducer coupling	car set	4	4860	19440
184.	Capacitor filter fuse	car set	2	1822	3644

THIS FORM ADDED BY ADDENDUM NO. A650-5

SCHEDULE OF PRICES--SPARE PARTS REQUIREMENTS

Pricing Form DD

Item No.	Description	Unit	Quantity	Unit Price	Total Price
185.	Line filter	car set	2	4219	8438
186.	Motor reactor (if used)	car set	2	4628	9256
187.	Resistive brake grid	car set	4	8931	35724
188.	Traction motor brush	each	100	36	3600
189.	Ground brush	each	10	643	6430
190.	Traction motor cooling fan with motor (if used)	each	4	4972	19888
191.	Knife switch assembly	each	3	4131	12393
192.	Motor quick disconnect assembly	car set	2	2835	5670
193.	Speed sensor	car set	6	1307	7842
194.	Transducer, load weigh assembly	car set	2	946	1892
195.	Logic power supply	each	4	3037	12148
196.	Chopper cooling fan with motor	car set	2	4972	9944
197.	Traction motor brush holder	car set	4	1440	5760
	Friction Brakes				
198.	Gasket, diaphragm, o-ring	car set	4	916	3664
199.	Disc brake pad set (for one disc) or tread brake shoe	each	100	19	1900
200.	Electronic control PC card	car set	2	8237	16474
201.	Electronic control unit	car set	2	9450	18900
202.	Parking brake component	car set	2	922	1844
203.	Control valve	car set	4	12557	50228
204.	Control unit, pneumatic	car set	2	10818	21636
205.	Logic power supply (if different from propulsion logic power supply)	each	4	650	2600
206.	Cutout device	car set	2	305	610
207.	Brake disc (if used)	car set	2	N.A.	
208.	Brake caliper or tread brake unit	car set	1	20036	20036
209.	Air hose	car set	4	558	2232

SCHEDULE OF PRICES--SPARE PARTS REQUIREMENTS

Pricing Form DD

Item No.	Description	Unit	Quantity	Unit Price	Total Price
	Air Compressor				
210.	Air compressor assembly	each	2	16053	32106
211.	Compressor governor	each	2	1681	3362
212.	Drain valve	each	4	399	1596
213.	Air dryer	each	4	1162	4648
214.	Filter for air dryer, disposable	each	60	21	1260
215.	Starting contactors, relays & controls	car set	2	3318	6636
216.	Pressure switch and tranducer	car set	4	3937	15748
217.	Inlet filter	each	30	22	660
218.	Air dryer desiccant	each	30	52	1560
219.	Oil filter	each	30	5	150
220.	Cylinder head valve assembly	each	5	261	1305
221.	Drive motor	each	2	8831	17662
222.	Safety valve	car set	3	234	702
	Communications				
223.	PA speaker	each	4	61	244
224.	Cab speaker	each	4	33	132
225.	Passenger IC station assembly	each	8	562	4496
226.	Communications control unit	each	4	1687	6748
227.	Microphone with gooseneck	each	8	123	984
228.	Communication system relay & switch (all types)	car set	2	705	1410
229.	Power and all interface connectors	car set	2	158	316
230.	IC Amplifier	each	4	included in ITEM 225	
231.	PA Amplifier	each	4	1670	6680

THIS FORM ADDED BY ADDENDUM NO. A650-5

SCHEDULE OF PRICES--SPARE PARTS REQUIREMENTS

Pricing Form DD

Item No.	Description	Unit	Quantity	Unit Price	Total Price
	Automatic Train Operation				
232.	Automatic speed regulation equipment	each	4	29095	116380
233.	Programmed station stopping and berthing equipment, carborne	each	4		
234.	Programmed station stopping and berthing, station set (all wayside equipment)	each	1	32827	32827
235.	Printed circuit cards and relays for ASR and PSS (carborne and wayside)	each type	4	16576	66304
		TOTAL FOR SPARE PARTS Enter into Pricing Form AA, Item 6			$3,239,041

Spare Parts Firm Price Agreement

Contractor agrees that prices quoted in Pricing Form DD will be firm for orders placed within the indicated number of months from the date of contract award. Any period shorter than 12 months is not acceptable.

ABOVE PRICES ARE FIRM FOR 12 MONTHS AFTER AWARD.

*Assembly - Includes appurtenances such as connectors and wire harnesses so that the assembly may be installed on a passenger vehicle without shop assembly work.

END OF PRICING FORM DD

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SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT

METRO RAIL PROJECT

PASSENGER VEHICLE

CONTRACT A650

Request for Best and Final Offer Dated_____

Proposer_____

SCHEDULE OF PRICES

Pricing Form EE

MISCELLANEOUS ITEMS

Complete this Pricing Form for the items listed.

Item	Description	Price
EE1	Two coupler adapters	$ 6.000
EE2	Scale model of dependent pair 3/8 in. = 1 ft	$ 9.741
EE3	Mock-up--section of vehicle interior	$ 263.111
EE4	Mock-up--Underfloor equipment arrangement	$ 135.397
TOTAL FOR MISCELLANEOUS ITEMS Enter into Pricing Form AA, Item 7		$ 414.249

END OF PRICING FORM EE

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SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT

METRO RAIL PROJECT

PASSENGER VEHICLE

CONTRACT A650

Request for Best and Final Offer Dated 1/28/88

Proposer BREDA C.F.

SCHEDULE OF OPTION FOR FUTURE PURCHASES

Pricing Form FF

OPTION

The District will have the option to purchase 42 additional vehicles, configured in dependent pairs, identical to the vehicles delivered for the Base Contract and to purchase 11 additional sets of Wayside Station Stop Equipment. The District may exercise such option by giving written notice to the Contractor within 18 months of NTP.

Notice of exercise of option shall specify that the District elects to purchase a specific quantity of dependent pairs, but no fewer than 17 dependent pairs (34 vehicles) and of Wayside Station Stop Equipment, but no fewer than 7 sets. Unit prices quoted shall apply if less than 42 vehicles and less than 11 sets of Wayside Station Stop Equipment are ordered by exercise of the option. In that event, total price shall be unit price extended by quantity ordered.

	Qty.	Unit Price	Total Price
1. Passenger Vehicle - Option Price Quotation			
Passenger Vehicles - A-car	21	$ 1'392'750	$ 29'247'750
Passenger Vehicles - B-car	21	$ 1'362'231	$ 28'606'851
Performance Bond			$ 626'220
PASSENGER VEHICLE OPTION TOTAL PRICE			$ 58'480'821

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	Qty.	Unit Price	Total Price
2. Wayside Station Stop Equipment - Option Price Quotation			
Wayside Station Stop Equipment	11	$ 26'082	$ 286'902
Performance Bond			$ 3'300
WAYSIDE STATION STOP EQUIPMENT OPTION TOTAL PRICE			$ 290'202

Proposer BREDA C.F.

Signature [signature]

Roberto Cai, General Manager
Printed Name and Title

Date March 2, 1988

END OF PRICING FORM FF

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THIS FORM ADDED BY ADDENDUM NO. A650-5

SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT

METRO RAIL PROJECT

PASSENGER VEHICLE

CONTRACT A650

Request for Best and Final Offer Dated_____

Proposer_____

QUALIFICATIONS AND BUSINESS REFERENCES QUESTIONNAIRE

This questionnaire is intended as a basis for establishing the qualifications of Contractors for undertaking Work under the jurisdiction of the Southern California Rapid Transit District.

The District will, to the extent permitted by law, treat this information as confidential, except that parts of it may be discussed with persons and firms given as references by the Contractor. If the Contractor is a joint venture, each member of the joint venture shall prepare and submit a separate questionnaire.

NOTE: If more space is needed than provided for certain items of information, use separate sheets of paper as necessary. Mark additional sheets appropriately.

I. GENERAL

A. Legal Name and Address of Contractor:

_____

_____

B. Name, Title, and Address of Local Representative:

_____

_____

C. _____Corporation _____Partnership
_____Joint Venture (Check One)

C.1. If a Corporation--State:

Date of Incorporation _____

State in which Incorporated _____

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Name and Title Principal Officers	Date of Assuming Position

C.2. If Partnership--State:
Date of Organization _____ Nature of Partnership (General, Limited, or Association) _____

Names and Addresses of Partners

C.3. If Joint Venture--State:
Names and Addresses of Each Member of Joint Venture

Names and Titles of Principal Officers

II. GENERAL

A. Describe the facilities to be used on this Contract for significant portions of the Work, including subcontractors' facilities. Indicate location, work to be done, length of time facility has been in operation to do such work, and whether facility is owned or leased. State the production rate capability of manufacturing facilities.

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B. Is any member of your organization employed by the SCRTD, or in any way connected with the SCRTD?
_____ If yes, explain: _____

C. Give name and data about any contracts you have failed to complete, including any terminations for default.

D. Has your organization or any of its Directors, Officers, Partners, or Supervisory Personnel ever been party to any criminal action relating directly or indirectly to the general conduct of your business?
If yes, explain: _____

E. Has your organization ever been denied an award on which you were the lowest bidder?_____ If yes, explain: _____

F. Have you ever been assessed actual or liquidated damages for late completion? _____ If so, give full particulars:

III. FINANCIAL

A. Provide financial data for your organization to show the financial capability to perform a project of the magnitude being contemplated. The District is particularly concerned that your organization has adequate working capital and trade credit to meet the needs of the project described in the solicitation for the Proposal.

B. Give total sales by your organization in each of the last 3 years:
_____ 19__, _____ 19__, _____ 19__

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C. Give contract value of work presently being accomplished by, or pending award to your organization:_____
_____(Date)

D. Give value of any judgements or liens outstanding against your organization:_____

E. Has any bonding company refused to write you a bond on any project? _____ If yes, explain._____
_____
_____

F. Give maximum value of contract work for which you could obtain a bond:_____

G. Name, address, and phone number of bonding company to be used if you become the successful Proposer:
_____
_____
_____
_____
_____

IV. EXPERIENCE

A. Indicate type of contracting undertaken by your organization and number of years of experience:

Prime Contractor: No. Years _____
Subcontractor: No. Years _____
Type of Work: _____ No. Years _____

B. State transit supply experience of principal members of your organization including your project manager:

Transit Supply Experience

Name and Title (Pres.,Mgr.,etc.)	Experience (Years)	Type of Project	In What Capacity (Foreman, Supt.,etc.)

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_____ _____ _____ _____

_____ _____ _____ _____

_____ _____ _____ _____

C. List some principal projects completed by your organization:

Name of Work	_____	_____	_____	_____
	_____	_____	_____	_____
Prime or Sub (If sub, what type of work)	_____	_____	_____	_____
	_____	_____	_____	_____
Contract Amount	_____	_____	_____	_____
	_____	_____	_____	_____
Year	_____	_____	_____	_____
Authority's Name and Address	_____	_____	_____	_____
	_____	_____	_____	_____

D. If Prime Contractor, list some subcontractors in various fields who have worked for you: _____

_____

_____

_____

E. If subcontractor, list some Prime Contractors for whom you have worked: _____

_____

_____

_____

F. Previous Project Values:

1. What is the money value of the largest project accomplished by your organization? _____

2. What is the money value of the largest project completed in the last 3 years: _____

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H. Quality:

1. Organization has complied with the following quality assurance requirements on past contracts (MIL-STD, ANSI, ASQC, etc.):

_____

_____

_____

2. Submit evidence that your firm has a quality assurance and inspection program and is adequately staffed with quality assurance personnel to assure compliance with the QA requirements for this Contract.

The Undersigned states that he/she is legally authorized by the Proposer to make the statements and representations contained in this document, and represents and warrants that the foregoing information is true and accurate to the best of his/her knowledge, and intends that the District rely thereon in awarding the contract. The undersigned further understands that any misrepresentation made in this form shall be a basis for rejection of the BAFO.

Dated at _____ this ____ day of _____ 19__.

By _____

_____
(Type or Print Name)

_____
(Title of Person Signing)

_____
(Name of Organization)

END OF QUALIFICATIONS AND
BUSINESS REFERENCES QUESTIONNAIRE

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SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT

METRO RAIL PROJECT

PASSENGER VEHICLE

CONTRACT A650

Request for Best and Final Offer Dated 1/28/88

Proposer BREDA C.F.

LIST OF SUBCONTRACTORS

List the subcontractor for each major subsystem and equipment listed below.

	NAME	ADDRESS	IDENTIFY WHETHER DBE FIRM
1.	TRUCKS:		
	BREDA - Via Ciliegiole 110/B 51100 Pistoia (Italy)		
2.	PROPULSION MOTORS AND CONTROLS:		
	GARRETT - 2525 W. 190th St., Torrance CA 90509		*
3.	HEATING, VENTILATING, AND AIR CONDITIONING:		
	STONE SAFETY - 26 Barnes Park Road North, Wallingford CT 06492		*
4.	AUXILIARY ELECTRICAL EQUIPMENT:		
	GARRETT - 2525 W. 190th St., Torrance CA 90509		*
5.	BATTERY:		
	ALCAD - Union St., Smallwood Redditch Worcesteshire B987W-England		
6.	FRICTION BRAKING:		
	WABCO - Spartanburg, South Carolina 29304		*
7.	COUPLER ASSEMBLY:		
	OHIO BRASS - 380 North Main Street, Mansfield, Ohio		*

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8. DOOR OPERATORS AND CONTROLS:

FAIVELEY - World's Fair Drive, Somerset, N.J. 08873 *

9. OPERATOR CAB EQUIPMENT:

BREDA - Via Ciliegiole 110/B 51100 Pistoia (Italy)

10. SEATS:

ARTCRAFT - 320 E. Buffalo St., Milwaukee WI 53202 *

11. ATO EQUIPMENT:

SIGNARAIL - 5650 Dessiant St., St. Laurent, QE, Canada H56TA6 *

12. COMMUNICATIONS:

MIDWEST - 4945 W. Belmont Avenue, Chicago, IL 60641

13. DESTINATION SIGNS:

LUMINATOR - 1200 E. Plano Parkway, Plano TX 75074 *

14. LIGHTING:

LUMINATOR - 1200 E. Plano Parkway, Plano TX 75074 *

15. CARBODY:

SOREFAME - Rua Vice Almirante Azevedo Coutinho, Apartado 5
2701 Amdora, Portugal

END OF LIST OF SUBCONTRACTORS

* DBE firm

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SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT

METRO RAIL PROJECT

PASSENGER VEHICLE

CONTRACT A650

Request for Best and Final Offer Dated 1/28/88

Proposer BREDA C.F.

TRANSIT VEHICLE MANUFACTURER CERTIFICATION

The Proposer , if a transit vehicle manufacturer, hereby certifies that it has complied with the requirements of 49 CFR Section 23.67 by submitting an annual DBE/WBE goal to the Urban Mass Transportation Administration (UMTA). The goal has either been approved or not disapproved by UMTA.

The Proposer, if a nonmanufacturer supplier, hereby certifies that the manufacturer of the transit vehicle to be supplied has complied with the above-referenced requirement of 49 CFR Section 23.67.

Proposer BREDA C.F.

Signature

ROBERTO CA. - GENERAL MANAGER
Printed Name and Title

Date March 2, 1988

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SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT

METRO RAIL PROJECT

PASSENGER VEHICLE

CONTRACT A650

Request for Best and Final Offer Dated 3/16/87

Proposer BREDA C.F.

BUY AMERICA CERTIFICATION

FOR COMPLIANCE

The Proposer hereby certifies that it will comply with the requirements of Section 165 (b) (3) of the Surface Transportation Assistance Act of 1982 and the applicable regulations in 49 CFR Part 661.11.

Proposer BREDA C.F.

Signature

ROBERTO CAI - GENERAL MANAGER
Printed Name and Title

Date March 2, 1988

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SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT

METRO RAIL PROJECT

PASSENGER VEHICLE

CONTRACT A650

Request for Best and Final Offer Dated_____

Proposer_____

BUY AMERICA CERTIFICATION

FOR NON-COMPLIANCE

The Proposer hereby certifies that it cannot comply with the requirements of Section 165 (b) (3) of the Surface Transportation Assistance Act of 1982, but may qualify for an exception to the requirement pursuant to Section 165 (b) (2) or (b) (4) of the Surface Transportation Assistance Act and regulations in 49 CFR Part 661.7.

Proposer _____

Signature NOT APPLICABLE

_____

Printed Name and Title

Date _____

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SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT

METRO RAIL PROJECT

PASSENGER VEHICLE

CONTRACT A650

Request for Best and Final Offer Dated 1/28/88

Proposer BREDA C.F.

SOUTH AFRICA CERTIFICATION

1. I hereby certify, under penalty of perjury, that the entity submitting this Proposal (check correct block):

   A. _____ Is doing business in or with the Republic of South Africa

   B. X Is not doing business in or with the Republic of South Africa

2. If block 1.A is checked, describe nature and extent of business:

   NOT APPLICABLE

3. I certify that, to the best of my knowledge, goods to be provided:

   A. _____ Were manufactured, produced, assembled, grown or mined in the Republic of South Africa

   B. X Were not manufactured, produced, assembled, grown or mined in the Republic of South Africa

4. If block 3.A is checked, list types, and value of goods.

   NOT APPLICABLE

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THIS FORM ADDED BY ADDENDUM NO. A650-5

5. I agree to promptly notify the District should any change occur in the information provided above during the term of any Contract awarded as a result of this BAFO.

Proposer BREDA C.F.

Signature _____

ROBERTO CAI - GENERAL MANAGER
Printed Name and Title

Date March 2, 1988

END OF BEST AND FINAL OFFER FORMS

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SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT

METRO RAIL PROJECT

PASSENGER VEHICLE

CONTRACT A650

III. CONTRACT FORMS

SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT

METRO RAIL PROJECT

PASSENGER VEHICLE

CONTRACT A650

CONTRACT

THIS CONTRACT IS between the Southern California Rapid Transit District (District) whose address is 425 South Main Street. Los Angeles, California 90013, and Breda Costruzioni Ferroviarie S.p.A. (Contractor) whose address is: Via Ciliegiole 110/B, 51100 Pistoia-Italy

In consideration of the agreements herein contained, the parties agree as follows:

1.0 WORK TO BE PERFORMED. Contractor shall furnish all necessary labor, materials, supplies, services and transportation necessary to

FURNISH PASSENGER VEHICLES

in accordance with the Contract A650 Documents dated March 1987, (including any addenda) and Contractor's Best and Final Offer dated March 3, 1988, all of which are incorporated herein as fully set forth.

2.0 NOTICE TO PROCEED. Contractor shall commence Work after execution of Contract, upon notice to proceed, and shall complete all Work in accordance with the schedule provided in the Contract Documents.

3.0 PAYMENT. In consideration of the Work performed, District shall pay Contractor the sum of $53,986,560, payable as provided in the General and Special Provisions of the Contract Documents.

Southern California Rapid Transit District

By _____

Maynard Z. Walters
Director, Office of Contracts, Procurement and Materiel

May 13, 1988
(Date)

Contractor

By _____

Giuseppe Capuano
(Typed Name)

President
(Title)

May 6, 1988
(Date)

APPROVED AS TO LEGAL FORM:

_____
COUNSEL

SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT

OPTIONAL FORM 175
(FORMERLY FS-88)
MARCH 1975
DEPT. OF STATE
50175-101

Certificate of Acknowledgment of Execution of an Instrument

REPUBLIC OF ITALY
(Country)

PROVINCE OF ROME
(County and/or other political division)

CITY OF ROME
(County and/or other political division)

EMBASSY OF THE UNITED STATES OF AMERICA
(Name of foreign service office)

SS:

I, Steven J. Wangsness

of the United States of America at Rome, Italy

duly commissioned and qualified, do hereby certify that on this 6th

day of May, 1988 (DATE), *before me personally appeared* Giuseppe Capuano

to me personally known, and known to me to be the individual--described in, whose name is *subscribed to, and who executed the annexed instrument, and being informed by me of the contents of said instrument* he *duly acknowledged to me that* he *executed the same freely and voluntarily for the uses and purposes therein mentioned.*

[SEAL]

In witness whereof I have hereunto set my hand and official seal the day and year last above written.

Steven J. Wangsness

Vice Consul *of the United States of America.*

NOTE.–Wherever practicable all signatures to a document should be included in one certificate.

☆U.S.GPO:1980-0-311-153/5279

REPUBLIC OF ITALY)
PROVINCE OF FLORENCE)
CITY OF FLORENCE)
CONSULATE GENERAL OF)SS.
THE UNITED STATES OF)
AMERICA,)

I hereby solemnly declare:

That my name is Isobel WILKE

That I reside at Via Cosimo Trinci 22, Pistoia, Italy

That I am thoroughly acquainted with the English and Italian languages:

That I have made the translation of the attached document and that this translation is true and correct rendering into English of the Italian Text.

Isobel WILKE

Subscribed and sworn to before me this ..28th.. day of ..April.....19.88.. at FLORENCE, Italy.

Virginia Morris
Consul of the United States
of America

WP-0033M - 9/87

The Court of Pistoia

The Undersigned clerk of the Court

certifies that

- The Corporate Company "BREDA COSTRUZIONI FERROVIARIE S.p.A." with main office in Pistoia, Via Ciliegiole, 110/b and subsidiary office in Rome, Via Giorgione, 129, with company capital of Lit. 120,000,000,000 =, fully paid up, duration established as up to 31 December 2020, having as purpose the manufacture, repair, assembly and sale of rolling stock, both tractive and trailer, for the transportation of persons and things on separate right-of-way and on rail or road, as well as metal structural work and mechanical work in general is inscribed in the Registry of Companies of this Court under number 2867;

- said Company according to its own bylaws is managed by a Board of Directors comprised of from four to eight members whose term of office is three years and who can be reappointed;

- the administrative body has the widest powers for ordinary and special administration of the Company which are not by law irrevocably reserved to shareholders;

- the legal representatives of the Company for all matters concerning third parties and in Courts of Law is the sole Chairman of the Board of Directors;

- the current Chairman is Capuano Giuseppe, born in Barletta

on June 4, 1921, residing in Pistoia, Via Ciliegiole 110/b, for the term of office;

- the Board of Directors has unanimously conferred upon the Chairman of the Board itself, in the report dated July 15, 1987, all powers of ordinary and special administration, apart from those not delegable by law, to be exercised with his sole signature;

- Mr. Capuano, with the document notarized by Gualtiero Cappellini Notary, on September 21, 1983, rep. N. 117291/12970 here registered, exercising the powers conferred upon him by the Board of Directors, conferred upon Mr. Corrado Fici, Board Member and General Manager of the Company, born in Florence on June 2, 1934, and Roberto Cai, General Manager of the Company, born in Pistoia on August 13, 1937, the following powers to be exercised with individual signature :

1) rent and take in rental real estate for a duration not exceeding nine years;

2) purchase equipment, machinery and their accessories, equipment, goods, raw materials, consumable materials, furniture, furnishings and all else needed for the Company's activity, sell them and exchange them;

3) sell and exchange goods and products, hire and confer services, supplies, purveyances and supply contracts of any kind, as regards either private or public administrations,

stipulating the relative contracts and specifications

present the Company in all import and export operations;

4) concur in the establishment of Consortiums, Associations and/or Joint Ventures;

5) hire the laborers and office staff needed for running the Company, establish their salaries and wages, suspend or dismiss personnel, represent the Company with trade union organizations, stipulate consultant's contracts establishing compensation and terms;

6) nominate and terminate contracts with agents, franchisers and representatives, establish their powers and compensations, give and receive fees;

7) participate in public and private auctions, tenders, bids, signing the relevant contracts and specifications;

8) stipulate insurance contracts of any kind and nature;

9) arrange for payments to be made and issue order to pay and draw cheques on Bank accounts, also those in deficit, from financial institutions in Italy and abroad, and from public agencies, juridical persons or collective organizations;

10) exact payment of credits of any amount due the Company, make and withdraw deposits of sums and securities at any public or private Bank;

11) cash postal and telegraphic money orders, pay orders and cheques of any kind, including pay orders to the treasuries of the State, the Regions, the Provinces, the Municipalities

and any other juridical person, public or private, issuing receipts;

12) endorse, exact and receive promissory notes, bank money orders and drafts, bank cheques, as well as issue drafts also for casning and discount;

13) request banks, financial institutions, insurance companies and other organizations, bonds in favour of Public Administrations and private agencies, taking on all relative obligations;

14) settle any issue in which the Company may be involved, making compromises, accepting or rejecting proposals for settlement, proceeding to readjust and pay off counts and payables and receivables;

15) promote and sustain legal action for any purpose and at any level of jurisdiction, including Courts of Appeal and Supreme Court and arbitrational proceedings in any form; promote bankruptcy procedures and represent the Company in them, claim credits in bankruptcy procedures, attend bankruptcy procedures; nominate lawyers and attorneys for litigations and confer upon them the necessary powers, nominate Arbitrators, also as "aimable compositeurs";

16) represent tne Company before tne competent judge and Authorities, promote and sustain petitions, appeals and claims before same, for any purpose, also as preventive or executive remedies, with the power of delegating others to repre-

sent the Company in disputes with employees and laborers, and confer upon them all the necessary powers as per art. 420 of the Civil Law Code, including those of settling and conciliating;

17) attend deliveries and tests of materials and/or finished products with the power of delegating others to represent the Company;

18) receive registered mail and insured letters, postal packages and packages of any kind, carry out any transaction with postal, railway and customs offices, transport and navigation Companies, delegate others to carry out such transactions, exonerate said agencies and the administrations in general from any and all responsibilities;

19) issue certificates and declarations for income tax returns, except from pay-rolls and statements concerning personnel for social security, insurance and health and welfare agencies, as well as for other agencies and private concerns;

20) sign correspondence inherent to the delegated powers;

21) issue and terminate, within the limits of the conferred powers, proxy "ad negotia";

- said Company is not in liquidation and that there are no pending suits for bankruptcy, composition before bankruptcy or controlled administration before this Court of Law, and that such proceedings have not taken place in the past five

years.

Pistoia, February 24, 1988

TRIBUNALE DI PISTOIA

Il sottoscritto Cancelliere

certifica

. che al n. 2867 registro delle Società esistente presso questa Cancelleria Commerciale risulta iscritta la Società per azioni denominata "BREDA COSTRUZIONI FERROVIARIE SPA" con sede in Pistoia, Via Ciliegiole 110B, sede secondaria in Roma, Via Giorgione, 129 capitale sociale di lire 120.000.000.000, interamente versato, durata fissata fino al 31 dicembre 2020, avente per oggetto la costruzione, la riparazione, il montaggio in opera e il commercio di materiale mobile trainante e trainato per trasporto di persone e di cose su sede propria e su rotaie o su strada, nonchè di carpenterie metalliche e lavorazioni meccaniche in genere;

. che detta società a norma del suo statuto sociale, è amministrata da un consiglio di amministrazione composto da quattro ad otto membri i quali durano in carica tre esercizi sociali e sono rieleggibili;

. che all'organo amministrativo spettano i più ampi poteri per la gestione ordinaria e straordinaria della società, che non siano per legge riservati inderogabilmente all'assemblea dei soci;

. che la rappresentanza della società di fronte ai terzi ed in giudizio spetta al Presidente del Consiglio di

MARCA COMUNE LIRE

24 FEB. 1988

DIRITTI CANCELLERIA
BOLLETTA N. 3841
£ 20000

Amministrazione;

. che attualmente riveste la carica di Presidente del Consiglio di amministrazione il Sig. CAPUANO Dr. Ing. GIUSEPPE, nato a Barletta il 4/6/1921, domiciliato per la carica a Pistoia, Via Ciliegiole, 110B;

. che il Consiglio di Amministrazione con verbale in data 15 luglio 1987, all'unanimità ha conferito al Presidente del Consiglio stesso, ad eccezione di quelli non delegabili per legge, tutti i poteri di ordinaria e straordinaria amministrazione da esercitare con firma singola;

. che l'ing. Giuseppe Capuano in virtù dei poteri a lui conferiti delegò in data 21 settembre 1983 con atto rogito notaio Cappellini Gualtiero rep. n.117291/12970 regolarmente depositato a norma di legge, all'Amministratore e Direttore Generale della Società ing. CORRADO FICI nato a Firenze il 2 giugno 1934, ed all'ing. ROBERTO CAI, Direttore Generale della Società, nato a Pistoia il 13 agosto 1937 i seguenti poteri da esercitare con firma singola:

1) Locare ed assumere in locazione beni immobili per durata non superiore a nove anni.

2) Acquistare impianti, macchinari e loro accessori, attrezzature, materie prime, merci, materiali di consumo, mobili, arredi, e quant'altro necessario per l'attività aziendale, venderli e permutarli.

3) Vendere e permutare merci e prodotti, assumere e conferire servizi, forniture, somministrazioni ed appalti di qualsiasi specie, sia nei riguardi di privati sia di pubbliche amministrazioni, stipulando i relativi contratti e capitolati, rappresentare la società nello svolgimento di tutte le pratiche di importazione ed esportazione.

4) Concorrere alla costituzione di consorzi, associazioni e/o raggruppamenti di aziende.

5) Assumere il personale operaio ed impiegatizio occorrente per la gestione dell'azienda, fissarle le relative attribuzioni, sospenderlo e revocarlo, rappresentare la società presso le organizzazioni di categoria e sindacali; stipulare contratti di consulenza fissandone compensi e modalità.

6) Nominare e revocare agenti, concessionari e rappresentanti fissarne le attribuzioni ed i compensi, dare e ricevere commissioni.

7) Adire ad aste ed incanti pubblici e privati, gare, licitazioni, appalti concorso, firmando i relativi contratti e capitolati.

8) Stipulare contratti di assicurazione di qualsiasi genere e natura.

9) Dare disposizioni per l'esecuzione di pagamenti ed emettere mandati ed assegni sui conti correnti, anche passivi, della Società, presso qualunque Istituto di

credito in Italia ed all'Estero, presso Enti pubblici, persone giuridiche od Enti collettivi.

10) Esigere crediti e qualunque somma dovuta alla società; fare e ritirare depositi di somme e valori presso qualunque cassa pubblica e privata.

11) Riscuotere vaglia postali e telegrafici, mandati ed assegni di qualsiasi specie, compresi i mandati sulle Tesorerie dello Stato, le Regioni, le Provincie, i Comuni e qualsiasi altra persona giuridica pubblica o privata, rilasciando scarichi e liberazioni.

12) Girare, esigere e quietanzare cambiali, vaglia bancari e cambiari, assegni bancari nonchè emettere tratte anche per l'incasso e lo sconto.

13) Richiedere a Banche, Istituti di Credito, Compagnie di Assicurazioni ed altri Enti, fidejussioni a favore di Amministrazioni pubbliche ed Enti Privati assumento le corrispondenti obbligazioni.

14) Transigere qualsiasi questione nella quale la società possa essere interessata, fare compromessi, accettare o respingere proposte di concordato, procedere a revisioni e liquidazioni di conti e di partite attive e passive.

15) Promuovere e sostenere azioni giudiziarie per qualunque oggetto ed in qualunque grado di giurisdizione, compresi i giudizi di revocazione e cassazione e procedimenti arbitrali rituali ed irrituali. Promuovere procedure

fallimentari e rappresentare in esse la Società, fare insinuazioni di crediti, assistere alle adunanze dei creditori. Nominare avvocati e procuratori alle liti e conferire loro gli occorrenti poteri, nominare arbitri anche come amichevoli compositori.

16) Rappresentare la società avanti le competenti giurisdizioni ed autorità, promuovere e sostenere istanze, ricorsi e reclami avanti le stesse per qualunque oggetto, anche in via di preventiva cautela o di esecuzione, con facoltà di delegare altri a rappresentare la società stessa nelle vertenze con il personale impiegatizio e salariato e conferire all'uopo tutti i poteri di cui all'art. 420 codice procedura civile, compresi quelli di transigere e conciliare.

17) Assistere a consegne e collaudi di materiali e/o prodotti finiti, con la facoltà di delegare altri a rappresentare la società.

18) Ritirare lettere raccomandate ed assicurate, pacchi postali e pieghi di qualunque specie, compiere qualsiasi operazione presso gli uffici postali, ferroviari, doganali, imprese di trasporto e di navigazione: delegare altri a compiere le operazioni stesse. Esonerare gli Enti stessi e le Amministrazioni in genere da ogni e qualsiasi responsabilità.

19) Rilasciare certificati e dichiarazioni per la denuncia

dei redditi, estratti dei libri paga ed attestazioni riguardanti il personale sia per gli Enti previdenziali, assicurativi e mutualistici, che per altri Enti e Privati;

20) Firmare la corrispondenza inerente ai poteri delegati.

21) Rilasciare e revocare nei limiti dei poteri conferiti procure "ad negotia".

. che detta società non risulta in liquidazione e che a carico della stessa non risultano pendenti presso questo Tribunale procedure di fallimento, concordato preventivo o di amministrazione controllata;

. che dette procedure non si sono verificate nel quinquennio precedente la data odierna.

Pistoia, 24 FEB. 1988

IL DIRETTORE DI CANCELLERIA
(Vittoria Bocchini)

TRIBUNALE CIVILE PISTOIA

REPUBLIC OF ITALY)
PROVINCE OF FLORENCE)
CITY OF FLORENCE)
CONSULATE GENERAL OF)SS.
THE UNITED STATES OF)
AMERICA,)

I hereby solemnly declare:

That my name is Isobel WILKE

That I reside at Via Cosimo Trinci 22, Pistoia, Italy

That I am thoroughly acquainted with the English and Italian languages:

That I have made the translation of the attached document and that this translation is true and correct rendering into English of the Italian Text.

Isobel WILKE

Subscribed and sworn to before me this 5th day of May 1988 at FLORENCE, Italy.

Virginia Morris
Consul of the United States
of America

WP-0033M - 9/87

REPUBLIC OF ITALY

SPECIAL PROXY

In the year nineteeneightyeight on the second day of May at the facility of BREDA COSTRUZIONI FERROVIARIE SpA - located in Pistoia - Via Ciliegiole, 110B, before me Giulio Cesare Cappellini Notary, resident in Pistoia, registered in the Roll of the United Notarial Districts of Florence, Pistoia, and Prato, I have personally appointed :

- Giuseppe CAPUANO, Manager, born in Barletta on June 4, 1921, residing for the term of office at the Company's address, who requests my accepting the present document in his role as Chairman of the Board and legal representative of the Company "BREDA COSTRUZIONI FERROVIARIE S.p.A." located in Pistoia, Via Ciliegiole, 110B, company capital Lit. 120,000,000,000.= inscribed in the Registry of Companies of the Pistoia Court under number 2867, fiscal code 00109949478, exercising the powers conferred upon him by the Members of the Board on July 15, 1987, of whose identity I am personally certain, after explicit renunciation, with my agreement, of the assistance of witnesses to the present act, declares to nominate, and nominates as special Procurator of BREDA COSTRUZIONI FERROVIARIE S.p.A.:

Eutimio TILIACOS, born in Rome on September 1945, Chief Manager of Administration, Finance and Control of the Company; so he may in name and on behalf of the above sign

the following documents connected to the execution of supply Contract n° A650 with the SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT of Los Angeles :

- performance bond as per article 7.0 of the "GENERAL PROVISIONS" of the contract;

- Insurance coverage as per article 8.0 of the "GENERAL PROVISIONS" of the contract;

- guarantees and/or counter-guarantees with Banks or other Financial Institutions;

- every and any document complementary to the above mentioned and in any case necessary for the execution of the above contract.

With the widest powers for fulfilment of the present proxy.

On request the undersigned has received the present document, typewritten by a trustworthy person, over one page and part of the second page of one sheet, read by me to the appearing person who approves in my presence and with me, Notary, undersigns it.

REPUBBLICA ITALIANA

PROCURA SPECIALE

Rep. 24051

L'anno millenovecentoottantotto addì 2 (due) del mese di maggio presso lo Stabilimento della BREDA COSTRUZIONI FERROVIARIE SPA - sito in Pistoia - Via Ciliegiole, 110B

Avanti a me Dott. Giulio Cesare Cappellini Notaro, residente in Pistoia, iscritto al Ruolo dei Distretti Notarili Riuniti di Firenze, Pistoia e Prato, ho personalmente costituito il Signor:

- Dr. ing. Giuseppe CAPUANO nato a Barletta il 4.6.1921, domiciliato per la carica in Pistoia, presso la sede della Società, dirigente, che mi richiede di ricevere il presente atto nella sua qualità di Presidente del Consiglio e legale rappresentante della società "BREDA COSTRUZIONI FERROVIARIE Società per Azioni" con sede in Pistoia, Via Ciliegiole, 110B, capitale sociale L. 120.000.000.000.= iscritta nel Registro Società del Tribunale di Pistoia al n° 2867, con codice fiscale 00109940478, in appoggio ai poteri conferitigli dal Consiglio di Amministrazione con delibera del 15.7.1987,

Detto Signore, della cui identità personale sono certo, fatta espressa rinuncia, con me d'accordo, all'assistenza dei testimoni al presente atto, dichiara di nominare, siccome nomina, in Procuratore Speciale della BREDA COSTRUZIONI FERROVIARIE SpA, il Signor

Dr. EUTIMIO TILIACOS, nato a Roma il 6. settembre 1945,

Direttore Centrale Amministrazione, Finanza e Controllo della Società, affinchè a nome e per conto della suddetta sottoscriva i sottoelencati atti connessi con il perfezionamento del contratto di fornitura n° A650 con la Spett.le SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT di Los Angeles.

- performance bond di cui all'articolo 7.0 delle "GENERAL PROVISIONS" del contratto;

- coperture assicurative di cui all'articolo 8.0 delle "GENERAL PROVISIONS" del contratto;

- garanzie e/o controgaranzie bancarie e/o di altri Enti;

- ogni e qualsiasi documento complementare ai suddetti e comunque necessario per il perfezionamento del contratto suddetto.

Con tutti i più ampi poteri per l'espletamento del presente mandato.

Richiesto ha ricevuto il presente atto, scritto a macchina da persona di mia fiducia in una pagina e parte della seconda di un foglio, letto da me al comparente che lo approva e con me Notaro come appresso lo sottoscrive.

BOND NO. 24484

SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT

METRO RAIL PROJECT

PASSENGER VEHICLE

CONTRACT A650

Request for Best and Final Offer Dated January 28, 1988.

Proposer _____

PERFORMANCE BOND

KNOW ALL PERSONS BY THESE PRESENTS:

THAT BREDA COSTRUZIONI, FERROVIARE SpA _____, as Principal, and AMERICAN HOME ASSURANCE COMPANY AND NATIONAL UNION FIRE INSURANCE COMPANY OF PITTSBURGH, PA, a corporation duly organized under the laws of the State of NEW YORK/PENNSYLVANIA as Surety, are held and firmly bound unto the Southern California Rapid Transit District (District) a public corporation of the State of California, in the sum of FIFTY THREE MILLION NINE HUNDRED EIGHTY SIX THOUSAND FIVE HUNDRED SIXTY AND 00/100 _____ Dollars ($ 53,986,560 .00) for the payment of which we hereby bind ourselves, our heirs, executors, administrators, and assigns, jointly and severally, firmly by these presents.

WHEREAS, Principal has by written agreement dated _____ entered into a Contract with the District, which Contract is by reference made a part hereof, and is hereinafter referred to as the Contract.

The condition of the foregoing obligation is such that if the said Principal shall perform all things agreed to in said Contract to be done and performed, then this obligation is to be void; otherwise to remain in full force and effect;

PROVIDED,

A. Any alteration in the Work to be done, or the material to be furnished, which may be made shall not in any way release the

Principal or the Surety hereunder, nor shall any extensions of time granted release either the Principal or the Surety, and notice of such alterations or extensions of the Contract is hereby waived by the Surety.

B. Whenever Principal shall be, and is declared by the District to be in default under the Contract, the District having performed its obligations thereunder, the Surety may promptly remedy the default or shall promptly:

1. Complete the Contract in accordance with the District's terms and conditions, or

2. Provide sufficient funds to pay the cost of completion less the balance of the Contract price; but not exceeding, including other costs and damages for which the Surety may be liable hereunder, the amount set forth in the first paragraph hereof. The term "balance of the Contract price," as used in this paragraph, shall mean the total amount payable by the District to Principal under the Contract and any amendments thereto, less the amount properly paid by District to Principal.

C. The Surety on the Performance Bond provided for in the Contract shall not be entitled to take over the Contractor's performance of Work in case of termination for default, except with the written consent of the District.

Signed and sealed this 9th day of MAY, 1988.

Principal BREDA COSTRUZIONI FERROVIARE SpA

Signature _____

EUTIMIO TILIACOS, CHIEF MANAGER OF ADMINISTRATION, FINANCE AND CONTROL

Printed Name and Title

AMERICAN HOME ASSURANCE COMPANY

And Surety

ALAN J. THOMPSON, ATTORNEY IN FACT

(SEAL) Signature NATIONAL UNION FIRE INSURANCE CO. OF PITTSBURGH, PA

_____

Printed Name and Title

ALAN J. THOMPSON, ATTORNEY IN FACT

END OF CONTRACT FORMS

American Home Assurance Company
National Union Fire Insurance Company of Pittsburgh, Pa.
Principal Bond Office: 70 Pine Street, New York, N.Y. 10270

POWER OF ATTORNEY

No. 01-B-15388

KNOW ALL MEN BY THESE PRESENTS:

That American Home Assurance Company, a New York corporation, and National Union Fire Insurance Company of Pittsburgh, Pa., a Pennsylvania corporation, does each hereby appoint

---Alan J. Thompson, Janson H. Bedell, William R. Cotter, Francesca Papa, John Tyman: of New York, New York---

its true and lawful Attorney(s)-in-Fact, with full authority to execute on its behalf bonds, undertakings, recognizances and other contracts of indemnity and writings obligatory in the nature thereof, issued in the course of its business, and to bind the respective company thereby.

IN WITNESS WHEREOF, American Home Assurance Company and National Union Fire Insurance Company of Pittsburgh, Pa. have each executed these presents

this 11 day of August, 19 86.

Edward J. French, Vice President

STATE OF NEW YORK
COUNTY OF NEW YORK } ss.

On this 11 day of August, 19 86, before me came the above named officer of American Home Assurance Company and National Union Fire Insurance Company of Pittsburgh, Pa., to me personally known to be the individual and officer described herein, and acknowledged that he executed the foregoing instrument and affixed the seals of said corporations thereto by authority of his office.

JAMES A. DiPASQUALE
Notary Public, State of New York
No. 30 - 4841475
Qualified in Nassau County
Certificate filed in New York County
Commission Expires March 30, 1987

CERTIFICATE

Excerpts of Resolutions adopted by the Boards of Directors of American Home Assurance Company and National Union Fire Insurance Company of Pittsburgh, Pa. on May 18, 1976:

"RESOLVED, that the Chairman of the Board, the President, or any Vice President be, and hereby is, authorized to appoint Attorneys-in-Fact to represent and act for and on behalf of the Company to execute bonds, undertakings, recognizances and other contracts of indemnity and writings obligatory in the nature thereof, and to attach thereto the corporate seal of the Company, in the transaction of its surety business;

"RESOLVED, that the signatures and attestations of such officers and the seal of the Company may be affixed to any such Power of Attorney or to any certificate relating thereto by facsimile, and any such Power of Attorney or certificate bearing such facsimile signatures or facsimile seal shall be valid and binding upon the Company when so affixed with respect to any bond, undertaking, recognizance or other contract of indemnity or writing obligatory in the nature thereof;

"RESOLVED, that any such Attorney-in-Fact delivering a secretarial certification that the foregoing resolutions still be in effect may insert in such certification the date thereof, said date to be not later than the date of delivery thereof by such Attorney-in-Fact."

I, Maureen P. Tully, Secretary of American Home Assurance Company and of National Union Fire Insurance Company of Pittsburgh, Pa. do hereby certify that the foregoing excerpts of Resolutions adopted by the Boards of Directors of these corporations, and the Powers of Attorney issued pursuant thereto, are true and correct, and that both the Resolutions and the Powers of Attorney are in full force and effect.

IN WITNESS WHEREOF, I have hereunto set my hand and affixed the facsimile seal of each corporation

this 24th day of May, 1988.

Maureen P. Tully, Secretary

240 (9/85)

Individual Acknowledgment

State of _____ }
County of _____ } ss.

On this _____ day of _____, 19 __, before me personally came

_____ to me known,

and known to me to be the individual described in and who executed the foregoing instrument, and acknowledged to me that he executed the same.

My commission expires _____

_____
Notary Public

Firm Acknowledgment

State of _____ }
County of _____ } ss.

On this _____ day of _____, 19 __, before me personally came

_____ to me known and known to me

to be a member of the firm of _____

described in and who executed the foregoing instrument, and he thereupon acknowledged to me that he executed the same as and for the act and deed of said firm.

My commission expires _____

_____
Notary Public

Corporation Acknowledgment

State of NEW YORK }
County of NEW YORK } ss.

On this 9TH day of MAY, 1988, before me personally came

EUTIMIO TILIACOS, to me known,

who being by me duly sworn, did depose and say that he is the CHIEF OFFICER, ADMINISTRATION, FINANCE & CONTROL of BREDA COSTRUZIONI FERROVIARE SPA

the corporation described in and which executed the above instrument; that he knows the seal of said corporation; that the seal affixed to said instrument is such corporate seal; that it was so affixed by order of the Board of Directors of said corporation, and that he signed his name thereto by like order.

BRENDAN R. DAVENPORT
Notary Public, State of New York
No. 03-4755643
Qualified in Bronx County
Certificate filed in New York County
Commission Expires July 31, 1990

Brendan R. Davenport
Notary Public

BRENDAN R. DAVENPORT
Notary Public, State of New York
No. 03-4755643
Qualified in Bronx County
Certificate filed in New York County
Commission Expires July 31, 1990

Surety Acknowledgment

State of New York }
County of Nassau } ss.

On this 9th day of May, 1988, before me personally came

Alan J. Thompson to me known, who, being by me duly sworn, did depose and say that he is an attorney-in-fact of American Home Assurance Company the corporation described in and which executed the within instrument; that he knows the corporate seal of said corporation; that the seal affixed to the within instrument is such corporate seal, and that he signed the said instrument and affixed the said seal as Attorney-in-Fact by authority of the Board of Directors of said corporation and by authority of this office under the Standing Resolutions thereof

DEBORAH A. NICASTRO
Notary Public, State of New York
No. 4713401
Qualified in Suffolk County
Commission Expires May 31, 1989

My commission expires _____

Deborah A. Nicastro
Notary Public

American Home Assurance Company

Executive Offices
70 Pine Street, New York, NY 10270

Worldwide Bonding
American International Companies

FINANCIAL STATEMENT

as of DECEMBER 31, 1986

ASSETS		LIABILITIES	
Bonds	$1,238,868,046	Reserve for Losses and Loss Expenses	$1,597,856,039
Stocks	370,676,134	Reserve for Unearned Premiums	322,492,835
Collateral Loans	—0—	Reserve for Expenses, Taxes, Licenses and Fees	37,171,297
Cash and Bank Deposits	23,210,572	Reserve for Unauthorized Reinsurance	35,942,083
Agents Balances or Uncollected Premiums	268,429,220	Funds Held Under Reinsurance Treaties	63,907,968
Funds Held by Ceding Reinsurers	58,853,527	Other Liabilities	37,810,744
Reinsurance Recoverable on Loss Payments	184,079,113	Capital Stock	4,237,635
Company's Interest in Assets of AIUA and AIUOA	61,319,325	Surplus	466,876,736
Other Admitted Assets	360,859,400		
		TOTAL POLICYHOLDERS' SURPLUS	471,114,371
TOTAL ASSETS	$2,566,295,337	TOTAL LIABILITIES AND POLICYHOLDERS' SURPLUS	$2,566,295,337

Bonds and stocks are valued in accordance with the basis adopted by the National Association of Insurance Commissioners.
Securites carried at $154,020,345 in the above Statement are deposited as required by law.

CERTIFICATE

MAUREEN P. TULLY, Secretary and Steven Skalicky, Comptroller of the American Home Assurance Company being duly sworn each for himself disposes and says that they are the above described officers of the said Company and that on the 31st day of December 31, 1986 the Company was actually possessed of the assets set forth in the foregoing statement and that such assets were available for the payment of losses and claims and held for the protection of its policyholders and creditors, except as hereinbefore indicated, and that the foregoing statement is a correct exhibit of such assets and liabilities of the said company on the 31st day of December, 1986 according to the best of their information, knowledge and belief, respectively.

Maureen Tully
Secretary

Steven J. Skalicky
Comptroller

STATE OF NEW YORK }
COUNTY OF NEW YORK } SS.:

On this 30 day of April, 19 87, before me came the above named officers of the American Home Assurance Company, to me personally known to be the individuals and officers described herein, and acknowledged that they executed the foregoing instrument and affixed the seal of said corporation thereto by authority of their office.

BRENDAN R. DAVENPORT NOTARY PUBLIC State of New York

Brendan R. Davenport

BRENDAN R. DAVENPORT
Notary Public, State of New York
No. 03-4755643
Qualified in Bronx County
Certificate Filed in New York County
Commission Expires July 31, 1988

31078 (4/87)

State of _____ }
County of _____ } ss.

On this _____ day of _____, 19 __, before me personally cam

_____ to me known

and known to me to be the individual described in and who executed the foregoing instrument, and acknowledged to me tha he executed the same.

My commission expires _____

_____
Notary Public

State of _____ }
County of _____ } ss.

On this _____ day of _____, 19 __, before me personally came

_____ to me known and known to me

to be a member of the firm of _____
described in and who executed the foregoing instrument, and he thereupon acknowledged to me that he executed the same as and for the act and deed of said firm.

My commission expires _____

_____
Notary Public

State of _____ }
County of _____ } ss.

On this _____ day of _____, 19 __, before me personally came

_____, to me known,

who being by me duly sworn, did depose and say that he is the _____

of _____,
the corporation described in and which executed the above instrument; that he knows the seal of said corporation; that the seal affixed to said instrument is such corporate seal; that it was so affixed by order of the Board of Directors of said corporation, and that he signed his name thereto by like order.

My commission expires _____

_____
Notary Public

State of New York }
County of Nassau } ss.

On this 9th day of May, 19 28, before me personally came

Allan J. Thompson to me known, who, being by me duly sworn, did depose and say that

he is an attorney-in-fact of National Union Fire Insurance Company of Pittsburg the corporation described in and which executed the within instrument; that he knows the corporate seal of said corporation; that the seal affixed to the within instrument is such corporate seal, and that he signed the said instrument and affixed the said seal as Attorney-in-Fact by authority of the Board of Directors of said corporation and by authority of this office under the Standing Resolutions thereof

DEBORAH A. NICASTRO
Notary Public, State of New York
No. 4513401
Qualified in Suffolk County
Commission Expires May 31, 19 [illegible]

My commission expires _____

Deborah A. Nicastro
Notary Public

B-22 (12-75)

National Union Fire Insurance Company of Pittsburgh, Pa.

Executive Offices
70 Pine Street, New York, NY 10270

Worldwide Bonding
American International Companies

FINANCIAL STATEMENT

as of DECEMBER 31, 1986

ASSETS	
Bonds	$1,160,176,242
Stocks	352,631,758
Collateral Loans	—0—
Cash and Bank Deposits	386,250,915
Agents Balances or Uncollected Premiums	283,011,050
Funds Held by Ceding Reinsurers	62,103,643
Reinsurance Recoverable on Loss Payments	194,303,028
Company's Interest in Assets of AIUA and AIUOA	64,725,951
Other Admitted Assets	289,256,642
TOTAL ASSETS	**$2,792,459,229**

LIABILITIES	
Reserve for Losses and Loss Expenses	$1,681,791,078
Reserve for Unearned Premiums	339,151,725
Reserve for Expenses, Taxes, Licenses and Fees	38,852,396
Reserve for Unauthorized Reinsurance	37,874,823
Funds Held Under Reinsurance Treaties	66,942,111
Other Liabilities	154,663,164
Capital Stock	4,478,750
Surplus	468,705,182
TOTAL POLICYHOLDERS' SURPLUS	**473,183,932**
TOTAL LIABILITIES AND POLICYHOLDERS' SURPLUS	**$2,792,459,229**

Bonds and stocks are valued in accordance with the basis adopted by the National Association of Insurance Commissioners.
Securites carried at $48,187,916 in the above Statement are deposited as required by law.

CERTIFICATE

MAUREEN P. TULLY, Secretary and Steven Skalicky, Comptroller of the National Union Fire Insurance Company of Pittsburgh, Pa. being duly sworn each for himself disposes and says that they are the above described officers of the said Company and that such assets were available for the payment of losses and claims and held for the protection of its policyholders and creditors, except as hereinbefore indicated, and that the foregoing statement is a correct exhibit of such assets and liabilities of the said company on the 31st day of December, 1986 according to the best of their information, knowledge and belief, respectively.

Maureen Tully
Secretary

Steven Skalicky
Comptroller

STATE OF NEW YORK } SS.:
COUNTY OF NEW YORK }

On this 30 day of April, 19 87, before me came the above named officers of the National Union Fire Insurance Company of Pittsburgh, Pa., to me personally known to be the individuals and officers described herein, and acknowledged that they executed the foregoing instrument and affixed the seal of said corporation thereto by authority of their office.

BRENDAN R. DAVENPORT NOTARY PUBLIC State of New York

Brendan R. Davenport

BRENDAN R. DAVENPORT
Notary Public, State of New York
No. 03-4755643
Qualified in Bronx County
Certificate Filed in New York County
Commission Expires July 31, 1988

31079 (4/87)

acord CERTIFICATE OF INSURANCE

ISSUE DATE (MM/DD/YY): May 5, 1988

PRODUCER

Rollins Burdick Hunter Co. of Illinois
123 N. Wacker Drive
Chicago, Illinois 60606

THIS CERTIFICATE IS ISSUED AS A MATTER OF INFORMATION ONLY AND CONFERS NO RIGHTS UPON THE CERTIFICATE HOLDER. THIS CERTIFICATE DOES NOT AMEND, EXTEND OR ALTER THE COVERAGE AFFORDED BY THE POLICIES BELOW.

INSURED

Breda Costruzioni Ferroviarie S.P.A.

COMPANIES AFFORDING COVERAGE

COMPANY LETTER A: First State Insurance Company
COMPANY LETTER B:
COMPANY LETTER C:
COMPANY LETTER D:
COMPANY LETTER E:

COVERAGES

THIS IS TO CERTIFY THAT POLICIES OF INSURANCE LISTED BELOW HAVE BEEN ISSUED TO THE INSURED NAMED ABOVE FOR THE POLICY PERIOD INDICATED, NOTWITHSTANDING ANY REQUIREMENT, TERM OR CONDITION OF ANY CONTRACT OR OTHER DOCUMENT WITH RESPECT TO WHICH THIS CERTIFICATE MAY BE ISSUED OR MAY PERTAIN, THE INSURANCE AFFORDED BY THE POLICIES DESCRIBED HEREIN IS SUBJECT TO ALL THE TERMS, EXCLUSIONS, AND CONDITIONS OF SUCH POLICIES.

CO LTR	TYPE OF INSURANCE	POLICY NUMBER	POLICY EFFECTIVE DATE (MM/DD/YY)	POLICY EXPIRATION DATE (MM/DD/YY)	ALL LIMITS IN THOUSANDS	
A	GENERAL LIABILITY COMMERCIAL GENERAL LIABILITY [x] CLAIMS MADE [ ] OCCURRENCE OWNER'S & CONTRACTORS PROTECTIVE	EL000304	8-1-87	8-1-88	GENERAL AGGREGATE	$5,000
					PRODUCTS-COMP/OPS AGGREGATE	$5,000
					PERSONAL & ADVERTISING INJURY	$5,000
					EACH OCCURRENCE	$5,000
					FIRE DAMAGE (ANY ONE FIRE)	$
					MEDICAL EXPENSE (ANY ONE PERSON)	$
A	AUTOMOBILE LIABILITY ANY AUTO ALL OWNED AUTOS SCHEDULED AUTOS [x] HIRED AUTOS [x] NON-OWNED AUTOS GARAGE LIABILITY	EL000304	8-1-87	8-1-88	CSL	$5,000
					BODILY INJURY (PER PERSON)	$
					BODILY INJURY (PER ACCIDENT)	$
					PROPERTY DAMAGE	$
	EXCESS LIABILITY OTHER THAN UMBRELLA FORM				EACH OCCURRENCE $	AGGREGATE $
	WORKERS' COMPENSATION AND EMPLOYERS' LIABILITY				STATUTORY	
					$ (EACH ACCIDENT)	
					$ (DISEASE-POLICY LIMIT)	
					$ (DISEASE-EACH EMPLOYEE)	
	OTHER					

DESCRIPTION OF OPERATIONS/LOCATIONS/VEHICLES/RESTRICTIONS/SPECIAL ITEMS

Additional Insured: Southern California Rapid Transit District, General Consultant, Construction Manager, System Engineering and Analyses Consultant as respects work performed by the named insured for contract A650. This insurance is primary over any insurance that may be obtained by the district.

CERTIFICATE HOLDER

Southern California Rapid Transit District
600 Spring Street
Los Angeles, California 90014

CANCELLATION

SHOULD ANY OF THE ABOVE DESCRIBED POLICIES BE CANCELLED BEFORE THE EXPIRATION DATE THEREOF, THE ISSUING COMPANY WILL ENDEAVOR TO MAIL 30 DAYS WRITTEN NOTICE TO THE CERTIFICATE HOLDER NAMED TO THE LEFT, BUT FAILURE TO MAIL SUCH NOTICE SHALL IMPOSE NO OBLIGATION OR LIABILITY OF ANY KIND UPON THE COMPANY, ITS AGENTS OR REPRESENTATIVES.

AUTHORIZED REPRESENTATIVE

D.A. Wilson

Rollins Burdick Hunter of Illinois, Inc.
123 North Wacker Drive, Chicago, Illinois 60606 / Telephone 312 701-4000

ROLLINS BURDICK HUNTER

May 9, 1988

Breda Costruzioni
Ferroviarie, S.P.A.
Pistoia, Italy

Southern California Rapid Transit District
600 Spring Street
Los Angels, California 90014

RE: BREDA COSTRUZIONI FERRONIARIE, S.P.A.
SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT CONTRACT
A650

As respects Item 8.1.A Workers Compensation insurance it is our understanding that Breda does not have any employees or exposure in the State of California at the present time. At the time they will have any exposures in the State of California it is our intent to negotiate on their behalf the purchase of Workers Compensation coverage required under this provision with a company or companies acceptable to the District.

Sincerely,

ROLLINS BURDICK HUNTER OF ILLINOIS, INC.

Elaine Zachery

Elaine Zachery
Assistant Vice President

EZ/mt

Enclosure

SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT

METRO RAIL PROJECT

PASSENGER VEHICLE

CONTRACT A650

IV. SPECIAL PROVISIONS

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SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT

METRO RAIL PROJECT

PASSENGER VEHICLE

CONTRACT A650

SPECIAL PROVISIONS

1.0 STATEMENT OF WORK

This Article provides a summary scope of Work for the Contract. The complete detailed scope of Work is as specified in the Contract Documents. This Article shall in no way be construed as limiting or modifying the Work as specified therein.

The Contractor shall provide all management, labor, materials, services and facilities to accomplish the following tasks:

A. Design, manufacture, and deliver passenger vehicles.

B. Furnish the wayside Automatic Train Operation (ATO) equipment required by the Technical Provisions and assist in supervision of installation and test.

C. Install the carborne District-Furnished Equipment (DFE) for automatic train control and communications as required in the Technical Provisions. Design and control the interfaces for the installation of the DFE.

D. Attend or conduct meetings at the places specified for design reviews, program reviews, interface management, negotiation of changes, and other Contract-related purposes.

E. Deliver drawings, schedules, reports, specifications, procedures, plans, and other data as specified in the General Provisions and Technical Provisions, including the Contract Data Requirements List. (CDRL)

F. Perform all factory acceptance testing required by the Technical Provisions. Provide trained and qualified personnel to conduct and support the testing of two dependent pairs at the Transportation Test Center (TTC) at Pueblo, Colorado. Per- 5 5

form the acceptance testing of vehicles on District property. Provide required instrumentation parts and materials.

G. Provide manuals. Prepare and deliver training material. Conduct training program(s).

H. Provide spare parts.

I. Provide Diagnostic and Test Equipment (DTE) and special maintenance tools.

J. Provide personnel and material to fulfill the warranty obligations of the Contract.

K. Provide mock-ups and models required by the Technical Provisions.

2.0 DELIVERY REQUIREMENTS

2.1 Contract Start

Notice To Proceed (NTP) will be given to the Contractor as provided for in the General Provisions. All schedule months referred to herein are months after NTP.

2.2 Passenger Vehicles - Original Buy (30 Vehicles)

The first two vehicles, configured in a dependent pair, shall be delivered to TTC within 26 months after NTP. The second dependent pair shall be delivered to TTC within 27 months after NTP. All testing activity at the TTC on the two dependent pairs shall be completed within a 6-month period. After testing, vehicles shall be retrofitted, as necessary, to incorporate any modifications resulting from testing. The vehicles shall be cleaned and prepared for shipment to the Project Site.

Vehicles, including the four from TTC, shall be delivered to the Project Site, in dependent pairs, starting in month 35, according to the following schedule:

Month	Pairs
35	1
36	2
37	2
38	2
39	2
40	2
41	2
42	2

Before delivery of vehicles to the Project Site commences, the testing at TTC shall be completed and the test results accepted by the District. If modifications to the vehicles are required as a result of the testing, the design for such modifications shall be completed by the Contractor and approved by the District prior to the shipment of vehicles to the Project Site.

2.3 Diagnostic and Test Equipment and Special Tools

The DTE and special tools shall be available for demonstration and use at TTC. The total complement of DTE and special tools shall be delivered to the District by month 32.

2.4 Manuals

Ten draft copies of all manuals shall be available for use before the start of testing at TTC. Ten copies of updated drafts of the manuals shall be available for use prior to the start of delivery of vehicles to the Project Site. Final manuals shall be printed and delivered with the sixteenth vehicle.

2.5 Training Materials

All instructors and training materials shall be ready for the training of District personnel 45 days prior to the delivery of the first dependent pair to the Project Site.

2.6 Spare Parts

Spare parts shall be delivered between months 31 and 37. The Contractor shall secure District approval before starting to deliver spare parts. The District will act on a written request to ship, within 15 days from receipt of same from the Contractor.

There shall be an adequate supply of Contractor-owned spares for use in warranty repairs warehoused in the Los Angeles area, prior to delivery of the first vehicles to the Project Site. District-owned spare parts shall not be used to support TTC testing or warranty work.

2.7 Wayside Programmed Station Stopping/Berthing Equipment

All wayside programmed station stopping and berthing equipment shall be delivered within 33 months after NTP.

3.0 DISADVANTAGED BUSINESS ENTERPRISE (DBE) REQUIREMENTS

This procurement is subject to the provisions of 49 CFR Section 23.67. Accordingly, the manufacturer of the transit vehicle must have an annual DBE goal, submitted to UMTA, that has either been approved or not disapproved by UMTA.

4.0 PAYMENT

4.1 Progress Payment--Passenger Vehicles Base Buy (Pricing Form AA)

Progress payments will be made upon satisfactory completion and acceptance of each milestone, in accordance with the milestone allocation percentages listed below.

	Milestone	Percentage of Contract Subtotal - (Pricing Form AA)
1.	Upon acceptance of bar chart schedule and design review schedule (#2011)	5
2.	Upon completion of CDR	5
3.	Upon completion of PDR	5
4.	Upon completion of F-end and underfloor mock-up review	5
5.	Upon completion of FDR	5
6.	Upon acceptance of carbody test report and truck test report	4
7.	Upon completion of FACI of major subsystems included in the List of Subcontractors Form	5
8.	Upon acceptance of climate chamber test report	2
9.	Upon acceptance of draft manuals (#2203)	2
10.	Upon acceptance of training lesson plans (#2204)	2
11.	Upon completion of all tests at TTC	4

Milestone	Percentage of Contract Subtotal - (Pricing Form AA)
12. Upon approval for shipment of completed dependent pairs to Project Site*	30
13. Upon acceptance of dependent pairs at Project Site*	20
14. Upon acceptance of maintainability demonstration test report	2
15. Upon acceptance of reliability demo test report and completion of warranty	4
TOTAL	100

* (Payment for each dependent pair shall be prorated at 1/15th of the milestone allocation percentage.)

In order to be eligible for the payment of a milestone, the Contractor shall:

1. Have all submittals required prior to that milestone delivered to and accepted by the District; and

2. Perform the portion of work, including warranty support, required prior to that milestone.

4.2 Progress Payment--DTE, Spare Parts and Miscellaneous Items (Pricing Forms CC, DD and EE)

DTE, Spare Parts and Miscellaneous Items will be paid for at unit prices on a per item basis when delivered to and accepted by the District. (Not less than $100,000 in value per delivery.)

4.3 Progress Payment--Wayside Station Stop Equipment Base Buy and Option Total Price (Pricing Forms AA and FF)

Wayside Station Stop Equipment will be paid for at unit prices on a per item basis when delivered to and accepted by the District.

4.4 Progress Payment--Passenger Vehicles Option Total Price (Pricing Form FF)

Progress payment will be made upon satisfactory comple-

tion of each milestone, in accordance with the milestone allocation percentages listed below:

Milestone	Percentage of Passenger Vehicle Option Total Price (Pricing Form FF)
1. Upon acceptance of bar chart schedule for option cars	15
2. Upon completion of watertightness test of dependent pairs*	40
3. Upon approval for shipment of completed dependent pairs to Project Site*	25
4. Upon acceptance of dependent pairs at Project Site*	20
TOTAL	100

* (Based on the actual option order quantity, payment for each dependent pair shall be prorated at between 1/17th to 1/21st of the milestone allocation percentage.)

4.5 Milestone Progress Payment Request

The Contractor shall submit its milestone progress payment request to the District for payment no later than the 25th of each month. Invoices shall be of a format acceptable to the District. The District will make payment to the Contractor within 30 days after receipt of and based on the milestone progress payment request as approved by the District. Approval of requests for payment is subject to District verification of the accuracy of the data presented. Said verification will be accomplished by whatever reasonable means the District deems necessary.

4.6 Certification

With each invoice submitted (except the initial invoice), the Contractor shall provide a certification that it has paid to its subcontractors that portion of funds received from the District to which they are entitled by the terms of their contracts. The Contractor shall promptly provide documentary evidence to substantiate the certification if the District requests same.

5.0 WARRANTY PERIOD

5.1 Vehicles

The Contractor shall warrant each vehicle, including all subsystems, against any defects or failures for 2 years after the vehicle is placed into revenue service or for 3 years after its final acceptance, whichever occurs first. In addition, the carbody, truck structural members, traction motors (except brushes), and gear reducers for propulsion subsystem shall be warranted for 5 years after final acceptance of the vehicle.

Acceptance of each vehicle in a dependent pair shall be as specified in Article 13.0 of these Special Provisions.

5.2 Spare Parts

The Contractor shall warrant each spare part furnished under the Contract against any defects or failures for 2 years after the part is installed on the vehicle or for 5 years after delivery of the part, whichever occurs first.

5.3 Test Equipment and Special Tools

The Contractor shall warrant DTE, special tools, and other items not part of the vehicle, furnished under the Contract, against defects or failures for 2 years after acceptance.

5.4 Warranty Replacement Parts

The Contractor shall warrant each part supplied to replace a defective part under this warranty for the remainder of the warranty on the part replaced, or for 1 year after the replacement part is installed, whichever occurs last.

5.5 Wayside-Programmed Station Stopping/Berthing Equipment

The Contractor shall warrant each set of wayside-programmed station stopping and berthing equipment against any defects or failures for 2 years after the start of revenue service for the equipment, or for 3 years after its final acceptance, whichever occurs first.

5.6 Additional Warranty

In addition to the warranties specified above, the Contractor shall further warrant the vehicles against excessive independent failure rates.

The Contractor shall make corrections when the failure rate of any Lowest Level Replaceable Unit (LLRU) is excessive. If the failure rate of any LLRU exceeds 15 percent of the population of the item in any single year during the general Warranty Period, extending until the last vehicle is out of warranty, the Contractor shall make necessary corrections at no charge to the District. Such corrections shall be made in a manner acceptable to the District and shall be made to all vehicles in the fleet, including those for which the warranty has expired.

5.7 Vehicle Reliability

Failure of any vehicle equipment to meet the reliability requirements during Vehicle Reliability Demonstrations, when performed to Contractor-supplied procedures, shall be the responsibility of the Contractor. If correction requires modifications, they shall be made to all vehicles at no cost to the District.

6.0 LIQUIDATED DAMAGES

A. Satisfactory completion and operation of the passenger vehicle fleet and wayside-programmed station stopping and berthing equipment is of paramount importance to the District. It is a prerequisite to the District's prerevenue testing and operations. If the equipment identified herein is not delivered according to the schedule identified in Article 2.0 of the Special Provisions, the District will be damaged. The damage may include, but may not be limited to:

1. Loss of revenue

2. Increased cost because of the need to compress the period of prerevenue operations

3. Increased cost because of impact on other contracts

4. Increased cost of contract administration and construction management.

B. In lieu of actual damages in the event of late delivery, the Contractor hereby agrees to pay the District an amount of money as a reasonable estimate of just compensation for the damages contemplated in this Article.

The values agreed for the items are:

1. For late delivery of the two dependent pairs to TTC, 450 dollars for each vehicle for each day that the actual delivery date exceeds the Contract schedule date. For purpose of liquidated damage determination, vehicle delivery occurs when a dependent pair is on the rails at the delivery site, with all equipment installed and ready for test.

2. For vehicle delivery to the project site, the amount shall be 200 dollars per vehicle per day until month 39, after which it shall be increased to 375 dollars per vehicle per day.

3. For late delivery of the wayside-programmed station stopping and berthing equipment, 300 dollars per day for each day that actual delivery date exceeds the Contract schedule date.

The Contractor agrees to make payment in the above amounts if late, and agrees that the District may withhold monies for such from any funds due.

C. Liquidated damages will be limited, for all causes, to a maximum of 10 percent of the total price of the Contract. This limitation is applicable to all option quantities on the same basis.

D. Application of the "Liquidated Damages" provisions of the Contract in no way alters the District's rights under the Article entitled TERMINATION FOR DEFAULT in the General Provisions.

E. Payment to the Contractor by the District for vehicles delivered late shall in no way constitute a waiver by the District of its rights to payment from the Contractor for liquidated damages.

7.0 WEIGHT PRICE ADJUSTMENT

A. The District's energy cost may be increased or decreased if the vehicles are over or under the AWO weight of 80,000 lb. Completed vehicles shall be weighed at the point of shipment, and a certified weight ticket for each vehicle shall be provided to the District.

B. To compensate the District for the increased cost for overweight vehicles, the Contractor agrees to reduce the vehicle price by three dollars per pound for each pound the vehicle is over the AWO weight.

C. As an incentive to the Contractor for weight reduction under 80,000 lb, the District agrees to increase the vehicle price by three dollars per pound for each pound the vehicle is under the AW0 weight, to a limit of 78,000 lb. There will be no additional adjustment in price if the weight is below that limit.

D. Should the empty vehicle weight (AWO) exceed 82,000 lb, the vehicle will be rejected by the District, and liquidated damages will be assessed until a vehicle with an acceptable weight has been supplied.

E. The AW0 weight includes an allowance of 1,000 pounds for DFE. For the purpose of price adjustment, certified vehicle weights will be adjusted for any difference between 1,000 pounds and the actual delivered weight of DFE.

8.0 FACILITIES FOR DISTRICT REPRESENTATIVES

At each of the Contractor's facilities and at each of its subcontractors' facilities where significant production or fabrication activities take place, the Contractor shall provide an estimated 400 sq ft of office space and suitable parking space for District representatives. Accommodations shall be equivalent to those used by the Contractor's staff and shall be acceptable to the District.

9.0 DISTRICT FACILITIES FOR TESTING

The District will make available to the Contractor adequate trackage on the District's property to permit the Contractor to conduct specified tests. The District will also provide shop facilities and personnel to operate the cars. Facilities and personnel will be available to the Contractor for up to 16 hours a day and 5 days a week, exclusive of Saturdays, Sundays, and holidays. Contractor must schedule requirements 30 days in advance of actual test operations. Schedules shall be submitted for District approval.

10.0 CONTRACTOR'S TECHNICAL PROPOSAL

The Contractor's Technical Proposal as modified through negotiations shall become a Contract Document upon execution of the Contract, and all materials and services proposed therein shall be provided to the District as proposed. The Article entitled PRECEDENCE OF CONTRACT DOCUMENTS in the General Provisions provides the order of precedence for Contract Documents when con-

flicting requirements are to be resolved. The Technical Proposal shall be placed in the precedence list under the Contract Drawings and above the Reference Drawings.

11.0 BUY AMERICA

This procurement is subject to the UMTA Buy America Requirements in 49 CFR Part 661. In order to qualify as a domestic end product, the cost of components produced in the United States must exceed 50 percent of the cost of all components, and final assembly must take place in the United States. However, preproduction vehicles are exempt from the requirement for final assembly in the United States.

12.0 OPTION

12.1 Option Exercise Period - Passenger Vehicles

With this Contract, the Contractor has given the District an option to purchase additional vehicles having the same configuration as the original 30 vehicles provided under the Contract. The Option may be exercised anytime within 18 months after NTP by written notification of exercise from the District to the Contractor.

12.2 Option Terms - Passenger Vehicles

A. Quantity -- The number of Option vehicles purchased will be within the range from a minimum of 34 to a maximum of 42 vehicles and shall be configured in dependent pairs.

B. Price -- Vehicle prices shall be at the unit prices quoted on Pricing Form FF.

C. Delivery -- The Option cars will be delivered at a rate of four vehicles (two dependent pairs) per month with the first delivery to begin within 2 months after the scheduled final delivery of the Base Contract vehicles.

D. Payment -- Payment will be made in the same manner as prescribed for vehicles in Article 4.0 of these Special Provisions.

E. Liquidated Damages -- Liquidated damages will be assessed at the rate of 200 dollars per day per vehicle for late delivery to the Project Site.

The increased scope of supply will be incorporated into the Contract by a Contract Amendment at the time of exercise of the Option.

12.3 Option Exercise Period - Wayside Station Stop Equipment

With this Contract, the Contractor has given the District an option to purchase additional wayside station stop equipment having the same configuration as the original five sets provided under the Contract. The Option may be exercised anytime within 33 months after NTP by written notification of exercise from the District to the Contractor.

12.4 Option Terms - Wayside Station Stop Equipment

A. Quantity -- The number of Option wayside station stop equipment purchased will be no fewer than seven sets.

B. Price -- Wayside station stop equipment prices shall be at the unit prices quoted on Pricing Form FF.

C. Delivery -- The Option wayside station stop equipment will be delivered 33 months after exercise of option, unless otherwise approved.

D. Payment -- Payment will be made in the same manner as prescribed for wayside station stop equipment in Article 4.0 of these Special Provisions.

E. Liquidated Damages -- Liquidated damages will be assessed at the rate of 300 dollars per day for each day that actual delivery date exceeds the Contract schedule date.

The increased scope of supply will be incorporated into the Contract by a Contract Amendment at the time of exercise of the Option.

12.5 Unpriced Option

It is the District's intention, contingent upon obtaining necessary authorizations and funding, to proceed with construction of the entire 20 mile Metro Rail System. In that event, it is projected that the District will ultimately require a total of approximately 130 rail vehicles. To facilitate this possible procurement, the Contractor grants to the District an unpriced option to purchase additional vehicles. The Option may be exercised anytime within 48 months after NTP, after agreement as to quantity, price and delivery, by written notification of exercise from the District to the Contractor.

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SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT

METRO RAIL PROJECT

PASSENGER VEHICLE

CONTRACT A650

V. GENERAL PROVISIONS

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GENERAL PROVISIONS

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GENERAL PROVISIONS - SECTION 1

Section 1 of the General Provisions applies to all Metro Rail Procurement Contracts whether for the supply of equipment, installation of equipment, or both supply and installation of equipment. In addition, when the Contract requires installation work at the Project Site, the articles of Section 2 of the General Provisions are applicable to the Work performed at the Project Site.

1.0 ABBREVIATIONS, ACRONYMS, AND DEFINITIONS

The more common abbreviations, acronyms, and definitions used in the Contract Documents are summarized as follows:

1.1 Abbreviations

Cal/OSHA	California Occupational Safety and Health Administration, Department of Industrial Relations
CFR	Code of Federal Regulations
CM	Construction Manager
CDRL	Contract Data Requirements List
DBE	Disadvantaged Business Enterprise
DOT	United States Department of Transportation
EPA	United States Environmental Protection Agency
FAR	Federal Acquisition Regulations
GC	General Consultant
HDBK	Handbook
HVAC	Heating, Ventilation and Air Conditioning
ICC	Interstate Commerce Commission
ITB	Invitation To Bid
NTP	Notice To Proceed
OSHA	Occupational Safety and Health Administration, United States Department of Labor; Occupational Safety and Health Act
PUC	State of California Public Utilities Commission
SCRTD	Southern California Rapid Transit District
TTC	Transportation Test Center (AAR Test Facility at Pueblo, Colorado)
UMTA	Urban Mass Transportation Administration (DOT)
US	United States of America
USC	United States Code
5 Deleted	5

1.2 Definitions

Technical definitions are contained in the Technical Provisions.

Acceptance. Written documentation attesting to the act of an authorized representative of the District, by

which all Work or a specific portion thereof, under the Contract has been identified as complete to the satisfaction of the District.

Addenda. Written interpretations, revisions, or additions to any of the Proposal or Contract Documents issued by the District.

Award. Written notification to a Contractor of acceptance by the District of its Offer for the Work, subject to the execution and approval of a satisfactory contract therefor, and bond to secure the performance thereof, and to such other conditions as may be specified or otherwise required by law.

Change Order. A written order directing the Contractor to make a change that the Changes Article authorizes the District to make without the Contractor's consent. The effective date of the Change Order shall be the issue date of said order.

Conformed Contract Documents. True copies of the Procurement Specifications Book and Contract Drawings revised to incorporate all changes made to the Bid Documents or Contract Documents by addenda or as indicated on the bid or contract form, as well as true copies of fully executed contract modifications.

Construction Manager (CM). The Joint Venture of Ralph M. Parsons Company, Dillingham Construction, Inc., and DeLeuw, Cather and Company doing business as PDCD, engaged by the District as the Construction Manager, and its successors, if any, acting directly or through properly authorized agents within the scope of the particular duties delegated to them by the District.

Contract. The written agreement executed by the District and the Contractor which sets forth the rights and obligations of the parties relative to the performance of the Work.

Contract Amendment. A document that changes the Contract by alteration in the specifications, delivery point, rate of delivery, contract period, price, or quantity, whether accomplished by Change Order or by mutual action of the parties to the Contract.

Contract Data Requirements List (CDRL). The listing identified as an Appendix or Table (so titled) in the Technical Provisions, which codifies, defines, and schedules deliverable data requirements.

Contract Documents. The completed and executed Contract Agreement, Performance Bond, DBE/WBE Certification, Special Provisions, General Provisions, Technical

Provisions, Contract Drawings, Insurance Specifications, and additional documents incorporated by reference into the Contract Agreement or any other Contract Document.

Contract Drawings. The drawings that show configuration, character, general arrangement, dimensions, and details of the Work. Contract Drawings will either be included in, or enclosed with, the Procurement Specifications Book.

Contract Milestone. An established event or occurrence that is associated with the contract schedule as documented in the Procurement Specifications Book.

Contracting Officer (CO). The person with the authority to execute the contract and make related determinations and findings thereto on behalf of the District.

Contractor. The individual, partnership, firm, corporation, or combination thereof, who has entered into a contract with the District to provide the required services and products.

Critical Path Network. The documents required under the Contract that depict key activities and events, the order and interdependence of planned activities as well as activities by Others which affect the Contractor's planning, and the critical path by which the Contractor intends to prosecute the Work.

Days. Unless otherwise designated, days mean calendar days.

District. The Southern California Rapid Transit District.

District's Authorized Representative (DAR). The person designated by the District acting within prescribed limits of authority in the management of the Contract.

Equipment. A general term including material, fittings, devices, appliances, fixtures, apparatus, and the like used in the performance of a specific function or functions.

Execution of Contract. The validation by both the District and the Contractor of the Contract Agreement obligating the Contractor to furnish the supplies or services and the District to pay for them.

General Consultant (GC). Metro Rail Transit Consultants, a joint venture composed of the firms Daniel, Mann, Johnson & Mendenhall (DMJM): Parsons, Brinckerhoff, Quade & Douglas, Inc. (PBQD); Kaiser Engineers (California) Corporation (KE), and Harry Weese & Assoc-

iates (HWA), doing business as "Metro Rail Transit Consultants," engaged by the District as the General Consultant and its successors, if any, acting directly or through properly authorized agents within the scope of the particular duties delegated to them.

General Provisions. The provisions of a system procurement contract that describe the contractual relationship of the parties and their rights and responsibilities to each other.

Government. The government of the United States of America.

Indicated. As shown on the Contract Drawings, or as described or specified in the Technical Provisions, or as required by other Contract Documents.

Insurance Specifications. The document specifying the insurance coverage to be provided by the District and the insurance coverage to be provided by the Contractor.

Metro Rail System. The District's Heavy Rail Rapid Transit System including right-of-way, pavement, tracks, structures, equipment, appurtenances, and other property and fixtures associated therewith.

Notice of Acceptance. Formal written acceptance by the District of the Contractor's Notice of Completion.

Notice of Award. Notice to a Contractor of the acceptance of its offer and the intent to execute a contract.

Notice of Completion. Written notice from the Contractor specifying that the Work is fully completed as specified in the Specifications.

Notice of Termination. Written notice from the District to the Contractor and its surety terminating the Contract completely or partially for convenience of the District or default due to the Contractor's failure to perform its contractual obligations.

Notice To Proceed (NTP). Written notice from the District to the Contractor of the date to proceed with the Work.

5 Preproduction Vehicle. Preproduction vehicles shall 5
5 be the first two dependent pairs manufactured and sent 5
5 to the Transportation Test Center for testing. 5

Procurement Specifications Book. A set of documents issued by the District for the Work, which includes the Request for Proposal, Special Provisions, General Provisions, Technical Provisions, Contract Drawings (as

applicable), Proposal Forms, Contract Forms, Appendices, and other forms and exhibits identified therein.

Project Site. The right-of-way, tracks, maintenance facilities, and all other property of the District where Work will be performed under the Contract.

Proposal Documents. Documents provided by the District for the purpose of soliciting proposals for the procurement. Proposal Documents consist of the Passenger Vehicle Procurement Specifications Book which includes the Proposal Requirements, Proposal Forms, Contract Forms, Special Provisions, General Provisions, Technical Provisions, and half-size Contract Drawings; and Guidelines for Preparation of Safety and System Assurance Analyses, SCRTD 5-001.

Reference Drawings. Those drawings, other than the Contract Drawings, that are provided for information to the Contractor as part of the Proposal Documents, which depict the major areas of system interface peculiar to the procurement.

Right-of-Way. Real property, and interests therein, acquired by the District.

Special Provisions. Special requirements peculiar and applicable to individual system procurement contract packages which supplement or modify the General Provisions.

Specifications. The directions, provisions, and requirements contained or referred to in the Procurement Specifications Book, pertaining to the manner of performing the Work, or to the quantities of Work.

State. The State of California.

Subcontractor. Any individual, partnership, firm, or corporation which undertakes integrally on the Work, the partial or total design, manufacture, or performance of one or more items of Work under the terms of the Contract. As used herein, the terms subcontractor and supplier are synonymous.

Supplemental Agreement. A contract modification that is accomplished by the mutual action of the parties and signed by both the Contracting Officer and the Contractor.

Surety. The corporate body bound with and for the Contractor, for the full and complete performance of the Contract and for the payment of all debts pertaining to the Work.

System Engineering and Analyses Consultant. The consulting firm of Booz Allen and Hamilton, Inc., under contract to the District for special engineering services.

Technical Provisions. Requirements that set forth the details of the Work including design, performance, material, testing, methods of manufacture, and other requirements peculiar to the procurement.

United States Department of Transportation. The Secretary of the US Department of Transportation and other persons who may at the time be acting in the capacity of the Secretary or authorized to perform the functions to be performed hereunder by DOT, including representatives of the Urban Mass Transportation Administration (UMTA).

Work. The furnishing of all the products, materials, equipment, data, and services in accordance with the Contract Documents including changes thereto.

2.0 INTENT OF THE CONTRACT

It is the intent of the Southern California Rapid Transit District (District) that this procurement Contract result in delivery to the District of the specified equipment that is, in all respects, suitable for its intended use on the Metro Rail System. The Technical Provisions and Contract Drawings are intended to be generally complete and comprehensive, but do not show all details of the Work required to be performed. The Contractor, based on its experience, shall complete the detail design as necessary to supply equipment in conformance with the Technical Provisions and Contract Drawing.

The Contractor shall be solely responsible for the design of the equipment. If at any time the Contractor finds that any requirement of these Specifications appears to be in error or in conflict with the general intent of the Contract, it shall expeditiously bring such conflict to the attention of the District's Authorized Representative (DAR) in writing for resolution.

3.0 PRECEDENCE OF CONTRACT DOCUMENTS

The Special Provisions, General Provisions, Technical Provisions, Contract Drawings, and all other Contract Documents referenced therein are part of the Contract. They are intended to describe the Work and be complementary.

Any inconsistency in requirements of the documents shall be resolved by giving precedence in the following order:

A. Executed Contract
B. Special Provisions
C. General Provisions
D. Technical Provisions
E. Contract Drawings
F. Reference Drawings
G. Cited Codes and Standards

All Contract Documents shall take precedence over approved Contractor drawings. In case of differences between small and large scale drawings, the large scale drawings shall govern. Written dimensions on drawings shall have precedence over scaled dimensions in case of a discrepancy.

4.0 CONTRACT DRAWINGS

Contract Drawings are those drawings and revision levels identified and contained in the Procurement Specifications Book. For contracts having a large number of drawings, they may instead be contained in a separate Contract Drawing Book. These drawings are complementary but subsidiary to the Specifications. Anything mentioned in the Specifications (including General and Technical Provisions) and not shown on the Contract Drawings, or shown on the Contract Drawings and not mentioned in the Specifications, will be of like effect as if shown in both.

5.0 DISTRICT'S AUTHORIZED REPRESENTATIVES

The District will authorize representatives to perform, on behalf of the District, certain functions in the administration of the Contract. A copy of the authorization will be furnished to the Contractor upon issuance of the Notice to Proceed and revised as necessary. A list of District representatives authorized to act on behalf of the District will be furnished to the Contractor. The District shall be bound by the acts of the District employees and authorized representatives only with respect to matters delegated to them in writing.

6.0 CONTRACTOR'S PROJECT MANAGER

The Contractor shall provide, within 10 days after notice of award, the name and resume (including title, qualifications, and experience) of its Project Manager (PM) to the District for approval. Once approved, the PM shall devote full time to the project until all program plans and schedules have been submitted and approved by the District. Should the Contractor later wish to reduce the level of PM effort to part-time, it may do so only with prior approval of the District. The PM shall not be reassigned from the project without concurrence of the District.

A written description of the authority of the Contractor's PM shall be provided to the District.

7.0 PERFORMANCE BOND

The Contractor shall provide, within 10 days after notice of award of either the base buy or notice of exercise for the option, a performance bond in the amount of 100 percent of the total contract price. The performance bond shall be on the form provided by the District, and shall be executed as surety by a corporation or corporations authorized to issue surety bonds in the State of California, and satisfactory to the District. A foreign surety may be acceptable if authorized to do business in California and supported with an Irrevocable Letter of Credit, with terms approved by the District, for 100 percent of the Contract price from a bank authorized to do business in California.

The provisions of the performance bond and/or the letter of credit shall be such that alterations, extensions of time, extra and additional work, and other changes authorized by the Contract Documents may be made without the consent of the surety or sureties.

8.0 INSURANCE

8.1 Within 10 days after notice of award of the Contract and before any part of the Work is commenced, the Contractor shall at the Contractor's sole cost, cause insurance policies underwritten by companies acceptable to the District to be issued for not less than limits and coverages as set forth below and maintained during the entire progress of the Work:

A. Worker's Compensation, including Employer's Liability, in the minimum amount of $1,000,000, in states where employees are working under the Contract.

B. Comprehensive General Liability including Contractual Liability and Products Liability covering bodily injury, including death, and property damage in the single limit per occurrence amount of $5,000,000.

C. Comprehensive Automobile Liability including owned, nonowned, and hired vehicles covering bodily injury, including death, and property damage in the single limit per occurrence amount of $5,000,000.

8.2 The policy of insurance which affords Comprehensive General Liability shall contain a provision or endorsement stating that such insurance:

A. Applies to the liability assumed by the Contractor under this Contract, subject to all of the terms and provisions of such insurance.

B. Does not contain any exclusion as to loss or damage to property caused by explosion or resulting from collapse of buildings or structures or damage to property underground, commonly referred to by insurers as the "XCU" hazards.

8.3 Certificates of Insurance satisfactory in form to the District shall be supplied by the Contractor to the District evidencing that the above insurance is in full force and the District, the General Consultant (GC), and the Construction Manager (CM), and the System Engineering and Analyses Consultant have been made additional insureds on, or are indemnified under, said policies in respect of liabilities to third parties, and that not less than 30 days prior written notice will be given the District before any cancellation or restrictive modification of the policies.

The Certificates of Insurance shall include a statement that said insurance is primary over any insurance which may be obtained by the District.

8.4 None of the requirements contained herein as to types, limits, and the District's approval of insurance coverage to be maintained by the Contractor are intended to and shall not in any manner limit or qualify the liabilities and obligations assumed by the Contractor under the Contract.

9.0 NOTICE TO PROCEED

The District will issue a Notice To Proceed (NTP) within 30 days of Execution of Contract, provided the Contractor has delivered the required bond and certificates, and has designated a Project Manager. The Contractor is not authorized to perform Work under the Contract prior to receiving the NTP. Upon receipt of the NTP, the Contractor shall commence the Work and shall diligently prosecute the Work to completion in accordance with the delivery requirements specified in the Contract documents.

10.0 DOCUMENTATION

10.1 All official correspondence and documentation transmitted to the District shall be in the English language.

10.2 Unless stated otherwise in the Contract Documents, the District will respond to all correspondence submitted for District action within 30 calendar days of the date the correspondence is received by the District. The

District will only be bound to this period of time for review and response if the Contractor submits its documentation in accordance with the dates for submittals shown in the approved project schedule.

10.3 Should the Contractor make submittals at a rate that differs from the schedule, which rate results in placing higher peak loading on the District's resources than submittals to the approved schedule would cause, the District will make its best efforts to respond within 30 days. If, however, the District is unable to respond within that period, the Contractor shall not be entitled to any extra time.

11.0 WARRANTY

11.1 Except where longer periods of warranty are specified in the Special Provisions, the Contractor warrants all equipment, materials, and labor furnished or performed under the Contract shall be satisfactory for their intended purposes and shall be free of all defects in the design, materials, and workmanship for a period of 1 year from and after final acceptance under the Contract, regardless of whether the same were furnished or performed by the Contractor or by any of its subcontractors of any tier. Upon receipt of written notice from the District of any defect in any such equipment, materials, or labor during the applicable warranty period, due to defective design, equipment, materials, or workmanship, the affected item or parts thereof shall be redesigned, repaired, or replaced within a time period and in a manner acceptable to the District.

11.2 The Contractor shall perform such tests as the District may require to verify that such redesign, repairs, and replacements comply with the requirements of the Contract Documents. All costs associated with such redesign, repair, replacement, and testing, including the removal, replacement, and reinstallation of equipment and materials necessary to gain access, shall be borne by Contractor. The Contractor warrants such redesigned, repaired, or replaced work against defective design, materials, and workmanship for the remainder of the warranty period or a period of 1 year from and after the date of acceptance thereof, whichever occurs later. Should the Contractor fail to promptly make the necessary redesign, repair, replacement, and test, the District may perform or cause to be performed the same at the Contractor's expense.

11.3 District-owned spare parts will not be used for warranty purposes. The Contractor shall maintain a sufficient

quantity of replacement parts on hand at or near the District repair facility to repair warrantable failures and defects. The security, control, shipping, and disposition of Contractor-owned parts shall be the responsibility of the Contractor.

Contractor personnel will be entitled to use District facilities and special equipment to perform warranty work, provided that such work is conducted during normal hours, does not interfere with other District activities, and is performed in accordance with District policies and directions. Damages to District property caused by Contractor representatives shall be the sole responsibility of the Contractor, and shall be corrected at the Contractor's expense.

11.4 The Contractor and its surety or sureties, shall be liable for the satisfaction and full performance of the warranties as set forth herein.

12.0 PROGRESS PAYMENT SCHEDULE

5 Deleted. 5

13.0 PAYMENT

5 13.1 Deleted. 5

5 13.2 Deleted. 5

5 13.3 Deleted. 5

5 13.4 Deleted. 5

14.0 NOTICE OF COMPLETION, FINAL ACCEPTANCE, AND PAYMENT

14.1 When the Contractor determines that the Work is fully completed, including satisfactory completion of such inspections, tests, and documentation as are specified in the Contract Documents, the Contractor shall give a written Notice of Completion specifying the Work completed and the date it was completed.

Within 30 calendar days after receipt of said Notice of Completion, the District will inspect the Work and shall either reject the Notice of Completion and specify defective or uncompleted portions of the Work, or shall issue the Contractor a written Notice of Acceptance of the Work. The warranty period for the Work starts with the issuance of the Notice of Acceptance.

14.2 If the District rejects the Notice of Completion and specifies defective or uncompleted portions of the Work, the Contractor shall promptly remedy such defective and uncompleted portions of the Work. Thereafter, the Contractor shall again give the District a written Notice of Completion of the Work, specifying a new date for the completion of the Work based upon the date such defective or uncompleted portions of the Work were corrected. The foregoing procedure shall apply again and successively thereafter until the District has given the Contractor written Notice of Acceptance for purposes of final payment and final acceptance.

5 14.3 The final invoice shall contain a complete itemized 5
5 listing of milestone progress payment invoices by num- 5
5 ber, date, gross amount, and the total amount of sums 5
5 due. It shall also contain, or be supported by, a writ- 5
ten Notice of Acceptance of the Work signed by the District for purposes of final payment and a final payment certification.

14.4 The District shall not be obligated to make final payment to the Contractor until the Contractor has delivered to the District a certificate and release satisfactory to the District stating that the Contractor has fully performed under the Contract, that all Contractor claims for the Work are satisfied upon the making of such final payment, and that no property used in connection with the Work is subject to any unsatisfied lien or claim as a result of the performance of the Work.

14.5 Unless otherwise specified by law, final payment will be made when the District concurs with the final invoice and documents, but not less than 35 calendar days after acceptance of the Contractor's Notice of Completion. In the event of disagreement on the amount of final payment, payment will be made within 10 calendar days after written concurrence with any amendments to the final invoice and documents, but not earlier than the 35 calendar days.

14.6 Any failure by the District to inspect or to reject the Work or to reject the Contractor's Notice of Completion as set forth above, shall not be deemed to be acceptance of the Work by the District nor imply acceptance of or agreement with said Notice of Completion.

15.0 CHANGES

15.1 Directed Changes - The District may at any time, without notice to the sureties, if any, by written order designated or indicated to be a Change Order, make any change in the Work within the general scope of the Contract, including but not limited to changes:

A. In the Specifications (including Technical Provisions, drawings, and designs);

B. In the method or manner of performance of the Work;

C. In the District-furnished facilities, equipment, materials, services, or site;

D. Directing acceleration in the performance of the Work; or

E. Resulting from approved cost reduction incentive proposals submitted by the Contractor.

15.2 Any other written or oral order (which shall include direction, instruction, interpretation, or determination) from the District, which causes a change, shall be treated as a Directed Change under this Article, provided that the Contractor gives the District written notice stating the date, circumstances, and source of the order and stating that the Contractor regards the order as a Directed Change, subject to District concurrence.

15.3 Except as herein provided, no order, statement, or conduct of the District shall be treated as a Directed Change under this Article or entitle the Contractor to an equitable adjustment hereunder.

15.4 If any Directed Change under this Article causes an increase or decrease in the Contractor's cost of or the

time required for the performance of any part of the Work under the Contract, whether or not changed by any such order, an equitable adjustment shall be made and the Contract modified in writing accordingly. Upon receipt of any Directed Change under this Article, the Contractor shall proceed with the Work as directed.

A. Except for claims based on defective Specifications, no claim for any change under Subarticle 15.2 shall be allowed for any costs or delays incurred more than 20 days before the Contractor gives written notice as therein required, provided that, in the case of defective Specifications for which the District is responsible, the equitable adjustment shall include any increased cost reasonably incurred by the Contractor in attempting to comply with such defective Specifications.

B. If the Contractor intends to assert a claim for an equitable adjustment under this Article, it shall, within 30 days after receipt of a written Change Order under Subarticle 15.1 or the furnishing of a written notice under Subarticle 15.2, submit to the District a written statement setting forth detailed cost and schedule adjustments, unless this period is extended by the District. The statement of claim hereunder may be included in the notice under Subarticle 15.2.

15.5 Proposed Changes - In addition to Directed Changes as specified under Subarticles 15.1 through 15.4, changes within the general scope of the Contract may be proposed by the District, by the issuance of a Change Notice. The Contractor may also propose changes. In either case, the Contractor shall prepare and submit a detailed proposal of cost and schedule adjustments to the District, within 30 days.

If the Contractor's proposal is accepted in whole or in part, such acceptance shall be implemented by the issuance of a Change Order.

15.6 If the Contractor claims cost and schedule adjustment for a Directed Change or a Proposed Change, the District and the Contractor shall negotiate an equitable adjustment.

15.7 Any claim for an equitable adjustment in compensation under this Article shall be in sufficient detail to permit a cost or price analysis of all material, labor, equipment, and subcontract costs and shall cover all Work involved, whether such Work was deleted, added, or changed. The District shall be the sole judge of the adequacy of the pricing data. Any amounts requested for

subcontractors shall be supported by a similar price breakdown.

For any change to the Contract involving aggregate increases or decreases in costs, including applicable profits, of more than $100,000, except any change for which the price is based on adequate price competition, based on established catalog or market prices of commercial items sold in substantial quatities to the general public, or set by law or regulation, the Contractor shall submit a Certificate of Current Cost or Pricing Data. In this certificate, the Contractor shall certify that, to the best of its knowledge, the cost or pricing data furnished or identified in the Contractor's request for adjustment are accurate, current, and complete, as of the date the Contract is amended for said adjustment.

In addition, any claim for equitable adjustment in time of performance shall be accompanied by a revised progress schedule, with justification therefor.

15.8 No claim by the Contractor for an equitable adjustment hereunder shall be allowed, if asserted after final payment under the Contract.

16.0 PRICING ADJUSTMENTS

The price of Work added, deleted, or changed will be determined by negotiation of requests for adjustment submitted by the Contractor.

Such requests shall be in sufficient detail to permit cost or price analysis by the District. The Contractor shall provide adequate cost backup data to enable the District to ascertain that the price is fair and reasonable. The District shall be the sole judge of the adequacy of the pricing data. The pricing of adjustments in the Contract price is also governed by the Article entitled PRICE REDUCTION FOR DEFECTIVE COST OR PRICING DATA in these General Provisions.

17.0 PRICE REDUCTION FOR DEFECTIVE COST OR PRICING DATA

17.1 Applicability

This Article applies to any modification to this contract involving aggregate increases and/or decreases in costs, plus applicable profits, of more than $100,000 except any modification for which the price is based on adequate price competition, based on established catalog or market prices of commercial items sold in substantial quantities to the general public, or set by law or regulation.

For such modifications, the Contractor shall submit a Certificate of Current Cost or Pricing Data. In this certificate, the Contractor shall certify that, to the best of its knowledge, the cost or pricing data furnished or identified in the Contractor's request for adjustment are accurate, current, and complete as of the date the Contract is amended for said adjustment.

Certificates from subcontractors are required if the price adjustment includes subcontracts or changes to subcontracts. The Contractor shall insert the substance of the following in each subcontract that exceeds $100,000 when entered into:

A. Before awarding any subcontract expected to exceed $100,000 when entered into, or pricing any subcontract modification involving aggregate increases and/or decreases in costs, plus applicable profits, expected to exceed $100,000, the Contractor shall require the subcontractor to submit cost or pricing data (actually or by specific identification in writing), unless the price is based on adequate competition, based on established catalog or market prices of commercial items sold in substantial quantities to the general public, or set by law or regulation.

B. The Contractor shall require the subcontractor to certify substantially the form prescribed in subsection 15.804-4 of the Federal Acquisition Regulations, that to the best of its knowledge and belief, the data submitted under Subarticle 17.1.A above were accurate, complete and current as of the date of agreement on the negotiated price of the subcontract or subcontract modification.

17.2 Adjustment

If any price, including profit or fee negotiated in connection with any modification under this Article, was increased because:

A. The Contractor or a subcontractor furnished cost or pricing data that were not complete, accurate, and current as certified in its Certificate of Current Cost or Pricing Data; or

B. A subcontractor or prospective subcontractor furnished to the Contractor cost or pricing data that were not complete, accurate, and current as certified in the Contractor's Certificate of Current Cost or Pricing Data; or

C. Any of these parties furnished data of any description that were not accurate; then the price or cost

shall be reduced accordingly and the Contract shall be modified to reflect the reduction.

This right to a price reduction is limited to that resulting from defects in data relating to modifications for which this Article is applicable in accordance with Subarticle 17.1. Failure to agree on a reduction shall be considered a dispute covered under the Article entitled DISPUTES in these General Provisions.

18.0 EXTENSION OF TIME

Except with respect to defaults of subcontractors at any tier, 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 if the failure to perform arises from causes such as acts of God, acts of governments, acts of the public enemy, fires, floods, earthquakes, epidemics, quarantine restrictions, strikes and labor disputes, freight embargoes, or weather substantially more severe than the norm, provided that the aforesaid causes were not foreseeable and did not result from the fault or negligence of the Contractor, and provided further that the Contractor has taken reasonable precautions to prevent further delays arising from such causes and has notified the District in writing of the cause or causes of delay within 5 days from the beginning of any such delay.

Within 30 days after the end of the delay, the Contractor shall furnish the District with detailed information concerning the causes and circumstances of the delay, the number of days actually delayed, the appropriate Contract references, and the measures taken to prevent or minimize the delay. Failure to submit all such information within the 30-day period will be sufficient cause for denying the claims for an extension of time. The District will ascertain the facts and the extent of the delay and its findings thereon will be final and conclusive subject to provisions of the Article entitled DISPUTES in these General Provisions. Neither a delay nor an extension of time granted pursuant to this Article shall be the basis of a claim for additional compensation or damages, and no damages or costs of any kind or nature will be paid for any delay or extension of time. Time extensions must be approved by the District prior to the interim or final completion date being extended.

19.0 STOP WORK ORDER

19.1 Notice

The CO may, at any time, by written order to the Contractor, require the Contractor to stop all or any part

of the Work called for by the Contract, for a period of up to 90 days and for any further period to which the parties may agree. Any such order will be specifically identified as a Stop Work Order, issued pursuant to this Article. As a minimum, any such Stop Work Order shall include the following written information:

A. A clear description of the Work to be suspended;

B. Instructions regarding Contractor's purchased materials and services;

C. Guidance as to action to be taken on subcontracts;

D. Other suggestions to the Contractor for minimizing cost.

Upon receipt of such order, the Contractor shall immediately comply with its terms and take all reasonable steps to minimize the incurrence of costs allocable to the Work covered by the order during the period of work stoppage. Within the period of the Stop Work Order, or within any extension of that period to which the parties shall have agreed, the CO shall either:

A. Cancel the Stop Work Order, or

B. Terminate the Work covered by such order as provided in the Article entitled TERMINATION FOR CONVENIENCE in these General Provisions.

19.2 Cancellation of Stop Work

If a Stop Work Order issued under this Article is cancelled, or the period of the order or any extension thereof expires, the Contractor shall resume the Work. An equitable adjustment to the Contract shall be made if:

A. The Stop Work Order results in an increase in the time required for, or in the Contractor's cost properly allocable to, the performance of any part of the Contract, and

B. The Contractor submits a claim for such adjustment within 30 days after the Stop Work Order is cancelled.

19.3 Termination

If a Stop Work Order is not cancelled and the Work covered by such order is terminated, the reasonable costs resulting from the Stop Work Order shall be allowed in arriving at the termination settlement.

20.0 TERMINATION FOR CONVENIENCE

The Contract may be terminated in whole or in part by the District whenever termination is in its best interest. Any such termination shall be effected by delivery to the Contractor of a Notice of Termination signed by the CO specifying the extent to which performance of Work under the Contract is terminated and the effective date.

20.1 Contractor's Obligation

After receipt of a Notice of Termination, and except as otherwise directed by the CO, the Contractor shall:

A. Stop Work 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 that which is necessary to complete the portion of the Work that 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. Assign to the District, in the manner, at the times, and to the extent directed by the CO, all of the rights, title, and interest of the Contractor under the orders and subcontracts so terminated. The District may, at its discretion, settle or pay any or all claims arising out of the termination of such orders and subcontracts.

E. Settle outstanding liabilities and claims arising out of the termination of orders and subcontracts with the approval or ratification of the CO, which approval or notification shall be final for the purposes of this Article.

F. When directed by the CO, transfer title and deliver to the District the following:

1. The fabricated or unfabricated parts, Work in process, completed Work, supplies, and other material procured as a part of, or acquired in connection with, the performance of the Work terminated, and

2. The completed or partially completed plans, drawings, information, and other property, which, if the Contract had been completed, would have been required to be furnished to the District.

G. When directed by the CO, use best efforts to sell, in the manner, at the times, to the extent, and at the price or prices directed or authorized by the CO, property of the types referred to in this Article, provided, however, that the Contractor:

1. Shall not be required to extend credit to any purchaser, and

2. May acquire any such property under the conditions prescribed and at a price or prices approved by the CO.

H. Complete performance of each part of the Work which is not terminated.

I. Take action necessary, or as the CO may direct, to protect and preserve the property related to the Contract which is in the possession of the Contractor and in which the District has or may acquire an interest.

The proceeds of any transfer or disposition of property of the types referred to in this Article shall be applied in reduction of any payments to be made by the District to the Contractor under the Contract, or will otherwise be credited to the price or cost of the Work covered by the Contract, or paid in such other manner as the CO may direct.

20.2 Termination Claim

A. After receipt of a Notice of Termination, the Contractor shall submit to the CO its termination claim, in the form and with certification prescribed by the CO. Such claim shall be submitted promptly, but in no event later than 1 year from the effective date of termination, unless extensions are granted by the CO. Upon failure of the Contractor to submit its termination claim within the time allowed, the CO may determine, on the basis of information available, the amount (if any) due the Contractor by reason of the termination. The District may thereupon pay the Contractor the amount so determined.

B. Subject to the above, the Contractor and the CO may agree upon the whole or any part of the amounts to be paid to the Contractor by reason of the total or partial termination of Work pursuant to this Article. Such amount or amounts may include an allowance for profit on Work done, providing that such agreed amount or amounts, exclusive of settlement costs, shall not exceed the total Contract price as reduced by the amount of payments other-

wise made and as further reduced by the Contract Price of Work not terminated. The Contract will be amended accordingly and the Contractor will be paid the agreed amount.

C. Failure of the Contractor and the CO to agree upon the whole amount to be paid the Contractor, by reason of the termination of Work pursuant to this Article, shall be considered a dispute covered under the Article entitled DISPUTES in these General Provisions.

20.3 In arriving at the amount due the Contractor under this Article, there will be deducted:

A. The amount of any claim which the District has against the Contractor in connection with the Contract; and

B. The agreed price for, or the proceeds of sale of materials, supplies, or other things acquired by the Contractor or sold, pursuant to the provisions of this Article, and not otherwise recovered by or credited to the District.

20.4 If the termination hereunder is partial, prior to the settlement of the terminated portion of the Contract, the Contractor may file with the CO a written request for an equitable adjustment of the price or prices specified in the Contract relating to the continued portion of the Contract (the portion not terminated by the Notice of Termination), and an equitable adjustment may be made in the price or prices.

20.5 The District may from time to time, under terms and conditions it prescribes, make partial payments and payments on account against costs incurred by the Contractor in connection with the terminated portion of the Contract whenever, in the opinion of the District, the aggregate of payments does not exceed the amount to which the Contractor is entitled. If the total of the payments is in excess of the amount finally agreed upon or determined to be due under this Article, the excess shall be paid by the Contractor to the District upon demand, together with interest at the rate of 10 percent per annum, for the period from the date the excess payment is received by the Contractor to the date on which the excess payment is repaid to the District.

20.6 For a period of 3 years after the effective date of final termination settlement, the Contractor shall preserve all its books, records, documents, and other evidence bearing on its costs and expenses incurred for the terminated portion of the Contract. When requested, the Contractor shall make such information available at

all reasonable times, at the office of the Contractor, and at no charge, to the District or its agents.

20.7 The Contractor shall include, or have included, the requirements of this Article in all subcontracts of any tier. The Contractor shall communicate any Notice of Termination issued by the District to the affected subcontractors of any tier, immediately upon its receipt.

20.8 Under no circumstances shall the Contractor be entitled to anticipatory or unearned profits or consequential damages as a result of a termination or partial termination under this Article.

21.0 TERMINATION FOR DEFAULT

21.1 District's Rights in Default

The CO may, by written Notice of Termination to the Contractor, terminate for default the Contractor's right to proceed with the Work or any part of the Work which is in default if:

A. The Contractor fails to make delivery of the supplies or to perform the services, including installation and test, within the time specified herein or any extension thereof; or

B. The Contractor fails to perform any of the other provisions of the Contract, or so fails to make progress as to endanger performance of the Contract in accordance with its terms; and

C. The Contractor does not remedy such failure or commence, within a period of 5 days after receipt of notice, to remedy such failure and proceed with diligence to complete the remedy on a schedule set by the District.

If the District terminates the Contract in whole or in part as provided in this Article, the District may procure supplies or services similar to those so terminated. The Contractor shall be liable to the District for any excess costs for such similar supplies or services.

The Contractor shall continue the Work not terminated.

21.2 Rights and Obligations in Termination for Default

On receipt of a Notice of Termination from the District, the Contractor shall:

A. Stop all Work under the Contract on the date of, and to the extent specified in, the Notice of Termination;

B. Place no further orders or subcontracts for materials, equipment, services, or facilities except that which is necessary to complete the portion of the Work which is not terminated;

C. Terminate all orders or subcontracts to the extent that they relate to the performance of Work terminated by the Notice of Termination;

D. Comply with all other requirements of the District specified in the Notice of Termination.

E. Upon the District's termination of the Contractor's right to proceed with the Work because of the Contractor's default under the Contract, the District may complete the Work by whatever means and method it deems advisable.

F. The expense of completing the Work will be charged to the Contractor and the expense so charged will be deducted by the District out of monies due or at any time thereafter becoming due to the Contractor. In case the expense is in excess of the sum which otherwise would have been payable to the Contractor under the Contract, then the Contractor or its surety shall promptly pay the amount of the excess to District upon notice from the District of the excess so due.

G. Rights of Surety - The Surety on the Performance Bond provided for in the Contract shall not be entitled to take over the Contractor's performance of Work in case of termination under this Article, except with the written consent of the District.

If the Contract is terminated as provided in this Article, the District may require the Contractor to transfer title and deliver to the District, as directed by the CO, the following:

A. Any completed supplies, and

B. Such partially completed supplies and materials, installations, parts, tools, dies, jigs, fixtures, plans, drawings, information, and contract rights (hereinafter called "manufacturing materials") that the Contractor has specifically produced or acquired for the terminated portion of this Contract. The Contractor shall also protect and preserve property in its possession in which the District has an interest.

21.3 Payment

Payment for completed supplies delivered to and accepted by the District shall be at the Contract price.

Payment for manufacturing materials, work-in-process, and partially completed installations delivered to and accepted by the District shall be in an amount agreed upon by the Contractor and the CO. Failure to agree on an amount shall be considered a dispute covered under the Article entitled DISPUTES in these General Provisions.

The District may withhold from amounts otherwise due the Contractor for such completed supplies or manufacturing materials such sum as the CO determines to be necessary to protect the District against loss because of outstanding liens or claims of former lienholders.

21.4 Exception in Default

The Contractor's rights to proceed may not be terminated for default arising out of delay, and the Contractor may not be charged with resulting damages, if a delay qualifies for an extension of time in accordance with the Article entitled EXTENSION OF TIME in these General Provisions.

If, after Notice of Termination of the Contractor's right to proceed under the provisions of this Article, it is determined that the Contractor was not in default or that the Contractor was entitled to an extension of time under the Article entitled EXTENSION OF TIME in these General Provisions, the rights and obligations of the parties shall be the same as if the Notice of Termination had been issued pursuant to the Article entitled TERMINATION FOR CONVENIENCE in these General Provisions.

21.5 Nonexclusive Remedy

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

22.0 CLAIMS

22.1 Notice of Claim

Claims for additional compensation or time for an act or failure to act on the part of the District, shall be by a written notice of the claim. This provision does not apply for claims arising out of events covered by the Article entitled CHANGES in these General Provisions.

The notice of claim shall set forth the reasons for which an adjustment is due, the nature of the costs involved, and an estimate of the amount of the potential claim. Notice shall be given to the CO within 15 days after the occurrence of the event giving rise to the claim and prior to the start of any Work because of it.

Requirements of this Article are intended to enable the District to investigate the facts on a timely basis in order to minimize or avoid any effects of a claim. Failure of the Contractor to make the required notice on time is likely to disadvantage the District. Therefore, no claim will be considered unless the Contractor has given notice within the time allotted.

22.2 Submittal of Claim

Claims filed by the Contractor shall be in sufficient detail to enable the District to ascertain the basis for both the claim and the amount claimed. When requested, the Contractor shall furnish any further information and details required by the District to determine the facts or evaluate the contentions involved in the claim. Failure to submit such information will be cause for denying the claim.

A claim shall be submitted within 30 days after notice of claim unless an extension of time is authorized by the CO. Upon the District's acknowledgement that the claim has merit, the parties shall negotiate an equitable adjustment and the Contract will be amended accordingly.

Contractor shall continue to perform its obligations in a timely manner during any claims proceedings unless the District directs otherwise by written instruction.

23.0 DISPUTES

If a dispute arises, every effort shall be made to resolve the dispute through negotiation. However, in the absence of settlement, the CO may, upon his own initiative or promptly upon the written request of the Contractor, make a determination thereof and such determination shall immediately be complied with by the Contractor pending resolution pursuant to the provisions of the following paragraphs of this Article.

Each determination made by the CO will be set forth in a written notice thereof to the Contractor. Within 30 days after the receipt of such notice, the Contractor shall respond to the District, in writing, either accepting the determination or stating in general terms the Contractor's factual or legal objections to the determination. If the response is an objection to the

determination, in whole or in part, the CO will respond, in writing, to the objection within 30 days after the District receipt thereof. The Contractor's failure to respond to the CO's determination within the 30 day period shall be deemed an acceptance thereof. No further response by either party shall be required.

Thereafter, either party may seek a judicial determination of a dispute, except when the Contractor accepts the CO's determination or fails to respond to the CO's determination within the 30 day time limit. Neither the CO's determination, nor either party's response, nor the continued performance of the Contract shall constitute an admission as to any factual or legal position in connection with the dispute, or a waiver of rights under this Contract or at law. Disputes subject to this Article shall be governed by the Article entitled GOVERNING LAW in these General Provisions.

24.0 RECORDS AND AUDIT RIGHTS

24.1 The Contractor shall make available and permit authorized representatives of the City of Los Angeles, the County of Los Angeles, the District, the California Department of Transportation, the US Department of Transportation (DOT) and the Comptroller General of the United States at its office at reasonable times, to inspect and audit all data and records of the Contractor relating to its performance under the Contract until 3 years after the final payment or, if the Contract is terminated in whole or in part, until 3 years after final termination settlement. Records pertaining to appeals under the Article entitled DISPUTES or to litigation or to the settlement of claims arising under or relating to the performance of the Contract shall be made available until disposition of the appeals, litigation, or claims. The Contractor shall include, or have included, the requirements of this Article in all subcontracts of any tier.

24.2 Cost or Pricing Data - If the Contractor has submitted cost or pricing data in connection with the pricing of any modification to the Contract, unless the pricing was based on adequate price competition, established catalog or market prices of commercial items sold in substantial quantities to the general public, or prices set by law or regulation, each agency listed in this Article shall have the right to examine and audit books, records, documents, and other data of the Contractor (including computations and projections) related to negotiating, pricing, or performing the modification in order to evaluate the accuracy, completeness, and currency of the cost or pricing data.

25.0 INSPECTION

25.1 In addition to the inspection and test required to be performed by the Contractor, all equipment (which term throughout this Article includes without limitation raw materials, components, intermediate assemblies, and end products) shall be subject to inspection and test by the District, to the extent practicable, at all reasonable times and places including the period of manufacture, and, in any event, prior to acceptance.

25.2 If equipment is defective in material or workmanship or otherwise not in conformity with the requirements of the Contract Documents, the District shall have the right either to reject it (with or without instructions as to its disposition) or to require its correction. Equipment which has been rejected or required to be corrected shall be removed or, if permitted or required by the DAR, corrected in-place by and at the expense of the Contractor, promptly after notice, and shall not thereafter be tendered for acceptance unless the former rejection or requirement of correction is disclosed. If the Contractor fails to promptly remove such supplies or lots of supplies which are required to be removed, or promptly to replace or correct such supplies or lots of supplies, the District may, either by contract or otherwise, replace or correct such supplies and charge to the Contractor the cost occasioned the District; or terminate this Contract for default, as provided in the Article entitled TERMINATION FOR DEFAULT in these General Provisions. Unless the Contractor corrects or replaces such equipment within the Contract schedule, the District may require the delivery of such equipment at a reduction in price which is equitable under the circumstances. Failure to agree to such reduction of price shall be a dispute under the Article entitled DISPUTES in these General Provisions.

25.3 If any inspection or test is made by the District on the premises of the Contractor or a subcontractor, the Contractor shall provide all reasonable facilities and assistance for the safety and convenience of the District in the performance of its duties. All inspections and tests by the District will be performed in a manner not to unduly delay the Work. The District reserves the right to charge to the Contractor any additional cost of District inspection and test when equipment is not ready at the time such inspection and test is requested by the Contractor, or when reinspection or retest is necessitated by prior rejection. Acceptance or rejection of the equipment shall be made as promptly as practicable after delivery, except as otherwise provided in this Contract. Failure of the District to inspect and accept or reject equipment shall neither relieve the Contractor from responsibility for equipment not in accordance with

the requirements of the Contract Documents, nor impose liability on the District thereto.

25.4 The inspection and test by the District does not relieve the Contractor from any responsibility regarding defects or other failures to meet the requirements of the Contract Documents.

25.5 The operations of the Contractor, its subcontractors and suppliers shall be subject at any time to District audit and verification of compliance to all requirements of the Contract Documents relative to practices, methods, procedures, and documentation.

26.0 DISTRICT-FURNISHED EQUIPMENT

The District may provide equipment for installation or other use by the Contractor in carrying out the Work under the Contract. When such District-Furnished Equipment (DFE) is provided for any purpose, the Contractor shall have responsibility as follows:

A. The schedule for delivery of the DFE to the Contractor will be mutually determined by the District and the Contractor. The Contractor shall provide required delivery dates in the master program schedule, as defined in the Technical Provisions. Once the District has accepted and approved the schedule, the delivery dates for DFE will become Contract Milestones. When appropriate, schedules for the return of any DFE from the Contractor will be established in a like manner.

B. DFE will be shipped FOB destination by common carrier to the location specified by the Contractor. The Contractor shall bear responsibility for unloading, handling, storage, and for all expense of same. Risk of loss shall lie with the Contractor from receipt until return to the District.

C. The Contractor shall also bear responsibility and all expense of same for pick-up from District storage facilities, located within the Los Angeles area, any DFE to be installed by the Contractor at the Project Site.

D. Should DFE be lost or damaged from any cause after receipt by the Contractor, the District shall be notified immediately. The Contractor shall replace or repair it in a manner acceptable to the District. If the District is subjected to extra expense because of such loss or damage, those costs will be recovered from monies due or becoming due to the Contractor.

E. Materials furnished by District shall be received by Contractor in the presence of District's authorized representative and quantities thereof shall be verified jointly by Contractor and District. The delivery and acceptance of all such materials shall be recorded in writing, and Contractor shall evidence receipt and acceptance of such materials by signing forms satisfactory to District. Contractor shall carefully note any visible damage to District-furnished materials prior to Contractor's acceptance of delivery.

F. Contractor shall notify District of any lack of, or requirement for, materials to be supplied by District in sufficient time for District to furnish said materials in advance of Contractor's need. In the event of misfit of District-furnished materials, Contractor shall promptly notify District of such misfit. Contractor shall take all reasonable steps to avoid standby time due to such misfit or lack of District-furnished materials and to continue progress of other portions of Work pending correction of such misfit and/or the furnishing of materials.

27.0 PACKING AND SHIPPING

27.1 Authorization

Certain items require District inspection prior to shipment, in accordance with the requirements of the Contract Documents. For such items, the Contractor shall, at least 10 days prior to the estimated shipping date, request authorization to ship. The request shall state the date equipment will be ready for inspection by the District and list exceptions or waivers for any Work not completed. The District may elect to conduct or waive inspection at the source prior to authorization of the shipment. The District will either authorize the shipment in writing or advise the Contractor that it will conduct further inspection and do so to meet the estimated shipping date.

Shipment authorizations by the District prior to acceptance, as specified in this Article, with or without District inspection, shall in no way constitute acceptance or relieve the Contractor from fulfilling the requirements of the Contract Documents.

27.2 Shipping Costs

All shipments shall be at the Contractor's expense, FOB destination within the consignee's facility.

27.3 Packing

All shipments shall be packaged and packed in accordance with the best commercial standards to insure the integrity of equipment during transportation, handling, and storage. Due regard shall be given to protection from loss and pilferage, physical damage, and the effect of the elements and environmental conditions. There shall be no on-deck shipments by cargo vessel without specific approval from the DAR. These requirements are in addition to any packaging requirements contained in the Special Provisions or Technical Provisions for specific items of equipment.

28.0 TITLE AND RISK OF LOSS OR DAMAGE

28.1 Title

As a security for partial, progress, or other payments, title to items for which such payments are made shall pass to the District at the time of payment. To the extent that title has not previously been vested in the District by reason of payments, title shall pass to the District when items are delivered to a carrier for transportation to the installation site (or other specified consignee) or at final acceptance, whichever occurs first. Items to which the District has received title by reason of progress or partial payments shall be segregated from other Contractor or subcontractor materials and clearly identified as District property.

The Contractor agrees to the following relative to Title:

A. The title transferred as above shall in each case be good, and free and clear from any and all security interests, liens, or other encumbrances. The Contractor promises and agrees that it will not pledge, hypothecate, or otherwise encumber the items in any manner that would result in any lien, security interest, charge, or claim upon or against said items.

B. The transfer of title as provided above shall not imply acceptance by the District, nor relieve the Contractor from the responsibility strictly to comply with the Contract, and shall not relieve the Contractor of responsibility for any loss of or damage to items.

C. The Contractor shall insert provisions in his subcontracts sufficient to ensure compliance with the content of this Article.

28.2 Risk of Loss or Damage

Notwithstanding passage of title in whole or in part to the District, the risk of loss or damage shall remain with the Contractor until installation in the District facilities (when installation is in the Contractor's Scope of Work) or delivery to other specified points. At that event, the risk of loss shall pass to the District.

29.0 GOVERNING LAW

The Contract shall be governed by and interpreted in accordance with the laws of the State of California. The Contractor shall also abide by all applicable city and county ordinances. However, to ensure that the Contract is performed in all respects in compliance with the provisions of all capital grants between the District and the Government relating to this Contract, and the relationship between the District and the Government in all other respects, questions arising in connection therewith shall be governed by the applicable federal law.

30.0 CONSENT TO JURISDICTION

The Contractor, by entering into the Contract, consents and submits to the jurisdiction of the Courts of the State of California, over any action at law, suit in equity, or other proceeding that may arise out of the Contract. If the Contractor is a corporation, it agrees during the periods of performance and of warranty, to maintain within the State of California an agent to accept service of legal process on its behalf.

31.0 ASSIGNMENT

The performance of the Work under the Contract may not be assigned except upon written consent of the District. Consent will not be given to a proposed assignment which would relieve the Contractor or its surety of their responsibilities under the Contract.

32.0 PAYMENT OF TAXES

The Contractor is responsible for paying all retail sales, income, real estate, sales and use, transportation, export, import, and special taxes and duties applicable to, and assessable against any materials, equipment, processes and operations incidental to or involved in the procurement. The Contractor is responsible for ascertaining and acquainting itself with such taxes and making all necessary arrangements to pay them. The prices established in the Contract shall include compensation for any taxes the Contractor is required to

pay by laws and regulations in effect on the Bid Opening date.

33.0 ANTI-DUMPING

The Contractor represents and warrants that its prices do not violate the United States Anti-Dumping Act, 19 USC 160 et seq., as amended, and agrees to pay any duties assessed under said Act. The Contractor agrees to indemnify and hold harmless the District from any loss or expense, including, but not limited to, reasonable attorney's fees that the District may incur from any claim, demand, or investigation of alleged violation of said Act.

34.0 PATENTS AND COPYRIGHTS

The Contractor shall warrant that the materials, equipment, or devices used on or incorporated in the Work shall be delivered free of any rightful claim of any third party for infringement of any patent or copyright. The Contractor shall defend or may settle, at its expense, any suit or proceeding against the District or its representatives based on a claimed infringement which would result in a breach of this warranty. The Contractor shall pay all damages and costs awarded therein due to such breach.

The Contractor shall bear all costs arising from the use of patented materials, equipment, devices or processes used on or incorporated in the Work. In case material, equipment, devices or processes are held to constitute an infringement and their use is enjoined, the Contractor, at its expense, shall:

A. Secure for the District the right to continue using said materials, equipment, devices or processes by suspension of the injunction or by procuring a license or licenses; or

B. Replace such materials, equipment, devices or processes with noninfringing materials, equipment, devices or processes; or

C. Modify them so that they become noninfringing or remove the enjoined materials, equipment, devices or processes and refund the sum paid therefore without prejudice to any other rights of the District.

The Contractor shall include, or have included, the requirements of this Article in all subcontracts of any tier.

35.0 RIGHTS IN TECHNICAL DATA AND COPYRIGHTS

35.1 Technical Data

Technical data, as used herein, means any form or format of technical writing, pictorial reproductions, drawings or other graphic representations, and documents of a technical nature, including computer software and program listings, which are developed or used pursuant to the Contract. The term does not include financial reports, cost analyses, and other information incidental to contract administration.

The District shall have the right, within the scope of the Contract and for the purpose of operating and maintaining the equipment supplied, to use, duplicate, or disclose the technical data listed below and the information conveyed therein, in whole or in part, in any manner and for any purpose whatsoever, and to have or permit others to do so:

A. Manuals or instructional materials prepared for installation, operation, maintenance, or training purposes;

B. Technical data pertaining to items, components, or processes which were prepared for the purpose of identifying sources, size, configuration, mating and attachment characteristics, functional characteristics and performance requirements;

C. Other technical data which have been or are normally furnished without restriction by the Contractor or subcontractors;

D. Computer and microprocessor software documentation including program design language or pseudo-code listings, fully annotated source code and machine level listings;

E. Other specifically described technical data which the parties have agreed will be furnished without restriction.

35.2 Data Covered By Copyrights

The Contractor shall agree to grant to the District and to its officers, agents, and employees acting within the scope of their official duties, a royalty-free license to publish, translate, reproduce, deliver, and use as it deems fit all technical data covered by copyright supplied for the Contract.

No such copyrighted matter shall be included in technical data furnished hereunder without the written permis-

sion of the copyright owner for the District to use such in the manner herein described.

The Contractor shall report to the District promptly and in reasonable written detail each notice or claim of copyright infringement received by the Contractor with respect to any technical data delivered hereunder.

36.0 INDEMNIFICATION

Contractor shall indemnify, hold harmless and defend the District, the Los Angeles County Transportation Commission (LACTC), the General Consultant (GC), GC members, the System Engineering and Analyses Consultant, the Construction Manager (CM), their officers, employees, agents, contractors, and subcontractors, individually, to the maximum extent allowed by law, from and against all liability, claims, losses, actions and expenses (including attorney's fees), on account of bodily injury to or death of any person (including employees of the parties to be indemnified) or for damage to or loss of use of property (including property of District) arising out of or resulting from the acts or omissions to act of Contractor, its subcontractors, anyone directly or indirectly employed by any of them or anyone for whose acts any of them are liable, in the performance of the Work, unless caused solely by the negligence or willful misconduct of or defects in design furnished by the parties to be indemnified.

Claims against the parties to be indemnified by any employee of Contractor, its subcontractors, anyone directly or indirectly employed by any of them or anyone for whose acts any of them may be liable, shall not limit the Contractor's indemnification obligation set forth above in any way by any limitation on the amount or type of damages, compensation or benefits payable by or for the Contractor or its subcontractors under workers' compensation acts, disability benefit acts or other employee benefit acts or insurances.

37.0 EQUAL EMPLOYMENT OPPORTUNITY

37.1 The Contractor shall not discriminate against any employee or applicant for employment because of race, religion, color, age, sex, or national origin. The Contractor shall take affirmative action to ensure that applicants are employed, and that employees are treated during their employment, without regard to their race, religion, color, age, sex, or national origin. 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 apprentice-

ship. The Contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices to be provided setting forth the provisions of this nondiscrimination clause. The Contractor further agrees to insert a similar provision in all subcontracts, except subcontracts for standard commercial supplies or raw materials.

37.2 The Contractor agrees to abide by the provision of California Labor Code Section 1777.5 with respect to the employment of indentured apprentices.

37.3 The Contractor shall, in all solicitations or advertisements for employees placed by or on behalf of the Contractor, state that all qualified applicants will receive consideration for employment without regard to race, religion, color, age, sex, or national origin.

37.4 The Contractor shall send to each labor union or representative of workers with which it has a collective bargaining agreement or other contract or understanding a notice to be provided advising the said labor union or workers' representatives of the Contractor's commitments under this Article, and shall post copies of the notice in conspicuous places available to employees and applicants for employment.

37.5 The Contractor shall comply with all provisions of Executive Order 11246, as amended, and of the rules, regulations, and relevant orders of the Secretary of Labor.

37.6 The Contractor shall furnish all information and reports required by Executive Order 11246, as amended, and by rules, regulations, and orders of the Secretary of Labor, or pursuant thereto, and shall permit access to its books, records, and accounts by the DOT and the Secretary of Labor for the purposes of investigation to ascertain compliance with such rules, regulations, and orders.

37.7 In the event of the Contractor's noncompliance with nondiscrimination clauses of the Contract or with any of the said rules, regulations, or orders, the Contract may be cancelled, terminated, or suspended in whole or in part, and the Contractor may be declared ineligible for further Government contracts in accordance with procedures authorized in Executive Order 11246, as amended, or by rule, regulation, or order of the Secretary of Labor, or as otherwise provided by law.

37.8 The Contractor shall include the provisions of Subarticles 37.1 through 37.7 in every subcontract or purchase order unless exempted by rules, regulations, or orders of the Secretary of Labor issued pursuant to

Section 204 of Executive Order 11246, as amended, so that such provisions will be binding upon each subcontractor or vendor. The Contractor shall take such action with respect to any subcontract or purchase order as the administering agency may direct as a means of enforcing such provisions, including sanctions for noncompliance; provided, however, that if a Contractor becomes involved in or is threatened with litigation with a subcontractor or vendor as a result of such direction by the administering agency, the Contractor may request the Government to enter into such litigation to protect the interests of the Government.

38.0 RESERVED

39.0 SUBCONTRACTORS

5 39.1 The Contractor shall use major Subcontractors and suppliers identified in the Contractor's proposal. Later additions, deletions or substitutions shall be specifically approved by the CO. 5 5 5 5

39.2 The Contractor shall be solely responsible for the performance of subcontractors and the fulfillment of all requirements of the Contract Documents. The District will recognize only the Contractor.

39.3 No contractual relationship shall exist between the District or anyone acting on behalf of the District and the subcontractors or suppliers of the Contractor or any of their lower-tier subcontractors or suppliers with respect to the Work described in the Contract Documents.

40.0 USE OF DISTRICT NAME IN CONTRACTOR ADVERTISING OR PUBLIC RELATIONS

The District reserves the right to review and approve District-related copy prior to publication. The Contractor agrees not to allow District-related copy to be published in Contractor's advertisement or public relations programs until submitting such District-related copy and receiving prior written approval from the District. Contractor agrees that published information on the District or the District programs shall be factual and in no way imply that the District endorses the Contractor's firm, service, or product. The Contractor shall include, or have included, the requirements of this Article in all subcontracts of any tier.

41.0 GRATUITIES AND CONFLICTS OF INTEREST

41.1 The District may, by written notice to the Contractor, terminate the right of the Contractor to proceed under the Contract if it is found that gratuities (in the form

of entertainment, gifts, or otherwise) were offered or given by the Contractor or any agent or representative of the Contractor to any director, officer or employee of the District or of any District's consultant or contractor with a view toward securing a contract or securing favorable treatment with respect to the awarding or amending or the making of any determinations with respect to the performance of such contract. The determination of the District shall be final, subject only to judicial review.

41.2 If the Contract is terminated as provided in Subarticle 41.1, the District shall be entitled to pursue the same remedies against the Contractor as it could pursue in the event of a breach of the Contract by the Contractor.

41.3 No member, officer or employee of the District or of a local public body, during the tenure of that person or for 1 year thereafter, shall have any interest, direct or indirect, in the Contract or the proceeds thereof, but this provision shall not be construed to extend to the Contract if made with a corporation for its general benefit. A full and complete disclosure of any such interest shall be made in writing, to the other parties even if such interest would not be considered a conflict under Section 1090 et seq. or Section 87100 et seq. of the Government Code of the State of California. Local public body as used in this Article, means the state, any political subdivision of the state, or any agency of the state or any political subdivision thereof.

41.4 No member of or delegate to the Congress of the United States of America shall be admitted to any share or part of the Contract or to any benefit arising therefrom, but this provision shall not be construed to extend to the Contract if made with a corporation for its general benefit.

41.5 The Contractor or its employees shall not enter into any contract involving services or property with a person or business prohibited from transacting such business with the District pursuant to Sections 1090 et seq. and 87100 et seq. of the Government Code of the State of California. To the knowledge of the District or of the Contractor, no Board member, officer or employee of the District has any interest, whether contractual, noncontractual, financial or otherwise, in this transaction, or in the business of the Contractor, and if any such transaction, comes to the knowledge of either party at any time, a full and complete disclosure of all such information shall be made in writing to the other party, even if such interest would not be considered a conflict under Sections 1090 et seq. or Sections 87100 et seq. of the Government Code of the State of California.

41.6 The rights and remedies of the District provided in this Article are not exclusive and are in addition to any other rights and remedies provided by law or under the Contract.

41.7 The Contractor shall comply with the Code of Conduct that is included as Exhibit 1 following the General Provisions. In the event of conflicts between Articles 41.1 through 41.6 and the Code of Conduct, the Code shall govern.

42.0 SANCTIONS UPON IMPROPER ACTS

If the Contractor or any of its officers, partners, principals, or employees is convicted of a crime arising out of, or in connection with, the Work to be done or payment to be made under the Contract, the Contract, in whole or any part thereof, may, at the discretion of the District, be terminated.

43.0 COVENANT AGAINST CONTINGENT FEES

43.1 The Contractor warrants that no person or agency has been employed or retained to solicit or obtain this Contract upon an agreement or understanding for a contingent fee, except a bona fide employee or agency. For breach or violation of this warranty, the District may terminate this Contract without liability or, at its discretion, deduct from the Contract Price or consideration, or otherwise recover the full amount of the contingent fees.

43.2 Bona fide agency, as used in this Article, means an established commercial or selling agency, maintained by the Contractor for the purpose of securing business, that neither exerts nor proposes to exert improper influence to solicit or obtain District contracts nor holds itself out as being able to obtain any District contract or contracts through improper influence.

43.3 Bona fide employee, as used in this Article, means a person, employed by the Contractor and subject to the Contractor's supervision and control as to time, place, and manner of performance, who neither exerts nor proposes to exert improper influence to solicit or obtain District contracts nor holds out as being able to obtain any District contract or contracts through improper influence.

43.4 Contingent fee, as used in this Article, means any commission, percentage, brokerage, or other fee that is contingent upon the success that a person or concern has in securing a District contract.

43.5 Improper influence, as used in this Article, means any influence that induces or tends to induce a District employee or officer to give consideration or to act regarding a District contract on any basis other than the merits of the matter.

44.0 USE AND POSSESSION PRIOR TO COMPLETION

The District may take possession or use any completed or partially completed part of the Work. Such possession or use shall not be deemed an acceptance of any Work not completed in accordance with the requirements of the Contract Documents. While the District is in possession, the Contractor shall be relieved of the responsibility for loss or damage to that part of the Work other than that loss or damage resulting from the Contractor's fault, negligence, or breach of warranty. If prior possession or use by the District delays the progress of the Work or causes additional expense to the Contractor, an equitable adjustment shall be made in the Contract Price or the time of completion of the Work.

45.0 ENVIRONMENTAL PROVISIONS

45.1 The Contractor shall submit evidence to the District that governing air and water pollution criteria will be met in accordance with criteria issued by the US Environmental Protection Agency (EPA). However, in locations where state or local air and water pollution regulations are in force, the more restrictive criteria shall govern.

This evidence and related documents will be retained onsite by the District for examination by appropriate governmental agencies.

45.2 Environmental Violations

For all contracts and subcontracts in excess of $100,000, the Contractor agrees to comply with all applicable standards, orders, or requirements issued under Section 306 of the Clean Water Act (42 USC 1857[h]), under Section 508 of the Clean Water Act (33 USC 1368), Executive Order 11378, and EPA regulations (40 CFR, 15) and specifically shall not use any facilities included on the EPA List of Violating Facilities. The Contractor shall report all violations to the District.

The Contractor shall promptly notify the District of receipt of any communications from the EPA's Director, Office of Federal Activities, or any successor agency, indicating that a facility to be utilized for the Contract is under consideration to be listed on the EPA List of Violating Facilities.

45.3 Subcontract Requirements

The Contractor shall include, or cause to be included, the requirements of this Article in every subcontract, of any tier, valued at more than $100,000, and further agrees to take such action as the District may direct as a means of enforcing those requirements.

46.0 CARGO PREFERENCE--USE OF UNITED STATES FLAG VESSELS

The Contractor agrees:

A. To utilize privately owned, US flag commercial vessels to ship at least 50 percent of the gross tonnage (computed separately for dry bulk carriers, dry cargo liners and tankers) involved, whenever shipping any equipment, materials, or commodities pursuant to the Contract, to the extent such vessels are available at fair and reasonable rates for US flag commercial vessels.

B. To furnish to the District within 30 days following the date of loading, for shipments originating within the US or within 30 working days following the date of loading for shipments originating outside the US, 4 legible copies of a rated, "on-board" commercial ocean bill-of-lading, in English, for each shipment of cargo described in paragraph A above (through the Contractor in the case of subcontractor bills-of-lading) and to:

Division of National Cargo,
Office of Market Development
MARITIME ADMINISTRATION,
Washington, DC 20230

marked with the appropriate identification of the Contract.

C. To include, or have included, the requirements of the Article in all subcontracts of any tier.

47.0 LABOR STANDARDS PROVISIONS

47.1 Overtime Requirements

The Contractor which may require or involve the employment of laborers or mechanics shall not require or permit any such laborer or mechanic, in any work week in which such laborer or mechanic is employed on the Work, to work in excess of 8 hours in any calendar day or in excess of 40 hours in any work week, unless such laborer or mechanic receives compensation at a rate not less than 1-1/2 times the basic rate of pay for all hours

worked in excess of 8 hours in any calendar day or in excess of 40 hours in any work week, whichever is greater.

47.2 Violation; Liability for Unpaid Wages; Liquidated Damages

In the event of any violation of the clause set forth in Subparagraph (b)(I) of 29 CFR 5.5, the Contractor shall be liable for the unpaid wages. In addition, the Contractor shall be liable to the US for liquidated damages. Such liquidated damages shall be computed with respect to each individual laborer or mechanic, including watchmen and guards, employed in violation of the clause set forth in Subparagraph (b)(1) of 29 CFR 5.5 in the sum of $10 for each calendar day on which such individual was required or permitted to work in excess of 8 hours or the standard work week of 40 hours without payment of the overtime wages required by the clause set forth in subparagraph (b)(1) of 29 CFR 5.5.

47.3 Withholding for Unpaid Wages and Liquidated Damages

The District shall, upon its own action or upon written request of the Department of Labor, withhold or cause to be withheld from any monies payable on account of Work performed by the Contractor under any such contract or any other federal contract with the same Contractor, or any other federally assisted contract subject to the Contract Work Hours and Safety Standards Act which is held by the Contractor, such sums as may be determined to be necessary to satisfy any liabilities of the Contractor for unpaid wages and liquidated damages as provided in the clause set forth in Subparagraph (b)(2) of 29 CFR 5.5.

47.4 Requirements for Records

The Contractor and its subcontractors shall maintain payrolls and basic payroll records during the course of the Work for all laborers and mechanics, including guards and watchmen, working on the Contract. Such records shall contain, for each employee, the name and address, social security number, correct classification, hourly rates of wages paid, daily and weekly number of hours worked, deductions made, and actual wages paid. Further, the records to be maintained under this Subarticle shall be made available by the Contractor for inspection, copying, or transcription by authorized representatives of DOT and the Department of Labor, and the Contractor shall permit such representatives to interview employees during working hours on the job.

47.5 Subcontracts

The Contractor shall include, or have included, the requirements set forth in Subarticles 47.1 through 47.4 in all subcontracts of any tier. The Contractor shall be responsible for compliance by any subcontractor or any lower-tier subcontractor with the clauses set forth in Subarticles 47.1 through 47.4.

48.0 SOUTH AFRICA POLICY

Contractor shall comply with "District Contracting Policy with Companies Doing Business in or with South Africa" attached hereto as Exhibit 2.

49.0 FINAL ASSEMBLY SITE

The Contractor shall identify and describe, within 12 months after NTP, the facility to be used for final assembly and factory testing of the vehicle. Final assembly and testing site will be subject to District approval.

50.0 COST REDUCTION INCENTIVE

50.1 The Contractor may submit to the District, in writing, proposals for modifying the plans, specifications or other requirements of the Contract for the sole purpose of reducing the total cost of procurement. The cost reduction proposal shall not impair, in any manner, the essential functions or characteristics of the project, including but not limited to service life, quality, economy of operation, ease of maintenance, desired appearance, or design and safety standards.

50.2 Cost reduction proposals shall contain the following information:

A. A description of both the existing Contract requirements for performing the Work and the proposed changes.

B. An itemization of the Contract requirements that must be changed if the proposal is adopted.

C. A detailed estimate of the cost of performing the Work under the existing Contract and under the proposed change. These estimates of cost shall be determined in the same manner as if the Work were to be paid for as a Change pursuant to the provisions of this Article.

D. A statement of the time within which the District must make a decision thereon.

E. The Contract items of Work affected by the proposed changes, including any quantity variation attributable thereto.

50.3 The provisions of this Subarticle shall not be construed to require the District to consider any cost reduction proposal which may be submitted hereunder; proposed changes in basic design of an element will not be considered as an acceptable cost reduction proposal; the District will not be liable to the Contractor for failure to accept or act upon any cost reduction proposal submitted pursuant to this Subarticle nor for any delays to the Work attributable to any such proposal. If a cost reduction proposal is similar to a change in the plans or specifications under consideration by the District for the project at the time said proposal is submitted or if such a proposal is based upon or is similar to the Contract Documents or a Change Order adopted by the District after the advertisement for the Contract, the District will not accept such proposal and the District reserves the right to make such changes without compensation to the Contractor under the conditions of this Article.

50.4 The Contractor shall continue to perform the Work in accordance with the requirements of the Contract until an executed Change Order, incorporating the cost reduction proposal, has been issued. If an executed Change Order has not been issued by the date upon which the Contractor's cost reduction proposal specifies that a decision thereon should be made or such other date as the Contractor may subsequently have specified in writing, such cost reduction proposal shall be deemed rejected.

50.5 The District shall be the sole judge of the acceptability of a cost reduction proposal and of the estimated net savings in costs from the adoption of all or any part of such proposal. In determining the estimated net savings, the right is reserved to disregard the Contract bid prices if, in the judgment of the District, such prices do not represent a fair measure of the value of Work to be performed or to be deleted.

50.6 The District reserves the right, where it deems such action appropriate, to require the Contractor to share in the District's costs of investigating a cost reduction proposal submitted by the Contractor, as a condition of considering such proposal. Where such a condition is imposed, the Contractor shall indicate its acceptance thereof in writing, and such acceptance shall constitute full authority for the District to deduct amount payable to the District from any monies due or that may become due to the Contractor under the Contract.

50.7 If the Contractor's cost reduction proposal is accepted in whole or in part, such acceptance shall be by

a Change Order, which shall specifically state that it is executed pursuant to this Subarticle. Such Change Order shall incorporate the changes in the Contract Documents which are necessary to permit the cost reduction proposal, or such part of it as has been accepted, to be put into effect and shall include any conditions upon which the District's approval thereof is based, if the approval of the District is conditional. The Change Order shall also set forth the estimated net savings in costs attributable to the cost reduction proposal effectuated by the Change Order and shall further provide that the Contractor be paid 50 percent of said estimated net savings amount. The Contractor's cost of preparing the cost reduction incentive proposal and the District's costs of investigating a cost reduction incentive proposal, including any portion thereof paid by the Contractor, shall be excluded from consideration in determining the estimated net savings in costs.

50.8 Acceptance of the cost reduction proposal and performance of the Work thereunder shall not extend the time of completion of the Contract, unless specifically provided for in the Change Order authorizing the use of the cost reduction proposal.

50.9 The amount specified to be paid to the Contractor in the Change Order which effectuates a cost reduction proposal shall constitute full compensation to the Contractor for the cost reduction proposal and the performance of the Work thereof pursuant to the said Change Order.

50.10 The District expressly reserves the right to adopt a cost reduction proposal for general use on the contracts administered by the District when it determines that said proposal is suitable for application to other contracts. When an accepted cost reduction proposal is adopted for general use, only the Contractor which first submitted such proposal will be eligible for compensation pursuant to this Article, and, in that case, only as to those contracts awarded to it prior to submission of the accepted cost reduction proposal and as to which such cost reduction proposal is also submitted and accepted. Cost reduction proposals identical or similar to previously submitted proposals will be eligible for consideration and compensation under the provisions of this Subarticle, if the identical or similar previously submitted proposals were not adopted for general application to other contracts administered by the District. Subject to the conditions contained herein, the District or any other public agency shall have the right to use all or any part of any submitted cost reduction proposal without obligation or compensation of any kind to the Contractor.

END OF GENERAL PROVISIONS

SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT
METRO RAIL PROJECT

EXHIBIT 1

CODE OF CONDUCT

CODE OF CONDUCT

ADOPTED BY
SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT
BOARD OF DIRECTORS

February 20, 1986

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XVI. CODE OF CONDUCT

16.1 This Code of Conduct shall govern the conduct of all employees, consultants, and members of the Board of Directors of the Southern California Rapid Transit District.

16.2 There are numerous laws and regulations which govern the conduct of public officers and employees and which are applicable to the SCRTD. Because they are contained in various California Code sections and District policy statements, it is desirable to set them forth in one document for ready reference so that all persons affected can more easily become familiar with them.

16.3 The complete texts of the foregoing laws and regulations are attached hereto as Appendix A. When in doubt as to the applicability of any law or regulation to any particular situation, the potentially affected officer or employee should request an advisory opinion from the District's Legal Department.

> Comment: The comments and examples which follow do not have the force and effect of the sections of the Code to which they pertain, but are intended as an aid in interpreting the Code.

16.4 The following sections, which summarize laws and regulations pertaining to conduct of public officers and employees, govern the conduct of District Board members, officers, employees, and

consultants. All Board members, District officers and employees and consultants shall be familiar with the provisions of this Code of Conduct.

A. Board members, and District officers and employees shall not be financially interested in any contract made by them in their official capacity. Board members, District officers, or employees shall not be purchasers at any sale or vendors at any purchase made by them in their official capacity.

A contract made in violation of these sections may be voided by the Board of Directors. (Government Code §1090 et seq.).

Comment: Board members, officers, and employees (hereinafter called officers) are prohibited from having any interest in a contract "made by them in their official capacity". Cases applying this language have not confined it to the narrow and technical interpretation of the word "made". Rather if an officer was in any way involved with the contract through planning, preliminary discussions, compromises, drawing of plans and specifications, solicitation of bids or award of the contract, that officer has "made"

the contract under Section 1090. In such circumstances the District cannot enter into the contract. Should the contract be executed it would be void and the officer would be subject to a fine of up to $1,000 or imprisonment and would be forever disqualified from holding any office in this state. (Section 1097). If a Director is involved, the mere fact that he/she is a member of the Board constitutes participation in the award of a contract, irrespective of whether the Director abstains from discussion or voting. An officer is not deemed to be "interested" in a District contract if his/her interest is remote. These remote interests are set forth in Section 1091 in the appendix.

Similarly, an officer is viewed as having no interest whatsoever if he/she falls within one of the categories set forth in Section 1091.5 in the appendix.

Examples:

1. An officer of the District is a

member of a staff committee which will recommend 5 medical clinics to give physical examinations for District employees. The officer's wife, a physician, is part owner of one of the clinics. The District is prohibited from contracting with that clinic.

2. A member of the Board of Directors is a partner in a real estate venture which buys and sells commercial property. The District is accepting bids for the sale of an abandoned division site. Bids from the firm in which the Board member has an interest cannot be accepted.

B. District Board members or employees shall not engage in any employment or activity for compensation which is inconsistent or incompatible or in conflict with his or her duties as a District Board member or employee or with the duties of his appointing power or agency by which he is employed.

Comment: The purpose of this section is to insure that District personnel do not accept other employment that will impair their ability to exercise an independent,

objective judgment in their official roles and is based on the fundamental theory that a person cannot serve equally two masters. Incompatible employment may exist by virtue of a physical inability to execute diligently the functions of both jobs or because the duties and functions of each are inherently inconsistent or repugnant. The inherent inconsistency which makes employment incompatible lies in a potential conflict of interests or duties, as where one job is subject in some degree to the supervisory control of the other or where one activity will require a person to disclose confidential information which he has gained by reason of his other position or employment with the District.

Examples:

1. An Assistant Counsel of the District is retained by a homeowners' group to advise it in how to proceed in opposing a proposed Metro Rail station. The

attorney must terminate one of the relationships because he/she could not possibly give undivided loyalty to both employers.

2. A senior planner is asked to provide consultant services in his spare time to cities forming a transportation zone. The planner must abandon one of his occupations because they are incompatible.

For District employees, the General Manager may determine through written regulations or delegate to Department Heads the authority to determine outside activities which are incompatible with their duties as District employees. Employees may appeal the determination of incompatible activities through the Non-Contract Grievance Procedure or through the particular grievance procedure applicable to them. (Government Code §§1126 and 1128)

C. Board members, and all employees and consultants required to file Disclosure statements pursuant to the District's Conflict of Interest Code, shall disqualify themselves from making, or participating in the making of, or in any way attempting to use their official position to influence, a governmental decision in which they know or have reason to know they have a financial interest. (Government Code §87100).

All persons holding designated positions shall comply

with the District's Conflict of Interest Code.

Comment: This section of the Code of Conduct as well as the District's Conflict of Interest Code, is derived from Government Code Section 87100 et seq., which is the Initiative Measure approved in the primary election of June 1974. An officer is deemed to have a financial interest if the decision to be made will have a material financial effect on:

(a) Any business entity in which the public official has a direct or indirect investment worth $1,000 or more.

(b) Any real property in which the public official has a direct or indirect interest worth $1,000 or more.

(c) Any source of income, other than gifts and other than loans by a commercial lending institution in the regular course of business on terms available to the public without regard to official status, aggregating $250 or more in value

provided to, received by or promised to the public official within 12 months prior to the time when the decision is made.

(d) Any business entity in which the public official is a director, officer, partner, trustee, employee, or holds any position of management.

(e) Any donor of, or any intermediary or agent for a donor of, a gift or gifts aggregating $250 or more in value provided to, received by, or promised to the public official within 12 months prior to the time when the decision is made.

As provided in Section 87103, "indirect investment or interest means any investment or interest owned by the spouse or dependent child of a public official, by an agent on behalf of a public official, or by a business entity or trust in which the official, the official's agents, spouse, and dependent children own directly, indirectly, or beneficially a

10-percent interest or greater". It should be noted that, by virtue of Section 87101, an officer is not prohibited from making a decision if his participation is legally required in order for the decision to be made. In such case, the officer must disclose the nature of the financial interest before he/she participates in the making of the decision. However, the fact that the officer's vote is needed to break a tie does not make his participation "legally required". This section applies primarily to the need of a body to have a quorum present. The regulations defining the terms used in these sections are attached.

Examples: The above disclosure and non-participation requirements would apply to the following individuals:

1. A Board member owns shares valued at $2,500 in General Motors who has submitted a low bid of $1,700,000 in a District bus

procurement. The Board member must disclose the interest and disqualify him/herself from voting because the effect of the award would increase General Motors' gross revenue by over $100,000. (See Appendix B, Page 3).

2. A member of a staff committee selecting possible sites for a new division owns land valued at $10,000 adjacent to one of the sites. To have the division next door would increase the fair market value of the staff member's property by over 1/2 of one percent. (See Appendix B, Page 3).

D. No Board member or employee shall participate in the award or selection of a contract supported by federal funds if a real, or apparent, conflict of interest would be involved, as conflict is defined in §10, UMTA C4220.1A. (UMTA Circular 4220.1A)

E. No Board member, employee or agent of the District shall solicit or accept gratuities, favors or anything of monetary value from contractors/consultants, potential contractors/consultants or subcontractors/consultants. (§10 UMTA Circular 4220.1A). An unsolicited gift of a value less than twenty-five dollars shall be considered to be of

nominal intrinsic value and not in violation of this section, provided, however, that each District department shall set more restrictive requirements regarding unsolicited gifts as directed by the General Manager.

Examples:

1. A Board member or officer is invited by a District consultant to attend a $100 a plate dinner for an elected official. Assuming the value of the dinner is less than twenty-five dollars, the District representative may attend since the balance constitutes the consultant's contribution to the elected official's campaign fund.

2. A Board member running for office may not solicit or knowingly accept campaign donations from a person doing business with the District. There is, obviously, no violation if the Board member neither solicits nor is aware of the contribution; however, once it is discovered, it should be returned.

F. All inquiries from any proposer, bidder, or prospective bidder or proposer to any Board member or employee to discuss any RFP, specification, bid or proposal shall be

referred to the Office of Contracts, Procurement and Materiel. No actions shall be taken, or information provided, for or on behalf of any prospective contractor or vendor which interferes with free and open competition for District contracts. No Board member or employee shall disclose or otherwise use confidential information acquired by virtue of his/her position or employment with the District for his/her or another person's private gain.

16.5 In addition to the above requirements of Section 16.4c, Board members, employees and consultants shall conduct themselves as follows whenever the member, employee or consultant has, or may have, a financial interest in making or participating in the making of any governmental decision.

A. Directors: Unless his/her participation is legally required, when the matter comes up on the agenda, the Director shall:

1. Disclose his/her interest
2. refrain from participating in any way in the decision making process
3. withdraw from the room if the subject is being discussed in closed session.

B. Employees: The employee shall immediately report the nature of the matter and the existence of a conflict to his/her superior so that the work may be assigned to another.

C. Consultants: The consultant shall immediately report the nature of the matter and the existence of the conflict to

the General Manager.

16.6 No Board member, officer, or employee shall by his conduct give reasonable basis for the impression that any person improperly can influence him or unduly enjoy his favor in the performance of his official acts or actions, or that he is affected unduly by the kinship, rank, position of, or association with, any person.

16.7 A. An employee who violates any of the standards of conduct set forth herein is subject to discipline, up to and including discharge, in addition to any penalties provided by law.

B. If a Board member or consultant violates any of the standards of conduct set forth herein, the matter shall be referred to the Administration, Efficiency and Economy Committee of the Board which shall, following investigation and review, make a recommendation to the full Board for action to be taken, in addition to any penalties provided by law.

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APPENDIX A

GOVERNMENT CODE

§1090 Conflicts of Interest; Contracts, Sales and Purchases

Members of the Legislature, state, county, district, judicial district, and city officers or employees shall not be financially interested in any contract made by them in their official capacity, or by any body or board of which they are members. Nor shall state, county, district, judicial district, and city officers or employees be purchasers at any sale or vendors at any purchase made by them in their official capacity.

As used in this article, "district" means any agency of the state formed pursuant to general law or special act, for the local performance of governmental or proprietary functions within limited boundaries.

§1090.1 Acceptance of Commissions for Placement of Insurance

No officer or employee of the State nor any Member of the Legislature shall accept any commission for the placement of insurance on behalf of the State.

§1091 Remote Interest of Officer or Member

(a) An officer shall not be deemed to be interested in a contract entered into by a body or board of which the officer is a member within the meaning of this article if the officer has only a remote interest in the contract and if the fact of such interest is disclosed to the body of the board of which the officer is a member and noted in its official records, and thereafter the body or board authorizes, approves, or ratifies the contract in good faith by a vote of its membership sufficient for the purpose without counting the vote or votes of the officer or member with the remote interest.

(b) As used in this article, "remote interest" means any of the following:

(1) That of a nonsalaried officer of a nonprofit corporation, except as provided in paragraph (8) of subdivision (a) of Section 1091.5.

(2) That of an employee or agent of the contracting party, if such contracting party has 10 or more other employees and if the officer was an employee or agent of such contracting party for at least three years prior to the officer initially accepting his or her office.

For the purpose of this paragraph, time of employment with the contracting party by the officer shall be counted in computing the three-year period specified in this paragraph even though such contracting party has been converted form one form of business organization to a different form of business organization within three years of the initial taking of office by such officer. Time of employment in such case shall be counted only if, after the transfer or change in organization, the real or ultimate ownership of the contracting party is the same or substantially similar to that which existed before such transfer or change in organization. For the purposes of this paragraph, stockholders, bondholders, partners or other persons holding an interest in the contracting party are regarded as having the "real or ultimate ownership" of such contracting party.

(3) That of a parent in the earnings of his or her minor child for personal services.

(4) That of a landlord or tenant of the contracting party.

(5) That of an attorney of the contracting party.

(6) That of a member of a nonprofit corporation formed under the Food and Agricultural Code or a nonprofit corporation formed under the Corporations Code for the sole purpose of engaging in the merchandising of agricultural products or the supplying of water.

(7) That of a supplier of goods or services when such goods or services had been supplied to the contracting party by the officer for at least five years prior to his or her election or appointment to office.

(8) That of a person subject to the provisions of Section 1090 in any contract or agreement entered into pursuant to the provisions of the California Land Conservation Act of 1965.

(9) That of an officer, director or employee of a bank, bank holding company, or savings and loan association with which a party to the contract has the relationship of borrower or depositor, debtor or creditor.

(10) That of an engineer, geologist, or architect employed by a consulting engineering or architectural firm. This paragraph applies only to an employee of a consulting firm who does not serve in a primary management capacity, and does not apply to an officer or director of a consulting firm.

(c) The provisions of this section shall not be applicable

to any officer interested in a contact who influences or attempts to influence another member of the body or board of which he or she is a member to enter into the contract.

(d) The willful failure of an officer to disclose the fact of his or her interest in a contract pursuant to this section shall be punishable as provided in Section 1097. Such violation shall not void the contract, however, unless the contracting party had knowledge of the fact of the remote interest of the officer at the time the contract was executed.

§1091.1 Interest in Contracts; Subdivided Lands

The prohibition against an interest in contracts provided by this article or any other provision of law shall not be deemed to prohibit any public officer or member of any public board or commission from subdividing lands owned by him or in which he has an interest and which subdivision of lands is effected under the provisions of Division 2 (commencing with Section 66410) of Title 7 of the Government Code or any local ordinance concerning subdivisions; provided, that (a) said officer or member of such board or commission shall first fully disclose the nature of his interest in any such lands to the legislative body having jurisdiction over the subdivision thereof, and (b) said officer or member of such board or commission shall not cast his vote upon any matter or contract concerning said subdivision in any manner whatever.

§1091.5 Ownership of Corporate Shares; Reimbursement for Expenses; Recipient of Public Services; Landlord or Tenant Contracting with Federal or State Agencies; Employment of Spouse; Officer, Director, or Employee of Bank or Savings and Loan Association

(a) An officer or employee shall not be deemed to be interested in a contract if his or her interest is any of the following:

(1) The ownership of less than 3 percent of the shares of a corporation for profit, provided the total annual income to him or her from dividends, including the value of stock dividends, from the corporation does not exceed 5 percent of his or her total annual income, and any other payments made to him or her by the corporation do not exceed 5 percent of his or her total annual income.

(2) That of an officer in being reimbursed for his or her actual and necessary expenses incurred in the performance of official duty.

(3) That of a recipient of public services generally provided by the public body or board of which he or she

is a member, on the same terms and conditions as if he or she were not a member of the board.

(4) That of a landlord or tenant of the contracting party if such contracting party is the federal government or any federal department or agency, this state or an adjoining state, any department or agency of this state or an adjoining state, any county or city of this state or an adjoining state, or any public corporation or special, judicial, or other public district of this state or an adjoining state unless the subject matter of such contract is the property in which such officer or employee has such interest as landlord or tenant in which event his or her interest shall be deemed a remote interest within the meaning of, and subject to, the provisions of Section 1091.

(5) That of a tenant in a public housing authority created pursuant to Part 2 (commencing with Section 34200) of Division 24 of the Health and Safety Code in which he or she serves as a member of the board of commissioners of the authority or of a community development commission created pursuant to Part 1.7 (commencing with Section 34100) of Division 24 of the Health and Safety Code.

(6) That of a spouse of an officer or employee of a public agency in his or her spouse's employment or officeholding if his or her spouse's employment or officeholding has existed for at least one year prior to his or her election or appointment.

(7) That of a nonsalaried member of a nonprofit corporation, provided that such interest is disclosed to the body or board at the time of the first consideration of the contract, and provided further that such interest is noted in its official records.

(8) That of a noncompensated officer of a nonprofit, tax-exempt corporation, which, as one of its primary purposes, supports the functions of the body or board or to which the body or board has a legal obligation to give particular consideration, and provided further that such interest is noted in its official records.

For purposes of this paragraph an officer is "noncompensated" even though he or she receives reimbursement from the nonprofit, tax-exempt corporation for necessary travel and other actual expenses incurred in performing duties of his or her office.

(b) An officer or employee shall not be deemed to be interested in a contract made pursuant to competitive bidding under a procedure established by law if his or her sole

interest is that of an officer, director, or employee of a bank or savings and loan association with which a party to the contract has the relationship of borrower or depositor, debtor or creditor.

§1092 Avoidance of Contracts

Every contract made in violation of any of the provisions of Section 1090 may be avoided at the instance of any party except the officer interested therein. No such contract may be avoided because of the interest of an officer therein unless such contract is made in the official capacity of such officer, or by a board or body of which he is a member.

§1092.5 Lease, Purchase or Encumbrance of Real Property; Avoidance

Notwithstanding Section 1092, no lease or purchase of, or encumbrance on, real property may be avoided, under the terms of Section 1092, in derogation of the interest of a good faith lessee, purchaser, or encumbrancer where the lessee, purchaser, or encumbrancer paid value and acquired the interest without actual knowledge of a violation of any of the provisions of Section 1090.

§1093 Warrants and Other Evidences of Indebtedness, Private Use or Benefit

The State Treasurer and Controller, county and city officers, and their deputies and clerks shall not purchase or sell, or in any manner receive for their own or any other person's use or benefit any State, county or city warrants, scrip, orders, demands, claims, or other evidences of indebtedness against the State, or any county or city thereof. This section does not apply to evidences of indebtedness issued to or held by such an officer, deputy or clerk for services rendered by them, nor to evidences of the funded indebtedness of the State, county, or city.

§1094 Accounts; Certificate as Prerequisite to Allowance

Every officer whose duty it is to audit and allow the accounts of other state, county, or city officers shall, before allowing such accounts, require each of such offices to make and file with him an affidavit or certificate under penalty of perjury that he has not violated any of the provisions of this article, and any individual who willfully makes and subscribes such certificate to an account which he knows to be false as to any material matter shall be guilty of a felony and upon conviction thereof shall be subject to the penalties prescribed for perjury by the Penal Code of this State.

§1095 Warrants and Other Evidences of Indebtedness; Restrictions on Payment

Officers charged with the disbursement of public moneys shall not pay any warrant or other evidence of indebtedness against the State, county, or city when it has been purchased, sold, received, or transferred contrary to any of the provisions of this article.

§1096 Accounts; Suspension of Settlement or Payment; Prosecutions

Upon the officer charged with the disbursement of public moneys being informed by affidavit that any officer, whose account is about to be settled, audited, or paid by him, has violated any of the provisions of this article, the disbursing officer shall suspend such settlement or payment, and cause the district attorney to prosecute the officer for such violation. If judgment is rendered for the defendant upon such prosecution, the disbursing officer may proceed to settle, audit, or pay the account as if no affidavit had been filed.

§1097 Penalty for Violations

Every officer or person prohibited by the laws of this state from making or being interested in contracts, or from becoming a vendor or purchaser at sales, or from purchasing scrip, or other evidences of indebtedness, including any member of the governing board of a school district, who willfully violates any of the provisions of such laws, is punishable by a fine of not more than one thousand dollars ($1,000), or by imprisonment in the state prison, and is forever disqualified from holding any office in this state.

Activity or Enterprise by Local Agency Officer or Employee

(a) Except as provided in Section 1128, a local agency officer or employee shall not engage in any employment activity, or enterprise for compensation which is inconsistent, incompatible, in conflict with, or inimical to his or her duties as a local agency officer or employee or with the duties, functions, or responsibilities of his or her appointing power or the agency by which he or she is employed. Such officer or employee shall not perform any work, service, or counsel for compensation outside of his or her local agency employment where any part of his or her efforts will be subject to approval by any other officer, employee, board, or commission of his or her employing body, unless otherwise approved in the manner described by subdivision (b).

(b) Each appointing power may determine, subject to approval of the local agency, and consistent with the provisions of Section 1128 where applicable, those outside activities which, for employees under its jurisdiction, are inconsistent with, incompatible to, or in conflict with their duties as local agency officers or employees. An employee's outside

employment, activity, or enterprise may be prohibited if it: (1) involves the use for private gain or advantage of his or her local agency time, facilities, equipment and supplies; or the badge, uniform, prestige, or influence of his or her local agency office or employment or, (2) involved receipt or acceptance by the officer or employee of any money or other consideration from anyone other than his or her local agency for the performance of an act which the officer or employee, of not performing such act, would be required or expected to render in the regular course or hours of his or her local agency employment or as a part of his or her duties as a local agency officer or employee or, (3) involves the performance of an act in other than his or her capacity as a local agency officer or employee which act may later be subject directly or indirectly to the control, inspection, review, audit, or enforcement of any other officer or employee or the agency by which he or she is employed, or (4) involves such time demands as would render performance of his or her duties as a local agency officer or employee less efficient.

The local agency may adopt rules governing the application of this section. Such rules shall include provision for notice to employees of the determination of prohibited activities, of disciplinary action to be taken against employees for engaging in prohibited activities, and for appeal by employees from such a determination and from its application to an employee.

§1128 Agency Employed Attorneys; Service on Boards, etc.

Service on an appointed or elected governmental board, commission, committee, or other body by an attorney employed by a local agency in a non-elective position shall not, by itself, be deemed to be inconsistent, incompatible, in conflict with, or inimical to the duties of the attorney as an officer or employee of the local agency and shall not result in the automatic vacation of either such office.

§87100 Public Officials; State and Local; Financial Interest

No public official at any level of state or local government shall make, participate in making or in any way attempt to use his official position to influence a governmental decision in which he knows or has reason to know he has a financial interest.

SECTION 10

CODE OF CONDUCT. Grantees shall maintain a written code or standards of conduct which shall govern the performance of their officers, employees or agents engaged in the award and administration of contracts supported by Federal funds. No employee, officer or agent of the grantee shall participate in selection, or in the award or administration of a contract supported by Federal funds if a conflict of interest, real or apparent, would be involved. Such a conflict would arise when:

a. The employee, officer or agent;

b. Any member of his immediate family;

c. His or her partner; or

d. An organization which employs, or is about to employ, any of the above, has a financial or other interest in the firm selected for award.

The grantee's officers, employees or agents shall neither solicit nor accept gratuities, favors or anything of monetary value from contractors, potential contractors, or parties to subagreements.

Grantees may set minimum rules where the financial interest is not substantial or the gift is an unsolicited item of nominal intrinsic value.

To the extent permitted by State or local law or regulations, such standards of conduct shall provide for penalties, sanctions, or other disciplinary actions for violations of such standards by the grantee's officers, employees, or agents, or by contractors or their agents.

CHAPTER 7. CONFLICTS OF INTEREST

Article 1. Conflicts of Interest; General Prohibition

18700. Public Official Making, Participating in Making, or Using His Official Position to Influence a Governmental Decision (87100).

The provisions herein define terms as used in Chapter 7 of the Political Reform Act of 1974, as amended, Government Code Sections 87100–87312.

(a) "Public official at any level of state or local government" means every natural person who is a member, officer, employee or consultant of a state or local government agency.

(1) "Member" shall include, but not be limited to, salaried or unsalaried members of boards or commissions with decision-making authority. A board or commission possesses decision-making authority whenever:

(A) It may make a final governmental decision;

(B) It may compel a governmental decision; or it may prevent a governmental decision either by reason of an exclusive power to initiate the decision or by reason of a veto which may not be overridden; or

(C) It makes substantive recommendations which are, and over an extended period of time have been, regularly approved without significant amendment or modification by another public official or governmental agency.

(2) "Consultant" shall include any natural person who provides, under contract, information, advice, recommendation or counsel to a state or local government agency, provided, however, that "consultant" shall not include a person who:

(A) Conducts research and arrives at conclusions with respect to his or her rendition of information, advice, recommendation or counsel independent of the control and direction of the agency or of any agency official, other than normal contract monitoring; and

(B) Possesses no authority with respect to any agency decision beyond the rendition of information, advice, recommendation or counsel.

(b) A public official "makes a governmental decision," except as provided in subsection (d) of this section, when he or she, acting within the authority of his or her office:

(1) Votes on a matter;

(2) Appoints a person;

(3) Obligates or commits his or her agency to any course of action;

(4) Enters into any contractual agreement on behalf of his or her agency;

(5) Determines not to act, within the meaning of sub-paragraphs (1), (2), (3) or (4), unless such determination is made because of his or her financial interest. When the determination not to act occurs because of his or her financial interest, the official's determination must be accompanied by disclosure of the financial interest, made part of the agency's official record or made in writing to the official's supervisor, appointing power or any other person specified in a conflict of interest code adopted pursuant to Government Code Section 87300.

(c) A public official or designated employee "participates in the making of a governmental decision" when, acting within the authority of his or her position, he or she:

(1) Negotiates, without significant substantive review, with a governmental entity or private person regarding the decision; or

(2) Advises or makes recommendations to the decision-maker, either directly or without significant intervening substantive review, by:

(A) Conducting research or making any investigation which requires the exercise of judgment on the part of the official or designated employee and the purpose of which is to influence the decision; or

(B) Preparing or presenting any report, analysis or opinion, orally or in writing, which requires the exercise of judgment on the part of the official or designated employee and the purpose of which is to influence the decision.

(d) Making or participating in the making of a governmental decision shall not include:

(1) Actions of public officials which are solely ministerial, secretarial, manual or clerical;

(2) Appearances by a public official as a member of the general public before an agency in the course of its prescribed governmental function to represent himself or herself on matters related solely to his or her personal interests; or

(3) Actions by public officials, employees, or employee representatives relating to their compensation or the terms or conditions of their employment or contract.

(e) "In any way attempting to use his or her official position to influence a governmental decision" shall include furthering or attempting to affect in any manner any decision:

(1) Within or before his or her agency; or

(2) Before any agency which is appointed by or subject to the budgetary control of his or her agency.

(f) "In any way attempting to use his or her official position to influence a governmental decision" shall not include:

(1) Appearances by a public official as a member of the general public before an agency in the course of its prescribed governmental function to represent himself or herself on matters related solely to his or her personal interest;

(2) Actions by public officials, employees or employee representatives relating to their compensation or the terms or conditions of their employment or contract.

NOTE: Authority cited: Section 83112, Government Code. Reference: Section 87100, Government Code.

History 1. Repealer and new section filed 12-17-76, as an emergency; effective upon filing (Register 76, No. 51). For prior history, see Register 76, No. 40.
2. Certificate of Compliance filed 3-31-77 (Register 77, No. 14).

18702. Material Financial Effect.

(a) The financial effect of a governmental decision on a financial interest of a public official is material if the decision will have a significant effect on the business entity, real property or source of income in question.

(b) In determining whether it is reasonably foreseeable that the effects of a governmental decision will be significant within the meaning of the general standard set forth in paragraph (a), consideration should be given to the following factors:

(1) Whether, in the case of a business entity in which the public official holds a direct or indirect investment of one thousand dollars ($1,000) or more or in the case of a business entity in which the public official is a director, officer, partner, employee, trustee or holds any position of management, the effect of the decision will be to increase or decrease:

(A) The annualized gross revenues by the lesser of:

1. One hundred thousand dollars ($100,000); or

2. One percent if the effect is one thousand dollars ($1,000) or more; or

(B) Annual net income by the lesser of:

1. Fifty thousand dollars ($50,000); or

2. One half of one percent if the effect is one thousand dollars ($1,000) or more; or

(C) Current assets or liabilities by the lesser of:

1. One hundred thousand dollars ($100,000); or

2. One half of one percent if the effect is one thousand dollars ($1,000) or more.

Current assets are deemed to be decreased by the amount of any expenses incurred as a result of a governmental decision.

(2) Whether, in the case of a direct or indirect interest in real property of one thousand dollars ($1,000) or more held by a public official, the effect of the decision will be to increase or decrease:

(A) The income producing potential of the property by the lesser of:

1. One thousand dollars ($1,000) per month; or

2. Five percent per month if the effect is fifty dollars ($50) or more per month; or

(B) The fair market value of the property by the lesser of:

1. Ten thousand dollars ($10,000); or

2. One half of one percent if the effect is one thousand dollars ($1,000) or more.

(3) Whether, in the case of a source of income, as defined in Government Code Section 87103(c), of two hundred fifty dollars ($250) or more received by or promised to a public official within 12 months prior to the time the decision is made:

(A) The effect of the decision will be to directly increase or decrease the amount of income (other than rents) to be received by the official, or to confer a financial benefit or detriment upon the official or a member of the official's immediate family, in an amount of one hundred dollars ($100) or more; or

(B) There is a nexus between the governmental decision and the purpose for which the official receives income; or

(C) In the case of a source of income which is a business entity, the business entity will be affected in a manner described in subsection (b)(1) above; or

(D) If the source of income is not a business entity, the decision will have a significant effect on the source.

(c) Subsections (a) and (b) of this section notwithstanding, the making or participation in the making of a governmental decision by a contract consultant or by a person retained to provide information, advice, recommendation or counsel has no material financial effect on a business entity or source of income in which such consultant or person retained is an officer, employee, sole proprietor or partner, if the only financial effects of the decision are the modification, perpetuation or renewal of the contractual or retainer agreement and/or the opportunity to bid competitively on a project or contract.

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SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT
METRO RAIL PROJECT

EXHIBIT 2

DISTRICT CONTRACTING POLICY WITH COMPANIES DOING BUSINESS IN OR WITH SOUTH AFRICA

DISTRICT CONTRACTING POLICY WITH COMPANIES DOING BUSINESS IN OR WITH SOUTH AFRICA

1. The District shall not enter into any contract:

   A. For goods manufactured, produced, assembled, grown or mined in South Africa.

   B. For goods or services with:

      1) The government of South Africa;

      2) Any vendor organized under the laws of South Africa;

      3) Any vendor who owns property or is doing business in South Africa; or

   C. For goods and services with any vendor doing business with the government of South Africa or which has done business with the government of South Africa within the preceding twelve (12) months.

2. Contracts not exempted from this policy may be subject to termination and refusal of payment for goods or services received if the District determines that the contractor was ineligible at time of contract award or became ineligible thereafter.

3. The following contracts are exempt from this policy:

   A. Contracts mandated to be let through competitive bidding by Section 20231 of the Public Contract Code;

   B. Contracts, including amendments, modifications, or renewals, in existence at the effective date of this policy and any subsequent amendments, modifications, or renewals in which the scope or duration of the underlying contract is not significantly altered;

   C. Contracts for the purchase of sole source goods and services;

   D. Contracts wherein application of this article would disqualify all but a single supplier of goods or services;

   E. Contracts wherein application of this policy would, with reasonable foreseeability, result in significant loss of quality or significant additional costs to the District;

   F. Contracts wherein the Board of Directors determines that such application would otherwise be contrary to the best interests of the District.

4. This policy is not applicable where prohibited by federal or state law or where application would violate or be inconsistent with the terms or conditions of a grant or contract with an agency of the United States, the State of California or the instruction of an authorized representative of any such agency with respect to any such grant or contract.

5. Each bidder or proposer shall complete the certificate provided in the Forms for Submittal of Bids, under penalty of perjury, declaring the nature and extent it is doing business in or with South Africa and the origin of goods to be provided. FAILURE TO SUBMIT THE COMPLETED STATEMENT MAY RESULT IN REJECTION OF THE BID OR PROPOSAL.

SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT

METRO RAIL PROJECT

PASSENGER VEHICLE

CONTRACT A650

VI. TECHNICAL PROVISIONS

TECHNICAL PROVISIONS

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SECTION 1

SCOPE

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SECTION 1

SCOPE

1.1 GENERAL

These Technical Provisions and Contract Drawings specify the design, material, and performance requirements for the passenger vehicles to be provided for the Southern California Rapid Transit District (District) Metro Rail System. The Work shall include design, manufacture, test, initial in-service support, and in-service performance verification of the vehicles.

1.2 CITED REFERENCES

The publications, codes, and standards are applicable to the extent cited in these Technical Provisions. Where no specific date or issue of the publication is noted, the issue (and supplements thereto) in effect on the date of the Request for Proposal shall be considered to be the issue in effect. Substitute codes and standards shall not be used unless approved. Requests for substitutions shall be submitted with the Conceptual Design Review (CDR) package (Reference: Section 20) and shall include a paragraph-by-paragraph comparison with the specified document, an explanation of differences, and a rationale for making a substitution. (CDRL) Request shall be in the English language.

1.3 SYSTEM DESCRIPTION

1.3.1 Metro Rail System

The Metro Rail System is a two-branch, 20-mi rail rapid transit line being constructed by the District from downtown Los Angeles to the Wilshire District and to the San Fernando Valley via Hollywood. It will consist of both subway and aerial segments. This line will be the core element of a regional rail rapid transit system. In addition to the 20-mi line, two future extensions of the Metro Rail System have been identified as part of the regional rapid transit system.

1.3.2 Initial Operating Segment

A. The first 4 mi of the line have been identified as the initial operating segment because there are currently insufficient federal funds to construct the 20-mi Metro Rail System. This initial segment,

identified as MOS-1, consists of double-track main line subway from Union Station to the Wilshire/ Alvarado Station with additional subway and surface track connecting to the Yard southeast of Union Station. It includes the Yard and shop facilities planned for the 20-mi system with the exception of part of the Yard storage tracks, which will be installed as warranted by system extension and fleet expansion.

B. The MOS-1 line has five stations. The main line route begins at Union Station (northeast of the Los Angeles Civic Center), runs through the central business district, and terminates on the west side at the Wilshire/Alvarado Station. The rail line is entirely in subway with line segments constructed by tunnel boring machines and stations and cross-overs excavated by cut and cover construction techniques. Three double crossovers are included in the subway portion of MOS-1, one at each end of Union Station and one at the east end of the Wilshire/Alvarado Station.

1.3.3 Operation

System operation will be centrally controlled from the Rail Control Center (RCC), located in the Yard, using communication links with facilities and trains involving telephones, radios, closed circuit television, and data transmission (Reference: Sections 16 and 17).

1.3.4 Maintenance

The Metro Rail maintenance program will consist of preventive and corrective maintenance activities directed towards the periodic inspecting, servicing, repairing, and overhauling of Metro Rail equipment and facilities. The Main Shop building will have equipment and facilities for servicing, inspecting, and repairing the passenger vehicles. A blowdown facility, service and inspection area, heavy repair area, truck shop, wheel shop, and equipment maintenance shops will be included with the Main Shop. Separate car-wash facilities will be used for exterior cleaning of the passenger vehicles. The Maintenance-of-Way building will support maintenance of fixed facilities, track structure, and associated equipment. The Central Maintenance Facility will handle electronic component repairs to electronic equipment and equipment that are common to bus and rail operations. The Central Maintenance Facility will include shops for the repair of air conditioning, heating, and ventilating equipment, antennas, closed-circuit tele-

vision equipment, data transmission equipment, destination signs, fare collection equipment, radios, seats, and telephones.

1.3.5 Stations

The five initial stations will be primarily of a double-ended design with two mezzanines, but one station, Wilshire/Alvarado, will be of the single-mezzanine design characteristic of the majority of the stations on the 20-mi line. Elevators, escalators, and stairs will provide normal vertical circulation among surface, mezzanine, and platform levels. Stations will be equipped for both attended and unattended operation. Some stations will have adjacent parking facilities, pick-up/drop off areas and/or bus pull-in areas to accommodate patrons arriving by automobile or by bus.

1.3.6 Ridership

Ridership on MOS-1 is projected to be approximately 54,000 per day. Service for MOS-1 is planned to be provided by two-dependent-pair trains operating at headways of 5 min during peak hours, increasing to 20 min during evenings and weekends. However, three-dependent-pair trains operating at 2.5-min headways will be required to serve projected demand for the 20-mi line.

END OF SECTION

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SECTION 2

ABBREVIATIONS AND DEFINITIONS

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SECTION 2

ABBREVIATIONS AND DEFINITIONS

2.1 GENERAL

Whenever verbs such as submit, provide, or furnish are used without a subject, it shall be understood that the subject is the Contractor unless stated otherwise.

2.2 ABBREVIATIONS AND DEFINITIONS

Wherever in the Technical Provisions and other Contract Documents the following abbreviations and definitions, or pronouns in place of them, are used, the intent and meaning shall be interpreted as noted herein.

2.2.1 Abbreviations

AATCC	American Association of Textile Chemists and Colorists
AFBMA	Anti-friction Bearing Manufacturers' Association
AGMA	American Gear Manufacturers' Association
AISI	American Iron and Steel Institute
ALCOA	Aluminum Company of America
ANSI	American National Standards Institute
ASHRAE	American Society of Heating, Refrigeration, and Air Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASR	Automatic Speed Regulation
ASTM	American Society for Testing and Materials
ATC	Automatic Train Control
ATO	Automatic Train Operation
ATP	Automatic Train Protection
ATS	Automatic Train Supervision

AWG	American Wire Gauge
AWS	American Welding Society
CAC	California Administrative Code
CAL/OSHA	California Occupational Safety and Health Administration, Department of Industrial Relations
CCU	Communications Control Unit
CDR	Conceptual Design Review
CDRL	Contract Data Requirements List
CFR	Code of Federal Regulations
dB	Decibel
dBC	Decibel (C-weighted sound level)
DFE	District-furnished Equipment
DIS	Division of Industrial Safety, State of California
DOT	United States Department of Transportation
DTE	Diagnostic and Test Equipment
EIA	Electronic Industries Association
EMI	Electromagnetic Interference
EMO	Emergency Manual Operation
FAA	Federal Aviation Administration
FACI	First Article Configuration Inspection
FDR	Final Design Review
FED-STD	Federal Standard
FMECA	Failure Mode, Effects, and Criticality Analysis
FMVSS	Federal Motor Vehicle Safety Standards
FRA	Federal Railroad Administration

FS	Federal Specification or Standard
HVAC	Heating, Ventilation, and Air Conditioning
IC	Intercommunications
IEEE	Institute of Electrical and Electronics Engineers
LLRU	Lowest Level Replaceable Unit
LVPS	Low-voltage Power Supply
MIL-STD	Military Standard
MMBF	Mean Miles Between Failures
MRT	Mean Restoration Time
MTBF	Mean Time Between Failures
MTO	Manual Train Operation
MTTR	Mean Time To Repair
NEMA	National Electrical Manufacturers' Association
NFPA	National Fire Protection Association
PA	Public Address
PDR	Preliminary Design Review
ppm	Parts Per Million
PSS	Programmed Station Stopping
PUC	State of California Public Utilities Commission
QA	Quality Assurance
RCC	Rail Control Center
rms	Root Mean Square
SAE	Society of Automotive Engineers
SCRTD	Southern California Rapid Transit District
SPL	Sound Pressure Level

TICU	Train Identification Control Unit
TIG	Tungsten Inert Gas
TTC	Transportation Test Center (AAR Test Facility at Pueblo, Colorado)
UIC	Union International de Chemins de Fer (International Union of Railways)
UL	Underwriters Laboratories, Inc.
UMTA	Urban Mass Transportation Administration (DOT)
US	United States of America

2.2.2 Definitions

A-car - The passenger vehicle of a dependent pair that carries the air compressor.

Age Date - For elastomers, the date at which a stored elastomer is no longer suitable for use.

Anchorage - The swiveling attachment between draft gear and draft sill.

Approval/Approved - Written approval by the District unless specifically stated otherwise.

Approved Equal, or Equivalent - An item, material, or method that is offered as a substitute for that designated herein and is approved.

ATC Dynamic Acceptance Tests - On-site tests performed to verify proper operation of the ATC system in conjunction with operation of the Metro Rail passenger vehicle.

ATP Speed Limit - The upper limit of train speed as enforced by ATP.

Automatic Speed Regulation (ASR) - That function of ATO which controls vehicle propulsion and braking effort to reach and maintain a desired speed within a desired tolerance.

Automatic Train Control (ATC) - The system for automatically controlling train movement, enforcing train safety, and directing train operations. ATC includes the ATO, ATP, and ATS subsystems.

Automatic Train Operation (ATO) - 1. That subsystem of the ATC that performs the functions of berthing verification, speed regulation, programmed station stopping, and unintentional movement protection. 2. The primary normal mode of operation in revenue service.

Automatic Train Protection (ATP) - That subsystem of ATC that maintains safe train operation through a combination of train detection, train separation, interlocking, and speed limit enforcement.

Automatic Train Supervision (ATS) - That subsystem of ATC that monitors Metro Rail System status and provides the appropriate controls to direct the operation of trains to maintain intended traffic patterns and minimize the effects of train delays.

Auxiliary Equipment - Any mechanism or structure other than the passenger vehicle body, traction motor, or propulsion equipment gearing that performs a function at some time during the operation of the vehicle; for example, heating, ventilating, and air conditioning subsystem, pumps, vehicle door operators, motor-alternator or motor generator set, air compressor or hydraulic power unit, and passenger vehicle lighting.

AW0, AW1, AW2, and AW3 - Vehicle assigned weights under various load conditions. AW0 is the actual empty vehicle weight including all equipment and subsystems required for revenue service. AW1 is the AW0 weight plus a full complement of seated passengers. AW2 is the AW0 weight plus seated passengers plus standees. AW3 is the AW0 weight plus seated passengers plus crush-loaded standees. AW3 is principally for structural definition, and not an anticipated normal operating condition. Where noted, AW3 is also applicable for mechanical design and tests.

B-car - The passenger vehicle of a dependent pair that does not carry the air compressor.

Blended Braking - A simultaneous electrical and friction brake application in which the effort of electric braking is supplemented by friction braking to achieve the required total brake effort.

BRK Signal - A two-level signal to the propulsion control that assures the tractive effort mode on a per-train basis.

Car - Used interchangeably with vehicle.

Change Request - The written form originated by the Contractor or prepared at the request of the District, for identifying, proposing, controlling, estimating, and recommending changes or modifications of the physical or functional configuration of the Work.

Chopper - A propulsion control device using solid-state thyristors to modulate motoring and electric braking.

Coast - The mode of operation of a train in which motoring and braking are inactive; the train is moving by momentum alone.

Coefficient of Adhesion - During rolling contact, the ratio between the longitudinal tangential force and the normal force at the wheel-rail interface.

Communications Control Unit (CCU) - A portion of the operator console panel that serves to coordinate all passenger vehicle communications, facilitating communications mode selection and control, including controls and indications for the vehicle radio equipment.

Consist - The number and specific identity of vehicles that make up a train.

Contact Rail - A busbar located alongside the track that carries the electrical power for energizing the vehicles.

Contact Rail Assembly - The contact rail plus coverboard, insulation, and supports.

Contract - The written agreement executed by the District and the Contractor that sets forth the rights and obligations of the parties relative to the performance of the Work.

Contract Data Requirements List (CDRL) - The listing identified as an Appendix or Table (so titled) in the Technical Provisions, which codifies, defines; and schedules deliverable data requirements.

Contract Documents - The completed and executed Contract Agreement, Performance Bond, DBE/WBE Certification, Special Provisions, General Provisions, Technical Provisions, Contract Drawings, Insurance Specifications, and additional documents incorporated by reference into the Contract Agreement or any other Contract Document.

Contract Drawings - The drawings that show configuration, character, general arrangement, dimensions, and

details of the Work. Contract Drawings will either be included in, or enclosed with, the Procurement Specifications Book.

Contractor - The individual, partnership, firm, corporation, or combination thereof, which has entered into a contract with the District to provide the required services and products.

Cross Level - Equal transverse elevation of the two running rails.

Data Dictionary - A collection of names of all data items used in a software system, together with relevant properties of those items; for example, length of data item, representation, etc.

Days - Unless otherwise designated, days mean calendar days.

Dead Time - Time from the occurrence of a control signal step change to the beginning of the controlled variable change.

Deadman Feature - A device to detect inattention or disability of a train operator, which causes a brake application.

Dependent Pair - Two passenger vehicles that must be coupled together for operation, consisting of an A-car and a B-car.

District - The Southern California Rapid Transit District.

Draft Gear - The energy-absorbing mechanism that attaches the coupler to the anchorage.

Draft Sill - That portion of the carbody end underframe to which the anchorage is attached.

Dwell - The period of time measured from the instant a train stops at a station until the instant it resumes moving.

Electric Braking - Braking effort provided by driving the traction motors as generators to provide regenerative braking and resistive braking.

Emergency Braking - An irrevocable braking effort to fully stop a vehicle at a higher retardation rate than is obtained with a full-service brake application.

Emergency Manual Operation (EMO) - A submode of MTO mode that permits train operation when carborne ATP has failed.

Emergency Stop - A complete stop caused by emergency braking effort.

Energy Consumption - Total electrical power required by a vehicle under specified conditions, including propulsion, HVAC, lighting, and other loads.

F-end - The end of a vehicle containing the operator cab.

Factory Acceptance Tests - Tests performed at Contractor's facilities prior to shipment to verify compliance with specifications and quality standards.

Fail-safe - A characteristic of a system which ensures that any malfunction affecting safety will cause the system to revert to a state that is known to be safe.

Failure - The event, or inoperable state, in which any item or part of an item does not, or would not, perform as specified.

Field Acceptance Tests - On-site tests performed to verify proper installation and operation of equipment and subsystems.

Gauge (Track) - The distance between the inside faces of rails, measured 0.625 in. below the top of the centerline of heads of running rails and at right angles thereto.

Headway - The time separation between two trains, both traveling in the same direction on the same track, measured from the time the head end of the leading train passes a given reference point to the time the head end of the train immediately following passes the same reference point.

Horizontal Alignment - The horizontal location of a track as described by curves and tangents.

Human Factors - The application of biological and behavioral sciences to the design of equipment and systems so that the best use is made of human capabilities.

Independent Failure - A failure that occurs without being caused by the failure of another item.

Indicated - As shown on the Contract Drawings, or as described or specified in the Technical Provisions, or as required by other Contract Documents.

Interface - 1. The defined common boundary between two systems or subsystems that may be electrical, mechanical, functional, or contractual. 2. A point where a system, subsystem or component comes into functional or physical contact with another.

Interlock - A condition whereby one function is dependent on the operation of another function.

Jerk - Rate of change of acceleration, equal to the second derivative of velocity with respect to time.

Lead or Leading Vehicle - The vehicle in the front of a train.

Left Side - The area, objects, or space to an observer's left when the observer is facing the guideway while standing in the F-end doorway of the leading vehicle.

Load Weight Compensation - A function incorporated into the suspension subsystem, which measures gross vehicle weight and interfaces with the propulsion and friction brake subsystems. It serves to control the tractive effort in order to achieve a constant effort-to-weight ratio.

Lowest Level Replaceable Unit (LLRU) - The lowest assemblage of components to which a malfunction can be isolated and that can be readily replaced in its field application.

Maintainability - The collective properties of an item that determine consumption of resources, including time, per maintenance event.

Maintenance Action - Any type of maintenance activity, whether it involves a preventive or repair action.

Manual Controller - A device in the operator cab that allows the operator to manually control the tractive effort.

Manual Train Operation (MTO) - The alternate normal operational mode used in revenue service. Speed regulation and stopping are controlled by the train operator using the Manual Controller.

Mean Miles Between Failures (MMBF) - The arithmetic average of the miles between successive failures of an individual item or of each of the members of a population of items. Actual observed test MMBF is the range of the true MMBF cumulatively demonstrated under test conditions.

Mean Restoration Time (MRT) - The mean time required for maintenance or operational restoration of service following a service delay or failure.

Mean Time Between Failures (MTBF) - The arithmetic average of the times between successive failures of an individual item or of each of the members of a population of items. Actual observed test MTBF is the range of the true MTBF cumulatively demonstrated under test conditions.

Mean Time To Repair (MTTR) - The mean elapsed time required to perform the task of isolating an independent failure to the LLRU, to remove and replace the failed LLRU, and to verify the proper equipment function.

Motoring - Propelling force developed by the propulsion subsystem. Also called positive tractive effort.

Negative Tractive Effort - Retarding force developed by either or both the propulsion and friction brake subsystems. Also called braking.

Nonvolatile Indicator - A visual indicator that, if lighted when a power outage occurs, will relight automatically when power is restored.

Operational Failure - Failure that results in a vehicle or subsystem remaining operational and safe, although performance may be degraded.

P-Signal - Linear analog current signal that effects continuous proportional control of tractive effort.

Pair - A dependent pair, when referring to pairs of vehicles, such as two-pair train.

Passenger Reading Plane - An imaginary, 15-in.-diameter circular plane, facing passenger at 45 degrees from vertical, centered 33 in. above floor and 24 in. in front of passenger seat backrest on centerline of individual seat.

Performance Level - One of a series of commands from ATS or train operator to ASR, used to modify acceleration and ATP speed limit to achieve desired traffic pattern.

Pitch - Angular displacement about an axis parallel to the lateral axis of the passenger vehicle.

Profile Grade - A straight line representing an established grade line in relation to the horizontal.

Programmed Station Stop - A train stop produced by closed-loop braking, such that the train is stopped at a designated point within a station according to a predetermined speed-distance profile.

Provide - In reference to Work to be performed by the Contractor, provide means to furnish, deliver, store, and install, and test completed in place.

Pseudo Code - A combination of programming language and natural language used for computer program design that is intended to be transportable between different processors.

R-End - The end of a vehicle that does not contain the operator cab.

Radio - A two-way radio located in the operator cab of each vehicle, which permits voice communication between the train operator and Rail Control Center.

Rail Control Center (RCC) - The facility from which rail system operation will be monitored and controlled.

Recovery Time - The time required for a system or condition to return to its original state (or some stated percentage of its original value) after being disrupted or destabilized.

Regenerative Braking - Electric braking in which the generated power is conditioned and returned to the contact rail.

Reliability - The probability of performing a specified function, without failure and within design parameters, for the period of time intended under actual operating conditions.

Reproducible Failure - A failure that can be duplicated.

Resistive Braking - Electric braking in which the generated power is dissipated by carborne resistor grids and equipment.

Restricted Manual Submode - A submode of MTO mode that is used for normal operation in the Yard and used during failure of wayside ATC equipment on the main line.

Revenue Service - Train service on established routes, supported by fare collection.

Right Side - The area, objects, or space to the observer's right when the observer is facing the guideway while standing in the F-end doorway of the leading vehicle.

Roll - Rotational motion of carbody about a longitudinal axis.

Running Rail - The rail on which the wheels of the vehicle ride and are guided.

Safety Critical - Any condition, event, operation, process, component, assembly, subsystem, or system, the failure or malfunction of which can result in severe injury, severe occupational illness, or major damage.

Schedule Speed - The average speed of a train from terminal to terminal obtained by dividing the distance between these points by the time taken to make the trip, including time for intermediate station stops.

Service Braking - Modulated braking effort under continuous direction of ATO or Manual Controller.

Slide - The condition in which the equivalent linear velocity of a wheel is less that the linear velocity of the vehicle.

Spare Parts - Like, or approved equivalent items to replace consumed, failed, or worn parts.

Speed Taper - During deceleration, a change in the braking rate as a function of train speed.

Spin - The condition in which the equivalent linear velocity of a wheel is greater than the linear velocity of the vehicle.

Standard Part - A part available as a catalog item from 2 or more manufacturers.

State - The State of California.

Subcontractor - Any individual, partnership, firm, or corporation which undertakes integrally on the Work, the partial or total design, manufacture, or performance of one or more items of Work under the terms of the Contract. As used herein, the terms subcontractor and supplier are synonymous.

Subsystem - A major part or an assembly of parts of a vehicle, or of another system, as indicated.

Superelevation - On a curve, the vertical distance measured in inches that the outer running rail is above the inner running rail.

Superelevation, Unbalanced - For a train negotiating a curve at a given speed, the number of inches of additional superelevation that would be required to equalize the normal wheel forces on the inner and outer running rails.

3 System Integration Tests - On-site tests performed to 3
3 ensure that Metro Rail systems and facilities function 3
properly together.

Technical Provisions - Requirements that set forth the detail of the Work including design, performance, material, testing, methods of manufacture, and other requirements peculiar to the procurement.

Trailing Vehicle - The vehicle at the rear end of a train.

Train - An ensemble of two or more coupled vehicles that is operable as a unit.

Train Operator - A District employee aboard a train in service whose principal duties are to oversee safety, perform emergency operations, operate train in MTO mode and submodes, and oversee train operation in the ATO mode.

Train-to-Wayside Radio (TWR) - That function of ATS that provides the RCC with the capability to receive and transmit data necessary for monitoring the trains and maintaining traffic patterns.

Trainline - The means of sending a signal to all vehicles in a consist via a continuous electrical, air, or fluid circuit connected through appropriate coupling devices.

Vehicle - The Metro Rail passenger vehicle.

Vital Relay - A gravity-drop railway signal relay that has nonweldable contacts and nonweldable armature stops, which meets or exceeds AAR recommendations for safety relays. It is so designed that the probability of its failing to return to the prescribed state upon deenergization is so low as to be considered nonexistent.

Work - The furnishing of all the products, materials, equipment, data, and services in accordance with the Contract Documents, including changes thereto.

Zero Speed - Vehicle velocity of less than 3 mi/hr for more than 1 sec.

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SECTION 3

GENERAL REQUIREMENTS

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GENERAL REQUIREMENTS

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SECTION 3

GENERAL REQUIREMENTS

3.1 GENERAL

This Section specifies the general requirements for the design of the vehicle, including the physical characteristics, performance, ride quality, and noise criteria.

3.1.1 Cited References

Organization	Number	Title
ANSI	S1.4	Specification for Sound Level Meters
ANSI	S1.11	Specification for Octave, Half Octave, and Third Octave Band Filter Sets
US	MIL-STD-462	Measurement of Electromagnetic Interference Characteristics
US	MIL-STD-1472	Human Engineering Design Criteria

3.1.2 Basic Requirements

A. The exterior and interior perspective and general arrangement of the vehicle, as well as certain detail and interface information, are shown in the Contract Drawings. Where noted, the Contract Drawings illustrate a configuration which may be modified if approved.

B. The vehicle shall be designed for a 30-yr minimum life on the Metro Rail System. Subsystem components, as well as carbody and trucks, shall have a history of successful rail transit revenue service of at least 2 yr on a minimum of 30 vehicles, accumulating a total of 3 million mi. Evolutionary modifications to service-proven equipment, or modifications for the purpose of achieving the performance requirements herein shall be approved. The design shall provide for reliable service and ease of maintenance. The safety of the passengers shall be of primary importance.

C. The vehicles shall be configured to operate as quick-separable (less than 1 hr to join or separate) dependent pairs, each pair consisting of one A- and one B-car that must be coupled together for operation. Each vehicle shall have a cab at one end (F-end) so that the pair can be operated in either direction. It shall be possible to couple any A-car with any B-car to form a fully operable dependent pair. Trains shall be capable of operation in consists of one, two, or three dependent pairs.

3.2 GENERAL DESIGN REQUIREMENTS

3.2.1 General

A. Particular attention shall be paid to fault indication, diagnosis, isolation, and correction. The equipment shall employ the minimum number of moving parts compatible with safe operation under fault conditions. The use of solid-state control and logic circuitry with high levels of circuit integration is encouraged where it improves reliability and reduces component count, wire size, power requirements, or weight.

B. Microprocessor-based logic shall perform self-testing upon being energized and periodically during operation. Pass/fail status of self-test shall be indicated on the outside of the logic enclosure. Failure of self-test of logic used in ATO, friction brake, and propulsion subsystems shall be annunciated in the active operator cab as SERVICE BRAKE FAILURE for friction brake logic failure and as PROPULSION FAILURE for ATO and propulsion logic failure (Reference: Section 9).

C. Air exhausts from underfloor-mounted equipment shall be directed in a vertical downward direction.

D. Circuits that are safety-critical shall be designed such that no single failure or multiple failures from a single event shall cause an unsafe condition. Approved redundancy, fail-safe, or fail-operational principles shall be incorporated into the design. Fail-operational is defined to mean that a failure results in the vehicle remaining operational and safe, although performance may be degraded.

3.2.2 Maintainability Requirements

Maintenance considerations, including maximum use of modular LLRUs, shall be incorporated into the design. The design shall be such that MTTR and MRT are minimized. A minimum number of types of external test equipment shall be required. Built-in annunciation to identify electrical faults to the module or equivalent field-replaceable unit shall be provided. The following maintainability features shall be in the design of the vehicle:

A. Panels and openings shall permit ready access from normal service work areas.

B. Self-retaining fasteners shall be used wherever practical.

C. Special access-opening tools shall not be used unless considered necessary to resist vandalism.

D. Latched hold-open devices shall be incorporated into access covers whenever practical for additional safety. Underfloor box shall have two or more devices, one of which shall be sufficient to hold the box door open.

E. Components most frequently maintained or adjusted shall be most accessible. Provisions for visual inspection of components shall be maximized.

F. Design of electrical equipment shall be such that routine adjustments are not required for shift, drift, and degradation. Adjustments to mechanical equipment shall be minimized.

G. Design shall minimize the necessity for special tools and special support equipment.

H. Design shall allow physical interchangeability without field adjustment of parts, LLRUs, assemblies, and components that are functionally interchangeable. Conversely, items that are not functionally interchangeable shall not be physically interchangeable, except for components such as resistors and diodes when their values are clearly labeled.

I. Devices shall be provided to facilitate the handling of heavy or difficult-to-access items.

J. Design shall maximize the use of standard, commercially available hardware and components. Similar

components supplied by one manufacturer shall be used to the maximum extent practical.

K. Subsystems and assemblies shall include multipin connectors (test sockets) for establishing connection with DTE. Outputs to these connectors shall be buffered or isolated to minimize damage to equipment caused by defects in test equipment or incorrect connection. Connectors shall be accessible without removing equipment and, where practical, from interior of vehicle.

L. Design of microprocessor-based and other complex digital logic shall include diagnostic displays on the logic enclosure for troubleshooting and fault correcting. The display shall provide details of failures including error messages if the software ceases to operate correctly because of either hardware failure or software error, and including where practicable, identification of the failed component. Logic used in ATO, friction brake, and propulsion subsystems shall store diagnostic data preceding subsystem failures in nonvolatile memory. Provisions shall be included for transferring the data to a portable memory medium, such as a floppy disc.

M. In addition to the above, the design shall include the maintainability concepts of the paragraph entitled "Design for Maintainability" of MIL-STD-1472.

3.3 DIMENSIONAL AND CLEARANCE DATA

3.3.1 Vehicle Physical Characteristics

The vehicle physical characteristics shall fall within the dimensions and clearances indicated and as follows:

PARAMETER	REQUIRED	ACCEPTABLE RANGE	TOLERANCES
A. Length:			
1. Over coupler faces	75 ft		±0.75 in.
2. Over anticlimbers		74 ft 3 in. 74 ft 9 in.	

PARAMETER	REQUIRED	ACCEPTABLE RANGE	TOLERANCES
B. Height with New Wheels:			
1. Top of rail to top of roof	12 ft 0.75 in. max.		
2. Top of rail to top clearance point	12 ft 4.687 in. max.		
3. Top of rail to top of finished floor, measured at the door threshold	44.75 in.		+0 -0.50 in.
C. Passenger Area Height at Longitudinal Centerline, Finished Floor to Ceiling:			
1. Under evaporator units	6 ft 8 in. min.		
2. Other		6 ft 10 in. to 7 ft 2.5 in.	
D. Carbody Width:			
1. In any plane	10 ft 6 in. max.		
2. Over thresholds	10 ft 4 in.		+0 -0.125 in.
E. Side Door Openings, Clear:			
1. Height	6 ft 3 in. min.		
2. Width		48 to 54 in.	
F. End Door Openings, Clear:			
1. Height	6 ft 3 in. min.		
2. Width		28 to 34 in.	
G. Distance between Truck Centers:		52 to 54 ft	±0.25 in.
H. Truck Wheel Base:	7 ft 7 in. max.		
I. Standard Wheel Gauge between Backs of Flanges:	4 ft 5.375 in.		+0 -0.250 in.
J. Clearance between Equipment and Plane of Rails, Worst Case, including Failure of Suspension and Wear Allowances:			
1. Under Truck	2 in. min.		
2. Under Vehicle	4 in. min.		

	PARAMETER	REQUIRED	ACCEPTABLE RANGE	TOLERANCES
	K. Wheel Diameter, New, except as: specified herein (Reference: Article 15.4)		28 to 34.5 in.	
	L. Wheel Wear, Before Replacement:		3 in. of diameter	
5	M. Passenger Seats:			5
5	1. Single seat width	20 in. min.		5
5	2. Double seat width	40 in. min.		5
5	3. Width of individual seat within a double seat	20 in. min.		5
5	4. Clear vertical space between side of a single seat and front of adjacent transverse double seat	10 in. min		5
5	5. Clear vertical space between adjacent transverse double seats	8 in. min		5
5	N. Passenger Area Aisle Clear Width:	32 in. min		5
5	O. Standback Space between Side-door Frame Edge and Windscreen:		15 to 19 in.	5

3.3.2 Guideway Interfaces

A. Track Characteristics:

1. Rail Type: 115 RE section, continuous welded steel, installed to a 1:40 cant. Rail will have been ground by the District before use by the vehicles.

2. Minimum Lateral Radius at Centerline of Tracks Outside of Special Work:

a. Yard: 250 ft

b. Main Line: 750 ft.

3. Maximum actual superelevation is 6 in. with maximum unbalanced superelevation of 4.5 in.

4. Most Severe Reverse Curve Conditions:

a. Main Line Outside of Special Work: The minimum tangent length is 0 ft with spirals back to back.

b. Yards Outside of Special Work: Reverse curves with 250-ft radii and zero intervening tangent.

c. Yard Special Work: Two No. 6 turnouts with their points of switch 14 ft apart and facing each other.

5. Smallest Turnout: No. 6

6. Vertical Grades:

a. Main Line: ± 4.0 percent maximum

b. Yard: ± 1.5 percent maximum.

7. Vertical Curves (Rate of Change of Profile Grade):

a. Main Line: ± 2.4 percent maximum per 100 ft (parabolic)

b. Yard and Storage Tracks: ± 5 percent maximum per 100 ft (parabolic).

8. Nominal Track Gauge:

a. Standard Trackwork (Horizontal Track Alignment):

1) Tangent Track: 4 ft 8.5 in.

2) On Curves with Radii Greater than 700 ft: 4 ft 8.5 in.

3) On Curves with Radii of 700 ft or Less, but with Radii Greater than 500 ft: 4 ft 8.75 in.

4) On Curves with Radii of 500 ft or Less: 4 ft 9 in.

b. Special Trackwork:

Turnout No.	Straight Side	Turnout Side
8	4 ft 8.5 in.	4 ft 8.5 in.
6	4 ft 8.5 in.(1)	4 ft 9 in.(1),(2)

(1) Gauge will be 4 ft 9.25 in. between point of switch and heel of switch.

(2) If guard rails are used, frog guard rail gauge will be 4 ft 6.625 in. regardless of track gauge.

c. Double Crossover Gauge: 4 ft 8.5 in. between the frogs.

d. For every 0.25 in. change in track gauge, the transition length will not be less than 31 ft except in special trackwork.

9. Minimum Track Quality:

a. Gauge Variation per 31 ft of Track: ±0.25 in.

b. Cross Level Variation per 31 ft of Track: ±0.25 in.

c. Superelevation per 31 ft of Track: ±0.25 in.

d. Vertical and Horizontal Alignment, Mid-ordinate, 62-ft Chord: ±0.25 in.

10. Track Spacing: 14 ft minimum, center to center, tangent track.

11. Running Rail Wear: 0.5 in. maximum, vertical and horizontal.

12. Contact Rail:

a. Main Line and Yard: Either steel rail with aluminum bus bars fastened on both sides of the rail web, or aluminum rail with stainless steel contact surface.

b. Height at Top of Contact Rail above Top of Running Rail: see Contract Drawings.

c. Contact Rail Ramp:

1) Main Line: 1 degree, nominal

2) Yard: 2 degrees, nominal.

d. Distance between Centerline of Contact Rail and Gauge Point of Near Running Rail: see Contract Drawings.

e. Height of Lower Side of Coverboard above Contact Rail: see Contract Drawings.

f. Location on 250- to 350-ft Curves: Outside of curve.

B. Station Characteristics and Clearances:

1. Platform Length: 450 ft, nominal

2. Distance from Centerline of Track to Edge of Finished Platform: 5 ft 5 in., nominal

3. Platform Height Above Top of Rail: 44 in., nominal

4. Track Grade at Stations: 1 percent, maximum.

3.4 WEIGHT CRITERIA

3.4.1 Weight Requirement

The A- or B-car AW0 weight (nominal 80,000 lb) shall be confirmed by actual measured and certified weight at shipment including DFE and Contractor-furnished carborne equipment (Reference: Special Provisions).

3.4.2 Maximum Weight Difference

A. The maximum permitted AW0 weight difference between an A- and B-car shall be no greater than 1,500 lb. Location of shared equipment for A- and B-car shall be Contractor's responsibility, unless otherwise specified.

B. At AW0, the weight measured under each truck of a single vehicle shall not be less than 49 percent of the actual total vehicle weight. The weight measured on each side of the longitudinal centerline of an AW0 vehicle shall not be less than 49 percent of the actual AW0 vehicle weight.

C. Weights of delivered A- and B-cars shall be within ±400 lb of their respective average final AW0 vehicle weights.

3.5 PERFORMANCE CRITERIA

Vehicle performance requirements shall be met with a consist of any size and the following conditions, except as noted.

3.5.1 Primary Power Supply

A. Nominal system primary voltage will be 750 V dc from 12-pulse rectification in the Yard and main line, and from 6-pulse rectification in the shop area. Vehicle equipment shall be capable of proper operation and performance at voltage levels between 450 and 900 V dc, and with sustained step changes of up to 200 V dc caused by the regenerative capabilities of the vehicles. Performance of individual subsystems may be reduced at voltage levels between 450 and 650 V dc. No equipment shall be damaged when primary voltage drops below 450 V dc. Actual degraded performance levels shall be submitted for approval. (CDRL)

B. The expected transient voltage will be ±3,000 V for 20 msec duration and 30 kJ or 5,000 V peak rising exponentially in 1.2 microsec and decaying to half value in 50 microsec.

C. Contact Rail:

1. Electrical resistance at 20°C: Approximately 2 milliohm per 1,000 ft on the main line and approximately 4 milliohm per 1,000 ft in the Yard.

2. Reactance at 60 Hz: Approximately 50 microhm per ft on the main line, and approximately 55 microhm per ft in the Yard.

D. Running Rail:

1. Dc resistance: Approximately 9 microhm per ft.

2. Reactance at 60 Hz: Approximately 2 milliohm per ft.

E. Contact and Running Rail Loop Inductance:

1. Contact Rail in the Yard: Approximately 0.14 microH per ft.

2. Contact Rail on the Main Line: Approximately 0.13 microH per ft.

3. Running Rail in both the Yard and Main Line: Approximately 5 microH per ft.

3.5.2 Carborne Power Circuit Voltages

A. Primary Power, including Direct (Unfiltered), Filtered, and Regulated Power Circuits: Voltages (nominal) as approved (Reference: Section 13).

B. Ac Auxiliary Power Circuits: 60 Hz, unless otherwise approved, at either 277/480 V ac (nominal), 3-phase; or 120/208 V ac (nominal), 3-phase; and 120 V ac (nominal) single-phase. Auxiliary equipment shall operate with voltage and frequency fluctuations of ±10 percent. No equipment shall be damaged by low voltage down to zero volts.

C. Dc Auxiliary Power Circuits: As approved (Reference: Section 13).

D. Low-voltage Power Circuits: 37.5 V dc, nominal. Total range 24 to 42 V dc, or as approved. No equipment shall be damaged by low voltage down to zero volts.

E. Control Circuits within Equipment Enclosures: Manufacturer's standard voltage, except as specified.

3.5.3 Carborne Compressed Air

Carborne compressed air shall be supplied from the air compressor furnished with the friction brake subsystem (Reference: Section 15).

3.5.4 Ambient Conditions

A. The vehicles shall be suitable for service in the following environment:

1.	Temperature Range (°F)	20 to 120
2.	Relative Humidity Range (%)	10 to 85
3.	Rainfall (maximum in./hr)	4
4.	Wind (steady state/ gusts, maximum mi/hr)	10/62
5.	Hail/Snow	Trace
6.	Heavy Fog (days/yr)	42
7.	Air Quality:	

a. Particulate (maximum mg/m^3) 0.248

b. Particulate (average mg/m^3) 0.142

c. O_3 (maximum-ppm) 0.35

d. NO_x (maximum-ppm) 0.44

e. SO_x (maximum-ppm) 0.037

f. CO (maximum-ppm) 29

g. Chloride Content (mg/m^3) 13.9

h. Moisture Acidity (ph) 4.41

i. CO_2 (maximum mg/m^3) >9,000

8. Solar Radiation (maximum $Btu/hr\text{-}ft^2$) 275

B. Allowances shall be made for the heat generated within the equipment and for the vehicle being exposed to direct sunlight for prolonged periods.

C. The carbody will be subjected to negative pressure with differential of 5 in. water column across walls when entering or leaving tunnels. Upon entering tunnel, the front of the lead vehicle shall withstand a positive pressure of 12 in. water column.

D. Vehicles will be washed with either acid or detergent washing compound and water in an automatic washing installation as frequently as once per day.

3.5.5 Performance Criteria Control Parameters

A. For performance design purposes, the weight of each vehicle shall be defined by the following:

1. AW0: Actual empty vehicle weight (including DFE).

2. AW1: AW0 plus 9,086 lb passenger load (based upon passenger weight of 154 lb each).

3. AW2: AW0 plus 27,720 lb seated and standee passenger load.

4. AW3: AW0 plus 46,354 lb

5. For initial design purposes, DFE may be assumed to weigh a total of 1,000 lb per dependent pair (Reference: Section 4).

B. Acceleration, deceleration, and speed requirements shall be met with new and fully-worn wheels on clean, dry, level, open tangent track, unless otherwise specified.

C. For design purposes, the resistance of the vehicle and trains shall be calculated based upon the following:

1. On Open, Level Tangent Track in Still Air: The following Davis equation:

$$TR = 1.3W + 116N + 0.045WV + [(0.0024) + (N-1)(0.00034)] AV^2$$

where: TR = Resistance, total, lb
W = Weight per train, tons
V = Train speed, mi/hr
N = Number of vehicles in train
A = Frontal area of lead vehicle, ft^2

2. On Level Tangent Track Inside the Tunnel: The above Davis equation modified as approved.

D. Estimated annual vehicle usage for the 18-mi line is 75,000 mi at 30 mi/hr average speed. Estimated annual vehicle usage for MOS-1 is 35,000 mi.

3.6 THERMAL CAPACITY

3.6.1 General Conditions

The thermal capacity rating of the friction brake and propulsion subsystems shall be based upon continuous round-trip operation of specified consists. The consists shall be operating in ATO mode including PSS (Reference: Section 16). Primary voltage at the current collector shall be 700 V dc in propulsion, and 750 V dc in electric braking. Round-trip operation shall be between and including Union and North Hollywood Stations, with stops at intermediate and terminal stations. Dwell time shall be 20 sec at intermediate stations. Track profile and speed data shall be as in Appendix TP-3-A. Speed restrictions shall be observed. 5 Carborne ATP equipment will detect changes in ATP speed 5 5 limit (maximum authorized speed) when the F-end of the 5 5 lead vehicle is at the block boundary. After a 2-sec 5 5 delay, carborne ATP will signal the new ATP speed limit 5

5 to the ATO equipment. ATO reaction time shall be stated and included in the analyses. (Calculations for block boundary locations have already considered PUC requirements, Reference: Appendix TP-16-B.) Temperature rise limits shall be as specified (Reference: Sections 14 and 15). Operation shall start at Union Station. Operation from Union Station to North Hollywood shall be on the AR track. Operation from North Hollywood to Union Station shall be on the AL track. For these analyses, the change from AR to AL track (or vice versa) at terminal stations shall occur at the crossover (X-over) as the train approaches the station.

3.6.2 Worst-case Analyses (CDRL)

Parameters which may vary shall be analyzed to establish the worst-case consist for each thermal capacity evaluation. In addition to the specified variations in consist size, contact rail receptivity, time of emergency brake application, and location of inoperative motors, parameters such as wheel diameter shall be included in the analyses.

3.6.3 Performance Conditions

A. Propulsion subsystem thermal capacity rating shall be based on AW2, three-pair consists operating with PL-1 in effect and the specified electric service braking rates. The consists shall not have friction braking available (except in the electric braking fade region). The rating shall include 0 and 100 percent contact rail receptivity during braking. Terminal station dwell time, including turnback time shall be 120 sec.

B. Friction brake subsystem thermal capacity rating shall be based on AW0 plus 20,790 lb per vehicle, three-pair consists operating with PL-2 in effect and a 2.2 mi/hr/sec service braking rate. The consists shall not have electric braking available. The rating shall include at least one emergency brake application that may occur at any time during the trip. Terminal station dwell time, including turnback time shall be 150 sec.

C. Friction brake and propulsion subsystems thermal capacity rating shall include AW2, two-pair consists operating without damage when either or both the friction brake and propulsion (braking and motoring) subsystems of one vehicle are not operating, except that emergency braking capability shall be available on all vehicles. Operation shall be in PL-1 with 2.2 mi/hr/sec service-brake-

rate request. (The acceleration and braking rates of the consist will be less because of the non-operating equipment, except in the case of PSS where the ATO subsystem automatically compensates for any reduced braking effort.) Temperature rise limits specified (Reference: Sections 14 and 15) may be exceeded provided that equipment shall operate without damage. Terminal station dwell time, including turnback time shall be 180 sec.

3.7 ACCELERATION REQUIREMENTS

Each of the acceleration requirements (speed achieved/time-to-achieve) specified shall be met by up to AW2 one-pair consists. The consists shall have new to fully-worn wheels. Compensation for wheel wear shall be automatically applied on a per-vehicle basis. A variance of up to 0.5 in. in wheel diameter difference on a per vehicle basis shall be provided for in the design. Primary power at the current collector shall be between 650 and 900 V dc.

3.7.1 Speed Achieved/Time-to-Achieve

The speeds to be achieved and times to achieve those speeds with jerk limiting operative shall be as listed below. Maximum deviation from the specified Time-to-Achieve shall not exceed ± 6.5 percent.

Speed Achieved (mi/hr)	Time-to-Achieve (sec)
15	6.0
25	9.6
30	11.5
40	16.5
50	25.0
60	40.0
70	77.0

3.7.2 Worst-case Analyses (CDRL)

Parameters which may vary shall be analyzed to establish the worst-case consist for the acceleration requirements. The specified variations in consist size, primary power, and wheel size shall be included in the analyses.

3.8 SPEED REQUIREMENTS

3.8.1 Automatic and Manual Train Operation Modes

Maximum operating speed with new to fully-worn wheels shall be 70 +4, -1 mi/hr, referred to herein as 70

mi/hr. In ATO and MTO modes train speed will be enforced by ATP (Reference: Section 16). In MTO submodes, train speed shall be limited, as specified.

3.8.2 Restricted Manual Submode

The speed limit in the Restricted Manual submode of MTO mode will be enforced by ATP at 10 ±1 mi/hr.

3.8.3 Wash/Couple Submode

The speed of an AW0 train operating in the Wash/Couple submode of MTO mode shall be limited to 2 ±1 mi/hr by the propulsion subsystem.

3.8.4 Emergency Manual Submode

Train speed in EMO submode of MTO mode shall be limited to 24 ±2 mi/hr by the propulsion subsystem.

3.9 DECELERATION REQUIREMENTS

Deceleration rates shall be based upon open, level tangent track in still air.

3.9.1 Service Braking

Service braking shall utilize blended braking with electric braking having priority over friction braking. When available, electric braking shall provide all of the requested brake rate. A maximum blended braking rate of 3.0 mi/hr/sec shall be available for up to AW3 consists. Except as specified, normal service braking rate shall be 2.2 mi/hr/sec.

A. A nominal 3.0 mi/hr/sec brake rate shall be demonstrated for AW3 consists (Reference: Section 21).

B. Average deviation from a requested rate shall be ±7 percent, or less, over any 5 sec time interval. Maximum deviation shall be ±10 percent, or less.

3.9.2 Electric Braking

At AW2, electric braking shall have capability to provide the service braking rate within ±5 percent of requested rate, except as specified herein. Electric braking shall not be initiated if speed is less than 15 mi/hr. Once established, electric braking shall be maintained to approximately 5 mi/hr (brake fade region). At AW2, the following braking rates shall be available:

Speed (mi/hr)	Braking Rate (mi/hr/sec)
70	2.1
70 to 47	linear from 2.1 to 3.0
47 to brake fade region	3.0

3.9.3 Service Friction Braking

A. With electric braking not operational on the train, friction braking alone shall provide the specified service braking.

B. Friction braking average rates shall be measured by noting the velocity (V) at the completion of jerk limiting and measuring the distance (s) to 0 mi/hr. The average rate ($V^2/2s$) achieved shall not deviate more than ±18 percent from the requested rate in wet and dry conditions. Peak rates (v/t) shall not deviate beyond ±25 percent of requested rate, where t is any 1 sec time period from the completion of jerk limiting and v is the change in velocity during that time period.

3.9.4 Emergency Braking

Emergency braking shall be by friction braking only and, when initiated, shall continue until the consist comes to a complete stop. The average emergency braking rate ($V^2/2s$) under dry or wet conditions for all weights up to AW3 shall not be less than 2.8 mi/hr/sec, exclusive of dead time and brake buildup time. The total dead time and brake buildup time (to 90 percent of final brake cylinder pressure) for a train shall not exceed 1.5 sec. The instantaneous maximum braking rate (v/t) shall not exceed 4.2 mi/hr/sec, where t is any 1 sec time period from the completion of jerk limiting and v is the change in velocity during that time period.

3.10 JERK LIMITING

The jerk limit under normal acceleration or deceleration shall be 2.0 $mi/hr/sec^2$ ±10 percent.

3.10.1 Spin/Slide Conditions

Jerk limiting shall apply during reapplication of motoring following spin correction. Jerk limiting shall not apply to release of braking effort during slide correction but shall apply to reapplication of braking effort.

3.10.2 Contact Rail Gaps

Jerk limiting shall apply following reapplication of tractive effort after low-speed passage of contact rail gap.

3.10.3 Emergency Braking Conditions

Normal jerk limiting shall not be active during emergency braking. The Contractor shall define the value of jerk under dry and wet track conditions and submit support data for approval. (CDRL)

3.11 WHEEL SPIN/SLIDE CORRECTION

Wheel spin/slide correction function shall detect random or synchronous spins and slides, and shall modulate tractive effort in both braking and motoring, except in emergency braking. Spurious spin/slide detections caused by EMI, truck dynamics, and the like shall be precluded. Spin/slide shall be controlled on either a per-truck or a per-vehicle basis for propulsion equipment, and on a per-truck basis for friction braking equipment.

3.11.1 Braking

A. Fail-safe features shall be inherent in the design so that failure of spin/slide correction shall result in no less than the requested braking effort.

B. Upon detection of a slide during braking, the braking effort shall be reduced until the slide is corrected, but not longer than the specified time period. The time period shall be adjustable from 2 to 5 sec, with the initial setting at 3 sec.

1. The electric braking effort shall be reduced, and, on the affected truck, the friction braking effort, if any, shall be removed upon detection of the slide.

2. When the slide is corrected within the specified time period, service braking shall be reapplied automatically. The service braking rate shall be consistent with obtaining maximum performance without exceeding the specified jerk limit.

3. When the slide is not corrected within the specified time period, the electric braking and slide correction efforts shall be discontinued on the affected vehicle. Service friction braking shall be reapplied and provide all

braking effort without spin/slide correction for the remaining portion of the brake application. Upon completion of the brake application, electric braking and spin/slide correction shall be reset and available for the next brake application.

3.11.2 Motoring

Upon detection of a spin during acceleration, the propulsion subsystem shall modulate the tractive effort until the spin is corrected. Reapplication of motoring shall occur at a jerk-limited rate.

3.11.3 Efficiency

Above a coefficient of adhesion of 6 percent and a speed of 5 mi/hr, spin/slide efficiency shall be a minimum of 80 percent in braking and 60 percent in motoring (Reference: Article 21.4).

3.12 LOAD WEIGH COMPENSATION

Load weigh signals to propulsion and friction brake subsystems shall be continuous functions. The signals shall be available for vehicle weights up to and including AW3. Load compensation shall be effected while the train is stationary. If the load sensing is lost or is beyond the accepted range of AW0 to AW3, load weigh compensation shall respond as if the vehicle weight were AW1.

3.13 CONTROL REQUIREMENTS

3.13.1 Braking and Motoring Control Signals

A. Tractive effort demand shall be on a per-train basis by a trainlined analog signal (P-signal) that represents the percent of maximum tractive effort to be developed by propulsion and friction brake subsystems. Brake, Coast, and Power shall be separate ranges of the P-signal, as indicated on Figure TP-3-1. The propulsion and friction brake subsystems shall, as a minimum, respond to changes in the P-signal greater than 4 percent of full scale. Each vehicle shall control its own tractive effort based on the P-signal, vehicle speed, vehicle load weigh signal, and performance level (Reference: Section 16). The P-signal circuit shall be carried in a two-wire, looped shielded circuit that is designated as safety critical. The circuit shall be isolated from ground and circuits common to other functions. The shielding continuity shall be ensured on a per-vehicle basis.

B. A BRK signal, a separate two-level (high/low) signal as indicated on Figure TP-3-1, shall ensure the operation in the proper tractive effort mode (Brake or Power) on a per-train basis (Reference: Section 16). The BRK signal circuit shall be a two-wire shielded circuit that is designated as safety critical. The circuit shall be isolated from ground and circuits common to other functions. Shielding continuity shall be ensured on a per-vehicle basis.

C. The emergency stop circuit, a safety-critical circuit, shall open the P-signal and BRK signal circuits, and cause the traction power line breaker to be opened (Reference: Section 14). The circuit shall ensure an irretrievable stop after an emergency application is initiated, and ensure that the train is brought to zero speed before it can proceed in any mode of operation. Resetting of the emergency stop circuit shall be possible only from the energized cab after the train is at zero speed. Emergency stop circuit shall be routed to and from ATP. If the friction brake subsystem control utilizes an electric trainline (Reference: Section 15), the emergency stop circuit shall be a loop circuit.

D. Other service-proven, tractive effort control methods may be submitted for approval.

3.13.2 Control Response Time

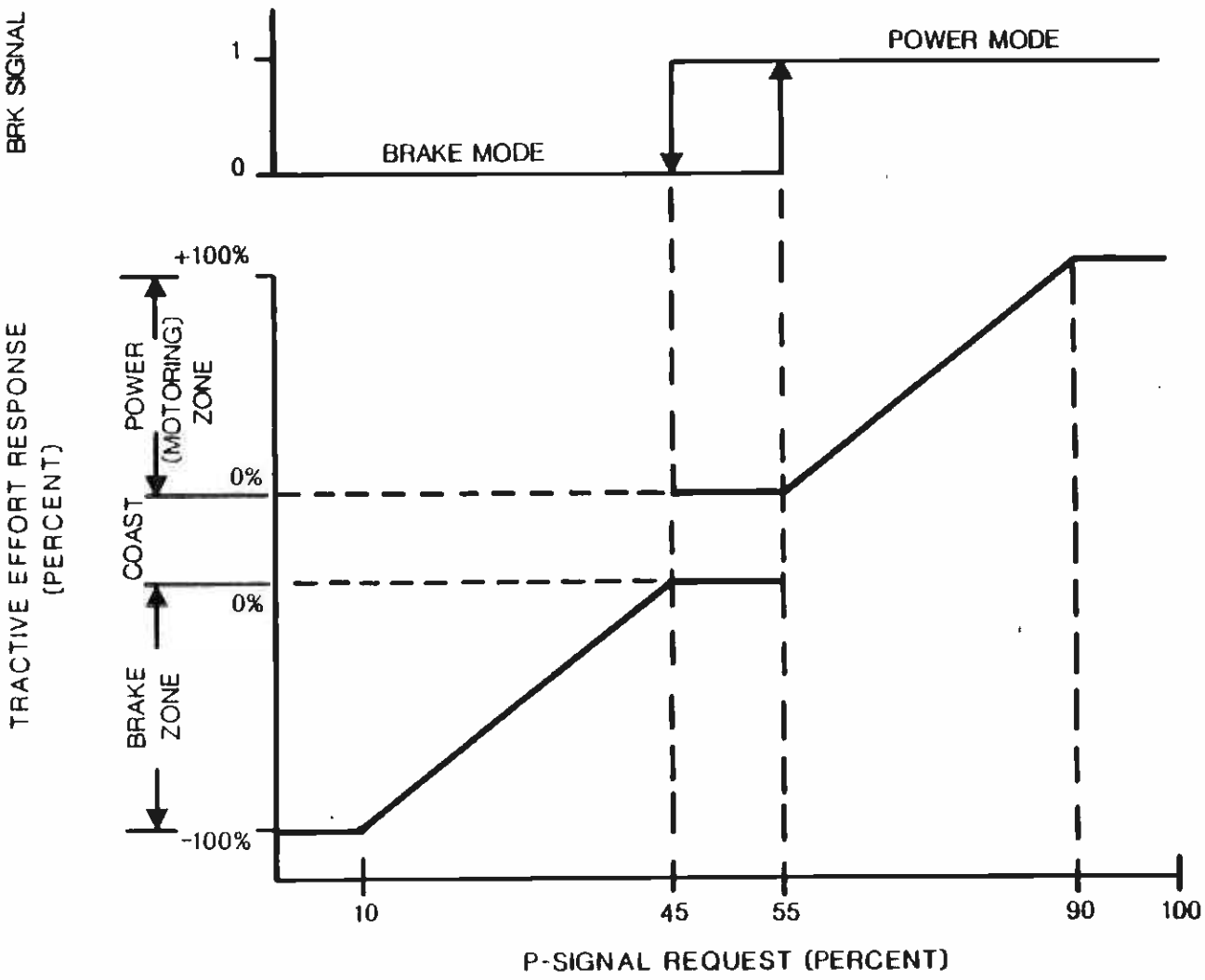
A. Maximum dead time from step change of command signal until beginning of traction motor torque reaction for modulation within the Power or Brake zones shall be 0.1 sec.

B. Mode change dead time, exclusive of jerk limit ramp (Power-to-Brake or Brake-to-Power), shall not be greater than 0.5 sec.

C. Maximum dead time of the friction brake subsystem from step change of command signal until beginning of the brake cylinder pressure change shall not exceed 0.2 sec.

3.13.3 Trainlined Circuits

Trainline requirements shall be consistent with the requirements specified herein and shall be submitted for approval. (CDRL) Trainlines shall be functional for trains of at least four dependent pairs.



BRK SIGNAL MODE AND TRACTIVE EFFORT RESPONSE VS. P-SIGNAL REQUEST

FIGURE TP-3-1

0021.0.0
03/16/87 00588

A. Safety critical circuits shall utilize two-wires with control (switching) of both wires.

B. Direction control shall utilize a dedicated pair of trainlines for each direction and be a shielded circuit energized from the LVPS.

C. Shielding of each trainline shall be grounded at only one point from the energized Operator Console to the low-voltage ground plate, unless otherwise approved. Shielding continuity shall be ensured on a per-vehicle basis.

D. Trainlined control and indication functions shall include the following as a minimum:

1. ATC information

2. Communications circuits

3. Annunciation indication, and reset functions

4. Lighting

5. Auxiliary load control.

E. Cutouts shall be provided so that no single fault or combination of faults from a single cause will immobilize a complete train (Reference: Sections 9 and 17).

3.14 NOISE CONTROL AND CRITERIA

Enclosures, baffles, seals, acoustical absorption, body panels, and other approved methods shall be incorporated into the vehicle design to attenuate noise and vibration. Estimates of noise levels inside and outside the vehicle shall be submitted with supporting data, including analyses, structural data, test results, and calculations. Vehicle weight for noise testing shall be AW0 unless otherwise specified. (CDRL)

3.14.1 Definitions

A. Sound Pressure Level (SPL): The SPL in dB is defined as 20 log p/p_o, where p is the measured rms sound pressure and p_o is the reference pressure, 20 microPa.

B. Measurement: For acoustical tests and measurements, the sound measuring system shall meet the ANSI S1.4 requirements for a Type I instrument.

Where 1/3-octave band measurements are specified, the analyzer shall meet ANSI S1.11 requirements for Class II filters. Narrow-band noise or pure tones shall be identified using filters with a bandwidth not exceeding 1/3 octave.

C. Environment: SPL criteria specified herein for the stationary vehicle are based upon measurements taken in an essentially free-field environment, away from any reflective surfaces other than the ballast-and-tie trackbed on which the vehicle is parked and the adjacent flat, clear ground.

D. Subsystems: For acoustical tests and measurements, a subsystem is any mechanism or structure other than the carbody, traction motor, or traction gearbox that performs a function at some time during the operation of the vehicle (e.g., HVAC equipment). Subsystems SPL measurements shall be performed with primary voltage at 750 V dc ± 5 percent, except as specified.

E. Pure Tone or Narrow-band: If the SPL of any 1/3-octave band within the range of 315 to 4,000 Hz exceeds the average of SPLs in the two adjacent 1/3-octave bands by 5 dB or more, that band shall be considered to contain pure tone or narrow-band components.

3.14.2 Requirements for Noise Control

A. Interior SPL along the vehicle longitudinal centerline 4.5 ft above the floor and 2 ft or more from the end walls shall not exceed the following limits:

Condition	Maximum SPL
1. In the open; on dry, level tangent ballast-and-tie track; at any speed up to 60 mi/hr; in any normal mode of acceleration, deceleration, or coasting; with all subsystems operating.	72 dBA
2. Vehicle stationary; in the open; on ballast-and-tie track; with all subsystems except doors operating simultaneously at maximum capacity, including any propulsion subsystem components capable of operating with the vehicle stationary.	68 dBA and 80 dBC

B. Wayside SPL, for the specified test condition, shall not exceed the values shown below for a dependent pair on dry, level tangent track. Measurements shall be made at the indicated distance from the track centerline, 5 ft above top of rail.

Condition	Maximum SPL
All subsystems operating simultaneously, vehicles stationary	60 dBA at 50 ft
Each subsystem alone, vehicles stationary	67 dBA at 15 ft
Dependent pair at 70 mi/hr on ballast-and-tie track	82 dBA (fast) at 50 ft

C. Equipment noise control shall be as follows:

1. SPL produced by either the traction motor or the traction motor and gear reducer assembly prior to installation shall not exceed 92 dBA at 15 ft from the center of the motor while the equipment is operating at any speed from zero to the equivalent of 70 mi/hr vehicle speed, and at loads equivalent to maximum electric braking in either direction. If the traction motor is tested alone, the gear reducer alone shall not create SPLs in excess of 84 dBA at 15 ft in any direction from the center of the gear reducer with the gears rotating in either direction at all speeds from zero to the equivalent of 70 mi/hr vehicle speed, and at loads equivalent to maximum electric braking.

2. SPL produced by the individual operation of subsystem equipment or each complete operating subsystem shall not exceed 67 dBA at 15 ft in any direction from the center of the equipment. Ductwork, baffles, or appurtenances that form a part of the installed assembly shall be included as part of the equipment for SPL tests. With primary power at 900 V dc, the SPL shall not exceed 72 dBA.

3. SPL produced by operation of all side doors on one side of the vehicle shall not exceed 74 dBA (slow) or 80 dBA (fast) at any point within the vehicle 1 ft or more from the doors or door pockets and between 3 and 6 ft above the floor.

4. SPL produced by full or partial application of service braking or service friction braking at speeds from 0 to 15 mi/hr shall not exceed 75 dBA (fast) at 15 ft from the track centerline in the horizontal plane 5 ft above the top of rail.

5. SPL generated by PA equipment in the "Standby" or "Off" condition shall not exceed 40 dBA 1 ft from any loudspeaker when other subsystem equipment is energized.

6. SPL generated by fluorescent lamps, fixtures, and ballasts installed in the vehicle with all fixtures energized at the rated voltage and frequency shall not exceed 45 dBA 1 ft from any lighting fixture.

D. If SPL produced by traction motors, gears, or subsystem equipment contains pure tone or narrow-band components as specified herein, requirements shall be lowered by 3 dBA.

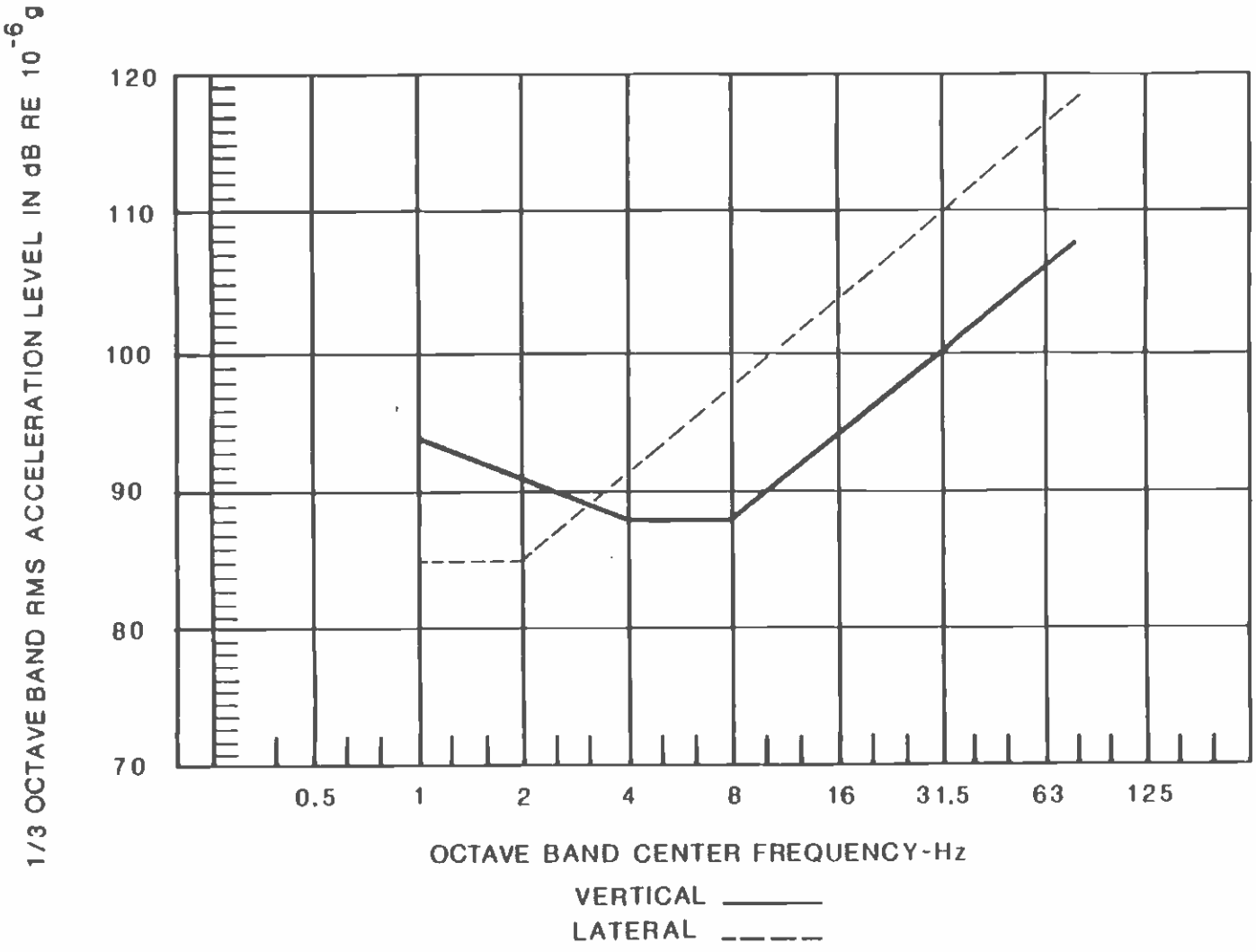
3.15 RIDE QUALITY

3.15.1 Vibration Levels

With vehicle in motion on track complying with track characteristics specified herein, floor structure acceleration on vehicle longitudinal centerline and at midpoint of vehicle shall not exceed the values listed below. Measurements shall be made using 1/3-octave bands. Values shown on Figure TP-3-2 at center of each 1/3-octave band shall apply. If a single discrete frequency component determines the magnitude of vibration within a particular 1/3-octave band, then the limitation shown at the vibratory frequency shall apply.

A. At any steady vehicle speed up to 70 mi/hr on level tangent track, acceleration of vehicle floor in the vertical and lateral axes shall not exceed limits shown on Figure TP-3-2. Steady-state ride quality shall be measured repeatedly or continuously with rms responding instrumentation having integration time or effective averaging time of 1 to 4 sec.

B. During any slow or rapid linear acceleration or deceleration, or at switches or crossovers, maximum vehicle floor structure acceleration shall not exceed 0.15 g rms in any direction when measured to include frequencies from 1 to 30 Hz simultaneously. Average vibration level during any 10 sec period shall not exceed the values shown on Figure TP-3-2.



RIDE QUALITY VIBRATION LEVEL CRITERIA

FIGURE TP-3-2

3.15.2 Body Roll

Body roll shall not cause the vehicle to exceed the dynamic outline indicated under any conditions. Roll rate shall be commensurate with ride quality specified.

3.16 COMPONENT VIBRATION AND SHOCK CRITERIA

Components mounted on the carbody, truck, or axle shall have structural integrity and be operationally reliable over the life of the vehicle in the vibration and shock environment existing at the point of attachment of the component. Components and mounting arrangements shall prevent unacceptable vibration levels at any location in the vehicle.

3.16.1 Vibration and Shock Environment

A. Components mounted on the carbody shall withstand continuous sinusoidal vibrations of 0.4 g rms at any frequency from 1 to 100 Hz in the three major axes, and randomly oriented shock impulses of 3 g peak with a duration of from 4 to 10 msec.

B. Truck frame-mounted components shall withstand, without fatigue or deterioration, the normally occurring random shock and vibration magnitudes present at the support points on the truck frame. These magnitudes shall be considered to be 1 g rms with a crest factor (ratio of peak to rms acceleration level) of 5 within the frequency range from 20 Hz to 10 kHz in all directions, and shocks occurring up to 100 times per operating day of 20 g peak in the vertical axis and 6 g peak in the lateral axis with pulse durations of from 4 to 10 msec.

C. Axle-mounted components shall withstand, as a minimum, continuous random vibrations of 10 g rms within the frequency range of 100 Hz to 10 kHz in all directions and shock pulses of 100 g in each major axis, with durations from 0.5 to 2.0 msec occurring approximately 100 times per operating day.

3.16.2 Vibration Levels

A. The displacement of a traction motor, detached and supported on resilient mounting providing at least 0.25 in. static deflection, shall not exceed 0.0015 in. peak-to-peak at the motor bearing housings and mounting bosses while the motor is rotating at any speed between 50 and 100 percent of the maximum normal operating speed.

B. With the vehicle stationary, with each individual subsystem operating at rated capacity, and with all subsystems operating simultaneously, the vertical or horizontal vibrations of the floor, walls, seat frames, or any surface with which the passengers or train operator can come into contact shall not exceed the following values:

1. Displacement, Peak-to-Peak: 0.10 in.

2. Acceleration, Peak Value: 0.01 g below 20 Hz

3. Velocity, Peak Value: 0.03 in./sec above 20 Hz.

3.17 ELECTROMAGNETIC COMPATIBILITY

3.17.1 Electrical Interference

Design techniques, construction methods, and equipment shall be employed to prevent interference caused by internal sources from affecting proper operation of vehicle subsystems. Balancing, filtering, shielding, modulation techniques, and isolation shall be provided as necessary to maintain signal-to-noise ratios within acceptable limits. Information and test procedures to demonstrate compliance with the requirements specified herein shall be submitted and approved. (CDRL)

A. Electrostatic and magnetic electrical shielding methods shall be employed to minimize the effects of stray signals and transient voltages on low-level interconnecting cables. Power and signal cables shall be physically separated where practical and magnetically shielded where necessary. Transient suppression devices shall be used on electromagnetic components to protect low-level circuits.

B. Components and functional circuits shall be grouped according to their similar sensitivities to electrical interference and power supply needs, and to reduce effects of voltage drops in ground circuits. Power and return leads shall be routed in same raceway or harness. Transient suppression devices shall be used on power supply and input circuits where necessary.

C. In addition to transient suppression devices, resistor-capacitor or other frequency selective filters shall be provided on each input and output of assemblies containing microprocessors or solid-state logic.

3.17.2 Radiated Emission

When measured in accordance with MIL-STD-462 and at a distance of 50 ft from the track centerline, vehicle equipment shall not exceed the following EMI:

A. 109 dB above 1 microV/m/MHz bandwith at 150 kHz to 84 dB above 1 microV/m/MHz bandwidth at 30 MHz (straight line, semilog)

B. 58 dB above 1 microV/m/MHz bandwidth from 30 MHz through 90 MHz

C. 68 dB above 1 microV/m/MHz bandwidth from 90 MHz through 400 MHz.

3.17.3 Conducted Emission (CDRL)

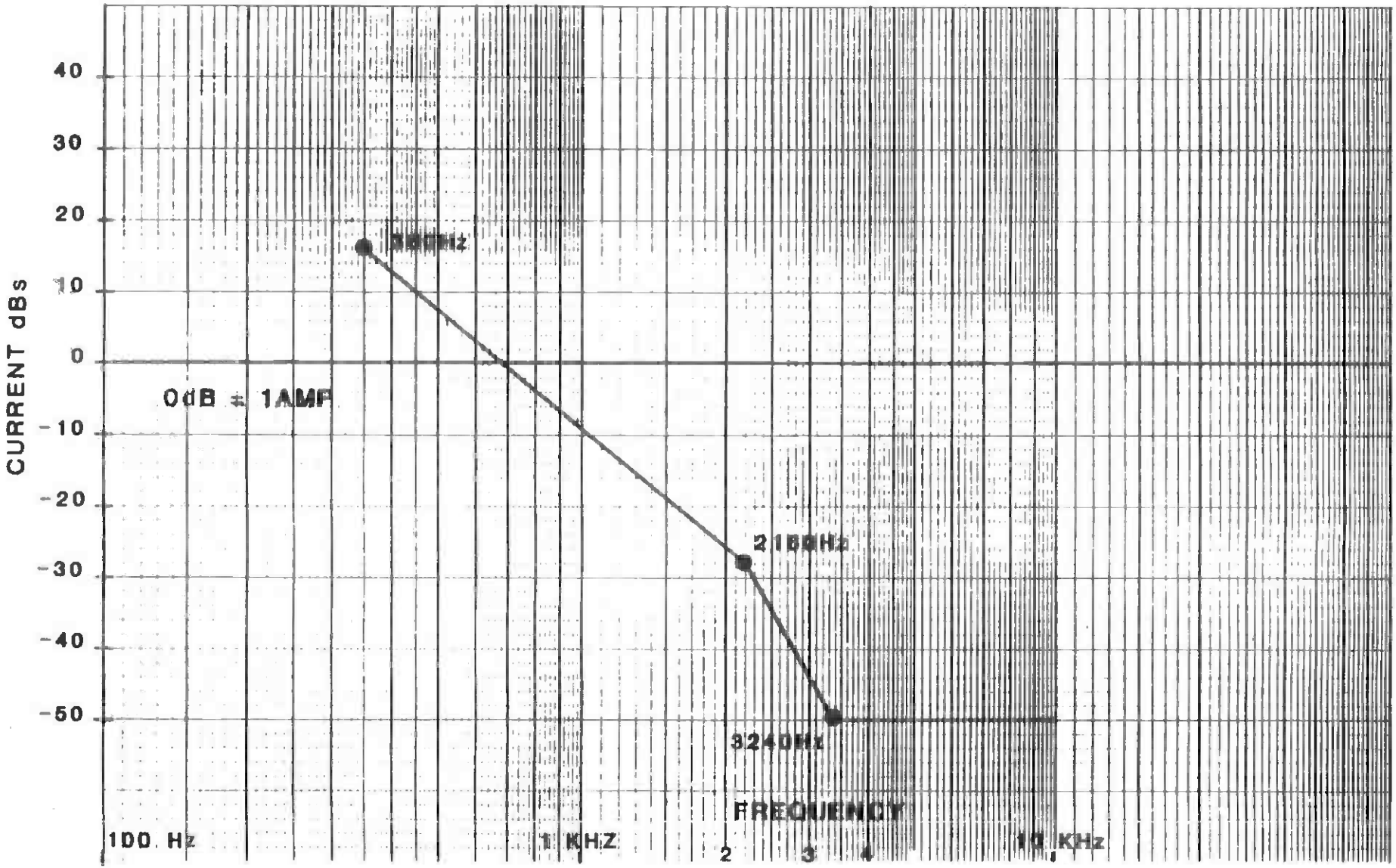
Conducted emissions generated by the chopper (Reference: Section 14) shall not exceed limits shown on Figure TP-3-3. Emissions shall be measured as emitted from the vehicle at a position closest to the substation as a three-pair train accelerates from a station or decelerates into a station. Deceleration shall be caused by electric braking regenerating into a fully receptive rail. Worst case shall be determined by analysis. Analyses and test results shall demonstrate the functional capability of the various subsystems, as well as compatibility of the total vehicle to operate within its operating environment without either suffering or causing harmful interference because of conducted voltages and currents.

3.18 SUBMITTAL REQUIREMENTS (CDRL)

Submit the following performance calculations, curves, and tabular values for each vehicle of three-dependent-pair trains or as specified.

3.18.1 Run Time and Energy Consumption Versus Distance

Curves and tables of kWh per vehicle (motoring energy only) versus distance, and run times versus distance for runs of 0.25 to 3 mi on open, level tangent track in still air, for AW0, AW2, and AW3 trains operating at PL-1 and PL-4.



ALLOWABLE SINGLE-VEHICLE CHOPPER HARMONICS
FIGURE TP-3-3

3.18.2 Speed and Time Versus Distance

A. Curves and tables of speed and time versus distance for a 3-mi motoring-only run on open, level tangent track in still air, for AW0 and AW2 trains at PL-1.

B. Curves and tables of speed and time versus distance for each interstation run (Reference: Appendix TP-3-A) in the tunnel for AW0 and AW2 trains at PL-1, PL-2, and PL-3. Interstation braking rate shall be 2.2 mi/hr/sec. Station braking rate shall be 2.0 mi/hr/sec.

C. Tables of speed, time, tractive effort, line and motor current, power consumption at the train, and power dissipation on each vehicle versus distance for each interstation run in the tunnel for AW0 and AW2 trains at PL-1, PL-2, and PL-3, and 0, 50, and 100 percent line receptivity.

3.18.3 Current Versus Time

Curves and tables of line current at the vehicle versus time for a 3-mi motoring-only run for AW0, AW1, AW2, and AW3 trains.

3.18.4 Motor Characteristic Curves

Curves and tables of both speed versus current and tractive effort versus current, showing the traction motor characteristics, including inefficiencies, using 650, 750, and 900 V dc primary voltages. Operating points for AW0 and AW2 vehicles with new and fully worn wheels at PL-1 and PL-4 shall be identified on each curve.

3.18.5 Regenerative Current and Power Versus Speed

Curves and tables of regenerative current, power to the contact rail, and power that is dissipated within each vehicle versus speed. Data shall be developed for AW0 and AW2 vehicles operating over the range of 70 to 0 mi/hr with braking rates of 1.0, 2.0, and 3.0 mi/hr/sec. Vehicles shall be operating on open, level tangent track in still air using primary voltages of 650, 750, and 900 V dc. Line receptivity at 650 and 750 V dc shall be 100 percent and at 900 V dc shall be 50 and 0 percent.

3.18.6 Operating Speed Versus Equipment Availability

Table of maximum available operating speeds for a one-way trip from terminal station to terminal station and for one round trip (Reference: Appendix TP-3-A) by a single-pair consist and a three-pair consist when traction equipment availability is limited. The traction equipment shall not be operational in braking or motoring on one vehicle of the single-pair consist, and on two vehicles of the three-pair consists. Consists shall be AW0 plus 20,790 lb per vehicle. Other general conditions shall be as specified for thermal capacity, except operation may be in MTO mode.

END OF SECTION

APPENDIX TP-3-A

TRACK PROFILE DATA

2 LIST OF ABBREVIATIONS AND SYMBOLS 2

AL	Left Track - Line A (North Hollywood - Union Station)
AR	Right Track - Line A (Union Station - North Hollywood)
BC	Begin Curve
CS	Curve to Spiral
L	Curve to Left
MAS	Maximum Authorized (Train Control Command) Speed
PC	Point of Change from Tangent to Circular Curve
POB	Point of Beginning
POC	Point on Curve
POT	Point on Tangent
PS	Point of Switch
PT	Point of Change from Circular Curve to Tangent
PVC	Begin Vertical Curve
PVI	Point of Vertical Intersection
PVT	End Vertical Curve
R	Curve to Right
SC	Spiral to Curve
SE	Superelevation (Actual only; unbalanced not included)
ST	Spiral to Tangent
*STA EQ BK	Station Equation Backward
*STA EQ AHD	Station Equation Ahead
TC	Tangent to Curve
TS	Tangent to Spiral, or Tangent Length of Circular Curve
2 --	ATP Block Boundary 2

* Station numbering has been changed to account for changes in track alignment without revising the entire route stationing.

HORIZONTAL AND VERTICAL
CONTROL ELEMENTS
AR TRACK

STATION NAME OR CONTROL POINT	STATIONING (ft)	MAS (mi/hr)	GRADE (%)	RADIUS CURVE (ft)	S.E. (in.)
UNION STATION*	103+00.95	45	-0.30	0	
UNION STATION	107+50.95	45	-0.30	0	
PS NO. 10 TO X-OVER	108+25.95	45	-0.30	0	
PS NO. 10 TO X-OVER	112+10.89	45	-0.30	0	
TS 1100	112+99.94	45	-0.30	0	
SC 1100	115+19.94	45	-0.30	1000.00L	4
PVC	118+85.00	45	-0.30	1000.00L	4
PVI	119+65.00	45	1.25	1000.00L	4
PVT	120+45.00	45	1.25	1000.00L	4
CS 1100	121+72.71	45	1.25	1000.00L	4
ST 1100	123+92.71	45	1.25	0	
TS 1120	127+81.69	45	1.25	0	
	128+90.00	--			
SC 1120	130+21.69	55	1.25	2000.00L	3.50
	134+90.00	--			
		45			
CS 1120	142+95.94	45	1.25	2000.00L	3.50
PVC	144+58.00	45	1.25	(6158.58L)	(1.14)
ST 1120	145+35.94	45	1.25	0	
PVI	145+48.00	45	-1.00	0	
PVT	146+38.00	45	-1.00	0	
CIVIC CENTER STATION	147+13.00	45	-1.00	0	
CIVIC CENTER STATION	151+63.00	45	-1.00	0	
PVC	151+63.00	45	-1.00	0	
PC 1130	152+28.83	45	-1.00	35000.00L	0
PVI	152+78.00	45	-3.99	35000.00L	0

*(TERMINAL STATION)

HORIZONTAL AND VERTICAL
CONTROL ELEMENTS
AR TRACK

STATION NAME OR CONTROL POINT	STATIONING (ft)	MAS (mi/hr)	GRADE (%)	RADIUS CURVE (ft)	S.E. (in.)
PVT	153+93.00	45	-3.99	35000.00L	0
PT 1130	154+30.75	45	-3.99	35000.00L	0
	158+43.00	--			
		55			
PVC	160+68.85	55	-3.99	0	
PVI	162+18.85	55	-0.30	0	
PVT	163+68.85	55	-0.30	0	
	165+50.00	--			
		45			
5TH/HILL STATION	171+38.83	45	-0.30	0	
5TH/HILL STATION	175+88.83	45	-0.30	0	
PVC	176+45.44	45	-0.30	0	
PVI	178+55.44	45	-3.99	0	
PVT	179+65.44	45	-3.99	0	
TS 1200	179+68.60	45	-3.99	0	
SC 1200	182+18.60	45	-3.99	960.00R	4
PVC	184+92.44	45	-3.99	960.00R	4
PVI	186+52.44	45	3.00	960.00R	4
PVT	188+12.44	45	3.00	960.00R	4
CS 1200	194+74.87	45	3.00	960.00R	4
PVC	196+75.76	45	3.00	(4886.99R)	(0.79)
ST 1200	197+24.87	45	3.00	0	
	198+15.00	--			
PVI	198+25.76	40	0.00	0	
STA EQ BK =	199+37.80	40	0.00	0	
STA EQ AHD	199+22.04	40	0.00	0	
PVT	199+60.00	40	0.00	0	
7TH/FLOWER STATION	200+13.04	40	0.00	0	
7TH/FLOWER STATION	204+63.04	40	0.00	0	
TS 1250	204+64.41	40	0.00	0	
SC 1250	206+54.41	40	0.00	1000.00L	4
PVC	207+77.00	40	0.00	1000.00L	4
CS 1250	207+87.44	40	0.00	1000.00L	4
PVI	209+27.00	40	-3.00	(3766.85L)	(1.06)

HORIZONTAL AND VERTICAL
CONTROL ELEMENTS
AR TRACK

STATION NAME OR CONTROL POINT	STATIONING (ft)	MAS (mi/hr)	GRADE (%)	RADIUS CURVE (ft)	S.E. (in.)
ST 1250	209+77.44	40	-3.00	0	
PC 1260	210+71.20	40	-3.00	11000.00R	0
PVT	210+77.00	40	-3.00	11000.00R	0
PVC	212+47.00	40	-3.00	11000.00R	0
	214+27.07	--			
PVI	214+72.00	55	1.00	11000.00R	0
PVT	216+97.00	55	1.00	11000.00R	0
PT 1260	228+55.08	55	1.00	11000.00R	0
STA EQ BK =	228+55.08	55	1.00	0	
STA EQ AHD	228+54.47	55	1.00	0	
TS 1310	245+19.48	55	1.00	0	
SC 1310	247+79.48	55	1.00	1650.00R	4
PVC	248+75.00	55	1.00	1650.00R	4
CS 1310	248+75.99	55	1.00	1650.00R	4
PVI	250+00.00	55	-1.00	(3154.64R)	(2.09)
PVT	251+25.00	55	-1.00	(39035.49R)	(0.17)
ST 1310	251+35.99	55	-1.00	0	
	254+51.00	--			
PS NO. 10 TO X-OVER	254+77.97	45	-1.00	0	
PS NO. 10 TO X-OVER	258+39.24	45	-1.00	0	
WILSHIRE/ALVARADO STA.	259+14.24	45	-1.00	0	
WILSHIRE/ALVARADO STA.	263+64.24	45	-1.00	0	
	263+94.00	--			
PVC	264+50.00	55	-1.00	0	
PVI	265+75.00	55	-3.00	0	
PVT	267+00.00	55	-3.00	0	
PVC	269+59.50	55	-3.00	0	
PVI	271+34.50	55	-1.00	0	
PVT	273+09.50	55	-1.00	0	
TS 1320	273+24.37	55	-1.00	0	
SC 1320	276+64.37	55	-1.00	2500.00L	4
CS 1320	278+64.66	55	-1.00	2500.00L	4
ST 1320	282+04.66	55	-1.00	0	
TS 1380	287+94.44	55	-1.00	0	
SC 1380	290+04.44	55	-1.00	4800.00R	2.50
CS 1380	291+09.81	55	-1.00	4800.00R	2.50
ST 1380	293+19.81	55	-1.00	0	

HORIZONTAL AND VERTICAL
CONTROL ELEMENTS
AR TRACK

STATION NAME OR CONTROL POINT	STATIONING (ft)	MAS (mi/hr)	GRADE (%)	RADIUS CURVE (ft)	S.E. (in.)
TS 1390	294+45.13	55	-1.00	0	
PVC	297+11.00	55	-1.00	(2110.05L)	(3.22)
SC 1390	297+75.13	55	-1.00	1700.00L	4
PVI	299+11.00	55	3.00	1700.00L	4
PVT	301+11.00	55	3.00	1700.00L	4
CS 1390	303+75.48	55	3.00	1700.00L	4
PVC	306+18.00	55	3.00	(6412.89L)	(1.06)
ST 1390	307+05.48	55	3.00	0	
	307+60.00	--			
PVI	307+93.00	45	-0.30	0	
PVT	309+68.00	45	-0.30	0	
WILSHIRE/VERMONT STA.	314+11.68	45	-0.30	0	
WILSHIRE/VERMONT STA.	318+61.68	45	-0.30	0	
PVC	318+68.00	45	-0.30	0	
PVI	319+73.00	45	-3.77	0	
PVT	320+73.00	45	-3.77	0	
TS 1410	325+99.79	45	-3.77	0	
SC 1410	328+19.79	45	-3.77	1000.00L	4
CS 1410	331+84.47	45	-3.77	1000.00L	4
ST 1410	334+04.47	45	-3.77	0	
TS 1420	334+10.76	45	-3.77	0	
PVC	335+69.61	45	-3.77	(1384.95)	(2.89)
SC 1420	336+30.76	45	-3.77	1000.00R	4
PVI	336+39.61	45	3.77	1000.00R	4
PVT	339+09.61	45	3.77	1000.00R	4
CS 1420	339+72.90	45	3.77	1000.00R	4
ST 1420	341+92.90	45	3.77	0	
PVC	344+07.00	45	3.77	0	
PVI	344+85.00	45	0.30	0	
PVT	345+63.00	45	0.30	0	
WILSHIRE/NORMANDIE STA.	345+69.90	45	0.30	0	
WILSHIRE/NORMANDIE STA.	350+19.90	45	0.30	0	
	350+50.00	--			
PVC	350+93.00	55	0.30	0	
PVI	351+43.00	55	-0.89	0	
PVT	351+93.00	55	-0.89	0	

HORIZONTAL AND VERTICAL
CONTROL ELEMENTS
AR TRACK

STATION NAME OR CONTROL POINT	STATIONING (ft)	MAS (mi/hr)	GRADE (%)	RADIUS CURVE (ft)	S.E. (in.)
	362+77.00	--			
PVC	365+70.00	45	-0.89	0	
PVI	366+50.00	45	-0.50	0	
PVT	367+30.00	45	-0.50	0	
WILSHIRE/WESTERN STA.	368+11.14	45	-0.50	0	
WILSHIRE/WESTERN STA.	372+61.14	45	-0.50	0	
	372+91.00	--			
PC 1430	373+78.27	55	-0.50	25000.00R	0
PT 1430	374+51.36	55	-0.50	25000.00R	0
PVC	376+72.00	55	-0.50	0	
PVI	377+72.00	55	0.30	0	
PVT	378+72.00	55	0.30	0	
TS 1440	391+85.64	55	0.30	0	
SC 1440	392+85.64	55	0.30	7500.00R	1
CS 1440	394+12.75	55	0.30	7500.00R	1
	394+52.00	--			
ST 1440	395+12.75	45	0.30	0	
STA EQ BK =	395+12.75	45	0.30	0	
STA EQ AHD	395+12.71	45	0.30	0	
PS NO. 10 TO X-OVER	395+87.72	45	0.30	0	
PS NO. 10 TO X-OVER	399+49.00	45	0.30	0	
WILSHIRE/CRENSHAW STA.	400+24.00	45	0.30	0	
WILSHIRE/CRENSHAW STA.	404+74.00	45	0.30	0	
	405+04.00	--			
PVC	420+60.00	55	0.30	0	
PVI	421+50.00	55	-0.30	0	
PVT	422+40.00	--	-0.30	0	
PC 1460	433+27.72	70	-0.30	80000.00L	0
PT 1460	435+51.51	70	-0.30	80000.00L	0
	452+63.00	--			

HORIZONTAL AND VERTICAL
CONTROL ELEMENTS
AR TRACK

STATION NAME OR CONTROL POINT	STATIONING (ft)	MAS (mi/hr)	GRADE (%)	RADIUS CURVE (ft)	S.E. (in.)
PVC	465+16.66	55	-0.30	0	
PVI	466+16.66	55	0.56	0	
PVT	467+16.66	55	0.56	0	
	469+17.00	--			
PVC	471+80.00	45	0.56	0	
PVI	472+80.00	45	-0.50	0	
PVT	473+80.00	45	-0.50	0	
WILSHIRE/LA BREA STA.	475+01.49	45	-0.50	0	
WILSHIRE/LA BREA STA.	479+51.49	45	-0.50	0	
	479+81.00	--			
STA EQ BK =	480+05.49	55	-0.50	0	
STA EQ AHD	480+05.62	55	-0.50	0	
PVC	483+05.00	55	-0.50	0	
PVI	484+45.00	55	-1.50	0	
PVT	485+85.00	55	-1.50	0	
PC 1470	489+27.04	55	-1.50	10000.00L	0
PT 1470	495+02.30	55	-1.50	10000.00L	0
PC 1480	496+02.37	55	-1.50	10000.00R	0
PVC	498+66.00	55	-1.50	10000.00R	0
PVI	500+01.00	55	-0.50	10000.00R	0
PVT	501+36.00	55	-0.50	10000.00R	0
PT 1480	501+77.61	55	-0.50	10000.00R	0
	504+00.00	--			
TS 1500	516+36.75	40	-0.50	0	
SC 1500	518+36.75	40	-0.50	900.00R	4
PVC	520+31.00	40	-0.50	900.00R	4
PVI	520+91.00	40	-0.30	900.00R	4
PVT	521+51.00	40	-0.30	900.00R	4
CS 1500	523+37.73	40	-0.30	900.00R	4
	524+23.00	--			
ST 1500	525+37.73	25	-0.30	0	
WILSHIRE/FAIRFAX STA.	525+37.73	25	-0.30	0	
WILSHIRE/FAIRFAX STA.	529+87.73	25	-0.30	0	

HORIZONTAL AND VERTICAL
CONTROL ELEMENTS
AR TRACK

STATION NAME OR CONTROL POINT	STATIONING (ft)	MAS (mi/hr)	GRADE (%)	RADIUS CURVE (ft)	S.E. (in.)
PC 1510	530+61.89	25	-0.30	1300.00R	0
PT 1510	531+26.84	25	-0.30	1300.00R	0
	531+27.00	--			
TS 1550	531+52.01	45	-0.30	0	
SC 1550	533+72.01	45	-0.30	1000.00R	4
CS 1550	542+65.59	45	-0.30	1000.00R	4
ST 1550	544+85.59	45	-0.30	0	
TS 1600	547+32.89	45	-0.30	0	
PVC	549+21.00	45	-0.30	(1169.53L)	(3.42)
SC 1600	549+52.89	45	-0.30	1000.00L	4
PVI	550+21.00	45	2.79	1000.00L	4
PVT	551+21.00	45	2.79	1000.00L	4
CS 1600	551+30.71	45	2.79	1000.00L	4
ST 1600	553+50.71	45	2.79	0	
PVC	561+92.74	45	2.79	0	
PVI	562+92.74	45	0.30	0	
PVT	563+92.74	45	0.30	0	
STA EQ BK =	564+46.49	45	0.30	0	
STA EQ AHD	563+64.40	45	0.30	0	
PS NO. 10 TO X-OVER	563+83.32	45	0.30	0	
PS NO. 10 TO X-OVER	567+44.60	45	0.30	0	
FAIRFAX/BEVERLY STA.	568+19.60	45	0.30	0	
FAIRFAX/BEVERLY STA.	572+69.60	45	0.30	0	
STA EQ BK =	573+23.60	45	0.30	0	
STA EQ AHD	573+23.94	45	0.30	0	
TS 1620	573+54.26	45	0.30	0	
PVC	574+86.00	45	0.30	(6057.39L)	(2.04)
SC 1620	575+64.26	45	0.30	3800.00L	3.25
PVI	575+71.00	45	1.49	3800.00L	3.25
PVT	576+56.00	--	1.49	3800.00L	3.25
CS 1620	577+73.20	55	1.49	3800.00L	3.25
ST 1620	579+83.20	55	1.49	0	
TS 1630	581+65.28	55	1.49	0	
SC 1630	584+05.28	55	1.49	3800.00R	3.25
CS 1630	585+80.26	55	1.49	3800.00R	3.25
ST 1630	588+20.26	55	1.49	0	

HORIZONTAL AND VERTICAL
CONTROL ELEMENTS
AR TRACK

STATION NAME OR CONTROL POINT	STATIONING (ft)	MAS (mi/hr)	GRADE (%)	RADIUS CURVE (ft)	S.E. (in.)
PVC	609+81.00	55	1.49	0	
PVI	611+11.00	55	3.00	0	
PVT	612+41.00	55	3.00	0	
	618+05.00	--			
PVC	618+24.00	45	3.00	0	
PVI	620+24.00	45	0.00	0	
PVT	622+24.00	45	0.00	0	
FAIRFAX/SANTA MONICA STA.	624+45.35	45	0.00	0	
FAIRFAX/SANTA MONICA STA.	628+95.35	45	0.00	0	
	629+25.00	--			
PVC	630+11.00	55	0.00	0	
PVI	631+61.00	55	1.50	0	
PVT	633+11.00	55	1.50	0	
TS 1650	634+91.31	55	1.50	0	
SC 1650	638+21.31	55	1.50	1700.00R	4
CS 1650	661+83.12	55	1.50	1700.00R	4
ST 1650	665+13.12	55	1.50	0	
PVC	684+61.00	55	1.50	0	
PVI	685+81.00	55	0.00	0	
PVT	687+01.00	55	0.00	0	
	689+75.00	--			
		45			
LA BREA/SUNSET STA.	695+44.04	45	0.00	0	
LA BREA/SUNSET STA.	699+94.04	45	0.00	0	
	700+24.00	--			
PC 1680	700+71.28	55	0.00	15500.00L	0
PT 1680	702+83.01	55	0.00	15500.00L	0
PVC	703+61.50	55	0.00	0	
PC 1700	705+25.24	55	0.00	38000.00R	0
PVI	705+33.50	55	-1.62	38000.00R	0
PT 1700	706+29.05	55	-1.62	38000.00R	0
PVT	707+05.50	55	-1.62	0	

HORIZONTAL AND VERTICAL
CONTROL ELEMENTS
AR TRACK

STATION NAME OR CONTROL POINT	STATIONING (ft)	MAS (mi/hr)	GRADE (%)	RADIUS CURVE (ft)	S.E. (in.)
PVC	711+16.00	55	-1.62	0	
PVI	712+36.00	55	0.60	0	
PVT	713+56.00	55	0.60	0	
	719+16.00	--			
TS 1710	730+01.09	40	0.60	0	
SC 1710	731+89.09	40	0.60	1000.00L	4
PVC	733+50.00	40	0.60	1000.00L	4
PVI	734+40.00	40	2.84	1000.00L	4
PVT	735+30.00	40	2.84	1000.00L	4
PVC	744+20.00	40	2.84	1000.00L	4
CS 1710	745+06.76	40	2.84	1000.00L	4
PVI	745+10.00	40	0.30	(1017.54L)	(3.93)
PVT	746+00.00	40	0.30	(1983.96L)	(2.02)
ST 1710	746+94.76	40	0.30	0	
	747+53.00	--			
HOLLYWOOD/CAHUENGA STA.	747+83.05	45	0.30	0	
HOLLYWOOD/CAHUENGA STA.	752+33.05	45	0.30	0	
PS NO. 10 TO POCKET TRK	753+06.48	45	0.30	0	
TS 1720	755+30.30	45	0.30	0	
SC 1720	757+32.05	45	0.30	2238.83L	3
CS 1720	759+40.75	45	0.30	2238.83L	3
ST 1720	761+42.50	45	0.30	0	
PS NO. 10 TO POCKET TRK	763+66.31	45	0.30	0	
STA EQ BK =	763+85.23	45	0.30	0	
STA EQ AHD	763+85.64	45	0.30	0	
PVC	763+96.61	45	0.30	0	
PVI	765+46.61	45	3.87	0	
PVT	766+96.61	45	3.87	0	
TS 1730	767+53.65	45	3.87	0	
SC 1730	769+73.65	45	3.87	1000.00L	4
CS 1730	775+23.71	45	3.87	1000.00L	4
ST 1730	777+43.71	45	3.87	0	
STA EQ BK =	777+47.93	45	3.87	0	
STA EQ AHD	779+03.55	45	3.87	0	

HORIZONTAL AND VERTICAL
CONTROL ELEMENTS
AR TRACK

STATION NAME OR CONTROL POINT	STATIONING (ft)	MAS (mi/hr)	GRADE (%)	RADIUS CURVE (ft)	S.E. (in.)
TS 1740	791+80.81	45	3.87	0	
PVC	794+39.00	45	3.87	(5112.51R)	(1.17)
SC 1740	795+10.81	45	3.87	4000.00R	1.50
CS 1740	795+27.94	45	3.87	4000.00R	1.50
PVI	796+49.00	45	0.30	(6317.60R)	(0.95)
ST 1740	798+57.94	45	0.30	0	
PVT	798+59.00	45	0.30	0	
(HOLLYWOOD BOWL STA.)	799+39.22	45	0.30	0	
(HOLLYWOOD BOWL STA.)	803+89.22	45	0.30	0	
	804+19.00	--			
PVC	805+80.00	70	0.30	0	
PVI	807+00.00	70	1.00	0	
PVT	808+20.00	70	1.00	0	
PVC	869+86.19	70	1.00	0	
PVI	871+26.19	70	-0.30	0	
PVT	872+66.19	70	-0.30	0	
	891+52.00	--			
TS 1800	904+05.85	55	-0.30	0	
SC 1800	907+05.85	55	-0.30	1800.00R	4
CS 1800	924+89.18	55	-0.30	1800.00R	4
	925+86.00	--			
ST 1800	927+89.18	45	-0.30	0	
STA EQ BK =	927+89.18	45	-0.30	0	
STA EQ AHD	927+89.35	45	-0.30	0	

HORIZONTAL AND VERTICAL
CONTROL ELEMENTS
AR TRACK

STATION NAME OR CONTROL POINT	STATIONING (ft)	MAS (mi/hr)	GRADE (%)	RADIUS CURVE (ft)	S.E. (in.)
UNIVERSAL CITY STA.	931+45.26	45	-0.30	0	
UNIVERSAL CITY STA.	935+95.26	45	-0.30	0	
TS 1810	936+70.26	45	-0.30	0	
PVC	937+52.00	45	-0.30	(2960.61L)	(1.49)
PVI	938+37.00	45	-0.97	(1451.36L)	(3.03)
SC 1810	938+90.26	45	-0.97	1100.00L	4
PVT	939+22.00	45	-0.97	1100.00L	4
CS 1810	940+65.81	45	-0.97	1100.00L	4
ST 1810	942+85.81	45	-0.97	0	
	942+86.00	--			
TS 1820	945+76.95	55	-0.97	0	
SC 1820	948+76.95	55	-0.97	1800.00L	4
PVC	950+00.00	55	-0.97	1800.00L	4
PVI	951+00.00	55	0.30	1800.00L	4
PVT	952+00.00	55	0.30	1800.00L	4
CS 1820	954+03.78	55	0.30	1800.00L	4
ST 1820	957+03.78	55	0.30	0	
STA EQ BK =	957+03.78	55	0.30	0	
STA EQ AHD	958+08.00	55	0.30	0	
	958+60.00	--			
		70			
	992+17.00	--			
		55			
PVC	1001+70.00	55	0.30	0	
PVI	1003+00.00	55	2.00	0	
PVT	1004+30.00	55	2.00	0	
	1037+50.00	--			
PVC	1038+09.00	45	2.00	0	
PVI	1039+39.00	45	0.30	0	
PVT	1040+69.00	45	0.30	0	

HORIZONTAL AND VERTICAL
CONTROL ELEMENTS
AR TRACK

STATION NAME OR CONTROL POINT	STATIONING (ft)	MAS (mi/hr)	GRADE (%)	RADIUS CURVE (ft)	S.E. (in.)
	1043+41.00	--			
PS NO. 10 TO X-OVER	1043+68.23	25	0.30	0	
PS NO. 10 TO X-OVER	1047+29.51	25	0.30	0	
	1047+37.00	--			
NORTH HOLLYWOOD STA.*	1048+04.51	9	0.30	0	
NORTH HOLLYWOOD STA.	1052+54.51	9	0.30	0	

*(TERMINAL STATION)

HORIZONTAL AND VERTICAL
CONTROL ELEMENTS
AL TRACK

STATION NAME OR CONTROL POINT	STATIONING (ft)	MAS (mi/hr)	GRADE (%)	RADIUS CURVE (ft)	S.E. (in.)
NORTH HOLLYWOOD STA.*	1052+54.51	45	0.30	0	
NORTH HOLLYWOOD STA.	1048+04.51	45	0.30	0	
	1047+37.00	--			
PS NO. 10 TO X-OVER	1047+29.51	55	0.30	0	
PS NO. 10 TO X-OVER	1043+68.23	55	0.30	0	
PVT	1040+69.00	55	0.30	0	
PVI	1039+39.00	55	0.30	0	
PVC	1038+09.00	--	2.00	0	
		70			
	1016+25.00	--			
PVT	1004+30.00	55	2.00	0	
PVI	1003+00.00	55	2.00	0	
PVC	1001+70.00	--	0.30	0	
		70			
	970+50.00	--			
PVT	958+97.16	55	0.30	0	
STA EQ AHD	958+08.00	55	0.30	0	
STA EQ BK =	956+75.17	55	0.30	0	
PVI	956+64.33	55	0.30	0	
ST 2820	956+64.33	55	0.32	0	
PVC	955+64.33	55	0.32	(5400.00L)	(1.33)
CS 2820	953+64.33	55	0.32	1800.00L	4
	952+22.00	--			
PVT	952+00.00	45	0.32	1800.00L	4
PVI	951+00.00	45	0.32	1800.00L	4
PVC	950+00.00	45	-0.97	1800.00L	4
SC 2820	948+37.51	45	-0.97	1800.00L	4
TS 2820	945+37.51	45	-0.97	0	

*(TERMINAL STATION)

HORIZONTAL AND VERTICAL
CONTROL ELEMENTS
AL TRACK

STATION NAME OR CONTROL POINT	STATIONING (ft)	MAS (mi/hr)	GRADE (%)	RADIUS CURVE (ft)	S.E. (in.)
ST 2810	943+03.85	45	-0.97	0	
CS 2810	940+83.85	45	-0.97	11.00L	4
PVT	939+22.00	45	-0.97	1100.00L	4
SC 2810	939+08.30	45	-0.97	1100.00L	4
PVI	938+37.00	45	-0.97	(1627.44L)	(2.70)
PVC	937+52.00	45	-0.30	(3799.06L)	(1.16)
TS 2810	936+88.30	45	-0.30	0	
UNIVERSAL CITY STATION	935+95.26	45	-0.30	0	
UNIVERSAL CITY STATION	931+45.26	45	-0.30	0	
	931+15.00	--			
STA EQ AHD	927+89.35	55	-0.30	0	
STA EQ BK =	928+41.30	55	-0.30	0	
ST 2800	928+29.84	55	-0.30	0	
CS 2800	925+29.84	55	-0.30	1840.00R	4
PVT	920+90.21	55	-0.30	1840.00R	4
PVI	920+00.21	55	-0.30	1840.00R	4
PVC	919+10.21	55	-0.29	1840.00R	4
SC 2800	907+00.22	55	-0.29	1840.00R	4
PVT	904+90.22	55	-0.29	(6133.33R)	(1.20)
TS 2800	904+00.22	55	-0.29	0	
PVI	904+00.22	55	-0.29	0	
	904+00.00	--			
PVC	903+10.22	70	-0.30	0	
PVT	872+66.19	70	-0.30	0	
PVI	871+26.19	70	-0.30	0	
PVC	869+86.19	70	1.00	0	
STA EQ AHD	860+74.54	70	1.00	0	
STA EQ BK =	860+74.58	70	1.00	0	
PT 2780	860+74.58	70	1.00	40000.00R	0
PC 2780	857+25.52	70	1.00	40000.00R	0
PT 2760	847+94.96	70	1.00	40000.00L	0
PC 2760	844+45.90	70	1.00	40000.00L	0

HORIZONTAL AND VERTICAL
CONTROL ELEMENTS
AL TRACK

STATION NAME OR CONTROL POINT	STATIONING (ft)	MAS (mi/hr)	GRADE (%)	RADIUS CURVE (ft)	S.E. (in.)
	818+57.00	--			
PVT	808+20.00	45	1.00	0	
PVI	807+00.00	45	1.00	0	
PVC	805+80.00	45	0.30	0	
HOLLYWOOD BOWL STA.	803+89.22	45	0.30	0	
HOLLYWOOD BOWL STA.	799+39.22	45	0.30	0	
STA EQ AHD	798+57.94	45	0.30	0	
STA EQ BK =	798+61.79	45	0.30	0	
PVT	798+58.33	45	0.30	0	
ST 2740	797+31.27	45	0.30	0	
PVI	796+48.33	45	3.87	(15915.12R)	(0.38)
PVC	794+38.33	45	3.87	(4506.04R)	(1.33)
CS 2740	794+01.27	45	3.87	4000.00R	1.50
SC 2740	793+84.14	45	3.87	4000.00R	1.50
TS 2740	790+54.14	45	3.87	0	
PVT	780+03.55	45	3.87	0	
STA EQ AHD	779+03.55	45	3.87	0	
STA EQ BK =	777+11.93	45	3.87	0	
PVI	777+11.93	45	3.87	0	
ST 2730	777+11.93	45	3.99	0	
PVC	776+11.93	45	3.99	(2200.00L)	(1.82)
CS 2730	774+91.93	45	3.99	1000.00L	4
SC 2730	769+41.88	45	3.99	1000.00L	4
TS 2730	767+21.88	45	3.99	0	
PVT	766+96.61	45	3.99	0	
PVI	765+46.61	45	3.99	0	
PVC	763+96.61	45	0.30	0	
STA EQ AHD	763+85.64	45	0.30	0	
STA EQ BK =	763+78.11	45	0.30	0	
PS NO. 10 TO POCKET TRACK	763+59.20	45	0.30	0	
ST 2720	761+34.51	45	0.30	0	
CS 2720	759+34.51	45	0.30	2200.00L	3
SC 2720	757+31.17	45	0.30	2200.00L	3
TS 2720	755+31.17	45	0.30	0	
PS NO. 10 TO POCKET TRACK	753+06.48	45	0.30	0	
	752+99.00	--			
HOLLYWOOD/CAHUENGA STA.	752+33.05	40	0.30	0	

HORIZONTAL AND VERTICAL
CONTROL ELEMENTS
AL TRACK

STATION NAME OR CONTROL POINT	STATIONING (ft)	MAS (mi/hr)	GRADE (%)	RADIUS CURVE (ft)	S.E. (in.)
HOLLYWOOD/CAHUENGA STA.	747+83.05	40	0.30	0	
STA EQ AHD	746+94.82	40	0.30	0	
STA EQ BK =	746+36.24	40	0.30	0	
ST 2710	746+36.24	40	0.30	0	
PVT	745+57.75	40	0.30	(2302.20L)	(1.67)
PVI	744+64.75	40	0.30	(1053.71L)	(3.65)
CS 2710	744+48.24	40	2.87	961.17L	4
PVC	743+71.75	40	2.87	961.17L	4
PVT	734+88.00	40	2.87	961.17L	4
PVI	733+98.00	40	2.87	961.17L	4
PVC	733+08.00	40	0.60	961.17L	4
SC 2710	731+89.04	40	0.60	9861.17L	4
TS 2710	730+01.04	40	0.60	0	
	730+01.00	--			
PVT	713+56.00	55	0.60	0	
PVI	712+36.00	55	0.60	0	
PVC	711+16.00	55	-1.62	0	
	707+00.00	--			
PVT	707+08.92	45	-1.62	0	
STA EQ AHD	706+29.05	45	-1.62	0	
STA EQ BK =	706+28.63	45	-1.62	0	
PT 2700	706+28.63	45	-1.62	38038.83R	0
PVI	705+33.50	45	-1.62	38038.83R	0
PC 2700	705+24.71	45	0.00	38038.83R	0
PVC	703+58.50	45	0.00	0	
PT 2680	702+82.48	45	0.00	15461.17L	0
PC 2680	701+71.28	45	0.00	15461.17L	0
LA BREA/SUNSET STA.	699+94.04	45	0.00	0	
LA BREA/SUNSET STA.	695+44.04	45	0.00	0	
	695+14.00	--			
PVT	687+01.00	55	0.00	0	
PVI	685+81.00	55	0.00	0	
PVC	684+61.00	--	1.48	0	
		70			
	679+29.00	--			
STA EQ AHD	665+13.12	55	1.48	0	
STA EQ BK =	665+74.72	55	1.48	0	
ST 2650	665+74.66	55	1.48	0	

HORIZONTAL AND VERTICAL
CONTROL ELEMENTS
AL TRACK

STATION NAME OR CONTROL POINT	STATIONING (ft)	MAS (mi/hr)	GRADE (%)	RADIUS CURVE (ft)	S.E. (in.)
CS 2650	662+44.66	55	1.48	1738.83R	4
SC 2650	638+21.37	55	1.48	1738.83R	4
	636+29.00	--			
TS 2650	634+91.37	45	1.48	0	
PVT	633+10.00	45	1.48	0	
PVI	631+60.00	45	1.48	0	
PVC	630+10.00	45	0.00	0	
FAIRFAX/SANTA MONICA STA.	628+95.35	45	0.00	0	
FAIRFAX/SANTA MONICA STA.	624+45.35	45	0.00	0	
	624+15.00	--			
PVT	622+24.00	55	0.00	0	
PVI	620+24.00	55	0.00	0	
PVC	618+24.00	55	3.00	0	
PVT	612+41.00	55	3.00	0	
PVI	611+11.00	55	3.00	0	
PVC	609+81.00	55	1.49	0	
ST 2630	588+27.86	55	1.49	0	
CS 2630	585+87.86	55	1.49	3838.00R	3.25
SC 2630	584+08.73	55	1.49	3838.00R	3.25
TS 2630	581+68.73	55	1.49	0	
	580+04.00	--			
ST 2620	579+86.53	45	1.49	0	
CS 2620	577+76.53	45	1.49	3761.17L	3.25
PVT	576+61.38	45	1.49	3761.17L	3.25
SC 2620	575+71.88	45	1.49	3761.17L	3.25
PVI	575+71.38	45	1.49	(3770.15L)	(3.24)
PVC	574+81.38	45	0.30	(6609.59L)	(1.85)
TS 2620	573+61.88	45	0.30	0	
STA EQ AHD	573+23.98	45	0.30	0	
STA EQ BK =	573+23.60	45	0.30	0	
FAIRFAX/BEVERLY STA.	572+69.60	45	0.30	0	
FAIRFAX/BEVERLY STA.	568+19.60	45	0.30	0	
PS NO. 10 TO X-OVER	567+44.60	45	0.30	0	
PS NO. 10 TO X-OVER	563+83.32	45	0.30	0	
STA EQ AHD	563+64.40	45	0.30	0	
STA EQ BK =	564+46.49	45	0.30	0	

HORIZONTAL AND VERTICAL
CONTROL ELEMENTS
AL TRACK

STATION NAME OR CONTROL POINT	STATIONING (ft)	MAS (mi/hr)	GRADE (%)	RADIUS CURVE (ft)	S.E. (in.)
PVT	563+92.74	45	0.30	0	
PVI	562+92.74	45	0.30	0	
PVC	561+92.74	45	2.79	0	
STA EQ AHD	553+58.54	45	2.79	0	
STA EQ BK =	553+67.06	45	2.79	0	
ST 2600	553+67.06	45	2.79	0	
PVT	553+65.60	45	2.79	0	
PVI	553+00.60	45	2.79	0	
PVC	552+35.60	45	2.14	0	
CS 2600	551+47.06	45	2.14	1000.00L	4
PVT	550+54.00	45	2.14	1000.00L	4
SC 2600	549+69.24	45	2.14	1000.00L	4
PVI	549+64.00	45	2.14	(1024.40L)	(3.90)
PVC	548+74.00	45	3.75	(1763.39L)	(2.27)
TS 2600	547+49.24	45	3.75	0	
ST 2550	545+28.87	45	3.75	0	
CS 2550	543+08.87	45	3.75	1000.00R	4
PVT	541+97.00	45	3.75	1000.00R	4
PVI	540+72.00	45	3.75	1000.00R	4
	540+21.00	--			
PVC	539+47.00	25	-1.20	1000.00R	4
PVT	534+87.00	25	-1.20	1000.00R	4
SC 2550	534+15.29	25	-1.20	1000.00R	4
PVI	534+12.00	25	-1.20	(1015.18R)	(3.94)
PVC	533+37.00	25	-0.30	(1552.47R)	(2.58)
TS 2550	531+95.29	25	-0.30	0	
PT 2510	531+26.84	25	-0.30	1300.00R	0
PC 2510	530+61.89	25	-0.30	1300.00R	0
	530+18.00	--			
WILSHIRE/FAIRFAX STA.	529+87.73	40	-0.30	0	
WILSHIRE/FAIRFAX STA.	525+37.73	40	-0.30	0	
ST 2500	525+37.73	40	-0.30	0	
PVT	524+62.00	40	-0.30	(2376.87R)	(1.51)
PVI	523+82.00	40	-0.30	(1155.85R)	(3.11)
CS 2500	523+37.73	40	2.21	900.00R	4
PVC	523+02.00	40	2.21	900.00R	4
PVT	520+87.00	40	2.21	900.00R	4
PVI	520+02.00	40	2.21	900.00R	4
PVC	519+17.00	40	0.30	900.00R	4
SC 2500	518+36.75	40	0.30	900.00R	4
	516+37.00	--			
TS 2500	516+36.75	45	0.30	0	
PVT	514+12.00	45	0.30	0	

HORIZONTAL AND VERTICAL
CONTROL ELEMENTS
AL TRACK

	STATION NAME OR CONTROL POINT	STATIONING (ft)	MAS (mi/hr)	GRADE (%)	RADIUS CURVE (ft)	S.E. (in.)	
5	PVI	513+12.00	45	0.30	0		5
	PVC	512+12.00	45	-0.30	0		
5							5
	PVT	501+09.00	45	-0.30			
	PVI	499+79.00	45	-0.30	0		
	PVC	498+49.00	45	-4.00	0		
		487+61.00	--				
	PVT	482+55.58	40	-4.00	0		
	PVI	481+65.58	40	-4.00	0		
	PVC	480+75.58	40	-0.50	0		
	STA EQ AHD	480+06.42	40	-0.50	0		
	STA EQ BK =	480+05.49	40	-0.50	0		
		479+81.00	--				
	WILSHIRE/LA BREA STA.	479+51.49	45	-0.50	0		
	WILSHIRE/LA BREA STA.	475+01.49	45	-0.50	0		
		474+71.00	--				
	PVT	473+80.00	55	-0.50	0		
	PVI	472+80.00	55	-0.50	0		
	PVC	471+80.00	55	0.56	0		
	PVT	467+16.66	55	0.56	0		
	PVI	466+16.66	55	0.56	0		
		465+17.00	--				
	PVC	465+16.66	70	-0.30	0		
5							5
5							5
5							5
	STA EQ AHD	435+51.56	70	-0.30	0		
	STA EQ BK =	435+51.45	70	-0.30	0		
	PT 2460	435+51.45	70	-0.30	80000.00L	0	
		434+74.00	--				
	PC 2460	433+27.66	55	-0.30	80000.00L	0	
	PVT	422+40.00	55	-0.30	0		
	PVI	421+50.00	55	-0.30	0		
	PVC	420+60.00	--	0.30	0		
5							5
5							5
	WILSHIRE/CRENSHAW STA.	404+74.00	45	0.30	0		
	WILSHIRE/CRENSHAW STA.	400+24.00	--	0.30	0		
			45				
		399+56.00	--				
	PS NO. 10 TO X-OVER	399+49.00	55	0.30	0		
	PS NO. 10 TO X-OVER	395+87.72	55	0.30	0		
5							5
	STA EQ AHD	395+12.71	55	0.30	0		

HORIZONTAL AND VERTICAL
CONTROL ELEMENTS
AL TRACK

STATION NAME OR CONTROL POINT	STATIONING (ft)	MAS (mi/hr)	GRADE (%)	RADIUS CURVE (ft)	S.E. (in.)
STA EQ BK =	395+13.92	55	0.30	0	
ST 2440	395+13.33	55	0.30	0	
CS 2440	394+13.33	55	0.30	7500.00R	1
SC 2440	392+86.22	55	0.30	7500.00R	1
TS 2440	391+86.22	55	0.30	0	
	380+35.00	--			
PVT	378+72.00	45	0.30	0	
PVI	377+72.00	45	0.30	0	
PVC	376+72.00	45	-0.50	0	
STA EQ AHD	374+51.36	45	-0.50	0	
STA EQ BK =	374+51.47	45	-0.50	0	
PT 2430	374+51.44	45	-0.50	25000.00R	0
PC 2430	373+78.36	45	-0.50	25000.00R	0
WILSHIRE/WESTERN STA.	372+61.14	45	-0.50	0	
WILSHIRE/WESTERN STA.	368+11.14	45	-0.50	0	
PVT	367+30.00	45	-0.50	0	
PVI	366+50.00	45	-0.50	0	
PVC	365+70.00	45	-0.89	0	
PVT	351+93.00	45	-0.89	0	
PVI	351+43.00	45	-0.89	0	
PVC	350+93.00	45	0.30	0	
WILSHIRE/NORMANDIE STA.	350+19.90	45	0.30	0	
WILSHIRE/NORMANDIE STA.	345+69.90	45	0.30	0	
PVT	345+63.00	45	0.30	0	
PVI	344+85.00	45	0.30	0	
PVC	344+07.00	45	3.75	0	
STA EQ AHD	341+98.26	45	3.75	0	
STA EQ BK =	342+00.23	45	3.75	0	
ST 2420	342+00.23	45	3.75	0	
PVT	341+80.00	45	3.75	0	
PVI	341+30.00	45	3.75	0	
PVC	340+80.00	45	3.57	0	
CS 2420	339+80.23	45	-3.57	1000.00R	4
PVT	338+98.84	45	-3.57	1000.00R	4
PVI	337+28.84	45	-3.57	1000.00R	4
SC 2420	336+38.09	45	-3.77	1000.00R	4
PVC	335+58.84	45	-3.77	1563.06R	(2.56)
TS 2420	334+18.09	45	-3.77	0	
ST 2410	333+94.86	45	-3.77	0	
CS 2410	331+74.86	45	-3.77	1000.00L	4

HORIZONTAL AND VERTICAL
CONTROL ELEMENTS
AL TRACK

STATION NAME OR CONTROL POINT	STATIONING (ft)	MAS (mi/hr)	GRADE (%)	RADIUS CURVE (ft)	S.E. (in.)
SC 2410	327+97.13	45	-3.77	1000.00L	4
TS 2410	325+77.13	45	-3.77	0	
PVT	320+73.00	45	-3.77	0	
PT 2400	320+52.49	45	-3.77	10351.58R	0
PVI	319+73.00	45	-3.77	10351.58R	0
PC 2400	319+17.49	45	-0.30	10351.58R	0
PVC	318+73.00	45	-0.30	0	
WILSHIRE/VERMONT STA.	318+61.68	45	-0.30	0	
WILSHIRE/VERMONT STA.	314+11.68	45	-0.30	0	
	313+82.00	--			
STA EQ AHD	309+80.00	55	-0.30	0	
STA EQ BK =	309+54.99	55	-0.30	0	
PVT	309+43.00	55	-0.30	0	
PVI	307+68.00	55	-0.30	0	
ST 2390	306+65.98	55	3.09	0	
PVC	305+93.00	55	3.09	(7551.38)	(0.88)
CS 2390	303+35.98	55	3.09	1670.00L	4
PVT	301+11.00	55	3.09	1670.00L	4
PVI	299+11.00	55	3.09	1670.00L	4
SC 2390	297+52.05	55	-1.00	1670.00L	4
PVC	297+11.00	55	-1.00	(1907.25L)	(3.50)
TS 2390	294+22.05	55	-1.00	0	
ST 2380	291+91.87	55	-1.00	0	
CS 2380	289+81.87	55	-1.00	4830.00R	2.50
SC 2380	288+74.53	55	-1.00	4830.00R	2.50
TS 2380	286+64.53	55	-1.00	0	
ST 2320	282+05.01	55	-1.00	0	
CS 2320	278+55.01	55	-1.00	2460.00L	4
SC 2320	276+73.37	55	-1.00	2460.00L	4
TS 2320	273+23.37	55	-1.00	0	
PVT	273+09.50	55	-1.00	0	
	272+58.00	--			
PVI	271+34.50	45	-1.00	0	
PVC	269+59.50	45	-3.00	0	
PVT	267+00.00	45	-3.00	0	
PVI	265+75.00	45	-3.00	0	
PVC	264+50.00	45	-1.00	0	
WILSHIRE/ALVARADO STA.	263+64.24	45	-1.00	0	
WILSHIRE/ALVARADO STA.	259+14.24	45	-1.00	0	
	258+46.00	--			
PS NO. 10 TO X-OVER	258+39.24	55	-1.00	0	

HORIZONTAL AND VERTICAL
CONTROL ELEMENTS
AL TRACK

STATION NAME OR CONTROL POINT	STATIONING (ft)	MAS (mi/hr)	GRADE (%)	RADIUS CURVE (ft)	S.E. (in.)
PS NO. 10 TO X-OVER	254+77.97	55	-1.00	0	
STA EQ AHD	251+40.00	55	-1.00	0	
STA EQ BK =	251+41.28	55	-1.00	0	
ST 2310	251+41.28	55	-1.00	0	
PVT	251+26.28	55	-1.00	(29293.33R)	(0.23)
PVI	250+01.28	55	-1.00	(3138.57R)	(2.15)
CS 2310	248+81.28	55	1.00	1690.00R	4
PVC	248+76.28	55	1.00	1690.00R	4
SC 2310	247+76.12	55	1.00	1690.00R	4
TS 2310	245+16.12	55	1.00	0	
STA EQ AHD	228+75.33	55	1.00	0	
STA EQ BK =	228+76.37	55	1.00	0	
PT 2260	228+76.37	55	1.00	11000.00R	0
	221+37.00	--			
PVT	216+98.29	40	1.00	11000.00R	0
PVI	214+73.29	40	1.00	11000.00R	0
PVC	212+48.29	40	-2.99	11000.00R	0
PC 2260	210+92.50	40	-2.99	11000.00R	0
PVT	210+77.00	40	-2.99	0	
ST 2250	210+01.44	40	-2.99	0	
PVI	209+27.00	40	-2.99	(2552.39L)	(1.57)
CS 2250	208+11.44	40	0.00	1000.00L	4
PVC	207+77.00	40	0.00	1000.00L	4
SC 2250	206+78.40	40	0.00	1000.00L	4
TS 2250	204+88.40	40	0.00	0	
7th/FLOWER STATION	204+63.04	40	0.00	0	
	200+43.00	--			
7th/FLOWER STATION	200+13.04	45	0.00	0	
PVT	199+60.00	45	0.00	0	
STA EQ AHD	199+22.04	45	0.00	0	
STA EQ BK =	200+05.00	45	0.00	0	
PVI	198+92.96	45	0.00	0	
ST 2200	197+94.83	45	2.90	0	
PVC	197+42.96	45	2.90	(4939.91R)	(0.81)
CS 2200	195+39.32	45	2.90	1002.83R	4
PVT	188+37.37	45	2.90	1002.83R	4
PVI	186+77.37	45	2.90	1002.83R	4
PVC	185+17.37	45	-3.87	1002.83R	4

HORIZONTAL AND VERTICAL
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STATION NAME OR CONTROL POINT	STATIONING (ft)	MAS (mi/hr)	GRADE (%)	RADIUS CURVE (ft)	S.E. (in.)
SC 2200	182+21.36	45	-3.87	1002.83R	4
TS 2200	179+65.85	45	-3.87	0	
PVT	179+65.44	45	-3.87	0	
PVI	178+55.44	45	-3.87	0	
PVC	177+45.44	45	-0.30	0	
5th/HILL STATION	175+88.83	45	-0.30	0	
5th/HILL STATION	171+38.83	45	-0.30	0	
	171+09.00	--			
PVT	163+68.85	55	-0.30	0	
PVI	162+18.85	55	-0.30	0	
PVC	160+68.85	55	-3.99	0	
	158+30.00	--			
STA EQ AHD	154+30.75	45	-3.99	0	
STA EQ BK =	154+30.51	45	-3.99	0	
PT 2130	154+30.51	45	-3.99	34957.17L	0
PVT	153+92.88	45	-3.99	34957.17L	0
PVI	152+77.94	45	-3.99	34957.17L	0
PC 2130	152+28.83	45	-1.00	34957.17L	0
PVC	151+63.00	45	-1.00	0	
CIVIC CENTER STATION	151+63.00	45	-1.00	0	
CIVIC CENTER STATION	147+13.00	45	-1.00	0	
PVT	146+38.00	45	-1.00	0	
PVI	145+48.00	45	-1.00	0	
STA EQ AHD	145+35.94	45	1.27	0	
STA EQ BK =	145+05.31	45	1.27	0	
ST 2120	144+99.41	45	1.27	0	
PVC	144+27.37	45	1.27	(6529.71L)	(1.05)
	144+27.00	--			
CS 2120	142+59.41	55	1.27	1960.00L	3.50
	135+19.00	--			
SC 2120	130+15.44	45	1.27	1960.00L	3.50
TS 2120	127+75.44	45	1.27	0	
STA EQ AHD	124+16.74	45	1.27	0	
STA EQ BK =	123+79.04	45	1.27	0	
ST 2100	123+79.04	45	1.27	0	
CS 2100	121+59.04	45	1.27	1000.00L	4
PVT	120+25.98	45	1.27	1000.00L	4
PVI	119+45.98	45	1.27	1000.00L	4
PVC	118+65.98	45	-0.30	1000.00L	4
SC 2100	115+06.27	45	-0.30	1000.00L	4

HORIZONTAL AND VERTICAL
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AL TRACK

STATION NAME OR CONTROL POINT	STATIONING (ft)	MAS (mi/hr)	GRADE (%)	RADIUS CURVE (ft)	S.E. (in.)
	114+60.00	--			
TS 2100	112+86.27	25	-0.30	0	
PS NO. 10 TO X-OVER	112+10.89	25	-0.30	0	
PS NO. 10 TO X-OVER	108+25.95	25	-0.30	0	
UNION STATION*	107+50.95	25	-0.30	0	
UNION STATION	103+00.95	25	-0.30	0	

*(TERMINAL STATION)

SECTION 4

INTERFACES

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SECTION 4

INTERFACES

4.1 GENERAL

This Section identifies functional and physical interfaces that will exist between Contractor-furnished equipment and District-furnished facilities, systems, and carborne equipment.

4.1.1 Cited References

Organization	Number	Title
CAC	Title 24	State Building Code
City of Los Angeles	-	Building Code
EIA	RS-232-C	Interface Between Data Terminal Equipment and Data Communication Equipment Employing Serial Binary Data Exchange
IEEE	488	Digital Interface for Programmable Instrumentation

4.1.2 Environmental Conditions

A. Outdoor and wayside ambient conditions and air quality are specified in Section 3.

B. Station Communications/Train Control Room ambient conditions will be:

1. Continuous Temperature Range (°F): 65 to 80
2. Intermittent Temperature Range (°F, 2 hr): 32 to 122
3. Relative Humidity Range (percent): 10 to 90
4. Pressure Change from Atmospheric (lb/ft^2): ±20

C. Maintenance shop ambient conditions will be:

1. Continuous Temperature Range (°F): 65 to 104

2. Intermittent Temperature Range (°F, 2 hr): 40 to 110

D. Equipment to be installed in District facilities shall have seismic restraints in accordance with City of Los Angeles Building Code and CAC Title 24. Equipment shall be considered as essential facilities equipment within Seismic Hazard Zone 4.

4.1.3 Facilities and Systems

The following facilities and systems will be provided by the District:

A. Traction Power System (Reference: Section 3 and Contract Drawings)

B. Guideway (Reference: Section 3 and Contract Drawings)

C. Stations, tunnels, and Yard

D. Maintenance shop, including compressed air at 100 and 130 psig, and electric power at:

1. 750 V dc

2. 480 V ac, 3-phase, 60 Hz

3. 208 V ac, 3-phase, 60 Hz

4. 120 V ac, single-phase, 60 Hz.

E. Space and certain equipment for training classes (Reference: Section 22)

F. Locomotive with coupler to mate with coupler adapter (Reference: Section 12)

G. Vehicle washing equipment

H. ATS, including Communications System except as specified (Reference: Section 17)

I. ATC System, except ATO (Reference: Section 16) and as specified.

J. Fire extinguishers (Reference: Section 8)

K. Station Communications/Train Control Rooms for station equipment, including battery power at 24 V dc and equipment racks. 5 5

4.1.4 Carborne Equipment

The following carborne equipment will be furnished to the Contractor for installation:

A. ATP subsystem, except speed sensor

B. Radio subsystem

C. TICU subsystem.

4.1.5 District-installed Equipment

The Contractor shall furnish the station and wayside equipment for the PSS and berthing verification functions of the ATO subsystem to the District for installation (Reference: Section 16).

4.1.6 District-furnished Diagnostic and Test Equipment

DFE DTE will include a Beaver-Major MDC Model EM57900 electronic equipment tester manufactured by ATE Systems, Inc. (Beaver-Major). Electronic assemblies, equipment, and circuit boards shall be compatible with the Beaver-Major, except as noted herein (Reference: Article 22.6). Characteristics and interface details of the Beaver-Major include the following:

A. Serial Interface: EIA RS-232-C

B. Programmable External Instrumentation Interface: IEEE 488

C. Data Transmission Rate: 9,600 baud

D. Logic and Analog Circuit Testing Range: 100 microV to 100 V

E. Dual Internal Thresholding Capability on all Lines: 0 to +10 V in 100 mV steps

F. High-speed serial conditioning digital patterns to 1 MHz rates by 256 bits long

G. Broadside arrays to 64 pins wide

H. Storage Capacity: 790 individual tests without media reload

I. Unit Test Program Loading into Random Access Memory: 3.5-in. floppy disk

J. Terminal Programming: Interactive intelligent, combination of English language and standard electronic engineering terms.

4.2 DETAILED REQUIREMENTS

4.2.1 General

A. Interface activities and requirements shall be identified in the Management Program (Reference: Section 20) and Systems Assurance Program (Reference: Section 19). Major external interfaces are defined in the Interface Data Sheets (IDS) of Appendix TP-4-A. Principal external interfaces are further described herein. (External interfaces are the interfaces between the Contractor and DFE and District-furnished facilities.) The District will coordinate interface activities between the Contractor and other contractors supplying equipment to the District. Interface meetings will be held on a scheduled basis. Meeting minutes will be distributed by the District. IDS will be prepared and furnished by the District for each major external interface. Interface requirements between the Contractor and its subcontractors shall be as specified. (Reference: Article 20.6.)

B. Equipment to be installed in District facilities shall conform to the requirements herein and shall include power supplies.

C. Equipment supplied by the Contractor for installation by the District shall be provided with technical information, installation instructions, installation test instructions, system test assistance, and, when required, installation and installation test assistance in accordance with approved plans and schedule. (CDRL) System test shall include Integrated Vehicle Systems Test and Systems Demonstration Test (Reference: Section 21).

D. For carborne DFE, the Contractor shall design, provide, and install interfacing hardware, wiring, and trainlines, and shall test as if the DFE were a vehicle subsystem. Installation instructions, and test assistance and supervision will be provided by the District. Interfacing hardware shall include bolts, fasteners, mounting pads and brackets, nuts,

screws, shims, supports, washers, and other elements required to install the DFE.

4.2.2 District-furnished Carborne Automatic Train Protection Equipment

The District will furnish two ATP receiver coils to be installed on each vehicle and one set of rack-mounted ATP equipment with power supply and shock-mounted rack (or other required mounting provisions) to be installed in the cab of one vehicle of each dependent pair (IDS No. 620-650-00-01). Each receiver coil will be 6.5-in. in diameter maximum by 18-in. long maximum and weigh a maximum of 5 lb. Receiver coils shall not require special housings. The Contractor shall:

A. Install receiver coils at locations to be determined under the vehicle or on the F-end truck, including mounting brackets, cable, and cable connectors (both halves).

B. Provide an enclosure (ATC enclosure) inside one cab of each dependent pair for carborne ATC equipment. The enclosure shall be naturally ventilated, be not less than 15-in. deep by 37-in. high by 42-in. wide, and shall include support provisions for the DFE racks. The space for DFE carborne ATC equipment shall be not less than 12.5-in. deep by 36-in. high by 42-in. wide. Drawings shall be approved. (CDRL)

C. Install equipment racks and DFE in the ATC enclosure.

D. Provide LVPS including wiring connectors (both halves) to the DFE.

E. Provide interconnections to DFE interface connections, both halves of connectors, and interlocking devices as required to meet the functional requirements described (Reference: Sections 9, 16, and 17, and the Contract Drawings). (CDRL)

4.2.3 District-furnished Carborne Radio Equipment

The District will furnish one multichannel, two-way radio with antenna (IDS No. 640-650-00-01, 640-650-00-02, and 640-650-00-04). Radio will include power supply. Antenna will include radome assembly. The Contractor shall:

A. Provide space for two antennae on the cab roof of one vehicle of each dependent pair. Dimensions of antennae are to be determined.

B. Provide space for two radios in an approved, naturally ventilated cabinet in the cab of one vehicle of a dependent pair. Space shall be not less than 15-in. deep by 19-in. wide by 10-in. high.

C. Install one antenna at an approved location, including mounting supports, hardware, and sealing of roof. Provide and install coaxial cable, including cable connectors, from antenna to radio.

D. Provide space and approved installation provisions for second antenna and coaxial transmission cable into the cab (future installation by District).

E. Install one radio and power supply. Provide power cable, connectors, and connection to the emergency bus of the LVPS.

F. Install approved provisions for second radio (future installation by District), including wireway for power from Low-Voltage Circuit Breaker Panel.

G. Provide interconnections and interlocking devices to meet the functional requirements described (Reference: Sections 9, 16, and 17, and the Contract Drawings).

4.2.4 District-furnished Carborne Train Identification and Control Unit

The District will furnish the TICU in three assemblies for each dependent pair (IDS No. 640-650-00-03). Two of the assemblies will be Identification Control panels to be installed in each cab of each vehicle. The third assembly will be a set of control logic with regulated power supply to be installed in one cab of each dependent pair. The Contractor shall:

A. Provide space for an Identification Control Panel in each cab, at an approved location within reach and sight of a seated Train Operator, as indicated.

B. Provide space for the control logic in the same cabinet and near the DFE radio. The space requirement will be not more than 19-in. wide by 15-in. deep by 5-in. high.

C. Install the Identification Control Panels. Provide interconnecting wiring between control logic and Identification Control Panels, including both halves of connectors, and mounting hardware, including bezels if required.

D. Install the control logic. Provide power cable from LVPS including both halves of connectors.

E. Install DFE interconnecting wiring between DFE radio and control logic.

F. Provide interconnecting wiring including trainlines, both halves of connectors, and contacts to meet the functional requirements listed below. Contacts shall be rated for 5 A noninductive, 5 to 50 V.

1. Adjust destination and run-number signs via 19-binary-coded-decimal parallel-format signal from the TICU (Reference: Article 8.9), via 19-wire-plus-common-wire connection to the sign transmitter or control unit. 5

2. Adjust performance level via dry-contact closures from the TICU.

3. Advise of change in status as indicated below via dry-contact closures to the TICU.

   a. Operating Mode: Two contacts, contact closure indicates operation in ATO mode and MTO mode.

   b. MTO Submode: Three contacts, contact closure indicates operation in EMO, Restricted Manual, and Wash/Couple.

   c. Side Door Open: Contact closure indicates one or more side-door leafs are open contrary to the last command from the energized cab.

   d. Side Door Closed: Contact closure indicates one or more side-door leafs are closed contrary to the last command from the energized cab.

   e. EMO Enable Switch: Contact closure indicates the switch is actuated.

   f. Performance level: Five contacts, contact closure indicates the performance level in which ASR is operating.

   g. Propulsion Failure: Contact closure indicates a propulsion failure or an overload in any part of the propulsion subsystems on the train.

h. Service Brake Failure: Contact closure indicates that a service brake failure has occurred anywhere on the train.

i. Auxiliary Power Failure: Contact closure indicates a failure in the individual auxiliary power circuits on the train.

j. Propulsion Cutout: Contact closure indicates one or more propulsion subsystems on train are cut out.

k. Electric Brake Cutout: Contact closure indicates electric braking has been cut out anywhere on the train.

l. Friction Brake Cutout: Contact closure indicates friction braking on one or more trucks on the train is cut out.

m. Compressor Cutout: Contact closure indicates one or more air compressors on train have been cut out.

n. Emergency Brake: Contact closure indicates emergency braking has been applied throughout the train. Contact shall open when emergency braking is reset.

o. Parking Brake: Contact closure indicates parking brake is "on" on one or more trucks on the train.

p. EMO Enable: Contact closure indicates EMO ENABLE Switch is activated.

q. Doors Bypass: Contact closure indicates the DOORS CLOSED BYPASS Switch is activated.

r. Movement Bypass: Contact closure indicates the MOVEMENT DETECTION BYPASS Switch is activated.

s. Zero Speed Bypass: Contact closure indicates the ZERO SPEED BYPASS Switch is activated.

t. Berthing Bypass: Contact closure indicates the BERTHING BYPASS Switch is activated.

u. Deadman: Contact closure indicates the deadman feature is activated.

v. Door Cutout: Contact closure indicates that one or more side doors have been cutout.

4. Activate DWELL EXPIRED Indicator via dry-contact closure from the TICU.

4.2.5 Contractor-furnished Station and Wayside Equipment

A. Wayside equipment to be installed in or within 5 ft of the guideway shall include installation hardware, special materials, cable connectors (both halves), and interconnecting cables, except cable to equipment installed in station Communications/ Train Control Rooms (IDS No. 650-620-00-01).

B. Equipment to be installed in station Communications/Train Control Rooms, such as control modules, shall be suitable for mounting in standard 19-in. racks (IDS No. 650-620-00-02).

C. District installation will include providing and connecting power supply wiring and wiring interconnecting Communications/Train Control Room equipment with equipment to be installed in the guideway. Contractor shall furnish both halves of connectors to Contractor-furnished equipment.

END OF SECTION

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APPENDIX TP-4-A
A650 INTERFACE DATA SHEETS FOR EXTERNAL INTERFACES

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A650 INTERFACE DATA SHEET INDEX

IDS NUMBER	INTERFACING CONTRACT	INTERFACE DESCRIPTION
*650-112-00-01	A112 Main Shop Building	Vehicle Jacking Pads/Shop Hoists
*650-112-00-02	A112 Main Shop Building	Wheels/Wheel Truing Machine
650-112-00-03	A112 Main Shop Building	Vehicle Test Power Input Stud/Shop Cable
650-112-00-04	A112 Main Shop Building	Current Collector/Shop Stinger System
650-130-00-01	A130 Yard Leads & Transfer Zone	Vehicle/Car Wash
650-136-00-01	A136 Union Station, Stage II	Vehicle/Station Platform
650-141-00-01	A141 Line Section, Union Station to 5th/Hill Station	Vehicle/Tunnel
650-146-00-01	A146 Line Section, 5th/Hill to 7th/ Flower Station	Vehicle/Tunnel
650-147-00-01	A147 Civic Center Station, Stage II	Vehicle/Station Platform
650-157-00-01	A157 5th/Hill Station, Stage II	Vehicle/Station Platform
650-167-00-01	A167 7th/Flower Station, Stage II	Vehicle/Station Platform
650-171-00-01	A171 Line Section, 7th/Flower to Wilshire/Alvarado Station	Vehicle/Tunnel
650-187-00-01	A187 Wilshire/Alvarado Station, Stage II	Vehicle/Station Platform
650-610-00-01	A610 Trackwork Installation	Vehicle/Trackwork

*IDS Examples Included.

IDS NUMBER	INTERFACING CONTRACT	INTERFACE DESCRIPTION
*650-610-00-02	A610 Trackwork Installation	Vehicle/Bumping Posts
*650-612-00-01	A612 Contact Rail	Current Collector/Contact Rail
650-615-00-01	A615 Coverboard	Current Collector/Coverboard
*650-620-00-01	A620 Automatic Train Control	Wayside PSS and Berthing Verification Equipment/ATC
*650-620-00-02	A620 Automatic Train Control	TC&C Room PSS and Berthing Verification Equipment/ATC
650-671-00-01	A671 Locomotive	Coupler Adapter/Locomotive
650-775-00-01	A775 Mobile Emergency and Maintenance Equipment	Vehicle/Rerailing Equipment
650-785-00-01	A785 Fire Suppression Equipment	Vehicle/Fire extinguishers
*650-DE-00-01	Diagnostic & Test Equipment	Vehicle/Diagnostic and Test Equipment
*620-650-00-01	A620 Automatic Train Control	ATC Vehicle Equip./Equip. Enclosure
*620-650-00-02	A620 Automatic Train Control	ATC Wiring/Vehicle Wiring
*620-650-00-03	A620 Automatic Train Control	ATP Receiver Coils/Mounting Location
*620-650-00-04	A620 Automatic Train Control	Train Stop Trip Arm/Trip Cock
*640-650-00-01	A640 Communications	Communications Antenna/Vehicle
*640-650-00-02	A640 Communications	Communications Radio/Vehicle
*640-650-00-03	A640 Communications	Communications TICU/Vehicle
*640-650-00-04	A640 Communications	CCU/Radio Controls

INTERFACE DATA SHEET

CONTRACT No.: A650 Passenger Vehicle SUBSYSTEM: Carbody SPEC. REFERENCE: TP 7.3.5 Jacking and Hoisting	LOCATION: INTERFACE No.: REV: Vehicle Jacking Pads/Shop Hoists 650-112-00-01 REFER TO INTERFACE DATA TABLE:
CONTRACT No.: A112 Main Shop Building SUBSYSTEM: Truck Hoists & Body Supports SPEC. REFERENCE: Section 11550 Truck Hoists & Body Supports	ATTACHMENTS: Attachment 1 Technical Requirements Attachment 2 Interface Drawing Utilization List

FUNCTIONAL DESCRIPTION:

Physical interface between eight jacking pads of carbody and Main Shop Building vehicle hoists and body supports for lifting and supporting the passenger vehicle.

TECHNICAL REQUIREMENTS:

See Attachment 1.

PHYSICAL DESCRIPTION:

The vehicle shall be capable of being jacked and supported on either the four corner pads or the four bolster pads by the vehicle hoists and body supports in the Main Shop Building.

ORGANIZATION CONTACT:

SCRTD Project Engineer

COMMENTS:

REFERENCES:

See Attachment 2.

REVISION:		PREPARED BY:		IMPLEMENTATION RESPONSIBILITY (THIRD PARTY):
No.	DATE	INITIALS	DATE	

ATTACHMENT 1

TECHNICAL REQUIREMENTS

1) PASSENGER VEHICLE Contractor A650

A650 Contractor shall provide eight jacking pads in locations shown on Contract Drawing V-023 (longitudinal dimensions only). Jacking pads shall be designed to interface with vehicle hoist and body supports furnished by A112 Contractor. A650 Contractor will provide jacking pad locations and descriptive drawings to District for A112 Contractor (for interface with shop vehicle hoists).

2) MAIN SHOP BUILDING Contractor A112

A112 Contractor shall furnish and install vehicle hoist and body support system to lift and support the trucks for performing required service, maintenance and testing. Truck hoists shall interface with jacking pads at locations shown on Passenger Vehicle detail drawings furnished by A650 Contractor.

ATTACHMENT 2

INTERFACE DRAWING UTILIZATION LIST

A650 Contract Drawings

Drawing	V-023	Passenger Vehicle Jacking Pad Locations

INTERFACE DATA SHEET

CONTRACT No.: A650 Passenger Vehicle SUBSYSTEM: Trucks & Suspension SPEC. REFERENCE: TP 11.1.2 Configuration	LOCATION: INTERFACE No.: REV: Wheels/Wheel Truing Machine 650-112-00-02 REFER TO INTERFACE DATA TABLE:
CONTRACT No.: A112 Main Shop Building SUBSYSTEM: Wheel Truing Machine SPEC. REFERENCE: Section 11555 Wheel Truing Machine	ATTACHMENTS: Attachment 1 Technical Requirements Attachment 2 Interface Drawing Utilization List

FUNCTIONAL DESCRIPTION:

Interface between A650 Contractor-furnished vehicle wheel and A112 Contractor-furnished wheel truing machine

TECHNICAL REQUIREMENTS:

See Attachment 1.

PHYSICAL DESCRIPTION:

Underfloor-type wheel truing machine for reprofiling and truing the flanged wheels of the vehicle.

ORGANIZATION CONTACT:

SCRTD Project Engineer

COMMENTS:

REFERENCES:

See Attachment 2.

REVISION:		PREPARED BY:		IMPLEMENTATION RESPONSIBILITY (THIRD PARTY):
No.	DATE	INITIALS	DATE	

ATTACHMENT 1

TECHNICAL REQUIREMENTS

1) PASSENGER VEHICLE Contractor A650

A650 Contractor truck design shall be such that typical underfloor wheel truing machines can be used for reprofiling and truing the flanged vehicle wheels. A650 Contractor shall provide necessary vehicle truck and wheel design and detail drawings to District for A112 Contractor (for required interfaces).

2) MAIN SHOP BUILDING Contractor A112

A112 Contractor-furnished wheel truing machine shall be capable of machining wheel treads and flanges of wheels with profile specified on A650 Contract Drawing V-021. Wheels will mounted on hollow or solid axles with inboard or outboard journals and will have either outboard disc brakes or tread brakes. Wheel truing machine shall be capable of simultaneously truing both wheels of one axle to the required profile and tape size under any of the following conditions:

a. A separate single pair of wheels on a common axle

b. A pair of wheels on a truck detached from the carbody

c. A pair of wheels on a truck mounted under a passenger vehicle.

ATTACHMENT 2

INTERFACE DRAWING UTILIZATION LIST

A650 Contract Drawings

Drawing V-021 Wheel Tread Contour

INTERFACE DATA SHEET

CONTRACT No.: A650 Passenger Vehicle SUBSYSTEM: General Requirements & Carbody SPEC. REFERENCE: TP Sections 3 & 7	LOCATION: Vehicle/Bumping Posts INTERFACE No.: 650-610-00-02 REV: REFER TO INTERFACE DATA TABLE:
CONTRACT No.: A610 Trackwork Installation SUBSYSTEM: Section 02459 Track Appurtenances & Other Track Mat'l SPEC. REFERENCE: TP Article 2.16 Bumping Posts	ATTACHMENTS: Attachment 1 Technical Requirements Attachment 2 Interface Drawing Utilization List

FUNCTIONAL DESCRIPTION:

Interface between A650 Contractor-furnished Passenger Vehicle anticlimber and A610 Contractor bumping posts.

TECHNICAL REQUIREMENTS:

See Attachment 1.

PHYSICAL DESCRIPTION:

The striking face of bumping posts shall engage with vehicle anticlimber and withstand 6 mph impact without damage to the vehicle. All types of bumping posts shall be designed to be bolted to running rails.

ORGANIZATION CONTACT:

SCRTD Project Engineer

COMMENTS:

REFERENCES:

See Attachment 2.

REVISION:		PREPARED BY:		IMPLEMENTATION RESPONSIBILITY (THIRD PARTY):
No.	DATE	INITIALS	DATE	

ATTACHMENT 1

TECHNICAL REQUIREMENTS

1) PASSENGER VEHICLE Contractor A650

A650 Contractor shall provide arrangement drawings of vehicle anticlimber to A610 Contractor for proper interface with bumping posts and vehicle crashworthiness characteristics.

2) TRACKWORK INSTALLATION Contractor A610

A610 Contractor shall furnish bumping posts with the striking face to engage the vehicle anticlimber at required height above the rail and impact loads specified without damage to the vehicle.

ATTACHMENT 2

INTERFACE DRAWING UTILIZATION LIST

1) A650 Contract Drawings

Drawing	V-004	Passenger Vehicle General Arrangement Side Elevation

2) A610 Contract Drawings

Drawing	T-237	Bumper Post Detail - Hydraulic (NOTE: Anticlimber detail shown is not binding on A650 Contractor.)
Drawing	T-238	Bumper Post Detail - Standard

INTERFACE DATA SHEET

CONTRACT No.: A650 Passenger Vehicle SUBSYSTEM: Power Supply and Electrical Equip. SPEC. REFERENCE: TP 13.2.1 Current Collector	LOCATION: INTERFACE No.: REV: Current Collector/ Contact Rail 650-612-00-01 REFER TO INTERFACE DATA TABLE:
CONTRACT No.: A612 Contact Rail SUBSYSTEM: Technical Requirements SPEC. REFERENCE: TP Section 3	ATTACHMENTS: Attachment 1 Technical Requirements Attachment 2 Interface Drawing Utilization List

FUNCTIONAL DESCRIPTION:

Interface between A650 Contractor-furnished vehicle current collector and A612 Contractor-furnished contact rail.

TECHNICAL REQUIREMENTS:

See Attachment 1.

PHYSICAL DESCRIPTION: The current collector assembly shall include a collector shoe that slides along the top of the contact rail. Associated springs or other devices will provide an adjustable force of 10 to 30 lbs to maintain continuous contact of the shoe to the contact rail.

ORGANIZATION CONTACT:

SCRTD Project Engineer

COMMENTS:

REFERENCES:

See Attachment 2.

REVISION:		PREPARED BY:		IMPLEMENTATION RESPONSIBILITY (THIRD PARTY):
No.	DATE	INITIALS	DATE	

ATTACHMENT 1

TECHNICAL REQUIREMENTS

1) PASSENGER VEHICLE Contractor A650

A650 Contractor shall furnish current collectors on the vehicle to interface with contact rail and coverboard as depicted on Contract Drawing V-020.

2) CONTACT RAIL Contractor A612

A612 Contractor shall furnish and A610 Contractor shall install contact rails along the trackside at the location as shown on A650 Contract Drawing V-020 and A612 Contract contact rail installation drawings.

ATTACHMENT 2

INTERFACE DRAWING UTILIZATION LIST

A650 Contract Drawings

Drawing V-020	Passenger Vehicle Current Collector/Coverboard Relationship

INTERFACE DATA SHEET

CONTRACT No.: A650 Passenger Vehicle SUBSYSTEM: Automatic Train Operation SPEC. REFERENCE: TP 4.2.5.A Contractor-furnished Station and Wayside Equipment	LOCATION: Wayside PSS and Berthing Verification Equipment/ATC INTERFACE No.: 650-620-00-01 REV: REFER TO INTERFACE DATA TABLE:
CONTRACT No.: A620 Automatic Train Control SUBSYSTEM: Scope SPEC. REFERENCE: TP 1.3.4 District-furnished Equipment installed by Contractor	ATTACHMENTS: Attachment 1 Technical Requirements

FUNCTIONAL DESCRIPTION:

Interface between A650 Contractor-furnished PSS and Berthing Verification wayside equipment and A620 Contractor installation.

TECHNICAL REQUIREMENTS:

See Attachment 1.

PHYSICAL DESCRIPTION:

Details of PSS and Berthing Verification wayside equipment type and installation location to be determined.

ORGANIZATION CONTACT:

SCRTD Project Engineer

COMMENTS:

REFERENCES:

REVISION:		PREPARED BY:		IMPLEMENTATION RESPONSIBILITY (THIRD PARTY):
No.	DATE	INITIALS	DATE	

ATTACHMENT 1

TECHNICAL REQUIREMENTS

1) PASSENGER VEHICLE Contractor A650

A650 Contractor shall furnish PSS and Berthing Verification wayside equipment for installation on the wayside and/or in the TC&C Room. Wayside equipment includes required hardware, special materials, both halves of cable connectors, and interconnecting cables. A650 Contractor shall provide installation instructions and drawings to District for A620 Contractor equipment installation.

2) ATC Contractor A620

A620 Contractor shall install PSS and Berthing Verification wayside equipment per A650 Contractor instructions and shall furnish and install cable from TC&C Room to wayside PSS and Berthing Verification equipment.

INTERFACE DATA SHEET

CONTRACT No.: A650 Passenger Vehicle SUBSYSTEM: Automatic Train Operation SPEC. REFERENCE: TP 4.2.5.B Contractor-furnished Station and Wayside Equipment	LOCATION: INTERFACE No.: REV: TC&C Room PSS and Berthing Verification Equipment/ATC 650-620-00-02 REFER TO INTERFACE DATA TABLE:
CONTRACT No.: A620 Automatic Train Control SUBSYSTEM: Scope SPEC. REFERENCE: TP 1.3.4 District-furnished Equipment installed by Contractor	ATTACHMENTS: Attachment 1 Technical Requirements

FUNCTIONAL DESCRIPTION:

Interface between A650 Contractor-furnished PSS and Berthing Verification TC&C Room equipment and A620 Contractor installation.

TECHNICAL REQUIREMENTS:

See Attachment 1.

PHYSICAL DESCRIPTION:

Details of PSS and Berthing Verification TC&C Room equipment type and installation location to be determined.

ORGANIZATION CONTACT:

SCRTD Project Engineer.

COMMENTS:

REFERENCES:

REVISION:		PREPARED BY:		IMPLEMENTATION RESPONSIBILITY (THIRD PARTY):
No.	DATE	INITIALS	DATE	

ATTACHMENT 1

TECHNICAL REQUIREMENTS

1) PASSENGER VEHICLE Contractor A650

A650 Contractor shall furnish PSS and Berthing Verification equipment, such as control modules, for installation in station TC&C Rooms. Equipment shall be mounted in standard 19 in. racks not exceeding 32 in. in height. Equipment racks and both halves of wiring connectors shall be included. A650 Contractor shall provide installation instructions and drawings to District for A620 Contractor equipment installation.

2) ATC Contractor A620

A620 Contractor shall install PSS and Berthing Verification equipment in TC&C Room per A650 Contractor installation instructions. A620 Contractor shall install 19 in. equipment racks and provide space for PSS and Berthing Verification equipment. A620 Contractor shall provide dc power including wiring from the supply to PSS and Berthing Verification equipment.

INTERFACE DATA SHEET

CONTRACT No.: A650 Passenger Vehicle SUBSYSTEM: SPEC. REFERENCE: TP 4.1.6 District-furnished Diagnostic and Test Equipment & TP 22.6.4 Circuit Board/Electronic Subassembly Repair	LOCATION: INTERFACE No.: REV: Vehicle/Diagnostic and Test Equipment 650-DE-00-01 REFER TO INTERFACE DATA TABLE:
CONTRACT No.: SUBSYSTEM: SPEC. REFERENCE: Note: Existing DTE from District Telecommunications Shop	ATTACHMENTS: None

FUNCTIONAL DESCRIPTION:

Interface between Passenger Vehicle subsystems and components with District Diagnostic Test Equipment (DTE).

TECHNICAL REQUIREMENTS:

Circuit boards and electronic assemblies shall be compatible with District DTE Beaver-Major MDC Model EM57900 electronic equipment tester manufactured by ATE Systems.

PHYSICAL DESCRIPTION:

Characteristic and interface details of the Beaver-Major test equipment are listed in the A650 Technical Provisions, Paragraphs 4.1.6.A through J, 22.6.2, and 22.6.4.

ORGANIZATION CONTACT:

SCRTD Project Engineer

COMMENTS:

REFERENCES:

SCRTD will provide details upon request.

REVISION:		PREPARED BY:		IMPLEMENTATION RESPONSIBILITY (THIRD PARTY):
No.	DATE	INITIALS	DATE	

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INTERFACE DATA SHEET

CONTRACT No.: A620 Automatic Train Control SUBSYSTEM: ATC Vehicle Equipment SPEC. REFERENCE: TP 8.4.1 Physical Constraints	LOCATION: ATC Vehicle Equipment/Equipment Enclosure INTERFACE No.: 620-650-00-01 REV: REFER TO INTERFACE DATA TABLE:
CONTRACT No.: A650 Passenger Vehicle SUBSYSTEM: Interfaces SPEC. REFERENCE: TP 4.2.2.B&C District-furnished Carborne ATP Equipment	ATTACHMENTS: Attachment 1 Technical Requirements

FUNCTIONAL DESCRIPTION:

Mechanical interface between A620 ATC vehicle equipment racks and A650 ATP equipment enclosure.

TECHNICAL REQUIREMENTS:

See Attachment 1.

PHYSICAL DESCRIPTION:

The ATP equipment enclosure is located inside one cab of each dependent pair and houses all A620 carborne equipment except ATP receiver coils. Enclosure dimensions: 37-in. high x 42-in. wide x 15-in. deep.

ORGANIZATION CONTACT:

SCRTD Project Engineer

COMMENTS:

REFERENCES:

REVISION:		PREPARED BY:		IMPLEMENTATION RESPONSIBILITY (THIRD PARTY):
No.	DATE	INITIALS	DATE	

ATTACHMENT 1

TECHNICAL REQUIREMENTS

1) ATC Contractor A620

a) A620 Contractor shall furnish equipment and equipment racks per ATC Technical Provisions Paragraph 8.4.1, "Physical Constraints."

b) A620 Contractor shall furnish installation instructions and test procedures per ATC Technical Provisions Paragraph 10.3.1, "Responsibilities." (CDRL)

2) PASSENGER VEHICLE Contractor A650

a) A650 Contractor shall provide enclosure for all A620 Contractor-furnished carborne equipment other than ATP receiver coils.

b) A650 Contractor shall provide drawing of ATP equipment enclosure. (CDRL)

c) A650 Contractor shall install and test A620 Contractor-furnished carborne equipment.

INTERFACE DATA SHEET

CONTRACT No.: A620 Automatic Train Control SUBSYSTEM: ATC Vehicle Equipment SPEC. REFERENCE: TP 8.4.2 Electrical Connection	LOCATION: ATC Wiring/Vehicle Wiring INTERFACE No.: 620-650-00-02 REV: REFER TO INTERFACE DATA TABLE:
CONTRACT No.: A650 Passenger Vehicle SUBSYSTEM: Interfaces SPEC. REFERENCE: TP 4.2.2.E District-furnished Carborne ATP Equipment	ATTACHMENTS: Attachment 1 Technical Requirements Attachment 2 Interface Drawing Utilization List

FUNCTIONAL DESCRIPTION:

Wiring interface between Passenger Vehicle and A620 Contractor-furnished ATP equipment; interconnection and compatibility of carborne ATP apparatus.

TECHNICAL REQUIREMENTS:

See Attachment 1.

PHYSICAL DESCRIPTION:

Wiring interface shall be through interface connectors furnished by A650 Contractor. Connector shall be mounted to A620 ATP equipment rack located in one cab of each dependent pair.

ORGANIZATION CONTACT:

SCRTD Project Engineer

COMMENTS:

REFERENCES:

See Attachment 2.

REVISION:		PREPARED BY:		IMPLEMENTATION RESPONSIBILITY (THIRD PARTY):
No.	DATE	INITIALS	DATE	

ATTACHMENT 1

TECHNICAL REQUIREMENTS

1) ATC Contractor A620

A620 Contractor shall provide connector requirements and mounting location details. (CDRL) A620 Contractor shall furnish and install wiring from ATP equipment to interface connections. A620 Contractor shall install male connector, furnished by A650 Contractor and mounted to ATP equipment rack before shipping to vehicle plant.

2) PASSENGER VEHICLE Contractor A650

Interface connectors shall be furnished by A650 Contractor. A650 Contractor shall furnish connector details. (CDRL) A650 Contractor shall furnish male chassis-mounted connector for installation by A620 Contractor on ATP equipment rack. A650 Contractor shall install and connect female connector to vehicle wiring. Connectors shall be within the ATP equipment enclosure located in the vehicle cab.

ATTACHMENT 2

INTERFACE DRAWING UTILIZATION LIST

A650 Reference Drawings

Drawing Q-087 Automatic Train Control/
Passenger Vehicle Interface,
Sheet 1 of 3

Drawing Q-088 Automatic Train Control/
Passenger Vehicle Interface,
Sheet 2 of 3

Drawing Q-089 Automatic Train Control/
Passenger Vehicle Interface,
Sheet 3 of 3

INTERFACE DATA SHEET

CONTRACT No.: A620 Automatic Train Control SUBSYSTEM: ATC Vehicle Equipment SPEC. REFERENCE: TP 8.3.2.A Receiver Coils	LOCATION: INTERFACE No.: REV: ATP Receiver Coils/ 620-650-00-03 Mounting Location REFER TO INTERFACE DATA TABLE:
CONTRACT No.: A650 Passenger Vehicle SUBSYSTEM: Interfaces SPEC. REFERENCE: TP 4.2.2 District-furnished Carborne ATP Equipment	ATTACHMENTS: Attachment 1 Technical Requirements Attachment 2 Interface Drawing Utilization List

FUNCTIONAL DESCRIPTION:

Interface between A620 Contractor-furnished ATP receiver coils and A650 mounting location.

TECHNICAL REQUIREMENTS:

See Attachment 1.

PHYSICAL DESCRIPTION:

Mount two ATP receiver coils ahead of lead axle on F-end of each vehicle.

ORGANIZATION CONTACT:

SCRTD Project Engineer

COMMENTS:

REFERENCES:

See Attachment 2.

REVISION:		PREPARED BY:		IMPLEMENTATION RESPONSIBILITY (THIRD PARTY):
No.	DATE	INITIALS	DATE	

ATTACHMENT 1

TECHNICAL REQUIREMENTS

1) ATC Contractor A620

A620 Contractor shall furnish receiver coil details, including proximity to rail. (CDRL) A620 Contractor shall furnish receiver coils with nonterminated leads, to be terminated by A650 Contractor, and installation instructions.

2) PASSENGER VEHICLE Contractor A650

A650 Contractor shall install A620 Contractor-furnished ATP receiver coils. A650 Contractor shall furnish and install cable connectors (both halves) for the truck terminations, cable, and mounting brackets.

ATTACHMENT 2

INTERFACE DRAWING UTILIZATION LIST

A650 Reference Drawings

Drawing Q-087 Automatic Train Control/Passenger Vehicle Interface, Sheet 1 of 3

INTERFACE DATA SHEET

CONTRACT No.:	A620 Automatic Train Control	LOCATION: Train Stop Trip Arm/Trip Cock	INTERFACE No.: 620-650-00-04 REV:
SUBSYSTEM:	Main Line Wayside Equipment	REFER TO INTERFACE DATA TABLE:	
SPEC. REFERENCE: Train Stop Layout	TP 7.4		
CONTRACT No.:	A650 Passenger Vehicle	ATTACHMENTS: Attachment 1 Technical Requirements Attachment 2 Interface Drawing Utilization List	
SUBSYSTEM:	Friction Brake		
SPEC. REFERENCE: Trip Cock	TP 15.4.7		

FUNCTIONAL DESCRIPTION:

Interface between A650 Contractor-furnished trip cock and A620 Contractor-furnished train stop trip arm.

TECHNICAL REQUIREMENTS:

See Attachment 1.

PHYSICAL DESCRIPTION:

Train stop trip arm mechanism located on wayside shall cause activation of carborne trip cock. The trip cock shall be self-resetting and upon activation shall cause an emergency brake application.

ORGANIZATION CONTACT:

SCRTD Project Engineer

COMMENTS:

REFERENCES:

See Attachment 2.

REVISION:		PREPARED BY:		IMPLEMENTATION RESPONSIBILITY (THIRD PARTY):
No.	DATE	INITIALS	DATE	

ATTACHMENT 1

TECHNICAL REQUIREMENTS

1) ATC Contractor A620

A620 Contractor shall furnish and install train stop trip arm mechanism located on the wayside as shown on A620 and A650 Contract Drawings.

2) PASSENGER VEHICLE Contractor A650

A650 Contractor shall furnish and install trip cock on the right side of each F-end truck and as indicated on A650 Contract Drawings.

ATTACHMENT 2

INTERFACE DRAWING UTILIZATION LIST

1) A620 Contract Drawings

Drawing Q-119	Layout of All Electric Train Stop - Tie & Ballast Area, Sheet 1 of 2
Drawing Q-120	Layout of All Electric Train Stop - Embedded Tie Area, Sheet 2 of 2

2) A650 Contract Drawings

Drawing V-022	Passenger Vehicle Trip Cock Installation

INTERFACE DATA SHEET

CONTRACT No.: A640 Communications SUBSYSTEM: Radio Subsystem SPEC. REFERENCE: TP 4.2.9 Mobile Radio Antennas	LOCATION: INTERFACE No.: REV: Communications Antenna/Vehicle 640-650-00-01 REFER TO INTERFACE DATA TABLE: Passenger Vehicle
CONTRACT No.: A650 Passenger Vehicle SUBSYSTEM: Interfaces SPEC. REFERENCE: TP 4.2.3 District-furnished Carborne Radio Equipment	ATTACHMENTS: Attachment 1 Technical Requirements Attachment 2 Interface Drawing Utilization List

FUNCTIONAL DESCRIPTION:

Interface between A640 Contractor-furnished antenna and A650 Contractor installation of antenna and equipment.

TECHNICAL REQUIREMENTS:

See Attachment 1.

PHYSICAL DESCRIPTION:

Radio antenna and antenna radome assembly for the communications radio shall be installed on the cab roof of one vehicle of each dependent pair.

ORGANIZATION CONTACT:

SCRTD Project Engineer

COMMENTS:

REFERENCES:

See Attachment 2.

REVISION:		PREPARED BY:		IMPLEMENTATION RESPONSIBILITY (THIRD PARTY):
No.	DATE	INITIALS	DATE	

ATTACHMENT 1

TECHNICAL REQUIREMENTS

1) COMMUNICATIONS Contractor A640

A640 Contractor shall furnish radio antennae and radio antenna radomes as shown on A640 Contract Drawing N-095. A640 Contractor shall provide required mounting detail drawings and installation instructions. (CDRL)

2) PASSENGER VEHICLE Contractor A650

A650 Contractor shall provide the following:

a) Provide space for two antennae on one vehicle of each dependent pair.

b) Install one antenna at an approved location, including mounting supports, hardware, and sealing of roof. Provide and install coaxial cable, including both halves of cable connectors, from antenna to radio.

c) Provide space and approved installation provisions for second future antenna and coaxial transmission cable into the cab.

ATTACHMENT 2

INTERFACE DRAWING UTILIZATION LIST

A640 Contract Drawings

Drawing	N-095	Communications Passenger Vehicle Mechanical Interfaces

INTERFACE DATA SHEET

CONTRACT No.: A640 Communications SUBSYSTEM: Radio Subsystem SPEC. REFERENCE: TP Section 4 Radio Subsystem	LOCATION: INTERFACE No.: REV: Communications Radio/Vehicle 640-650-00-02 REFER TO INTERFACE DATA TABLE: Passenger Vehicle
CONTRACT No.: A650 Passenger Vehicle SUBSYSTEM: Interfaces SPEC. REFERENCE: TP 4.2.3 District-furnished Carborne Radio Equipment	ATTACHMENTS: Attachment 1 Technical Requirements Attachment 2 Interface Drawing Utilization List

FUNCTIONAL DESCRIPTION:

Interface between A640 Contractor-furnished communications radio and A650 Contractor installation.

TECHNICAL REQUIREMENTS:

See Attachment 1.

PHYSICAL DESCRIPTION:

Two-way communications radio shall be installed in an approved naturally ventilated cabinet in the operator cab of one vehicle of a dependent pair.

ORGANIZATION CONTACT:

SCRTD Project Engineer

COMMENTS:

REFERENCES:

See Attachment 2.

REVISION:		PREPARED BY:		IMPLEMENTATION RESPONSIBILITY (THIRD PARTY):
No.	DATE	INITIALS	DATE	

ATTACHMENT 1

TECHNICAL REQUIREMENTS

1) COMMUNICATIONS Contractor A640

A640 Contractor shall furnish one communications radio as shown on A640 Contract Drawing N-095. A640 Contractor shall provide connector requirement information, mounting detail drawings of equipment and installation instructions. (CDRL)

2) PASSENGER VEHICLE Contractor A650

A650 Contractor shall provide the following:

a) Provide space for two radios. Space for each shall be not less than 15-in. deep by 19-in. wide by 10-in. high.

b) Install one radio and power supply. Provide power cable, both halves of connectors, installation hardware and interconnection wiring to LVPS. Install female connectors to car wiring. Provide male chassis-mounted connectors for installation on radio by A640 Contractor.

c) Install approved provisions for second future radio including wireway for power from Low-Voltage Circuit Breaker Panel.

ATTACHMENT 2

INTERFACE DRAWING UTILIZATION LIST

A640 Contract Drawings

Drawing N-095 Communications
Passenger Vehicle
Mechanical Interfaces

INTERFACE DATA SHEET

CONTRACT No.: A640 Communications SUBSYSTEM: Radio Subsystem SPEC. REFERENCE: TP 4.2.10 Train Identification & Control Unit	LOCATION: INTERFACE No.: REV: Communications TICU/Vehicle 640-650-00-03 REFER TO INTERFACE DATA TABLE: Passenger Vehicle
CONTRACT No.: A650 Passenger Vehicle SUBSYSTEM: Interfaces SPEC. REFERENCE: TP 4.2.4 District-furnished Carborne Train Identification and Control Unit Equipment	ATTACHMENTS: Attachment 1 Technical Requirements Attachment 2 Interface Drawing Utilization List

FUNCTIONAL DESCRIPTION:

Interface between A640 Contractor-furnished train identification and control unit (TICU) and A650 Contractor installation.

TECHNICAL REQUIREMENTS:

See Attachment 1.

PHYSICAL DESCRIPTION:

TICU furnished by A640 Contractor shall be located in the vehicle operator cab within easy reach of seated operator.

ORGANIZATION CONTACT:

SCRTD Project Engineer

COMMENTS:

REFERENCES:

See Attachment 2.

REVISION:		PREPARED BY:		IMPLEMENTATION RESPONSIBILITY (THIRD PARTY):
No.	DATE	INITIALS	DATE	

ATTACHMENT 1

TECHNICAL REQUIREMENTS

1) COMMUNICATIONS Contractor A640

A640 Contractor shall furnish TICU equipment and provide installation instructions to A650 Contractor. (CDRL)

2) PASSENGER VEHICLE Contractor A650

A650 Contractor shall install TICU, and furnish and install interfacing hardware and interconnecting wiring on both halves of required connectors.

ATTACHMENT 2

INTERFACE DRAWING UTILIZATION LIST

A640 Contract Drawings

Drawing N-095 Communications
Passenger Vehicle
Mechanical Interfaces

INTERFACE DATA SHEET

CONTRACT No.: A640 Communications SUBSYSTEM: Radio Subsystem SPEC. REFERENCE: TP Section 4 Radio Subsystem	LOCATION: INTERFACE No.: REV: CCU/ Radio Controls 640-650-00-04 REFER TO INTERFACE DATA TABLE: Passenger Vehicle
CONTRACT No.: A650 Passenger Vehicle SUBSYSTEM: Interfaces SPEC. REFERENCE: TP 4.2.3 District-furnished Carborne Radio Equipment	ATTACHMENTS: Attachment 1 Technical Requirements

FUNCTIONAL DESCRIPTION:

Interfaces between Communications radio furnished by A640 Contractor and Communications Control Unit furnished by A650 Contractor. Interface connections are at the RADIO VOLUME control, CHANNEL SELECTOR switch, RCC to PA switch, and RADIO, PUSH TO TALK switch.

TECHNICAL REQUIREMENTS:

See Attachment 1.

PHYSICAL DESCRIPTION:

Volume control for the cab radio speaker, radio CHANNEL SELECTOR switch, RCC to PA switch, and RADIO, PUSH TO TALK switch shall be furnished and installed by A650 Contractor on the vehicle CCU.

ORGANIZATION CONTACT:

SCRTD Project Engineer

COMMENTS:

REFERENCES:

REVISION:		PREPARED BY:		IMPLEMENTATION RESPONSIBILITY (THIRD PARTY):
No.	DATE	INITIALS	DATE	

ATTACHMENT 1

TECHNICAL REQUIREMENTS

1) COMMUNICATIONS Contractor A640

A640 Contractor shall furnish Communications radio and required interface detail drawings for installation of A650 Contractor-furnished RADIO VOLUME control, CHANNEL SELECTOR switch, RCC to PA switch, and RADIO, PUSH TO TALK switch. (CDRL)

2) PASSENGER VEHICLE Contractor A650

A650 Contractor shall furnish the following:

a) Provide and install RADIO VOLUME control and wiring per Technical Provisions Section 9. Base design upon potentiometer in parallel with Communications radio volume control furnished by A640 Contractor.

b) Provide and install CHANNEL SELECTOR switch and wiring per Technical Provisions Section 9. Base design upon a nine-wire interface with the radio furnished by A640 Contractor.

c) Provide and install RADIO, PUSH TO TALK switch and wiring per Technical Provisions Section 9.

d) Provide and install RCC to PA switch which connects the radio to the PA system. Base design on four-wire interface.

SECTION 5

MOCK-UPS AND MODELS

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SECTION 5

MOCK-UPS AND MODELS

5.1 GENERAL

This Section specifies requirements for designing and furnishing of mock-ups, prototype seats, and scale models.

5.1.1 Design Requirements

During design and construction of mock-ups, prototype seats, and scale models, emphasis shall be placed upon the following design requirements:

A. Optimum space utilization

B. Observance of wayside clearance constraints

C. Effective subsystem and component interface and integration

D. Human factors related to passengers, including elderly and handicapped, and to operating and maintenance personnel

E. Safety for passengers, operators, and maintenance personnel

F. Maintainability, accessibility, and serviceability

G. Industrial design, including selection of materials, colors, textures, and finishes

H. Emergency egress, equipment, and controls.

5.1.2 Delivery

Following completion and approval, mock-ups and models shall be delivered to the District.

5.2 MOCK-UPS

5.2.1 General

A. The following mock-ups shall be furnished:

1. Undercar Equipment Arrangement

2. F-end Exterior

3. Section of Vehicle Interior.

B. Construction of the mock-ups shall commence immediately following approval of pertinent drawings.

C. Mock-ups shall be constructed for the purpose of evaluating preliminary design work, spaces, accessibility, and interfaces, and providing for early identification of potential problem areas and development of alternative solutions.

D. Wood, plastics, or other appropriate materials shall be used to ensure mock-up structural integrity. The mock-up construction techniques shall permit modifications following the District's reviews. Where practicable, actual hardware and components shall be used in full-size mock-ups. Where an item is not available, a simulated item of the same size and configuration shall be substituted.

E. Mock-ups shall be adequately complete to demonstrate that the configuration meets requirements, including those of maintenance access, safety, and equipment interactions. The mock-ups shall verify and demonstrate acceptability with respect to human factors considerations.

5.2.2 Underfloor Equipment Arrangement

The mock-up of the underfloor equipment shall be 1/8-scale or larger and mounted on a mock-up of the floor structure. The mock-up shall demonstrate subsystems and component placement, accessibility, and interfaces. The underfloor mock-up shall demonstrate the following as a minimum:

A. Subsystems and components, wiring, raceways, conduit, piping, hoses, trucks, and couplers in their correct position and location

B. Ability to remove components from the undercar area

C. Access to components for maintenance

D. Clearance between the trucks and structures and underfloor equipment.

5.2.3 F-end Exterior

The mock-up of the F-end exterior shall be full-size and shall be installed on the end of the mock-up of the

vehicle interior. Mock-up shall accurately represent the exterior appearance of the F-end of the vehicle, including as a minimum:

A. The color, finish, and shape of the molded, fiberglass-reinforced plastic shell

B. Glazing and F-end door (same components as used for vehicle interior mock-up)

C. Complete fittings, such as F-end door hardware, grab handles, destination sign, windshield wiper, headlights, taillights, anticlimber, and exterior graphics and striping.

5.2.4 Section of Vehicle Interior

The mock-up of a section of the interior shall be full-size and comprised of approximately 40 percent of the vehicle. The mock-up shall duplicate the F-end of the interior, including the complete operator cab and the passenger compartment from the cab to the front edge of the center side doors. Mock-up shall include as a minimum:

A. Ceiling liners, side liners, window masks, and flooring complete and accurately simulated. Glazing shall be installed throughout.

B. Operable lighting, both in cab and in passenger compartment for preliminary testing of lighting levels and to assist with selection of lamp color. Cool, neutral, and warm color lamps shall be available for District's use in selecting lamp color.

C. HVAC diffusers shall be represented accurately and shall be operable to demonstrate air circulation.

D. Outfittings and Furnishings:

1. Prototype seats

2. One operable side door (other side door may be inoperable), including emergency release handle and access doors for maintenance of door operators. Access doors shall incorporate frames for system maps and advertising cards

3. Windscreens, complete with integral stanchions

4. Overhead handrail assembly, including stanchions connected to seat grabrails

5. Floor-to-ceiling stanchion in door vestibule

6. Intercom at wheelchair location

7. Interior hardware, such as door handles, latches, and locks

8. Emergency equipment, controls, and signage

9. Equipment labelling

10. Interior signage.

E. Cab Interior:

1. Control console realistically duplicating the controls, switches, indicators, built-in lighting, and other apparatus to be mounted on the console. Controls shall move as intended

2. All other control, annunciator, and circuit breaker panels

3. Equipment enclosures with operable enclosure doors

4. Operator seat (moveable)

5. Realistic duplication of ceiling and wall liners, window masks, inner face of the F-end door, and both sides of partition between cab and passenger compartment including operable door between cab and passenger compartment

6. Microphone

7. Speaker grilles

8. Sun visor (moveable)

9. Run number sign

10. Provisions for a fire extinguisher

11. Convenience outlet

12. Shoe paddle isolators

13. Coat hook

14. Sliding cab side windows

15. Cup holder

16. Equipment labelling.

5.2.5 Prototype Seats

Passenger and operator seats shall be prototypes representing production seats as closely as possible in appearance and seating comfort. Pedestals may be used to support the prototype seats in lieu of cantilevers from the side wall. To the extent practicable, the same materials, colors, and finishes as those to be used in production seats shall be used in:

A. Seat structure, including method of mounting seat to side wall

B. Cushion support and springing

C. Cushion material and cushion covering material, including methods for installing and replacing cushions and covering material

D. Seat back panel

E. Energy-absorbing crash pad

F. Energy-absorbing horizontal grabrail, with fitting for vertical stanchion.

5.2.6 Review by the District

The Contractor shall give 20 days advance notice that a mock-up will be complete, ready for review.

5.3 SCALE MODEL OF DEPENDENT PAIR

A scale model of a dependent pair of vehicles in the scale of 3/8 in. = 1 ft 0 in. shall be provided. The model shall be on running rails mounted on a wooden base and shall have a clear plastic dust cover. Drawings for the vehicle shall be approved before model construction begins. The model shall represent the approved design of the vehicles. Exterior features shall be represented with reasonable accuracy. Model shall include a contact rail with top coverboard.

5.3.1 Finish

A. One vehicle shall have a finished interior, with features represented with reasonable accuracy. The other vehicle shall not have a finished interior.

B. The roof of the vehicle with finished interior shall be removable. A clear plastic cradle shall

be provided for holding the roof when the interior is being viewed. The cradle shall be located to the side of the vehicle.

C. Finishes of the vehicles, including exterior stainless steel, fiberglass colors, graphics and color striping, interior wall and ceiling liners, upholstery fabrics and colors, and floor textures and colors shall be realistically represented.

5.3.2 Carrying Case

A lightweight, wood carrying case shall be provided for storing and transporting the scale model. Case shall protect the model from damage during shipment. Case shall be complete with cushioning foam rubber pads on the inside and hinged, recessed carrying handles on each end.

END OF SECTION

SECTION 6

WORKMANSHIP, PROCESSES, AND MATERIALS

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WORKMANSHIP, PROCESSES, AND MATERIALS

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WORKMANSHIP, PROCESSES, AND MATERIALS

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SECTION 6

WORKMANSHIP, PROCESSES, AND MATERIALS

6.1 GENERAL

This Section specifies the requirements for workmanship, processes, and materials (including components and equipment) to be applied in the design and construction of the vehicle.

6.1.1 Cited References

Organization	Number	Title
AA	ASD-1	Aluminum Standards and Data
AA	ED-33	Engineering Data for Aluminum Structures
AA	SAS-30	Specifications for Aluminum Structures
AAR	M-126	Forgings, Carbon Steel
AAR	M-127	Forgings, Alloy Steel
AAR	M-201	Steel Castings
AAR	M-618	Hose, Air, Wire Reinforced
AAR	S-501	Wiring and Cable Specification
AAR	-	Signal Manual, Volume 2, Section 6 - Relays
AATCC	86-1968	Drycleaning: Durability of Applied Designs and Finishes
AATCC	Method 16E	Colorfastness to Light: Water-cooled Xenon-arc Lamp, Continuous Light
AFBMA	STD9	Load Ratings and Fatigue Life for Ball Bearings
AFBMA	STD11	Load Ratings and Fatigue Life for Roller Bearings

Organization	Number	Title
ALCOA	TR-524	Specification Covering Use of Aluminum in Passenger Carrying Railway Vehicles
ANSI	B1.1	Unified Inch Screw Threads
ANSI	B16.18	Cast Copper Alloy Solder Joint Pressure Fittings
ANSI	B16.22	Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
ANSI	B31.1	Power Piping
ANSI	B31.3	Chemical Plant and Petroleum Refinery Piping
ANSI	Z26.1	Safety Code for Glazing Materials for Glazing Motor Vehicles Operating on Land Highways
ASME	Section VIII	Boiler and Pressure Vessel Codes - Pressure Vessels
ASME	Section IX	Boiler and Pressure Vessel Codes - Welding and Brazing Qualifications
ASTM	A29	Specification for General Requirements for Steel Bars, Carbon and Alloy, Hot-Wrought and Cold-Finished
ASTM	A31	Specification for Steel Rivets and Bars for Rivets, Pressure Vessels
ASTM	A131	Specification for Structural Steel for Ships
ASTM	A165	Specification for Electro-deposited Coatings of Cadmium on Steel
ASTM	A194	Specification for Carbon and Alloy Steel Nuts for Bolts for High-Pressure and High-Temperature Service
ASTM	A242	Specification for High Strength Low-Alloy Structural Steel

Organization	Number	Title
ASTM	A325	Specification for High-Strength Bolts for Structural Steel Joints
ASTM	A354	Specification for Quenched and Tempered Alloy Steel Bolts, Studs, and Other Externally Threaded Fasteners
ASTM	A490	Specification for Heat-Treated Steel Structural Bolts, 150 ksi Minimum Tensile Strength
ASTM	A502	Specification for Steel Structural Rivets
ASTM	A514	Specification for High-Yield Strength, Quenched and Tempered Alloy Steel Plate, Suitable for Welding
ASTM	A563	Specification for Carbon and Alloy Steel Nuts
ASTM	A588	Specification for High-strength Low-alloy Structural Steel with 50 ksi (345 MPa) Minimum Yield Point to 4 in. (100 mm) Thick
ASTM	A606	Specification for Steel, Sheet and Strap, High-strength, Low-alloy, Hot-rolled and Cold-rolled with Atmospheric Corrosion Resistance
ASTM	A666	Specification for Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar for Structural Applications
ASTM	A710	Standard Specification for Low-carbon, Age-hardening Nickel-Chromium-Molybdenum-Columbium, and Nickel-Copper-Columbium Alloy Steels
ASTM	A730	Specification for Forgings, Carbon and Alloy Steel, for Railway Use
ASTM	B26	Specification for Aluminum-Alloy Sand Castings

Organization	Number	Title
ASTM	B32	Specification for Solder Metal
ASTM	B33	Specification for Tinned Soft or Annealed Copper Wire for Electrical Purposes
ASTM	B85	Specification for Aluminum-Alloy Die Castings
ASTM	B108	Specification for Aluminum-Alloy Permanent Mold Castings
ASTM	B174	Specification for Bunch-Stranded Copper Conductors for Electrical Conductors
ASTM	B456	Specification for Electro-deposited Coatings of Copper Plus Nickel Plus Chromium and Nickel Plus Chromium
ASTM	B633	Specification for Electro-deposited Coatings of Zinc on Iron and Steel
ASTM	C297	Method of Tension Test of Flat Sandwich Constructions in Flatwise Plane
ASTM	C542-76	Specification for Lock-Strip Gaskets
ASTM	D395	Test Methods for Rubber Property - Compression Set
ASTM	D412	Test Methods for Rubber Properties in Tension
ASTM	D470	Methods of Testing Crosslinked Insulations and Jackets for Wire and Cable
ASTM	D471	Test Method for Rubber Property - Effect of Liquids
ASTM	D523	Test Method for Specular Gloss
ASTM	D573	Test Method for Rubber - Deterioration in an Air Oven
ASTM	D624	Test Method for Rubber Property - Tear Resistance

Organization	Number	Title
ASTM	D638	Test Method for Tensile Properties of Plastics
ASTM	D1149	Test Method for Rubber Deterioration - Surface Ozone Cracking in a Chamber (Flat Specimen)
ASTM	D1204	Test Method for Linear Dimensional Changes of Nonrigid Thermoplastic Sheeting or Film at Elevated Temperature
ASTM	D1683	Test Method for Failure in Sewn Seams of Woven Fabrics
ASTM	D2200	Pictorial Surface Preparation Standards for Painting Steel Surfaces
ASTM	D2240	Test Method for Rubber Property - Durometer Hardness
ASTM	D2671	Methods of Testing Heat-Shrinkable Tubing for Electrical Use
ASTM	E96	Test Methods for Water Vapor Transmission of Materials
ASTM	E119	Methods of Fire Tests of Building Construction and Materials
ASTM	E125	Reference Photographs for Magnetic Particle Indications on Ferrous Castings
ASTM	E162-78	Test Method for Surface Flammability of Materials Using a Radiant Heat Energy Source
ASTM	E446	Reference Radiographs for Steel Castings up to 2 in. (51 mm) in Thickness
ASTM	E662-79	Test Method for Specific Optical Density of Smoke Generated by Solid Materials
ASTM	F436	Specification for Hardened Steel Washers

Organization	Number	Title
AWS	A2.4	Symbols for Welding and Nondestructive Testing
AWS	A3.0	Welding Terms and Definitions
AWS	A5 Series	Specifications for Welding Electrodes
AWS	D1.1	Structural Welding Code
AWS	D1.2	Commentary on Structural Welding Code, Aluminum
AWS	D1.3	Structural Welding Code, Sheet Steel
AWS	D9.1	Specification for Welding Sheet Metal
AWS	D14.4	Classification and Application of Welded Joints for Machinery and Equipment
AWS		Welding Handbook
CAC	Title 8	Unfired Pressure Vessel Safety Orders
FAA	Regulation 25.853	Air Worthiness Standards: Transport Category Airplanes, Fire Protection, Compartment Interiors
IEEE	11	IEEE Standard for Rotating Electric Machinery for Rail and Road Vehicles
IEEE	16	American Standard for Electric Control Apparatus for Land Transportation Vehicles
IEEE	383	IEEE Standards for Type Test of Class IE Electric Cables, Field Splices, and Connections for Nuclear Power Generating Stations
NEMA	AB1	Molded Case Circuit Breakers
NEMA	LI1	Industrial Laminated Thermosetting Products

Organization	Number	Title
NEMA	MG1	Motors and Generators
NEMA	WC3	Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy
NEMA	WC5	Thermoplastic-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy
NEMA	WC7	Cross-Linked-Thermosetting-Polyethylene-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy
NFPA	70	National Electrical Code
NFPA	130	Standard for Fixed Guideway Transit Systems
NFPA	253	Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source
SAE	J429	Mechanical and Material Requirements for Externally Threaded Fasteners, SAE Standard
SAE	J1401	Road Vehicle - Hydraulic Brake Hose Assemblies for Use with Non-Petroleum Base Hydraulic Fluids, SAE Standard
US	FED-STD-191	Textile Test Methods
US	FED-STD-501	Floor Covering, Resilient, Nontextile, Sampling and Testing
US	FS DD-G-451	Glass, Float or Plate, Sheet, Figured, (Flat, for Glazing, Mirrors and Other Uses)
US	FS DD-G-1403	Glass, Float, Sheet, Figured, Coated (Heat-strengthened and Tempered)

Organization	Number	Title
US	FS TT-P-664	Primer Coating, Synthetic, Rust-Inhibiting, Lacquer Resisting
US	FS WW-T-799	Tube Copper, Seamless, Water (For Use with Solder - Flared - or Compression-Type Fittings)
US	MIL-STD-275	Printed Wiring for Electronic Equipment
US	MIL-STD-454	Standard General Requirements for Electronic Equipment
US	MIL-STD-883	Test Methods and Procedures for Microelectronics
US	MIL-STD-889	Dissimilar Metals
US	MIL-C-5015	Connector, Electrical, Circular Threaded, AN Type, General Specification for Materials
US	MIL-R-5757	Relays, Electromagnetic, General Specification for
US	MIL-R-6106	Relays, Electromagnetic, (Including Established Reliability (ER) Types), General Specification for
US	MIL-C-7438	Core Material, Aluminum, for Sandwich Construction
US	MIL-P-8053	Plywood, Metal-Faced
US	MIL-H-21040	Honeycomb Materials, Water Migration Resistant-Type, Structural, Paper Base
US	MIL-P-25690	Plastic, Sheets and Parts, Modified Acrylic Base, Monolithic, Crack Propagation Resistant
US	MIL-M-43719	Marking Materials and Markers, Adhesive, Elastomeric, Pigmented, General Specification for

Organization	Number	Title
US	MIL-W-81381	Wire, Electric, Polyimide-Insulated, Copper or Copper Alloy
US	MIL-A-83377	Adhesive Bonding (Structural) for Aerospace and Other Systems, Requirements for
UL	44	Rubber-Insulated Wires and Cables
UL	83	Thermoplastic-Insulated Wires and Cables
UL	347	High-Voltage Industrial Control Equipment
UL	508	Industrial Control Equipment

6.1.2 Nonspecified Material (CDRL)

Specifications of materials not specified herein shall be submitted for approval. Materials shall be clearly identified by name and address of manufacturer, generic name, and commercial trademark if appropriate. Specifications shall include flame spread index (I_s) and specific optical density (D_s) data.

6.2 FIRE SAFETY PERFORMANCE REQUIREMENTS

6.2.1 General

Material flammability, toxicity, and smoke emission requirements are specified herein. Nonspecified material flammability, toxicity, and smoke emission tests, including I_s and D_s tests, shall be performed by an approved independent laboratory.

A. Prior Test Results:

If approved, certified results of prior tests may be substituted in lieu of performing specified tests. Results shall indicate compliance with material standards and tests, as specified.

B. Nonmetallic Materials List: (CDRL)

A list of nonmetallic materials used in the vehicle shall be submitted for approval. Up to 5 lb per vehicle of small parts and components such as O-rings, gaskets, washers, short-length wiring, and other similar applications may be exempted from

this list. The list shall include the following as a minimum:

1. Generic name and trademark
2. Specific weight
3. Heat value per lb
4. Number of pounds per vehicle
5. Total heat value
6. Location and use
7. I_s
8. Flash point
9. D_s
10. Name of manufacturer and supplier
11. Information related to toxicity.

6.2.2 Fire Loading (CDRL)

The total fire loading of each vehicle shall not exceed 60 million Btu. No more than 33 million Btu fire loading shall be above the floor. The above-floor figure includes the floor covering but not the plymetal floor. Heating values shall be totaled separately for interior surface materials, for exterior materials (excluding underfloor), and for underfloor materials. Fire loading shall be calculated by multiplying the lower heating value of each nonmetallic material by the number of pounds of such material, and adding these values. Fire loading data and calculations shall be submitted for approval.

6.2.3 Toxic Gas Requirements

Materials recognized to have high toxic products of combustion shall not be used. The Nonmetallic Materials List will be evaluated by the District regarding toxicity. Approval of materials will be based upon products of combustion, quantity, location, and application.

6.2.4 Flammability of Materials

Nonmetallic materials shall meet the following requirements as a minimum:

A. Upholstery and other fabric materials shall be tested by FAA Regulation 25.853, Vertical Test, Appendix F (b), with the modifications listed below. Fabrics that must be machine washed or dry cleaned must meet these requirements after leaching according to FED-STD-191, Method 5830, or after dry cleaning according to AATCC 86. Fabrics that cannot be machine washed or dry cleaned shall be so labeled and shall pass the leaching tests after being cleaned as recommended by the manufacturer.

1. The average flame time after removal of the flame source may not exceed 10 sec.

2. Burn length shall not exceed 6 in.

3. Flaming dripping shall not occur.

B. Seat cushions shall pass the Radiant Panel Test of ASTM E162 with the I_s not exceeding 10, and with the following modifications:

1. Running or dripping of flaming material shall not occur.

2. Wire mesh screening shall be used in accordance with Section 5.9.2 of ASTM E162.

3. A 6-in. pilot flame shall be used with the burner tip situated 1-1/4 in. beyond the frame.

4. Aluminum foil shall be wrapped around the back and sides of the specimen.

C. The composite of seat cushions and seat upholstery coverings shall pass the test required for seat cushions, except the I_s shall not exceed 35.

D. Thermal and acoustical insulation (tested in its end-use configuration), seat frames, seat shrouds, and the interior surface of end caps shall pass the test required for seat cushions, except the I_s shall not exceed 25.

E. Wall and ceiling panels, opaque windscreens, partitions, and ducting (including materials in air handling enclosures) shall pass the test required for seat cushions, except the I_s shall not exceed 35.

F. Transparencies such as glazing, light diffusers, and transparent windscreens shall pass the test for seat cushions, except the I_s shall not exceed 100. Testing shall be on the vehicle interior side,

and, for transparencies located at the end of vehicles, the exterior side as well.

G. The floor-covering material placed over the structural floor shall be capable of passing the Flooring Radiant Panel Test of NFPA 253, with a minimum critical radiant flux of 0.50 W/cm^2. The flooring material shall be tested together with any underlay used.

H. Elastomers used as door nosing and seals and as window gasketing shall pass ASTM C542.

I. Wires for low-voltage circuits (less than 100 V ac or 150 V dc) shall meet the requirements of NEMA WC3 (Paragraph 6.19.6), WC5 and WC7, AAR S-501, or UL 44 for thermosetting insulation, and UL 83 for thermoplastic insulation.

J. Power cable shall meet the requirements of IEEE 383, Section 2.5, with the additional requirement that circuit integrity continue for 5 min after the start of the test.

6.2.5 Smoke Emission of Interior Materials

Nonmetallic materials shall be tested for smoke emission in accordance with ASTM E662. The optical density in both flaming and nonflaming modes shall not exceed 200 in 4 min.

6.2.6 Fire Characteristics of Exterior Materials

A. Whenever practical, apparatus shall be external to the passenger compartment to isolate potential ignition sources from combustible material and to control fire and smoke propagation. When necessary to install apparatus in the vehicles, provide shields or enclosures to isolate the apparatus from the passenger area.

B. Battery cases shall be spaced well away from combustible materials at the trucks, and away from undervehicle sources of high temperatures such as resistor banks and compressors.

C. Exterior surfaces of end caps shall pass the Radiant Panel Test of ASTM E162 with an I_s not exceeding 35.

D. End caps and their connections to the floor shall be designed to preclude propagation of underfloor fire to the interior.

E. End caps shall be completely separated from the vehicle interior by exterior panels, or the void space shall be fully filled with thermal insulation.

6.2.7 Underfloor Fire Separations

The floor assembly shall pass the ASTM E119 fire endurance test of its classification for a test time of at least 1 hr.

A. Test specimen shall be of approved design and construction. Test specimen shall be a full-width vehicle section, including that portion of the walls which extends below the upper surface of the floor. Specimen shall have an exposed area of 180 ft^2. If approved, the exposed area may be reduced to meet a length limitation imposed by the size of a test furnace, but the length shall not be less than 15 ft. No fewer than two typical penetrations, spaced from each other a distance no greater than that which will exist in the actual construction, shall be included in the test specimen. The specimen shall include typical splice configurations.

B. Specimen under test shall be placed within the combustion chamber and shall have clearances of not less than 8 in. from the furnace walls.

C. Test specimen shall be loaded to AW3 equivalent.

D. Conditions of acceptance for this test shall be those required for unrestrained assembly.

6.3 CONSTRUCTION MATERIAL

6.3.1 General

Prior to attachment or joining, materials shall be mill finished unless otherwise specified. Joining surfaces shall be clean and free from dirt, grease, and other contaminants.

6.3.2 Carbon and Low-alloy Steels

A. Structural heat-treated alloy steel intended for welding shall conform to the requirements of ASTM A514, Grade F, or be approved.

B. Low-alloy, high-tensile structural steel shall conform to the requirements of ASTM A242, A588, A606, A710, or as approved.

C. Castings shall conform to AAR M-201; ASTM E446, severity level 3 or better; and ASTM E125, Type II through IV discontinuity. Contractor shall evaluate and specify severity level based upon design justification which shall be subject to approval. Type I discontinuity shall not be permitted. The District reserves the right to require the Contractor to perform destructive testing of one or more of each shape up to 3 percent of total contract quantity to determine acceptability of metal in regions not exposed by various machining operations. If approved, nondestructive tests may be used to check soundness of castings. Porous and otherwise unsound castings shall be replaced.

D. Steel forgings shall comply with the following:

1. Carbon Steel: AAR M-126, Grade F

2. Alloy Steel: ASTM A730, Grade N or AAR M-127, Grade F.

E. Hot-rolled bar steel shall conform to the requirements of ASTM A29, grade designation 1044, 1050, or 1020.

6.3.3 Corrosion-resistant Steel

A. Corrosion-resistant steels that are visible to the public shall be austenitic stainless, conforming to: ASTM A666, Types 301, 302, 304, 316; AISI Types 301L, 304L, 316L, 347; or as approved.

B. Structural and sheathing members that are hidden from the public may be constructed from: ASTM A666, Types 201, 202; AISI Types 309, 310; or as approved.

C. The maximum grade of stainless steel in the cold-rolled condition shall be 3/4 hard.

6.3.4 Aluminum Alloys

A. Structural members shall be designed in accordance with the requirements of AA SAS-30 and AA ED-33. Allowance shall be made for effects of fatigue and for column and plate stability. Magnesium alloys shall not be used.

B. Sheet and plate aluminum alloys shall conform to AA ASD-1 for aluminum mill products 3003-H14, 5052-H32, 5052-H34, 5083-H321, 6061-T4, or 6061-T6.

C. Aluminum alloy castings shall conform to the requirements of ASTM B26, B85, and B108. Castings shall be free from blowholes, cracks, shrinkage, and other defects.

D. Aluminum alloy extrusions shall conform to the requirements of AA 5083-H111, 6061-T4, 6061-T6, 6063-T5, or 6351-T5 or T6.

E. Forming of aluminum parts, including joining by bolting, riveting, and welding, and protection of contact surfaces shall conform to the requirements of ALCOA TR 254 except as otherwise specified herein. Measures shall be taken to prevent electrolytic corrosion.

6.3.5 Plastics Panels, Liners, and Parts

A. Melamine finished panels shall be either a lamination of melamine facing permanently bonded to a substrate panel or a melamine facing integral with a substrate panel. Melamine facing shall be pigmented to match colors to be provided by the District.

B. Fiberglass-reinforced plastic panels and parts shall be phenolic or polyester resin substrate, glass fiber reinforced, and gelcoated or other face finished. Gelcoats or other face finishes shall be pigmented to match colors to be provided by the District.

1. Panels and parts shall be manufactured by an approved method.

2. Physical and mechanical properties shall be submitted for approval. (CDRL)

3. Panels and parts shall have greater thickness, or other means of hidden reinforcement, at attachment points and edges, and shall have no unfinished or sharp edges.

4. Gelcoats, or other face finishes, shall be resistant to scuffing, weather, perspiration, cleaning agents, and vandalism.

C. Finish and surface of panels shall facilitate the removal of graffiti of all types, including, but

not limited to, ink, lipstick, spray paints, and dry markers.

D. Interior panels shall be suitable for cleaning with a minimum of three widely available commercial and industrial cleaning agents that are known to be chemically compatible.

E. Polyvinylchloride and urethane plastics and similar smoke producing materials shall not be used unless approved.

6.3.6 Neoprene Foam

A. Neoprene foam shall be high-resiliency foam latex. Base elastomer of latex shall be polymerized chloroprene (polychloroprene) and shall contain no reclaimed rubber.

B. Structure of foam shall consist of a network of cells of uniform character that are essentially open and interconnecting.

C. Physical and performance characteristics shall be submitted for approval. (CDRL)

6.3.7 Sandwich Panels

A. Panels shall include, but not be limited to, plywood-, honeycomb-, or lumber-core panels with metal or other approved facing material. When finished, continuous edge reinforcement shall be incorporated if needed to facilitate transfer of stresses and to seal edge against moisture penetration and other damage.

B. Panel tests shall be as follows:

1. Indentation test shall be performed on face side of panel. Test shall consist of applying vertical load of 500 lb to 3/4-in. steel ball resting on surface of fully supported horizontal test panel. Permanent indentation shall not exceed 0.05 in. for any of five randomly spaced impressions per side.

2. Panel specimens shall be tested for tensile strength in flat plane in compliance with requirements of ASTM C297. Sandwich panel material shall be rejected if tensile failure occurs in bond between facing and core.

C. Materials Requirements:

1. Plywood-core panels shall conform to MIL-P-8053, unless otherwise specified.

2. Lumber shall be kiln dried and, unless approved otherwise, treated with fire retardant before using. Lumber shall be dressed on all surfaces to full dimensions.

3. Honeycomb-core panels shall conform to requirements of MIL-C-7438, MIL-H-21040, and MIL-A-83377, unless otherwise specified.

6.3.8 Elastomers

A. Elastomeric parts, including door and window seals, glazing strips, truck bumpers and snubbers, structural and compressible gaskets, and mounting pads shall be of neoprene unless otherwise approved. Elastomeric parts shall be subject to age control. No vehicle elastomeric part shall be installed that will reach its age date less than 9 mo after delivery of the vehicle.

B. Elastomeric parts shall be fabricated from materials which shall retain their physical properties under the environmental conditions, as specified. Elastomeric parts shall not be painted without approval.

C. Elastomeric materials shall demonstrate the minimum properties listed in Table TP-6-1 when tested in accordance with the indicated test methods.

TABLE TP-6-1

ELASTOMERIC MINIMUM PROPERTIES

Physical Property	ASTM Test Method	Performance Requirement Value
Hardness, Durometer A	D2240	45 to 75
Tensile Strength	D412	1,500 lb/in.^{2} minimum
Ultimate Elongation	D412	300% minimum
Ozone Resistance	D1149	No cracks
Heat Aging Resistance	D573	

TABLE TP-6-1 (Cont'd.)

ELASTOMERIC MINIMUM PROPERTIES

Physical Property	ASTM Test Method	Performance Requirement Value
Oil Aging Resistance	D471	+80% compression set maximum
Permanent Set Resistance	D395 (Method B)	25% compression set maximum
Tear Resistance	D624	200 lb/in. minimum

D. Metal parts to which elastomeric parts or materials are cured shall be made of SAE 1020 or AISI 1045 hot-rolled steel.

E. Unless otherwise specified, elastomeric parts shall be natural finish, smooth, and colored black.

6.3.9 Decals

A. Marking film decals and adhesives shall conform to requirements of MIL-M-43719, Type II. Application techniques shall be in accordance with manufacturer's recommendations.

B. Physical Properties:

1. Lettering film shall, when applied, hide contrasting background.

2. There shall be initial 60-degree gloss value of 40 when tested in accordance with ASTM D523.

3. Films shall retain adhesive properties after 1 week of continuous exposure to temperature of 150°F.

4. Films shall conform to contours of the vehicle interior and exterior surfaces at locations where decals are to be applied.

5. Overall thickness of processed film shall be between 1.5 and 4.5 mil.

6. Films shall withstand immersion in either distilled water or SAE No. 20 motor oil for 24 hr at temperatures of from 70 to 90°F.

7. Marking films shall withstand effects of detergents and brushes used in washing procedures for removal of graffiti.

8. Films shall be resistant to cracking and crazing.

6.3.10 Adhesives

Adhesive bonding of structural elements will not be permitted unless approved. A list of adhesives used on the interior, including procedures for their use, shall be submitted for approval. (CDRL)

6.4 ELECTRICAL MATERIAL AND INSTALLATION

6.4.1 General

Electrical controls shall comply with IEEE 16. Wiring performance and physical requirements for the vehicle, except for internal wiring of carborne equipment, shall conform to the following:

A. Insofar as practicable, wiring shall be prefabricated into standard harnesses and shall be installed with identical arrangement and location in each vehicle having similar equipment.

B. Conductors shall be a soft, annealed, tinned copper conforming to ASTM B33.

C. Conductors shall have minimum stranding complying with:

1. AAR S-501, Class I or equivalent, for general purpose carbody wire

2. ASTM B174, Class K, for flexible wire between carbody and electric coupler or truck-mounted equipment.

D. Minimum Voltage Ratings:

1. 300 V cable shall be used for low-voltage control circuits.

2. 600 V cable shall be used for auxiliary power circuits.

3. 2,000 V cable shall be used for primary power circuits.

E. Multiconductor Cable: Outer jacket material of multiconductor cable shall be the same as that used to insulate individual conductors unless physical considerations indicate a different material with superior characteristics. Each multiconductor cable shall provide at least 10 percent spare wires of each wire type. One spare wire of each type shall be provided if number of wires is less than ten.

F. Electrical and physical requirements of NEMA WC 3 for rubber insulations, NEMA WC7 for thermosetting insulations, AAR S-501 for crosslinked polyolefin insulations, and NEMA WC5 for thermoplastic insulations shall be met. Wire complying with the requirements of MIL-W-81381 may be used within enclosed equipment or otherwise suitably protected locations.

1. Insulation for general purpose wire and cable shall be suitable for use at conductor temperatures of 75°C minimum in dry or wet locations.

2. Insulation for high-temperature applications, such as connecting to heaters, shall be suitable for use at maximum conductor temperatures of 110°C in dry or wet locations.

3. Asbestos-, urethane-, polyvinylchloride-, and polytetrafluoroethylene-based insulations or jacket materials shall not be used.

G. Shielding shall be used over multiconductor cable for safety-critical circuits. Shielding material shall be woven wire providing not less than 60 percent coverage and shall be soft, annealed, tinned copper.

H. Nonconducting separator may be applied between conductor and insulation on conductor sizes greater than No. 5 AWG.

I. Insulation and shielding for communications wire and cable shall have an effective capacitance between two conductors of a twisted pair of not greater than 30 pF/ft.

1. Each twisted pair shall be shielded with metalized foil or woven wire providing not less than 72 percent coverage.

2. Shield drain or braid wire shall be soft, annealed, tinned copper.

3. Jacket shall be waterproof and abrasion-resistant and shall provide insulation resistance greater than 1 Mohm/ft between shield and water.

6.4.2 Wire Testing

A. Dielectric: Test per Table 1A of ASTM D470, ozone-resistant insulation material, 133 percent insulating levels.

B. Insulation Resistance: Test per ASTM D470; minimum accepted value shall be 1 Mohm/ft.

C. Spark Test: Test per UL 44.

D. Air Aging:

1. Test per ASTM D638. Age sample for 7 days at 302°F in an air oven. Minimum tensile strength shall not be less than 85 percent of the unaged values. Minimum elongation shall not be less than 55 percent.

2. Test per IEEE 383 and ASTM D573 for extended life characteristics.

E. Cold Bend: Test per NEMA WC5 or NEMA WC3.

F. Chemical Resistance Test: Length of sample, initial insulation diameter, and total weight shall be measured and recorded. Individual samples shall be immersed in each of the test fluids to within 3 in. of each end for 24 hr at 149°F. During the immersion stage, the minimum bend radius of the sample shall be ten times the diameter of the wire being tested. Upon removal from the test fluid, the sample shall be cooled to room temperature for 1 hr 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 shall include:

1. Humble No. 2214 Railroad Diesel Lubricating Oil

2. Mineral oil

3. Hydrochloric acid, nitric acid, sodium hydroxide, sulfuric acid, and typical cleaning solutions used in vehicle washing operations

4. Potassium hydroxide

5. Petroleum distillates (i.e., graffiti removers)

6. Kerosene solvents

7. Trisodium phosphate solution

8. Water.

G. Temperature Transient Test: Samples of insulated wire and cable shall be subjected to maximum temperature transients imposed by the operating loads and the operating environment, followed by a cold bend test, as specified, after the insulation has reached the minimum operating temperature imposed by that environment.

H. Corrosivity Resistance: Test per ASTM D2671, copper mirror. Copper film corrosion shall not exceed 5 percent.

6.4.3 Wire Installation

A. Type of wire, insulation, materials, shielding methods, and identification of wire and cable used shall comply with NEMA WC3 for rubber-insulated wire and cable, NEMA WC5 for thermoplastic-insulated wire and cable, NEMA WC7 for thermosetting wire and cable, and AAR S-501 for cross-linked polyolefin-insulated wire and cable. Wire complying with the requirements of MIL-W-81381 may be used within enclosed equipment or otherwise suitably protected locations.

B. Wiring shall comply with requirements of NFPA 70, Chapter 3.

C. Clearance and Creepage Distance:

1. Electric apparatus and associated cabling shall be designed with clearance and creepage distance in accordance with the environmental conditions to which the apparatus and cabling will be subjected. The following definitions shall apply:

a. Clearance: The minimum separation in air between two conductors or between conductors and ground. Also, called "air gap."

b. Creepage Distance: The shortest distance along an insulating surface between two conductors or between a conductor and ground, over which a current can flow

along the surface or through joints of the insulation.

c. Normal Apparatus: Electric apparatus which is reasonably expected to remain clean and dry. Normal apparatus includes:

1) Apparatus housed in sealed enclosures

2) Convection-cooled electronic control apparatus located inside a vehicle and protected against dirt, moisture, and the intrusions of contamination incidential to interior vehicle cleaning

3) Underfloor apparatus housed in well-gasketed enclosures and cooled either by convection or well-filtered air

4) External terminal posts well-protected by tape or tight-fitting boots.

d. Dirty Apparatus: Electric apparatus which is exposed to contamination, and is essentially unenclosed, or is subject to build up of ionized gases. Dirty apparatus includes brake resistors, open fuse holders, unvented line switches, circuit breakers, and frequently-switched contactors.

e. Special Apparatus: Electric apparatus which is operating under especially adverse conditions for which the clearance and creepage distance given for dirty apparatus have proven to be inadequate, for example, wooden third rail shoe beams.

f. The governing voltage, V, between two conductors or between a conductor and carbody ground shall be the greater of the following:

1) Working voltage corresponding to nominal system-input conditions, but not less than 80 percent of the maximum voltage during normal operating conditions

2) Nominal internally-generated voltage, but not less than 80 percent of the

maximum-normal internally-generated voltage.

g. The wave form of the governing voltage shall be taken to be as follows:

1) For Essentially Sinusoidal Wave Form: The rms value

2) For Essentially dc Wave Form: No additional allowance for up to 20 percent ripple (average to peak value)

3) For Complex Wave Form: The dc value plus 71 percent of the peak of the ac component.

2. The clearance and creepage distance given herein shall not apply to the following:

a. Inside encapsulated assemblies

b. In the inner layers of multiple-layer printed-circuit cards

c. To conformal-coated printed-circuit boards, including connectors

d. To current collection apparatus

e. To spacings between open contacts of switch gear.

3. Clearance shall be as follows:

a. For Normal Apparatus:

1) For Governing Voltage up to and Including 300 V ac or dc: UL 508

2) For Governing Voltage Greater than 300 V ac or dc: NFPA 130.

b. For Dirty Apparatus:

1) For Governing Voltage up to and Including 500 V ac or dc, not less than:

Clearance = 0.197 + 0.0020V (in.)

2) For Governing Voltage Greater than 500 V ac or dc, not less than:

Clearance = 0.787 + 0.0008V (in.)

c. For Special Apparatus: By analysis.

4. Creepage distance shall be as follows:

a. For Normal Apparatus:

1) For Governing Voltage up to and Including 300 V ac or dc: UL 508

2) For Governing Voltages Greater than 300 V ac or dc: NFPA 130.

b. For Dirty Apparatus:

1) For Governing Voltage up to and Including 300 V ac or dc: UL 508

2) For Governing Voltage Greater than 300 V ac or dc, not less than:

Creepage = 1.00 + 0.0018V (in.)

c. For Special Apparatus: By analysis.

D. Wire Runs:

1. Wires shall be run in covered metal raceways with removable covers and continuous and unbroken lengths between connection points. Firestops shall be provided at floor penetrations, at entrances to and exits from major components, and at changes of direction to control the spread of fire. Water drainage shall be provided at low points. Metallic conduits may be used for special applications if approved.

2. Wiring arrangement shall be grouped to allow easy connections at equipment enclosures. Wireways shall be extended into devices and equipment enclosures where practical.

3. Conductors of different circuit voltages shall be run separately, as indicated. Circuit conductors carrying alternating current shall be grouped in the same raceway to prevent heating of adjacent metal surfaces by induction. Conductors within conduit or raceway enclosures shall be insulated for maximum voltage of any conductor within the same raceway enclosure. Wires connected to control apparatus shall not touch wires connected to a

higher voltage source than that for control voltage.

4. Watertight bushings and drip loops shall be provided on exposed cables to prevent fluid runoff into connected equipment.

5. Slack shall be provided at equipment terminals to allow for shock and vibration movements and equipment shifting for alignment, cover removal, and component replacement.

6. Sufficient wire length shall be provided at points of termination to allow for connections without the use of splices and to allow for a minimum of two service repairs. Splices outside equipment enclosures shall be as approved.

7. Flexible conduits shall be used where flexibility and mechanical protection are required.

E. Wire Supports:

1. Exposed wiring shall be supported at not greater than 30-in. spacings.

2. Cables shall be cleated or properly protected from abrasion where they pass through bulkheads and structural members. Cleats and cable supports shall have inserts that prevent chafing and cutting of cable.

F. Watertight strain relief bushings or watertight quick disconnects shall be used where cable enters or leaves junction boxes or equipment enclosures.

G. Junction boxes shall be provided specifically for application with cable systems. Boxes shall be of sufficient size to provide free space for conductors, in accordance with NFPA 70, Chapter 3. Boxes shall be clean-cut in every detail; designed to preclude abrasion and damage to wiring; smooth and free from scars, holes, and blemishes; and supplied with screw-fastened gasketed covers.

H. Multiple-conductor harnesses containing more than two wires shall be provided in prefabricated, bench-tested, interchangeable harnesses. Each harness shall be permanently marked within 1 to 3 in. of each termination, using machine-printed permanent plastic sleeves or wire identification printed along wire.

I. Cables shall be identified at both ends of run, adjacent to terminals, with permanent plastic sleeves or stamps. Each conductor shall be identifiable by a combination of legibly machine-printed letters and numbers spaced a maximum of 18 in. center-to-center. Color-coded wire marking or approved equivalent shall be used for system identification.

J. Wire Code System: (CDRL)

1. Basic identification shall be assigned to each separate system of circuits. Lines of any system shall be designated with a basic single capital letter which shall prefix the numbers added in sequence after a line passes through major circuit components or devices.

2. Contractor shall coordinate wiring designations so that interconnections between different subsystems are identifiable, as specified.

K. Each conductor shall have a terminal.

1. Compression terminals shall be attached to conductors with manufacturer-recommended crimping tools. The number of different types of crimping tools required shall be minimized. "Fast-on" type terminals shall not be used, unless otherwise approved.

2. Solder connections shall not be used except for printed or wired circuit applications within a subsystem or component.

3. Communications, static control equipment, and lighting fixtures shall use cable terminations with separable connections.

L. Terminal blocks shall be modular with stud or screw terminals. Individual modular blocks shall have the following features:

1. Cross-connectable by shunting straps

2. Facility for affixing markers for identification

3. Metal parts recessed below surface of insulating material on the mounting side of the terminal blocks.

M. Connectors shall be used only where necessary for vehicle maintenance and where specified. Where

molded-watertight connectors are used for exterior applications, cable shall be sealed and vulcanized.

1. Connectors that are external to equipment enclosures and connectors in safety-critical circuits shall be quick-disconnect, three-point-positive-lock bayonet type with metal housings that are watertight when connected. Gold-plated resilient-mounted, crimp-type contact pins rated for 500 insertions shall be used for safety-critical circuits and low-level logic signals, unless otherwise approved. Silver-plated pins shall be used on other applications.

2. Connectors within equipment enclosures, except connectors in safety-critical circuits, shall be three-point-positive-lock bayonet type, or approved equivalent.

3. Connectors shall meet the environmental and electrical requirements of MIL-C-5015.

4. For moisture protection, back shells, sealing glands, encased moldings, or other means specifically designed for the connector and cable system used shall be provided.

5. Commercial connectors may be used with approval for interior applications that are not safety-critical, such as lighting and speaker disconnects.

6. Cable connectors shall be spaced far enough apart so that they can be grasped firmly for connecting and disconnecting. Connectors shall be properly labeled and keyed so that they cannot be interchanged nor improperly installed. Signal and power pins shall not be adjacent.

N. Splices or tapes shall not be used in raceways or cable runs.

O. Ten percent spare wires shall be provided for carbody harnesses and cables. Half of spare wires shall terminate in unused connector pins and terminal block terminals. Remaining wires shall be tied back near terminal.

P. Wiring continuity shall be tested and high-potential tested in accordance with IEEE 16.

Q. Neoprene-jacketed flexible cable may be used for truck wiring and in areas of free movement, provided that adequate clamping, support, and abrasion protection are employed. Heat-shrinkable sleeving may be used in special locations if approved.

R. Wiring within the floor, sides, ends, and roof shall be carried in raceways, conduit, or cable runs. Wiring for ceiling-mounted equipment shall be installed in raceways or preassembled harnesses.

S. Cables used for connections between carbody and traction motors, carbody and ground brushes, and carbody and current collectors shall have a high degree of flexibility. Flexible cables used for these three purposes shall have an approved protective jacket. The total insulation thickness shall equal or exceed that specified in NEMA WC3 for phase-to-phase voltage of 2,000 V and insulation levels of 133 percent.

T. Traction motor leads shall have an insulation suitable for the operating environment and shall be supported and protected so as to offer the least possible chance of mechanical damage. Traction motor leads, where entering the frame, shall be securely clamped and shall fit snugly so as to prevent moisture from entering the traction motor case. Drip loops shall be formed in traction motor leads so as to minimize water running along the lead onto the traction motor case.

6.4.4 Motors

A. Except for traction motors, the following motor data shall be provided with each motor dimensional print: (CDRL)

1. Manufacturer and type

2. Horsepower output, insulation, and high-potential test requirements

3. Full-load speed (rpm)

4. Full-load torque

5. Efficiency at 100 and 75 percent loads

6. Weight

7. Locked-rotor current

8. Full-load current

9. Lubrication data

10. Commutator construction

11. Field and armature coil details

12. Motor rebuilding information

13. Brush type and life expectancy

14. Inrush current at minimum, nominal, and maximum line voltage

15. Commutator bar-to-bar voltage.

B. Alternating Current Motors:

1. Motors shall be squirrel-cage induction type, rated for ambient temperature encountered in installed location. Energy-efficient design shall be provided.

2. Motors shall be designed, constructed, and tested in accordance with NEMA MG1. Motors weighing more than 25 lb shall incorporate lifting provisions and be complete with suitable handling devices.

3. Motors shall be suitable for full-voltage starting and capable of accelerating load with 90 percent rated voltage at motor terminals. Three-phase motors, NEMA MG1 Design B or Design C, shall be used.

C. Low-voltage dc motors shall be designed, constructed, and tested in accordance with NEMA MG1 unless otherwise approved.

D. Ac and low-voltage dc motor bearings shall be designed in accordance with AFBMA STD9 and AFBMA STD11 as applicable for L_{10} life of 50,000 hr and shall be grease-lubricated. Motors shall be provided with automatic-resetting thermal protection built into motor, or other approved current limiting features.

E. Auxiliary Direct Current Motors:

1. Motors shall be designed to meet the noise and vibration requirements (Reference: Section 3) over the ranges of voltage and connected load.

Motors shall comply with the following as a minimum:

a. Insulation shall be NEMA Class H minimum and installed by the vacuum pressure-impregnating method.

b. Armature connections on motors rated at 5 hp and above shall be TIG welded.

c. Commutator shall be dynamically balanced and run-out shall not exceed 0.001 in.

d. Inside surfaces of housing near the commutator shall be coated with track-resistant epoxy enamel.

e. Brush holders shall apply constant pressure throughout the wear length of brushes.

f. Motors shall meet commutation tests as required by IEEE 11.

2. Bus bars shall be fabricated from hard drawn copper. As a minimum, the connection points shall be plated to maintain good conductivity throughout the life of the equipment. The current density shall not exceed 1,000 A/in.^{2} of cross section.

6.4.5 Miscellaneous Electrical Equipment and Devices

A. Motor Starters:

1. Auxiliary motors shall be equipped with individual starters, except that motors powered by primary power or LVPS, which are capable of full-voltage starting with normal starting torque and noninjurious heating when operating within the voltage tolerance specified, may not require starters, if approved.

2. Starters shall be rated for continuous duty at service indicated, equipped with magnetic holding coils, and capable of resetting automatically upon loss of supply voltage.

3. Starters shall be equipped with sufficient auxiliary contacts to comply with requirements for annunciator circuits, as indicated.

4. Thermal overload protection shall be provided.

5. Three-phase starters shall be three-pole. Reduced-voltage starters shall be equipped with adjustable reset circuits which shall provide quick release and restart down to 20 percent below nominal voltage.

B. Circuit Protection:

1. Circuit breakers shall be molded-case type, single- or multi-pole, with frame size suitable for continuous current and interrupting duty.

   a. Handles shall indicate ON, OFF, and TRIPPED positions. Each pole shall be equipped with trip mechanism consisting of inverse time element for overload protection and instantaneous magnetic element for short circuit protection. Each pole shall be equipped with adequate means of arc extinction to prevent flashover.

   b. Multipole breakers shall operate contacts simultaneously. Breaker current rating shall be clearly visible after installation and comply with requirements of NEMA AB1.

   c. Continuous current rating shall be selected in accordance with NFPA 70 for load and type of service indicated.

   d. Electrically controlled breakers shall be equipped for operation from LVPS. Circuit breakers shall be properly coordinated with protective devices.

2. Fuses shall be provided as indicated for 750 V dc circuits, suitable for continuous current and interrupting duty. Fuses shall be properly coordinated with transient suppressors. Fuses shall not be used for ac and low-voltage applications. Indicator-type fuses shall be permitted within electronic assemblies and special applications with approval.

C. Switches:

Switches shall be heavy-duty, with electrical characteristics, ratings, and accessories as required for circuit application. Switches interfacing with the ATC system shall have double-break contacts, unless otherwise approved.

D. Relays and Contactors:

1. Low-current relays (less than 10 A per pole) shall have silver-alloy contacts. Very low current relays (1A and less) shall have gold-plated, silver-alloy contacts. Low-current and very low current relays that have not been proven in rail service shall comply with requirements of MIL-R-5757. Higher-current relays and contactors that have not been proven in rail service shall comply with requirements of MIL-R-6106.

2. Relays shall be capable of at least one million electrical operations at rated contact capacity. Plug-in relays shall be secured in their sockets by mechanical restraint.

3. Relay and contactor coils shall be suppressed to mitigate transient voltage spikes. Relays and contactors, except low-power miniature relays mounted on printed-circuit boards, shall incorporate means of visually determining whether contactors are picked up or dropped out.

4. Relays used in safety-critical circuits shall comply with requirements of the AAR Signal Manual, Volume 2, Section 6 - Relays, unless otherwise approved. Relays interfacing with the ATC system shall have double-break contacts, unless otherwise approved.

E. Pushbutton Switches and Indicators:

1. Pushbutton (including illuminated) switches shall have silver-plated or silver-alloy terminals.

2. Indicators and pushbutton switches shall have insulation resistance of at least 1 Gohm to case at 500 V dc. Indicators shall be two-lamp type with one-color projection. Relamping of indicators shall be from front.

3. Contacts shall have maximum resistance of 0.10 ohm at 3 V dc and 10 mA load. Minimum open contact resistance shall be 50 Mohm.

4. Contacts shall be rated for inductive loads. The contacts shall normally operate at not more than 20 percent of the manufacturer's inductive rating for 25,000 cycles of operation at 25°C. The electrical-contact material shall be silver or silver with a gold flash or gold plate, and

be normally a break-before-make type. Push-button switches interfacing with the ATC system shall have double-break contacts, unless otherwise approved.

F. Inductors:

Inductors shall have vacuum-impregnated windings and be rated to withstand at least twice the maximum peak-to-peak voltage expected in normal operation. Inductors shall not emit audible noise in excess of 65 dB referred to 20 microPa at a distance of 2 ft while operating at rated voltage and load.

G. Transformers:

Transformers shall have vacuum-impregnated windings and have minimum interwinding breakdown voltage of 1,500 V dc. Transformers shall not emit audible noise in excess of 65 dB referred to 20 microPa at a distance of 2 ft while operating at rated voltage and load.

6.4.6 Miscellaneous Electronic Components

A. Electronic components shall comply with the following requirements, unless otherwise specified or approved:

1. Components shall be free of storage and handling damage. Components shall be clearly and permanently labeled with values or type identification.

2. Components as applied in their circuits shall be derated by at least 25 percent from manufacturer's ratings.

3. For power semiconductors, derating of current shall be such that manufacturer's maximum junction temperature is not exceeded with 25 percent increase in semiconductor current above that required for performance.

B. Semiconductor devices shall be available from more than one qualified manufacturer.

C. Resistors other than power/braking resistors shall be derated 50 percent minimum.

D. Capacitors shall be rated for transients of at least twice the maximum peak voltage expected in normal operation and be applied at continuous

voltages not greater than 80 percent of rated working voltages.

E. Printed circuit boards shall be of glass epoxy construction, comply with requirements of NEMA LI1, grade FR-4, and have minimum nominal thickness of 0.063 in. Conductor material shall be copper. Thickness and width of conductors shall be determined on basis of current carrying capacity and in accordance with MIL-STD-275, Figure 1. Minimum conductor thickness shall be 2 mil.

1. Printed circuit boards and components shall be covered with conformal coating 0.003 to 0.007 in. thick.

2. Edge connectors and boards shall be keyed to prevent insertion of board in wrong position and mounted for ease of board removal and replacement.

3. Component labeling shall be provided.

F. Microprocessor components and other integrated circuits shall be screened to MIL-STD-883. Plastic packages will not be allowed.

1. Integrated circuit packages with more than 24 pins shall be mounted in sockets and not soldered directly to the printed circuit boards. The sockets shall retain the integrated circuits under worst-case resonance conditions when subjected to the shock and vibration specified (Reference: Section 3).

2. Integrated circuits containing microprocessor firmware shall be mounted in sockets to permit removal for reprogramming. The integrated circuits shall be positively identified with the configuration revision of embedded software. The microprocessor software shall include provisions to inhibit equipment operation unless a correctly configured set of integrated circuits, containing the firmware, are inserted into the correct sockets on the printed circuit boards. Firmware is defined as computer data loaded in a class of memory which cannot be dynamically modified by the computer during processing.

6.5 PIPING

6.5.1 Material

Seamless copper tubing or stainless steel tubing shall be used, unless otherwise specified or approved.

A. Copper tubing shall be in accordance with FS WW-T-799, Type L, Class I. Fittings shall be wrought copper or cast copper to conform with ANSI B16.22 and B16.18. Copper tubing for air conditioning lines shall be Type K.

B. Pipe insulation, where used, shall be fire-retardant, closed-cell foam.

C. Sealing compound shall be used to seal threaded pipe connections and fittings.

6.5.2 Piping Requirements

A. Air hoses shall comply with AAR M-618 and have AAR-approved reusable fittings.

B. Hydraulic hoses shall comply with SAE J1401.

C. Installation, cleaning, and testing of piping shall be in accordance with ANSI B31.1.

D. Piping shall be adequately clamped to prevent vibrating, rubbing, and chafing. Clamps shall be provided with insulation to prevent noise generation. Copper tubes shall not be in contact with aluminum parts.

6.5.3 Unfired Pressure Vessels

A. Unfired pressure vessels shall conform to the following:

1. ASME Boiler and Pressure Vessel Code, Section VIII

2. CAC, Title 8, State DIS, Subchapter 1, Unfired Pressure Vessel Safety Orders.

B. Each vessel shall be pressure-tested and ASME code-stamped.

C. Reservoirs shall have check valves and, if required, pressure reducing valves. Installed reservoirs shall slope from end to end and have drain cocks and drain plugs located at the lowest

point. Reservoirs shall be corrosion-protected inside and out.

D. Test reports for each pressure vessel shall be maintained as part of QA records.

6.6 FASTENERS

6.6.1 General

5 A. Fasteners for primary maintenance level access 5
5 shall be either per ANSI B1.1 or International 5
5 Organization for Standardization (ISO) equivalent 5
5 standard. Fasteners at the primary maintenance 5
5 level shall not be a mixture of ANSI and ISO fas- 5
5 teners. Fasteners within subsystems shall be to 5
5 either ANSI or ISO standards. ANSI and ISO fas- 5
5 teners shall not be mixed within the same subsystem 5
5 unless otherwise approved. Stainless steel bolts 5
and nuts shall be used for fastening of stainless steel. Self-tapping screws shall not be used. Special-application fasteners shall be approved.

B. Fasteners shall be stainless steel or cadmium-plated, chrome-plated, zinc-plated, or galvanized steel as approved.

1. Cadmium plating per ASTM A165, Type NS

2. Chrome plating per ASTM B456 Classification SC-3

3. Galvanizing: Hot dip with purest quality zinc, having minimum thickness of 1 mil.

4. Zinc plating per ASTM B633, Class Fe/Zn5, Type III.

6.6.2 Bolts and Nuts

A. General:

1. Aluminum alloy bolts, nuts, and screws shall not be used.

2. Lock bolts with swaged collars will be permitted.

B. Bolts shall be furnished with high-temperature elastic stop nuts or drilled for use with, and furnished with, cotter pins and nuts suitable for cotter pin applications. Bolts shall not be peened. Other types of locking devices may be used subject to approval.

1. Bolts shall have minimum of one and one-half threads and maximum of six threads protruding beyond nut or fastener.

2. Bolts for use in structural applications shall be no smaller than 0.375-in. diameter and sized so that the number of different sizes shall be held to a minimum.

3. Carbon and alloy steel bolts shall comply with ASTM A325, A354 Grade BD, SAE J429 Grade 5, or A490, as applicable.

C. Bolts and nuts shall have ANSI B1.1 thread series threads with Class 2 fit minimum, or approved equivalent if to ISO standards.

D. Nuts shall comply with ASTM A194, A325, or A563 as applicable.

E. Washers shall conform to ASTM F436.

6.6.3 Rivets

A. Blind rivets shall not be used unless otherwise approved.

B. Steel rivets shall comply with ASTM A31, A131, or A502, as applicable.

6.6.4 Locking Devices

A. Lock wire shall be stainless steel or monel alloy.

B. Elastic stop nuts with nylon collars shall be used when mounting equipment to aluminum structure.

6.6.5 Tamperproof Fasteners

Fasteners exposed to passengers shall be tamperproof. Slot-headed or cross-headed-type fasteners shall not be used. Special tools to remove and install tamperproof fasteners shall be provided. A list of tamperproof fasteners, including types and locations, shall be submitted for approval. (CDRL)

6.7 METAL JOINING

6.7.1 Welding

A. Unless otherwise specified or approved, the welding standards listed below shall be followed for applications noted.

Standard	Welding Application
ANSI B31.3	Pressure- and Vacuum-Retaining Piping and Related Components
ASME Boiler and Pressure Vessel Code, Section VIII	Pressure- and Vacuum-Retaining Vessels Other Than Piping and Related Components
AWS A2.4	Symbols for Welding and Nondestructive Testing
AWS A3.0	Welding Terms and Definitions
AWS A5 Series	Selection of Welding Filler Materials
AWS D1.1	Low Carbon, Low Alloy Structural Steel Equal to or Greater Than 1/8 in. Thick
AWS D1.2	Structural Aluminum Joining
AWS D1.3	Low Carbon, Low Alloy Structural Steel Less Than 1/8 in. Thick
AWS D9.1	Non-structural, Non-pressure Retaining Sheet Steel
AWS D14.4	Fabrication of Machinery and Equipment for Static and Dynamic Loading
AWS Welding Handbook	Design, Materials, Control, Quality and Workmanship, General Recommended Procedures

B. All welds shall be visually examined. Critical welds shall be identified on the fabrication drawings and shall be nondestructively examined (NDE). Full penetration welds shall also be identified on the fabrication drawings and shall be either volumetrically or progessively NDE. Where frequency of NDE is not specified within the above-noted standards, a production NDE frequency shall be selected to provide 95-percent confidence level that the weld complies with design and quality

requirements. NDE and production quality control procedures shall be submitted for approval prior to production (Reference: Section 19).

C. Sample resistance welds shall be provided in accordance with the following requirements:

1. For each type of metal joint or built-up assembly to be resistance-welded, prior sample of joint shall be welded with prescribed settings of current, time, and tip pressure; then static tested for shear strength or tested to destruction by tearing to ensure that weld nugget is pulled out of one of the plates. Sample welds shall be subject to approval.

2. At beginning of each shift and whenever there is change in welder, material, material assembly thickness, electrodes, or welding machine settings, such welds shall be made and tested by either shear strength or tear test method.

3. Complete records of setups and sample weld test results shall be maintained with QA records (Reference: Section 19).

6.7.2 Brazing

Brazing shall comply with requirements and recommendations of the AWS Welding Handbook, Volume 2, Chapter 11.

6.7.3 Soldering

Soldering shall be used only in nonstructural applications. Tin-antimony solder shall be used for all copper tubing and fittings, except for air conditioning tubing which shall be brazed. The flux used shall be noncorrosive. Solder joint fittings shall conform with ANSI B16.22 and B16.18 for wrought copper alloy and cast copper alloy, respectively. Only silver solder containing no antimony shall be used on brass. Solder used for electrical connections shall be in accordance with ASTM B32.

A. Tin-Antimony Solder:

Tin-antimony solder shall conform to the following chemical composition or better:

1. Tin: 95.0 percent nominal; 94.5 percent minimum

2. Antimony: 5.0 percent nominal; 4.5 percent minimum

3. Copper: 0.8 percent maximum

4. Other Impurities: 0.10 percent maximum.

B. Silver Solder: Silver solder shall have the following nominal composition:

1. Silver: 50.0 percent

2. Copper: 15.5 percent

3. Zinc: 16.5 percent

4. Cadmium: 18.0 percent.

6.8 FLOOR COVERING

The floor covering shall be made from a compound utilizing synthetic rubber and/or natural rubber. The reinforcing fillers shall be hard clays added to impart hardness values of 85 to 95 Shore A. The rubber composition shall be homogeneous throughout the entire thickness. The floor covering shall conform to the requirements outlined below.

6.8.1 Tensile Strength

The tensile strength of the flooring shall not be less than 500 $lb/in.^2$ when tested in accordance with ASTM D412 using die C for preparing the dumbbell specimens.

6.8.2 Ultimate Elongation

The ultimate elongation shall not be less than 25 percent when tested in accordance with ASTM D412 using die C for preparing the dumbbell specimens.

6.8.3 Cracks

The floor covering shall not crack or show any indication of weakness when tested in accordance with Method 3111 of FED-STD-501. The mandrel diameter shall be 1 in. nominal.

6.8.4 Linear Stability

The floor covering shall not change in linear dimensions more than ±0.035 in./ft. Stability shall be determined in accordance with ASTM D1204.

6.9 INTERIOR HARDWARE

6.9.1 General

Interior hardware shall be securely attached with recessed screws. Where machine screws are used, tapped metal shall be reinforced, if required, by welding or by the use of clinch-type elastic stopnuts. Screws shall not tap into aluminum.

6.9.2 Material

Interior hardware shall be stainless steel with satin finish or nickel bronze.

6.10 INSULATION MATERIALS, THERMAL AND ACOUSTICAL

6.10.1 Thermal Insulation

A. Materials shall be graded and labeled as standard with recognized industry associations and societies. Labels shall be permanently affixed to, or imprinted on, packages or containers of materials. Materials shall be rigid, nonrigid, or spray-on type, nonabsorptive of fluids and gases, and verminproof.

B. Insulation shall be encased when located where it could be fouled by dirt or fluids. Insulation shall have vapor-barrier rating of 2.5 perm at 90°F, 50 percent relative humidity, when tested in accordance with requirements of ASTM E96, Water Method.

6.10.2 Acoustical Materials (CDRL)

List and description of materials proposed for use shall be submitted for approval. Thickness of materials shall be sufficient to meet noise and vibration requirements specified (Reference: Section 3).

6.11 GLASS

6.11.1 General

A. Laminated safety glass shall be float glass, FS DD-G-451, Type I, Class 1, Quality q3. Except for windshields, both sides shall be fully tempered in accordance with FS DD-G-1403. Windshields shall be manufactured such that the inner glass does not shard and visibility is retained after impact. Spall shields shall not be used.

B. Glass shall have smooth, seamed edges with sheet overlap not exceeding 1/16 in.; laminated to center sheet of polyvinylbutyral resin of 0.03-in. minimum thickness; and clearly marked on tempered side surface.

6.11.2 Performance Group

A. Group I Glass:

1. Laminated safety glass shall be clear.

2. Glass shall have minimum thickness of 0.375 in. and certified to comply with requirements of ANSI Z26.1, Table 1, Item 1, with additional test requirements as follows:

a. Glass shall pass ANSI Z26.1 Test 8, Impact, using shot bag dropped from a height of 15 ft.

b. Glass shall pass ANSI Z26.1 Test 26, Penetration Resistance, modified to include entire windshield assembly, simulating the impact of a 1-lb ball at 80 mi/hr and the impact of a 5-lb ball at 50 mi/hr.

c. If required to meet impact loading, one ply of glass assembly may consist of abrasion-resistant, coated, stretched acrylic complying with MIL-P-25690.

B. Group II Glass:

1. Glass shall be treated laminated safety type and have minimum thickness of 0.25 in.

2. Glass shall be certified to comply with requirements of ANSI Z26.1, Table 1, Item 3, with tint to match supplied samples; have maximum luminous light transmittance of 37 to 55 percent; and maximum solar heat transmittance of 27 percent.

3. Glass shall have minimum average sound transmission loss of 30 dBA in octave band with 1,000 Hz center frequency.

C. Group III Glass: Glass shall be clear laminated safety glass having minimum thickness of 0.25 in.

and certified to comply with requirements of ANSI Z26.1, Table 1, Item 1.

D. Group IV Glass: Glass shall be clear laminated safety glass and have minimum thickness of 0.25 in. Glass shall be certified to comply with requirements of ANSI Z26.1, Table 1, Item 1. Glass shall have minimum average sound transmission loss of 30 dBA in octave band with 1,000 Hz center frequency.

6.12 UPHOLSTERY FABRIC

6.12.1 General

A. Woven upholstery fabrics for vehicle seats shall be approved transportation-grade fabrics with backing. Fiber content shall be 90 percent wool and 10 percent nylon. Fabric weight exclusive of backing shall be not less than 12.2 oz/yd².

B. Maximum fabric shrinkage shall be 2 percent in either warp or fill direction. Fiber shall be worsted spun. Pattern and colors shall be submitted for approval. Tolerance shall be 3.0 McAdam units maximum from approved color standard.

C. A sample, 42 by 8 in. minimum, of each fabric that has a different pattern or color shall be submitted for approval prior to production manufacturing of fabric materials.

D. Fabric shall be suitable for cleaning with a minimum of three widely available commercial and industrial cleaning agents that are known to be chemically compatible.

6.12.2 Fabric Requirements

Fabrics shall comply with the following requirements:

PHYSICAL PROPERTY	TEST METHOD	PERFORMANCE REQUIREMENTS
Thread Count	FED-STD-191 Method 5050	
1. Warp		16/in. min
2. Fill		23/in. min
Tensile Strength	FED-STD-191 Method 5100	
1. Warp		170 lb min
2. Fill		210 lb min

PHYSICAL PROPERTY	TEST METHOD	PERFORMANCE REQUIREMENTS
Seam Strength	ASTM D1683 Nylon Thread 8 to 10 stitches/in.	
1. Warp		60 lb min
2. Fill		60 lb min
Tear Strength	FED-STD-191 Method 5134	
1. Warp		20 lb min
2. Fill		40 lb min
Abrasion Resistance	FED-STD-191 Taber Method Calibrese Wheels, 500-gram load	No thread breakage after minimum of 3,000 cycles
Perspiration Resistance		Good, consistent with flame-retardant treatment
Dry Crocking	FED-STD-191 Method 5651	Good
Wet Crocking	FED-STD-191 Method 5651	Good
Resistance to Solvents		Resistant to common cleaning agents, oil, food, and drink
Odor		No objectionable odor
Colorfastness to Light	AATCC Method 16E	No fading in a 200-hr exposure period

6.13 PAINTS, COATING, PLATING, SEALING, AND PROTECTION

6.13.1 Paints and Coatings

A. Surface Preparation:

1. Surfaces shall be free of corrosion, scale, grease, and other foreign material immediately preceding the application of each coat of primer or finish paint.

2. Dents, roughness, or other surface imperfections shall be removed by straightening, filing, and sanding prior to application of first priming coat.

3. Surfaces to be painted shall be prepared as recommended or approved by paint manufacturer.

B. Mixing:

1. Paint shall be mixed, thinned, or otherwise prepared for application in accordance with paint manufacturer's recommendations.

2. Thinning materials or paint additives shall be those recommended or approved by the paint manufacturer.

C. Provide copy of manufacturer's specifications for paint materials and applications proposed for use. (CDRL)

D. Application Requirements:

1. Painting materials shall be brushed, sprayed, or dipped and baked on or air dried in accordance with paint manufacturer's written instructions, service requirements of the surface or part to be painted, and method of painting.

2. Each coat shall be uniformly applied to thickness recommended by paint manufacturer over surfaces to be covered and shall present neat appearance free from runs, sags, or other application defects.

E. Repair of Defects:

1. Painted surfaces that are scratched or damaged during shipment, storage, handling, or installation shall receive touch-up paint as required to present satisfactory appearance.

2. Touch-up paint shall have properties as close as possible to those of the original paint.

F. Colors and finishes shall be as indicated or as approved.

G. Areas exposed to corrosive fluids or cleaning solutions shall be protected with coatings resistant to those fluids.

H. Following fabrication, low-alloy, high-tensile steel parts shall be prepared for painting in conformance with requirements of ASTM D2200 and shall immediately thereafter be painted with one coat of primer, conforming to FS TT-P-664, and one coat of approved sealer gray paint to prevent rusting, except that underframe shall have two coats.

I. Powder coating finishes may be used for equipment weldments.

J. Interiors of equipment enclosures shall be primed and single-coated with white insulating varnish or be single-coated with insulating varnish and finish-coated with white enamel or approved equal material.

K. Where painting of fiberglass-reinforced plastic on exterior is approved, the plastic shall be painted with single coat of primer and double coat of synthetic acrylic or polyurethane enamel.

6.13.2 Protection of Metals

A. Surface Treatment:

1. Corrosion-resistant Steel:

a. Corrosion-resistant steels need not be plated or coated except in dissimilar metal contact applications, as specified.

b. Where the steel on interior and exterior is exposed to view, the finish shall be as approved.

2. Carbon Alloy Steels: Basic materials shall have mill finish, except where zinc or organic protective coating platings are specified. Low-carbon steel used for underfloor box and equipment supports shall be painted with two coats of epoxy paint. Paint and application procedure shall be approved.

3. Other Metals: Brass, bronze, copper, and nickel alloys shall not require any surface treatment. Aluminum shall be finished as suitable for exposure and use.

B. Dissimilar Metal Protection:

1. General:

a. Dissimilar metals shall be protected in accordance with requirements of MIL-STD-889.

b. Requirements for selection and protection of dissimilar metals relative to electrical wiring and electronic equipment shall comply with MIL-STD-454, Classes 2 and 3. Alternative methods shall be subject to approval.

c. Isolation of incompatible metals and materials shall be provided in installations.

2. Copper shall not come in contact with dissimilar metals, except tin, lead, or stainless steel. When copper abuts, overlaps, or is joined to dissimilar metals, the copper shall be coated with bituminous plastic cement or be separated by other inert material, except as otherwise specified.

6.14 BEARINGS

6.14.1 Antifriction Bearings

Antifriction bearings shall be used for rotary shaft support. Bearings subject to atmospheric or liquid contamination shall be sealed by labyrinth, lip, or face seals. Bearings not internally splash- or bath-lubricated shall be permanently sealed or be provided with standard grease fittings and drain plugs or pressure release devices.

6.14.2 Sleeve Bearings and Bushings

Sleeve bearings shall be used for shafts with rotary motion of less than one full revolution. Sleeve bearings and bushings shall be adequately lubricated. Self-lubricated bushings (sintered metal) shall be used in accordance with manufacturer's recommendations. Sleeve bearings and bushings supporting ferrous shafts shall be composed of bronze, brass, aluminum alloys, or as approved.

6.15 LUBRICANTS AND FILTERS

6.15.1 Lubricants

Lubricating oils and greases shall be approved. In general, oils and greases shall be as recommended by the supplier of the parts to be lubricated. The Contractor shall keep the number of different types of lubricants to a minimum.

6.15.2 Filters

Filters shall be either designed or selected in accordance with manufacturer's recommendations for the specific equipment. Filters shall be designed to meet the performance requirements of each installation as indicated and as approved. Filters shall be replaceable-media type unless otherwise approved.

END OF SECTION

SECTION 7

CARBODY

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SECTION 7

CARBODY

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SECTION 7

CARBODY

7.1 GENERAL

This Section specifies construction and performance requirements of the carbody, including structure, underframe, ends, roof, sides, doors, floor, glazing, insulation, boxes and enclosures for undervehicle-mounted equipment, intervehicle passageways, and related elements. The carbody arrangement and dimensions shall be as indicated.

7.1.1 Cited References

Organization	Number	Title
UMTA	MA-06-0025-75-16	An Assessment of the Crashworthiness of Existing Urban Rail Vehicles

7.2 MATERIALS

7.2.1 General

A. Material shall be stainless steel, except as specified, fastened by either welding or flush-riveting where fasteners are visible. Where the fasteners are hidden, lockpins or rivets with other head configurations may be used. Adhesive bonding of structural elements will not be permitted unless approved.

B. In addition to the tolerances specified (Reference: Section 3), the following tolerances shall be adhered to:

5 1. Carbody Width in any Plane: +0 -0.5 in. 5

2. Vehicle Length over Anticlimbers: ±0.5 in.

5 3. Vehicle Height with New Wheels, from Top of Rail to Top of Roof: +0 -0.5 in. 5

5 4. Vehicle Height with New Wheels, from Top of Rail to Top Clearance Point: +0 -0.5 in. 5

5. Passenger Area Height at Longitudinal Centerline, Finished Floor to Ceiling, Clear: ±0.125 in.

6. Door Openings Height and Width: ±0.125 in.

7.2.2 Structural Integrity

Particular attention shall be given to structural integrity and weight.

A. Detailed stress analyses shall be performed. Finite element stress analyses, including crashworthiness analyses, shall be performed for critical areas to ensure that minimum structural weights are obtained while maintaining adequate margins of safety. (CDRL)

B. Testing shall be performed to show compliance of the structure to loading conditions specified herein, except a 20 mi/hr crashworthiness test will not be required.

7.3 STRENGTH REQUIREMENTS

7.3.1 Compression Loading

Vehicles shall be designed to withstand a static, compressive end force of 200,000 lb combined with a static floor load equal to AW3 minus AW0 without permanent deformation of any part of the structure. The end load shall be distributed within a 2-ft-wide band at the center of the anticlimber and shall act along the longitudinal centerline of the vehicle. The floor load shall be evenly distributed over the top of the floor and shall act vertically. The combined stresses due to the above loading condition shall not exceed 90 percent of the structural material yield strength.

7.3.2 Vertical Loading

A vertical, evenly distributed load equivalent to AW3 minus AW0 applied to the structure shall not cause the stress level to exceed 50 percent of the yield strength in any structural member.

7.3.3 Camber and Stiffness

Carbody shall have a positive camber measured relative to a horizontal line between body bolsters. Camber shall not be less than zero for an AW3 vehicle, and no more than 0.5 in. for an AW0 vehicle. Camber

measurements shall be made at each side sill at locations midway between bolsters. Stiffness under vertical loading conditions shall be compatible with camber requirements.

7.3.4 Crashworthiness

A. The carbody shall be designed with maximum energy-absorbing capability within the specified strength parameters. In the event of a collision between trains on level tangent track with mating anticlimbers locked together, the crushing of the structure shall start at the ends and progress toward the bolsters without buckling or telescoping of structure elements between bolsters. Each end shall remain attached to the roof and floor structure.

B. A three-dependent-pair train loaded to AW1 shall be capable of withstanding a 4-mi/hr coupling with another three-dependent-pair train loaded at AW1 that is stationary with brakes applied. Neither train shall be damaged.

C. The vehicles shall be so designed that when a three-dependent-pair train traveling at 20-mi/hr impacts another three-dependent-pair train standing still with brakes applied, assuming that trains are on level tangent track with mating anticlimbers locked together, the following conditions shall be met:

1. One vehicle shall not telescope into another.

2. At AW2 throughout both trains, the maximum vehicle penetration shall not exceed either 5 ft or the depth of the operator cab, whichever is less.

3. At AW1 throughout both trains, the severity index (SI) shall not exceed 1,000 for passengers seated in transverse seats:

$$SI = \int_0^t a^{2.5}\, dt$$

a = passenger acceleration during the crash in g's

t = time during the crash in sec

D. Analyses verifying the progressive crushing of the structure, the SI impacts, and damages at speeds of

4 mi/hr and 20 mi/hr shall be submitted. (CDRL) The analyses shall confirm that the design precludes the floor from being penetrated from below in the event of a collision. Guidelines for crashworthiness analyses are covered in UMTA MA-06-0025-75-16.

7.3.5 Jacking and Hoisting

A. The carbody shall be designed with jacking pads, as indicated, to permit lifting an AW0 vehicle with trucks attached.

B. The vehicle shall be capable of being jacked and supported on the corner pads or the four bolster pads.

C. The carbody shall be capable of resisting torsional and bending loads imposed by jacking conditions, including diagonal jacking at two of the most adversely opposed jacking pads, without permanent deformation or physical damage.

D. Pads shall feature antislip design. There shall be a clear vertical space under each pad so that vehicle hoists and jacks can be used without removing carborne equipment (Reference: Section 4, IDS Numbers 650-112-00-01 and 650-775-00-01).

7.3.6 Equipment Supports

A. Underfloor equipment supports may be low-carbon steel. Underfloor equipment and equipment supports shall be of sufficient strength and rigidity to resist the following ultimate load conditions without failure:

1. Longitudinal:	6.0 g
2. Lateral:	2.0 g
3. Vertical:	3.0 g

B. Following the loss of one support point, the remaining supports shall restrain underfloor equipment under 1.5 g vertical loading, acting downward. Supports shall be fatigue-resistant throughout the design life. For equipment weighing 151 lb or more, mounting fasteners shall not restrain equipment in shear or tension against the force of gravity, unless approved, and supports shall hold equipment captive in the event of a fastener failure. Equipment weighing 150 lb or less may be restrained with fasteners in shear or

5 tension against the force of gravity and without 5
5 the additional supports required to hold equip- 5
5 ment captive in event of a fastener failure. 5

C. Underfloor equipment mounting bolts shall be installed heads-up and in a manner to provide accessibility of mounting bolt heads, unless otherwise approved.

7.4 SHELL REQUIREMENTS

The shell shall include end, roof, and side assemblies mounted to the underframe. Design shall provide structural stiffening and reinforcing required for structural integrity, equipment mounting, and for appearance.

7.4.1 General

A. Visible fastener heads shall be minimized. Where visible, rivets and welds shall cause a minimum of surface indentation and material discoloration, and shall be arranged in uniform patterns.

B. Drain holes shall be provided to preclude water entrapment. In areas where water might intrude (such as door pockets and air inlets), drain lines or drain pans with drain lines shall be provided to ensure that water is drained clear of equipment and structure.

7.4.2 Thermal Insulation

A. The overall heat transfer rate shall be 800 Btu/hr/°F, maximum, with the vehicle stationary and in still air.

B. Insulation shall be held securely in place by mechanical means that will not fail because of vibration.

7.4.3 Ends

A. The structural frames of both the F-end and R-end shall be designed to provide equal strength and to transfer longitudinal loads in a manner consistent with the basic design. Both ends shall be designed to preclude propagation of fire and/or smoke from under the floor into the vehicle.

B. The F-end shall consist of a molded, fiberglass-reinforced plastic shell over metal framing members. The fiberglass-reinforced plastic end shall not be considered to be a part of the vehicle

structure. Except for essential penetrations, such as windows, the outer skin immediately behind the end cap shall be stainless steel and completely enclose the F-end.

C. Both ends shall be provided with vertical collision posts adjacent to the end-door openings, and with vertical corner posts designed to meet the requirements specified herein.

7.4.4 Sides

A. The sides shall consist of outer skin (external sheathing), vertical framing members, and longitudinal stiffening members. The skin may include corrugated material from the lower edge of the side windows downward to the top of the side sill.

B. Side structures shall be designed to withstand induced loadings, such as vertical bending effects, vehicle body compression, vehicle jacking, and cantilever seat effects.

C. Reinforced members framing door and window openings shall limit lateral deflections and maintain stresses within allowable fatigue limits. Deflections shall be limited to prevent door movement from being restricted, and window glazing from coming loose, being damaged, or leaking.

D. The skin shall be uniformly flat along the vehicle. Except where corrugated material is used, vertical and longitudinal undulations shall not exceed the lesser of 0.125 in. or 1/300 of the span between adjacent members. If more than one node occurs in a bay, the span shall be measured between nodes.

E. The side structure shall withstand a pressure of 60 lb/ft^2 to allow for passage through washing equipment. The wash zone shall be assumed to be limited to a 12-in.-wide band extending transversely along the carbody.

7.4.5 Roof

A. The roof structure shall consist of outer skin over purlins. The skin may include corrugated material. Rain gutters shall extend over side doors and cab side windows. The roof structure shall withstand, without permanent deformation, the loads of roof-mounted equipment, stanchions which extend from ceiling to floor, horizontal handrails, and vertical loads of 250 lb acting downward and spaced every 30 in., corresponding to a maximum of three people on the roof at the same time.

B. Joints shall be sealed with an approved waterproof compound.

7.5 UNDERFRAME

7.5.1 General

The underframe shall consist of the structural assemblies on which the floor shall be mounted and to which the shell, trucks, couplers, and underfloor equipment shall be attached. At a loading of AW3 less the weight of the trucks, the underframe shall withstand forces from the coupler/draft gear units and from the trucks.

7.5.2 End Underframe

The end underframe shall be a welded stainless steel or low-alloy, high-tensile steel assembly consisting of the draft sill, body bolster, and end sill. The assembly shall act as an integral unit to transfer loads from the anticlimber, coupler and draft gear, and truck interfaces. The design shall provide for load path continuity at joints. If single-bevel welds are used, backup strips shall be included wherever possible.

A. The draft sill structure shall be designed to resist the loads from the coupler and draft gear unit and from the anticlimber. No damage or permanent deformation shall result from loads up to the load which activates the draft gear emergency release mechanism.

B. The body bolster shall be a built-up structure capable of transferring loads between the trucks and the carbody. The bolsters shall be capable of reacting to design loads transferred from the draft sill. Fatigue resistance shall be a prime requirement of the body bolster design.

C. The end sill structure shall be the mating structure between the anticlimber and the draft sill for the transfer of collision loads. Together with the draft sill, the end sill shall be capable of resisting, without permanent deformation, a 75,000-lb vertical load, induced by the anticlimber and acting upward or downward between the collision posts.

D. An anticlimber shall be welded to each end sill and shall extend laterally over approximately the center third of the vehicle width, as required to provide adequate clearance between the corners of adjacent vehicles in all system operations. Each anticlimber shall have a least three ribs. Under collision conditions, an anticlimber shall mate

with an opposing anticlimber to prevent one vehicle from climbing over the other. No structural deformation or slippage shall occur under a vertical load of 75,000 lb, acting upward or downward, combined with a longitudinal compression load of 200,000 lb, and with only two ribs per anticlimber in engagement. Anticlimbers shall be designed to assist in emergency passage between vehicles. The gap between two opposing anticlimbers shall be minimized.

7.5.3 Cross-bearers and Side Sills

Cross-bearers shall be the main lateral floor beams fastened to the side sills to form the basic framing for support of floor panels and underfloor equipment. Supplementary beams and intercostals shall be provided as required for equipment support and to control floor deflection. Primary loading shall be from passengers, floor, interior furnishings, and underfloor equipment. Lateral, longitudinal, and vertical load conditions generated by underfloor equipment shall be as specified.

7.6 FLOOR

7.6.1 General

Floors shall include the panels on which the interior covering is laid; acoustical, thermal, and vibration insulation; and the necessary supporting beams that are attached to the underframe structure. Floor panel splices shall be arranged to coincide with underfloor members. Floor panels shall be fastened to the underfloor members in such manner as to prevent chafing or horizontal movement between adjacent surfaces. The assembled floor shall be level and flat, except for specified camber, with the upper surface free from indentations. Exposed edges of floor panels shall be sealed, including openings for ducts, wireways, and joints between floor sections.

7.6.2 Loading

Floors shall be designed to withstand the dead load plus an equivalent passenger load of 100 lb/ft^2 without exceeding 50 percent of the yield stress of the material. No permanent deformation shall occur during the design life of the vehicle. Vertical deflection shall be limited to 1/360 of the short span.

7.6.3 Insulation

Thermal and acoustical insulation shall be provided in the subfloor space formed by the floor and the underfloor members. The space shall be sealed with stainless steel sheets that retain and shield the insulation. The sheets shall be reinforced to prevent sagging and vibrating. Openings through the sheets shall be minimized. Openings shall be protected with covers equivalent to the ratings of the sheets for resistance to fire and penetration.

7.7 UNDERFLOOR EQUIPMENT INSTALLATION

7.7.1 Arrangement

Equipment requiring inspection or attention more often than once a year shall be accessible and replaceable without removal of other apparatus. Underfloor equipment shall be arranged to be readily accessible from maintenance pits or from the sides of the vehicle.

7.7.2 Design

Equipment shall be retained above the running rail clearance plane (Reference: Section 3) and within the vehicle maximum dynamic outline after loss of any one point of support. Underfloor boxes shall allow easy handling during installation and removal and shall allow ready access to the enclosed equipment. Major components enclosed in underfloor boxes and enclosures shall not be fastened directly to the walls, roof, or floor of the box or enclosure unless approved. Hardware used to secure doors on underfloor boxes and enclosures shall be made of noncorroding metal or plated to prevent corrosion. Drainage shall be provided for each box without compromising weathertightness. Boxes shall be designed to protect equipment from underfloor environmental conditions.

7.7.3 Covers and Latches

Boxes shall be provided with top-hinged, removable covers. Boxes shall be watertight and dust-tight. Each cover shall be the same material as its equipment box or be fiberglass-reinforced plastic. Access cover latches shall be of proven design, captive type. Fiberglass-reinforced plastic used in underfloor box covers shall conform to the flammability, smoke emission, and toxicity requirements specified herein (Reference: Section 6). Covers shall be stamped or otherwise permanently and legibly marked on the exterior with their respective vehicle number.

7.8 GLAZING

7.8.1 General

Windows shall be laminated safety glass and comply with the applicable group as specified (Reference: Section 6). Windows shall be fixed (nonopening), except cab side windows.

7.8.2 Side and Side-door Windows

Glass shall be set in elastomeric glazing strips and shall be Group II. Side windows shall be one size. Side-door windows shall be of one size, and have the same vertical dimension and be aligned with the side windows.

7.8.3 Cab Side Windows

Windows shall utilize horizontal sliding sash, which shall be held securely in open and closed positions by means of latch. Window on right hand side of vehicle shall have standard vehicle key lock for locking in a closed position from inside the cab. Windows shall be weatherstripped, reinforced, and designed to prevent rattling. Glass shall be set in elastomeric glazing strips and shall be Group II.

7.8.4 End-door and R-end Windows

Glass shall be set in elastomeric glazing strips and shall be Group I for F-end doors and Group IV for R-end doors and end windows.

7.8.5 Cab Door Window

Glass shall be set in elastomeric glazing strips and shall be Group III.

7.8.6 Windshields

Glass shall be Group I, set in openings such that it cannot be forced into vehicle, shall be retained in elastomeric glazing section, and shall be replaceable from outside of vehicle without need for sealing compounds.

7.8.7 Pressure Loading

F-end windows shall be designed for pressure loadings of 70 lb/ft^2 with minimum safety factor of 2.5. Side windows shall be designed for pressure loadings of 40 lb/ft^2 with minimum safety factor of 2.5. Deflections shall be limited to length of short span divided by 180.

7.9 DOORS

Doors of the same configuration shall be interchangeable.

7.9.1 End Doors

A. F-end and R-end door construction shall utilize materials that are consistent with exterior materials. Door seals shall be designed to exclude wind and other weather elements experienced during operation. Doors and latches shall be designed to withstand a pressure of 70 lb/ft^2 of door surface area, including window, with a minimum safety factor of 2.5. Doors shall be capable of being manually opened from inside and outside. A mechanism shall close and latch the door upon door release. The mechanism shall include an adjustable decelerating device to assure a safe closing operation. Doors shall be capable of being latched in the open position.

B. F-end and R-end doors shall be hinged and inward-swinging. Doors shall be of metal construction and shall have a window in the top half.

C. F-end door shall be faced with fiberglass-reinforced plastic or, if approved, may be painted to match F-end plastic shell. Each F-end door shall be provided with a locking device which is controlled by a trainline. F-end door locking devices shall be interconnected such as to lock the F-end doors of only the leading and trailing vehicles in any consist when the trainline is energized. The trainline shall be energized when the KEY SWITCH is actuated in any cab in the consist and shall be deenergized when no KEY SWITCH is actuated in any cab in the consist. An emergency-release mechanism shall be provided on both the inside and outside of the door.

7.9.2 Cab Door

The door between the cab area and the passenger area shall be a 180-degree swinging door capable of closing off either the whole cab end or the portion of the cab containing the console, as indicated. Cab door shall be keyed from the passenger-area side, and self-locking in both of the two closed positions. Standard vehicle key shall be used. An emergency release mechanism shall be provided on passenger side of door. Emergency release mechanism shall not open cab door when it is closing off

the portion of the cab containing the Operator Console. There shall be a window in the top half of the door. Breakable glass shall not be used to provide access to the emergency release.

7.9.3 Side Doors

Side doors shall be compatible with the side door operators and controls (Reference: Section 10).

A. Side doors shall be sliding, biparting doors that fully retract into adjacent side wall pockets upon opening.

B. Doors shall of the same size and configuration and contoured to blend with the vehicle exterior. There shall be a window in the top half of each door.

C. Joints and edges shall be sealed. If hollow-type construction is used, drain holes shall be provided in the bottom of the doors. The door leafs shall use the same facing material as used on the vehicle exterior.

D. Doors shall be able to sustain, with maximum deflection of 0.3 in., a force of 200 lb applied on an area of 24 by 12 in., with the long axis parallel to that of the door, 2 in. from the door edge and centered within the height of the door.

E. Door leafs shall be hung at the top from a low-friction track-and-ball arrangement, with a guide at the bottom to restrict lateral movement. Door installation shall minimize rattling and vibration in the closed position when the vehicle is in motion. Convenient access to door adjustments shall be provided. It shall be possible to remove and replace a door leaf without removing windscreens or interior panels.

F. The leading edge of each door shall have a resilient edge that mates with the opposing resilient edge and forms a weathertight seal. Leading edge shall be compatible with the obstruction detection circuit (Reference: Section 10).

G. Doors shall be weatherstripped for sealing against weather and noise. The sealing shall keep water out under operating conditions. The seals shall not result in friction loading on the door leaf in excess of 2 lb. A stainless steel drain pan shall be placed below the floor in door pocket areas to drain water clear of underfloor equipment.

H. Door thresholds shall be of aluminum alloy or stainless steel, have an abrasive-type antislip surface, and incorporate guides for the sliding doors. The threshold plates shall have weather-tight connections at floor and door frame. The design of the bottom guide and threshold shall act to minimize dirt and debris accumulation and to eject foreign material from the track during door operation.

7.10 INTERVEHICLE PASSAGEWAY

7.10.1 General

Intervehicle passageway shall provide for safe emergency passage between vehicles while train is moving or standing.

7.10.2 F-end

Passage protection between adjoining F-ends shall consist of vertical grab bars installed on the front face of the carbody, on the latch side of the door only, beginning 8 in. above floor level and ending 70 in. above floor level.

7.10.3 R-end

Passage protection between R-ends shall be window-height barriers of semirigid rubber composition construction, attached to the rear face of both the A- and B-car. Vertical grab bar shall be provided on the rear face of each vehicle, beginning 2 in. above the termination of the rubber barriers and ending 70 in. above floor level.

END OF SECTION

SECTION 8

OUTFITTINGS AND FURNISHINGS

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SECTION 8

OUTFITTINGS AND FURNISHINGS

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SECTION 8

OUTFITTINGS AND FURNISHINGS

8.1 GENERAL

This Section provides the requirements for the exterior and interior outfittings and furnishings of the vehicle. Equipment exposed to passengers shall be vandal-resistant.

8.2 CITED REFERENCES

Organization	Number	Title
SAE	J599	Lighting/Inspection Code
US	49 CFR Part 27	Nondiscrimination on the Basis of Handicap
US	49 CFR Part 609	Transportation for Elderly and Handicapped
US	MIL-STD-1472	Human Engineering Design Criteria for Military Systems, Equipment, and Facilities
US	FMVSS 222	Federal Motor Vehicle Safety Standard

8.3 FLOOR COVERING

8.3.1 Surface

Slip-resistant floor covering (ribbed, if necessary) shall be applied in aisle, door area, and operator cab. Smooth slip-resistant floor covering shall be applied in passenger seating areas, including handicapped space. Slip-resistant characteristics shall be retained when wet. Ribbed indentations, if used, shall be approved.

8.3.2 Installation

Installation shall be smooth and level at joints, including junction with thresholds. Installation shall prevent cleaning materials and liquids from collecting.

8.4 INTERIOR LINERS

8.4.1 General

A. Side liner design shall eliminate unnecessary joints and accommodate dimensional changes due to fluctuations in environmental conditions and vehicle loading. Side liners shall be fitted in sections to facilitate removal. Sections shall fit through the side doors.

B. To the extent consistent with practical assembly, attachment to structure shall be by concealed fasteners to discourage vandalism and tampering and to permit easy removal of liners for maintenance.

C. "Antisqueak" tape or similar material shall be used between liners and any structure to which liners are attached or with which liners come in contact.

D. Liner material shall be supported to prevent sagging and drumming.

E. Provide convenient maintenance access to any equipment located behind liners.

8.4.2 Loads

Side liners, windscreens, and partitions shall be designed to the following deflection and impact load conditions and be integrated with supporting structure such that integrity of supporting structure is retained under these loads:

A. Centrally applied static load of 30 lb applied on maximum area of 4 $in.^2$ shall not deflect panels more than 1/360 of short span between structural supports.

B. Uniform pressure of 15 lb/ft^2 shall not deflect panels more than 1/360 of short span between structural supports.

C. Centrally applied impact load of 5 ft-lb applied on maximum area of 4 in., shall not deflect panels more than 1/180 of short span between structural supports, and shall not result in permanent deformation or cracking.

8.4.3 Door Pocket Liners

Door pocket liners adjacent to each side door location shall match side lining. Access doors shall be provided in door pocket liners, shall have concealed hinges, and shall be lockable with standard vehicle key.

8.5 SEATS

5 Seats for 59 passengers and one operator, and space for 5
5 a wheelchair shall be provided in each vehicle. Seat- 5
ing arrangement and configuration shall be as indicated
5 (Reference: Contract Drawings V-004, V-006, V-007, 5
5 V-008, V-009, and V-025). Passenger seats shall be can- 5
5 tilevered type, except for seats with backs against 5
5 the cab or end wall at the F- and R-ends, respectively, 5
5 which may be supported by equipment enclosures. Opera- 5
tor seat shall be supported on a pedestal.

8.5.1 Design

A. Specific consideration shall be given to seat performance and crash protection, adequate seat anchorage provisions, padding in vulnerable hit areas, and the elimination of lethal surfaces.

B. Contouring derived from studies based on human factors shall be used for providing comfort, occupant retention safety, and designation of seat separation through a range of physical dimensions from the 5th percentile female through 95th percentile male, based on MIL-STD-1472.

8.5.2 Transverse Seats

A. Seat frame structure shall be metal. Frame members shall be a corrosion-resistant material or treated with a corrosion-resistant coating. Wall side of the frame structure shall be attached to wall by a heavy gauge, metal mounting bracket. Attachment of seats to wall shall not create dirt holding pockets. Supporting structure shall be within the cross-sectional area of the seat and seat back, and shall be configured to be as unobtrusive as possible.

B. Seats, except back-to-back seats or seats with backs against the walls, shall be fitted with a horizontal, energy-absorbing grab rail and crash pad. Provide crash pads on the upper rear area of the seat back. Design crash pad for Head Injury Criteria value as expressed in FMVSS 222.

C. Seat shall be molded fiberglass, contoured with step-down reliefs in seat and back areas for padded inserts. Back panel shall be high impact-strength plastic, 0.090 in. minimum thickness. Seat shell and back panel shall be free of sharp corners and protrusions. Seat shell shall be securely fastened to the seat frame structure so that structural integrity of seat is maintained. Visible fastening elements shall be minimized.

2 D. Seat and back padded inserts shall be low-smoke neoprene foam covered with woven fabric. Corresponding padded inserts shall be interchangeable. Attach padded inserts to seat in a manner that will discourage unauthorized removal. It shall be possible to remove and replace any padded insert with the aid of a tool without having to dismantle the seat. 2

8.5.3. Longitudinal Seats

Longitudinal seats shall be similar to transverse seats except grabrail and crash pad are not required.

8.5.4 Loads

Passenger seat structure, including the carbody support structure and attachments to the vehicle structure, shall resist the loads listed below without permanent deformation greater than 0.125 in. Seat or seat components shall not separate from the vehicle wall structure or from the mounting bracket at any attachment point when the following individual loads are applied:

A. Distributed load of 500 lb per passenger applied horizontally along the upper edge of the seat back, in either direction

B. Vertical load of 250 lb applied downward on the top edge of the seat back at midspan of dual seat

C. Vertical load of 500 lb per passenger applied at the center of each seat bottom

D. Vertical load of 500 lb per passenger applied at the center of the front edge of each seat

E. Handhold load of 330 lb applied in any direction.

8.5.5 Access to Apparatus

Convenient access for maintenance personnel shall be provided to any equipment located between back-to-back

seats. A standard vehicle key or special tools shall be required to gain access to the equipment, except fire extinguishers.

8.5.6 Operator Seat

Operator seat shall have longitudinal and vertical adjustment with positive position stops. The assembly shall contain a spring-loaded mechanism to assist seat height adjustment. Seat shall be capable of swiveling at least 90 degrees from forward to either side. Seat back shall have tilt adjustment. Seat structure, support, attachments, and adjustment locking mechanisms shall withstand, without permanent deformation greater than 0.125 in. or disengagement, in all positions, a vertical, uniformly distributed load of 330 lb applied at the forward edge of the seat and a horizontal, uniformly distributed load of 500 lb applied to the upper edge of the seat back in either direction. Seat assemblies and components of identical seats shall be interchangeable. Operator seat shall be removable and replaceable without using special tools.

8.6 INTERIOR EQUIPMENT ENCLOSURES AND ACCESS PANELS

8.6.1 Equipment Enclosure

Cabinets shall be made of metal unless otherwise approved. Equipment not located in the secured cab area shall be secured with locks operable with standard vehicle keys. Air vents shall be provided as required. Access shall be provided to normally concealed equipment.

8.6.2 Access Panels/Doors

Access panels (or doors) shall match adjacent interior liners and liner installation. Access panels shall be flush mounted. Access to equipment enclosures located under passenger seats shall be subject to approval.

8.7 ELDERLY AND HANDICAPPED PROVISIONS

Outfittings and furnishings shall meet the requirements of 49 CFR, Part 27 and 49 CFR, Part 609.

8.8 EXTERIOR HANDLES AND STEPS

8.8.1 Grab Handles

Provide grab handles as indicated. Grab handles shall be stainless steel round bars. Handles shall be designed to withstand, without permanent deformation, concentrated load of 330 lb applied at midpoint and acting in any direction.

8.8.2 Steps

Provide crew steps as indicated. Steps shall have antislip treads. Design steps with safety factor of 1.5, and to withstand without permanent deformation the loads imposed by a 330-lb person.

8.9 SIGNS AND GRAPHICS

Provide exterior graphics, interior graphics, and provisions for system maps and advertising.

8.9.1 Exterior Graphics

A. Plastic film transfers of official District logotypes and striping shall be applied to the vehicle exteriors in the sizes and at the locations indicated. Logotype master art and color specifications will be provided by the District.

B. Number signs shall be applied on the F-end, on the underside, and on both sides of each vehicle. Number signs on the F-end and sides shall be mounted as indicated. Number signs shall be mounted on the underside of both right and left side sills at the midpoint of the vehicle such that identification can be readily determined from inside the maintenance pit.

1. A-cars shall be odd numbered, starting with number 501; B-cars shall be even numbered, starting with number 502.

2. Number signs shall be stainless steel with finish matching the exterior skin and shall be attached to the structure with screws. Numbers shall be a minimum height of 4 in., deep-etched, and black paint filled. Typeface shall be Helvetica Medium.

C. Standard wheelchair symbols shall be applied on each side of the exterior at the F-end side doors, in the size and at the location indicated. Symbols shall be satin-finish anodized aluminum and shall be cemented to vehicle skin.

8.9.2 Interior Graphics

Various symbols and message elements shall be provided throughout the vehicle interior as directed by the District. Symbols and message elements shall be developed during industrial design (Reference:

Section 20) and shall include the application of anodized-aluminum sign panels, decals, and silk-screening to interior surfaces. Symbol and message elements shall include the following as a minimum:

A. Do Not Lean Against Doors

B. Eating and Drinking Prohibited

C. Wheelchair Location

D. Priority Seating

E. No Smoking

F. Fire Extinguisher

G. No Passage Through End Door--EMERGENCY ONLY

H. Emergency Door Release

I. Radio Playing Prohibited Without Use of Earphones

J. Vehicle Number

K. Door Leaf Numbers

L. Patron-Assist Intercom

M. WARNING--A Valid Ticket Must Be In Your Possession At All Times.

8.9.3 System Maps/Advertising

Provisions for system maps and advertising cards shall be located within each vehicle in the access doors to each side door pocket. System maps and advertising cards shall be mounted in frames that are integral with the access door material, without added metal or plastic trim ("frameless" frames). Frames shall be sized to contain maps and cards 21-in. high by 20-in. wide.

8.9.4 Destination and Run Number Signs

Provide three destination signs and a run number sign in each vehicle. Destination signs shall be located on the F-end as indicated (Reference: Contract Drawings V-002, V-004, V,005, and V-024)and near the center door on each side. Run number sign shall be located below the operator windshield in the cab as indicated (Reference: Contract Drawings V-002, V-004, V-005, and V-024) or at another approved location on the left side of the F-end, where it is clearly visible from the station platform. Destination signs near center doors may

be located above a window or, if the side liner is aesthetically extended and formed such that the window appears to be smaller, in a window, or as indicated (Reference: Contract Drawings V-002, V-004, and V-024).

A. Front destination signs shall utilize front-illuminated, yellow-colored electromagnetic dots to display a minimum of 12 alphanumeric characters approximately 3-in. high. Side destination signs shall be the same as front destination signs or be other approved electronic display. Sign legends shall be legible within a minimum viewing angle of 60 degrees left and right of a line perpendicular to the center of the display surface under all ambient light conditions from darkness to bright sunlight.

B. Run number sign shall be same type as side-destination sign, except three-digit display.

C. One twisted, shielded pair of trainlines shall control destination and run number signs in the train. Destination sign control shall be by a 7-binary-coded-decimal signal and run number sign control shall be by a 12 binary-coded-decimal signal (19-wire plus common wire) from the TICU (Reference: Article 4.2) to the sign transmitter or control unit.

D. Destination and run number signs shall be powered from the LVPS through a separate circuit breaker.

8.10 FIRE EXTINGUISHER PROVISIONS

Provisions shall be made for the District to install two DFE fire extinguishers in each vehicle.

8.10.1 Type

DFE extinguishers will be UL approved, 10-lb, 4A-30B:C multipurpose.

8.10.2 Locations

One DFE extinguisher will be located in the cab. The other will be located in the passenger area in a compartment between the backs of double seats. Provide the compartment and a breakable clear glass or equivalent ready access arrangement to the passenger area extinguisher.

8.11 LOCKS AND KEYS

8.11.1 Locks

Locks shall be suitable for the anticipated usage in the environment indicated for the life of the vehicle.

8.11.2 Keys and Keying

Provide two sets of keys with each vehicle. Keys shall be interchangeable among vehicles furnished hereunder.

A. Two different keys shall be provided:

1. Control key that operates Key Switch on Operator Console in operator cab. Key shall be made from a controlled blank.

2. Standard vehicle key that operates all other locks, and protected or key-actuated operators, switches, access openings, doors, covers, and other devices.

B. Key system shall be designed so that a third key can be added.

C. Keys shall be milled-bit type made of corrosion-resistant steel or nonferrous alloy with minimum hardness of 150 Brinell.

8.12 EMERGENCY LADDER

Provide a nonconductive ladder, a minimum of 22-in. wide by 6-ft long. Ladder shall be stored inside the vehicle at an approved location. Ladder shall support a 450-lb load concentrated at its center.

8.13 CONVENIENCE OUTLETS

Provide two duplex convenience outlets in each vehicle. Locate one outlet in the cab. Locate the other outlet on the inside sidewall of the passenger area. Locations shall be approved. Outlets shall be either 120 V, 60 Hz, if available, and protected by a single 15 A circuit breaker, or 37.5 V dc and protected by a single 30 A circuit breaker.

8.14 STANCHIONS, HANDRAILS, AND WINDSCREENS

8.14.1 Stanchions and Handrails

Equip each vehicle with handrails and stanchions, as indicated, for safe on-board circulation and to provide sitting and standing assistance. Stanchions and hand-

rails shall be seamless or welded stainless steel tubing with stainless steel fittings free of burrs and sharp edges.

A. Diameter of stanchions shall be 1.250 in., except diameter of vertical stanchions located in the center of door vestibules shall be 1.625 in. Installation shall be rattle-free. Stanchions shall withstand, without permanent deformation, a load of 330 lb applied in any direction at the free-span midpoint.

B. Handrails shall withstand a distributed load of 10 lb/in. applied at any angle within a 45-degree cone from vertical downward.

8.14.2 Windscreens

Locate windscreens, of the heights indicated, on each side of each side door. A stanchion shall be designed as an integral part of the windscreen.

8.15 INTERIOR LIGHTING

Lighting in the passenger area, except indicator lights, shall be fluorescent type.

8.15.1 Illumination Requirements

Intensity after 20 hr of operation and with rated LVPS voltage at terminals:

A. Average light intensity on passenger's reading plane shall be 30 to 40 footcandles (fc).

B. Average light intensity at floor in passenger aisles and at side doors, shall be not less than 15 fc.

C. Minimum light intensity at the end interiors shall be 25 fc at a height of 33 in. above the floor.

8.15.2 Brightness Ratio

A. Color and hue of vehicle interior shall be of sufficiently high reflectance factors that contrast and brightness ratios are minimized. Reflectivity of interior surfaces shall not be less than 70 percent for the ceiling, 60 percent for walls, and 30 percent for floor covering.

B. Average brightness ratio between lighting fixtures and adjacent areas shall not exceed 80:1. Brightness ratio between any adjacent areas in the normal

field of view shall not exceed 60:1. Brightness ratio between a maximum and average fixture brightness shall not exceed 5:1. The luminance measured by a luminance instrument with a 5-degree field of view is to be used for establishing the relative brightness values. The normal field of view of the passenger is defined as all angles below and a maximum of 30 degrees above the horizontal plane, in which zone all brightness evaluations are to be conducted.

8.15.3 Glare

Fixture lumen output in zone 60 to 90 degrees from nadir shall not be greater than 12 percent of total output of fixture.

8.15.4 Fixtures

A. Lamp sockets or other approved devices shall support lamp body in such a way that vibration shall not cause lamp to fall. Support by contact pin will not be allowed. If fixture assembly is not readily removable, lamp sockets shall be removable from below fixtures with use of ordinary hand tools.

B. Lamp ballasts shall be static type, capable of operating with fluorescent lamps. Multiple lamp ballasts may be used providing lamps operate independently and a failed lamp does not degrade life of ballast or operating lamps. Ballasts shall operate in rapid-start mode, produce full-rated lamp output, and provide a MTBF of 100,000 hr. Ballasts shall comply with the following:

1. Tolerate open and short circuits at each lamp location without damage to ballast

2. If inverters are used, operate at a frequency of not less than 20,000 Hz with any input voltage over the operating range and have reverse polarity protection

3. Have transient suppression to withstand surge and transient voltage of 2,000 V with an energy level of 10 J

4. Utilize connector to allow quick change of ballast

5. Be changeable from below

6. Operate over vehicle design temperature range and provide full-lamp starting within 2 sec with interior temperature of 36°F and within the vehicle input voltage operating range

7. Have no energized component external to housing

8. Be available from more than one independent source

9. Be thermally protected with automatic reset.

C. Lamps shall have a minimum mean life of 10,000 hr. Lamp color shall be determined following testing (Reference: Section 5).

D. Lenses shall be clear, prismatic, ultraviolet-stabilized polycarbonate.

E. Bezels shall provide access to lamps for quick changes, conform to ceiling contour, contain lenses, be securely locked to fixture, and be dust and moisture resistant.

F. Hardware shall be series 300 stainless steel.

G. Fixture shall be fitted with electrical connector.

8.15.5 Power and Controls

Provide power from two-wire ungrounded supply (Reference: Figure 13-1). Lighting shall be on not fewer than three circuits with one circuit supplying emergency lighting.

8.15.6 Emergency Lighting

Provide emergency lighting, consisting of a least two lighting fixtures, for a minimum lighting level of 1 fc measured at the floor at each side door vestibule, each threshold area, and each end door. Power emergency lights through a separate low-voltage circuit breaker from the vehicle battery.

8.15.7 Indicator Lights

Provide a door indicator light over each side door opening. Light shall be red, or have a red lens, and be 0.5 in. in diameter or less. Light shall be illuminated when either door leaf is open or unlocked. Light shall remain illuminated until both door leafs return to the closed and locked position. Light shall be visible from within the passenger area.

8.16. EXTERIOR LIGHTING

8.16.1 General

Exterior lights shall operate from LVPS. Fixture assemblies shall conform to clearance requirements, be weathertight, and prevent moisture from entering carbody. Lights and fixtures shall not be damaged by the wash equipment. Relamping shall be accomplished from exterior.

8.16.2 Headlights and Taillights

A. Provide two headlights on the F-end of each vehicle. Mounting shall be adjustable in accordance with SAE J599. Replacement of lamp shall not require readjustment. Lamps shall be sealed-beam 200 PAR, 30 V.

B. Provide two taillights with red lens on the F-end of each vehicle. Red reflective tape shall be applied to taillight bezels. Lamps shall be 60 PAR/2/R, 38 V.

C. Headlights on the leading vehicle and taillights on the trailing vehicle shall be automatically activated by the Operator Console Key Switch, and shall be on in all operating modes. Lights on intermediate vehicles shall not be activated except when the train is being operated from the cab of an intermediate vehicle (Reference: Section 9).

8.16.3 Indicator Lights

A. Provide a red indicating light with shaded lens and metal housing over each side door opening. Light shall be visible from both ends of the train in bright sunlight by a person with normal visual acuity.

1. Light shall be illuminated when either door leaf is open or unlocked. Light shall remain illuminated until both door leafs return to the closed and locked position.

2. Light shall flash whenever Call pushbutton switch on remote passenger IC unit within the same vehicle is depressed. Light shall continue to flash until train operator cancels the IC call (Reference: Section 17).

B. Provide an indicator light with blue lens on the exterior of each cabside. Light shall indicate

vehicle trouble as summarized by the Auxiliary Annunciator Panel.

C. Provide an indicator light with white lens on the exterior of each cabside. Indicator light on the lead vehicle only shall flash to indicate operation of the train in EMO submode. Indicator light control shall include a latching feature, such that means to reset the latching feature are not available to the train operator. Indicator light shall be actuated when EMO submode is established and shall flash until:

1. The train has ceased to operate in EMO submode -- at that point, the indicator light shall illuminate steadily, until reset;

2. The vehicle no longer has the energized cab -- henceforth, the indicator light shall illuminate steadily, whenever any cab in the train is energized, until reset;

3. Loss of power to the train -- henceforth, the indicator light shall illuminate steadily, whenevery any cab in the train is energized, until reset.

8.17 OTHER EQUIPMENT

8.17.1 Horn

Provide a two-tone, single-level pneumatic horn under the F-end of each vehicle. Sound level at 100 ft shall be 70 to 80 dBA. Sound level measurement shall be along centerline of guideway in front of vehicle. Distance shall be measured from anticlimber.

8.17.2 Windshield Wiper

Furnish a two-speed windshield wiper for each operator's windshield. Wiper shall provide coverage for 75 percent, minimum, of windshield above Operator Console. When in parked position, windshield wiper shall not obscure operator's view of roadbed. Wiper shall not be damaged by vehicle washing operations. Use either electric- or pneumatic-driven, pantographic-arm wiper with flexible blade. Wiper life shall be two million cycles, minimum.

8.17.3 Windshield Washer

Furnish an electric- or pneumatic-driven windshield washer for each operator's windshield. Washer shall pump a stream of washer fluid to the center of the

windshield at vehicle speeds up to 30 mi/hr, minimum. Provide facilities for filling washer from inside operator cab. Capacity of washer fluid container shall be 1 gal, minimum.

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OPERATOR CAB

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SECTION 9

OPERATOR CAB

9.1 GENERAL

This Section specifies the requirements for the operator cab of each vehicle. Operator cab shall be located at the F-end with the Operator Console located at the left side. Cab shall be full width when leading the train. At other times, cab door shall close off the console area.

9.1.1 Cited References

Organization	Number	Title
US	MIL-STD-1472	Human Engineering Design Criteria for Military Systems, Equipment, and Facilities

9.1.2 Train Operation

Normal train operation will be from the cab of the leading vehicle. Emergency provisions for manually operating the train from any intermediate forward-facing cab shall be incorporated into the design. As a minimum, these provisions shall include control of the trainline functions listed below for the entire consist:

A. Propulsion

B. Friction Braking

C. Communications

D. Lighting

E. Annunciation.

9.1.3 Visibility Requirements

The cab arrangement shall provide adequate visibility for the train operator to the guideway, to station platforms for safety and control of the train, and to the vehicle interior for safety of the passengers.

9.1.4 Arrangement

The operator cab and its equipment shall be arranged as indicated (Reference: Contract Drawings V-008, V-009, V-010, V-012, V-013, V-014, V-015, V-016, V-017, and V-025), unless otherwise approved. Depth of cab as measured along the longitudinal centerline of the vehicle, from the face of the anticlimber to the cab-side of the partition separating the cab from the passenger compartment, shall be 65 in., unless approved human factors study (see below) concludes that a smaller dimension is feasible; however, in no case shall the dimension be less than 61 in.

9.1.5 Human Factors

Design and arrangement shall be based upon the criteria contained in MIL-STD-1472. Controls, gauges, and switches (except coupling/uncoupling controls and right-side door controls) required for train operation shall permit identification by, and be within reach of, a seated train operator. Provide for 5th percentile female through 95th percentile male train operators. Demonstrate design and specification compliance in the full-size cab mock-up (Reference: Section 5).

9.1.6 Cab Equipment

Include the following as a minimum:

A. Operator Console

B. Adjustable seat (Reference: Section 8)

C. Auxiliary Annunciator Panel

D. Auxiliary Control and Switch Panel

E. Low-Voltage Circuit Breaker Panel

F. DFE Identification Control Panel (Reference: Section 4)

G. Side Door Control Panels

H. Couple/Uncouple Auxiliary Power Control Panel

I. Emergency Manual Uncoupling Control

J. Lighting/Windshield Device Control Panel

K. Equipment Enclosures as Specified

L. Microphone

N. Coat Hook

O. Sun Visor

P. Windshield Defogger

Q. Lighting

R. Cup Holder

S. Convenience Outlet (Reference: Section 8)

T. Provisions for Fire Extinguisher (Reference: Section 8).

9.1.7 Panel, Control, and Indicator General Requirements

A. Panels shall be nonreflective, finished in an approved dark gray color, and installed with cross-recess machine screws having heads colored to match the panel color. Separate the display into functional parts by lines engraved on panels that are paint-filled with an approved light color. Wherever practical, legends shall be adjacent to the appropriate switch or indicator. Legends shall be engraved on panels and paint-filled with an approved light color. Where clarity is enhanced, legends may be engraved on the top surface of pushbuttons and shall be visible by reflected light as well as internal illumination.

B. Pushbuttons, indicators, and lamps shall be commercially available, uniform in style, and from the same manufacturer whenever possible. Switches and pushbuttons shall be positioned and mounted to minimize the risk of inadvertent operation. Guards shall be used where necessary.

C. Lamps shall have minimum rated life of 20,000 hr at rated voltage and shall not operate at more than 90 percent of rated voltage when in the high-intensity mode. Solid-state lamps and indicators shall be used for status indication whenever their use allows adequate visibility. Two lamps shall be used for each indication where practical.

9.2 OPERATOR CONSOLE

9.2.1 General

Operator Console shall be of modular construction and shall house the controls and indicators needed for operation and supervision of the train. Functions of

controls and indicators shall be as specified (Reference: Sections 1, 3, 15, 16, and 17).

A. Design to restrict liquids spilled onto the panel from penetrating the console or coming into contact with control wiring or circuitry.

B. Design for easy removal and replacement of components. Except for the Manual Controller, the console modules shall be individually removable from the front, with quick-disconnect wiring, for maintenance or replacement.

C. Provide lighting built into console that illuminates controls when console is energized. Conceal lighting from direct view of seated train operator. Lighting shall come on whenever console is energized and remain on until console is deenergized.

9.2.2 Key Switch

KEY SWITCH shall be a heavy-duty, break-before-make, two-position type.

A. Placing the KEY SWITCH in the ON position shall establish the vehicle containing it as the lead vehicle, energize the console, enable movement of the Mode Selection switch at only the energized console, and shall illuminate an OTHER CAB ON indicator in all other cabs.

B. Provide a safety-critical circuit to ATP indicating which console is energized. An attempt to actuate the KEY SWITCH in a second cab when one console is already energized shall cause application of emergency braking.

C. Removal of the key shall be possible only in the OFF position, with the Mode Selection switch in the OFF position, and the Manual Controller in the FULL SERVICE BRAKE position.

9.2.3 Mode Selection Switch

Train operation mode selection shall be by a three-position, heavy-duty, cam-type switch. Indicate the three positions (OFF/MANUAL/AUTO) by a mechanical pointer. Position changes shall be made by depressing and turning the switch to the desired position. Transfer from AUTO to MANUAL position shall be possible above zero speed. Transfer from MANUAL to AUTO, from MANUAL to OFF, or from OFF to MANUAL positions shall be possible only when Manual Controller is in the FULL SERVICE

BRAKE position and train is at zero speed. The Manual Controller shall be mechanically locked in the FULL SERVICE BRAKE position when AUTO position is selected. Provide an indication to ATP and to the TICU of the mode of operation (AUTO or MANUAL) selected.

9.2.4 Manual Submodes Indication

Indicate Restricted Manual and EMO submodes on the console.

A. RESTRICTED Indicator: Shall flash to signify that the Restricted Manual submode has been established.

B. EMO Indicator: When illuminated, shall indicate that EMO submode is in effect.

9.2.5 Manual Controller

A. The Manual Controller shall control tractive effort, via a P-signal, when the MTO mode, Restricted Manual submode, or EMO submode of train operation has been established. The Manual Controller shall have a T-shaped handle that moves in an essentially linear manner parallel to the vehicle longitudinal axis. The T handle shall incorporate a deadman feature that requires that the handle be rotated 45 degrees about the base of the T to be in the run position. The handle shall have a spring return to the deadman position when released. In the run position, the crossbar of the T shall be parallel to the transverse axis of the vehicle. Except when in EMO submode, the handle in the deadman position shall cause a full service brake application and provide a signal to ATP for brake assurance. Returning the handle to the run position within 3 sec shall reestablish the previously selected tractive effort. When in EMO submode, an emergency stop shall be immediately initiated when the handle is in the deadman position. The deadman feature shall not be applicable when the Manual Controller is in the FULL SERVICE BRAKE position.

B. The longitudinal range of movement of the Manual Controller handle shall be divided into two zones. The rear zone, closer to the train operator, shall be the Brake Zone and shall constitute half of the range of motion. The forward range of motion shall be the Power Zone. A light detent shall separate the Brake Zone from the Power Zone. This position

shall be designated as COAST. The P-signal and BRK signal shall be as specified (Reference: Section 3).

1. In the Brake Zone, the service braking effort request signal shall vary linearly between 0 and 100 percent. Service braking effort shall increase as the handle is moved toward the FULL SERVICE BRAKE position, and shall be 100 percent when in the FULL SERVICE BRAKE position. Movement into the Brake Zone and into the FULL SERVICE BRAKE position shall be detected by approved means to provide the interlocks with ATP and with ATO and MTO submodes. A light detent shall signify the FULL SERVICE BRAKE position. The BRK trainline shall be in its low state when the handle is in the Brake Zone.

5 2. Zero or minimal (Reference: Article 14.2) tractive effort shall occur at the COAST position. Transition of the BRK trainline from low to high or high to low shall occur after passing through the COAST position. 5

3. In the Power Zone, the signal for positive tractive effort shall vary linearly between 0 and 100 percent. Movement of the handle toward the FULL POWER position shall increase motoring. The BRK trainline shall be in its high state when the handle is in the Power Zone.

9.2.6 Emergency Stop Controls

A. The EMERGENCY STOP control shall be a red mushroom-shaped pushbutton. When depressed, pushbutton shall initiate emergency braking of the entire train. Pushbutton shall be manual reset (pull-off) type.

B. Activation of the emergency stop RESET pushbutton shall reenergize the appropriate trainline following an emergency stop. Reset shall be possible only with Manual Controller in FULL SERVICE BRAKE position.

9.2.7 Speedometer

The speedometer shall have an analog display of actual train speed and a series of high-intensity LEDs. The LEDs shall illuminate sequentially to indicate ATP speed limit, and shall flash when ATP detects train overspeed.

9.2.8 Regulated Speed Indicator

An approved REGULATED SPEED indicator shall display the ATP speed limit as adjusted by performance level (Reference: Section 16). Display shall be in digital form when ATO or MTO mode has been established.

9.2.9 Overspeed Alarm

Overspeed alarm shall be a pulsating tone audible signal that annunciates when ATP has detected train overspeed in MTO mode and Restricted Manual submode. The annunciation shall be silenced when the train operator places the Manual Controller in the Brake Zone.

9.2.10 Trainline Indicators

The TRAINLINE INDICATORS panel shall display trainlined indications of critical functions. Each indicator shall illuminate when impairment of the function occurs or the function is cut out. An indication that flashes upon function failure shall change to steady illumination when the failure is acknowledged. Indicator shall remain illuminated until the impairment is rectified. Signal shall be provided to the TICU (Reference: Article 4.2). Indicators shall include the following as a minimum:

A. PROPULSION FAILURE: Flashing indicates a propulsion failure or an overload in any part of the propulsion subsystems on the train.

B. SERVICE BRAKE FAILURE: Flashing indicates that a service brake failure has occurred anywhere on the train.

C. AUXILIARY POWER FAILURE: Flashing indicates a failure in the individual auxiliary power circuits on the train.

D. PROPULSION CUTOUT: Indicates one or more propulsion subsystems on train are cut out.

E. ELECTRIC BRAKE CUTOUT: Indicates electric braking has been cut out anywhere on the train.

F. FRICTION BRAKE CUTOUT: Indicates friction braking on one or more trucks on the train is cut out.

G. COMPRESSOR CUTOUT: Indicates one or more air compressors on train have been cut out.

H. FRICTION BRAKE ON: Indicates brake cylinder pressure exists on any truck on the train.

I. EMERGENCY BRAKE ON: Flashing indicates emergency braking has been applied throughout the train. Indication shall extinguish when emergency braking is reset. This indication may not be required if other approved positive means of displaying emergency brake application on entire train is available.

J. PARKING BRAKE ON: Flashing indicates parking brake is "on" on one or more trucks on the train (used only if application and release are not automatic).

9.2.11 Communications Control Unit

The CCU shall contain switches, pushbuttons, and indicators required for control of carborne voice communications equipment, including the following as a minimum:

A. PASSENGER PA illuminated, momentary pushbutton

B. PASSENGER IC alternate action, illuminated pushbutton

C. CAB IC momentary, illuminated pushbutton

D. RCC to PA alternate action, illuminated pushbutton

E. RADIO, PUSH TO TALK illuminated, momentary pushbutton

F. POWER ON two LEDs (CCU and RADIO)

G. RADIO VOLUME rotary-action volume control device

H. CHANNEL SELECTOR eight-position rotary switch.

9.2.12 Air Pressure Gauge

Air pressure gauge shall be a dual-pointer type. One pointer shall indicate main reservoir pressure, and the other shall indicate brake cylinder pressure.

9.2.13 Horn Pushbutton

HORN momentary pushbutton shall actuate the horn.

9.2.14 Lamp Test Pushbutton

LAMP TEST momentary pushbutton shall cause all indicators and illuminated pushbuttons on the console to be illuminated in the high-intensity state.

9.2.15 Overload Reset Pushbutton

Depressing the OVERLOAD RESET pushbutton shall cause the line breakers throughout the train to be reset (Reference: Section 14).

9.3 AUXILIARY ANNUNCIATOR PANEL

9.3.1 General

Auxiliary Annunciator Panel shall be in view of seated train operator and shall include subsystem annunciators and fault indicators for individual vehicle only, except as specified herein.

9.3.2 Annunciators and Indicators

Annunciators and indicators shall be approved and shall include as a minimum:

A. Propulsion Group:

1. PROPULSION CUTOUT: Illuminates when propulsion subsystem has been cut out.

2. PROPULSION FAILURE: Illuminates when propulsion power modulation equipment has been internally shut down or propulsion equipment has been latched out. Includes blower failure, overvoltage, main fuse failure, or chopper-related failures.

3. ELECTRIC BRAKE FAILURE: Illuminates when braking resistors are above normal operating temperatures or when failure of electric braking circuit occurs.

4. SPARE.

B. Friction Brakes Group:

1. SERVICE BRAKE FAILURE: Illuminates when a failure of control/interlock logic or control supply occurs.

2. FRICTION BRAKE ON: Illuminates when brake cylinder air pressure exists on a truck.

3. COMPRESSOR CUTOUT: Illuminates when air compressor of a dependent pair has been cut out.

4. FRICTION BRAKE CUTOUT: Illuminates when friction braking has been cut out.

C. Auxiliaries Group:

1. AUXILIARY POWER FAILURE: Illuminates when auxiliary power is not available.

2. LVPS FAILURE: Illuminates when no output is available from LVPS.

3. HVAC FAILURE: Illuminates when HVAC subsystem is not operating normally or has failed.

4. SPARE.

D. Miscellaneous Group:

1. ZERO SPEED: Illuminates when vehicle is at zero speed.

2. SPARE.

9.4 AUXILIARY CONTROL AND SWITCH PANEL

9.4.1 General

Auxiliary Control and Switch Panel shall be mounted on face of electrical cabinet behind train operator seat. Panel shall be in direct view and easy reach when train operator swivels in seat. Include subsystem bypass and cutout switches. Bypass switches shall be sealed, such that seal must be broken to operate. Provide signal to the TICU upon activation of any bypass switch (Reference: Article 4.2).

9.4.2 Switches

Switches shall be approved and shall include as a minimum:

A. EMO ENABLE: Sealed, momentary-action toggle switch that enables EMO submode when activated from the energized cab. Provide signal to the TICU upon activation.

B. DOORS CLOSED BYPASS: Circumvents the door interlock circuit of the door controls of the train and disables ATO mode. Bypass activation shall permit movement in MTO mode or MTO submodes of a train with door-interlock failure. 5 5 5 5 5 5 5 5

C. MOVEMENT DETECTION BYPASS: Circumvents the unintentional movement detection circuit of the vehicle.

D. ZERO SPEED BYPASS: Circumvents zero speed portion of the door control interlock circuit. Bypass activation from the energized cab shall permit operation of doors when zero speed interlock has failed or when train is in motion.

E. BERTHING BYPASS: Circumvents the berthing verification trainline. Bypass activation from the energized cab shall permit operation of doors on both sides of train when berthing interlock has failed or when train is not correctly berthed.

F. PROPULSION CUTOUT: Disables the propulsion equipment on the vehicle.

G. SERVICE FRICTION BRAKE CUTOUT: Disables the service friction braking on the vehicle. (Emergency braking shall not be cut out.)

H. ELECTRIC BRAKE CUTOUT: Disables electric braking (dynamic and regenerative) on the train when activated from the energized cab.

I. COMPRESSOR CUTOUT: Disables the trainlined pressure switch of the air compressor on the pair (A-car only).

J. HEADLIGHT BYPASS: When the Operator Console KEY SWITCH is in the OFF position, activation causes headlights of the vehicle to be illuminated.

9.5 LOW-VOLTAGE CIRCUIT BREAKER PANEL

9.5.1 General

Low-Voltage Circuit Breaker Panel shall be mounted on face of electrical cabinet behind train operator seat. Panel shall include circuit breakers and meters.

9.5.2 Circuit Breakers

Circuit breakers shall be provided for subsystem protec-

tion, on-off control, and reset. The panel shall include the following circuit breakers as a minimum:

A. ATP: Controls power to the ATP equipment.

B. ATO: Controls power to the ATO equipment.

C. COMM 1: Controls power to the PA and IC equipment.

D. COMM 2: Controls power to the radio equipment.

E. CONSOLE ANNUNCIATOR PANEL: Controls power to the Operator Console display, lights, and controls, and to the Auxiliary Annunciator Panel.

F. DOOR CONTROL: Controls power to the side door controls.

G. PROPULSION CONTROL: Controls power to the propulsion subsystem.

H. FRICTION BRAKE: Controls power to the friction brake subsystem.

I. HVAC SUPPLY CONTROL: Controls power to the HVAC control circuits.

J. EXTERIOR LIGHTS: Controls power to exterior lights, including headlights and taillights.

K. INTERIOR LIGHTS I: Controls power to one-half of the nonemergency interior fluorescent lighting.

L. INTERIOR LIGHTS II: Controls power to one-half of the nonemergency interior fluorescent lighting.

M. EMERGENCY LIGHTS: Controls power to emergency lighting.

N. AUX CONTROL AND SWITCH PANEL: Controls power to Auxiliary Control and Switch Panel.

O. RIGHT DOOR OPERATORS: Controls power to the right side door operators.

P. LEFT DOOR OPERATORS: Controls power to the left side door operators.

Q. IDENT. UNIT: Controls power to the Train Identification and Control Unit (TICU).

R. COUPLER CONTROL: Controls power to the couple/uncouple circuits.

S. COMPRESSOR: Controls power to air compressor controls (A-car only).

T. DESTINATION AND RUN SIGNS: Controls power to destination and run signs.

U. SPARE.

V. SPARE.

9.5.3 Meters

Digital meters in the panel shall be approved and be as follows:

A. HOUR METER AT SPEED: Five-digit totalization of vehicle operating time when not at zero speed, up to 99,999 hr minimum.

B. HOUR METER AUXILIARIES: Five-digit totalization of auxiliary power supply energization time, up to 9,999 hr minimum.

C. MILEAGE ODOMETER: Six-digit totalization of vehicle mileage, in either direction, as indicated by the speed sensors (Reference: Section 14), up to 999,999 mi minimum.

9.6 SIDE DOOR CONTROL PANELS

9.6.1 Left Side Door Control Panel

Left Side Door Control Panel shall be mounted on face of electrical cabinet behind train operator seat, as indicated. When train operator swivels in seat to lean out cab side window to observe platform and left side doors, the panel shall be in direct view and within convenient reach of operator's left hand. Position panel to allow direct view and convenient operation of controls from standing position. Panel shall contain the following (for interlocks, Reference: Section 16):

A. OPEN Control: Momentary pushbutton, depression of which shall open left side doors on entire train.

B. CLOSE Control: Momentary pushbutton, depression of which shall close left side doors on entire train and, in the ATO mode, initiate acceleration sequence of the train (Reference: Article 16.4).

C. TRAIN BERTHED Indicator: Illuminates when train is properly berthed within platform. Indicator signals train operator to initiate left door open command.

D. DOORS CLOSED Indicator: Illuminates when left side doors on entire train are closed and locked. Indicator shall not illuminate if any left side door is open or unlocked.

9.6.2 Right Side Door Control Panel

Right Side Door Control Panel shall be mounted on cab-side face of wall between cab and passenger compartment, on right side of train, as indicated. When train operator leans from cab right side window to observe platform and right side doors, the panel shall be in direct view and within convenient reach of operator's right hand. Provide sliding locked cover, openable with standard vehicle key. Panel shall contain (for interlocks, Reference: Section 16):

A. EMERGENCY STOP Control: Red mushroom-shaped pushbutton which, when depressed in the energized cab, shall initiate emergency braking of entire train. The control function shall be nullified in non-energized cabs.

B. OPEN Control: Momentary pushbutton, depression of which shall open right side doors on entire train.

C. CLOSE Control: Momentary pushbutton, depression of which shall close right side doors on entire train and, in the ATO Mode, initiate acceleration sequence of the train (Reference: Article 16.4).

D. TRAIN BERTHED Indicator: Illuminates when train is properly berthed within platform. Indicator signals train operator to initiate right door open command.

E. DOORS CLOSED Indicator: Illuminates when right side doors on entire train are closed and locked. Indicator shall not illuminate if any right side door is open or unlocked.

F. DWELL EXPIRED Indicator: Annunciates with approved tone and illuminates when dwell has expired at the station.

9.7 COUPLE/UNCOUPLE, AUXILIARY POWER CONTROL PANEL

9.7.1 General

Couple/Uncouple, Auxiliary Power Control Panel shall be mounted on face of operator cab front wall, to the left side of the F-end door, as indicated. Panel shall be positioned to be in direct view of standing train operator facing F-end door and within convenient reach of operator's left hand. Provide lockable cover that is openable with standard vehicle key.

9.7.2 Controls

Panel shall contain:

A. ELECTRIC COUPLER ISOLATE: Momentary pushbutton (with guards), depression of which shall isolate either all electric pins or selected pins, as approved.

B. AUTOMATIC UNCOUPLE (Alternative: REVERSE JOG): Momentary pushbutton, depression of which shall initiate automatic uncoupling operation or reverse jog function (Reference: Section 12).

C. WASH/COUPLE: Momentary pushbutton which, when held depressed, shall initiate and hold in effect the Wash/Couple submode (for interlocks, Reference: Section 16).

D. AUXILIARY POWER Control: Three-position switch operated by standard vehicle key for alternate control of the auxiliaries trainlines.

1. Position 1, ON: Activates auxiliary subsystems. Key shall not be removable in Position 1.

2. Position 2, OFF (DELAY): Initiates an internally adjustable (5- to 60-min) time delay to effect delayed shutdown of auxiliary subsystems when key is moved from Position 1 to Position 2. Key shall be removable in Position 2.

3. Position 3, OFF: Causes immediate shutdown of auxiliary subsystems except subsystems having delayed shutdown features for internal protection. This position shall be momentary. Key shall not be removable in Position 3.

9.8 EMERGENCY MANUAL UNCOUPLING CONTROL

Provide manual control to facilitate uncoupling when electric power is not available. Location of control shall be approved and shall be lockable with standard vehicle key.

9.9 LIGHTING/WINDSHIELD DEVICE CONTROL PANEL

Locate Lighting/Windshield Device Control Panel within sight and reach of seated train operator, as indicated, but not on Operator Console. The panel shall contain cab lighting, windshield device, and HVAC controls.

9.9.1 Lighting Controls

A. CEILING: Alternate action pushbutton (on/off).

B. INTENSITY: Rotary-action control that varies the illumination intensity of pushbuttons and indicators on the console. The LOW position shall provide good visibility and legibility of the controls. The HIGH position shall ensure visibility and legibility of the illuminated pushbuttons and indicators under the brightest ambient light conditions.

C. READING LIGHT: Alternate action pushbutton (on/off).

9.9.2 Windshield Controls

A. WIPER: Three-position switch (OFF PARK/SLOW/FAST)

B. WASHER: Momentary switch, actuating windshield washer and, after time delay, wiper. May be incorporated into WIPER control using WIPER/WASHER legend

C. DEFOGGER: Three-position switch (OFF/FAN/HEAT).

9.9.3 HVAC Shutdown

Two-position (OFF/AUTO) switch to allow train operator to shut down the HVAC subsystems in the event of an emergency.

9.10 OTHER CAB EQUIPMENT

9.10.1 Equipment Enclosures

As a minimum, the following equipment enclosures shall be located in the cab:

A. ATC and Communications cabinets

B. Propulsion and friction brake control cabinets

C. Miscellaneous equipment cabinets, as approved.

9.10.2 Microphone

Install a microphone in each operator cab (Reference: Section 17). Mount microphone support arm on cab left sidewall or on left front corner post. Support arm shall be rigid but adjustable in the vertical plane. Microphone shall be suspended over the CCU approximately 12 in. above the face of the console. Location and adjustments (support arm adjustment and flexible tube) shall allow proper use of microphone by a seated train operator without interfering with the observation of the Operator Console by the train operator.

9.10.3 Collector Shoe Isolators

Provide two paddle-type, portable collector shoe isolators for each vehicle. Isolators shall be electrically nonconductive and shall be stored in the cab in an approved location.

9.10.4 Coat Hook

One coat hook shall be installed in an approved location in each operator cab.

9.10.5 Sun Visor

Mount a sun visor above the train operator windshield in each cab. Sun visor shall be adjustable, capable of shielding the windshield in one position and pivoting to shade the left side window, and stored in a position out of the train operator's way when not in use.

9.10.6 Windshield Defogger

Provide a blower/heater unit to defog the area of the windshield swept by the windshield wipers, as a minimum. Operating temperature shall not damage or shorten the life of the windshield elastomers, glazing, or frame, or equipment and materials near the unit.

9.10.7 Lighting

A. Provide general illumination in cab area by fluorescent lamp fixtures mounted in the ceiling (Reference: Section 8). Minimum intensity shall

be 25 Fc at a height of 33 in. above the floor in the aisle at the F-end door and on the right side of the cab.

B. Provide a reading light in the cab ceiling above the operator seat. Design and install the light such that it causes minimum interference with the train operator's observation of the guideway.

9.10.8 Cup Holder

Provide a recessed area suitable for holding a drinking cup near the train operator seat. Location and configuration shall be approved.

END OF SECTION

SECTION 10

SIDE DOOR OPERATORS AND CONTROLS

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SECTION 10

SIDE DOOR OPERATORS AND CONTROLS

10.1 GENERAL

This Section specifies the requirements for side door operators, including related controls, devices, and associated safety and interlock items for each vehicle. Side door operators and controls shall be compatible with side doors (Reference: Section 7).

10.2 SIDE DOORS AND OPERATORS

10.2.1 General

A. Each vehicle shall have three biparting doors per side for passenger entrance and exit. Doors shall be actuated with either one operator per door leaf or one operator per doorway. Fully opened doors shall present an unobstructed opening (Reference: Section 3).

B. Each door leaf shall move from the closed position to within 3 in. of the fully open position within 2 sec. Each door leaf shall move from the fully open position to the fully closed position in not less than 2 sec nor more than 3 sec. Operating speeds shall be adjustable for synchronization. Doors shall be designed to preclude impact at either extreme of the closing/opening cycle.

C. Each door leaf shall exert a closing force ranging from 15 lb minimum to 28 lb maximum as measured at midstroke. Each door leaf shall be capable of closing or opening with a 60-lb force applied perpendicular to the interior door surface.

10.2.2 Door Operators

A. Door operators and, where practical, controls shall be in a self-contained package located between the interior liner and outer skin either above the door frame or adjacent to each side door leaf location. Access to the package for removal, installation, repair, and maintenance of the components shall be through a lockable hinged panel (Reference: Section 8). Adjustment shall be available from the exposed side of door operator when the panel is open.

1. Door operator and operating linkage shall provide sufficient damping to prevent doors from bouncing off stops at end of opening and closing cycles. Doors shall travel in a smooth manner, without perceptible jerk.

2. Linkage between door operator drive and door leaf shall contain an over-center linkage geometry or equivalent mechanism to mechanically lock closed door leafs under normal conditions.

B. Door operators shall utilize electric, electromechanical, or pneumatic drives. Electric devices shall be powered from the LVPS. Compressed air shall be from the air compressor (Reference: Section 15). Door operators shall not be damaged by attempts to move obstructed doors. Electric operators shall be permanent-stall type, or shall have approved current-limiting features or devices to protect against overload. Current-limiting features and overload devices shall be automatic including reset.

C. Limit switches shall provide door (fully closed and locked, or not) status information to the side door detection and interlock circuit. Limit switches shall be a LLRU. Limit switches shall be designed and installed such that, if they are replaced, no adjustments shall be necessary or possible to obtain proper functioning.

10.3 SIDE DOOR CONTROL

10.3.1 Trainline Door Operation

Normal door operation shall be by trainline signals controlled by the CLOSE and OPEN pushbuttons located in the energized cab (Reference: Section 9). Doors shall remain in the last commanded position when key is removed from Operator Console KEY SWITCH. The door control design shall preclude unintentional signals from operating the doors. Unless otherwise approved, four trainlines shall be used for the door control system: two for the left side command and two for the right side command. Momentary energization of the appropriate trainlines with one polarity shall open the doors on that side, and momentary energization with the reverse polarity shall close the doors. When the doors are closed, any unintentional spurious feed or ground signals or combination thereof shall not cause any door to open.

10.3.2 Local Operation

A. Local key operated switches (standard vehicle key) shall be provided on each side of the vehicle to allow the set of doors at the center of the vehicle, or as otherwise approved, to be closed or opened from the exterior and interior of the vehicle.

1. Positive action shall be required to close and open doors from either actuating location. It shall be possible to remove the key following any actuation. The doors shall remain in the commanded position after key removal, except as noted.

2. Doors opened from a local switch shall be capable of being closed by means of the controls in the energized cab.

3. Interior switches shall be placed in an approved location adjacent to doors.

4. Exterior switches shall be located on the exterior of the vehicle at a height of 60 to 65 in. above top of rail. Keyholes shall have spring-closed, weathertight covers. Crew steps (Reference: Section 8) shall be located near the exterior key switch but away from current collectors.

5. Local switches shall be operative from battery power without the need for the Auxiliary Key Switch to be turned ON.

B. Interior emergency release shall be provided for all side doors, and be an integral part of the door operating mechanism. Exterior emergency release shall be provided on each side of the vehicle for the center doors. Emergency releases shall be manually actuated and not require electric or pneumatic power, or use of a key.

1. Force required to actuate emergency release shall not exceed 20 lb.

2. Upon actuation, the emergency release shall interrupt the power to the door operator. The operator locking device shall be displaced from its locked position and shall allow the door to be pushed open manually.

3. Access door to emergency release shall be spring-loaded to discourage tampering. Breakable glass shall not be used to provide access to the emergency release.

4. Exterior emergency release shall be located 60 to 65 in. above top of rail at an approved location.

C. A manually actuated, combination cutout and locking device shall be provided at each door operator. The lock shall allow the door leafs to be mechanically locked in the closed position, and the cutout device shall simultaneously actuate the DOOR CLOSED indication circuit for that door. Provide signal to the TICU upon activation of the cutout device (Reference: Article 4.2).

D. Each door leaf shall be equipped with a mechanical push-back feature which, in conjunction with the door operator, shall limit the force developed by the door at the end of the closing cycle. The push-back feature shall be spring-loaded to allow each door leaf to be pushed back 2 in. Total opening shall be 5 in. maximum at the point where pressure is applied when 0.5-in. compression of each leaf resilient edge is included. The push-back feature shall not permit the door leaf to open fully. The force required for the push-back feature shall not be less than 15 lb or more than 25 lb.

10.3.3 Obstruction Detection

The door operators shall be equipped with an obstruction detection capability for passenger protection during door closing.

A. The presence of either a 2-in. wide by 0.375-in. thick solid test specimen inserted with the 2 in. dimension vertical or a 0.75-in.-diameter bar between leafs shall be detected.

B. Door closing shall be monitored by either a timer circuit or, if approved, sensitive door edges. The timer circuit shall be actuated through the door CLOSE trainline. If no DOORS CLOSED indication is received within an adjustable time range of 2 to 5 sec after the door CLOSE pushbutton is depressed, the closing force shall be removed from both door leafs. After an adjustable waiting period of 0 to 2 sec, the closing force shall be reapplied and continue to be applied until a DOORS CLOSED

indication is received. The doors shall not automatically return to the open position after obstruction detection.

10.3.4 Interlocking

Side door interlock and detection circuits are designated as safety critical.

A. Depression of an OPEN pushbutton shall cause the side doors to be opened when the following interlocks are confirmed, except as specified herein:

1. Operator Console KEY SWITCH is ON

2. Zero speed signal is being received

3. Brakes applied signal is being received

4. Proper berthing verification signal is being received (Reference: Section 16)

5. OPEN pushbutton in energized cab and on platform side of train is depressed.

B. Depression of the side door CLOSE pushbutton in the energized cab and on platform side of train shall cause an interlock with the PA circuit to be made (Reference: Section 17). The command to close the doors shall be delayed for an adjustable period of 0 to 2 sec after depression of the CLOSE pushbutton. The interlock with the PA circuit shall not be remade if the obstruction detection circuit is actuated.

C. Door detection circuit shall be interlocked with the BRK signal and P-signal. BRK signal and P-signal shall be deenergized until door closed and locked indications are received from all side door leafs of the train. BRK signal and P-signal shall be deenergized if any side door leaf is open, or opened, beyond the range of the push-back feature.

D. Door detection circuit shall be interlocked with the ATP. Opening of a door leaf beyond the range of the push-back feature while the train is above zero speed will cause activation of the deadman circuit as indicated.

END OF SECTION

SECTION 11

TRUCKS AND SUSPENSION

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SECTION 11

TRUCKS AND SUSPENSION

11.1 GENERAL

This Section specifies the requirements for the trucks and suspension subsystem, including any vehicle suspension components rigidly mounted on the carbody.

11.1.1 Cited References

Organization	Number	Title
AAR	M-101	Axles, Carbon Steel, Non-heat-treated and Heat-treated
AAR	M-107	Wheels, Wrought Carbon Steel
AAR	M-201	Steel Castings
AAR	M-934	Freight Car Journal Roller Bearings
AAR	M-942	Journal Roller Bearing Grease
AAR	RP-631	Section 2, Recommended Wheel Shop Practice
AAR	S-659	Section 1, Mandatory Rules Governing Wheel Shop Practice as Required by Interchange Rules
AFBMA	STD11	Load Ratings and Fatigue Life for Roller Bearings
ASME		Boiler and Pressure Vessel Code, Section VIII
ASTM	A25	Specification for Wrought Steel Wheels for Electric Railway Service
ASTM	A709	Specification for Structural Steel for Bridges
ASTM	A729	Specification for Alloy Steel Axles, Heat-treated, for Mass Transit and Electric Railway Service

Organization	Number	Title
ASTM	E94	Practice for Radiographic Testing
ASTM	E709	Recommended Practice for Magnetic Particle Examination

11.1.2 Configuration

Vehicle shall be supported on two 4-wheeled, roller-bearing-equipped swiveling trucks. Truck design shall be such that underfloor wheel truing machines can be used for the maintenance of wheels without requiring removal of the truck or any major components. F-end trucks shall have provisions for pilot bars, trip cocks, and, if required, ATP receiver coils (Reference: Section 4). The front of F-end trucks shall be the end with the pilot bar provisions.

11.1.3 Safety Mechanism

Trucks shall be attached to carbody with positive mechanical connections that shall provide for lifting the carbody and trucks as a unit. Connections shall be accessible and detachable, with conventional hand tools, to permit detrucking.

11.1.4 Interchangeability

A. Trucks shall be interchangeable without the need for cutting, drilling, riveting, tapping, welding, or otherwise modifying the truck. Interchangeability shall include exchange of trucks between ends of a vehicle and between vehicles, and rotation of an exchanged truck. Elements (such as ATP receiver coils and speed sensors, leveling valves, load weigh apparatus, parking brake rigging, pilot bars, and trip cocks) may be installed or removed. Redundant connecting and mounting provisions for elements shall be furnished as required to ensure interchangeability.

B. The following shall be interchangeable between all trucks: wheels, axles, journal bearings, brake units, gearboxes, current collectors, air springs, and motors. No welding, drilling, tapping, riveting, or cutting shall be necessary for conversion.

11.2 PERFORMANCE, DESIGN, AND STRENGTH REQUIREMENTS

11.2.1 Performance

A. Each truck shall withstand stresses and vibrations which might develop in service at specified speeds. Each truck shall endure the static and dynamic loads imposed by truck-mounted equipment. Safe operation shall be assured at specified speeds when any suspension elements become inoperative.

B. Trucks shall follow the running rails without lateral jerking on curves.

11.2.2 Design Features

A. Miscellaneous Features:

1. Truck assemblies shall include provisions for DFE ATP receiver coils (Reference: Section 4).

2. Stops shall be incorporated in vertical, lateral, and longitudinal bumpers to restrict carbody motion with respect to the truck. Bumpers shall be cushioned.

3. Moving contact surfaces shall be minimized. Resilient mounting or equal shall be used where practical. When used, moving contact surfaces shall be provided with renewable, low-friction wearing elements designed to minimize the transmission of noise and vibration.

4. Truck parts adjacent to, or above, current collector devices and uninsulated power connections shall be shielded against arc damage by dielectric, noncombustible barriers and protective shielding.

5. Pockets or partially enclosed spaces shall have provisions for drainage.

6. Configuration and design of truck-gearbox-traction motor assembly shall be such that the assembly provides restraint to keep one set of wheels between running rails in the event of derailment.

7. Means shall be provided for temporary positive attachment of trucks to carbody during rerailing. Vertical displacement (drop) of the axle during rerailing shall be less than 1 in.

8. Frames shall have tram marks above and below each journal bearing housing located within 0.01 in. of their true position.

B. Frame Stiffness:

1. The truck frame assembly, when centrally loaded to one-half of the AW3 vehicle weight less weight of trucks, shall maintain the axles parallel to within ±0.0625 in. of each other measured at journal bearings, and shall limit the difference between diagonally opposed bearing locations to 0.10 in.

2. When loaded as above and with an added horizontal couple, acting longitudinally, equivalent to 3,000 lb by 56.5 in., the assembly shall not permit a relative longitudinal displacement of the side frames greater than 0.25 in. measured at the journal centers.

C. Provisions shall be made for up to 2 in. of carbody height adjustment in increments of 0.25 in. The provisions shall permit adjustment with standard maintenance equipment and shall not impair the operation of the truck.

D. Truck parts, except wheels, shall clear the plane of the top of the running rails as specified (Reference: Section 3) under worst-case conditions of load, wear, and primary suspension deflection (including creep) over maximum vertical curves, as well as on tangent track. Under these conditions and with deflated air springs, clearance between truck and carbody shall be 1 in. minimum.

E. Weight Distribution:

1. With gear reducers and traction motors installed and with vertical load of one-half of the AW3 vehicle weight less weight of trucks applied through inflated or deflated air springs, truck frame assembly weight measured under each wheel shall be 23 percent minimum and 27 percent maximum of total load. When a wheel is raised up to 1.0 in., the weight distribution at any other wheel shall not change more than an average of 1.15 percent per 0.1 in. raised.

2. When the truck assembly is installed on a vehicle of any specified weight and with inflated or deflated air springs, one wheel

shall be capable of being jacked 2 in. without causing any other wheel of the truck to be lifted from the rails.

3. Braking and motoring forces shall be transmitted through the truck in a manner such that unequal loading on the wheels is minimized. The forces shall not induce excessive stresses, wear, or displacements in the truck and associated parts.

F. Components shall be shock-mounted when required. Safety support members shall be provided for emergency support to retain major components, including traction motors, clear of the track in the event of primary-mount failure. Safety support members shall not support any weight until a failure has occurred. Failure of the primary support shall be easily detectable.

G. Vibration requirements shall be as specified (Reference: Section 3). To minimize low-frequency, ground-borne noise and vibration, unsprung weight shall be minimized.

H. Maintenance Access:

1. Unobstructed access shall be provided to parts that require periodic inspection, lubrication, or removal. Lubrication fittings on the truck shall be readily accessible for servicing either from a pit or from side of the vehicle.

2. Major bolted, threaded, keyed, or pinned connections shall be readily accessible for visual inspection. Threaded fasteners shall be standard, accessible without removal of truck components or the truck from the vehicle, and located to permit removal by standard handtools.

I. Bolster trucks, if used, shall have a low-friction center pin bearing, or approved equal, that permits free truck swiveling.

J. Each truck shall be equipped with four jacking pads, approximately 6-in. long and 6-in. wide, located symmetrically on the underside of the truck frame near the journal bearing housings. During jacking operations, trucks shall withstand without damage a vertical difference of 2 in. between diagonally opposite jacks.

K. Radius rods and their attachments shall be designed to withstand the fatigue loads encountered. Rods shall withstand static tension and compression loads equivalent to at least three times truck weight. Each rod shall be designed for the rod to fail before its supporting structure is permanently deformed. Provisions shall be included that prevent contact between rods and the contact rail when rods fail.

L. Two mounting pads for pilot bar assemblies shall be provided at the front of the F-end truck, forward of the axle vertical centerline, not less than 5 in. forward of the wheels, and approximately 3.5 in. above the running rails. Each mounting pad shall withstand a 5,000-lb minimum horizontal force applied parallel to the direction of train travel.

M. Electrical Connections:

1. Connection to the primary-power ground plate shall be by a single cable with provisions for disconnection at the primary-power ground plate.

2. Connections between the carbody and truck for auxiliary, control, and low-voltage power shall be by quick-disconnect, multipin connectors of approved design.

3. Connections between the carbody and truck for primary power and motor leads shall be by clamshell-type quick-disconnect connectors, with positive latch feature or approved equivalent connector.

4. Cable and conduit shall be installed and supported in such a way as to preclude abrading, pinching, and rattling.

N. Piping:

1. Connections to the carbody piping shall be flexible and have threaded couplings.

2. Suspension air piping on trucks shall be seamless, galvanized carbon steel or stainless steel. The pipes shall be free of burrs, and shall be blown out with dry compressed air at the time of assembly. No water pockets shall be permitted.

3. Piping shall be installed and supported in such a way as to preclude abrading, pinching, and rattling.

4. Piping shall be electrically isolated from the carbody.

11.2.3 Strength Requirements

A. General:

1. Trucks shall be capable of withstanding loads produced by motors and transmitted to the wheel-rail interface. Trucks shall be capable of transmitting acceleration loads to carbody.

2. Structure shall be so designed that normal operating loads do not exceed 50 percent of yield strength of material.

3. Carbody-truck connections and truck components shall be capable of withstanding, without permanent deformation, one and one-half times gravity vertical acceleration of truck components.

B. Loads:

1. Static load condition composed of the following loads shall be equaled or exceeded without yield:

a. Vertical Load: 1.35 J

b. Lateral Load: 0.375 S

c. Longitudinal Load: 0.25 W

d. Traction motor reactions corresponding to locked rotor and 0.5 coefficient of adhesion

e. Braking reactions corresponding to decelerating at 6 mi/hr/sec

f. Above loads shall be logically combined to produce maximum stresses.

g. Definitions:

W = Weight at truck (track reaction), based upon 55 percent of assigned AW3 load

T = Weight of one truck

S = Sprung weight per truck (W - T)

A = Weight of axle and axle-mounted components

J = Journal reaction per truck (W - A).

2. Design fatigue load schedule shall be composed of the following loads:

   a. Vertical Component: S ±35 percent

   b. Lateral Component:- ±0.375 S

   c. Longitudinal Component: ±0.25 S

   d. Motor Torque Reaction: 3 mi/hr/sec acceleration or deceleration

   e. Braking Torque Reaction: 3.5 mi/hr/sec deceleration.

3. The truck shall be capable of withstanding a horizontal shear load generated by deceleration as a result of impacting with a horizontal force equivalent to three times AW0 applied at an end sill.

C. Truck structures used as air reservoirs shall comply with requirements for unfired pressure vessels as well as structures (Reference: Section 6). During pressure tests, the reservoir pressure shall be the maximum required by the standards specified. During fatigue testing (Reference: Section 21), the reservoir pressure shall be the service pressure required for load S on the carbody suspension.

11.3 TRUCK

11.3.1 General

A. Truck frames and, if used, bolsters shall be either cast low-alloy nickel steel, or fabricated steel. Other cast and welded combinations with proven satisfactory service in similar transit applications may be used with approval. Cast steel shall be suitable for welding. Fabricated truck weldments and weld repairs to defects in cast trucks shall be stress-relieved.

B. Truck components shall be clean and free of casting sand, mill scale, welding slag, and other contamination. Machined ferrous surfaces shall be coated with a strippable rust-preventive material. Other surfaces, except wheels and axles, shall be painted as specified herein. Truck components shall be given a complete coat of primer prior to assembly.

C. Following assembly, each truck shall be given two coats of paint. Accessible inside surfaces of truck frames and castings shall be painted. Grease fittings, insulators, linkages, threads for adjustment, and wearing surfaces shall be masked before painting. Truck wiring and elastomers shall not be painted.

11.3.2 Inspection

A. During initial production, soundness of truck frame castings and major structural welds, particularly in areas of potential stress concentration, shall be verified. Critical welds shall be identified on the fabrication drawings and those on the first 10 units shall be radiograph-inspected in accordance with ASTM E94 to approved acceptance criteria. Subsequently, every tenth unit shall have the critical welds radiograph inspected to the same criteria. Castings shall be inspected for defects by visual and magnetic particle methods in accordance with ASTM E709.

B. The repair of casting defects shall be in accordance with AAR M-201. The quality of repairs of defects that might impair the strength of the casting shall be verified by magnetic particle inspection in accordance with ASTM E709 or by radiography in accordance with ASTM E94.

11.4 SUSPENSION

11.4.1 General

Subsystem shall employ both primary suspension and secondary suspension.

A. The primary suspension shall be approved. The suspension shall be positively retained in the truck frame. The suspension shall provide for movement of each bearing location to allow load equalization. The natural frequency of the primary suspension shall not exceed 10 Hz.

B. The secondary suspension shall be pneumatic suspension elements (air springs). The suspension shall provide the ride quality and the automatic floor elevation adjustment specified herein. Design of suspension shall prevent excessive rise of air spring due to leveling valve failure.

C. The overall suspension shall have a natural frequency in the vertical direction not exceeding 1.5 Hz under any load condition between AW0 and AW3.

11.4.2 Leveling

Truck shall include a leveling method to automatically control carbody attitude and floor height.

A. Air spring pressure shall be controlled by a minimum of three leveling valves per vehicle, and shall reflect supported weight at each truck with repeatable accuracy of ±5 percent on any vehicle. Air springs shall be capable of cross-leveling the vehicle with 17,000 ft-lb of load unbalance acting around the longitudinal axis.

B. Leveling valves shall control the floor height to compensate for changes in passenger load and distribution. The valves shall incorporate dampening, with approved delay time, to prevent oscillation and excessive air consumption, to stabilize floor height, and to compensate for weight change rates of less than 600 lb/sec per truck.

C. Distance between top of running rail and top of threshold measured at lateral centerline of side doors shall be maintained within ±0.375 in. of the design height by means of the leveling valves. This level control requirement shall be demonstrated on a level track at AW0 and AW3 weights (Reference: Section 21).

11.4.3 Failure Response

A. Devices shall be provided to detect loss of air spring pressure at any truck and automatically deflate other suspension springs on that truck.

B. In case of failure of air springs, the vehicle shall be able to ride safely at all specified load and speed conditions on vertical bumpers, and the vehicle floor shall drop no more than 2 in. under an AW2 load, static condition.

11.4.4 Motion Dampening

Shock absorbers shall be provided to comply with ride quality requirements (Reference: Section 3).

11.4.5 Vehicle and Truck Displacement

A. Displacement of carbody from its centered level position in relation to truck shall not exceed the following:

1. Vertically: 2 in. up, 2 in. down

2. Laterally: 1.5 in.

3. Longitudinally: 0.375 in.

B. Carbody roll shall not exceed 4 degrees from track plane, including suspension failure on one side of truck while other side is raised solidly against vertical stop, with truck wheels in contact with top of rail.

C. Under static conditions on level track, subsystem shall retain centerline of vehicle floor over center of truck within 0.5 in. of lateral direction regardless of passenger weight distribution.

D. The subsystem shall not permit carbody motion to exceed the dynamic outline, as indicated.

11.4.6 Load Weigh Apparatus

Load weigh apparatus shall be furnished on each vehicle to provide vehicle-load information to the friction brake and propulsion subsystems (Reference: Sections 3, 14, and 15).

11.5 WHEELS

11.5.1 General

Wheels shall be wrought steel in accordance with AAR M-107, Class A or B. Wheel design diameter and wear allowance shall be as specified (Reference: Section 3). Wheels shall be shot-peened and rims shall be heat-treated in accordance with AAR M-107. Wheel tread contour shall be as indicated.

11.5.2 Tolerances

A. Wheel tolerances shall be within plus 0.125 in. to minus zero of design diameter. Wheels shall be supplied in marked pairs that are matched in diameter within one-half tape size.

B. When wheel/axle assemblies are rolled on their journals, eccentricity of treads shall not exceed 5 mil.

11.5.3 Mounting

Wheels shall be mounted on axles using pressures and fits in accordance with AAR RP-631 and S-659. A pressure graph shall be recorded for every wheel mounted.

11.5.4 Marking

Wheels shall be legibly identified with serial number, manufacturer's name, and date stamped on the wheel in a location visible from side of vehicle as described in AAR M-107.

11.5.5 Balancing

Wheels shall be dynamically balanced to within 6 oz at the outside diameter of the rim. Manufacturer's data showing that the machining process negates the need for balancing shall be submitted for approval if required.

11.6 AXLES

Axles shall be solid or hollow. Hollow axles shall be provided with suitably attached protective metal end caps. Axle material shall conform to ASTM A729 or AAR M-101, Grade G.

11.6.1 Finish

Axles shall have an exterior finish in accordance with AAR S-659 and M-101.

11.6.2 Inspection

Ultrasonic inspection shall be in accordance with AAR M-101. After finish machining, the axles shall be subjected to a magnetic particle inspection in accordance with ASTM A709.

11.6.3 Marking

Marking shall be in accordance with AAR M-101. Axles shall be serialized.

11.6.4 Strength

Axles shall be designed to maintain stress within endurance limits under the operational environment indicated.

11.7 FRICTION BRAKE DISC MOUNTING

If disc brakes are used, provisions shall be made to facilitate installation and removal of each outboard-mounted friction brake disc from an axle or wheel.

11.8 JOURNAL BEARINGS

11.8.1 General

Journal bearings shall be no-field-lubrication type roller bearings in accordance with AAR M-934. Design shall have record of successful service in similar service conditions.

11.8.2 Life

Bearings shall be designed to AFBMA STD11 for L_{10} life equivalent to one million mi at AW2 vehicle weight. Bearings shall not require inspection more than once every 500,000 mi.

11.8.3 Mounting

Bearing housings shall be resiliently mounted to the truck frames. The mounting arrangement shall be so designed that weight of vehicle shall keep bearing in place should fastening fail or become loose. The resilient material shall be nonconductive elastomer.

11.8.4 Lubrication

Bearings shall be grease-lubricated in accordance with AAR M-942.

11.8.5 Marking

Bearings shall be marked in accordance with AAR M-934.

END OF SECTION

SECTION 12

COUPLER AND DRAFT GEAR

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SECTION 12

COUPLER AND DRAFT GEAR

12.1 GENERAL

This Section specifies the requirements for couplers, drawbars, and draft gear.

12.1.1 Cited References

Organization	Number	Title
AAR	M-201 Section A	Steel Castings

12.1.2 Physical Requirements

A. An automatic coupler with draft gear shall be installed at the F-end of each vehicle. The coupler shall have an electric coupler integral with a mechanical coupler to allow automatic mechanical, electrical, and pneumatic coupling and uncoupling with other F-ends.

B. A semipermanently coupled drawbar shall be installed at the R-end of each vehicle.

C. It shall be possible to couple F-ends of two A-cars, two B-cars or one A- to one B-car with the trainlined functions operating properly in each case. It shall be possible to connect the R-end of any A-car with the R-end of any B-car.

12.1.3 Performance Requirements

A. Coupler assemblies and drawbars shall permit free negotiation of curves encountered on the system (Reference: Section 3).

B. Coupler assemblies shall conform to the crash-worthiness requirements (Reference: Section 7).

12.2 COUPLING CONNECTIONS

12.2.1 Electric

A. The trainlines shall connect with the automatic electric coupler at the F-end of each vehicle by means of a flexible multiconductor cable.

B. Jumper cables with quick-disconnect fittings shall connect trainlines between the R-ends of each vehicle.

12.2.2 Pneumatic

A. Pneumatic pipes shall be permanently connected to the coupler at the F-end of each vehicle. Pneumatic continuity between vehicles shall be automatic upon coupling.

B. Pneumatic connections on the R-end shall be made with hoses.

12.2.3 Mechanical

A structural connecting unit (coupler anchor) shall be provided for the attachment of the coupler and drawbar draft gear assemblies to the draft sill. The anchor shall be of high-strength steel or ductile iron, and shall comply with the requirements herein.

12.3 MATERIAL AND STRENGTH REQUIREMENTS

12.3.1 Static Load Requirements

A. Coupler, drawbar, and draft gear assemblies shall withstand a minimum static loading of 160,000 lb in buff and draft without permanent deformation. The assemblies shall be designed to provide satisfactory service in emergency operations with trains of up to six dependent pairs.

B. The anchorage point of the draft gear to the vehicle draft sill shall withstand a minimum static loading of 175,000 lb in buff and draft without permanent deformation.

C. Coupler, drawbar, and draft gear assemblies shall be able to transmit, as a minimum, a vertical load of 40,000 lb applied upward and downward through the longitudinal axis of the coupler to the draft sill without permanent deformation to structures or components.

D. Any part of the coupler and drawbar assemblies that could be used as a step shall be able to withstand, as a minimum, a downward vertical load of 360 lb without permanent deformation.

12.3.2 Material

Material for mechanical couplers and drawbars shall conform to the requirements of AAR M-201, Grade C or approved equal or better.

12.4 SUPPORT AND CENTERING DEVICE

Support and centering device on the F-end shall permit the required range of coupler head movement in the vertical and horizontal planes, as specified.

12.4.1 Height Support

The coupler shall be supported at normal height by a radial carrier bar or other approved spring-leaf device. Provisions shall be included for vertical adjustment and wear compensation, if necessary.

12.4.2 Coupler Centering

The mechanical coupler assembly shall include a centering device that shall maintain coupler alignment within one-half of its horizontal gathering range when uncoupled. Provisions shall be made for manual disengagement of the centering device, and to allow the couplers to be moved manually with a force not greater than 50 lb under normal operating conditions. Disengagement and reengagement of the centering device shall not require the use of special tools.

12.5 DRAFT GEAR

12.5.1 General

Draft gear provided at each end of each vehicle shall convey coupler or drawbar loads to the carbody through the coupler anchor. The draft gear shall be double-acting, preloading type capable of absorbing shock both in buff and draft.

12.5.2 Emergency Release

A. The draft gear shall be provided with an automatic release mechanism to permit mating of the anti-climbers during severe end impacts. The mechanism shall be designed to release upon a buff load of 140,000 lb ± 10 percent. After release, coupler heads shall be free to travel inboard far enough to allow engagement of the anticlimbers. The coupler equipment shall remain capable of transmitting draft loads following the release.

B. No special tools and minimum effort shall be required to restore the mechanical coupler to a normal operating condition. Disassembly of the draft gear or removal of parts from the vehicle, other than those associated with the automatic release mechanism, shall not be required. Energy absorbing, self-resetting draft gear having similar load characteristics may be provided if approved.

C. For inspection purposes, positive indication shall be provided on the exterior of the draft gear housing to indicate the normal position of the emergency release mechanism and whether or not a full or partial release has taken place. The emergency release mechanism shall be designed to facilitate dismantling and reassembly in the event of partial release.

12.6 COUPLER AND DRAWBAR DETAIL

12.6.1 General

A. Slack-free, fully automatic, pneumatically operated mechanical coupler of the tight-lock hook type shall be provided at the F-end of each vehicle.

B. Draft gear and release mechanism on F-end and R-end shall be compatible and interchangeable.

C. Couplers and drawbars shall have replaceable, hardened bushings and lubrication fittings at wear points.

D. Pivots shall either be equipped with a method of compensating for wear or shall, when lubricated according to the manufacturer's approved schedule, operate satisfactorily for 450,000 mi without accumulating more than twice the bearing clearance developed in the first 15,000 mi of operation.

12.6.2 Gathering Range

Each coupler pair shall have a minimum 3 in. gathering range in either direction from lateral and vertical centerlines.

12.6.3 Coupling at F-End

Automatic electric, mechanical, and pneumatic coupling shall be safely accomplished at speeds specified (Reference: Section 3). During coupling action, the mating surfaces of the electric coupler heads shall be aligned

to prevent damage to electric contacts. Alignment shall be accomplished by a sufficiently long guide or by retraction of the electrical contacts until the mechanical coupling is completed.

12.6.4 Uncoupling at F-End

A. Automatic uncoupling of electric, mechanical, and pneumatic connections shall be initiated by a single electric or pneumatic signal activated from the energized cab (Reference: Section 9). Either cab adjacent to the mated couplers may be energized, but not both cabs. Depressing the AUTOMATIC UNCOUPLE pushbutton shall result in the following operations:

1. Set emergency brakes on the vehicles to be left parked.

2. Isolate the pins of the electric coupler and properly configure trainline circuits for normal operation.

3. Buff the vehicles, if required, and unlock the coupler hook.

4. Shut off the pneumatic connections.

5. Back up the vehicle from which automatic uncoupling is initiated a maximum of 9 ft.

B. Alternatively, operations 3 and 5 above may be accomplished by the train operator using the WASH/COUPLE pushbutton for buffing and a separate REVERSE JOG pushbutton for separation.

C. Reverse motion power shall be established at a minimum motoring level to permit uncoupling on grade. Reverse motion shall be possible only if initiated through the automatic uncoupling control when the two dependent pairs being separated are mechanically and electrically coupled. A timing switch shall limit the reverse motion period to that necessary for a vehicle separation of 9 ft maximum.

12.6.5 Manual Uncoupling

A. Provisions shall permit manual uncoupling of mated couplers (F-end) by one person at trackside. Manual uncoupling shall be accomplished without air supply availability. The uncoupling device shall be

accessible from either side of the vehicles without standing between the vehicles.

B. Drawbar connect/disconnect operation (R-end) shall be completed within 1 hr.

12.6.6 Pneumatic Detail

A. The design of the system shall ensure emergency brake application in the event of an undesired train separation. Brake application shall be to vehicles on both sides of train separation.

B. On F-ends, vehicle-to-vehicle air line coupling shall be made automatically when couplers are mechanically engaged and locked.

1. A self-closing vented valve shall automatically close off air lines when vehicles are uncoupled and open air lines between coupled vehicles. Emergency brakes shall be automatically applied to the vehicles being parked.

2. Provisions shall be made to preclude unwanted buildup of air pressure in the uncoupling cylinder because of an uncoupling valve leakage.

C. On R-ends, hoses shall be connected to carbody piping with standard unions.

12.7 ELECTRIC CONNECTIONS AND WIRING REQUIREMENTS

12.7.1 General

A. The F-end of each vehicle shall be equipped with a retractable or nonretractable electric coupler, compatible with the type of mechanical gathering device used. The electric coupler heads shall be mounted to either side of, or beneath, the mechanical coupler. The coupler shall be capable of making the required number of electric connections between vehicles plus one additional spare or 10 percent spares, whichever is greater, for each type of trainline function. The contacts shall be capable of maintaining electric continuity under normal operating conditions.

B. Electric connections between R-ends shall be by means of multiconductor jumper cables equipped with

self-locking connectors at each end. The connectors shall be keyed to preclude insertion into the wrong receptacles.

1. Cables, strain relief bushings, and connectors shall provide a watertight connection without the requirement for potting.

2. Jumper cables shall be supported and of sufficient length so that no strain shall be imposed on the wires while the train is under the most adverse operating conditions.

3. The cable shall separate from carbody connector in the event of an unintentional uncoupling, thereby preventing internal damage to the vehicle wiring.

4. With one end uncoupled, the jumper cable shall not trail on the track bed or touch the contact rail.

12.7.2 Automatic Electric Coupler Details

A. Contact Details:

1. Circuits shall be established between dependent pairs through self-contained, face-to-face, 0.030-in., coin-silver alloy-tipped contacts.

2. Individual contacts shall be replaceable without disassembly of the coupler or its wiring harness.

3. Electric contact pins shall be designed to maintain a positive pressure with a minimum force of 10 lb between coupled contact interfaces, unless otherwise approved.

4. Contacts shall have minimum rating to carry 30 A at 40 V dc continuously and 40 A for 1 hr, unless otherwise approved.

5. Contacts and associated hardware shall be constructed of corrosion-resistant metal alloy and shall be mounted in a block of insulating material.

6. Individual contacts shall be clearly and permanently indentified by engraving the insulating block and filling the engraving

with a nonconducting material of contrasting color.

B. Housing and Cover:

1. The housing of the electric coupler box shall be provided with a covered opening to permit inspection, repair, and connection to terminals and other parts.

2. Provisions shall be made to safeguard the electric coupler heads from damage in the event of improper alignment during the coupling maneuver.

3. Each electric coupler shall be provided with an independently operable cover to protect the coupler contacts from dirt and water when the electric coupler is uncoupled. The cover shall automatically swing clear when a mechanical coupling is initiated, and swing closed following uncoupling.

4. The cover shall be removable, dirttight, weatherproof, preclude entrance of liquids from vehicle washing operations, and shall be provided with a drain orifice.

5. The design of the insulating block and contacts shall preclude water entry into the electrical housing with the cover open, shall be nonabsorbing, and shall neither embrittle nor soften in the specified operating environment.

6. When coupled, the electric coupler and contacts shall be protected from dirt, water, rain, and frozen precipitation by a soft elastomeric gasket completely enclosing the periphery of the insulating block.

C. Electric Connections:

1. Connections from the electric couplers to the carbody shall be by means of multiple-conductor cables equipped with self-locking plugs. Crimp connections shall be used to connect each wire to terminals at the trainline junction box end of the cables. Plugs and receptacles shall be keyed to preclude the insertion of any plug into the wrong receptacle.

2. Connections to the back of the electric coupler contacts shall be either by means of compression-type terminals integral with the contact, or by means of eye-type terminals bolted thereto and accessible for maintenance. Connection wires shall have sufficient slack to provide for three terminal repairs.

12.8 TRAINLINE CONTROL AND ISOLATION

12.8.1 Trainline Control

A. For Uncoupling:

Sense the uncoupled state, deenergize trainlines, isolate pipes, close loop circuits, and activate the relays needed to establish the train end.

B. For Coupling:

Sense the coupled state, restore continuity to trainlines and pipes, and activate the relays needed to establish the coupled end.

C. A fail-safe uncoupling circuit shall be provided for break-in-two protection.

12.8.2 Isolation

Two isolation switches shall be provided to isolate electric coupler pins in the event of electrical trainline malfunction. One isolation switch shall be provided in the cab as indicated, and the other underneath the F-end of each vehicle.

12.9 COUPLER ADAPTER

Provide coupler adapter for coupling vehicles to DFE locomotive. Locomotive coupler will be AAR Type "E" or Type "F." Coupler adapter shall be of an approved design.

END OF SECTION

SECTION 13

POWER SUPPLY AND ELECTRICAL EQUIPMENT

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SECTION 13

POWER SUPPLY AND ELECTRICAL EQUIPMENT

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SECTION 13

POWER SUPPLY AND ELECTRICAL EQUIPMENT

13.1 GENERAL

This Section specifies the high-voltage and low-voltage power supply networks, including primary power collectors, ac and dc conversion equipment, battery, control devices, protection devices, panel boards, and bonding and grounding methods for each vehicle.

13.1.1 Cited References

Organization	Number	Title
IEEE	16	American Standard for Electric Control Apparatus for Land Transportation Vehicles
IEEE	S-135	Power Cable Ampacities, Copper Conductors and Aluminum Conductors
NFPA	70	National Electric Code
NFPA	130	Fixed Guideway Transit Systems

13.1.2 Basic Voltage Groups

Vehicle power circuits shall be grouped into three basic voltages consisting of primary power, auxiliary power, and low-voltage power as indicated in Figure TP-13-1 and specified (Reference: Section 3).

A. Primary power circuits shall be powered from the primary power supply.

1. Conductors between traction motors and traction power control equipment, including current-collector and motor leads, shall be sized according to IEEE S-135 or using 150 percent rms current, whichever is greater. Ampacities of other primary power conductors shall be per NFPA 70, Chapter 3. Ampacity of primary power return wires to ground brushes shall be 150 percent of rms load.

a. The rms current shall be based upon the round trip operation specified for the propulsion and friction brake subsystems thermal capacity (Reference: Section 3).

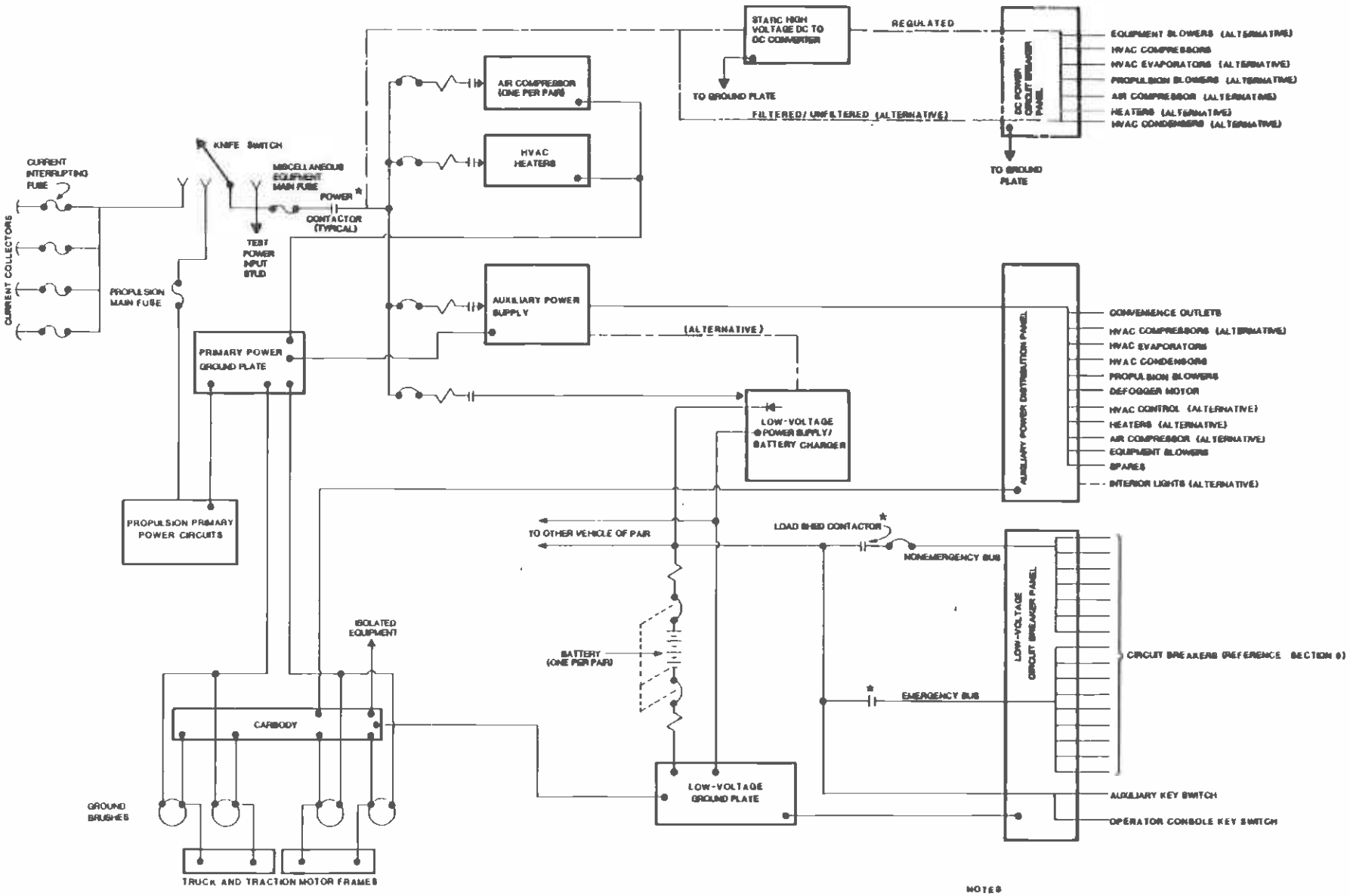

FIGURE TP-13-1
ELECTRICAL DISTRIBUTION
FUNCTIONAL SCHEMATIC

NOTES
1. ★ INDICATES CONTACTORS OPERATED BY DELAY OF AUXILIARY POWER CONTROL (REFERENCE, SECTION 8)

b. Minimum wire size shall be 14 AWG.

2. Maximum allowable voltage drop between the primary power supply and the point of use with nominal voltage and maximum loads shall be:

a. 1 percent for feeder circuit (two collector shoes to knife switch and ground plate to four ground brushes)

b. 3 percent for inverter, air compressor, and heater circuits

c. 5 percent for propulsion circuit.

B. Auxiliary power circuits shall include feeder from auxiliary power supply to distribution panel.

1. Ampacity of conductors shall be per NFPA 70, Chapter 3. No conductor shall be less than 14 AWG.

2. Maximum allowable voltage drop between auxiliary power supply and point of use with nominal voltage and maximum loads shall be:

a. 1/2 percent for feeders from inverter to distribution panel

b. 3 percent for each circuit supplying continuous load

c. 5 percent for each circuit supplying intermittent load.

C. Low-voltage circuits, including control circuits, shall be powered from LVPS. Circuits shall include feeders from LVPS to distribution panel.

1. Ampacity of conductors shall be per NFPA 70, Chapter 3. Minimum wire size for undervehicle wiring shall be 14 AWG for power and 16 AWG for control circuits. Within equipment enclosures, minimum wire size shall be 20 AWG.

2. Maximum allowable voltage drop between LVPS and point of use with nominal voltage and maximum loads shall be:

a. 1/2 V between LVPS or battery and distribution panel

b. 1-1/2 V for each circuit feeding continuous load

c. 3 V for each circuit supplying intermittent load.

13.1.3 Electrical Materials and Installation Methods

Electrical materials (including cable, wire, and circuit protective devices) and installation methods shall be as specified (Reference: Section 6).

13.2 PRIMARY POWER

13.2.1 Current Collector

Each vehicle shall have four current collector assemblies, one mounted on the left side of each truck and one mounted on right side of each truck. The current collectors shall conduct primary power from the contact rail to the vehicle, and shall conduct regenerative braking power from the vehicle to the contact rail. Each current collector shall be designed to conduct both the primary power and regenerative braking power requirements of the entire vehicle. Current collectors shall comply with the clearance envelope, as indicated.

A. Current collectors shall be compatible with the characteristics and clearances of the contact rail. The current collector assembly shall include a collector shoe that slides along the top of the contact rail, associated springs or other devices necessary to maintain the shoe on the contact rail with an adjustable contact force of 10 to 30 lb, shunt wires to carry current from the shoe to the current collector fuse terminals, fuse holder, fuse, and base assembly.

B. The current collector shall provide for vertical adjustment due to wheel wear.

C. The current collector shall be capable of absorbing motions imparted by the truck without loss of effective contact. Horizontal displacement, lateral to the contact rail, shall be 1.5 in. maximum. Vertical motion relative to the contact rail shall be upward 0.5 in., nominal. Maximum shoe downward travel below the nominal top of the contact rail when off the rail shall be 1.0 in. Displacement due to truck primary suspension shall be added to the specified values.

D. Each current collector shoe shall have a minimum life of 50,000 vehicle mi. The shoe shall be compatible with and sacrificial to the contact rail wear surface, and shall resist welding to the contact rail. The shoe shall shear upon contact with an obstruction before damage can occur to the collector shoe holder. The current collector shoe shall include a wear indicator to permit quick visual indication for necessary shoe replacement.

E. Provision shall be made for easy lubrication of movable connections to bearings, if required, and the entire collector design shall assure convenient removal, inspection, and cleaning.

F. The current collector shoe shall have pressure on the surface area in contact with the rail to pass the current under operating conditions without being heated to a temperature that would be detrimental to the collector shoe or mechanism. Contact force shall be adjustable independent of the collector height. Each shoe shall be rated to carry the maximum fault current and not to fail before the fuse. The shoe mounting shall preclude loosening of the mechanical and electrical connections in service.

G. The current collector shall be insulated from the carbody. When dry, the insulation shall withstand a test voltage of 30,000 V, 60 Hz for 1 min. When wet, the insulation shall withstand a test voltage of 20,000 V, 60 Hz for 10 sec. The insulation material shall not absorb water, oil, or grease with prolonged exposure. A current collector arc shield shall be provided, shall be rated for a nominal voltage of 1,500 V dc, and shall be of noncombustible material.

H. A current-interrupting fuse with current-limiting capability shall be provided on each current collector. The fuse shall be easily accessible. A blown fuse indicator shall be provided with the fuse holder. The fuse characteristics shall be coordinated with those of the propulsion subsystem. Fuse shall be mounted such that the arc is directed away from grounded parts of the vehicle.

13.2.2 Ground Brush

A. Two isolated ground brushes, insulated holders, and support assemblies shall be provided for each axle, as indicated in Figure TP-13-1.

B. Primary power shall be returned to one ground brush per axle. The other ground brush per axle shall be connected to the truck and carbody safety ground and traction motor frames.

C. Brushes shall bear against ground rings pressed on axles. Brush contact area shall have current capacity sufficient to carry 200 percent of intended load per axle.

D. Brushes shall have minimum life of 100,000 vehicle mi. Ground rings shall have minimum life of one million vehicle mi.

13.2.3 Power Distribution Assembly

A. Primary power distribution assemblies shall include knife (main disconnect) switch, test power input stud, propulsion main fuse, miscellaneous equipment main fuse, circuit breakers, power contactors, and primary power ground plate. Assemblies shall be suitable for undervehicle mounting.

B. Single-pole, three-position or four-position knife switch shall be provided and shall comply with the following requirements:

1. In position 1, connect primary power to propulsion and auxiliary loads.

2. In position 2, disconnect primary power from vehicle-carried systems.

3. In position 3, connect loads (except propulsion loads) to test power input stud.

4. In position 4, if provided, connect primary power with auxiliary loads, and disconnect propulsion loads and test power input stud.

5. Be accessible from side of vehicle, and be arranged so that enclosure cover cannot be closed when switch is in any position other than position 1.

6. Have current rating over the specified range of primary voltage meeting primary power distribution requirements, including regenerative braking.

7. Be designed such that power from test power input stud cannot energize current collectors.

C. Provide a 0.625-in. diameter by 1.5-in.-long stud for connecting test power plug. Stud shall be rated for 100 A minimum at 750 V dc and shall be sacrificial to knife switch assembly.

D. Provide main fuse for propulsion circuit protection.

E. Provide main fuse for short-circuit protection for feeder cables supplying 750 V dc circuit breakers in miscellaneous equipment circuits.

F. Provide individual isolation and overcurrent protection for HVAC heaters, auxiliary power supply, air compressor, and LVPS, unless otherwise approved.

G. Provide power contactor for on/off control of auxiliary power supply, air compressor, heaters, and, if the power feed is directly from the primary power supply, LVPS.

1. Contactors shall be single pole to interrupt high side of line.

2. Contactors shall be operated by low-voltage power. Low-voltage wiring shall be isolated from primary power by either nonconducting or grounded-metal separator.

3. Control of contactors shall be through the Auxiliaries On/Off trainlines.

4. Means of turning on LVPS from outside the equipment enclosure when the battery voltage is low shall be provided. Switch shall be accessible from one side of the vehicle.

H. Provide primary power ground plate isolated from ground and insulated for 3,000 V minimum. The plate shall be accessible and have studs for connection of F-end and R-end truck ground brush cables, propulsion return cables, and other equipment return wires. Only one wire or cable shall be connected per stud. Provide one spare 0.375- and two spare 0.25-in.-diameter studs.

13.2.4 Insulation Requirements

Insulation requirements for vehicle wiring with ground brushes lifted and high and low sides connected together shall comply with the following:

A. Minimum resistance between primary wiring and carbody shall be 3 Mohm when measured with a 1,000 V megohmmeter at relative humidity of 0 to 85 percent.

B. Dielectric test shall be as specified in IEEE 16.

13.2.5 Circuit Protection Coordination

Fuses, including shoe fuses, and circuit breakers shall be coordinated to provide correct operation and protection. Coordination shall verify that circuit interruption localizes the fault, that protective devices act to backup the downstream devices, and that protective devices are capable of interrupting the maximum as well as the minimum fault currents. Circuit breakers with thermal and magnetic overloads shall be used in preference to fuses, except as specified.

13.3 AUXILIARY POWER

13.3.1 General

A. Auxiliary power shall be provided for auxiliary loads as specified and as indicated in Figure TP-13-1.

B. Feeder breakers shall be provided in feeds from auxiliary power supply. Select breaker rating that provides overcurrent protection for equipment and feeder cables per NFPA 70, Chapter 3. Locate breakers in an enclosure accessible from side of vehicle.

C. Branch circuit breakers shall be provided for auxiliary loads. Select breaker rating that provides short-circuit and overload protection to branch circuit wiring and equipment. Locate breaker enclosure inside the operator cab or where it is accessible from a side of vehicle.

D. Contactors and Starters:

1. Provide motor starters for rotating loads, where necessary, and contactors for nonrotating loads.

2. Select thermal overload elements to provide overload protection for motors. Consider repetitive starts required when traversing multiple rail gaps.

3. Provide contactors and starters that operate from LVPS.

4. Provide interlocks and timers as necessary to sequence startup of loads, if required, and to disconnect unnecessary loads when supply shutdown is delayed.

E. With neutral and three-phase conductors connected together at each load and source point, minimum resistance between auxiliary wiring and carbody shall be 2 Mohm when measured with a 500 V Mohmmeter. Dielectric test shall be as specified in IEEE 16.

13.3.2 Auxiliary Power Supply Equipment Alternatives

Auxiliary power supply shall be provided using any one of the four alternatives specified below. If converters are furnished, converters shall operate at one fixed frequency of either 360 or 720 Hz. Convertors operating at other than either of these frequencies shall be subject to approval after submittal of analyses that support assurance of electromagnetic compatibility with DFE ATP and as required herein (Reference: Article 3.17).

A. Only Alternating Current: Ac auxiliary power supply shall be provided on either a per vehicle basis or a per dependent-pair basis for air compressors, convenience outlets, defogger motors, equipment blowers, HVAC subsystems, interior lights, and propulsion blowers. LVPS and battery charger may be powered from the auxiliary power supply. Power supply shall be underfloor mounted and either rotating machine or static inverter. Static inverters shall be naturally cooled, unless otherwise approved.

1. Without load shedding, the power supply shall have 10 percent reserve capacity over that required to start HVAC compressors while simultaneously supplying the other loads.

2. If one power supply per vehicle is provided, essential auxiliary loads shall be cross-fed between the two vehicles of a dependent pair. The failure of one power supply shall not cause the failure of the other power supply, or loss of power to essential auxiliary loads on either vehicle. Essential loads shall include, as a minimum, air compressors, equipment blowers required for safe operation of vehicles, 50 percent of nonemergency interior lights, one

HVAC circuit per vehicle, propulsion blowers, and LVPS with a reduced battery charging capability.

3. Auxiliary power failure shall be indicated in the operator cab (Reference: Section 9) when output voltage and frequency are out of limits. Indication of failure shall be delayed as required to allow traversing of contact rail gaps.

4. There shall be no perceptible interruption of lighting output when any auxiliary loads are switched or contact rail gaps are traversed.

5. Steady-state voltage regulation shall maintain output voltage within 4 percent of nominal value over entire range of connected loads and over the specified input voltage range. Steady-state frequency regulation shall maintain supply frequency at 60 ±3 Hz.

6. The rms value of the harmonic voltages shall be compatible with permanently connected loads. The value shall not exceed 20 percent of the fundamental voltage and shall not cause interference with ATC signaling and other circuits.

7. Transient response shall be such that voltage or frequency shall return to a steady-state value within 3 sec after either a 150 V step change of primary voltage or a 50 percent step change in output current.

8. Circuits shall be protected against primary power transients, and sustained overvoltages and undervoltages. Overcurrent protection shall be provided by circuit breakers having magnetic and thermal overloads or other approved methods.

B. Combination of Alternating and Direct Current: Ac power supply shall provide the power to the HVAC subsystem (except controls), blowers for propulsion and other equipment, defogger motors, and convenience outlets. Power converting and cross-feed between the two vehicles of a dependent pair, and other requirements shall be as specified above. Air compressor and heaters may be powered directly from primary power.

C. High-voltage Direct Current: Dc auxiliary power supply shall be provided on either a per vehicle basis or a per dependent-pair basis for air com-

pressors, equipment blowers, HVAC subsystems (except controls), and propulsion blowers. LVPS and battery charger may be powered from the auxiliary power supply. Power supply shall be underfloor mounted, static dc-to-dc converter powered by primary power, and have a common return.

1. Each converter shall be rated and sized for the total connected load.

2. If one power supply per vehicle is provided, essential auxiliary loads shall be cross-fed between the two vehicles of a dependent pair. The failure of one power supply shall not cause the failure of the other power supply or loss of power to essential auxiliary loads on either vehicle. Essential loads shall include, as a minimum, air compressors, equipment blowers required for safe operation of vehicles, HVAC controls and one-half of the HVAC equipment, propulsion blowers, and LVPS with a reduced battery charging capability. If the two power supplies are connected in parallel, design shall ensure ±20 percent of normal load sharing. Converter regulator stability shall be sufficient to ensure that no oscillatory interchange of power between parallel converters will occur with any combination or application of loads, including connected nonloaded converters.

3. As a minimum, converter efficiencies shall be 50 percent at 10 percent rated load, 75 percent at 50 percent rated load, and 80 percent at 100 percent rated load.

4. Converter protection shall include inverse time-delay load protection, short-circuit output protection, 120 percent current limit control, overtemperature protection, and ground fault protection.

5. Converter shall be naturally cooled unless otherwise approved and enclosed in a weatherproof enclosure suitable for underfloor mounting.

D. Direct Primary Power: Primary power shall be fed directly (unfiltered), filtered, or regulated prior to being fed to auxiliary equipment.

13.4 LOW-VOLTAGE POWER SUPPLY

13.4.1 General

A. LVPS shall be provided on a per vehicle basis or per dependent-pair basis. If one LVPS per vehicle is provided, loads shall be cross-fed between the two vehicles of a dependent pair, and failure of one LVPS shall not result in failure of the other LVPS, 50 percent of interior lighting, control circuits, or battery charging capability. If powered from an ac auxiliary power supply, the LVPS shall be electrically isolated from the ac power supply.

B. Converters fed from primary voltage or high-voltage dc shall operate at one fixed frequency of either 360 or 720 Hz. Convertors operating at other than either of these frequencies shall be subject to approval after submittal of analyses that support assurance of electromagnetic compatibility with DFE ATP and as required herein (Reference: Article 3.17).

13.4.2 Battery Charging

Battery charging circuit shall be compatible with the approved batteries furnished. Battery charger may be provided separate from the LVPS.

13.4.3 Capacity

LVPS shall be rated to supply 120 percent of total connected loads, including recharging a fully discharged battery to 50 percent within 3 hr.

13.4.4 Regulation

LVPS shall maintain constant output of 37.5 ±0.5 V for any combination of input voltage and output load. Temperature compensation of voltage is permitted if necessary to meet battery watering requirements. Power supply shall have output ripple less than 3 percent peak-to-peak from zero to full load with battery connected.

13.4.5 Protection

Power supply shall have overvoltage and overcurrent protection.

13.4.6 Control

Normal control shall be through Auxiliaries On/Off trainlines.

13.4.7 Auxiliary Contacts

A. LVPS failures shall be indicated in the operator cab (Reference: Section 9). Indication of failure shall be delayed as required to allow traversing of contact rail gaps.
B. Contact shall be provided for use by load shed function (if provided) to establish emergency bus.

13.5 LOW-VOLTAGE POWER DISTRIBUTION

13.5.1 General

Low-voltage power shall be distributed from the Low-Voltage Circuit Breaker Panel in the operator cab (Reference: Section 9).

13.5.2 Circuit Breakers

As a minimum, circuit breakers shall be provided for each branch circuit as specified. Breaker rating shall be selected for ampacity of branch circuit wiring or load requirement, whichever is less. Breakers shall be fitted with magnetic and thermal overload activation.

13.5.3 Low-voltage Power Contactor

Contactors shall be provided in series with the power feed to low-voltage circuit breakers, except those supplying power to the Operator Console KEY SWITCH and Auxiliary Key Switch. Control of the contactors shall be through the Auxiliaries On/Off trainlines.

13.5.4 Load Shed Control

A load shed contactor shall be used when nonemergency lighting is taken from the LVPS. The contactor shall be in series with nonemergency lighting circuit breakers and shall be energized whenever LVPS is operating within specified limits. Contactor shall be deenergized 30 sec after the LVPS output fails and shall be automatically reinstated when the LVPS returns to normal.

13.5.5 Low-voltage Ground Plate

Provide an isolated ground plate within Low-Voltage Circuit Breaker Panel enclosure. Ground plate shall be isolated from any power source. Provide one stud each for each branch circuit return wire, the ground wire, the low-voltage feeder return, and the battery negative. Provide ground wire between ground plate and carbody.

13.5.6 Insulation Requirements

With ground wire removed from carbody, high side connected to ground plate, battery circuit open, circuit breakers closed, and load shed contactor blocked closed, minimum resistance between low-voltage circuits and carbody shall be 2 Mohm when measured with a 500 V megohmmeter. Dielectric test shall be as specified in IEEE 16.

13.6 BATTERY

13.6.1 General

A. An approved battery shall be provided on a per vehicle basis or per dependent-pair basis. Limits of electrolyte level shall be clearly marked and visible without dismantling the assembly. Vent caps shall be captive, sprayproof type designed to permit gas to escape from the battery container.

B. Battery shall be assembled on pallet-type grating to allow for installation and removal from side of vehicle as complete assembly. Battery enclosure shall be stainless steel and ventilated, and sized to accommodate batteries having comparable ratings from at least three approved manufacturers. Organic materials shall not be used in battery enclosure.

C. Means shall be provided to prevent overcharging of battery.

D. Battery circuit breaker shall be mounted near the battery enclosure in a position accessible from end or side of vehicle.

E. Battery installation shall comply with requirements of NFPA 130.

F. Individual cells shall be legibly and permanently marked with the following information:

1. Name of manufacturer

2. Date of manufacture

3. Ahr capacity

4. Type and designation or part number

5. Polarity of terminal posts

6. Terminal voltage.

13.6.2 Design

Battery, at specified ambient operating temperature, initially charged to 80 percent of capacity, discharged until terminal voltage is 1 V per cell for nickel-cadmium type or 1.75 V per cell for lead-acid type, and with 18 A ATC load, shall have sufficient capacity to:

A. Carry low-voltage loads until load shed contactor, if provided, is opened when the LVPS output is interrupted.

B. Carry remaining low-voltage loads for 1 hr after load shed contactor is opened when operating the lead vehicle of a three-dependent-pair train and with LVPS off.

C. Not require watering more than once every 1,500 hr of operation under normal service conditions.

13.7 GROUNDING AND SHIELDING

13.7.1 General

A. Provide vehicle safety grounding to running rail while precluding stray currents in carbody by using one of two independent ground brushes per axle.

B. Provide bonding of equipment and enclosures to the vehicle structure by metal-to-metal contact or by flexible conductors of sufficient cross-sectional area to carry fault current. Enclosures shall provide a low-impedance path from equipment to vehicle structure. Current-carrying capacity of bonds shall be greater than the current necessary to activate overload protection device of the equipment.

13.7.2 Equipment Grounds

A. Equipment safety grounding conductors shall be provided in accordance with NFPA 70, Chapter 2, Article 250. Requirements governing the use of dissimilar metals shall apply.

B. Truck side frames, carbody, bolsters, and traction motor frames shall be bonded together and connected to a safety ground brush at each axle.

C. Equipment shock-mounted to or otherwise isolated from carbody shall be bonded to the carbody.

D. Equipment rigidly mounted to carbody structure shall be considered grounded through the carbody structure.

E. Neutral of wye connection of ac auxiliary power supply output shall be connected to the carbody.

13.7.3 Shielded Circuits

Wire shields shall be provided to minimize audio frequency, radio frequency, and electromagnetic interference.

A. Shields used to reduce audio frequency interference at frequencies less than 150 kHz shall be grounded at one end only. Shielded trainline circuits shall have shields connected through F-end coupler, R-end connectors, and shall be grounded through contacts on, or controlled by, the Operator Console KEY SWITCH of the lead vehicle.

B. Shields used to attenuate radio frequency interference on circuits carrying signals at frequencies above 150 kHz shall be grounded at more than one point. These shields may be grounded at each connector or equipment enclosure and need not be carried through connectors or couplers.

C. Unless otherwise approved, shields used to exclude EMI at frequencies above 150 kHz shall be grounded at each side of connectors and at intervals of 3 ft minimum.

13.8 PASSENGER AND OPERATING PERSONNEL SAFETY

Metal parts that can be contacted by passengers or operating personnel, including equipment boxes, panels, and test receptacles, shall not differ from carbody potential. Exposed wiring shall be protected from mechanical damage and abrasion by approved shielding.

END OF SECTION

SECTION 14

PROPULSION SUBSYSTEM

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SECTION 14

PROPULSION SUBSYSTEM

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SECTION 14

PROPULSION SUBSYSTEM

14.1 GENERAL

This Section specifies the requirements for the propulsion subsystem to be supplied on each vehicle. The subsystem shall be chopper type, capable of providing motoring, coasting, and electric braking.

14.1.1 Cited References

Organization	Number	Title
IEEE	11	Rotating Electric Machinery for Rail and Road Vehicles
IEEE	16	Electric Control Apparatus for Land Transportation Vehicles
IEEE	43	Recommended Practice for Testing Insulation Resistance of Rotating Machinery
IEEE	113	Test Procedures for Direct-Current Machines
IEEE	304	Test Procedures for Evaluation and Classification of Insulation Systems for Direct-Current Machines

14.1.2 Physical Requirements

A. Propulsion subsystem shall include, but not be limited to, traction motors, gear reducers, electric braking apparatus, power control and conditioning equipment, control logic, and protective devices.

B. Four traction motor/gear reducer assemblies (one traction motor and gear reducer for each axle), shall be furnished for each vehicle. The traction motor/gear reducer assemblies shall be incorporated into the truck design to transfer motor torque to each axle. Traction return current shall be shunted around bearings and gears.

C. Brake resistor grids, power control and conditioning equipment, and protective devices shall be mounted under the vehicle. Low-voltage control logic assemblies shall be naturally cooled and located in an environmentally protected enclosure.

D. Metal enclosures that surround arcing devices shall be lined with approved insulating material, but lining will not be required on arc chutes that extend through the enclosure to vent the arcs to the outside air. Shields or separations shall be provided to prevent arcing to adjacent apparatus and wiring.

E. Electrical and electronic components and assemblies shall be modular, grouped within enclosures according to function, and arranged to ensure cooling, maintainability, and protection of heat-sensitive components. Circuits and components shall be located and mounted to ensure thermal and vibrational stability.

14.1.3 Functional Requirements

A. The propulsion subsystem shall cause motoring, permit coasting, and apply electric braking.

B. The propulsion subsystem shall provide the following functions:

1. Receive power from the primary power distribution assembly

2. Respond to command signals from the P-signal generators and the load weigh apparatus

3. Respond to BRK signal

4. Evaluate signals from, and provide signals to the friction brake subsystem to effect proper blending of service braking

5. Evaluate signals from speed sensors and spin/slide control apparatus

6. Connect, adjust, modulate, and disconnect primary power from the traction motors

7. Generate power for electric braking, and distribute that power to the primary power distribution assembly and to the brake resistor grids

8. Control and monitor propulsion subsystem auxiliary equipment

9. Provide signals indicating vehicle speed, subsystem status, and equipment status to the trainlined annunciators, the propulsion subsystem local control panel, and spin/slide control apparatus, as appropriate

10. Respond to inputs from DTE to permit proper adjustment, troubleshooting, maintenance, and repair.

14.2 PERFORMANCE REQUIREMENTS

14.2.1 General

A. A single traction control unit shall control the traction motors on each vehicle in motoring, resistive braking only, regenerative braking only, and any combination of electric braking specified. Fixed-frequency operation at 360 Hz shall be utilized. Two-frequency operation with motoring at 120 Hz from 0 to approximately 5 mi/hr and then changing to 360 Hz for higher speed operation may be utilized if approved. Two frequency operation shall have independent assurance of the chopping-frequency transition. 5

B. The propulsion subsystem shall meet the specified performance requirements with primary power as specified (Reference: Section 3).

C. The design shall be such that as many items as possible perform both the motoring and braking duties in order to keep the total quantity of equipment to a minimum. Where practical, failure of electric braking equipment shall not preclude operation in motoring.

D. Power circuit design shall ensure that motor circulating currents do not occur under operating conditions, including instances of low adhesion or pushing or pulling of another vehicle.

E. The traction equipment shall be designed so that (except under fault conditions) the line current is reduced before the line breaker opens when the control signals for motoring or braking are lost. Line voltage transients shall be kept to a minimum.

5 F. In the Coast mode, tractive effort (positive or negative) shall be reduced to less than 10 percent of the AWO tractive effort at that speed. 5 5 5 5

14.2.2 Emergency Duty

A. Under manual operation, AW2 load, and system grades specified (Reference: Section 3), the collective propulsion subsystems of a dependent pair shall be capable of pushing or towing an inoperable AW2-loaded two-pair train at a speed of 10 mi/hr until the passengers are off-loaded at the next station. After the passengers are off-loaded and the operable and inoperable vehicles are at AW0 load, the subsystems shall be capable of pushing or towing the inoperable train at a speed of 25 mi/hr to the Yard, pocket track, or storage tracks at the end of the line. Such pushing or towing shall not result in damage, in either motoring or braking, to the equipment of any vehicle.

B. At AW2 load, and with maximum tractive effort being requested, the propulsion equipment shall withstand a stalled condition for a period of 10 sec without damage. The equipment shall be automatically protected if the stall continues for more than 10 sec.

14.2.3 Motoring

A. The propulsion equipment shall be capable of providing the performance levels specified (Reference: Section 16).

B. The equipment shall provide speed protection independent of ATP such that train speed in EMO submode and Wash/Couple submode is limited as specified (Reference: Section 3).

14.2.4 Braking

A. The traction motors shall operate as generators to provide electric braking capabilities. Generated electric energy shall be distributed to the contact rail (regenerative braking) and/or the brake resistor grids (resistive braking). At the local control panel, provide means to manually select resistive braking only. With this selection, there shall be no power returned to the contact rail.

B. Generated electric energy shall be controlled so that a maximum of 900 V dc is present in the contact rail during regenerative braking and across

the input capacitor bank during resistive braking. Regenerative braking shall be tapered from 100 percent at 850 V dc to zero percent at 900 V dc to minimize low-frequency oscillating current in the contact rail. Alternative control may be used if approved.

C. An independent method of overvoltage protection shall be provided at not more than 40 V dc above the power line maximum voltage of 900 V dc. This overvoltage protection shall be activated if the equipment operates at or above the overvoltage setting for more than 0.3 sec. The line breaker shall remain open until reset by the OVERLOAD RESET pushbutton in the energized cab. A nonvolatile alarm indication shall be provided on the Auxiliary Annunciator Panel.

D. Regenerative braking shall take priority over resistive braking when the contact rail is receptive. The propulsion subsystem shall attempt to use regenerative braking on a per-chopper-cycle basis.

1. If the contact rail is receptive but cannot accept all energy generated by the regenerative braking, resistive braking shall be applied in a controlled manner so that the correct electric braking effort is achieved and the contact rail remains at, or near, the 900-V dc limit.

5 2. Deleted. 5

3. Regenerative braking shall not be utilized when the primary power supply voltage is less than 450 V dc.

14.2.5 Control

A. Except as otherwise specified, motor control shall be rated and tested per IEEE 16.

B. Torque shall be controlled on a per-truck or per-vehicle basis. Modulation shall be continuous over the entire speed range. Braking and motoring efforts shall not be applied at the same time.

C. Changes in mode shall be smooth, within the specified response times, and fully executed before the propulsion subsystem responds to any other mode change signal, except emergency braking commands shall be executed immediately.

2 D. Vehicle direction shall be changed by switching 2
2 either the armature or fields to reverse the trac- 2
tion motor rotation. Directional change shall be possible only when the vehicle is stopped and the traction motors are deenergized. The direction change command shall be fully executed before the propulsion subsystem responds to any additional commands.

E. Motoring power removal using approved service-proved equipment shall be furnished in response to emergency brake application or to the BRK trainline going to a low state. Removal of motoring power shall be such that no single failure or multiple failures from a single event shall prevent the power from being removed.

F. When service braking is requested, motoring power shall be removed at the jerk-limited rate and braking effort applied at the jerk-limited rate. When emergency braking is requested, motoring power shall be removed at a rate that will not cause damage to the propulsion equipment. Emergency braking shall be applied simultaneously with motoring power removal.

G. A single false signal or ground occurring at any point in a trainline shall not cause an unsafe signal to be present at a propulsion subsystem interface.

14.2.6 Annunciation and Indication

Signals shall be provided for annunciation and indication in the operator cab (Reference: Section 9). Indicators and test points shall be provided on a local control panel within the equipment enclosures as required for fault diagnosis. Nonvolatile indicators shall be provided as appropriate.

14.3 TRACTION MOTORS

14.3.1 General

A. Traction motors shall be either series-field or separately-excited-field type with the ratings required and the characteristics necessary to produce the traction and electric braking efforts needed to meet the specified performance and thermal capacity requirements in either forward or reverse direction without exceeding 90 percent of the rated winding temperature rise, and be capable

of emergency operation under overload conditions specified, with no damage (Reference: Section 3).

B. Motors shall be designed for a major overhaul cycle of 500,000 mi minimum.

C. Traction motors shall conform to the applicable requirements of IEEE 11, 43, 113, and 304.

D. Motor speed shall not exceed 5,000 rpm when driving a vehicle with fully worn wheels at 70 mi/hr. Higher motor speeds may be acceptable if supported by a successful rail transit service record and approved. Safe motor speed shall be at least 20 percent above the design maximum. The peripheral speed of a new commutator shall not exceed 12,000 ft/min when the motor speed is at maximum operating speed.

E. Motors shall be axle-mounted or mounted on or suspended from the truck frame with resilient mounts. Motor coupling to gear reducer shall compensate for misalignment forces.

1. Safety hangers shall be provided that preclude the motor from falling below the plane-of-rails clearance line.

2. Vibration requirements shall be as specified (Reference: Section 3).

3. Motor housings shall adequately protect motors from undervehicle contaminants, including those from vehicle washing operations.

4. Lifting lugs shall be provided.

F. Motor insulation shall be, as a minimum, Class F for field and Class H for armature utilizing suitable solventless resin. Field and armature shall be given vacuum-pressure impregnation insulation treatment.

G. Motor cooling air shall be forced or induced by self-ventilation or separate fan system.

14.3.2 Armature

A. Motor armature assemblies shall be dynamically balanced as follows:

Armature Speed (rpm)	Maximum Unbalance (in-ozf/lbm rotating mass)
0 to 4,000	0.0040
4,001 to 5,000	0.0032
5,001 to 6,000	0.0027

B. Armature shafts shall be replaceable so that shaft damage shall not necessitate replacement of undamaged commutators and armature windings.

14.3.3 Commutators

A. Commutators with wear at the condemning limit shall operate safely at all motor speeds, including the maximum safe motor speed. Sparking shall equal or better IEEE 11 degree 1.5, except at worst load/speed conditions. Sparking at worst load/speed conditions shall be better than IEEE 11 degree 2.

B. Provisions, such as rings or projections, shall be made to protect the commutators by grounding any flashover. Such flashovers shall be detected as ground faults.

C. Commutator bars shall be silver-bearing copper or approved equivalent. Bars shall have uniform thickness and be designed to permit 0.25 in. minimum of radial wear.

D. Commutator risers shall be TIG-welded to armature leads. Welds shall be of sufficient quality to prevent separation under specified duty cycles, including periods of extreme overtemperature.

14.3.4 Brushes and Brush Holders

A. Commutator brushes shall be split type, with pigtails, and shall have a useful life of 66,000 mi. Brushes shall be clearly marked to show the final 22,000 mi of useful life and the scrapping limit.

B. Commutator brush holders shall accommodate the rated radial wear of the commutator with fully worn brushes.

1. Constant-tension springs or equivalent shall provide constant brush pressure regardless of brush length and commutator wear. Brushes shall be resiliently attached. Brush holder springs shall not require adjustment.

2. The design of the brush holder shall assure that the axis of each brush lies perpendicular to the commutator to assure full-width contact when new, unbedded brushes are fitted to the motor.

3. Brush holder design shall provide for inspection and replacement from below the vehicle.

4. Brush holder and brush assembly resonant frequencies shall not occur within the frequency spectrum of the truck/motor assembly.

14.3.5 Bearings and Seals

A. Bearing and shaft seal selection shall consider and compensate for misalignment and vibrational forces transmitted through the shaft, and for bidirectional shaft rotation.

B. Bearings shall be antifriction, sealed-lubrication type, selected for a minimum L_{10} life equivalent to 500,000 mi of operation. Lubricant cavities shall have sufficient lubricant for 50,000 mi of operation.

C. Labyrinth or radial-lip shaft seals shall be provided on both sides of bearings to prevent lubricant leakage and to protect the bearings from dust, grit, water, and other contaminants, including those from vehicle washing operations. Seal life shall be equivalent to life of protected bearing.

14.4 GEAR REDUCERS AND COUPLINGS

14.4.1 General

A. Gear reducer and motor couplings shall be designed and manufactured to AGMA standards, and shall meet applicable safety codes.

B. Gear reducers shall be parallel type, with helical gears, and shall be interchangeable among axles, trucks, and vehicles.

1. Power ratings, reduction ratios, and number of reductions shall be as recommended by the gear reducer manufacturer for the duty cycles, service, overload, and operating conditions specified.

2. Housings shall maintain shaft positions under maximum loads, shall be of cast or fabricated steel or nodular iron, and, if attached to the motor housing, shall include provisions as required for motor cooling airflow. Provisions shall be included for mounting speed sensors and the ground brush assembly, as well as gear reducer-related appurtenances.

C. Gear reducers shall be rigidly mounted on the driven axle, coupled to the traction motor, and resiliently connected to the truck frame. The mounting arrangement shall accommodate all forces and relative motion between the axle and truck frame and between the axle and traction motor bearings, and shall dampen noise and vibration. Truck-mounted gear reducers may be used if approved.

D. The reducer and coupling shall have provisions for hydraulically assisted removal.

14.4.2 Gear Reducer Gears and Shafts

A. Gears and pinions shall be steel, carburized to 58 Rockwell C minimum, and designed for quiet operation while withstanding the jerk, torque, and other forces produced under service conditions. A minimum service life of one million mi without degradation of performance shall be provided.

B. Shafts shall be heat-treated steel designed to maintain accurate support and alignment of gearing, and to withstand jerk, thrust, torque, bending moments, and other stresses under the most adverse loading conditions specified.

14.4.3 Gear Reducer Bearings and Seals

A. Bearing and shaft seal selection shall consider and compensate for misalignment and vibrational forces transmitted from the axle and the traction motor, and for bidirectional shaft rotation.

B. Bearings shall be antifriction type, selected for a minimum L_{10} life equivalent to 500,000 mi of operation. Bearings shall be lubricated through the gear lubrication arrangement.

C. Shaft seals shall be designed for a minimum service life of 500,000 mi of operation. Seals shall

preclude the entrance of liquids and other contaminants and prevent lubricant leakage.

14.4.4 Gear Reducer Lubrication

A. The gear reducer lubrication arrangement shall provide the lubricant flow required by the gears and bearings for efficient cooling and lubrication during all speeds, duty cycles, overload, and ambient conditions. Industrial type petroleum-based rust- and oxidation-inhibited (R&O) gear oils shall be used as the lubricant unless automotive motor oils or synthetic or other lubricants increase the lubricant change interval in a cost-effective manner. High-pressure lubricants or other lubricants requiring changes more frequently than industrial type R&O gear oils shall not be used.

B. The lubricant reservoir shall be a part of the gear reducer housing. The housing and reservoir shall be designed to assure adequate lubricant flow, to cool the lubricant without external heat exchangers, and to prevent lubricant churning and foaming. The housing shall include:

1. Provisions underneath the vehicle for draining the lubricant without spillage onto sensitive equipment.

2. A magnet that removes metal particles from lubricant circulating within the gear reducer. If not a part of either the drain or fill plugs, the provisions for the magnet shall include self-closing features so that the magnet can be cleaned without draining the reducer and with minimum spillage of the lubricant.

3. Lubricant filling provisions located for easy access from under the vehicle and designed to maintain the required seal after the repeated lubricant fill and change cycles required during the life of the reducer.

4. Breathers designed to prevent the entrance of moisture and other contaminants, including acid and detergent water from washing operations.

5. Lubricant level indicators to assist with preventing overfilling during lubricant fill

operations as well as routine lubricant level checks. Dipsticks shall not be used.

6. Permanently attached metal plates on which are AGMA-required information, lubricant requirements, and lubrication instructions. Information shall be in English and shall be legibly embossed, stamped, or painted on the plates with appropriate background or highlighting techniques used to enhance legibility and with appropriate finishing materials and techniques used to retain legibility. The plates shall be located so that the complete information can be read by personnel standing in a maintenance pit.

7. Safety wiring or mechanical locking for fill, drain, and inspection plugs.

14.4.5 Couplings

If the gear reducers are truck-mounted, they shall be connected to the traction motors by flexible couplings designed to transmit the torques required for motoring and electric braking while compensating for the shock loads, vibrational loads, relative motion, and misalignment forces occuring under the specified operating conditions. Couplings shall permit the removal of the traction motor without removing the gear reducer. Couplings shall be service-proven (Reference: Section 3).

14.5 BRAKE RESISTOR GRIDS

14.5.1 General

A. Brake resistor grids shall be provided for dissipating energy generated during electric braking when the energy cannot be distributed to the contact rail, or when resistive braking only has been selected.

B. The brake resistor grids shall be sized to convert all of the generated electric energy to heat for the performance and duty cycle specified (Reference: Section 3) and to dissipate the heat to the atmosphere. Grids shall be thermally and electrically insulated to reduce the risk of flashover and heat transfer to adjacent equipment. Heated air shall be diverted onto the track. Resistors may

be cooled naturally or by force, using either separate blower or air exhausted from other equipment. If forced-cooled, loss of cooling air shall be annunciated on the local control panel. Resistors shall be mounted with air space between resistor elements and combustible materials. Barriers shall extend horizontally beyond resistor supports to ensure protection. Barriers shall be noncombustible, and thermally and electrically insulated.

C. Resistor surface temperature shall not exceed 90 percent of rated temperature as defined in IEEE 16.

14.5.2 Resistors

A. Resistors shall minimize self-inductance and radiated fields through bifilar-wound construction, or approved equivalent construction. Resistors shall be edge-wound ribbon type, or of equal-strength helical-coil construction.

B. Capacity shall be based on resistors in an aged or used condition.

C. Resistors shall expand and contract without warping or producing other detrimental effects.

14.5.3 Resistor Installation

A. Resistor assemblies shall be mounted under the vehicle. High-temperature electrical insulation shall be used to isolate the resistors from their frames, and the frames from the carbody.

B. The vehicle floor, substructure, and equipment adjacent to the resistors shall be protected from fire and heat by approved heat-shield methods.

C. Resistors shall be protected from trash, flying ballast, splashed water, and other undervehicle hazards that may cause fire or other damage.

D. Forced-cooled resistors shall be mounted in noncombustible, electrically-insulated ducts.

E. Provisions for cable connections shall be located outside of the heat rejection area and shall be protected from resistor heat.

F. Individual resistor elements shall be individually replaceable without disassembly or removal of the entire assembly.

G. Resistor assemblies shall be protected by overtemperature devices that discontinue electric braking. Overtemperature shall be annunciated (Reference: Section 9).

H. Resistor cable shall not exceed 80 percent of rated temperature rise when operating at maximum rms current, at maximum ambient temperature, and allowing for heat transfer along the conductor.

5 I. A noncombustible, high-temperature, insulating heat 5
5 shield shall be applied to the resistor sides ad- 5
5 jacent to equipment and to the resistor top. Suf- 5
5 ficient clearances shall be provided between the 5
5 resistor elements and the heat shield, and between 5
5 the heat shield and adjacent floor and equipment 5
5 to minimize the risk of fire and power arcs. The 5
5 heat shield shall extend a sufficient distance be- 5
5 yond the resistor to assure thermal protection for 5
5 the adjacent floor and equipment. 5

14.6 SPEED SENSORS

14.6.1 General

Speed sensors shall be noncontact type that sense either gear tooth movement or peripheral speed of a gear. Speed sensors shall be mounted on the gear reducers. Separate gears for exclusive use by speed sensors may be approved if service-proven. Speed sensors shall be interchangeable among speed signal user systems, unless otherwise approved.

A. One frequency-generator-type speed sensor shall be provided on each gear reducer for use by the ATO subsystem, odometer, propulsion logic control unit, speedometer, and spin/slide control apparatus.

B. A separate speed sensor shall be provided on axle number 3 (as indicated) gear reducer of each A-car for exclusive use by ATP. Sensor shall be a service-proved model, such as Electro Products Model
3 3040A, or approved equal. Sensor and signal char- 3
3 acteristics versus vehicle speed shall be sub- 3
3 mitted. (CDRL) 3

14.6.2 Mounting

A. Speed sensors shall be flange-mounted and mechanically fastened to the gear reducer housing.

B. Speed sensor location and speed sensor lead routing shall assure proper signals to associated equipment without interfering with routine maintenance of truck-mounted equipment.

C. Speed sensors shall not cause lubricant to leak from the gear reducer. Unused holes required for gear reducer interchangeability shall be sealed with removable caps or plugs.

D. Provisions shall be included for locking the speed sensor in place. Such locking mechanisms shall not be loosened by the vibrations incurred in service.

E. Speed sensor lead connectors shall be waterproof, safety-wired, and located at the interface of the carbody and the truck to ease truck removal.

F. Speed sensors shall be designed for installation without requiring adjustment of clearance between the sensor probe and gear teeth.

14.7 TRACTION POWER CIRCUITS

14.7.1 Knife Switch, Main Fuse, and Ground Brush

Knife switch, main fuse, and ground brush assembly shall be as specified (Reference: Section 13).

14.7.2 Line Breaker and Line Cutout Switch

A. A line breaker and line cutout switch rated for opening and clearing faults under maximum fault conditions shall be furnished either as combined or separate devices. The breaker shall immediately follow the main fuse in the traction power circuit and shall trip automatically on overload. The overload detection setting shall be lower than that of the main fuse.

B. Protection shall be provided by the line breaker for the following occurences as a minimum:

1. Propulsion overload

2. Ground fault (motoring or braking)

2 3. Deleted 2

4. Chopper frequency out of tolerance

5. Line voltage above 940 V dc

6. Loss of low-voltage control power

7. Request for emergency braking

2 8. Line ripple current above preset value. 2

C. Within a 15-min period, the line breaker shall be capable of being reset without damage from energized cab (OVERLOAD RESET) two times after being tripped by propulsion overload, ground fault, EMI, and line voltage above 940 V dc. If a third consecutive fault occurs within the 15-min period, manual reset shall be required. Manual reset shall be in a local control panel that is proximate to the line breaker and accessible from the side of the vehicle.

D. The tripping of the line breaker shall be indicated in the energized cab and on the local control panel. Nonvolatile indicators shall be provided on the local control panel for propulsion overload,
2 ground fault, ripple current, chopper frequency, 2
line voltage above 940 V dc, and loss of control power.

E. Contact tips shall be replaceable.

14.7.3 Line Filter

A. Each vehicle shall have a line filter circuit to protect the ATC system, propulsion subsystem, auxiliary power supply equipment, and control equipment from unwanted transients and interference. The line filter shall be sufficiently cooled, suitably housed, insulated, shielded, and mounted under the vehicle.

B. The capacitors of the line filter shall have a minimum life of 10 yr in the operating environment and may be protected by equalizing resistors and an indicator fuse in each parallel string. Pressure relief shall be provided as necessary to prevent damage.

1. A resistor shall provide a discharge path for capacitor deenergization. Discharge time from 750 V dc to 50 V dc shall not exceed 3 min.

2. Voltmeters or lamps that indicate capacitor charge shall be mounted in the capacitor housing cover and shall be visible from the side of the vehicle.

3. The line filter shall have a minimum inductance of 1.5 mH and shall not suffer any degradation

due to current saturation or frequency over the operating range up to 5 kHz. The filter shall have a 3 dB roll-off below 50 Hz.

C. Inrush oscillation amplitude on the contact rail shall not exceed 200 V peak-to-peak.

D. The Contractor shall provide curves showing: (CDRL)

1. The maximum ripple current amplitude frequency spectrum in the contact rail produced by chopper harmonics of one vehicle for 0 to 100 percent chopper conduction (Reference: Figure 3-4).

2. The maximum inrush current in the contact rail caused by the primary power supply and one input filter of one vehicle.

3. Total worst-case chopper-harmonic-caused ripple current amplitude frequency spectrum in the contact rail produced by one-, two-, and three-dependent-pair trains.

14.7.4 Power Modulation Control

A. Propulsion power, including motoring and electric braking, shall be controlled by solid-state controllers using proven thyristor-modulation chopper technology.

B. Chopper operation shall be crystal-controlled to 0.1 Hz. The controllers shall be designed to limit to specified values the ripple current induced into the running rails by chopper frequency coupling between the running and contact rails (Reference: Section 3). Continuous fail-safe monitoring equipment shall be provided to prevent operation of the chopper at other than the selected frequency. This monitoring equipment shall operate a latching circuit requiring resetting by maintenance personnel.

C. Chopper control shall provide rapid fault protection with differential and overcurrent-protective devices using the chopper or causing the line breaker to be tripped. Chopper-regulated fault currents shall not persist into a fault.

D. Line ripple current shall be monitored to ensure that average overall ripple amplitude does not exceed an approved value. An integral test feature

shall be provided to check that the ripple monitoring unit is functioning correctly.

E. Power modulation control equipment shall be contained in dustproof and weatherproof enclosures suitably insulated and mounted under the vehicle floor.

1. Unless otherwise approved, power semiconductors shall be standard industry types available from two or more manufacturers, shall utilize separable heat sinks, and shall be derated to meet reliability requirements.

2. Forced-air ventilation may be used. Heat sinks and devices in forced-air-ventilated circuits shall be protected from the buildup of contaminants and shall have sufficient thermal capacity for at least 30 sec of operation without the forced-air ventilation.

3. Semiconductors and associated snubbers shall be assembled into units that provide mechanical support and thermal impedance stability for at least 10 yr without special maintenance.

4. Critical dynamic parameters, such as dv/dt and di/dt, shall be controlled to ensure that components have a minimum service life of 30 yr.

5. Control and pulse transformers shall be encapsulated.

14.7.5 Motor Reactor

Motor reactors shall be furnished if necessary to smooth the motor current ripple to less than 15 percent of the rated rms value. Motor reactors may be cooled by either natural convection or exhaust air from other forced-cooled equipment. Motor reactors shall be housed, insulated, shielded, and mounted under the vehicle floor, and shall be isolated to prevent inductive coupling with line filter reactors, running rails, ATC track circuits, and other electronic equipment on the vehicle or with magnetic equipment carried by passengers.

14.7.6 Traction Motor Cutout and Electric Braking Cutout

Cutout switches or approved means or devices shall be provided for isolating the propulsion subsystem on each vehicle without affecting the functioning of the friction brake subsystem.

A. Propulsion cutout controls shall be accessible for manual operation from the cab (Reference: Section 9).

B. Traction motor circuits shall be opened to prevent the isolated motors from carrying current.

C. Electric braking circuits shall be opened.

14.8 LOGIC CONTROL

14.8.1 General

A. Logic control shall be used to control and monitor electric braking, friction braking, brake blending, load weigh, and spin/slide functions within the specified control and safety requirements. Logic control shall provide the following diagnostic functions:

1. Status of trainlines

2. Status of decoded outputs

3. Status of power supplies.

B. Logic control shall be solid-state, of proved technology, combined into a single unit containing a dedicated power supply, logic circuitry, and diagnostics, and shall be located in an environmentally protected enclosure accessible for normal troubleshooting.

C. Faults identified by microprocessor self-test shall be indicated as PROPULSION FAILURE in the cab (Reference: Section 9) and to ATS.

D. Logic control shall incorporate the electronic control unit specified (Reference: Section 15) if unit is not supplied with the friction brake subsystem.

14.8.2 Power

Power from the LVPS shall be regulated to provide a dedicated power supply for proper operation of the logic control despite LVPS fluctuations.

14.8.3 Diagnostic Circuits

Diagnostic circuits shall be provided to continuously monitor propulsion and friction braking component operation. The circuits shall have the capability of being used with DTE to identify failed components. During

monitoring operation, fault status shall be recorded on a solid-state memory which shall be derived from a first-event memory. Visual indicators shall be provided to allow for a minimum of 20 faults, of which at least 10 shall be driven by the memory device. Status information in the solid-state memory shall be retained when low-voltage power is removed.

END OF SECTION

SECTION 15

FRICTION BRAKE SUBSYSTEM

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SECTION 15

FRICTION BRAKE SUBSYSTEM

15.1 GENERAL

This Section specifies the requirements for the friction brake subsystem to be provided on each vehicle, except the air compressor unit shall be on A-cars only. Service, service friction, parking, and emergency braking shall meet performance requirements specified (Reference: Section 3). Subsystem shall apply retarding torque by means of tread brakes or outboard-mounted disc brakes; and shall be inherently fail-safe in design, construction, and operation to the degree specified herein. Friction brakes shall be pneumatically actuated or, if the hydraulic portion is self contained with no exposed hydraulic piping, pneumatic-over-hydraulic actuated. 5

15.2 CITED REFERENCES

Organization	Number	Title
AAR	M-618	Hose, Air, Wire Reinforced
AAR	M-927	Hose Fittings and Hose Assemblies, Air, Wire Reinforced
UIC	541-3 OR	Brakes - Brake Linings for Vehicles Equipped with Disc Brakes

15.3 STRENGTH AND THERMAL REQUIREMENTS

Subsystem shall withstand the loads induced while complying with the duty cycle and performance requirements when electric braking is inoperative. The effect of elevated temperatures due to all-friction braking action shall be included in the design analysis.

15.4 SUBSYSTEM REQUIREMENTS

15.4.1 General

As a minimum, the subsystem shall include tread brake units or discs and disc brake units, supply reservoirs, main reservoirs, an air compressor unit (per dependent

pair), dump valves, brake control units, emergency units, parking brake equipment, and cutout devices. Configuration of the subsystem control shall be in accordance with one of the following alternatives:

A. One pneumatic pipe: A single, trainlined, pneumatic supervisory pipe (brake pipe) shall provide a pneumatic control medium for operation of a consist and pneumatic activation of emergency braking. The brake pipe shall allow a dependent pair with an inoperative compressor to be charged from other vehicles.

B. Two pneumatic pipes: One, a trainlined brake pipe, shall provide a pneumatic control medium for operation of a consist and pneumatic activation of emergency braking. The second pipe, a separate trainlined, pneumatic main-reservoir-equalizing pipe, shall equalize main reservoir pressure and compressor duty cycles. The main-reservoir-equalizing pipe shall allow a dependent pair with an inoperative compressor to be charged from other vehicles.

C. One pneumatic pipe and electric trainline: A single, trainlined pneumatic main-reservoir pipe shall equalize main reservoir pressure and compressor duty cycles. The main-reservoir pipe shall allow a dependent pair with an inoperative compressor to be charged from other vehicles. An electric trainline shall provide activation of emergency braking.

15.4.2 Reservoir Storage Capacity

After loss of all compressor units in a train loaded to AW3, reservoir storage capacity shall provide five consecutive, full-service braking applications and releases, each 30-sec long. Compressor loss shall be assumed to occur when main reservoir is at cut-in pressure setting of compressor governor.

15.4.3 Discs

Discs, if used, shall be mounted outboard of each wheel. Mountings shall not interfere with access to the axle centers for wheel truing operations. Disc surface temperatures shall not exceed 900°F under service conditions. Discs shall have a minimum service life of 100,000 mi with all-friction braking. Service life shall be demonstrated by dynamometer test based upon no-coast round trips at the duty cycle specified (Reference: Section 3), except train shall be loaded to AW1.

Dynamometer tests shall confirm that the maximum allowable disc temperature is not exceeded. Test results shall be submitted for approval. (CDRL)

15.4.4 Dump Valve

Provide a solenoid-actuated dump valve for each truck to reduce brake cylinder air pressure upon command of the spin/slide control unit. The valve shall be energized to exhaust brake cylinder air.

15.4.5 Friction Material

Friction material used in the brake shoes or pads shall be compatible with the braking surface of the wheel or disc, including performance, thermal, and other conditions of all-friction braking. The brake shoes or pads, in either a fully worn or new (but bedded in) condition, shall be capable of developing the friction braking rate (service and emergency) characteristics specified (Reference: Section 3). Friction braking rates under wet conditions shall be at least 90 percent of those under dry conditions. New brake shoes or pads shall have a minimum wear life of 3,000 mi with all-friction braking. Minimum wear life shall be demonstrated by dynamometer test. (CDRL) The brake materials used shall not cause squeal or unpleasant odors during braking.

15.4.6 Electronic Control Unit

A. Each vehicle shall be furnished with an electronic control unit that receives the P-signal, BRK signal, and load weigh signals, and implements jerk limiting, speed taper, spin/slide correction, brake blending, load weigh compensation, and control of the brake control unit. The electronic control unit may be part of either the friction brake subsystem or the propulsion subsystem.

B. Faults identified by microprocessor self test shall be indicated as SERVICE BRAKE FAILURE in the cab (Reference: Section 9) and to the TICU (Reference: Article 4.2).

C. Test points for periodic adjustment and calibration shall be brought out to a convenient receptacle as the DTE interface.

15.4.7 Trip Assembly

A trip assembly (cock or switch) shall be provided on the right side of each F-end truck. The trip assembly shall be self-resetting and upon activation shall cause

an emergency brake application. The truck-mounted trip arm shall positively engage the track-mounted trip arm, as indicated (Reference: Contract Drawing V-022. Note: trip cock shown, switch similar). The trip assembly shall be adjustable vertically to compensate for wheel wear.

15.4.8 Cutout Devices

Cutout devices shall be provided for cutting in or out functions as described herein. Cutout and normal positions shall be identified.

A. One vented cutout cock for each truck shall be provided in the brake cylinder line to allow the pneumatic brake units to be cut out and released manually. Two controls shall be provided for each cock, one behind a locked panel for operation from inside the vehicle, and the other under the vehicle accessible from one side. Locations shall be approved.

B. A single, electrically operated, vented cutout valve shall be provided on each vehicle to cut out service friction braking but not emergency braking. Control for the valve shall be located in the operator cab (Reference: Section 9). The dump valves may be utilized for this function.

C. To permit pneumatic isolation of individual vehicles, vented cutout cocks shall be provided in the pneumatic trainlines at both the F- and R-ends.

D. Cutout cocks shall be provided for all pneumatic components and assemblies.

E. Cutout cock handle open and closed positions shall conform to standard AAR practices. Cutout cocks shall be positioned so that valve handle will not be moved unintentionally to the opposite position in service. Handles shall be self-locking type except those for brake cylinder cutouts.

15.4.9 Brake Units

A. Each tread brake unit, if used, shall be mounted on the truck frame. Automatic slack adjustment shall be provided to compensate for brake shoe wear. Minimum wheel diameter shall be 34 in. Wheel tread temperatures shall not exceed 800°F under service conditions. Dynamometer tests shall confirm that the maximum allowable wheel tread

temperature is not exceeded. Test results shall be submitted for approval. (CDRL)

B. Each disc brake unit, if used, shall be mounted on the truck frame. Automatic slack adjustment shall be provided to compensate for brake pad and disc wear. Unit shall provide for positive retraction such that pads clear the disc when brakes are released. The attachment of the brake pads to the brake head shall conform to UIC 541-3 OR. Pivot points used in the attachment and caliper links shall use self-lubricating bushings or approved equivalent.

5 C. Brake pad/shoe shall be clear of the disc/wheel 5
5 while electric brake is providing the requested 5
5 brake rate (no inshot). 5

15.4.10 Reservoir Arrangement

A main reservoir shall be provided on each vehicle for all air requirements of the vehicle. The main reservoir shall be provided with a manual drain cock constructed of noncorroding materials. Check valves shall be installed between the main reservoir pipe and pipes branching from the main reservoir pipe. Separate supply reservoirs shall be provided for service braking air requirements on each vehicle. Reservoirs for other functions shall be provided as required.

15.4.11 Brake Control Unit

The brake control unit shall control the air flow to and from the brake units. Control unit shall be bolted to brackets on carbody underframe. Control unit shall contain external pipe connections and passages for interconnection of mounted switches and valves. Control unit design shall permit removal of individual valve portions without disturbing piping. Electrical components incorporated into pneumatic valve portions shall be accessible and required adjustments shall be possible without removal of the valve portion. Electric interface shall be by connectors.

15.4.12 Friction Brake Piping

A. Flexible connections shall be provided between carbody air piping and air compressor, truck, and coupler air piping. Air hose shall be in locations where visual inspection can be made. Hose fittings shall be reusable and comply with AAR M-927. Hoses shall comply with AAR M-618.

B. Piping shall be installed as straight as possible with a minimum number of fittings. Unions shall be used only to permit replacement of apparatus. Service elbows shall not be used.

C. To the maximum extent practical, piping and fittings shall be arranged so that moisture will drain into reservoirs, and reservoirs shall be installed at the lowest points in the system.

D. Valves and cutout devices shall be protected from damage or inadvertent operation caused by flying ballast or rocks.

E. Copies of the piping procedures shall be submitted for approval. (CDRL)

15.4.13 Indicators

A. Brake cylinder pressure shall be read on the brake cylinder side of the brake cylinder cutout cock and indicated as FRICTION BRAKE ON in the cab (Reference: Section 9).

B. The cutout position of the brake cylinder cutout cock and service friction brake cutout valve shall be indicated as FRICTION BRAKE CUTOUT in the cab and to ATS (Reference: Section 17).

15.5 AIR COMPRESSOR

15.5.1 General

5 Each air compressor unit shall contain a heavy duty re- 5
5 ciprocating compressor, cooling provisions, safety 5
valves, drain reservoir, automatic drain valve, governor, dryer, and required appurtenances for all modes of operation. The air compressor shall be direct-driven and mounted under the A-car of each dependent pair.

15.5.2 Capacity

A. The compressor shall produce the required amount of compressed air for the operation of the friction brake subsystem, pneumatic suspension, horn, windshield wiper, couplers, and other pneumatic equipment as required. The compressor shall be rated for 23 ft^3/min minimum at 150 psig and for continuous operation.

B. The compressor shall obtain specified cut-in pressure within 10 min after startup at 0 psig on a dependent pair at AW0. The compressor duty cycle in normal operation shall not exceed 30 percent.

15.5.3 Design Features

A. The compressor shall have an integral oil sump. Lubricating oil shall be as specified by the manufacturer. An indicator visible from the side shall show when additional oil is required. Oil filter shall be approved, disposable, spin-on type.

B. The compressor intake filter shall be an approved disposable-element type and be easily serviceable.

C. After continuous compressor operation at full load for 60 min, the discharge air temperature shall be within 10°F of ambient inlet air temperature.

15.5.4 Compressor Control

Compressor cutout shall be indicated in the cab and to the TICU.

A. Compressor control shall be trainlined to turn on all compressors simultaneously.

B. Provisions shall be made for isolation of defective pressure switches from the trainlined compressor control circuit.

C. Provisions shall be made to cut out each compressor at both its discharge outlet and at its electric power input.

D. The maximum pressure in the compressed air circuit shall be limited by safety valving to 160 psig. Governor device shall be set at 130 and 150 psig representing the cut-in and cutout pressures. Maximum brake cylinder pressure shall be 100 psig.

15.5.5 Air Dryer

The air dryer shall be a regenerative, self-purging desiccant type. A minimum of 15°F of dewpoint depression shall be maintained throughout the useful life of the desiccant. The dewpoint depression shall be maintained while pumping up a dependent pair from 0 to 150 psig under the ambient conditions specified (Reference: Section 3). Air dryer inspection shall not be required more frequently than every 6 mo. Desiccant life shall be a minimum of 1 yr. Air dryer shall be equipped with an automatic drain valve that operates at the end of each period of air compressor operation.

15.5.6 Leakage

Allowable subsystem pressure drop due to leakage shall not exceed 5 psi in 10 min following a 5-min settlement period from the time that cutout pressure is attained and the air compressor shut off.

15.6 BRAKE CONTROL

The friction brake subsystem shall respond to load weigh signals and to brake command signals from ATP and the propulsion subsystem.

15.6.1 Friction Braking

The subsystem shall be controlled in conjunction with electric braking to provide service braking, service friction braking, spin/slide correcting, and jerk limiting functions. Braking shall be controlled on a per-vehicle basis, except spin/slide shall be corrected on a per-truck basis.

15.6.2 Emergency Braking

Emergency brake control shall be fail-safe to the extent that no single failure or series of common mode or common cause failures can occur that result in less than 75 percent of emergency braking effort per dependent pair being available.

15.6.3 Spin/Slide Correction

Spin/slide control units and associated dump valves shall be used to effect spin/slide correction (Reference: Section 3). A failure of any component of the spin/slide control apparatus shall not prevent full development of an emergency brake application.

15.6.4 Variable Load Control

Brake cylinder pressure shall be governed by variable load control acting upon load weigh signals.

15.7 PARKING BRAKE

15.7.1 General

Parking brakes shall be provided on a per-vehicle basis. The parking brake control shall be isolated from the emergency and service brake controls. Actuators shall be spring-applied, air-release configuration. The parking brake force shall be applied to a minimum of two

discs or wheels on separate axles and opposite sides of the F-end truck. It shall be possible to push or pull the vehicle with parking brakes on without locking wheels or damaging parking brake unit.

15.7.2 Capacity

The parking brake shall keep an AW0 pair from rolling on a 4.5 percent grade for a period of 30 days without primary or battery power applied.

15.7.3 Control

Application and release of the parking brake shall be pneumatically controlled. Application shall be automatic on drop of main reservoir pressure. Release shall be automatic on buildup of main reservoir pressure. Application shall be indicated as PARKING BRAKE ON in the cab (Reference: Section 9) and to the TICU.

15.7.4 Manual Operation

A per-unit manual release method shall be provided to allow for maintenance and for moving a vehicle under nonemergency conditions. The force necessary to manually release the parking brake shall be less than 50 lb on a hand lever. Nonintegral retraction bolt arrangements shall not be used. Manual controls shall be in an approved location and shall clearly indicate the On and Off positions. Reset of manual release shall be automatic on buildup of main reservoir pressure.

15.8 EMERGENCY BRAKING

15.8.1 General

A. An emergency brake application shall result from the following conditions as a minimum:

1. Depressing any EMERGENCY STOP pushbutton
2. Opening a trip cock
3. Unintentional uncoupling anywhere in a train
4. Activating command from ATP (Reference: Section 16)
5. Reducing air pressure in the main-reservoir-equalizing pipe or brake pipe below a specific approved pressure

6. Releasing Manual Controller handle when operating in EMO submode

7. Deenergizing any energized Operator Console

8. Attempting to energize an Operator Console while another is energized.

B. Emergency brake application shall be indicated as EMERGENCY BRAKE ON in the cab and to the TICU.

15.8.2 Control

A. Depressing an EMERGENCY STOP pushbutton (Reference: Section 9) shall cause operation of the emergency stop circuit. If a pneumatic medium is used for propagation of an emergency brake application, each EMERGENCY STOP pushbutton shall include a pneumatic portion which shall pilot a pneumatically controlled vent valve separate from any electrically controlled emergency apparatus.

B. Pneumatic trainline recharge times shall not exceed 10 sec for a train of any specified length.

C. It shall be possible to obtain a full emergency brake application at any time or at any stage of service brake or service friction brake application or release.

D. Emergency units shall be provided to control the passage of compressed air to the brake cylinders during emergency braking. Redundancy may be used to achieve fail-safe operation if approved. If approved, components that are not fail-safe or do not meet the specified fail-safe criteria may be used only on a per-truck basis.

END OF SECTION

SECTION 16

AUTOMATIC TRAIN OPERATION

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SECTION 16

AUTOMATIC TRAIN OPERATION

16.1 GENERAL

This Section specifies the equipment requirements for automatic and manual operation of trains, including related wayside equipment to be furnished for installation by the District.

16.1.1 Cited References

Organization	Number	Title
PUC	General Order No. 127	Regulations, Governing the Construction, Reconstruction, Maintenance, and Operation of Automatic Train Control Systems with Respect to Train Detection and Separation, Route Interlocking, Speed Enforcement and Right-of-Way Hazard Protection on Rapid Transit Systems

16.1.2 Functional Description

ATO is one subsystem of the ATC system. The other two subsystems, ATP and ATS, will be DFE except as specified. ATO subsystem shall be subordinate to ATP, as will ATS. ATO shall perform ASR, PSS, berthing verification, and unintentional movement protection operations automatically. In MTO mode, selected operations shall be performed manually.

16.1.3 General

A. Equipment shall be designed to have a high degree of fault tolerance.

B. Carborne ATC apparatus shall be in the cab of one vehicle of each dependent pair, unless otherwise approved.

C. Carborne ATO apparatus shall include power supplies necessary for operation from the LVPS.

D. Nonpassive carborne ATO apparatus shall be activated only when a single Operator Console is energized on the train and when the ATO apparatus is located on the same dependent pair as is the

energized Operator Console. ATO equipment located in a dependent pair that does not include the energized Operator Console shall not interfere with normal train operation.

16.2 FUNCTIONAL INTERFACE

16.2.1 ATP Functions

DFE ATP will maintain safe train operation. Commands and signals from ATP will be by relay contacts, as indicated (Reference: Reference Drawings Q-087,Q-088, and Q-089). Wayside ATP will use audio- and power-frequency track circuits. The following functions will be provided:

A. Speed Limit Indication: Decode ATP speed limits and indicate the information to the vehicle interface.

B. ATP Speed Limit Enforcement: Detect overspeed condition, command a service brake application, and signal for an alarm and indication (Reference: Section 9).

C. Brake Assurance: Following a service brake command by the overspeed protection function or by the deadman function, provide brake assurance to command an emergency stop if deceleration equivalent to a minimum of 1.6 mi/hr/sec on level tangent track is not confirmed within 3 sec.

D. Service Braking: Ensure that train is in braking mode by deenergizing BRK trainline.

E. Emergency Braking: Command emergency brake application by deenergizing emergency brake trainline.

F. Zero Speed Detection: Detect zero speed and furnish a signal to vehicle interface.

G. 8 NP Speed Limit: Command disabling of propulsion for the 8 mi/hr ATP speed limit.

16.2.2 ATS Functions

DFE ATS will monitor train operation and maintain traffic patterns. Train-to-Wayside Radio will communicate information to and from RCC (Reference: Article 4.2). Except as specified, signals from ATS will be by contacts from the TICU (Reference: Article 4.2). The following functions will be provided:

A. Dwell Timing: Provide signal for station-stop dwell-time expiration.

B. Performance Level: Provide signals to ASR to operate at a specific performance level.

16.2.3 ATO Subsystem Functions

A. In ATO mode, provide P-signal and ASR that maintains acceleration and speed within ATS-modified ATP speed limits.

B. In MTO mode, generate P-signal.

C. In ATO and MTO modes, provide BRK signal, and route the signal to and from ATP interface.

D. In ATO mode, perform station stopping within the prescribed stopping profile.

E. In ATO mode and, except as specified, in MTO mode, determine proper platform berthing and platform location at stations, and provide signals to appropriate side door control circuit and TRAIN BERTHED indicator in energized cab when proper berthing, platform location, zero speed, and brake application are confirmed.

F. In ATO and MTO modes and, except as specified, in MTO submodes, provide unintentional movement protection.

16.3 MODES OF TRAIN OPERATION

Controls in the energized cab permit selection of one of two normal modes of train operation, i.e., ATO mode and MTO mode. When MTO mode is selected, any of three submodes of train operation may also be available. All changes in mode and submode shall be signaled to ATS.

16.3.1 ATO Mode

ATO mode will be the primary normal operating mode in revenue service. ATO mode shall include the ATO and ATP functions described herein.

16.3.2 MTO Mode and Submodes

MTO mode will be the secondary normal train operation mode in revenue service. MTO functions shall be similar to those in ATO mode, except speed regulation and station stopping will be under control of the train operator, using the Manual Controller (Reference: Section 9). Failure of ATO mode equipment shall not prevent a train from operating normally in MTO mode.

A. The Restricted Manual submode of MTO mode will be used when wayside equipment fails on the main line, and for normal operation in the Yard. Restricted Manual submode shall be similar to MTO mode, except that the berthing verification function shall not be available, and only carborne ATP functions will be provided. A 10 mi/hr speed limit will be enforced by ATP. Initiating Restricted Manual submode shall require the Mode Selection switch in the MANUAL position (Reference: Section 9), Manual Controller in the FULL SERVICE BRAKE position, ATP detecting zero speed, and no ATP speed limit present. The train operator will manually control train movement, including maintaining a safe stopping distance. Side doors may be opened at any location, provided ATP zero speed signal is present and brakes are applied. Once established, Restricted Manual submode shall remain in effect until an ATP speed limit signal is received. Transfer to MTO mode shall be automatic.

ATP = 2.2

le of MTO mode will be used as a failure eans when a train is not operable because failure. Initiating EMO submode shall he side doors to be closed, the Mode switch in the MANUAL position, Manual in the FULL SERVICE BRAKE position, and of the EMO ENABLE switch. The train will manually control train movement ATP functions will not be in effect. ed shall be limited as specified (Refer- ection 3). The berthing verification shall not be available. Activation of EMO nall be signalled to the TICU, and shall EMO indicator lights to be energized e: Sections 8 and 9). EMO submode shall ed when side doors are opened and also Operator Console KEY SWITCH is turned to the OFF position. Reinitiation of submode shall be required to proceed in EMO submode beyond the point where disabled.

C. Wash/Couple submode of MTO mode will be used for wash rack operation and for coupling. Initiating Wash/Couple submode shall require Mode Selection switch in the MANUAL position, Manual Controller in the FULL SERVICE BRAKE position, side doors closed, and Wash/Couple pushbutton held depressed. Train speed shall be limited as specified (Reference: Section 3). When the Wash/Couple pushbutton is released, full service braking shall be applied.

16.4 AUTOMATIC SPEED REGULATION EQUIPMENT

16.4.1 Speed Control

In ATO mode, ASR equipment shall generate required P-signal. The P-signal logic shall consider the ATP speed limits, the performance levels, and the PSS speed profile.

A. The ATP speed limits will be 0, 8, 9, 25, 40, 45, 55, and 70 mi/hr.

B. When 0 mi/hr ATP speed limit is in effect, service braking shall be applied and maintained.

C. The ASR target speeds and associated tolerances over the range of ATP speed limits in PL-1 shall be as follows:

ATP Speed Limit mi/hr	ASR Target Speed mi/hr	ASR Tolerance mi/hr
9	7	±1
25	22.5	±1.5
Over 25	ATP Limit less 3	±2

D. The 8-mi/hr limit is a special limit, which is termed "8NP". When 8NP is present in ATO or MTO mode, the BRK trainline shall be de-energized. ASR shall respond to 8NP as though a 9-mi/hr ATP speed limit were present, except that no motoring effort shall be applied.

16.4.2 P-signal Generator

Two P-signal generators shall be provided: one for the ASR and the other for the Manual Controller. The P-signal shall be carried on a loop trainline. Signal characteristics shall be identical for both P-signal generators. The P-signal shall be continuous to regulate braking, coasting, and motoring as specified (Reference: Section 3). The P-signal generators shall respond to ATP commands for service brake application with a braking rate of 2.2 mi/hr/sec. Proportional and integral control shall be used near the ASR target speed to provide responsive, nonoscillatory control of train speed. During ASR-speed-maintaining operations, hysteresis shall be used to reduce the number of transitions from braking to motoring, and from motoring to braking.

16.4.3 Performance Adjustment

A. ASR shall adjust speed limit and acceleration in response to performance level signals from ATS via the TICU. ASR shall include provisions for the train operator to manually enter performance levels.

B. Normal service braking rate shall be utilized by ASR in all performance levels, except as specified.

C. Performance level adjustments shall be applied when ATP speed limits are greater than 25 mi/hr. No performance level adjustment shall reduce speed to less than 25 mi/hr. Absence of a performance level request shall result in operation at PL-2.

D. Means shall be provided so that the effect of performance level adjustments can be modified by the District. Initial performance levels shall be as follows:

1. PL-1: 100 percent ATP speed limit and 100 percent acceleration

2. PL-2: 85 percent ATP speed limit and 100 percent acceleration

3. PL-3: 85 percent ATP speed limit and acceleration limited to 2.4 mi/hr/sec

4. PL-4: 75 percent ATP speed limit and acceleration limited to 2.4 mi/hr/sec

5. PL-5: 50 percent ATP speed limit and acceleration limited to 1.5 mi/hr/sec.

5 E. PL-1 Operation: When a station-to-station run 5
5 is initiated in ATO mode, the train shall accele- 5
5 rate toward the applicable ATP speed limit. ASR 5
5 shall regulate tractive effort to obtain and main- 5
5 tain the ASR target speed. 5

5 1. When there is an increase in the ATP speed 5
5 limit, the train shall accelerate toward the 5
5 new ATP speed limit. ASR shall regulate trac- 5
5 tive effort to obtain and maintain the new ASR 5
5 target speed. 5

5 2. When there is a reduction in the ATP speed 5
5 limit and the train speed is above the new 5
5 limit, the DFE ATP will provide an overspeed 5
5 signal and open the BRK trainline. A normal 5
5 service braking rate shall be provided (Re- 5

ence: Article 3.9, also, Reference: Article 9.2). When the overspeed signal is removed and the BRK trainline is closed, ASR shall immediately regulate tractive effort to obtain and maintain the new ASR target speed.

F. Other Than PL-1 Operation: Only the ASR-motoring-control band shall be adjusted. The ASR-braking-control band shall remain at the PL-1 level. When a station-to-station run is initiated in ATO mode, the train shall accelerate toward the applicable ATP speed limit. ASR shall regulate the positive tractive effort to obtain the performance-level-adjusted-ASR-target speed. Whenever the train speed decreases into the adjusted-ASR-motoring-control band, ASR shall regulate the positive tractive effort to obtain the adjusted-ASR-target speed.

1. When the train speed increases above the adjusted-ASR-target speed (e.g., because at a downhill grade), ASR shall allow the train to coast, but remain in the motoring mode(BRK signal in the Power mode). When the ASR-braking-control band is reached, ASR shall command the braking mode and regulate negative tractive effort to obtain the PL-1 ASR target speed. When the train speed decreases below the PL-1 ASR target speed, ASR shall allow the train to coast, but remain in the braking mode (BRK signal in the Brake mode).

2. When the ATP speed limit is changed, the ASR-motoring-control band shall be adjusted for the new performance-level-adjusted-ASR-target speed, and the ASR-braking-control band shall be adjusted for the new PL-1 target speed.

   a. When the ATP speed limit is reduced and the train speed is above the new ATP speed limit, the reactions to the overspeed condition shall be as specified herein for PL-1 Operation. An exception shall be when the overspeed signal is removed and the BRK trainline closed, ASR shall remain in the braking mode and regulate negative tractive effort to obtain the PL-1 ASR target speed. Subsequent speed control shall be as specified above for Other Than PL-1 Operation.

   b. When the ATP speed limit is raised, speed control shall be as specified above, but based on the new adjusted

ASR target speed and PL-1 ASR target speed.

16.4.4 Station Stopping

ASR shall regulate speed within the requirements of the PSS speed profile. Acceleration command shall be automatic when side doors have been cycled open, a closed-and-locked signal has been received, and the CLOSE pushbutton is depressed.

16.5 PROGRAMMED STATION STOPPING

Station stopping shall be accomplished by a minimum time profile having a nominal deceleration rate of 2 mi/hr/sec, except for jerk limiting. A train of any specified length shall stop with the center of the train aligned with the center of the platform regardless of track grade. Station stops shall yield a Gaussian distribution with a maximum standard deviation of 9 in. PSS shall be for normal direction of travel, except at terminal stations. ATS will provide train length via the TICU. The PSS equipment shall not need modification when the Metro Rail System is expanded beyond the terminal station of this Contract. Compensation for wheel wear shall be automatically applied.

16.6 BERTHING VERIFICATION

In ATO and MTO modes, berthing verification shall confirm that the train is positioned within the limits of a station platform, determine on which side of the train the platform is located, and then cause the appropriate side door control interlock device to be actuated. Verification shall be provided regardless of train travel direction and which track the train is operating on. Verification signals shall be received and distinguished in the presence of spurious noise and other signals, including transmissions from ATP and ATS equipment.

16.7 UNINTENTIONAL MOVEMENT PROTECTION

Protection against unintentional movement of a train in ATO and MTO modes and MTO submodes, except Wash/Couple submode, shall be provided on each dependent pair. Protection method shall be approved. (CDRL)

16.7.1 Side Doors Open

If movement is detected when side doors are open, indicate to ATP through contacts in the deadman circuit on a per pair basis.

16.7.2 Side Doors Closed

If movement is detected when side doors are closed, and no propulsion current (or equivalent) is detected, indicate to ATP through contacts in the deadman circuit on a per vehicle basis. Unintentional movement shall not be indicated during normal operation in COAST or during changes in tractive effort mode.

16.8 WAYSIDE EQUIPMENT

PSS and berthing verification wayside equipment shall be furnished in station sets for District installation (Reference: Section 4).

16.9 SUBMITTAL REQUIREMENTS

The ATC system, including the ATO subsystem and related equipment furnished hereunder, shall comply with PUC General Order No. 127 (Reference: Appendix TP-16-B) except where the District has received permission to deviate from General Order No. 127 as indicated in Appendix TP-16-A. In addition to other submittal requirements, conformance to PUC General Order No. 127 shall be verified by a checklist. (CDRL) Form, format, and information for the checklist shall be as indicated.

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APPENDIX TP-16-A
PUBLIC UTILITIES COMMISSION OF THE STATE OF CALIFORNIA
RESOLUTION RTS-7

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PUBLIC UTILITIES COMMISSION OF THE STATE OF CALIFORNIA

R E S O L U T I O N

RESOLUTION AUTHORIZING A DEVIATION FROM SECTION 3.8(d), 3.8(e), 3.8(f) AND 3.9 OF GENERAL ORDER 127 WITH RESPECT TO TRAIN SPEED DETECTION, ZERO SPEED DETECTION ACCURACY, UNINTENTIONAL MOVEMENT PROTECTION AND SIGNAL RECOGNITION DURATION AS AFFECTING THE LOS ANGELES METRO RAIL SYSTEM

Section 3.8 of Commission General Order 127 requires Rail Transit District to control and operate train protection systems that ensure that the speed of trains never exceeds a safe speed distance profile over the entire system.

Section 3.8(d) limits the measurement and use of train speeds to plus or minus 0.5 mph (independent of wheel wear) for purposes of train speed detection; Section 3.8(e) requires certain use and detection of zero speed to prevent door operation and train direction reversal; and Section 3.8(f) requires the train protection system to initiate emergency braking before roll-back speeds over 1.0 mph in the event a train is detected to be rolling backward. Section 3.9 states that all signals that govern train movements shall be continuous and that any interruption of any signal for longer than 1.0 second shall automatically initiate open-loop braking.

Southern California Rapid Transit District has requested it be granted prescribed deviations from the above rules for its Los Angeles Metro Rail System as permitted by Section 5.("Exemption") of the General Order as set forward in a letter from the District dated June 24, 1986. The Commission has reviewed and evaluated the requested deviations and have found them to be reasonable in that it would permit safe train operation to the public and Transit District employees.

IT IS RESOLVED, that Southern California Rapid Transit District with respect to the Los Angeles Metro Rail System be permitted to deviate from Section 3.8(d), 3.8(e), 3.8(f) and 3.9 of General Order 127 in the following described manner:

3.8(d). SCRTD is permitted to construct and operate with a speed detection system with a speed accuracy of plus 3 mph minus 0 mph (worse case), rather than plus or minus 0.5 mph.

3.8(e). SCRTD is permitted to construct and operate with a zero speed detection system that will indicate zero speed when a train is moving at 3.0 mph (worse case) rather than limited to 1.0 mph as prescribed in the section.

3.8(f) SCRTD is permitted to use an unintentional Movement Protection System that indicates train rollback at 3.0 mph (worse case) rather than at 1.0, or before the rollback distance exceeds 20 inches, as prescribed in the section.

3.9 SCRTD is permitted to use a "train borne speed detection system" that requires 2.0 seconds to indicate an interruption in a train movement signal rather than "not longer than 1.0 second" as prescribed in the section.

This Resolution is effective today.

I certify that this Resolution was adopted by the Public Utilities Commission at its regular meeting on Jan. 14, 1987. The following Commissioners approved it:

Executive Director

Stanley W. Hulett
President
Donald Vial
G. Mitchell Wilk
Frederick Duda
Commissioners

APPENDIX TP-16-B
GENERAL ORDER NO. 127
PUBLIC UTILITIES COMMISSION OF THE STATE OF CALIFORNIA

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STATE OF CALIFORNIA

PUBLIC UTILITIES COMMISSION

GENERAL ORDERS

Wherever the phrase "Railroad Commission" appears in these General Orders, it shall be deemed to refer to the "Public Utilities Commission." The abbreviation "Cal. PUC" shall be used in place of the abbreviation "CRC" wherever the latter appears. (Com. Res. No. A-267.)

By constitutional amendment of November 6, 1946, the Railroad Commission was continued in existence as the Public Utilities Commission. (Cal. Const., Art. XII, sec. 22.)

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PUBLIC UTILITIES COMMISSION

State of California

Fifth Floor, California State Building, Civic Center, San Francisco 94102
Branch Office, State Office Building, 107 South Broadway, Los Angeles 90012

GENERAL ORDER NO. 127

Public Utilities Commission of the State of California

REGULATIONS, GOVERNING THE CONSTRUCTION, RECONSTRUCTION, MAINTENANCE AND OPERATION OF AUTOMATIC TRAIN CONTROL SYSTEMS WITH RESPECT TO TRAIN DETECTION AND SEPARATION, ROUTE INTERLOCKING, SPEED ENFORCEMENT AND RIGHT-OF-WAY HAZARD PROTECTION ON RAPID TRANSIT SYSTEMS.

Adopted August 15, 1967. Effective September 15, 1967. (Case No. 8670)

IT IS ORDERED that the following regulations governing the construction, reconstruction, maintenance and operation of automatic train control systems with respect to train detection and separation, route interlocking, speed enforcement and right-of-way hazard protection on rapid transit systems shall hereafter be observed in this state unless otherwise authorized or directed by the Commission.

DEFINITIONS

Section 1

1.1 *Rapid Transit System*—An electrified railroad operating on an exclusive grade separated right-of-way for the transportation of passengers and their incidental baggage.

1.2 *Automatic Train Control (ATC)*—The system for automatically controlling train movement, enforcing train safety, and directing train operations.

1.3 *Emergency Braking*—Irretrievable open-loop braking to a stop.

1.4 *Open-Loop Braking*—Braking at the maximum effort permitted by the traction system without continuous direction from the ATC system.

1.5 *Vital Circuit*—Any circuit, the function of which affects the safety of train operations.

1.6 *Closing-In*—Running a following train toward a leading train which is either stopped or running slower than the following train.

1.7 *Closing-Up*—Running a following train to a position that will enable it to couple to a leading train which is stopped.

1.8 *Control Limit*—The extent of route over which a gate is controlled.

1.9 *Departure Test*—Test made on complete train at transfer track before permitting train to operate in automatic mode.

1.10 *Fail-Safe*—A characteristic of a system which ensures that any malfunction affecting safety will cause the system to revert to a state that is known to be safe.

1.11 *Gate*—The limit of an interlocked route where entry to that route is governed.

1.12 *Fixed Gate*—The limit of an interlocked route past which automatic operation of trains is never permitted.

1.13 *Interlocking*—An arrangement of gates and control apparatus so interconnected that functions must succeed each other in predetermined sequence permitting train movements over controlled routes only if safe conditions exist.

1.14 *Locking*—The electrical or mechanical establishment of a condition for a switch, interlocked route, speed limit, or automatic function so that its state cannot be altered except by a prescribed and inviolate sequence of unlocking.

1.15 *Indication Locking*—Electrical locking, effective when a route is requested, which prevents the opening of a gate if a switch, another gate, or other operative unit is not detected as locked in a correct position corresponding to the requested route.

1.16 *Route Locking*—Electrical locking, effective when a train passes an open gate, which prevents the movement of any switch in the route governed by that gate and prevents the opening of a gate for any conflicting route.

1.17 *Time Locking*—A method of locking which, after a gate is opened, prevents, until after the expiration of a predetermined time interval after the gate has been closed again, the operation of any switch in the route governed by that gate, and which prevents a gate from being opened for any conflicting route for the same time interval.

1.18 *Reception*—The process of receiving a train at a terminal zone, station, or yard.

1.19 *Redundancy*—The existence in a system of more than one means of accomplishing a given function.

1.20 *Route*—A specified succession of contiguous zones over which trains operate between two controlled gates that are capable of stopping the train under automatic operation.

1.21 *Interlocking Route*—A route controlled by interlocking; equipped with gates to prevent conflicting movements.

1.22 *Normal Route*—A route established in the normal direction of train travel.

1.23 *Reverse Route*—A route in which trains run opposite to the normal direction.

1.24 *Route Request*—A control at an interlocking, immediately preceding the interlocking functions, that requests a desired interlocked route.

1.25 *Sectional Release (Of Locking)*—The partial release of route locking behind a train as it proceeds through an interlocked route, and unoccupies successive train detection zones, to expedite the establishment of subsequent routes.

1.26 *Civil Speed Limit*—The maximum safe speed allowed in a specified zone as determined by the physical limitations of the track structure.

1.27 *ATC Speed Limit*—The upper limit of a train speed as enforced by the train protection system.

1.28 *Absolute Stop*—A train stop which permits no exceptions such as reduced speed running, movement within restricting limits, or similar alternatives.

1.29 *Zero Speed*—A speed not greater than 1.0 miles per hour, for 1.0 second, and which shall include the condition that the traction control has been open-looped for 1.0 second after 1.0 miles per hour or less was detected.

1.30 *Switch and Lock Movement*—A device which performs the sequential functions of unlocking, operating, and locking a track switch.

1.31 *Normal Switch Position*—The designation for the position of a track switch and its controls when the switch's position corresponds to the defining track plan.

1.32 *Reverse Switch Position*—The designation for the position of a track switch and its controls when the switch's position is opposite to that shown in the defining track plan.

1.33 *Reaction Time*—Time from the occurrence of a step change of control signal to the first attainment of the new, steady-state value of the controlled variable, within a designated accuracy.

1.34 *Main Track*—A track that normally is under control of the automatic train control system, including leads into yard areas but excluding transfer tracks.

1.35 *Reversible Track*—A section of track on which the prescribed direction of running can be reversed if all its zones are unoccupied.

1.36 *Transfer Track*—A track in a yard area where the transfer between automatic main line and manual yard modes of operation takes place.

1.37 *Train Protection*—A subsystem which may be included within automatic train control, which enforces safe operation, including speed restriction and separation of trains running on the same track and over interlocked routes.

1.38 *Block Zone*—A length of track between two interlocking zones, between a terminal zone and an interlocking zone, or between two terminal zones, within which track occupancy and direction of trains must be detected.

1.39 *Gate Control Zone*—That portion of track extending between a controlled gate and the point on its approach side where gate control can affect the movement of trains.

1.40 *Interlocking Zone*—A zone in an interlocked route containing one or more track switches.

1.41 *Speed Limit Zone*—A zone in which maximum authorized train speed is defined by the physical limitations of the track structure or surrounding structures.

1.42 *Station Stop Zone*—A zone at a station platform within which controls and indications are transferred between train and station.

1.43 *Terminal Zone*—An interlocked zone within which the prescribed direction of running can be reversed while the zone is occupied by a train.

1.44 *Transfer Zone*—A zone in which transfer may be made from automatic to manual operation, or vice versa.

GENERAL REQUIREMENTS

Section 2

2.1 *Plans and Construction Shall Be Approved*

(a) No train protection equipment or circuits in such equipment, which is part of an automatic train control system, shall hereafter be constructed, nor shall any changes be made in such equipment or circuits, that affect the original operational concept, until plans and specifications for such construction and changes have been filed with and approved by the Commission. Changes made to improve performance that do not affect the basic concept may be made by the carrier without formal authorization by the Commission, if revised plans of such changes are submitted to the Commission within thirty days after the changes are made.

(b) When fixed equipment, cable, or other fixtures of the automatic train control system are replaced, repaired, or reconstructed such that the fixed equipment, cable, or other fixtures have the same prior design and function, such replacement, repair, or reconstruction shall not be considered as construction or a change for the purpose of this order.

(c) When an equipment has been replaced as a modular or plug-in unit of which it is a part, or a circuit is temporarily

changed, for maintenance or testing purposes, the replacement or change shall not be considered as a change for the purpose of this order.

(d) When the plans are submitted to the Commission for its approval, the request for such approval shall be signed by the General Manager of the carrier. The general track plan shall be signed by the General Manager or a responsible officer of the carrier. The request shall state the carriers' representative who will be in charge of the work, or portions of the work for which request is made.

2.2 *Plans To Be Filed*

Two copies of the following plans shall accompany each copy of the application of the carrier for approval of construction, of train protection equipment and vital circuits in an automatic train control system:

(a) Function Description and Functional Block Diagram of the Work which applies to train protection.

(b) Schedule for the progress and completion of the work.

(c) Elementary schematic diagrams of equipment and circuits which affect train protection in the work.

(d) Equipment Arrangement and Outline Drawings.

(e) Track Plan. This plan shall be drawn to a scale of not more than 200 feet per inch and shall show civil plan and profile, the extent of control zones, and the arrangement and nomenclature of zones, gates and switches, on a schematic track plan separate from the indicated civil plan and profile. In addition, the track plan shall convey a control limit diagram covering the full extent of the work. On every sheet of the track plans, these shall appear on the print, in any location most convenient with respect to the subject matter of the print, a white space which will have a vertical dimension of at least two inches and a horizontal dimension of at least three inches.

Note—All plans shall be furnished with the minimum number of folds to bring them with filing size, 8½″ x 13″, and so folded that title and drawing number appear on the outside. Drawings reduced to half size, whose reduced dimension shall be not less than 8½″ x 13″, may be furnished.

2.3 *Preparation of Exhibits*

In preparing exhibits, symbols shall conform to standards of the following organizations:

(a) American Standards Association

(b) Association of American Railroads—Signal Section

(c) Institute of Electrical and Electronic Engineers

(d) National Electrical Manufacturers Association

2.4 *Commission Shall Approve Plans*

(a) When plans are approved by the Commission, a copy so marked will be sent to the carrier.

(b) If the work is not commenced within one year after date of approval, a new approval shall be obtained.

2.5 *Request for Inspection*

(a) When the plans for the work have been approved by the Commission, and its construction, has been completed, the carrier shall request by letter or telegram to the Commission for inspection. The request for inspection shall be accompanied or preceded by a corrected copy of the plans on which any change has been made from those originally submitted.

(b) Request for inspection by letter or telegram shall be made by the carrier not less than ten days prior to the date of initial operation. After receipt of this request, the Commission shall notify applicant of the date of inspection. There shall be furnished to the Commission's representative, at a central location on the work site on the date set for inspection, a complete set of updated plans submitted to the Commission, a complete set of circuit plans, and tables showing route locking logic, and switch locking logic.

2.6 *Approval*

The representative of the Commission inspecting the work may, at his discretion, for what appears to him to be good cause, recommend changes necessary for the safe operation of the completed work and direct that the completed work be not operated until such changes are made.

If the inspection discloses the completed work to be in compliance with the general order, and changes shown to be necessary at the time of inspection have been made, the carrier will receive the written approval of the Commission for the operation of the completed work.

2.7 *Test and Inspection Records*

The carrier shall establish and maintain on file for at least one year the records of inspections and tests it makes of train protection equipment and vital circuits and equipment. Said records shall be made available on request to this Commission or its duly authorized representative.

GENERAL SPECIFICATIONS

Section 3

3.1 Every rapid transit carrier shall operate all revenue trains, and all trains which operate on track used for revenue service, under a system which shall automatically protect against:

(a) Rear end collisions which may result from one train overtaking another;

(b) Head-on or sideswipe collisions which may result from admission of trains upon conflicting routes;

(c) Derailment or collision which may result from a track-switch(s) being moved immediately ahead of or under a train;

(d) Derailment or collision which may result from excessive speed for track conditions;

(e) Such right-of-way hazards as may be detectable.

This system shall be subject to the approval of the Commission and may be integrally a part of an ATC system.

3.2 The train protection features shall subordinate all other features of the automatic train control system and possess fail-safety.

3.3 Trains shall be detected continuously. The maximum length of a train detection zone shall not exceed 5,000 feet. If the train detection equipment becomes incapable of detecting the presence of a train in a zone or zones, the effect shall indicate that zone or zones as occupied.

3.4 Whenever a condition arises in which the sole relief necessitates the operation of a train or trains without benefit of the train protection system, the carrier may employ immediately such relief, as an emergency measure, as the Commission will have approved.

3.5 The safe distance separating operating trains shall be not less than the maximum stopping distance of the following train. The maximum stopping distance shall be determined and make allowances for the effects of grade, propulsion and braking characteristics, equipment reaction time and the pertinent controls effecting the protection stopping distance.

3.6 Route interlocking shall provide for the alignment and locking of protected routes wherever trains may diverge, converge, cross, or conflict in any way. Standards of the Association of American Railroads-Signal Section shall govern the design and construction of all interlocking equipment.

(a) The interlocking circuits shall employ devices arranged to ensure that specified functions succeed each other in a predetermined order. The interlocking control logic shall be de-

signed according to route logic tables as submitted by the carrier.

(b) Control circuits shall be arranged so that an aligned and locked indication cannot be signaled until each switch point in the route is indicated to be in proper position through circuit controllers operated directly by the switch points and by the switch locking mechanism. The position of the closed points and locking of each switch controlled by the interlocking shall be detected.

(c) Interlocking shall receive one fail-safe signal of occupancy from each separate detection zone within the routes it controls and from each separate approach detection zone which effects time locking protecting the routes it controls. In addition, interlocking shall receive one fail-safe signal of gate closure for each gate that controls entry into the zones protected by the interlocking.

(d) Gates shall be located at each limit of all interlocking routes and shall control entry to all interlocking routes. When a gate is closed, the train movement control signal, normally transmitted to approaching trains, shall ensure that any approaching train in automatic mode will stop before the gate. Under the condition of a closed gate, the train movement control signal shall enforce a progressive reduction in train speed from the maximum speed allowed by the operating speed restriction to zero speed so that, if the gate remains closed, the approaching train will stop without violating the gate. When a gate is open, the train movement control signals shall be transmitted to an approaching train. Gate control circuits shall open a gate only when a route aligned and locked signal is established in the interlocking for the route controlled by the gate.

(e) Interlocking shall include time locking. The time settings for time locking shall be not less than the maximum time taken for a train to stop from the highest authorized speed approaching the gate controlling the entrance of the protected route. Time locking shall remain in effect after a gate closes regardless of the location or speed of the approaching train unless route locking is in effect.

(f) Interlocking shall include route locking. Route locking shall release time locking after detection of the train in two consecutive and separate detection zones and the train is clear of the interlocking zone. The route locking shall be protected against the effect of inadvertent momentary loss of train

detection. Route locking shall prevent the movement of any switches in the route, and prevent the opening of any gates for train movement to conflicting routes while a train is in the protected zone. When the rear of a train leaves the interlocked zone, electric locking on the switches that have been passed over and entrance gates that are no longer conflicting may unlock behind the train.

3.7 The automatic train control system shall provide a fail-safe method of limiting the speed of trains according to the track and wayside structure characteristics. The speed limit, which shall be determined according to the track and wayside characteristics, shall apply to the full length of the longest train it may govern throughout the entire length of the zone.

3.8 The train protection system shall ensure that the speed of trains never exceeds a safe speed-distance profile over the entire system.

(a) If the speed of a train broaches the safe speed-distance profile, the system shall immediately and automatically cause an open-loop brake application which shall be maintained at least until the train speed reduces to a value below the safe speed-distance profile.

(b) The safe speed-distance profile shall be a curve based on the track and wayside structure requirements and shall apply to each track throughout the length of the system. The profile transition from a lower speed limit to a higher speed limit shall not rise from the lower value until the rear of a train clears the lower speed limit. The profile transition from a higher speed limit to a lower speed limit shall be continuous curve beginning at a point preceding the entrance to the lower speed limit by a distance at least equal to the sum of the maximum open-loop braking distance and the distance traveled in 3.0 seconds at the higher speed limit, and the equipment reaction time distance at the higher speed limit, and ending at a point preceding the entrance to the lower speed limit by a distance at least equal to the sum of the distance traveled in 3.0 seconds at the lower speed limit, and the equipment reaction time distance at the lower speed limit.

(c) If the ATC speed limit is zero mph, the train protection system shall maintain an open-loop brake call after the train stops and until the train protection system changes the ATC speed limit.

(d) For purposes of train speed detection, the measurement of speed shall continuously represent true train speed within plus or minus 0.5 mph and independent of wheel wear.

(e) Zero speed shall be detected and used to prevent door operation and direction reversal when a train is moving.

(f) The train protection system shall initiate emergency braking in the event a train is detected to be rolling back. The emergency braking shall be applied before roll-back speed exceeds 1.0 mph, or before roll-back distance exceeds 20 inches.

3.9 All signals that govern train movements shall be continuous. The interruption of any such signal for longer than 1.0 second shall automatically initiate open-loop braking.

3.10 Wherever protection shall be provided against right-of-way hazards, the protection shall effect a zero speed limit at a distance at least equal to maximum stopping distance from the hazard area. The protection area circuits shall be continuously energized through normally closed contacts of detector control circuit switches, relays, and circuit controllers, as applicable. When the detector is actuated, the control circuit shall open and remain open, producing a zero speed limit until manually reset.

3.11 If the train protection governing train movement does not interface with an automatic train operation of the traction system, the carrier shall apply for approval by the Commission to install and manually operate such vehicles. Such vehicles shall be at least equipped with a visual speed limit indicator to advise the vehicle operator of the speed limit and direction authorized. The control of this indicator shall comply with the train protection functions specified in this order.

3.12 *Security For Equipment*

Security shall be provided within an equipment room, or for any cases, or enclosures, for all train control equipment related to the operational safety of trains. Access to this equipment shall be prevented by use of a key to prohibit persons other than those authorized by possession of the key.

3.13 *Cross and Ground Protection*

All circuits shall be designed and arranged, as far as practicable, to prevent the operation of apparatus by crosses or grounds. The carrier shall make periodic tests for crosses and grounds and report their results in the quarterly reports required by Section 4.1 of this order.

3.14 *Materials and Workmanship*

Materials and workmanship shall be first class throughout, and the system constructed in every way to warrant the safe and expeditious performance of the functions for which it is designed.

3.15 *Maintenance and Operation*
The train control system shall be maintained and operated in accordance with rules which the carrier shall submit for the Commission's approval. Such rules shall include emergency procedures which shall be instituted whenever portions of the system become inoperative.

3.16 No portion of the automatic train control system shall be abandoned nor its operation discontinued without the permission of this Commission.

REPORTS TO THE COMMISSION

Section 4

4.1 *Quarterly Reports of Performance*
Reports of the complete and operating automatic train control performance shall be prepared by the carrier for the quarter ending March 31, June 30, September 30, and December 31 of each year. Such reports shall be filed within thirty days after the end of the quarter for which they are made and shall be prepared in a manner prescribed and upon the forms provided by the Commission.

4.2 *Reports of Accidents and Investigations*
Within a period of fifteen days after the occurrence, a complete copy of the testimony given at all investigations conducted in connection with derailments or collisions, except those in yards and outside of the limits of the automatic train control system, must be forwarded to the Commission. In the event of serious personal injury, or property damage exceeding $1,000, occurring as a result of such accidents, the Commission shall be immediately notified by telephone or telegraph. Such accident report and transcript of testimony in accident investigations shall not be open to public inspection.

EXEMPTIONS

Section 5

5.1 Requests for deviations from these rules shall contain a full statement of the reasons justifying the requested deviations. Any deviation or exemption so granted shall be limited to the particular case covered by the request.

This order shall be effective on and after the 15th day of September, 1967.

Approved and dated at San Francisco, California, this 15th day of August, 1967.

PUBLIC UTILITIES COMMISSION
OF THE STATE OF CALIFORNIA
By WILLIAM W. DUNLOP, *Secretary*

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SECTION 17

COMMUNICATIONS

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SECTION 17

COMMUNICATIONS

17.1 GENERAL

This Section defines the passenger vehicle communications subsystem to be provided on each vehicle, except as noted, and specifies the CCU, PA, IC, microphone, and cab speakers.

17.1.1 Cited References

Organization	Number	Title
US	MIL-STD-1472	Human Engineering Design Criteria for Military Systems Equipment and Facilities

17.1.2 Functional Description

A. The communications subsystem shall allow the following:

1. One-way voice announcements from the energized cab to vehicles in a train, via the PA

2. One-way voice announcements from the DFE radio to vehicles in a train, via the PA

3. Chime or tone annunciation of side door being closed to vehicles of a train, via the PA (Reference: Section 10)

4. Two-way voice communication between energized cab and passenger area of vehicles of a train, via IC

5. Two-way voice communication between energized cab and any deenergized cab of a train, via IC

6. Two-way voice communication between energized cab and RCC, via DFE radio (Reference: Section 4)

B. Coordination and control of voice communications and side door closing annunciation shall be by the CCU.

C. The microphone shall be the voice interface between the train operator and the subsystem.

17.1.3 General

Communications equipment shall be powered from the emergency bus and shall include power supplies as required to utilize the LVPS. Circuits shall be routed and protected to minimize EMI. Communications subsystem shall be controlled from the energized cab. Power shall be applied to the communications equipment when the Operator Console KEY SWITCH is placed in the ON position. When the subsystem is thus activated, two indicators (CCU and RADIO) shall be illuminated on the CCU.

17.2 COMMUNICATIONS CONTROL UNIT

17.2.1 General

A CCU shall be installed in each Operator Console (Reference: Section 9). The CCU shall function as a communications mode selection and control panel. The CCU shall be of modular design and furnished with connectors.

17.2.2 Technical Requirements

The CCU shall provide appropriate controls and indications to allow the following functions:

A. PA to all vehicles from the train operator by utilization of the PASSENGER PA switch. This switch shall illuminate when actuated and shall require continuous actuation to connect the microphone to the PA.

B. Connection of the radio output to the PA by utilization of the RCC to PA switch. This switch shall illuminate when actuated and the required connections have been made. A second actuation shall disconnect the radio from the PA and extinguish the illumination.

C. Control of passenger-train operator intercommunications in the following sequence:

1. Passenger shall be able to call train operator by momentarily depressing Call pushbutton switch on remote IC unit. Remote IC unit Call switch shall illuminate. Exterior red indicating light over each side door opening of vehicle containing activated remote IC unit

shall flash (Reference: Section 8). At CCU, call shall be annunciated and PASSENGER IC switch illumination shall flash.

2. Train operator shall be able to acknowledge call and silence audible annunciation by actuating PASSENGER IC switch on the CCU. Passenger intercommunications shall then be possible utilizing the microphone, a cab speaker, and the remote IC unit. The PASSENGER IC switch shall illuminate steadily. A call from another remote IC unit shall be placed on-line without delay.

3. Cancellation of the IC call shall be accomplished by actuating the PASSENGER IC switch a second time, which shall also extinguish the exterior red indicating light.

D. When the CAB IC switch in a deenergized cab is actuated, it shall illuminate and alert the train operator in the energized cab of an incoming IC call as is done for passenger IC. The train operator shall be able to acknowledge and establish communications in the same manner as for passenger IC. The microphone, amplifier, and IC speaker in deenergized cabs shall function in a manner similar to those of the remote IC stations.

E. Connection of the microphone to the radio shall be provided by the RADIO, PUSH TO TALK switch. This switch shall be illuminated when actuated, shall mute the cab radio speaker, and shall function as a "press-to-talk" switch.

F. Output volume of the cab radio speaker shall be controlled by the RADIO VOLUME control. At the lowest position of the control, the radio speaker output shall be discernable in a 70 dB background ambient noise environment. The range from low to high shall be 14 dB.

G. Two POWER ON indicators are provided on the CCU. One (RADIO) shall indicate that power is applied to the radio. The other (CCU) shall indicate that power is applied to all other communications equipment in the train.

H. Radio channel selection shall be provided by an eight-channel switch (CHANNEL SELECTOR) on the CCU. Switch shall have a mechanical stop that is programmable in one-channel increments. Initial setting shall be four channels.

17.3 MICROPHONE

17.3.1 General

The microphone shall be a compact, tamperproof dynamic unit (Reference: Section 9). The unit shall have an attached cable and a standard 5/8-in., 27-thread connector with a tamperproof fastener and be mounted directly on a flexible tube (gooseneck) of 12-in. minimum length. The cable shall thread through the flexible tube to protect it from physical damage. The cable shall not be exposed. The dynamic element shall be rugged, reliable, and designed for easy field replacement.

17.3.2 Technical Requirements

The microphone shall be designed specifically for voice reproduction with a low-impedance output to permit long cable runs to the amplifier without adverse effect on response and output level. The microphone shall be provided with the following characteristics:

A.	Frequency Response:	300 to 3,000 Hz at any level, rising characteristics to 1,000 Hz
B.	Output Level:	-56.0 dB (0 dB = 1 mW per 10 kPa
C.	Diaphragm:	Nonhygroscopic
D.	Pick-up Pattern:	Noise-cancelling
E.	Cable:	Nondetachable, shielded, twisted pair
F.	Case:	All-metal case with stainless steel grille.

17.4 CAB SPEAKERS

Two identical speakers shall be installed in the cab ceiling area. One shall service the radio and the other shall service IC. Output response shall be 95 dBA at 1 ft on-axis with 400 Hz, 1 W input. When the radio is energized, incoming radio calls shall be routed to the cab radio speaker on a continuous basis.

17.5 PUBLIC ADDRESS

17.5.1 General

A PA shall be installed on a dependent-pair basis. PA shall include power amplifiers, trainline amplifiers, filters, power converters, and switching devices necessary to produce uniform and distortion-free sound in accordance with MIL-STD-1472. Speakers shall be powered by power amplifiers in each vehicle and interconnected so that the power amplifiers of a train are driven from the trainline amplifier (lead trainline amplifier) located in the dependent pair having the energized cab. When an announcement is made through the energized cab, a switching function shall automatically connect the radio or microphone to the appropriate input circuit of the lead trainline amplifier. A sound pressure level (SPL) of 70 dBA or more shall be provided, uniformly distributed throughout each vehicle at a level 4 ft above the floor.

17.5.2 Technical Requirements

A. PA shall be normally connected as follows:

1. Amplifiers shall be connected to their normal source of power.

2. The input of the power amplifiers shall be connected to +20 dBm (dB referenced to 1 mW) audio trainlines.

3. The lead trainline amplifier shall feed the audio trainline through an isolating and bridging transformer.

4. The IC speakers near the energized cab shall be muted to the extent required to inhibit audio feedback.

B. Audio trainlines shall be operated as a "stiff" line of approximately 200 ohm with a post-compression level of 20 dBm. The same trainlines shall be used for switching and control by superimposed dc signals. Switching and control signals shall cause no noticeable sound at passenger area speakers.

C. The trainlines shall be driven by a trainline amplifier furnished for each dependent pair. Trainline amplifiers shall be capable of developing +20 dBm with less than 1 percent distortion.

Maximum permissible variation in speaker output level shall not exceed 5 dB in trains of any length specified. Frequency response shall be ±1 dB in the range of 100 to 8,000 Hz. Maximum hum and noise shall be 60 dB below rated trainline output. Amplifier inputs and outputs shall be capable of open or short circuit operation with no resultant damage.

D. Each dependent pair shall be provided with two power amplifiers capable of continuous power output to a constant-voltage (70.7 V) speaker distribution line. Power output rating shall be as required to provide specified SPL. Headroom shall be sufficient to allow a minimum increase in output of 12 dB, without increase in hum, noise, or total harmonic distortion (THD) from the normal level, based upon increased ambient noise level in vehicle.

1. Power output shall not vary more than 6 dB when LVPS voltage is 35 percent below nominal. Hum and noise level shall be not less than 60 dB below rated output. Frequency response shall be ±1 dB between 200 and 8,000 Hz with a maximum THD of 1 percent. Amplifier inputs and outputs shall be capable of open or short circuit operation with no damage. Speaker level controls shall be provided.

2. A gain adjustment controller shall provide automatic control of the PA power output based upon ambient noise levels. The controller shall provide a graduated increase in power output in proportion to the increase in noise level caused by, for example, increased number of passengers due to rush hour. The operating range shall be a minimum of 12 dB from a preset ambient noise level (quiet period). Noise sensing devices shall be mounted in speaker enclosures. Automatic control shall be disabled during PA announcements, with the gain adjustment set automatically to the ambient noise existing just prior to use.

3. Amplifiers shall contain a compressor-limiter section designed to hold the output level within 2 dB post threshold with a delta input of 30 dB and maximum THD of 1 percent at the compressor output with nominal gain. Under full compression, the THD shall not exceed 2 percent. The attack time of the compressor

shall be a maximum of 10 msec and the release time shall be set at 800 msec. The compressor section shall have field adjustments for both range and threshold. Circuit provision shall cause symmetrical clipping if the 30 dB compression range is exceeded.

4. Each amplifier shall feed a distribution network designed to operate as a constant voltage system (nominally 200 ohm total reflected impedance to the amplifier). Line matching transformers shall be provided with a secondary impedance of 8 ohm. Frequency response shall be ±2 dB from 100 to 8,000 Hz. The THD shall not exceed 1 percent in the range of 100 to 8,000 Hz.

E. Each vehicle shall be furnished with PA speakers located in the ceiling. Speakers shall be of the double re-entrant type, complete with integral driver. Speakers shall contain a transformer suitable for use with a 70.7 V audio distribution arrangement. Each transformer shall have primary taps to adjust power to the speaker in 3 dB increments from 15 W downward. The axial sensitivity of speakers shall be 121 dB sound pressure referenced to 20 microPa at a distance of 4 ft with 15 W input power. Frequency response shall be ±3 dB in the range of 475 to 14,000, ±200 Hz. Speakers shall be designed so as to permit installation in a 6-in.-deep recess. Half of the speakers in each vehicle shall be powered by the power amplifier located in the adjacent vehicle of the dependent pair. Speakers shall have a power rating of not less than 15 W. Dispersion shall be 180 degrees with minimum variation of 3 dB at 400 Hz.

1. Speakers shall be properly phased and level adjusted for smooth sound level distribution. In vehicles having a load of 100 passengers, the acoustical level shall not vary more than ±3 dB at any normal listening position.

2. Each speaker shall be mounted in a suitable acoustical enclosure lined with sound absorbing material. The enclosure baffle shall be at least 25 percent acoustically transparent. Speakers and enclosures shall be securely mounted above the ceiling liner.

3. The grille shall be designed to minimize the possibility of damage to the speaker by sharp instruments passing through the openings.

F. The PA shall produce and distribute a tone or chime to alert passengers that the side doors are closing (Reference: Section 10).

17.6 PASSENGER INTERCOMMUNICATIONS

17.6.1 General

At least two remote IC stations shall be provided in the passenger area of each vehicle. Locations of remote IC stations shall be approved. Operating instructions and vehicle number shall be applied to the sidewall immediately below each remote IC station (Reference: Section 8). IC stations shall be mounted in durable metal cases. Simultaneous energization of at least six remote IC stations in a three-dependent-pair train shall be possible. Resetting a remote IC station shall be possible from the energized cab only.

17.6.2 Technical Requirements

A. IC station shall utilize a speaker and microphone, cushion-mounted in a subpanel.

1. The speaker shall be rated at 5 W continuous. Frequency response shall be within ±5 dB from 300 to 5,000 Hz with THD not exceeding 2 percent over this range. The speaker acoustical output shall be 95 dBA at 1 ft on-axis.

2. The microphone shall have a frequency response of 300 to 3,000 Hz at any level, rising characteristics to 1,000 Hz, an output level of -56.0 dB (0 dB = 1 mW per 10 kPa), and a non-hygroscopic diaphragm.

B. The baffle in front of the microphone and speaker shall have at least 25 percent acoustical transparency. The baffle shall include a grille that is designed to minimize the possibility of damage to the speaker or microphone by sharp instruments passing through the openings.

C. An illuminated, Call pushbutton switch shall be mounted on the subpanel. The switch shall be recessed and configured so that inadvertent activation, due to passengers leaning against the IC station, is not possible. When pressed, the switch

shall illuminate, and hands-free communication shall be possible.

D. A maximum of two shielded twisted pairs shall be used for passenger IC trainlines.

E. IC amplifier circuit shall contain compression circuitry to ensure that intelligibility of normal voice is not degraded at 3 ft from the microphone.

17.7 CAB-TO-CAB INTERCOMMUNICATIONS

Passenger IC in the cab shall provide for two-way cab-to-cab communications between the energized cab and other cabs in the train.

END OF SECTION

SECTION 18

HEATING, VENTILATING, AND AIR CONDITIONING

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SECTION 18

HEATING, VENTILATING, AND AIR CONDITIONING

18.1 GENERAL

This Section specifies the requirements of the heating, ventilating, and air conditioning (HVAC) subsystem to be provided as part of each vehicle.

18.1.1 Cited References

Organization	Number	Title
ASHRAE	52-76	Method of Testing Air Cleaning Devices Used in General Ventilation for Removing Particulate Matter
ASHRAE	_____	Handbook of Fundamentals
ASME	_____	Boiler and Pressure Vessel Code
ASTM	B194	Copper-Beryllium Alloy Plate, Sheet, Strip, and Rolled Bar

18.2 FUNCTION, EQUIPMENT, AND PERFORMANCE REQUIREMENTS

18.2.1 Function

The HVAC subsystem shall provide for passenger and train operator comfort by maintaining vehicle interior temperatures, air velocities, and outside air quantities within the parameters specified herein.

18.2.2 Equipment

The HVAC subsystem shall include the items listed below as a minimum. Subsystem power shall be as indicated (Reference: Section 13).

A. Two underfloor-mounted condensing units. Each unit shall be sized to provide one-half of the total required cooling capacity.

B. Two above-the-ceiling mounted fan-evaporator units. Units shall be located at opposite ends of the vehicle from each other. Each fan (also called ventilation fan) shall be sized to provide one-half

of the total required ventilating capacity, including one-half of the total required outside air quantity. Each evaporator shall be sized to provide one-half of the total cooling capacity.

C. Two sets of heaters. Each set shall be sized to provide one-half of the total required heating capacity. A heater set shall be mounted in or near each fan-evaporator unit.

D. Two sets of overhead duct-diffuser systems. Each set shall be sized to provide distribution of the air from one fan-evaporator unit over the entire length of the vehicle interior.

E. Outside air ducts. Each duct shall be sized to provide an equal portion of the total required outside air.

F. Control circuit. The circuit shall cause the vehicle interior to be maintained within the specified design conditions.

G. Safety controls, operation controls, and control panels.

H. Miscellaneous components and materials as required for a complete subsystem.

18.2.3 Performance

A. The HVAC subsystem shall provide continuous ventilation of the operator cab and the passenger area. The ventilation shall be supplemented by cooling or heating in stages, as required to automatically maintain the interior temperatures between 66 and 77°F under the ambient and operating conditions specified herein.

B. The air shall be distributed within the vehicle and returned from the vehicle in such a manner that the air velocity does not exceed 75 ft/min within the plane 5.5 ft above the floor.

C. The following temperature variations shall not be exceeded during normal operation when the subsystem has been in continuous operation for at least 2 hr:

1. Air temperature differences in the vertical plane shall not vary more than ±4°F from the average interior temperature. This applies

when the vertical plane temperatures are measured along the center aisle at any height between 6 in. from the floor surface to 12 in. from the ceiling surface.

2. Air temperature differences on a horizontal plane shall not vary more than ±3°F from the average interior temperature. This applies when measured throughout the vehicle between 6 in. above the floor and 12 in. from the ceiling and sides.

3. In the operator cab, the average air temperature shall be the same as in the passenger area and within the same temperature variations.

D. The subsystem shall maintain the vehicle interior pressure at not less than 0.10 in. water column above atmospheric pressure, when the vehicle is not moving and doors and windows are closed.

E. Condensation shall not form on interior surfaces of the vehicle as a result of HVAC subsystem operation, except on diffusers in outside door areas when caused by interaction with outside air infiltration.

F. The surface temperature shall not exceed 120°F on any exposed device or component of the subsystem.

18.3 DESIGN REQUIREMENTS

18.3.1 General

Design of the HVAC subsystem shall be in accordance with applicable provisions of the ASHRAE Handbook of Fundamentals.

A. Minimum outside air flow rate of 950 ft^3/min shall be maintained under normal operating conditions.

B. Under summer load conditions, the subsystem shall be capable of achieving the control interior temperature in 30 min or less after being activated with a stabilized interior temperature and two occupants on board.

C. Recovery time to control interior temperature shall be no longer than 2 min after the side doors on one side of the vehicle have been opened for 20 sec.

D. Condensing units shall be capable of operating without damage with 130°F air over the condenser. The capacity of the units may be reduced under this condition by use of modulating valves or other approved means. Full capacity shall be automatically regained at or before the temperature falls to 115°F.

E. The cooling circuit shall be capable of operating without damage when ambient air is 40°F.

18.3.2 Summer Load Conditions

The cooling circuit shall be designed and sized for the maximum air flow and heat gain of the following conditions:

A. Outside:

	Surface	Tunnel
1. Dry bulb temperature	97°F	105°F
2. Wet bulb temperature	71°F	76°F
3. Solar radiation, north latitude	34°N	N/A
4. Air over condenser	105°F	115°F
5. Track surface temperature	120°F	105°F
6. Average effective wind velocity moving (wind plus vehicle velocities)	40 mi/hr	30 mi/hr
7. Wind velocity at standstill	10 mi/hr	N/A

B. Interior:

1. Dry bulb temperature of 77°F and not more than 60 percent relative humidity

2. Occupant load of 180 persons releasing an average of 450 Btu/hr per person with a sensible heat ratio of 0.51

3. Heat transfer rate of 800 Btu/hr/°F through the vehicle body

4. Allowances for lighting, equipment, and duct losses

5. Air temperature of not less than 55°F leaving the evaporator coil, at the above design conditions.

18.3.3 Winter Load Conditions

The heating circuit shall be designed and sized for the maximum heat loss of the following conditions:

A. Outside:

1. Dry bulb temperature of 36°F

2. No solar heat load

3. Average effective wind velocity of 40 mi/hr when moving

4. Wind velocity of 10 mi/hr when at standstill.

B. Interior:

1. Dry bulb temperature of 66°F

2. No occupant load

3. Heat transfer rate of 800 Btu/hr/°F through the vehicle body

4. Cab defogger not operating.

18.4 VENTILATION

Air movement shall be accomplished by resiliently mounted ventilation fans. Outside air shall be drawn into the vehicle from openings in the roof or sides of each vehicle. The outside air from each opening shall pass through a duct to a mixing plenum on the upstream side of each fan-evaporator unit. Return air shall be drawn from the ceiling area into the mixing plenum to mix with outside air. The mixed air shall pass through filters before entering either the fans or the evaporator coil.

18.5 FILTERS

18.5.1 Filters

Filters shall have an average weight arrestance of 90 percent and an efficiency of 25 to 30 percent when tested in accordance with ASHRAE Standard 52. Filters shall be Class I UL rated, disposable-industrial type, in sizes commercially available, and with a minimum thickness of 2 in.

18.5.2 Dirty Filter Check

Gauge ports shall be provided for attaching portable differential pressure gauges to check the pressure drop across the filter. Ports shall be accessible from the passenger area.

18.6 DUCTING, DIFFUSERS, AND GRILLES

18.6.1 Ducting

A. Ducting shall be fabricated from fire-resistant materials.

B. Air velocity in ducts shall not exceed 1,000 ft/min.

C. Ducts for outside air shall exclude entrance of water.

D. Supply-air ducting shall be insulated with at least 1 in. of fiberglass with a vapor barrier on surfaces exposed to unconditioned air.

E. Flexible ducts shall be used wherever there is relative motion between operating elements.

F. Ducting shall be designed to prevent noise transmission from the fan to the passenger area.

G. Mixing plenums shall mix the outside air and return air and provide proper air flow through the filters to the fan or evaporator coil.

H. Access doors or easily removable flexible connections shall be provided for cleaning evaporators, filters, and heaters.

18.6.2 Diffusers

Diffusers shall distribute air evenly and quietly throughout the vehicle. Diffuser finish shall aesthetically blend with the vehicle interior.

A. Diffusers in the passenger area shall be nonadjustable types.

B. The operator cab shall be provided with two spot-cooler-type diffusers to permit the train operator to adjust both the air stream direction and volume.

18.6.3 Grilles

A. Outside-air inlet grilles shall allow the induction of outside air into the subsystem while precluding entry of airborne objects which may cause damage. The grilles shall aesthetically blend with the carbody.

B. Return-air grilles shall allow the induction of return air into the subsystem at an entrance velocity of less than 500 ft/min. The grille finish shall aesthetically blend with vehicle interior. Grilles shall prevent the accumulation of dirt and prevent airborne litter from entering the ducts. Grilles shall be hinged, have safety catches, and have tamperproof fasteners.

18.7 HEATING

18.7.1 General

Heating shall be by electric resistance heaters operating in at least three stages.

18.7.2 Heater Protection

A. A fused disconnect shall be provided in the power supply.

B. Heaters shall be electrically interlocked with the ventilation fan to preclude heater operation unless the fan is in operation.

C. Overtemperature protection provided shall include:

1. Air flow sensing devices to cause the heater contactors (Reference: Section 13) to open when the air flow falls below a safe minimum

2. Thermostats located near the heaters to cause the heater contactors and the circuit breakers to open upon detection of higher than normal temperatures

3. Fusible links in the power supplies. Links shall melt and open the circuit before hazardous temperatures are reached. Fusible links shall melt at a temperature higher than the thermostat setting.

18.8 COOLING

Each vehicle shall be cooled by electromechanical, simple vapor-cycle equipment. Refrigerant 22 or approved equivalent shall be used.

18.8.1 Condensing Units

A. Compressors shall be equipped for unloading, in steps, from full to at least one-half capacity, and designed for year-round operation.

1. Motors may be either single-speed or variable-speed to accommodate variable loading requirements.

2. Motors shall be interlocked to prevent starting the compressor when there is no air flow through its associated fan-evaporator unit.

B. Condenser coils shall be copper refrigerant tubes with copper fins mechanically bonded to the tubes. No more than 8 fins/in. shall be permitted.

1. The coil housing shall have access doors to allow for cleaning of the entire coil surface.

2. The tube sheets and coil casing shall be stainless steel or ASTM B194 copper alloy.

C. Refrigerant receiver shall have sufficient capacity to hold 125 percent of the refrigerant in the subsystem. The receiver shall be designed and fabricated to the ASME Boiler and Pressure Vessel Code. The receiver shall have a gauge valve, two sight glasses with floating-ball indicators, and inlet and outlet breakaway shutoff valves.

18.8.2 Fan-evaporator Units

A. Evaporator coils shall be copper refrigerant tubes with copper fins mechanically bonded to the tubes. No more than 10 fins/in. shall be permitted.

1. Coils shall be sized to handle the required air volume at a face velocity low enough to prevent carryover of condensed water into the air stream.

2. The casing shall be stainless steel or ASTM B194 copper alloy.

B. Expansion valves shall be nonadjustable type.

C. Evaporator coil drain pans shall be stainless steel. The pans shall collect and drain condensation without blow-by, spillage, or sweating. Two drain line connections per pan shall be provided. The connections shall be on opposite sides of the vehicle.

D. Fan wheels shall be welded to their hubs. Fan-motor units shall be balanced.

18.8.3 Piping

A. Refrigerant and drain piping shall be approved Type K copper tubing. Tubing shall be preformed where possible, and shall be assembled with the minimum number of fittings practical.

B. Piping shall be supported no more than 4 in. from joints, fittings, valves, and bends of 30 degrees or more. Supports shall be spaced no more than 30 in. apart on straight pipe runs.

C. Fittings shall be refrigeration-grade, wrought copper, and shall be located at identical positions in each vehicle.

D. Suction lines and, when above vehicle floor level, drain lines shall be insulated with 0.5-in.-thick, closed-cell foam tubing ($k = 0.26$ Btu-in./hr/ft^2/°F at 75°F).

E. Condensate drain lines shall be 0.75-in. (or larger) nominal diameter pipe.

18.8.4 Service Components

A. A service box shall house safety pressure switches, a test switch, manually operated valves, and connections for portable test gauges. The box shall be weatherproof, mounted near each condensing unit, and readily accessible from the side of the vehicle.

B. Service valves shall be provided in liquid lines to prevent loss of refrigerant when replacing major components, in the compressor discharge and suction lines to isolate the compressor for maintenance, and on both sides of filter/dryers for use when replacing cartridges.

C. Solenoid valves shall be provided for pumpdown.

D. Valves for high-side charging shall be provided.

E. High- and low-side gauge connections shall be self-sealing type with chained seal cap.

F. Filter/dryers with replaceable cartridges and with combination sight flow and moisture indicators shall be provided in liquid lines.

G. High- and low-pressure cutout switches and modulation pressure switches shall be provided.

18.9 TEMPERATURE AND SUBSYSTEM CONTROL

18.9.1 General

A. Components shall be removable and be of industrial quality. Electrical contactors, relays, and panelboards shall be protected from dirt, dust, and moisture. Devices, components, and equipment shall be located to facilitate inspection, maintenance, and replacement.

B. Components requiring operational adjustment shall not be used, where possible.

C. Electronic control assemblies shall be plug-in units. Plug-in units shall be keyed to prevent interchange of unlike units.

18.9.2 Temperature Sensors

One set of temperature sensors per vehicle shall control the subsystem. Temperature sensors shall be solid-state devices located where they are not unduly influenced by local heat sources, solar load, and outside air.

18.9.3 Control Power, Actuation, and Annunciation

The HVAC subsystem shall be automatically activated throughout a train when an Operator Console is energized, and shall be automatically deactivated when the Operator Console is deenergized (Reference: Section 9). Manual deactivation of the subsystem from the energized cab shall be trainlined.

18.9.4 Control Box

A control box shall be provided under the vehicle to house a local control panel and components, including

contactors for heaters and motors, control relays, trainline relays, timers, programmers, indicator lights, a MANUAL - OFF - AUTOMATIC switch for subsystem maintenance, and connectors for DTE. Controls for each condensing unit and fan-evaporator unit of a vehicle shall be separated physically, mechanically, and electrically within the control panel. The control box shall be accessible from a side of the vehicle.

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SECTION 19

SYSTEMS ASSURANCE PROGRAM

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SYSTEMS ASSURANCE PROGRAM

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SECTION 19

SYSTEMS ASSURANCE PROGRAM

19.1 GENERAL

This Section specifies the requirements of a Systems Assurance Program encompassing system safety, reliability, maintainability, and quality assurance to be applied to all suppliers, subcontractors, and phases of the Work, including in-service support, warranty, retrofits, and field modifications. If approved on a case-by-case basis, existing analyses, studies, and test results may be substituted for the analyses, studies, and tests specified. Substitution shall be subject to approval.

19.1.1 Cited References

Organization	Number	Title
CAC	Title 8	Occupational Safety and Health Administration
IEEE	730	Software Quality Assurance Plans
SCRTD	5-001	Guidelines for the Preparation of Safety and System Assurance Analyses

19.1.2 Systems Assurance Program Plan (CDRL)

A Systems Assurance Program Plan (SAPP) shall be established, maintained, and submitted for approval. The SAPP shall include, individually or collectively, plans for the following disciplines:

A. System Safety

B. Reliability

C. Maintainability

D. Quality Assurance.

19.1.3 Systems Assurance Approach

The system safety, reliability, maintainability, and quality assurance (QA) activities require:

A. Thorough planning and effective management

B. Definition of the major safety, reliability, maintainability, and QA tasks and their place as an integral part of the design and manufacturing process

C. Evaluation of hardware and software safety, reliability, maintainability, and quality, through analysis, test, review, and assessment

D. Timely status indication, by formal documentation and other reporting, to assist in the implementation of the safety, reliability, maintainability, and QA efforts

E. Compatible requirements among manufacturing, test, and operational facilities

F. Implementation of quality controls to adequately verify compliance with the requirements of the Contract Documents.

19.1.4 General Systems Assurance Program Objectives

The objectives of the Program are to ensure that:

A. Hazards are identified and resolved

B. Critical/catastrophic failures are identified and resolved, and reliability requirements specified are achieved

C. Vehicles, subsystems, and components are maintainable, and maintainability requirements specified are achieved

D. Quality controls are implemented and compliance with the requirements herein is verified.

19.1.5 General Systems Assurance Program Plan Requirements

The SAPP shall identify the activities, organization, and means of implementing each discipline. The SAPP shall address the following in the plan for each discipline, as applicable:

A. Program objectives

B. Program organization, including the authority, duties, qualifications, and responsibilities of personnel

C. Interfaces, including the lines of authority and relationship of each program with the Management Program (Reference: Section 20), subcontractors, suppliers, each other program specified herein, design, component selection, procurement, manufacture, assembly, installation, testing, logistics planning, other elements of the organization, in-service support, and warranty-related support

D. Tasks and procedures needed to establish the program:

1. Translation of these Technical Provisions into detailed design (where required), including evaluating the resultant design and proposed engineering changes

2. Analyses and predictions

3. Subcontractor and supplier evaluation, selection, and control

4. Tests, inspections, and verifications

5. Methods of identifying, evaluating, reporting, and correcting deficiencies

6. Audits, design reviews, and program documentation.

E. Program schedule, which includes identification of milestones, submittal schedules for analyses, major inspections, tests, and audits

F. Logistic considerations, including activity sites and facilities.

19.1.6 Program Management and Documentation

Each discipline shall be managed to ensure that the Program objectives are attained. The following shall be accomplished as a minimum:

A. Support design reviews with documentation and with personnel cognizant of relevant design issues.

B. Submit status reports in an approved format as a part of the Monthly Progress Reports (Reference: Section 20). Provide an accounting of progress, results, problem areas, actions proposed or being taken to resolve problems, and the overall status of the Systems Assurance Program. Define

significant work planned, work accomplished, and planned activities for the next reporting period.

C. Document incidents and failures that occur during acceptance and subsequent tests. Where required, submit reports in accordance with District procedures.

D. Maintain and submit action item lists resulting from design reviews, and lists of open or unresolved issues. (CDRL)

E. Perform scheduled and unscheduled systems assurance audits on the design, manufacturing, inspection, and test programs, including subcontractors and suppliers. Submit audit reports. (CDRL)

F. Follow up of any unscheduled audits which the District has conducted.

G. Maintain documentation and records from the Systems Assurance Program. Provide to the District on request.

19.1.7 Design Reviews

Systems assurance elements in design reviews shall include the following as a minimum:

A. System safety, reliability, maintainability, and QA requirements

B. Pertinent analyses, as defined herein

C. Trade-off studies and recommendations

D. Action items resulting from design review comments

E. Design review checklists, action item lists, and lists of open or unresolved issues

F. Audit reports.

19.1.8 System Safety Program, Reliability Program, and Maintainability Program General Requirements

The program plans for system safety, reliability, and maintainability shall include--in matrix form or equivalent format--the title of each task to be covered as part of each program with the following information about each task:

A. Other program plans involved

B. Organizations involved in the execution of each task

C. Program procedures and instructions that describe how each task is performed

D. Start and completion schedule of each task, including program schedule or milestone which the task supports

E. Output products of each task, including identification of deliverable and date.

19.2 SYSTEM SAFETY PROGRAM

Design vehicles, subsystems, components, and parts so that no single failure can result in an unsafe condition.

19.2.1 General

A. The System Safety Program Plan shall describe how the identification, elimination, and/or control of hazards, which could lead to injury, loss of life, or damage to equipment, will be achieved.

B. Work performed on District property shall comply with CAC Title 8.

19.2.2 Hazard Analyses and Critical/Catastrophic Item List (CDRL)

A. Prepare analyses of hazards to identify and ensure resolution of hazards. Identify and classify hazards in accordance with SCRTD 5-001, or approved equivalent. The following analyses shall be prepared and submitted:

1. Subsystem Hazard Analysis

2. Interface Hazard Analysis

3. Operating Hazard Analysis.

B. Compile critical/catastrophic items identified as a result of hazard analyses, Failure Mode, Effects, and Criticality Analysis (FMECA), or by other means into a Critical/Catastrophic Item List. Information provided shall be in accordance with SCRTD 5-001, or approved equivalent.

19.3 RELIABILITY PROGRAM

19.3.1 General

Describe the relationships of reliability activities with other systems assurance activities.

19.3.2 Quantitative Requirements

Reliability requirements stated in mean time between failure (MTBF) and mean miles between failure (MMBF) are established below. Approved trade-offs among major subsystems may be made as long as the dependent pair MTBF is attained. Support trade-offs by analyses and/or tests. If required, expand categories of major subsystems in an approved manner to include all equipment in the reliability analyses. Conversion from MTBF to MMBF shall be made using an average speed of 30 mi/hr, unless otherwise approved.

A. Dependent pairs shall have a MTBF of not less than 150 hr.

B. Major subsystems, except the ATO subsystem, on each vehicle shall have a MMBF of not less than the following:

	MMBF
1. Carbody (Reference: Section 7) and Outfittings and Furnishings (Reference: Section 8):	75,000
2. Side Door (Reference: Section 10) including door controls and interlocks:	75,000
3. Trucks and Suspension (Reference: Section 11) and truck-mounted equipment except friction brake and propulsion equipment:	300,000
4. Couplers and Draft Gear (Reference: Section 12):	450,000
5. Power Supply and Electrical Equipment (Reference: Section 13) including	

	Operator Cab equipment (Reference: Section 9):	150,000
6.	Propulsion Subsystem (Reference: Section 14):	24,000
7.	Friction Brake Subsystem (Reference: Section 15):	69,000
8.	Communications Subsystem (Reference: Section 17):	150,000
9.	HVAC Subsystem (Reference: Section 18):	180,000

C. The ATO subsystem (Reference: Section 16) shall have a MTBF of not less than 9,300 hr. Station and wayside equipment MTBF calculations shall be based on 24 hr/day, 365 day/yr operation.

19.3.3 Reliability Analyses (CDRL)

A. Identify the reliability allocation of vehicle components in a reliability block diagram and system apportionment. Use the block diagram for reliability prediction, reliability allocation, and criticality study. The format shall include:

1. Title containing kind or type of operation, mode of operation, and identification of the item under consideration

2. Statement of characteristics

3. Description of operation

4. Statement of conditions

5. Reliability allocation

6. Diagram blocks.

B. Identify single-point failures in Single-Point Failure Summaries. Format shall be approved.

C. Provide a FMECA prepared in accordance with SCRTD 5-001, or approved equivalent. Evaluate each potential failure to determine its effect on the vehicle, subsystem, assembly, and component operation, and rank as to its criticality. Provide for the design improvements and corrective actions required to either eliminate the causes or reduce risks to an acceptable level. 5 5

D. Reliability of microprocessor software shall be predicted from previous experience with similar software in rail transit revenue service, or by a reliability evaluation methodology based upon the number of errors detected in each phase of the software development cycle. The improvement in operational reliability provided by fault tolerance features shall be quantified.

19.3.4 Reliability Demonstration Plan (CDRL)

Reliability demonstration testing shall be as specified (Reference: Section 21). The Reliability Demonstration Plan shall include:

A. Demonstration test schedule. Identify facility and resource needs, support equipment, and coordination with the District

B. Description of major requirements relative to the tests, test philosophy and policy, technical data, spare/repair parts, and support equipment

C. Test planning, administration, and control

D. Description of recommended pass/fail criteria, demonstration test methods, preparation of facilities, and acquisition of support requirements

E. Identification of test environment that must be maintained during testing

F. Method of any necessary reliability simulation, including type and format of data requirements, data collection, data reduction, and data analyses

G. Detailed test procedures

H. Recommended pass/fail decision criteria that can be quantitatively measured and that can be quantified to the specified parameters

I. Requirements for preparation of a final test report covering reliability demonstration test results and supporting data.

19.4 MAINTAINABILITY PROGRAM

19.4.1 General

Describe the relationships among maintenance activities and maintainability requirements.

19.4.2 Quantitative Requirements

Maintainability requirements stated in maximum baseline time to repair (MAXMBTTR) are established below. The MAXMBTTR values represent the 90th percentile of the distribution of baseline time to repair, in hr, for major subsystems on each vehicle. Analyses shall show that the MAXMBTTR values are equaled or bettered.

		MAXMBTTR (hr)
A.	Carbody (Reference: Section 7) and Outfittings and Furnishings (Reference: Section 8):	3.5
B.	Side Door (Reference: Section 10) including door controls and interlocks:	1.7
C.	Trucks and Suspension (Reference: Section 11), and truck-mounted equipment except friction braking and propulsion equipment:	4.4
D.	Couplers and Draft Gear (Reference: Section 12):	6.2
E.	Power Supply and Electrical Equipment (Reference: Section 13) including operator cab equipment (Reference: Section 9):	3.9
F.	Propulsion Subsystem (Reference: Section 14):	4.6
G.	Friction Brake Subsystem (Reference: Section 15):	5.2
H.	ATO (Reference: Section 16):	3.5
I.	Communications (Reference: Section 17):	5.7
J.	HVAC Subsystem (Reference: Section 18):	3.9

K. Secondary Maintenance - repair of printed circuit boards, modules or assemblies. 2.7

19.4.3 Maintainability Demonstration Plan (CDRL)

Maintainability demonstration testing shall be as specified (Reference: Section 21). The Maintainability Demonstration Plan shall include:

A. Demonstration test schedule. Identify facility and resource needs, personnel selection, support equipment, and coordination with the District.

B. Description of the major requirements relative to tests, maintenance concepts and policies, technical data, spare/repair parts, and support equipment.

C. Test planning, administration, and control.

D. Description of recommended demonstration methods, corrective- and preventive-task selection, personnel training, preparation of facilities, and acquisition of support requirements.

E. Methods of task simulation, including type and format of data requirements, data collection, data reduction, and data analyses.

F. Proposed selection of representative tasks (corrective- and preventive-maintenance tasks) that constitute the maintainability demonstration sample. For purposes of maintainability demonstration, a task is defined as all necessary steps (i.e., troubleshooting, disassembling, removing, replacing, repairing, and verifying) that constitute one sample demonstration task.

G. Detailed test procedures.

H. Recommended pass/fail decision criteria for the demonstration test that can be quantitatively measured.

I. Requirements for preparation of a final test report covering demonstration test results and supporting data.

19.4.4 Maintainability Analyses (CDRL)

The Maintainability Analyses shall:

A. Allocate quantitative maintainability requirements to significant functional levels of the vehicle, subsystems, and equipment.

B. Provide predictions to determine the adequacy of the design to meet maintainability quantitative requirements.

C. Provide predictions to identify design features requiring corrective action during early stages of design and development.

D. Using the FMECA, identify significant corrective maintenance tasks to be performed on the system. Significant tasks are those identified as catastrophic or critical in the FMECA. A summary of critical and common failure modes shall be submitted in accordance with SCRTD 5-001, or approved equivalent.

E. Provide Corrective Maintenance Analyses and Preventive Maintenance Schedules prepared in accordance with SCRTD 5-001, or approved equivalent.

19.5 QUALITY ASSURANCE PROGRAM

19.5.1 General

A. Base the total QA concept on the principle that quality is a basic responsibility of each segment of the organization and shall be evidenced by:

1. Producible and inspectable designs

2. Established specifications for procurement and job performance

3. Established procedures for transmission of data and information to subcontractors, and assurance of subcontractor compliance with the procedures

4. Adequate inspection and testing programs for manufacturing and installation activities to ensure repetitive product conformity to design requirements

5. Program surveillance, with configuration control and verification of physical conformance of equipment manufactured and installed under the Contract.

B. Apply QA to all activities related to quality of items, including designing, purchasing, inspecting, handling, assembling, fabricating, testing, storing, shipping, installation, and warranty repair/rework.

19.5.2 Program Implementation

Provide and maintain the QA Program to regulate methods, procedures, and processes.

A. Clearly define the QA organization. QA personnel shall have sufficient, well-defined responsibility and organizational freedom to identify and evaluate quality problems; to initiate, recommend, or provide solutions; to verify implementation of solutions; and to control further processing, delivery, or installation of a nonconforming item until proper disposition has been obtained. Quality shall not be compromised for schedule or cost purposes. QA management personnel shall have direct contact with Contractor's Management at a level where appropriate action can be obtained. Responsibility for the QA program shall be set forth on the Contractor's policy and organization chart.

B. Prepare and submit for approval written QA procedures. (CDRL) Include, as a minimum, control of subcontractors; receiving, first article, in-process, and final inspection; production and process control; functional test; control of nonconformances; corrective action; calibration and certification of measuring and test equipment; drawing and configuration control; QA records; shipping inspection; and other quality activities necessary to ensure compliance with requirements.

C. For microprocessor-based equipment, a software QA plan shall be prepared based upon IEEE 730 unless otherwise approved. (CDRL)

19.5.3 Certificates of Compliance

When approved, certificates of compliance for certain equipment or materials and products may be accepted in lieu of the specified sampling and testing procedures. Maintain certificates required for demonstrating proof of compliance. As a minimum:

A. Include the heat, batch, lot, or serial number of the equipment or material represented to provide traceability

B. Have each certificate signed by an authorized representative of the Contractor or supplier

C. Include certified documentation of test results or state that such test results are on file and will be furnished to the District on request. Include information specified for samples, the name and address of the organization performing the tests, the date of the tests, and the quantity of equipment or materials represented with the documentation of test results.

19.5.4 Calibration/Certification of Measuring Equipment and Tools

Establish and maintain an effective time- or usage-cycled calibration/certification program. Ensure validity of measurements and tests through the use of suitable inspection, measurement, and test equipment of the range and type necessary to determine conformance of items with requirements.

A. At intervals established to ensure continued validity, verify or calibrate measuring devices against certified standards that have a known traceable relationship to the National Bureau of Standards. Include tooling and fixtures used as media of inspection in this program. Every device so verified shall bear an indication attesting to the current status and showing the date (or other basis) on which inspection or recalibration is next required.

B. Promptly recalibrate devices suspected of being out of calibration before the stated recalibration date. Promptly reinspect items on which inspections have been performed with devices proven to be out of calibration.

C. Record calibration certifications and include in QA records.

19.5.5 Quality Assurance Records

Maintain adequate records in a retrievable manner to provide documented evidence of quality and accountability. Include results of inspections and tests, process controls, certification of processes and

personnel, nonconforming materials (including records of disposition), and other quality requirements defined in the Contract. As a minimum, indicate on inspection records the inspection instructions reference, nature of the observation, the number of observations made, the number and types of nonconformances found, and the specified requirements. Indicate on inspection records the acceptability of work or products and any action taken in connection with the correction or disposition of nonconformances. Test records shall include information specified (Reference: Section 21).

19.5.6 Verification

The QA operations of the Contractor and suppliers will be subject to District verification at any time. The verification will include surveillance of the operations to determine that practices, methods, and procedures of the QA program are being properly applied; inspection to measure quality of items to be offered for acceptance; inspection of items awaiting release for shipment; and audits to ensure compliance.

19.5.7 Qualification and Certification of Personnel

QA personnel performing inspections and tests shall be qualified for such work by virtue of those skills that are obtained by experience or training. Manufacturing personnel performing special processes, such as welding and brazing, shall be certified to acceptable standards for such work.

A. Develop a procedure that encompasses the certification and qualification of such personnel, based upon experience, indoctrination, training, testing, and evaluation of performance. Establish minimum data requirements for certification records in the procedure.

B. The records of personnel certifications shall be maintained and monitored by QA personnel. Records shall be available for review upon request.

19.5.8 Special Processes

Perform processes such as heat treating, welding, plating, and nondestructive testing, by personnel certified to acceptable standards and in accordance with approved documented procedures.

19.5.9 Procurement Quality Assurance

Describe the methods to be used for the selection and control of procurement sources (suppliers) and include a description of the following in a procedure that outlines:

A. Selection of qualified suppliers

B. Evaluation and assessment of each supplier's QA system

C. Method of transmitting design and quality requirements to suppliers

D. Method of transmitting authorization to suppliers to implement product improvements or changes to design, quality, and test requirements

E. Inspections and tests that verify the procured items meet subcontract or purchase order requirements and specifications

F. Method of evaluating inspection and test results

G. Method of monitoring supplier's quality performance (utilize source inspection and auditing techniques)

H. Method of obtaining early and effective information feedback from the supplier

I. Corrective action and material review activities

J. Maintenance of inspection records, certificates, and corrective action documentation.

19.5.10 Inspection and Test

A. Inspect and physically or functionally test all items to be delivered (Reference: General Provisions and Section 21). Provide for reporting nonconformances or questionable conditions to the District in the inspection and test instructions.

1. Requests by the Contractor for District attendance at inspections and tests shall be in writing or by telephone notification followed by written confirmation a minimum of 10 days prior to the event. (CDRL) Except as otherwise agreed, inspections and tests to be witnessed by the District shall be performed during regular business hours. If, after proper

notification, the District does not attend the inspection or test, Contractor may proceed with the inspection or test as scheduled.

2. Certificates of compliance or formal test reports shall accompany shipments when required.

B. Inspection shall occur at appropriate points in the manufacturing and installation sequence to ensure compliance with drawings, test specifications, process specifications, and quality standards. The District may designate inspection hold points in the manufacturing, installation, and inspection planning.

C. Perform and document in-process tests, including tests of raw materials.

1. Tests shall provide a measure of overall quality of the product. Perform tests so that end product use and function are simulated to a sufficient degree. When modifications, repairs, or replacements are required, reinspect or retest the affected characteristics.

2. Submit test results as specified (Reference: Section 21).

19.5.11 Receiving Inspection

Inspect incoming materials to preclude the use of nonconforming materials. Ensure that only correct and accepted items are used and installed. Retain material certifications and test reports used as the basis for acceptance. Identify items at each stage of production to an applicable drawing, specification, or other pertinent technical document. Use permanent physical identification to the maximum extent possible.

19.5.12 Production Operation

Ensure that machining, wiring, batching, shaping, and other basic production operations, together with processing, fabricating, and installing are accomplished under controlled conditions.

A. Controlled conditions include documented work instructions, inspection instructions, adequate production and inspection equipment, and necessary special working environments.

B. Use documented work instructions as the criteria for production, process, and fabrication work. Effectively monitor the issuance of, and compliance with, these instructions.

C. Use quality inspection procedures where applicable. Accomplish physical examinations, measurements, or tests of the equipment, materials, or products processed in a suitable systematic manner subject to District audit and surveillance.

D. Take corrective action when nonconformance occurs.

E. Provide inspection pass/fail criteria for approval. (CDRL)

19.5.13 Shipping Inspection

Provide and enforce procedures for the inspection of deliverable products to ensure completion and conformance prior to shipment. Assure shipments are prepared as required to preclude damage during shipment. Verify inspection and preparation for shipment by QA personnel. Documented District authorization to ship shall be obtained prior to shipment.

19.5.14 Final Inspection

Final inspection shall be based upon completion of inspections and/or tests, as appropriate. Verification of final inspections and tests will be subject to review by District personnel.

19.5.15 Statistical Sampling Plan (CDRL)

A Statistical Sampling Plan for inspection shall be documented and approved. The Plan shall be based upon generally recognized and accepted statistical practices. The quality levels, selected from the Plan, shall ensure cost effective verification of conformance.

19.5.16 Changes to Drawings and Specifications

Ensure that inspections and acceptance tests are based upon the latest revision or change to drawings and specifications. Maintain a procedure that ensures adequacy, completeness, and currentness of drawings, and the control of changes (Reference: Section 20). Ensure that requirements for the effectivity point of changes are met and that obsolete drawings and change documents are promptly removed from all points of issue and use. Employ a means of recording the effectivity points.

Provide procedures for evaluation of the design and for determining the adequacy of proposed changes to drawings and specifications. Ensure that there is complete compliance with requirements for proposing, approving, and effecting engineering changes. The responsibility for drawings and changes shall extend to the drawings and changes provided by the suppliers.

19.5.17 Identification of Inspection Status

Maintain a system for identifying the inspection status of equipment, materials, components, subassemblies, and assemblies as to their acceptance, rejection, or non-inspection. Ensure that required inspections and tests are performed, and that the status of items with regard to inspections and test performance is known throughout manufacturing, installation, and test. Identify nonconforming items by physical segregation and status indicators (e.g., tags, serialization, markings, stamps, and inspection records). Ensure that only items that have passed the required inspections and tests are used or installed.

19.5.18 Identification and Control of Items

A. Identify production items, including raw materials (batch, lot, component, part), from the initial receipt and fabrication up to and including installation and use. Relate each item to an applicable design or other pertinent specifying document. Use physical identification to the maximum extent possible.

B. When used, apply identification markings using materials and methods that provide a clear and legible identification and do not detrimentally affect the function or service life of the item. Transfer markings to each part of an identified item when subdivided. Markings shall not be obliterated or hidden by surface treatment or coatings, unless other means of identification are substituted.

C. When specified by codes, standards, or specifications that include specific identification or traceability requirements (i.e., identification or traceability of the item to applicable specification and grade of material; heat, batch, lot, part, or serial number; or specified inspection, test, or other records), design the QA program to provide such identification and traceability control.

D. Where specified, identify and control items having limited calendar or operating life or cycles to preclude use of items whose shelf life or operating life has expired.

19.5.19 Handling, Storage, and Delivery

Provide for adequate work, surveillance, and inspection instructions for handling, storing, preserving, packaging, packing, marking, and shipping to protect the quality of products, as required.

19.5.20 Corrective Action

Establish, implement, and maintain procedures to ensure that conditions adverse to quality (such as failures, malfunctions, deficiencies, deviations, and defects) in equipment and material are identified and corrected. Ensure that the cause of any such condition is determined and corrective action is taken to preclude repetition of such conditions. Document corrective action and related information and make available upon request. Extend corrective action to the performance of suppliers. Include, as a minimum:

A. Analysis of data and examination of nonconforming products to determine extent and causes

B. Introduction of required improvements and correction, initial and follow-up review of the adequacy of such measures, and monitoring of the effectiveness of corrective action taken

C. Analysis of trends in processes or performance of work to prevent nonconforming products.

19.5.21 Nonconformance

Establish, implement, and maintain an effective system for controlling nonconforming material, including procedures for its identification, segregation, and disposition. Repair or rework of nonconforming material shall be in accordance with documented procedures approved by the District. The acceptance of nonconforming supplies will be a prerogative of and shall be as prescribed by the District. All nonconforming supplies shall be positively identified to prevent unauthorized use.

19.5.22 Audits

Establish a comprehensive system of planned and periodic internal and external audits to verify compliance with, and to determine the effectiveness of the QA Program. Prepare an audit procedure with a preliminary audit schedule. (CDRL) Perform audits with qualified personnel having no direct responsibilities in the area audited. Document audit results and review with personnel responsible for the area audited. Follow-up action, including reaudit of deficient areas, shall be approved. Submit audit reports (CDRL) and follow-up action reports.

19.5.23 Defects in Materials or Work

If damage, defect, error, or inaccuracy is found in equipment, material, item, or part, the District will have the right to reject (with or without instructions as to disposition) or to require correction of the defective part (Reference: General Provisions).

19.5.24 First Production Dependent Pair

Each stage of production of the first dependent pair shall precede that of all other vehicles. In addition to other inspection and test rights, the District may inspect, test, or witness testing of each assembled and completed part of the first pair before similar work is undertaken on the remaining vehicles. Approval shall be received before production proceeds beyond District-designated inspection points. The remaining vehicles shall be produced in accordance with the approved first dependent pair. Effectivity point of change shall be the affected inspection point, unless approved. No changes shall be made on the approved first dependent pair without approval. Typical inspection points are listed below. Final inspection points will be determined during design reviews.

A. Shell: Floor, side walls, roof, F-end, R-end, structure without liners and insulation, carbody and underfloor watertightness tests, piping, wiring, insulation, side door operation (without side liners), HVAC (without liners), exterior lighting, interior lighting, and liners (without seats)

B. Underfloor equipment arrangement: Clearance and accessibility on track and above typical maintenance pit, clearance between coupler and truck (including hoses and wiring), and wayside clearance

C. Completed operator cab

D. Completed dependent pair, ready to run.

END OF SECTION

SECTION 20

MANAGEMENT PROGRAM

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MANAGEMENT PROGRAM

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SECTION 20

MANAGEMENT PROGRAM

20.1 GENERAL

This Section defines the management program required to provide a program of planning, scheduling, controlling, and reporting.

20.2 CONTRACT MANAGEMENT

20.2.1 Project Manager

A Project Manager shall be designated in accordance with the General Provisions. The Contractor's management structure shall enable the Project Manager to manage the Work of this Contract. Formal communication, including correspondence, submittals, or other exchanges affecting program cost, schedule, technical, administrative or other parameters shall be between the Project Manager and the District.

20.2.2 Management Plan (CDRL)

Submit a Management Plan. The plan shall be explicit in the areas of organization, controls, planning, and schedules as defined in this Section. The plan shall include, but not be limited to:

A. An organization chart, including a definition of the responsibilities of personnel thereon; all departments shall be included

B. The methods and communications to be employed to monitor, oversee, and control the program schedule, technical performance, program changes, subcontracts, materials procurement, in-service support, warranty, and systems assurance analyses, tests, and demonstrations

C. A master program schedule, with key milestones and events emphasized

D. A flow chart of project task scheduling that depicts integration of, and interactive information requirements among, all tasks

E. A schedule of items of design and manufacture which require approval, including documents and drawings

F. Data management

G. Document tree reflecting the hierarchy of documents and plans.

20.2.3 Progress Reviews and Reports

A. As a minimum, progress reviews shall be held on a quarterly basis. When reviews are directed, support the reviews with technical and management expertise as dictated by program issues. The reviews may be held at either the Contractor's or the District's facilities, as directed by the District.

B. Provide Monthly Progress Reports. (CDRL)

1. The reports shall be based upon actual progress in the planned areas and upon schedule status. Information provided shall include progress of scheduled activities of major procurements, subcontracts, labor, submittals, design releases and reviews, District review/approval items, and other activities which offer a potential impact to maintaining approved schedules. Problem areas and plans for the forthcoming period shall also be included.

2. Special reports may be requested, depending on problem areas.

20.2.4 Schedules and Project Control

A. Submit a Bar Chart Schedule (CDRL), in sufficient detail to show the proposed sequence for doing the Work. Six copies of the initial Bar Chart Schedule and a narrative describing the Contractor's approach for meeting the required interim milestone and final completion dates shall be submitted within 20 days after NTP. The Bar Chart Schedule shall use the NTP date as the data date. The District will provide comments or approval within 14 days. Upon receipt of comments, the Contractor shall confer with the District in the appraisal and evaluation of the proposed Schedule. The Schedule shall be revised as necessary and resubmitted for approval within 10 days. The approved Schedule shall be used by the Contractor for planning, scheduling, managing, and executing the Work.

B. The Bar Chart Schedule shall be submitted in the following format:

1. Salient work items required to complete the Work shall be identified. Work item descriptions shall be brief but shall convey the scope of work involved. Work items shall be discrete items of work that, when complete, produce definable, recognizable events or deliverables.

2. Work items shall include the submittal and approval of drawings and procedures, design reviews, procurement and fabrication activities, installation and testing, and delivery of District-furnished items. Constraints resulting from work of other parties that may affect progress shall be indicated.

3. Work items shall have durations of 30 working days or less. For items of longer duration, interim events at approximately 30-day intervals shall be provided for tracking progress.

4. The NTP date, interim project milestones (as specified in the Special Provisions), and the Project Completion Date shall be identified.

5. A time-scaled schedule (by week, ending Friday) shall be included.

6. A data dateline shall be included.

7. Title block, revision block, Contract number, and legend shall be included.

8. The order and interdependence of work items and the sequence in which work items are to be accomplished shall be identified. Constraints between items shall be indicated.

9. Scheduled dates for work items shall be consistent with the Contract milestone dates. Milestone events specified in the Special Provisions shall be prominently identified and connected to the appropriate activity. Each start milestone event shall constrain the start of dependent work items. All work items associated with a completion milestone event must be finished before that milestone event can occur. Failure to include any element of work required for performance of the Contract shall not excuse the Contractor from completing the work.

10. The Bar Chart Schedule shall be clear, neat, and legible and shall be submitted on sheets not to exceed 24 in. by 36 in. on a medium suitable for reproduction.

C. The initial Bar Chart Schedule submittal shall include a written narrative sufficient to explain the basis for the determination of the durations used in the Schedule. This narrative should indicate production rates, hours per shift, and other details for establishing the Schedule. The Contractor shall describe the approach for meeting the required interim milestone and final completion dates. For critical activities, discuss how actions such as use of overtime, increased personnel, and extra shifts can be utilized to expedite work if it falls behind schedule. Indicate any significant risks associated with the proposed Schedule.

D. At the end of each month following NTP, the Contractor shall submit six copies of the updated Bar Chart Schedule, showing status as of the last day of the pay period. Job progress information shall include:

1. Actual completion dates for items completed during the report period

2. Actual start dates of items started during the report period

3. Estimated remaining duration for items in progress

4. Estimated start dates for items scheduled to start in the following month

5. Changes in duration of work items and minor logic changes

6. Progress of any work items not included in the Bar Chart Schedule.

E. The Contractor shall update the Bar Chart Schedule in the following manner:

1. The initial Schedule, depicted as a solid bar, shall remain the same for each update.

2. Actual progress shall be shown in a different pattern directly under the solid bar, with percentage of completion indicated. Projected

completion shall be shown if different from scheduled completion.

3. Date of data shall be shown for each update.

4. Actual start and finish dates shall be shown.

5. The sequence to interim milestones or Contract completion shall be identified.

F. If the Monthly Progress Report indicates an actual or potential delay in meeting interim milestones or contract completion, the Contractor shall provide a narrative discussion of the problem. The narrative shall identify the problem, the cause, the work items affected, shall describe the Contractor's plan for corrective action, and shall indicate the expected results of such action.

G. Revised Bar Chart Schedule submittals shall be in the same format and detail as the initial submittal and shall include an explanation of the reasons for the revision. Revisions are subject to approval by the District. A revision shall incorporate any previously approved changes and shall reflect as-built and as-planned conditions. A revised Bar Chart Schedule shall be submitted when required by the District for one of the following reasons:

1. The District directs a change that affects a Contract milestone specified in the Special Provisions.

2. A change order significantly affects the Contract completion date or the sequence of work items.

3. The Contractor elects to change the sequence of work items from the approved sequence, or in a way which may affect its interface with other contractors.

4. The Contractor's progress on critical items falls significantly behind schedule.

H. Upon Contract completion, the Contractor shall submit six copies of an as-built Bar Chart Schedule which shall reflect as-built work items.

I. The Contractor shall use the currently approved Bar Chart Schedule for planning, organizing, and

directing its work, for reporting progress, and for determining delays in achieving milestone dates.

20.3 INITIAL ACTIVITIES MEETING

This meeting shall take place no later than 20 days after NTP at a location designated by the District for the purpose of introducing the District's personnel to the Contractor's management team. Formal channels of communication will be established and procedures for letter and meeting numbering, etc., will be agreed upon. Also during these meetings, the Contractor shall present the project control methodology and convey the plans for the initial activities prior to formal progress reporting. Meeting minutes reflecting agreement, plans, and open items will be distributed by the District.

20.4 MANUFACTURING PLAN (CDRL)

Prepare and submit a Manufacturing Plan. The plan shall be developed in concert with the QA requirements herein. The plan shall contain the following: Overall flow diagram displaying manufacturing sequences from receipt of subsupplier equipment to shipment to the District, description of activities at each work station, and description of final assembly site (if required) and work to be accomplished at this location.

20.5 INDUSTRIAL DESIGN

20.5.1 General

Industrial design principles shall be employed throughout the design and manufacturing processes. These principles shall include, as a minimum, person/equipment interfaces, passenger comfort, use of materials, color schemes, and graphics.

20.5.2 Design Review

Industrial design aspects of the vehicle shall be reviewed during the scheduled design review meetings. Special industrial design review meetings shall be held, as required, to settle issues in a timely manner.

20.5.3 Samples (CDRL)

Submit sample materials for approval during the design process. Samples shall be of a size commensurate with that portion of the vehicle being represented.

20.5.4 Presentations

Support the District's efforts in making presentations to others, and make presentations to the District, as required. Drawings and color renderings shall be submitted in support of these presentations. (CDRL)

20.5.5 Human Factors

Submit a report summarizing the human factors engineering considerations given to the passenger vehicle design. (CDRL) The report shall include the following:

A. Reasons a particular alternative was recommended

B. A description of the major assumptions made concerning human capabilities and limitations, including data ensuring that operator performance and passenger considerations have been addressed

C. The results of mock-ups or simulation programs to determine the requirements for design

D. The results to date of analyses performed to determine the requirements for specialized training and training equipment.

20.6 CONFIGURATION MANAGEMENT PROGRAM

20.6.1 Configuration Management Plan (CDRL)

Submit a Configuration Management Plan which illustrates how the requirements of this Section will be met.

20.6.2 General Requirements

Establish and maintain a Configuration Management Program encompassing system hardware, microprocessor software, and interfaces between subsystems.

A. Maintain accurate and current configuration records, which shall be made available upon request.

B. The Configuration Management Program shall be comprised of the elements of configuration identification, configuration control, configuration accountability, and design.

20.6.3 Configuration Identification

The technical documentation shall define the approved configuration of system equipment under production, test, installation, or operational use.

20.6.4 Release Records and Documentation

The release records and documentation shall provide the capability of identifying the following:

A. The composition of any part, component, subassembly, or assembly, at any level, in terms of subordinate part numbers

B. Next assembly part, component, subassembly, or assembly of any part

C. The specification documents, specification control drawings, or source control drawing numbers associated with any assemblies, government standard items, industry standard items, part numbers, and subcontractor items

D. Engineering changes and records of superseded configuration requirements affecting items that will be submitted for acceptance or that have been accepted by the District.

20.6.5 Drawing and Part Numbering

Include, as a separate section in the Configuration Management Plan, the primary drawing numbering system to be utilized, including the significance of characters. Nameplates on major equipment items shall provide space for District numbers to be added by the Contractor.

A. Assign discrete serial numbers in sequence for the model series of each type of equipment to be serialized

B. Submit a list of the items to be serialized and a description of the serialization method to be used. (CDRL)

20.6.6 Drawing List

Submit a drawing tree and list. (CDRL) The list shall provide space for tracking the submittal status of each drawing and shall provide a subsystem orientation of drawings arranged in a hierarchical format.

20.6.7 Production Baseline

For the purposes of change control, the production baseline shall be established at First Article Configuration Inspection (FACI). Changes beyond FACI shall be documented in the form of change requests and submitted for approval. A proposed change request form shall be submitted as part of the Configuration Management Plan. Control of designs prior to baselining shall be by design review activity, drawing revision, and document control.

20.6.8 Configuration Accountability

Maintain records such that the configuration of any item delivered or installed shall be identifiable in terms of its component part numbers. This system of accountability shall be included in the Configuration Management Plan and shall indicate the requirements for the control of vehicle and equipment modifications at District facilities or at facilities other than Contractor's plant areas.

20.6.9 Design and Configuration Review

Conduct the design and configuration reviews and audits specified herein.

A. General:

These reviews shall be conducted to evaluate the progress and technical adequacy of the design and compatibility with the performance requirements of the Contract. Prior to each review, submit a data package that includes the CDRL and other items required for the review. Minutes of review meetings will be distributed by the District.

B. Design Review Schedule: (CDRL)

Establish design review schedule. The initial schedule shall be tentative and shall be updated as necessary to provide minimum notice of 30 calendar days for each scheduled review. Schedule reviews to include the maximum amount of equipment practical in logical groupings.

C. Conceptual Design Review:

The CDR shall be held no later than 60 days after NTP.

1. The CDR shall:

   a. Identify the Contractor's management team

   b. Be conducted at or near District facilities

   c. Identify subcontractors

   d. Include design concepts for major systems hardware proposed by Contractor and subcontractors

   e. Acquaint the Contractor and subcontractors with operating procedures and philosophies of the District.

2. The District will review design approaches and information on the intended operations and maintenance environment.

3. The District will familiarize the Contractor with the District's reliability, maintainability, and safety approaches.

4. The data package for this review shall be prepared and shall include the Management Plan and initial subcontractor proposals. (CDRL)

D. Preliminary Design Review:

1. The PDR shall be conducted incrementally prior to detail design to evaluate the progress and technical adequacy of the selected design approach and its compatibility with the performance requirements and interfaces of the Contract. The review shall be conducted on mutually agreeable dates at the Contractor's facilities. Major subsuppliers shall be present.

2. Design data covering the vehicle and subsystems shall be submitted prior to the PDR. (CDRL) These data shall be to a level of detail consistent with the preliminary stages of design. Each data submittal shall contain, as a minimum, a subsystem functional description, interface description, applicable engineering calculations and schematic, layout and general arrangement drawings. Specific data requirements are as follows:

a. List of trainlines and proposed coupler pin arrangement

b. Side door obstruction detection

c. Recommended pressure setting for current collector

d. Heat load calculations for HVAC subsystem, including psychrometric charts for each control condition

e. Engineering calculations, computer print-outs, and other relevant data that verify that the propulsion and friction brake equipment meet the specified performance and thermal duty cycle

f. Propulsion motor characteristics showing speed, voltage, and tractive effort versus motor current

g. List of special tools for each subsystem

h. List of all person/machine interfaces in the operator cab area

i. Roll center location and list of carbody motion limits in relation to truck as follows:

- o Vertical
- o Lateral
- o Longitudinal
- o Roll, degrees.

j. Suspension characteristics as follows:

- o Manufacturer of air spring
- o Damping constant of each shock absorber
- o Natural frequency and spring rate of primary and secondary suspension.

k. Microprocessor documentation as follows:

- o Description of the software architecture and the software modules which, when combined, form the complete software architecture
- o Specifications for each of the software modules that define the module requirements
- o Description of the microprocessor hardware components and second sources of component supply
- o Description of the programming language to be used.

l. Coupler adapter design

m. Glass and windshield specifications.

E. Final Design Review:

1. The FDR shall be conducted incrementally when detail design of a subsystem is essentially complete and the production drawings are ready for release. The FDR shall determine that the detail design of the subsystem under review will satisfy the design requirements established herein and to establish the exact interface relationships between the subsystem and other items of equipment or facilities that are District furnished. The reviews shall be held on mutually agreeable dates at the Contractor's facility.

2. Data submitted for the PDR shall be updated to a level of detail consistent with essentially completed design and submitted for the FDR. (CDRL)

3. Microprocessor software documentation submitted for the FDR shall consist of:

   a. Pseudo code written in English language in a structured fashion

   b. Input data definitions

   c. Output data definitions

d. Completed algorithms expressed in pseudo code

e. Interrupt structure definition

f. Program parameters

g. Diagnostic routines

h. Error handling routines

i. Data dictionary

j. Main program and module level flowcharts.

4. Data in addition to that submitted for the PDR shall include, as a minimum:

a. Battery design and sizing calculations

b. Battery charge and discharge curves

c. Circuit breaker characteristics

d. LVPS efficiency curves

e. Fuse characteristics

5 f. DTE design and interface requirements. 5

F. Mock-up Review:

When each required mock-up is complete, a design review shall be held. The purpose of these reviews is to verify that the hardware represented in each mock-up meets the requirements, is safe and maintainable, and includes proper human factors engineering.

G. First Article Configuration Inspection:

1. FACI shall take place at the point of assembly, whether at the subcontractor's or Contractor's facility, after completion of acceptance tests on first production hardware.

2. The District shall be notified a minimum of 10 days prior to date of FACI. The Contractor will be advised regarding District attendance.

3. FACI shall verify that production hardware complies with production drawings as agreed upon during FDR.

4. Thirty days prior to each FACI, data that include the latest drawings, specifications, and quality documentation required for adequate checkout of the equipment under inspection, and an indenture list of drawings shall be submitted. The list of drawings shall be identified by revision and be complete to the LLRU. (CDRL)

20.6.10 Drawing Requirements

A. Drawings for review shall include the following: (CDRL)

1. Dynamic outline of the vehicle including current collectors and radio antenna. The outline shall reflect all possible suspension limits and wear conditions.

2. Underfloor arrangement drawings for A- and B-cars showing underfloor equipment locations and outlines, including plane of rail clearance.

3. Top-level drawings, assembly and major subassembly drawings, installation and arrangement drawings, industrial design interior and exterior drawings, and detailed drawings of major parts. The drawings shall include a parts list or bill of materials.

4. Single-line, control schematic, and functional block diagram drawings for each subsystem.

5. Electrical wiring diagram and schematic drawings for each electrical circuit.

6. Single-line piping and flow diagram drawings for each fluid circuit, showing valves, operators, and control components.

7. Interface control drawings showing interfaces with related subsystems.

8. Outline drawings of major equipment components showing:

a. Overall dimension, orientation, center of gravity, points of normal support, and method of support during mounting and removal

b. Location of access doors and covers showing the relation to equipment inside the enclosure

c. Required drawout space and space required to open access doors

d. Location and space requirements for ventilation intake and exhaust openings, and for cable and pipe entrances.

B. Drawings shall be dimensioned in US units (ft, in.). Electrical schematic drawings shall be drawn in accordance with IEEE standards and need not be shown with components physically oriented. Drawings, including as-built drawings, shall be suitable for half-size reduction. Half-size reductions shall be legible to a person with normal visual acuity.

C. Submit six copies of each drawing for review in orderly groups.

D. Drawings shall provide a space of at least 3 by 4 in. near the title block for use by the District.

E. The review of drawings shall neither be construed as permitting any departure from the Contract, nor as relieving the Contractor of the responsibility for any error, including details, dimensions, and materials.

F. Submit as-built reproducibles on Mylar, or approved equivalent.

20.6.11 Interface Management

Numerous interfaces exist within the system which must be controlled to assure that hardware functions as intended when integrated into the system at installation. Define, as part of the Configuration Management Plan, how interfaces are to be controlled. As a minimum, each interface parameter between subsystems, subsystem-to-system, and subsystem/system to externally supplied hardware, software, and services external to the design shall be identified and documented to allow the District and others involved in the interface to concur with the requirement. Interfaces shall be identified and reported separate from the Configuration Management Plan. An approved Interface Data Requirements form shall be used for interfaces internal to this Contract. (CDRL) (For external interface requirements, Reference: Article 4.2.)

20.7 WEIGHT CONTROL PROGRAM

Establish and maintain a comprehensive weight control program. The program shall provide for the review and control of design efforts in order to assure that the vehicles comply with the weight requirements (Reference: Special Provisions and Section 3).

20.7.1 General Requirements

As a minimum, the weight control program shall:

A. Set design weight goals for the following major subsystems:

1. Carbody (Reference: Section 7)
2. Operator Cab (Reference: Section 9)
3. Side Door Operators and Controls (Reference: Section 10)
4. Trucks and Suspension (Reference: Section 11)
5. Coupler and Draft Gear (Reference: Section 12)
6. Power Supply and Electrical Equipment (Reference: Section 13)
7. Propulsion (Reference: Section 14)
8. Friction Brake (Reference: Section 15)
9. ATO (Reference: Section 16)
10. Communications (Reference: Section 17)
11. HVAC (Reference: Section 18).

B. Provide for periodic review throughout the design and production phases

C. Communicate the requirements of the program to subcontractors

D. Provide for the utilization of adequate measuring devices and facilities

E. Include any program tasks that are deemed necessary.

20.7.2 Weight Statement

Provide a weight statement for A- and B-cars. (CDRL) The weight statement shall include major component and assembly weights and shall be organized by the major subsystems. A final weight statement shall be submitted that provides the actual weights for the as-built vehicle.

A. The weight statement shall be updated, as a minimum, on a quarterly basis and shall include the following points:

1. Subsystem original and revised design weight
2. Current subsystem weights
3. Vehicle original and revised design weight
4. Current vehicle weight
5. Any additional data necessary to communicate the current status of the weight control effort.

B. Weight statements shall highlight problem areas and suggest corrective actions.

20.7.3 Program Reviews

At each scheduled design review, submit a weight statement that has been updated to the applicable design status.

20.8 STRENGTH PROGRAM

Establish and maintain a comprehensive vehicle strength program.

20.8.1 General

The program shall provide for the review and control of the structural design efforts and for the dissemination of relevant information within the Contractor's organization, including subcontractors, to assure that the vehicles comply with the strength requirements. The strength and weight control programs are interdependent and shall be managed accordingly.

20.8.2 Submittals

Submit updated design and test documentation disclosing the current status of the vehicle design effort with regard to the strength, stiffness, and stress level requirements. (CDRL) Reports shall include the following information:

A. Design Loads: Design loads shall be indicated for structures and subsystems due to expected loading conditions.

B. Stress and Deflection Analyses: Design stresses and deflections and actual stresses and deflections resulting from design loads shall be determined and compared to requirements. Stress analysis shall be carried out on load-bearing members. Problem areas shall be highlighted and discussed.

C. Structural Design: Reduced size drawings, perspectives, sketches, and data related to the structural design shall be submitted for review. The following information shall be included as a minimum:

1. Types of materials

2. Material gauges and cross sections

3. Attachment methods

4. Dimensions and tolerances.

20.8.3 Program Reviews

At each scheduled design review, submit a strength program report updated to the applicable design status.

20.9 INFORMATION MANAGEMENT PROGRAM

20.9.1 Data Management

Prepare and maintain an information management program to assure that information required is identified and readily available.

A. Define the information management program in the Management Plan.

B. The program shall include a monthly status report on submittals required herein. (CDRL) The report shall include, as a minimum, identification of

transmittals, action due dates, and actual completions. In addition to CDRL items, this report shall include:

1. Financial information on Contract or production progress, cost information, or schedules

2. Technical information, conclusions, and recommendations developed on technical and engineering activities

3. Other data needed to develop, test, operate, maintain, repair, modify, support, or reprocure subsystems and equipment.

20.9.2 Vehicle History Books (CDRL)

A. At time of delivery, provide a vehicle history book for each vehicle. Each vehicle history book shall contain the following information:

1. Certified weight

2. Description of modifications and completion dates of incorporation

3. List of defects noted and the disposition of each

4. List of serially numbered apparatus

5. Provision for recording malfunctions, inspection, servicing, and major overhaul

6. Shipping documents

7. Summary detail of each test performed on the complete vehicle or on any part thereof

8. Wheel, journal bearing, and gear mounting records

9. List of repairs.

B. Submit, for inclusion in the vehicle history book, documentation recording changes made during the warranty period.

C. Maintain vehicle history books until vehicle is accepted, and then turn over history book with vehicle.

END OF SECTION

SECTION 21

TEST PROGRAM

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SECTION 21

TEST PROGRAM

21.1 GENERAL

This Section defines the requirements for acceptance, qualification, vehicle performance, integrated systems, systems demonstration, reliability demonstration, maintainability demonstration, and supplemental tests, including testing at the Transportation Test Center (TTC) near Pueblo, Colorado, and on District property.

21.1.1 Cited References

Organization	Number	Title
IEEE	11	IEEE Standard for Rotating Electrical Machinery for Rail and Road Vehicles
DOT/UMTA	MA-06-0025-75-14	General Vehicle Test Plan for Urban Rail Transit Cars
DOT/UMTA	MA-06-0153-85-5	Conducted Interference In Rapid Transit Signaling Systems
DOT/UMTA	MA-06-0153-85-8	Inductive Interference In Rapid Transit Signaling Systems
DOT/UMTA	MA-06-0153-85-11	Radiated Interference In Rapid Transit Signaling Systems

21.1.2 Functional Requirements

A. Factory acceptance tests shall demonstrate that the item performs as specified prior to shipment.

B. Qualification tests shall demonstrate that the product performs satisfactorily at design limits, confirms access points and redundant features, demonstrates design life, and verifies interfaces with the next higher level of assembly.

C. Clearance test shall demonstrate that the vehicle interfaces with District facilities and that further testing may proceed.

D. Vehicle performance tests shall verify that performance requirements are achieved when the vehicle is operating as a complete system.

E. Vehicle receiving tests shall verify that each vehicle has arrived undamaged and is safe to operate.

F. Vehicle acceptance test on District property shall demonstrate that safety and operational features of each vehicle are functional and acceptable.

G. System integration tests shall demonstrate revenue service readiness of the vehicles and of District facilities.

H. Reliability demonstration tests (RDT) shall demonstrate reliability compliance.

I. Maintainability demonstration tests shall demonstrate maintainability compliance.

J. Supplemental tests shall augment other tests to confirm or demonstrate compliance with specific requirements.

21.2 TEST PROGRAM

21.2.1 Program

The test program shall be designed in a building block manner to provide a total, integrated test program. The vehicle shall be considered on the component, subsystem, complete vehicle, dependent pair, and multipair consist levels. Design, maintainability, performance, reliability, and safety requirements shall be identified for each test. Interface and interactions shall be identified and evaluated.

21.2.2 Plan (CDRL)

A Test Program Plan shall be developed, submitted for approval, and maintained. Changes to the plan shall be approved. The plan shall consider the Systems Assurance requirements (Reference: Section 19); tests required herein, including tests conducted at the TTC and on District property; and test assistance for Contractor-furnished District-installed equipment (Reference: Section 4). The plan shall include the following as a minimum:

A. Organization, including the authority, duty, qualification, and responsibility of personnel

B. Interfaces, including the lines of authority and relationship of the test program with the Management Program (Reference: Section 20), subcontractors, design, manufacture, assembly, installation, Systems Assurance, logistics planning, and other elements of the Contractor's organization

C. List of tests with objectives of each test

D. Schedule of tests with identification of item being tested, and test sequence

E. Logistic considerations, including test sites, test facilities, and outside services (including materials and personnel)

F. Cross-reference of test requirements and test results documentation

G. Test constraints and methods of identifying, evaluating, reporting, and correcting nonconformance

H. Provisions for retest in the event of test failure or item modification after test completion

I. Pass/fail criteria quantified to specified parameters.

21.2.3 Procedures (CDRL)

Test procedures for each test, except as specified, shall be submitted in an approved format and shall include the following as a minimum:

A. Scope, objectives, criticality classifications, and pass/fail criteria

B. Operational parameters and responsibilities, including environment, equipment, personnel, services, and setup

C. Prerequisite tests and activities

D. Microprocessor software test procedures and test cases designed to uncover software errors

E. Test constraints, including equipment, personnel, and services required from other contracts

F. Operational monitoring requirements including instructions for performing the test, permissible adjustments during the test, and representative test data sheets with instructions

G. Provisions for retest in cases of test failure or modification of the tested item

H. Means of updating test procedures based upon results of other tests

3 I. For TTC testing, vehicle operation instructions. 3

21.2.4 Notification and Reports (CDRL)

A. The District shall be notified in writing 10 days prior to each test. Notifications for tests involving safety-critical items shall be explicit in the identification of the safety critical nature of the test.

B. Interim reports summarizing the results of a test shall be submitted. Interim reports shall contain test data sheets, description of results (including failures), and description of corrective actions taken.

C. Final reports shall be submitted. Final reports shall include as a minimum:

1. Test description with cross-reference to the requirements satisfied

2. Summary of results

3. Test data sheets with supporting analyses, equipment identification, test method, environmental conditions, and adjustments to the test items

4. Copies of inspection records, if the requirement was satisfied by inspection

5. Description of failures, corrective action taken, and disposition of nonconforming items

6. Reference to test procedures

7. Identification of personnel conducting the testing.

21.2.5 Test Conditions

A. Unless otherwise specified, test conditions shall be ambient pressure, temperature, and relative humidity. When these conditions must be controlled to obtain reproducible results, a reference temperature of 73°F, a relative humidity of 50 percent, and an atmospheric pressure of 29.92 in. mercury shall be used. Tolerances of conditions shall be as needed to obtain the required measurement precision. Conditions shall be recorded periodically during the test.

B. The characteristics of any track used to test the vehicle dynamics or acoustics, or any related subsystems, shall meet the criteria specified (Reference: Section 3). Standard industry methodology shall be used to adjust recorded performance to level, tangent track equivalent.

21.3 COMPONENT AND SUBSYSTEM QUALIFICATION TESTS

3 21.3.1 Factory Acceptance Tests 3

Factory acceptance tests shall be performed on each production unit qualifying as a LLRU or subsystem prior to shipment from the Contractor or subcontractor. Additional acceptance tests shall be performed at approved stages of production and when a production unit is modified or repaired. Special operating and test conditions, including induced stresses, shall be applied if required to confirm safety-critical units, to confirm new applications or developments, or to represent end-use environment.

3 21.3.2 Qualification Tests 3

Qualification tests shall be performed on randomly selected production units qualifying as LLRUs or subsystems. Special operating and test conditions shall represent specified design limit conditions plus appropriate margins. Safety critical items identified in safety analyses shall be tested to confirm that the identified hazards do not exist.

A. Qualification tests shall be performed on one unit, and shall be performed only once for each level of production for a given unit. The District or, if approved, the Contractor may select more than one test unit if circumstances force the use of more than one test unit.

B. When approved, data may be submitted in lieu of test. Data may be either analysis, or evidence of

similarity to existing equipment operating under similar environments for not less than 10,000 hr unless otherwise approved.

21.4 VEHICLE TESTS

3 21.4.1 Vehicle Factory Acceptance Tests 3

A. Vehicle factory acceptance tests shall be performed on each vehicle prior to shipment to the District or to the TTC. Qualification and all lower level acceptance tests shall be completed before vehicle factory acceptance tests are conducted. Vehicle factory acceptance tests shall verify safety-related equipment operation and the following, as a minimum:

1. Subsystems energization and operation
2. Trainline functions
3. Circuit continuity and correct polarity
4. Insulation resistance
5. High-potential insulation
6. Vehicle and truck weights
7. Carbody watertightness
8. Underfloor watertightness
9. Traction motor connections
10. Coupler, truck, and cable clearances
11. Interior lighting levels
12. Side doors interlocks
13. Confirmation of door interior emergency release
14. Compressed air leakage
15. Capability of the compressed air circuit to withstand 160 psig for 30 min
16. Braking/motoring interlocks
17. False signals to the door and brake subsystems do not cause a hazardous condition to occur

18. Vehicle outline.

B. Interior lighting level tests shall be performed on the first dependent pair, and per approved sampling plan based upon results of first pair tests for remaining vehicles.

21.4.2 Vehicle Receiving Tests

Vehicle receiving tests shall be performed on each vehicle upon arrival at the TTC and District property. The tests shall confirm nondegradation of the vehicle during shipment, verify safety-related equipment operation, and confirm that the vehicle is ready to be coupled and tested as part of a dependent pair. Each pair shall be tested to confirm that the pair is ready for operation and further testing.

3 21.4.3 Vehicle Performance Tests 3

Vehicle performance tests shall be performed at the TTC unless otherwise approved. The tests shall be performed on a dependent-pair basis, except as noted. In addition to other approved tests, the following tests shall be performed:

A. Tests to verify the coefficients used in performance calculations. Tests shall measure train resistance of one- and two-pair consists.

B. Test to verify emergency duty capability of propulsion subsystem (Reference: Section 14).

C. Test to verify the efficiency of spin/slide correction (Reference: Article 3.11). Unless otherwise approved, spin/slide correction efficiency shall be verified by comparison of dry and wet test results. In braking, the test shall be as follows, unless otherwise approved:

1. In the first step, with spin/slide correction disabled, a single-pair consist shall enter a wet test section at an approved speed, V, and be brought to a stop. The run shall be repeated and the braking effort increased on each succeeding run until sliding is detected. The requested braking rate, D, at which sliding is detected shall be recorded.

2. In the second step, with spin/slide correction operational, the consist shall enter the same wet test section and be stopped from speed V with a requested braking rate slightly in

excess of D, and the resulting stopping distance, S1, shall be recorded.

3. In the third step, the consist shall enter the test section under dry track conditions and be stopped from speed V with the same requested braking rate used in the second step. The stopping distance, S2, shall be recorded.

4. Spin/slide correction efficiency shall be calculated by:

$$\text{Efficiency} = S2/S1.$$

5. The wetting agent utilized in the wet test section shall be either an oil and water emulsion or UIC-approved detergent solution. The wetting agent shall be applied to the track by either sprinkler hoses lying alongside the track or carborne spray container.

6. The dry test section shall be the same section of track as the wet section after being thoroughly washed and cleaned.

7. Braking shall be initiated at the same point on the track for all test runs.

D. Tests to verify ride quality (Reference: Section 3). A single-pair consist at AW0 and AW2 shall be tested at 20, 30, 50, and 70 mi/hr.

E. Tests to verify compressed-air storage capacity of a dependent pair (Reference: Section 15).

F. Tests to verify friction brake subsystem ability to withstand one and one-half times normal working pressure.

G. Tests to verify response time of friction brake subsystems on a dependent pair (Reference: Section 3).

H. Tests to verify parking brake capability with worn pads and new, seated pads (Reference: Section 15).

I. Tests to verify interior and wayside noise levels of a single-pair consist (Reference: Section 3). Reflected sound shall not influence the directly radiated sound measurements by more than 2 dBA. Ambient sound level shall be more than 10 dBA below

the noise being measured, when evaluated using the same weighting or octave band. Exterior and interior noise level tests of moving vehicles shall be performed without contact rail coverboard on the measurement side.

J. Tests to verify shock and vibrations levels of components (Reference: Section 3). Shock impulse durations and magnitudes shall be measured at support points of carbody and truck axle- and frame-mounted components. The vibration amplitudes of the floor, walls, and seat frames shall be measured in the vicinity of each operating or energized vehicle component on a dependent pair.

K. Test to demonstrate 3.0 mi/hr/sec brake rate (Reference: Section 3).

2 L. Tests to verify ATO functions (Reference: Section 16). Outputs of DFE ATP and DFE ATS shall be simulated.

5 M. Tests to verify conducted, induced, and radiated emissions (Reference: Article 3.17). The tests shall be conducted in two parts. The first part shall be conducted at the TTC, and the second part on District property. Test procedures required herein shall define which tests shall be conducted at each location. Test equipment shall be Contractor-furnished at both locations. Tests shall be performed in accordance with DOT/UMTA test procedures MA-06-0153-85-5, MA-06-0153-85-8, and MA-06-0153-85-11.

21.4.4 Clearance Test

The first dependent pair delivered to District property shall be used to verify contact rail, station platform, track, tunnel, and other clearances with District facility interfaces.

21.4.5 Vehicle Acceptance Tests on District Property

Vehicle acceptance tests on District property shall be performed on each vehicle. The tests shall demonstrate that the safety and operational features of each vehicle are functional and acceptable. Upon successful completion of the tests and approval of the test data, the 5 warranty period for that vehicle will begin (Reference: 5 Special Provisions).

A. The tests shall commence after the vehicle receiving tests are completed and modifications resulting from previous tests are completed. The vehicle

acceptance tests shall confirm performance of single-pair trains. Approved test procedures shall be used, as specified herein. Trained District crews shall be utilized under the direction of Contractor technical personnel.

B. Instrumentation sufficient for independently testing three pairs of vehicles simultaneously shall be provided, installed, and removed. Instrumentation shall become District property upon completion of the tests, except instrumentation for conducted, induced, and radiated emissions tests. Each vehicle in a test shall be instrumented to record the following, as a minimum:

1. Primary power current and voltage

2. Traction motor field and armature current, per truck

3. Brake cylinder pressure, per truck

4. Brake and motor control signals

5. Acceleration and deceleration

6. Speed

7. Energy (kW) and power (kWh) consumed and regenerated

C. Each dependent pair shall be tested to demonstrate proper trainline functions in multipair trains.

D. The second part of the tests to verify conducted, induced, and radiated emissions shall be performed as specified herein.

21.4.6 System Integration Tests

The District will conduct System Integration Tests after completion of the vehicle acceptance tests on District property. The Contractor shall provide technical assistance throughout the System Integration Tests. If applicable, maintainability data shall be collected.

A. The tests will be performed under operational conditions and utilize trained District crews. Numerous drills will be conducted including simulated emergencies and failures to confirm procedures and personnel training for:

1. Maintenance

2. Safety action

3. Emergency action.

B. The vehicle/ATC system interfaces shall be verified by demonstrating proper train control throughout the main line for all consist sizes.

C. The vehicle-radio-Communications system interfaces shall be verified throughout the main line.

21.4.7 Reliability Demonstration Test

A. A Reliability Demonstration Test (RDT) Procedure shall be developed, submitted for approval, and maintained. (CDRL) The RDT shall commence upon completion of the System Integration Tests and shall continue through the first 24 mo of revenue service. All vehicles shall be included in the RDT, and shall be operated in single-pair and multipair consists.

1. Data from the last 3 mo of the RDT (revenue service months 22, 23, and 24) will be used to determine the success or failure of the RDT. An accept decision will occur only if the actual observed MTBF/MMBF for each of the following meets or exceeds its specified MTBF/MMBF (Reference: Section 19):

a. Dependent pair

b. Side door

c. Propulsion subsystem

d. Friction brake subsystem.

2. An Incident Evaluation Committee (IEC) chaired by the District shall be formed at least 30 days prior to commencing the RDT. The IEC shall have three permanent members, two of whom will be from the District, and one shall be from the Contractor. The IEC shall be supported by additional personnel as required. All incidents and test time that have occurred during vehicle test shall be presented for IEC consideration at the first IEC meeting. The IEC shall have the following responsibilities as a minimum:

a. Determine those failures and test times that are to be included in calculations

b. Recommend the level of failure analysis to be performed on each incident

c. Determine the effectiveness of corrective actions taken by the Contractor.

3. The District will operate the vehicles, collect failure/incident data, and provide discrepant components.

4. The Contractor shall perform failure/incident data analyses, component analyses, and potential corrective action designs and tests. The Contractor shall incorporate all approved changes into all vehicles.

5. The Contractor shall submit a biweekly status report. The report shall include as a minimum:

a. Statement of failures

b. Status of failure dispositions in accordance with IEC direction

c. Projected MTBF and MMBF for a dependent pair and for each subsystem.

B. Test Conditions:

1. Each test day shall nominally consist of 24 hr, which will include nonrevenue service operating hours of the Metro Rail System. Exact test starting and finishing times will be designated by the District, prior to the beginning of testing.

2. Yard and nonrevenue incidents, shop-found failures, and all other miscellaneous reported incidents together with revenue incidents shall be evaluated by IEC for failure validation.

3. Mileage accumulated by the vehicles shall be included in the MMBF calculations for each subsystem under test. Adjustments to these calculations may be made to allow for a lower average speed than specified (Reference: Section 19). Ratios which allow for proper linear comparability between the actual observed test MMBF and the required MMBF may be made, if approved. Any adjustments, however, to MMBF due to significant variations

in average speed shall also be applied to the overall vehicle MTBF calculations.

4. For purposes of MMBF calculations and additional warranty calculations (Reference: Special Provisions), an incident will be defined as a test failure when the failure of an item is an independent failure that results in a loss of function of that item caused by either of the following:

   a. A fault in the item while operating within its design and environmental specification limits

   b. Improper operation, maintenance, or testing of the item as a result of Contractor-furnished documentation.

5. Nontest failures consist of any incidents or conditions of an item not included in the definition of test failure, such as the following:

   a. A failure caused by malfunction of other equipment

   b. A failure caused by human error, except as specified herein

   c. A failure caused by accidents not associated with the normal operation of the item, such as collision or striking a foreign object on the right-of-way

   d. A failure caused by operating the item outside of specification limits

   e. Failures due to improper maintenance or normal wear/replaceable items, such as brake pads.

C. Accept-reject Decisions:

1. An MTBF/MMBF accept decision shall be based upon the actual observed test MTBF/MMBF being equal to, or greater than specified herein. This shall be determined by the Contractor and documented as specified herein.

2. In the event of an MTBF/MMBF reject decision, the Contractor shall document and submit the results and then, within 10 working days, analyze the cause of the deficiency and

prepare recommendations within 15 working days.

3. In the event of a second reject decision or failure of the District to approve recommended action, the Contractor shall resolve the problem to the District's satisfaction.

21.4.8 Maintainability Demonstration Test

A Maintainability Demonstration Test shall be conducted on assemblies, components, and subsystems jointly selected by the District and the Contractor. The District reserves the right to settle any disputes in the selection of subsystems to be tested. The Maintainability Demonstration Test will be monitored by the District (Reference: Section 19). The Maintainability Demonstration Test shall meet the intent of MIL-STD-471 unless approved otherwise by the District.

21.5 TRANSPORTATION TEST CENTER TESTING

Vehicle performance tests specified herein and as approved shall be performed at the TTC near Pueblo, Colorado. TTC testing will be in accordance with the provisions of DOT/UMTA MA-06-0025-75-14 and the requirements herein. The District will perform the required coordination with the AAR at the TTC and during preparation of the test plan.

21.5.1 Test Sequence

Tests shall be accomplished in the following sequence:

A. Phase I: Vehicle Preparation

B. Phase II: Specification Compliance and Performance Assessment

C. Phase III: Endurance Testing.

21.5.2 Contractor Requirements

A. Vehicles shipment, with adequate spare parts, to and from the TTC

B. Vehicle maintenance personnel and services

C. Test procedures and vehicle operation instructions

5 D. Installation of test equipment and calibrated instrumentation, including brackets and fixtures 5
5 5

E. Special tools and coupler adapter for the TTC logistics mover

5 F. Data reduction and report preparation 5

G. Configuration management and Systems Assurance

H. Technical support personnel to achieve test program goals and ensure adequate data acquisition

I. Approved, temporary vehicle modifications necessary for the TTC climatic conditions

5 J. Test Engineer 5

5 K. Instrumentation engineers and technicians to in- 5
5 stall instrumentation and to collect data. 5

21.5.3 District-furnished Services

The District will be represented during the tests. Under contract provisions with the District, the TTC will provide the following:

A. Unloading of vehicles upon arrival, loading at test completion, and logistic moves

B. Powered test track

C. Wheel truing equipment and personnel

5 D. Deleted 5

E. Communications, office space, safety, security, and fire protection

F. Support personnel for vehicle operation, and overall supervision and coordination of test
5 facility 5

5 G. Deleted 5

5 H. Deleted 5

5 I. Deleted. 5

21.5.4 Scope of Testing

Testing duration shall be limited to 6 mo or less. Testing shall proceed on an 8-hr day, 5 days per week; however, special shifts may be approved. The following testing phase definitions are based upon typical tests performed on transit vehicles at the TTC and are furnished to assist with test planning:

A. Phase I, Vehicle Preparation, is typically 2 to 4 wk in duration. Phase I consists of unloading of vehicle, adapting to test configuration, installing of instrumentation, and performing certain static and dynamic tests. In general, Phase I includes the activity necessary to prepare the vehicle for formal testing.

B. Phase II, Specification Compliance and Performance Assessment, is typically 10 to 12 wk in duration. Phase II consists of tests that verify the conformance of measured performance with the required performance. In general, the tests performed during Phase II have included acoustics, spin/slide efficiency, subsystem performance, acceleration/speed/time versus distance evaluations at various traction power voltages, braking (all modes), ride quality, and truck characteristics.

C. Phase III, Endurance Testing, is typically 16 wk in duration. Tests are designed to accumulate maximum operating time while simulating duty cycles (Reference: Section 3) and operational cycling of equipment (e.g., doors).

21.6 SUPPLEMENTAL TESTS

The supplemental tests listed below shall be performed in addition to other tests specified. Unless otherwise approved, one-time supplemental tests shall be completed before vehicle acceptance tests on District property commence.

21.6.1 Carbody

A. Carbody compression tests shall be conducted at an approved facility on one A-car carbody. The carbody shall be structurally complete and include trucks, but may exclude doors, glazing, and outfittings and furnishings. Underfloor equipment may be either installed or its mass simulated, but equipment brackets and supports shall be essentially complete. The carbody shall be loaded to AW0 at the beginning of the test. The longitudinal and AW3 loads shall be applied and the data collected from strain gauges.

B. Vertical load tests shall be conducted on the same carbody used for the compression test. The carbody shall be taken through AW1, AW2, and AW3 loadings by the use of weights. Strain and deflection readings shall be recorded for each load condition.

C. Jacking tests shall be conducted on the same carbody used for the compression test. Jacking conditions shall be applied to an equivalent AW0 carbody.

21.6.2 Outfittings and Furnishings

A. The passenger seat assembly shall withstand, without permanent deformation, the following tests:

1. Vertical drop impact to the seat with 40-lb weight from 6-, 8-, 10-, and 12-in. heights; 1,000 drops for each height.

2. Squirming impact test for 100,000 cycles of a 150-lb buttock-shaped wooden device dropped in unpredictable sequence and twisted on the seat cushion.

3. On transverse seats, swinging impact with 40-lb weight to the back from front and rear. Test shall include impact through 6-, 8-, 10-, and 12-in. horizontal distances; 10,000 strokes for each distance. The pendulum length shall equal 36 in.

4. On transverse seats, deflections of grabrail caused by a 100-lb horizontal load placed on the grabrail and then removed. The load shall be placed at the point of maximum grabrail deflection for 25,000 cycles.

B. An operator seat assembly shall withstand, without permanent deformation, the following tests:

1. Vertical drop impact to the seat with 40-lb weight from a height of 12 in. for 10,000 drops. Seat shall be tested in lowest vertical position and repeated with seat in top vertical position.

2. Swinging impact test specified for passenger seat assembly. Seat shall be tested with back tilt adjustment in the rearward position.

3. Squirming impact test described for the passenger seat assembly.

C. A destination sign shall be life cycle tested to at least 100,000 cycles without failure. Normal maintenance procedures shall be followed during this fatigue test.

D. Interior lighting ballasts shall be subjected to an accelerated life cycle test to simulate at least 100,000 hr of service without failure.

E. Windshield wipers shall be life cycle tested to at least two million cycles.

21.6.3 Operator Cab

A. Sun visor shall be life cycle tested to at least 10,000 cycles of adjustment.

B. The following procedure shall apply for windshield defogging testing:

1. With environmental chamber stabilized at 36°F, raise cab temperature and humidity to 50°F minimum, dew point condition.

2. When heavy fog has developed on inside of windshield, turn on defogger and measure the time required to clear wiper-swept area of windshield. After wiper-swept area of windshield is clear, verify that the defogger will maintain this condition in the environment specified above.

21.6.4 Side Door Operators and Control

A life cycle test shall be performed on the side doors and associated apparatus prior to installation on the vehicle.

A. The test items shall be identical to those doors and appurtenances to be used on the vehicle.

B. Loads imposed on the test item shall be as specified (Reference: Section 7). In addition, physical deformation representative of the most adverse carbody deflection to be experienced in revenue operation shall be imposed on the test fixture.

C. One set of side doors (two leafs), including associated controls, shall demonstrate a performance capability of a minimum of one million cycles at a rate of 10 cycles/min without failure. External cooling air at ambient temperature may be used to prevent drive motor thermal cutout, if necessary. Testing performed up to the time of a component failure may be accepted, subject to approval if the test shows that a MTBF equivalent to one million cycles is possible.

D. Speed test shall be performed at the beginning and the end of the life cycle test.

E. The door operators shall be tested at the beginning and the end of the life cycle test for comparative evaluation, and shall demonstrate that the closing and opening forces exerted by each door leaf are in compliance with the specified requirements (Reference: Section 10).

F. Lubrication and linkage readjustment corresponding to the declared maintenance requirements may be executed during the test.

21.6.5 Trucks and Suspension

A. To demonstrate fatigue strength under dynamic loading, one truck shall be subjected to two million cycles of combined loading as specified (Reference: Section 11). The truck shall be tested as a unit and shall contain its internal elastomeric cushioning and springs, if any, but shall not include hydraulic dampening devices.

B. One truck shall be overloaded statically once to verify compliance. At the conclusion of this test, there shall be no permanent deformation to any portion of the truck assembly.

C. The first dependent pair shall be tested for weight distribution and for secondary suspension stability. The pair shall be loaded with weights to simulate various unbalanced loads and the suspension shall be checked for proper cross-level and centering characteristics.

21.6.6 Coupler and Draft Gear

A. One mechanical coupler/draft gear assembly shall be stress tested to verify strength.

B. One electric coupler/mechanical coupler/draft gear assembly shall undergo an approved cycle test.

C. The draft gear, electric coupler, mechanical coupler, and coupler controls shall be operationally tested at the subsystem and vehicle levels. The operational requirements shall be verified during these tests.

21.6.7 Power Supply and Electrical Equipment

A transient qualification test shall be performed on the first production motor of each motor that operates from

filtered or unfiltered primary power or high-voltage dc supply, except the traction motors.

A. The motor shall be run at rated load and speed for a minimum of 1,000 hr without maintenance or internal cleaning. The transient test shall then be run on the motor. No clean-up of the motor will be permitted during the test.

B. The transient event shall be either that defined (Reference: Section 3) or that resulting from the regeneration transient test, whichever is more severe.

C. The motor transient test shall consist of starting the motor at each indicated voltage, and then applying the transient event 5 to 10 sec after the motor reaches full speed. This test shall be repeated a total of 10 times. The motor shall continue to operate at the end of the test. The commutation grade, at rated load and speed, shall be no worse than degree 2 of IEEE 11. Upon post-test inspection, there shall be no visible damage to the motor and there shall be a minimum insulation value of 5 megohm when tested by a 500 V megohmmeter.

1. The motor shall operate either the actual load that it will drive, or a dynamometer or fan that will load the motor to at least 95 percent of rated load at rated speed.

2. The motor shall be within 50°F of the steady state temperature for rated load and speed at the start of each test segment.

3. The motor shall be started using voltages of 450, 750, and 850 V dc, or as otherwise approved.

21.6.8 Propulsion Subsystem

A. The first production traction motor and two additional production motors selected at random by the District shall be tested based on IEEE 11. The noise and vibration tests specified (Reference: Section 3) shall be performed on the first production motor.

B. The first production gear reducer and associated coupling shall be tested on a dynamometer for not less than 100 hr. The working cycle shall be to accelerate to 85 mi/hr equivalent vehicle speed, coast for 15 sec, decelerate to stop, remain at

rest for approximately 15 sec, and then to repeat the cycle. The working cycle shall not exceed 150 sec. Direction of rotation shall be reversed each hour. Acceleration torque shall be 20 percent greater than maximum for an AW2 vehicle. Oil temperature in sump shall not exceed 20°F above ambient at any time. Noise shall be within specified limits (Reference: Section 3).

C. Prior to installation on the vehicle, the first set of brake resistor grids shall be tested for proper heat capacity and heat rejection when operating at the most severe duty cycle.

D. During propulsion subsystem qualification testing, the line breaker shall be tested for proper operation under fault conditions.

E. Regeneration transient test shall verify the predicted transient input to auxiliary equipment that operates from filtered or unfiltered primary power. The test shall be run using a dynamometer or on a vehicle and shall utilize the complete propulsion subsystem for a vehicle. The test shall simulate the conditions that are predicted to cause the most severe transient (Reference: Section 14). Test data collection shall include regeneration voltage and current versus time on the contact rail side of the line filter and into the simulated auxiliary load. The frequency response of the data collection instrumentation shall be at least 2 kHz.

21.6.9 Friction Brake

A. Dynamometer tests shall be performed on the first set of friction brake equipment to confirm that the worst duty cycle does not create an abnormal wheel tread or disc temperature. Pad wear and disc temperature or brake shoe wear and wheel tread temperature shall be recorded during this test.

B. Each first production, friction brake subsystem component shall be endurance tested through one million cycles of full service friction braking applications and releases at AW2 load conditions.

C. Service life of brake shoes or discs and pads shall be demonstrated.

D. Subsystem capability to develop specified brake rate characteristics shall be demonstrated.

21.6.10 Heating, Ventilating, and Air Conditioning

A. An HVAC subsystem shall be installed in a laboratory calorimeter simulating the installation in the vehicle. Testing shall be performed to demonstrate the following, as a minimum:

1. Cooling capacity to meet the approved calculated load

2. Heating capacity to meet the approved calculated load

3. Overtemperature operation as specified

4. Air delivery at the required volume and anticipated static pressure

5. Operation of safety devices

6. Equipment SPL (Reference: Section 3).

B. A carborne HVAC subsystem shall be tested for air balance and distribution; control system function, sequence, and set points; refrigerant system charge and oil supply; and heating equipment function and electrical characteristics. After passing those tests, the subsystem shall be further tested:

1. The vehicle shall be placed in an environmental chamber in an approved testing laboratory having the following capabilities and facilities:

   a. Maintain any temperature between 30 and 100°F and any level of humidity between 25 and 90 percent. Temperatures shall be uniform within 5°F from the top of rail to 2 ft above the vehicle and from end to end of the vehicle. Fans may be used to achieve uniformity.

   b. Load (passenger and radiation) simulators consisting of electric resistance heaters and steam generators.

   c. Humidity, pressure, and temperature measuring instruments with printout.

   d. Power consumption measurement instruments for subsystem components and load simulators .

2. The following instrumentation shall be provided:

a. The vehicle interior shall be instrumented with a minimum of 16 temperature measuring instruments located (at least 2 of which shall be in the cab) in a manner to demonstrate that the requirements are met.

b. The environmental chamber shall be instrumented with temperature measuring instruments located in a manner that will confirm that required temperatures are maintained.

c. An event recorder shall be installed to indicate the operating mode (e.g. cooling) of the HVAC subsystem at all times.

d. Interior humidity, pressure, and temperature, and power consumption of subsystem components shall be recorded.

3. The vehicle shall be "soaked" (continuously subjected to specified conditions) at 36°F for a period of 8 hr, after which the subsystem shall be activated in the automatic mode. The time needed to reach control interior temperature shall be recorded. The point of control interior temperature shall be defined as the time at which the subsystem temperature sensor responds to modulate subsystem operation.

a. The above conditions shall be maintained until vehicle interior is stabilized (temperatures reach ±4°F of each other in the vertical plane, and ±3°F of each other in the horizontal plane). A 30-min recording shall then be made of the temperatures inside and outside the vehicle. Recordings shall be made at 1-min intervals.

b. With the chamber maintained at 36°F, the subsystem controls shall be deactivated. Using an approved number of electric resistance load simulators, the vehicle shall be stabilized to a uniform temperature throughout. Fans may be used to achieve uniformity. When uniformity is reached, a 1-hr recording shall be made of the temperatures inside and outside the vehicle. Recordings shall be made at 5-min intervals. Simultaneous recordings shall be made of the power input to the

load simulators to obtain the heat leakage of the carbody.

c. The operation of the heater protection devices shall be demonstrated under simulated failure conditions.

4. The vehicle shall be soaked at 97°F dry bulb/71°F wet bulb for a period of 8 hr, after which the subsystem shall be activated in the automatic mode and the interior lighting activated. The time needed to reach control interior temperature shall be recorded. The following tests shall be performed with and without simulated design passenger and radiation loads:

a. The above conditions shall be maintained until the vehicle interior is stabilized. A 30-min recording shall then be made of the temperatures inside and outside the vehicle. Recordings shall be made at 1-min intervals. Interior humidity and pressure measurements shall be made at 5-min intervals, if not part of the temperature recording.

b. The chamber temperature shall be reduced to 78°F dry bulb/67°F wet bulb and the vehicle interior stabilized by the subsystem in automatic mode. A 30-min recording shall be made as described above.

21.6.11 Assemblies With Microprocessors

For propulsion, friction brake, and ATO subsystems, assemblies containing microprocessor parts shall successfully pass a minimum 72-hr temperature-cycled burn-in test without failure.

A. Testing shall be performed with the microprocessor assemblies powered and connected to a simulator, which shall duplicate the input and output conditions seen during normal revenue service. The testing shall be performed with a configuration of software that has been approved.

B. The microprocessor assemblies shall be placed in an environmental chamber and cycled continuously between 25 and 140°F. Each cycle shall be 8 hr in duration, consisting of 3 hr and 40 min at 140°F, followed by a 20-min rate of change to 25°F, followed by 3 hr and 40 min at 25°F and a 20-min return to 140°F.

END OF SECTION

SECTION 22

SYSTEM SUPPORT

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SECTION 22

SYSTEM SUPPORT

22.1 GENERAL

This Section specifies the requirements for the technical support, operation and maintenance manuals, training, DTE, special tools, and spare parts to be provided.

22.1.1 Safety Practices

When on District property or facilities, the safety practices of the District shall be followed.

22.1.2 System Support Plan (CDRL)

A System Support Plan shall be established. The Plan shall identify the activities, organization, schedule, and means for providing each element of system support. System support elements include:

A. Technical support
B. Manuals
C. Microprocessor-based products
D. Training
E. Diagnostic and test equipment
F. Special tools
G. Spare parts.

22.2 TECHNICAL SUPPORT

Technical support in the form of personnel on and off District property shall be available from the time the first vehicle is delivered to District property through the warranty periods of all vehicles.

22.2.1 On-site Personnel

On-site personnel qualified to maintain the vehicles shall assist with District-run tests and with resolving operation and maintenance problems. The personnel shall be thoroughly familiar with the operation of the vehicles, including single-pair and multipair train operation. The personnel shall provide support during the warranty period by responding to any warranty claims, including initiation and follow-up of remedial action. On-site personnel shall include field service engineers, technicians, and repair personnel as required.

22.2.2 On-call Personnel

During the tests on District property and the warranty period, specialists, including subcontractor and supplier technical personnel, shall be on District property within 48 hr of a request to the Contractor for additional technical assistance and for warranty-related repairs.

22.3 MANUALS

22.3.1 General

A. One reproducible and the noted quantities for each of the following approved manuals shall be furnished (Reference: Special Provisions):

1. System Operation Instruction Manual: 23 copies

2. Repair and Maintenance Manual: 23 copies

3. Workshop Manual: 23 copies

2 4. Illustrated Parts Catalog: 23 copies 2

5. DTE and Special Tools Manual: 23 copies

6. Maintenance Manuals for Microprocessor-based Products: 23 copies

7. Integrated Wiring Diagrams: 23 copies.

B. Safety-related cautions, special procedures, warnings, or other information needed to maintain safe conditions shall be included in the manuals.

2 2

C. Block diagrams, exploded views, illustrated parts breakdowns, and schematic drawings shall be used to facilitate descriptions of assemblies and the relationships of components, subsystems, and systems. If approved, photographs may be used to support specific descriptions.

D. Outlines of manuals shall be submitted. (CDRL) Manuals shall be subdivided into the following topics (as applicable), with safety warnings included in each applicable topic:

1. Table of contents, list of figures, and revision list

2. General information and specifications, including operational characteristics, performance specifications, and general nontechnical subsystem description

3. Theory of operation, including interface description supported by figures

4. Preventive maintenance, including limits, settings, and tolerances

5. Lubrication and cleaning, including frequency, methods, trade identification of recommended materials, and locations and description of components

6. Corrective repair at subsystem level and component repair, including step-by-step procedures, techniques, use of DTE, and use of special tools

7. Troubleshooting, including flow sheets, tables, and symptom/cause/remedy charts

2 8. Replaceable parts. 2

E. Draft versions of manuals shall be developed prior to tests at the TTC. (CDRL) Information gathered at the TTC and prior to shipment of the first vehicle to District property shall be used to develop final draft versions of the manuals.

F. Revisions to final draft and approved manuals shall be recorded on a control list in the front of each manual. The list shall be issued with each revision and shall show the date of each revision and the page reference. Updated lists and revisions shall be maintained in the manuals by the Contractor until the warranty period expires. Revisions
2 shall be prepared prior to the arrival of altered 2
components, and as soon as possible after procedures are changed or errors are found. Approved manuals shall be numbered. Revisions to the approved manuals shall be issued by manual number.
2 Updating of lists and manuals shall be performed 2
2 on a not-less-than quarterly basis during the first 2
2 12 months after the final manuals are delivered 2
2 (Reference: Special Provisions), and then on a 2
2 not-less-than semi-annual basis for the duration of 2
2 the warranty period. Revisions related to major 2
2 alterations of principal subsystems or assemblies 2
2 shall be issued prior to the arrival of components. 2

G. Manuals shall be designed for continuous, long-term service in a maintenance shop environment. Manuals shall lie flat when opened, and shall permit adding and replacing pages. Covers shall be oil-, water-, and wear-resistant, and shall be black with white lettering.

1. Contents shall be indexed by white divider pages, 60-lb minimum, having white 0.375-in. rounded-corner tabs. Tabs shall be Mylar reinforced or equal, have bold black capital printing on both sides, and be in banks of five.

2. Pages, including drawings and figures, shall be on approved-grade paper and bound either in loose-leaf form with reinforced punch holes, or, if approved, in five- or seven-ring binders. Pages shall be 8.5-in. wide by 11-in. high except those for the System Operation Instruction Manual and the Repair and Maintenance Manual. Pages shall be printed on both sides. Sides of pages intentionally left blank shall be so noted.

3. Figures, including diagrams, drawings, and illustrations, shall be labeled as figures. If approved, figures may be 11-in. high by 17-in. wide, and folded to an 8.5-in. format with the identification displayed. Figures, including those reduced in size, shall be legible to a person with normal visual acuity.

4. The System Operation Instruction Manual and Repair and Maintenance Manual shall be approximately 4-in. high by 7-in. wide.

5. The Workshop Manual shall be provided in individually bound sections according to subsystem. The sections shall be integrated into a functional manual through the use of indices, cross-references, descriptions of subsystem interrelationships, and consistent nomenclature and terminology.

22.3.2 Functional Requirements

A. The System Operation Instruction Manual shall contain information needed for operation of vehicles and trains. The following sections shall be provided:

1. General vehicle familiarization material

2. Location, function, and operation of pertinent controls, gauges, indicators, and switches

3. Subsystem setup and shutdown procedures

4. Trouble symptoms, diagnostic methods, and procedures for isolating minor faults

5. Emergency procedures.

B. The Repair and Maintenance Manual shall provide information needed for troubleshooting in-service failures and for performing running maintenance, including general servicing, lubricating, inspecting, and adjusting. The manual shall expand on the information furnished in the System Operation Instruction Manual, and shall include basic schematic and block diagrams to provide fault diagnosis information appropriate for in-service maintenance.

C. The Workshop Manual shall provide information needed for in-shop repair and trouble diagnosis of each LLRU to the lowest-replaceable-component level. The manual shall contain detailed flow chart, exploded parts diagram and schematic drawings, and detailed analyses related to each LLRU so that District maintenance personnel will be able to effectively service, inspect, maintain, adjust, troubleshoot, repair, replace, and overhaul the LLRU.

D. The Illustrated Parts Catalog shall be indexed by subsystem. Each subsystem assembly, LLRU, and part to the lowest-replaceable-component level shall be referenced by assigned part number and, where applicable, original manufacturer's part number. Equivalent parts available from other manufacturers shall be identified. Catalogs shall include exploded parts diagrams, illustrated part breakdown, and schematic drawings to facilitate descriptions of parts and assemblies. Assigned part number shall not exceed 19-alphanumeric characters. Space shall be provided for the District to insert its 10-digit code.

E. DTE and Special Tools Manual shall provide application, operation, usage, adjustment, inspection, maintenance, troubleshooting, repair, storage instructions, and parts information.

F. The maintenance manuals for microprocessor-based products shall provide a complete set of the configured documentation developed during design and modified thereafter. In addition to the design

documentation that includes pseudo code, system level flowcharts, data flow diagrams and the data dictionary, the manuals shall contain:

1. A listing of fully configured source code and module flow diagrams

2. A description of interrupt sequences and other protocols

3. A listing of machine code indicating location in the microprocessor memory hardware

4. Memory maps and input-output maps

5. Documentation of automated design tools, including in-circuit emulators, required to modify, compile, assemble, test, and evaluate the software. Development software used in the microprocessor software development shall be furnished and details of development hardware provided. The equipment required to reprogram the microprocessor memory shall be provided.

G. Integrated Wiring Diagrams shall include the following drawings:

1. Electrical wiring schematic and piping and instrumentation diagram (P&ID) of pneumatic piping for a dependent pair

2. Trainline schematics, with connector and wire designations

3. Pin-to-pin connector terminal designations and wire designations at both sides of each connection for connectors and terminal blocks

4. Distribution schematics for primary, auxiliary, and low-voltage power

5. Subsystem-level wiring diagrams and schematics for each subsystem. The diagrams shall be compatible with the schematics and P&ID furnished herein.

22.4 MICROPROCESSOR-BASED PRODUCTS

22.4.1 Guidelines

Guidelines shall be provided for modification of the software, including limits and impacts of parameter modification, and for reconstruction of software self-checks such as checksums.

22.4.2 Assistance

Assistance in setting up software support shall be provided. In addition, recommendations shall be provided on minimum Contractor and subsystem supplier participation in software maintenance to preserve safety and reliability levels when software is modified.

22.5 TRAINING

The Training Program shall be divided into two curricula, one to train District systems and train operations personnel (student operators) and the other to train District instructors and supervisors (student instructors) to train others to be electrical/electronic maintenance personnel and mechanical maintenance personnel. The program shall include classroom, field, onboard, and shop instruction. The curricula shall be updated as required so that student operators and instructors are presented information that reflects the current equipment and vehicle configuration. Lesson plans and training material turned over to the District shall be updated throughout the warranty period as required to reflect alterations to the vehicles and equipment.

22.5.1 General

A. Approximately 25 students (10 student operators and 15 student instructors) shall be trained. Students entering the program will have the basic skills pertinent to their job classification, but they will not have knowledge of the features of the vehicle.

B. The curriculum for student operators shall be developed to prepare the student for operating single-pair and multipair consists in revenue service. Operational safety and the capabilities, characteristics, and limitations of the vehicle shall be emphasized. Troubleshooting methodology instruction, including simulated conditions and situations, shall be provided. The training shall enhance the student's abilities to diagnose and counteract failures and unusual equipment responses. The training shall include a brief introduction to all subsystems furnished hereunder, including wayside equipment.

C. The curriculum for student instructors shall cover basic fundamentals of the vehicles, ATO-wayside equipment, and in-depth maintenance, including the use of all DTE and special tools furnished under the Contract. Heavy repair, operation, routine maintenance, safety, scheduled maintenance, ser-

vice, troubleshooting, and unscheduled maintenance shall be covered from train level through LLRU. Maintenance of Contractor-furnished DTE shall be included. Simulated and artificially created failures that require the use of DTE, special tools, and diagnostic techniques shall be used as follow-up to classroom instruction.

1. An introductory course shall cover the fundamentals applicable to all student instructors. Upon completion of the introductory course, the class shall be divided into a course for electrical/electronic student instructors and a course for mechanical student instructors. Each course shall include a series of detailed classes on each subsystem.

2. Each series of detailed classes on each subsystem shall be separated by a break of approved duration, but not by more than 1 wk. Training activities before and after the break shall be designed to assist the student instructors with evaluating and retaining the information presented in the detailed classes preceding the break.

D. The program shall include the use of catalogs, drawings, actual equipment, film strips, flip charts, manuals, mock-ups, models, slides, transparencies, video cassettes, and other training aids, as required. Training aids shall be of durable construction and, except as approved, shall be turned over to the District at the completion of the program.

E. Classes shall be scheduled for an 8-hr day, 5-day, 40-hr wk. District holidays shall be observed.

F. Training for student operators shall be conducted on District property by at least two instructors. The training shall commence 2 wk prior to arrival of the first dependent pair on District property and shall continue for not less than 3 consecutive wk.

G. Training for student instructors shall be conducted on District property, unless otherwise approved, by an approved number of instructors. The introductory course shall commence upon arrival of the third dependent pair on District property. Upon completion of the introductory course, the electrical/electronic and mechanical courses shall commence. The duration of the overall student instructor training shall be as approved and not less than 10 wk, exclusive of break time.

22.5.2 Facility Visitation

Five of the student instructors will be sent to the Contractor's facility to acquire an understanding of vehicle assembly, subsystem installation, and vehicle testing. The visitation shall commence 3 wk prior to the arrival of the third dependent pair on District property and extend for not less than 2 consecutive wk. At least one qualified instructor shall be assigned to the student instructors. Principal activities shall be to observe the installation, adjustment, and checkout of subsystems, piping, and wiring; and the testing of completed vehicles.

22.5.3 Facilities and Equipment

The Contractor shall be responsible for District equipment and facilities used in the program. The following equipment and facilities will be provided at District property, if required:

A. Space for classroom lectures and practical training, including shop space

B. Training equipment, such as easels, projectors, screens, video cassette players, and similar equipment

C. Dependent pairs, including arrangements for Yard and main line operation.

22.5.4 Training Program

The System Support Plan shall include the following information for the training program, as a minimum:

A. A narrative description of the objectives, scope, and depth of the program

B. A brief statement of the experience of the entity having prime responsibility for preparation and implementation of the program, including qualifications of the assigned personnel

C. A description of the training courses to be conducted, including the following, as a minimum:

1. Curricula outlines, including classes, courses, and series

2. Lesson plan outline listing proposed lessons by descriptive titles and indicating the main content

3. Estimated time for presenting the lesson material

4. List of training aids

5. Description of facility requirements and estimated time of use

6. If approved, description of Contractor facilities, location, estimated time of use, and other logistical considerations.

D. Agenda for the visitation by student instructors.

E. A grading system which shall be established to report the progress of each student during the program. Grading shall be kept confidential and furnished only to personnel designated by the District.

22.5.5 Lesson Plans (CDRL)

Lesson plans shall be prepared and submitted at least 30 days prior to commencing training. The lesson plans shall include an in-depth outline of the material to be presented for each course and a listing of the training aids to be used. The lesson plans shall be in sufficient detail to be used by student instructors, after completing the training, to train others. Each student instructor shall receive a copy and a reproducible of each lesson plan used in both curricula.

22.6 DIAGNOSTIC AND TEST EQUIPMENT

DTE shown in Table TP-22-1 shall be furnished as a minimum, except as noted.

22.6.1 General

A. DTE, except as specified herein, shall be provided for the following classifications of maintenance:

1. Level 1 - Portable Equipment for Routine Inspection and Diagnostic Testing

2. Level 2 - Shop Level Maintenance

3. Level 3 - Circuit Board/Electronic Subassembly Repair.

TABLE TP-22-1

DIAGNOSTIC AND TEST EQUIPMENT REQUIREMENTS

	Subsystem	DTE	Test	Quantity	
5	Side Door Operators and Controls	Door Control (Portable)*	Check timing, trainline and local operation, interlocking.	2	5
5	HVAC	HVAC Control (Portable)*	Verify temperatures, proper operation; simulate control inputs; check sequence, timing.	2	5
	HVAC	HVAC (Shop)	Check internal operation including refrigerant circuit, sensors, controls, condenser, compressor, evaporator.	1	
	HVAC	Flushing (Shop)	Provide for proper cleaning, flushing, evacuating of subsystem.	1	
5	Power Supply and Electrical Equipment	LVPS (Portable)*	Check proper operation of dc circuits, timing, voltage regulation.	2	5
	Power Supply and Electrical Equipment	LVPS (Shop)	Check proper operation, control response to varying loads and input voltages.	2	
	Power Supply and Electrical Equipment	Auxiliary Power Supply (Portable)	Check proper operation of circuits, timing, voltage regulation.	2	
	Power Supply and Electrical Equipment	Auxiliary Power Supply (Shop)	Check proper operation, control response to varying loads and input voltages.	2	
5	Propulsion	Power Modulation Control (Portable)*	Verify proper control, braking and motoring modulation, torque, interlocking, safety features, trainline operation	4	5

TABLE TP-22-1 (Cont'd.)

Subsystem	DTE	Test	Quantity
Propulsion	Traction Power (Shop)	Verify proper operation of all subsystem elements.	2
Friction Brake	Friction Braking (Shop)	Verify proper operation of all subsystem elements.	2
Communications	PA/IC (Portable)*	Provide inputs to circuits for performance adjustments; check trainlines and signal levels.	2
Communications	PA Amplifier (Shop)	Verify proper operation and output levels; locate faults.	2
Communications	IC (Shop)	Verify proper operation; locate faults.	2
ATO	Carborne and Wayside Equipment (Portable)*	Verify proper operation; locate faults.	2
ATO	Carborne and Wayside Equipment (Shop)	Verify proper operation; locate faults.	2

*Built-in diagnostics with fault indication display which perform a test similar to that specified may be substituted for DTE, if approved.

B. DTE shall perform the specified functions on the final iteration of the subsystems. Modifications because of changes to the subsystems, including changes made during the warranty period, shall be implemented.

C. A list of recommended DTE shall be included with the PDR data submittal. (CDRL) The list shall be grouped by subsystem and shall include quantities commensurate with subsystem reliability and the number of vehicles ordered; description of test functions, facilities requirements, and special requirements; correlation with maintenance manuals; and cross-referencing where DTE services more than one subsystem. DTE duplicating that in Table TP-22-1 shall be identified.

22.6.2 Portable Equipment

Portable DTE shall be furnished to produce operating commands and other input signals necessary to exercise all components and functions, and to indicate the responses of equipment and subsystems. The DTE shall check and calibrate equipment and subsystems, and locate failed LLRU. In addition to the manuals specified herein, each portable DTE shall include instructions for use within the carrying case.

A. DTE-to-subsystem interface shall be by multipin connectors. DTE shall be capable of being powered from the LVPS, and may include rechargeable batteries where appropriate. There shall be no primary power or high-current connections to the DTE.

B. Input signal generators and response indicators shall be built into the DTE to the maximum extent possible.

C. Connection of external test apparatus to the DTE shall be submitted for approval. If approved, terminals shall be provided for the connection, and the external test apparatus shall be supplied on a one-to-one basis as part of the DTE.

D. Portable DTE shall be suitcase type. Cables, connectors, and associated materials required to interface with equipment or subsystems and LVPS shall be included.

22.6.3 Shop Level Equipment

A. Bench and semiportable DTE shall be furnished to test, troubleshoot, and calibrate components to the

LLRU, including electronic circuit boards, plug-in relays, sensors, and transducers. Extender card sets shall be included. Test points shall be provided for internal connection of meters, oscilloscopes, signal generators, and other response indicators to simplify and expedite the required work. Unless otherwise approved, external connection of such apparatus shall not be permitted. The DTE may use District compressed air and electric power. Design of the DTE shall be such that input signals or supplies, such as compressed air, can be varied over the full working range of the device.

B. Shop level DTE shall test and calibrate components in a manner that is equal in quality to that performed by the original supplier, except for environmental tests.

C. Tests shall be performed by manual manipulation of dials, levers, buttons, and other appropriate controls. Unless otherwise approved, performance of the tests shall not be accomplished automatically by the test device. Technicians shall establish input levels and provide internal connections between the equipment under test and appropriate power supplies, input signal generating devices, and devices measuring output signal and responses.

D. Instrument accuracy shall be such that calibrated components may be placed into service on any vehicle without need for further calibration.

E. Shop level equipment shall isolate failures of microprocessor equipment to the circuit board level, and to a component, or group of components, if practicable.

22.6.4 Circuit Board/Electronic Subassembly Repair

A. Fault diagnosis to the component level shall be available for circuit boards containing active components. Flow charts, operating procedures, pictorial diagrams, schematics, and test points shall be provided. (CDRL) Two approved sets of fixtures and software to support testing requirements shall be provided to the extent specified below:

1. If more than 500 electronic assemblies or circuit boards of the same type containing active components will be required for 130 vehicles identical to, and including, the vehicles being furnished under the Contract, provide capability in the electronic assemblies and circuit

boards for automatic fault diagnosis to the component level using DFE DTE (Beaver-Major, Reference: Section 4).

2. For other electronic assemblies and circuit boards containing active components, provide one of the following alternatives as a minimum:

   a. Built-in diagnostic capability for detecting faults to the LLRU or circuit board level

   b. DTE capable of detecting faults to the circuit board level, including two sets of documentation

   c. Fixtures and software capable of performing a functional and diagnostic test in conjunction with DFE DTE, including connectors on the assembly or circuit board for connecting to DFE DTE.

B. A software development system with in-circuit emulation capability shall be provided if the bench or semiportable DTE cannot isolate failures to the same level as an in-circuit emulator.

22.7 SPECIAL TOOLS

Special tools required to maintain each subsystem (including DTE) shall be furnished. Lists of approved and recommended special tools shall be included with each design review data submittal. (CDRL) The lists shall be grouped by subsystem, and shall include quantities commensurate with tool use; subsystem reliability and number of vehicles ordered; description of tool, facilities requirements, and special requirements; and correlation with maintenance manuals.

22.8 SPARE PARTS

22.8.1 General

A. Spare parts shall be interchangeable with their corresponding part.

B. Packaging shall consider the reliability of the parts and the requirements for inspecting and inventorying (e.g., the packaging selected for highly reliable parts shall be such that the parts can be identified, inspected, stored for long periods, and endure multiple inventories).

22.8.2 Recommendation

2 Spare parts recommendations shall include the following: 2

A. Grouping by subsystem, DTE, and special tools for stocking identification.

B. Generic name, trade name, description, rating, accuracy, Contractor's part number, manufacturer's name, manufacturer's part number, drawing references, and correlation with the maintenance manuals.

C. Correlation of the recommended quantities with reliability requirements, with lead time, and in consideration of the following classifications:

1. Wear: Parts that may be expected to require regular replacement under normal maintenance schedules, such as mechanical parts subject to continuous operation.

2. Consumables: Parts with an expected life of less than 5 yr, such as indicator lamps.

3. One Shot: Parts that normally require replacement after performing their function one time, such as fuses.

4. Long Lead: Parts that are not readily available from distributors or the manufacturer, such as specially made components.

5. Exchange Assemblies: Assemblies that will be exchanged with failed units (or units that are not responding as specified) on the supplied equipment and that must be inventoried as complete assemblies.

D. Where replacement components are common to more than one subsystem (whether vehicle, DTE, or special tool), include a cross-reference and indexing system. Such components shall have only one part number.

END OF SECTION

SECTION 23

CONTRACT DATA REQUIREMENTS LIST

TABLE OF CONTENTS

LIST OF TABLES

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SECTION 23

CONTRACT DATA REQUIREMENTS

23.1 GENERAL

Contractor shall comply with the requirements for the submission of schedules, reports, certificates, and other data listed in these Technical Provisions.

23.2 TECHNICAL DATA REQUIREMENTS

Technical data to be submitted shall be in accordance with the Contract Data Requirements List, Table TP-23-1. Column title definitions are:

A. Item No: Numeric identifier

B. Title: CDRL item

C. Reference Paragraph: Item's location in Technical Provisions

D. Format/Quantity: Submittal format and quantity

E. Scheduled Submittal Date/Frequency/Approval: Number of days after NTP for initial submittal, frequency of submittal, and approval requirement.

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TABLE TP-23-1

CONTRACT DATA REQUIREMENTS LIST

ITEM NO. (a)	TITLE (b)	REFERENCE PARAGRAPH (c)	FORMAT/ QUANTITY (d)	SCHEDULED SUBMITTAL DATE/ FREQUENCY/APPROVAL (e)
101	Substitute Codes and Standards	1.2	Letter/10 Copies	30 days prior to CDR/1 time/ Approval required
301	Degraded Performance Levels	3.5.1	Letter/5 Copies	120 days/1 time/Approval required
302	Worst-case Analyses - Thermal Capacity	3.6.2	Report/5 Copies	120 days/1 time/Approval required
303	Worst-case Analyses - Acceleration Requirements	3.7.2	Report/5 Copies	120 days/1 time/Approval required
304	Jerk Value Definition and Support Data	3.10.3	Letter/5 Copies Technical Data/ 5 Copies	150 days/1 time/Approval required
305	Trainline Requirements	3.13.3	List/5 Copies	150 days/1 time/Approval required
306	Noise Level Estimates	3.14	Report/5 Copies	180 days/1 time/Approval required
307	Electrical Interference	3.17.1	Letter and Procedures/ 5 Copies	300 days/1 time/Approval required
308	Conducted Emission	3.17.3	Report/5 Copies	300 days/1 time/Approval required
309	Run Time and Energy Consumption Versus Distance	3.18.1	Technical Data/ 5 Copies	200 days/1 time/Approval required
310	Speed and Time Versus Distance	3.18.2	Technical Data/ 5 Copies	200 days/1 time/Approval required
311	Current Versus Time	3.18.3	Technical Data/ 5 Copies	200 days/1 time/Approval required

TABLE TP-23-1 (Cont'd.)

CONTRACT DATA REQUIREMENTS LIST

ITEM NO. (a)	TITLE (b)	REFERENCE PARAGRAPH (c)	FORMAT/ QUANTITY (d)	SCHEDULED SUBMITTAL DATE/ FREQUENCY/APPROVAL (e)	
312	Motor Characteristic Curves	3.18.4	Technical Data/ 5 Copies	200 days/1 time/Approval required	
313	Regenerative Current and Power Versus Speed	3.18.5	Technical Data/ 5 Copies	200 days/1 time/Approval required	
314	Operating Speed Versus Equipment Availability	3.18.6	Technical Data/ 5 Copies	200 days/1 time/Approval required	
401	Contractor-furnished Equipment Installation Information	4.2.1	Procedure/ 5 Copies	30 days prior to FDR/1 time/ Approval required	
5 402 5	ATC Equipment Enclosure Drawings	4.2.2	Drawing/6 Copies/ 1 Reproducible	180 days/1 time/Approval required	5 5
403	Interface Connections	4.2.2	Technical Data/ 5 Copies	180 days/1 time/Approval required	
601	Nonspecified Material Specification	6.1.2	Specification/ 5 Copies	As required/1 time/ Approval required	
5 602	Nonmetallic Material List	6.2.1	List/10 Copies	180 days/1 time/Approval required	5
603	Fire Loading Data and Calculations	6.2.2	Technical Data/ 5 Copies	180 days/1 time/Approval required	
604	Plastic Panel Properties	6.3.5	Technical Data/ 5 Copies	180 days/1 time/Approval required	
605	Neoprene Properties	6.3.6	Technical Data/ 5 Copies	180 days/1 time/Approval required	
606	Adhesives List and Procedures	6.3.10	List/10 Copies Procedure/ 5 Copies	180 days/1 time/Approval required	

TABLE TP-23-1 (Cont'd.)

CONTRACT DATA REQUIREMENTS LIST

	ITEM NO. (a)	TITLE (b)	REFERENCE PARAGRAPH (c)	FORMAT/ QUANTITY (d)	SCHEDULED SUBMITTAL DATE/ FREQUENCY/APPROVAL (e)	
	607	Wire Code System	6.4.3	Letter/5 Copies	150 days/1 time/Approval required	
	608	Motor Dimensional Print and Data	6.4.4	Drawing/6 Copies Technical Data/ 5 Copies	As required/1 time/ Approval required	
	609	Tamperproof Fasteners List	6.6.5	List/5 Copies	180 days/1 time/Approval required	
	610	Acoustical Materials List	6.10.2	List/5 Copies	200 days/1 time/Approval required	
	611	Paint Material Specifications and Applications	6.13.1	Specifications/ 5 Copies	As required/1 time/ Approval required	
	701	Detailed Stress Analyses	7.2.2	Report/5 Copies	300 days/1 time/Approval required	
	702	Progressive Crushing Analyses	7.3.4	Report/5 Copies	300 days/1 time/Approval required	
3 3	1401	ATP Speed Sensor Characteristics	14.6.1	Technical Data/ 5 Copies	150 days/1 time/Approval required	3 3
3	1402	Ripple Current and Inrush Current Characteristics	14.7.3	Technical Data/ 5 Copies	240 days/1 time/Approval required	3
	1501	Dynamometer Test Results - Disc Temperature	15.4.3	Report/5 Copies	300 days/1 time/Approval required	
	1502	Friction Material Wear Life	15.4.5	Report/5 Copies	300 days/1 time/Approval required	
	1503	Dynamometer Test Results - Wheel Tread Temperature	15.4.9	Report/5 Copies	300 days/1 time/Approval required	
	1504	Piping Procedures	15.4.12	Procedure/ 5 Copies	210 days/1 time/Approval required	

TABLE TP-23-1 (Cont'd.)

CONTRACT DATA REQUIREMENTS LIST

ITEM NO. (a)	TITLE (b)	REFERENCE PARAGRAPH (c)	FORMAT/ QUANTITY (d)	SCHEDULED SUBMITTAL DATE/ FREQUENCY/APPROVAL (e)
1601	Unintentional Movement Protection Method	16.7	Plan/10 Copies	30 days prior to PDR/1 time/ Approval required
1602	PUC Checklist	16.9	List/6 Copies and 2 Reproducibles	180 days/Update as required/ Approval required
1901	System Assurance Program Plan	19.1.2	Plan/10 Copies	30 days prior to PDR/1 time/ Approval required
1902	Design Review Action Item Lists and Open/Unresolved Issues Lists	19.1.6	List/5 Copies	As required/1 time/ Information
1903	System Assurance Audit Reports	19.1.6	Report/5 Copies	As required/1 time/ Approval required
1904	Subsystem Hazard Analysis	19.2.2	Report/5 Copies	180 days/Quarterly/ Approval required
1905	Interface Hazard Analysis	19.2.2	Report/5 Copies	180 days/Quarterly/ Approval required
1906	Operating Hazard Analysis	19.2.2	Report/5 Copies	180 days/Quarterly/ Approval required
1907	Critical/Catastrophic Item List	19.2.2	List/5 Copies	180 days/Quarterly/ Approval required
1908	Reliability Allocation	19.3.3	Report/5 Copies	180 days/Quarterly/ Approval required
1909	Single-point Failure Summaries	19.3.3	Report/5 Copies	180 days/Quarterly/ Approval required
1910	FMECA	19.3.3	Report/5 Copies	180 days/Quarterly/ Approval required
1911	Reliability Demonstration Plan	19.3.4	Plan/10 Copies	200 days/1 time/ Approval required

TABLE TP-23-1 (Cont'd.)

CONTRACT DATA REQUIREMENTS LIST

ITEM NO. (a)	TITLE (b)	REFERENCE PARAGRAPH (c)	FORMAT/ QUANTITY (d)	SCHEDULED SUBMITTAL DATE/ FREQUENCY/APPROVAL (e)
1912	Maintainability Demonstration Plan	19.4.3	Plan/10 Copies	200 days/1 time/ Approval required
1913	Maintainability Analyses	19.4.4	Report/5 Copies	240 days/Quarterly/ Approval required
1914	QA Procedures	19.5.2	Procedures/ 5 Copies	100 days/1 time/ Approval required
1915	Software QA Plan	19.5.2	Plan/10 Copies	45 days/1 time/ Approval required
1916	Requests for District Attendance at Inspections and Tests	19.5.10	Letter/5 Copies	10 days prior/1 time/ Information
1917	Inspection Pass/ Fail Criteria for Production Operation	19.5.12	Letter/5 Copies	As required/1 time/ Approval required
1918	Statistical Sampling Plan	19.5.15	Plan/10 Copies	As required/1 time/ Approval required
1919	QA Program Audit Procedure with Preliminary Schedule	19.5.22	Procedure/ 5 Copies Schedule/ 10 Copies	120 days/1 time/ Approval required
1920	QA Program Audit Reports	19.5.22	Report/5 Copies	30 days after audit completion/ 1 time/Approval required
2001	Management Plan	20.2.2	Plan/10 Copies	45 days/1 time/Approval required
2002	Monthly Progress Report	20.2.3	Report/10 Copies	30 days/Monthly/Information
2003	Bar Chart Schedule	20.2.4	Schedule/ 6 Copies	20 days/Monthly/Approval required
2004	Manufacturing Plan	20.4	Plan/10 Copies	320 days/1 time/Information

TABLE TP-23-1 (Cont'd.)

CONTRACT DATA REQUIREMENTS LIST

ITEM NO. (a)	TITLE (b)	REFERENCE PARAGRAPH (c)	FORMAT/ QUANTITY (d)	SCHEDULED SUBMITTAL DATE/ FREQUENCY/APPROVAL (e)
2005	Samples	20.5.3	Material Samples	As Required/1 time/Approval required
2006	Drawings and Color Renderings for Presentations	20.5.4	Drawing/6 Copies	As required/1 time/Approval required
2007	Human Factors Report	20.5.5	Report/10 Copies	60 days/1 time/Approval required
2008	Configuration Management Plan	20.6.1	Plan/10 Copies	120 days/1 time/Approval required
2009	Serialized Items List and Method	20.6.5	List/5 Copies Plan/10 Copies	280 days/1 time/Approval required
2010	Drawing Tree and List	20.6.6	List/5 Copies	180 days/1 time/Approval required
2011	Design Review Schedule	20.6.9	Schedule/5 Copies	45 days/1 time/Approval required
2012	CDR Data Package	20.6.9	Data/10 Copies	30 days prior to CDR/1 time/ Approval required
2013	PDR Data Package	20.6.9	Data/10 Copies Drawings/6 Copies and 1 Reproducible	30 days prior to PDR/1 time/ Approval required
2014	FDR Data Package	20.6.9	Data/10 Copies Drawings/6 Copies and 1 Reproducible	30 days prior to FDR/1 time/ Approval required
2015	FACI Data Package	20.6.9	Data/10 Copies Drawings/6 Copies and 1 Reproducible	30 days prior to FACI/1 time/ Approval required
2016	FACI Indentured Drawing List	20.6.9	List/5 Copies	30 days prior to FACI/1 time/ Approval required

TABLE TP-23-1 (Cont'd.)

CONTRACT DATA REQUIREMENTS LIST

ITEM NO. (a)	TITLE (b)	REFERENCE PARAGRAPH (c)	FORMAT/ QUANTITY (d)	SCHEDULED SUBMITTAL DATE/ FREQUENCY/APPROVAL (e)
2017	Drawings	20.6.10	Drawings/6 Copies and 1 Reproducible /1 Mylar Reprodicible of As-builts and Finals	As required/1 time/Approval required
2018	Interface Data Requirements Form	20.6.11	Form/5 Copies	60 days/1 time/Approval required
2019	Weight Statement	20.7.2	Report/5 Copies	90 days/Quarterly/Approval required
2020	Strength Program Design and Test Documentation	20.8.2	Report/5 Copies	120 days/Quarterly/Approval required
2021	Monthly Status Report	20.9.1	Report/10 Copies	30 days/Monthly/Information
2022	Vehicle History Books	20.9.2	Book/One for each vehicle and 3 Copies	As required/1 time/Approval required
2101	Test Program Plan	21.2.2	Plan/10 Copies	200 days/1 time/Approval required
2102	Test Procedures	21.2.3	Procedure/ 5 Copies	As required/1 time/ Approval required
2103	Test Notification	21.2.4	Letter/5 Copies	10 days prior/1 time/Approval required
2104	Interim Test Report	21.2.4	Report/5 Copies	10 days after/1 time/ Approval required
2105	Final Test Report	21.2.4	Report/5 Copies	As required/1 time/ Approval required
2106	Reliability Demonstration Test Procedure	21.4.7	Procedure/ 5 Copies	60 days prior to TTC delivery/1 time/ Approval required

TABLE TP-23-1 (Cont'd.)

CONTRACT DATA REQUIREMENTS LIST

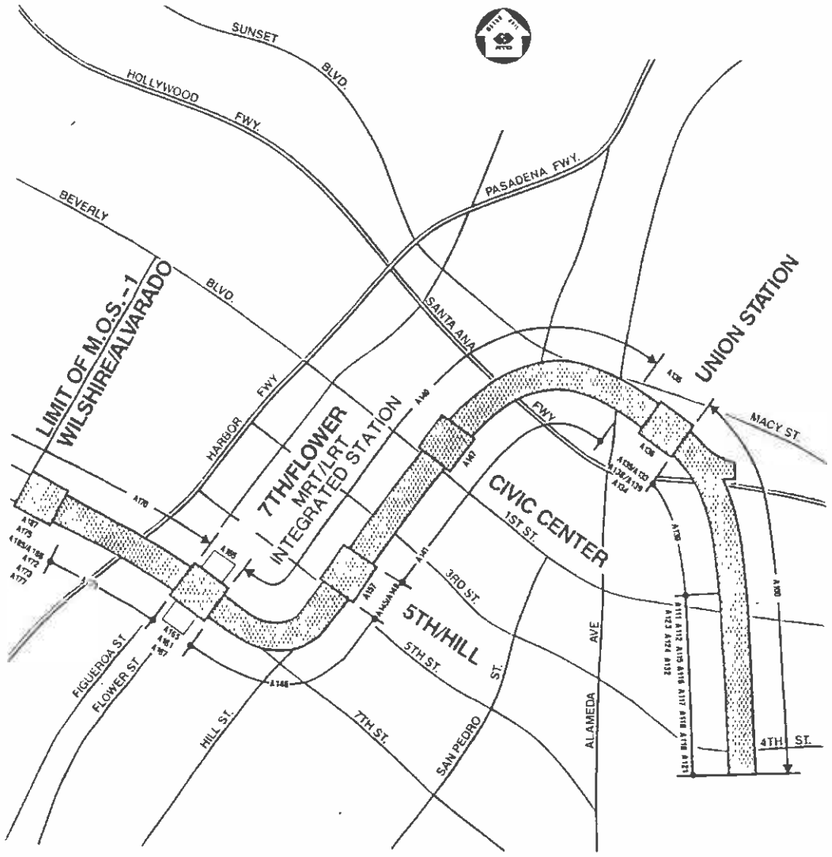
	ITEM NO. (a)	TITLE (b)	REFERENCE PARAGRAPH (c)	FORMAT/ QUANTITY (d)	SCHEDULED SUBMITTAL DATE/ FREQUENCY/APPROVAL (e)	
	2201	System Support Plan	22.1.2	Plan/10 Copies	100 days/1 time/Approval required	
	2202	Manual Outlines	22.3.1	Outline/5 Copies	540 days/1 time/Approval required	
	2203	Manual Draft Versions	22.3.1	Book/5 Copies	(Reference: Special Provisions)/ 1 time/Approval required	
	2204	Lesson Plans	22.5.5	Plan/10 Copies	30 days prior to training/1 time/ Approval required	
5	2205	Recommended DTE List	22.6.1	List/5 Copies	30 days prior to PDR/1 time/ Approval required	5
	2206	Testing Requirements Support	22.6.4	Technical Data/ 5 Copies Procedures/5 Copies Test Fixtures/2 Sets Software/2 Sets	30 days prior to FDR/1 time/ Approval required	
	2207	Special Tools Lists	22.7	List/5 Copies	30 days prior to each design review/ 1 time/Approval required	

END OF SECTION

SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT

METRO RAIL PROJECT

LOS ANGELES CENTRAL BUSINESS DISTRICT TO NORTH HOLLYWOOD



PASSENGER VEHICLE CONTRACT AND REFERENCE DRAWINGS

CONTRACT A650

ADVERTISED: MARCH 1987
AWARDED: APRIL 1988

The preparation of this document has been financed in part through a grant from the U.S. Department of Transportation, Urban Mass Transportation Administration, under the Urban Mass Transportation Act of 1964, as amended, the State of California, and the Los Angeles County Transportation Commission.

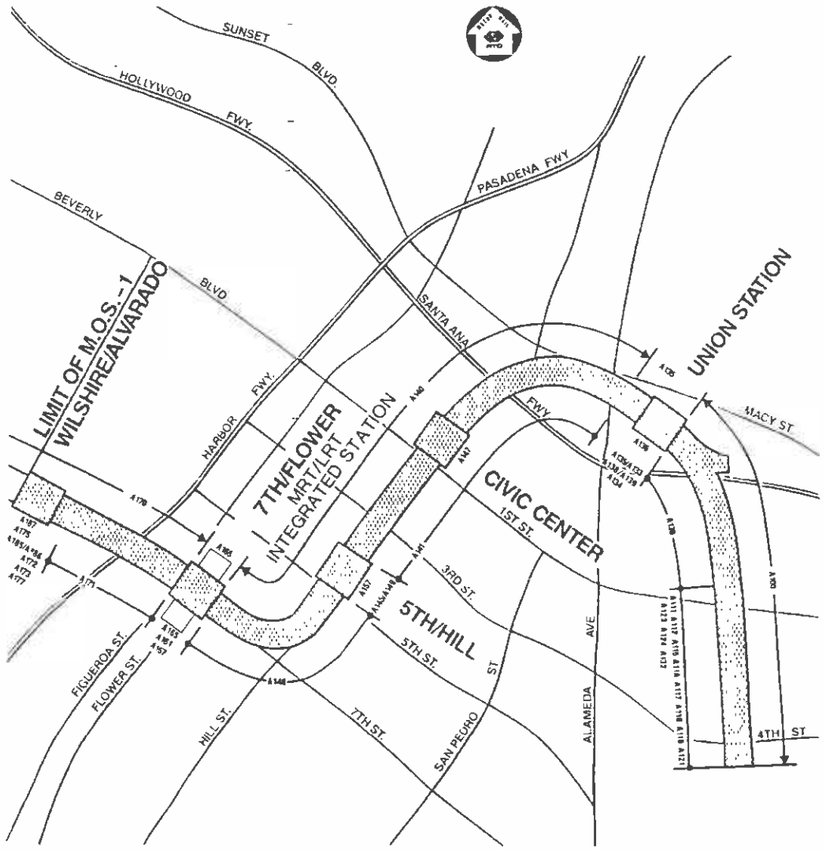
GENERAL CONSULTANT:

METRO RAIL TRANSIT CONSULTANTS
DMJM/PBQD/KE/HWA

SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT

METRO RAIL PROJECT

LOS ANGELES CENTRAL BUSINESS DISTRICT TO NORTH HOLLYWOOD



PASSENGER VEHICLE CONTRACT AND REFERENCE DRAWINGS

CONTRACT A650

ADVERTISED: MARCH 1987

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GENERAL CONSULTANT:

METRO RAIL TRANSIT CONSULTANTS
DMJM/PBQD/KE/HWA

APPROVED: _____ DATE: 3/14/87
PROJECT DIRECTOR

RTD
SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT

ACCEPTED: _____ DATE: 3-16-87
ASSISTANT GENERAL MANAGER
TRANSIT SYSTEMS DEVELOPMENT

HALF SIZE

INDEX OF DRAWINGS

SHEET NO.	DRAWING NO.	PASSENGER VEHICLE CONTRACT DRAWINGS
1	V-001	INDEX SHEET
2	V-002	EXTERIOR PERSPECTIVE
3	V-003	INTERIOR PERSPECTIVE
4	V-004	GENERAL ARRANGEMENT/SIDE ELEVATION
5	V-005	F-END / R-END ELEVATIONS
6	V-006	LONGITUDINAL SECTION/REFLECTED CEILING PLAN
7	V-007	INTERIOR CROSS-SECTIONS
8	V-008	SEAT DETAILS
9	V-009	OPERATOR CAB PLAN
10	V-010	OPERATOR CONSOLE
11		NOT USED
12	V-012	LEFT/RIGHT SIDE DOOR CONTROL PANELS
13	V-013	LIGHTING/WINDSHIELD DEVICE CONTROL PANEL
14	V-014	COUPLE/UNCOUPLE, AUXILIARY POWER CONTROL PANEL
15	V-015	AUXILIARY ANNUNCIATOR PANEL
16	V-016	AUXILIARY CONTROL AND SWITCH PANEL
17	V-017	LOW-VOLTAGE CIRCUIT BREAKER PANEL
18	V-018	MAXIMUM STATIC OUTLINE
19	V-019	MAXIMUM DYNAMIC OUTLINE
20	V-020	CURRENT COLLECTOR/COVERBOARD RELATIONSHIP
21	V-021	WHEEL TREAD CONTOUR
22	V-022	TRIP COCK INSTALLATION
23	V-023	JACKING PAD LOCATIONS
24	V-024	EXTERIOR GRAPHICS & COLOR SCHEME
25	V-025	INTERIOR GRAPHICS & COLOR SCHEME
26	V-026	CHECKLIST OF REQUIREMENTS, SHEET 1 OF 3
27	V-027	CHECKLIST OF REQUIREMENTS, SHEET 2 OF 3
28	V-028	CHECKLIST OF REQUIREMENTS, SHEET 3 OF 3

SHEET NO.	DRAWING NO.	PASSENGER VEHICLE REFERENCE DRAWINGS
101	Q-087	AUTOMATIC TRAIN CONTROL, PASSENGER VEHICLE INTERFACE, SHEET 1 OF 3
102	Q-088	AUTOMATIC TRAIN CONTROL, PASSENGER VEHICLE INTERFACE, SHEET 2 OF 3
103	Q-089	AUTOMATIC TRAIN CONTROL, PASSENGER VEHICLE INTERFACE, SHEET 3 OF 3
104	Q-120	AUTOMATIC TRAIN CONTROL, LAYOUT OF ALL-ELECTRIC TRAIN STOP, EMBEDDED TIE AREA
105	N-095	COMMUNICATIONS, PASSENGER VEHICLE MECHANICAL INTERFACE
106	T-237	TRACKWORK INSTALLATION, BUMPING POST DETAIL HYDRAULIC
107	T-238	TRACKWORK INSTALLATION, BUMPING POST DETAIL - STANDARD

HALF SIZE

THE PREPARATION OF THIS DRAWING HAS BEEN FINANCED IN PART THROUGH A GRANT FROM THE U. S. DEPARTMENT OF TRANSPORTATION, URBAN MASS TRANSPORTATION ADMINISTRATION, UNDER THE URBAN MASS TRANSPORTATION ACT OF 1964, AS AMENDED, AND IN PART BY THE TAXES OF THE CITIZENS OF LOS ANGELES COUNTY AND OF THE STATE OF CALIFORNIA

REV.	DATE	BY	SUB	APP	DESCRIPTION
1	11-5 88	CK	JNB		REVISED PER ACR650-5
0	3/16/87				PROPOSAL ISSUE

DESIGNED BY
DRAWN BY
CHECKED BY
IN CHARGE J. N. Brown
DATE 7 OCT 85

JOHN N. BROWN EXP 7/30/88 MECHANICAL

SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT
METRO RAIL PROJECT
RTD

SUBMITTED J. N. Brown

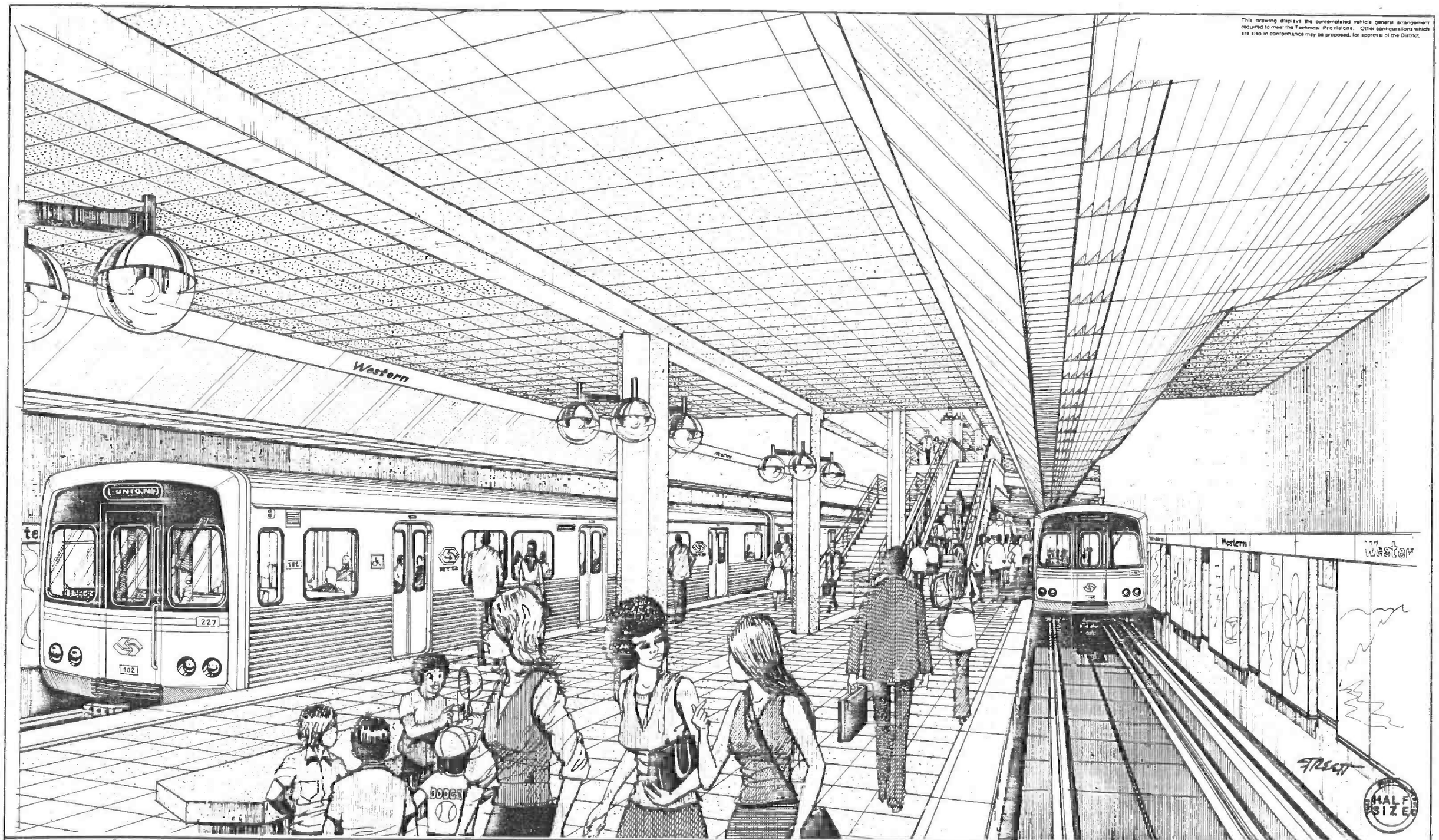
DMJM/PBQD/KE/HWA
A JOINT VENTURE
GENERAL CONSULTANTS

APPROVED Howard Wheeler

PASSENGER VEHICLE
INDEX SHEET

CONTRACT NO. A650
DRAWING NO. V-001
REV. 1
SCALE NO SCALE
SHEET NO. 1

This drawing displays the contemplated vehicle general arrangement required to meet the Technical Provisions. Other configurations which are also in conformance may be proposed, for approval of the District.



THE PREPARATION OF THIS DRAWING HAS BEEN FINANCED IN PART THROUGH A GRANT FROM THE U. S. DEPARTMENT OF TRANSPORTATION, URBAN MASS TRANSPORTATION ADMINISTRATION, UNDER THE URBAN MASS TRANSPORTATION ACT OF 1964, AS AMENDED, AND IN PART BY THE TAXES OF THE CITIZENS OF LOS ANGELES COUNTY AND OF THE STATE OF CALIFORNIA

REV.	DATE	BY	SUB.	APP.	DESCRIPTION
0	5/15/84				PROPOSAL ISSUE

DESIGNED BY
DRAWN BY
CHECKED BY
IN CHARGE
DATE 12 APR 84

SEAL NOT APPLICABLE

SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT
METRO RAIL PROJECT
RTD

SUBMITTED J.N. Brown

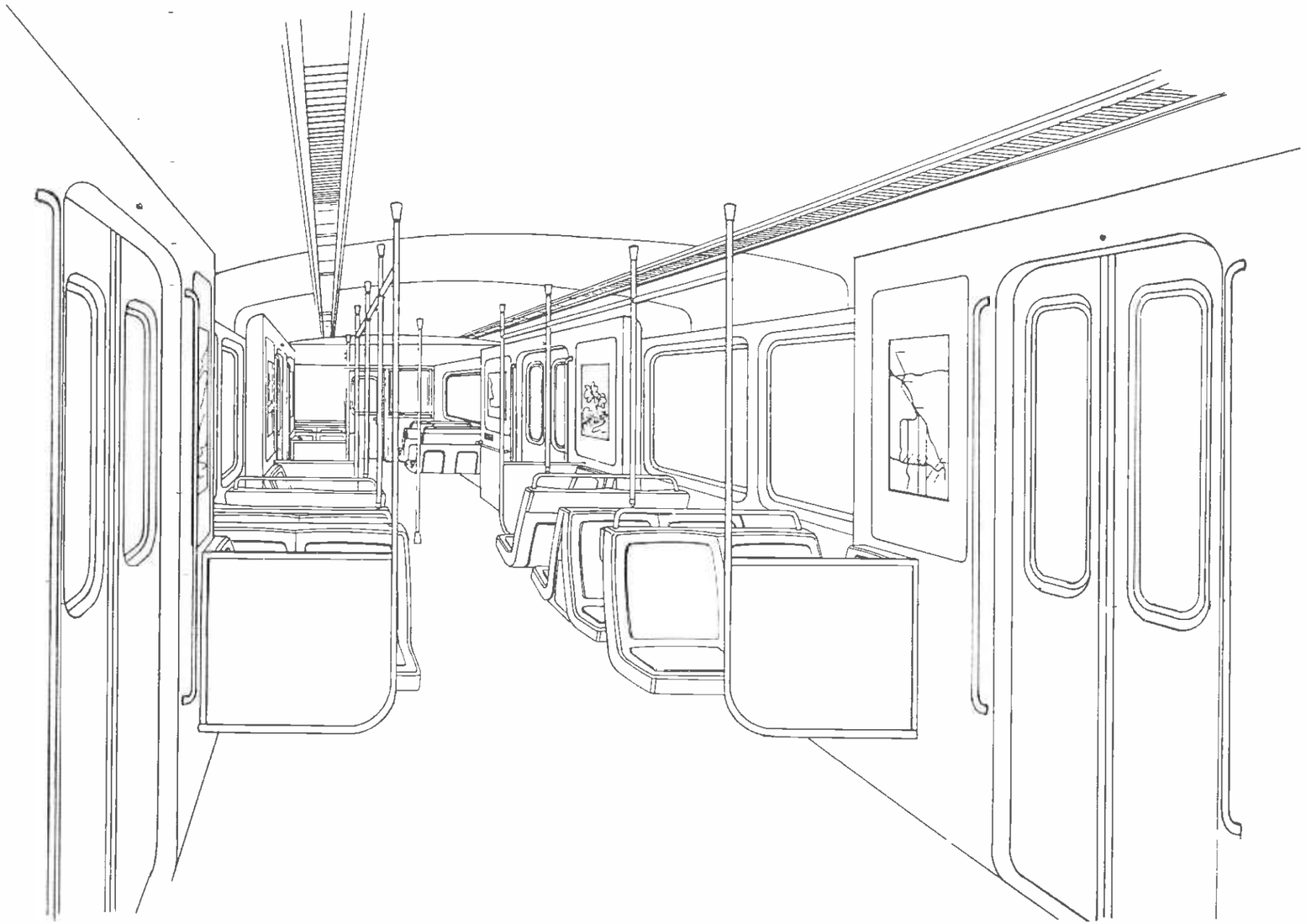
DMJM/PBQD/KE/HWA
A JOINT VENTURE
GENERAL CONSULTANTS

APPROVED

PASSENGER VEHICLE EXTERIOR PERSPECTIVE

CONTRACT NO. A 650
DRAWING NO. V-002
REV. 0
SCALE NO SCALE
SHEET NO. 2

This drawing displays the contemplated vehicle general arrangement required to meet the Technical Provisions. Other configurations which are also in conformance may be proposed, for approval of the District.



HALF SIZE

THE PREPARATION OF THIS DRAWING HAS BEEN FINANCED IN PART THROUGH A GRANT FROM THE U. S DEPARTMENT OF TRANSPORTATION, URBAN MASS TRANSPORTATION ADMINISTRATION, UNDER THE URBAN MASS TRANSPORTATION ACT OF 1964, AS AMENDED, AND IN PART BY THE TAXES OF THE CITIZENS OF LOS ANGELES COUNTY AND OF THE STATE OF CALIFORNIA

REV.	DATE	BY	SUB	APP.	DESCRIPTION
0	3/16/87				PROPOSAL ISSUE

REV.	DATE	BY	SUB.	APP.	DESCRIPTION

DESIGNED BY
DRAWN BY
CHECKED BY
IN CHARGE
DATE 11 APR 84

SEAL NOT APPLICABLE

SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT
METRO RAIL PROJECT
RTD

SUBMITTED J.M. Brown

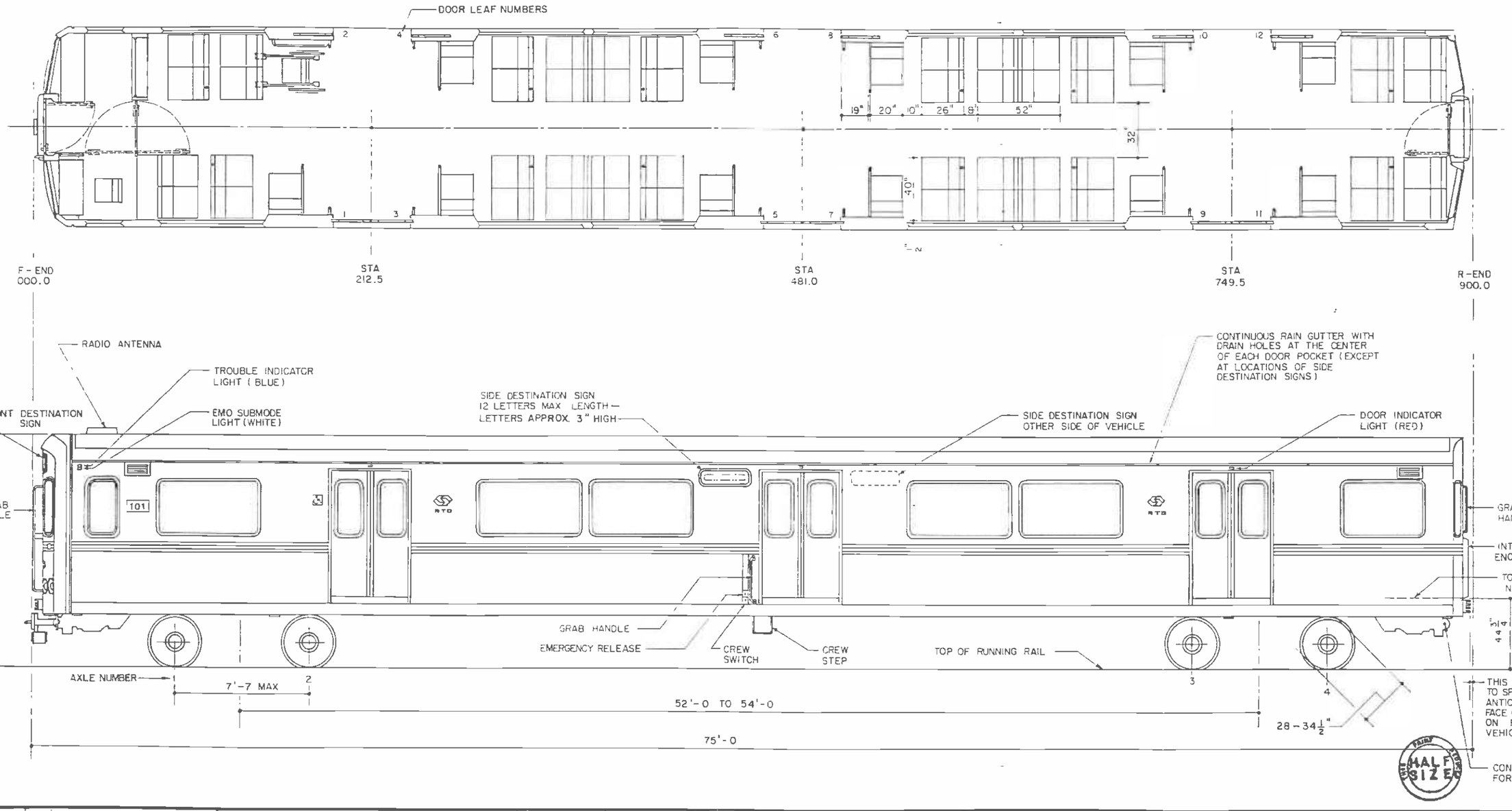
DMJM/PBQD/KE/HWA
A JOINT VENTURE
GENERAL CONSULTANTS

APPROVED

PASSENGER VEHICLE INTERIOR PERSPECTIVE

CONTRACT NO. A 650
DRAWING NO. V-003
REV 0
SCALE NO SCALE
SHEET NO. 3

This drawing discloses the contemplated vehicle general arrangement required to meet the Technical Provisions. Other configurations which are also in conformance may be proposed, for approval of the District.



THE PREPARATION OF THIS DRAWING HAS BEEN FINANCED IN PART THROUGH A GRANT FROM THE U. S. DEPARTMENT OF TRANSPORTATION, URBAN MASS TRANSPORTATION ADMINISTRATION, UNDER THE URBAN MASS TRANSPORTATION ACT OF 1964, AS AMENDED, AND IN PART BY THE TAXES OF THE CITIZENS OF LOS ANGELES COUNTY AND OF THE STATE OF CALIFORNIA

REV.	DATE	BY	SUB.	APP.	DESCRIPTION
0	3/16/87				PROPOSAL ISSUE

DESIGNED BY P. Karlen
DRAWN BY P. Karlen
CHECKED BY T. Mc Gann
IN CHARGE J. Cobb
DATE 12 FEB 85

REGISTERED PROFESSIONAL ENGINEER JOHN NICHOLAS BROWN Exp 9/30/88 No. 22744 J.N. Brown MECHANICAL STATE OF CALIFORNIA

SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT
METRO RAIL PROJECT
RTD

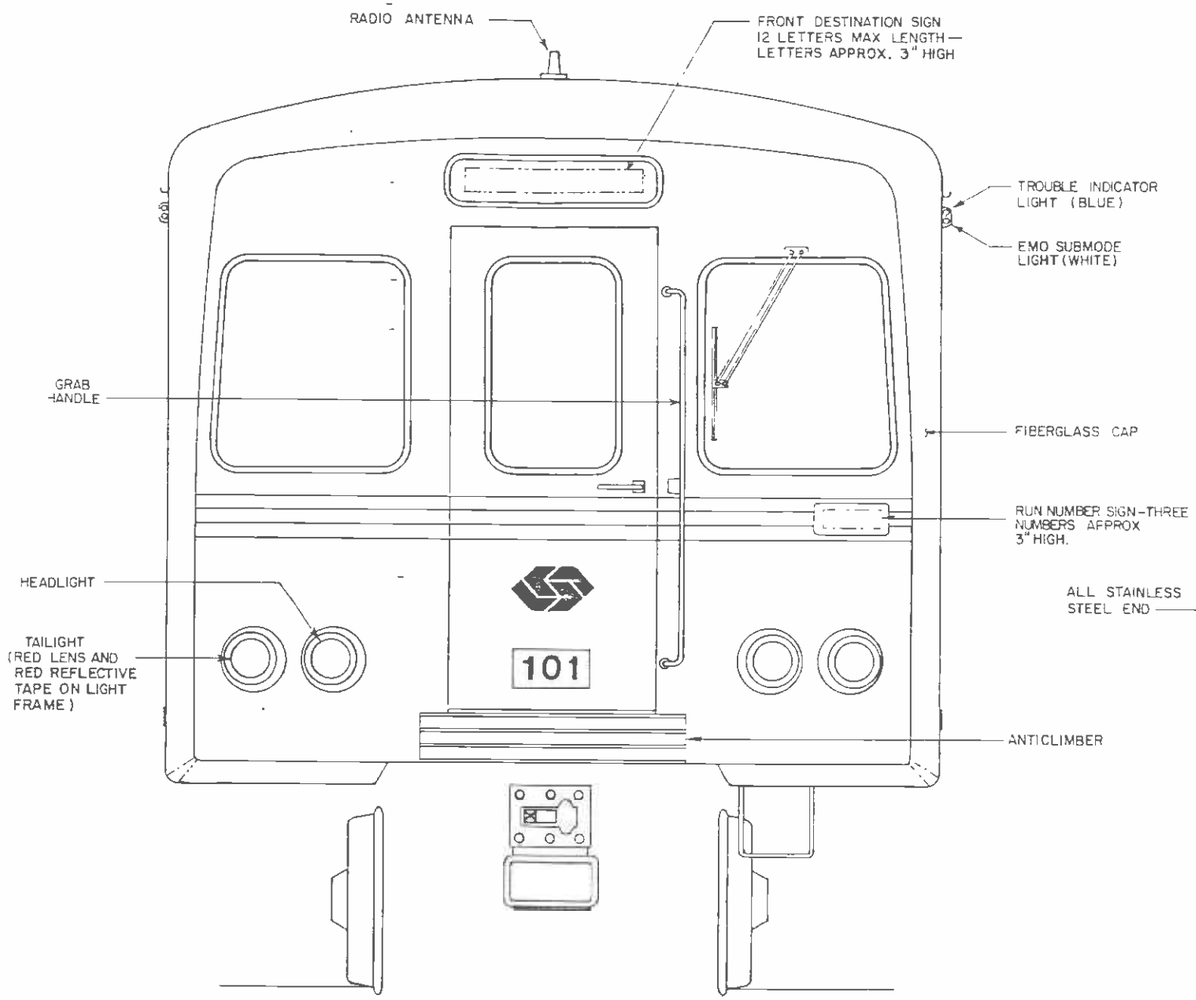
DMJM/PBQD/KE/HWA
A JOINT VENTURE
GENERAL CONSULTANTS

SUBMITTED J.N. Brown
APPROVED Howard Kheel

PASSENGER VEHICLE GENERAL ARRANGEMENT / SIDE ELEVATION

CONTRACT NO. A 650
DRAWING NO. V-004
REV. 0
SCALE ⅜" = 1'-0
SHEET NO. 4

This drawing depicts the contemplated vehicle general arrangement required to meet the Technical Provisions. Other configurations which give rise to nonconformance may be proposed, for approval of the District.



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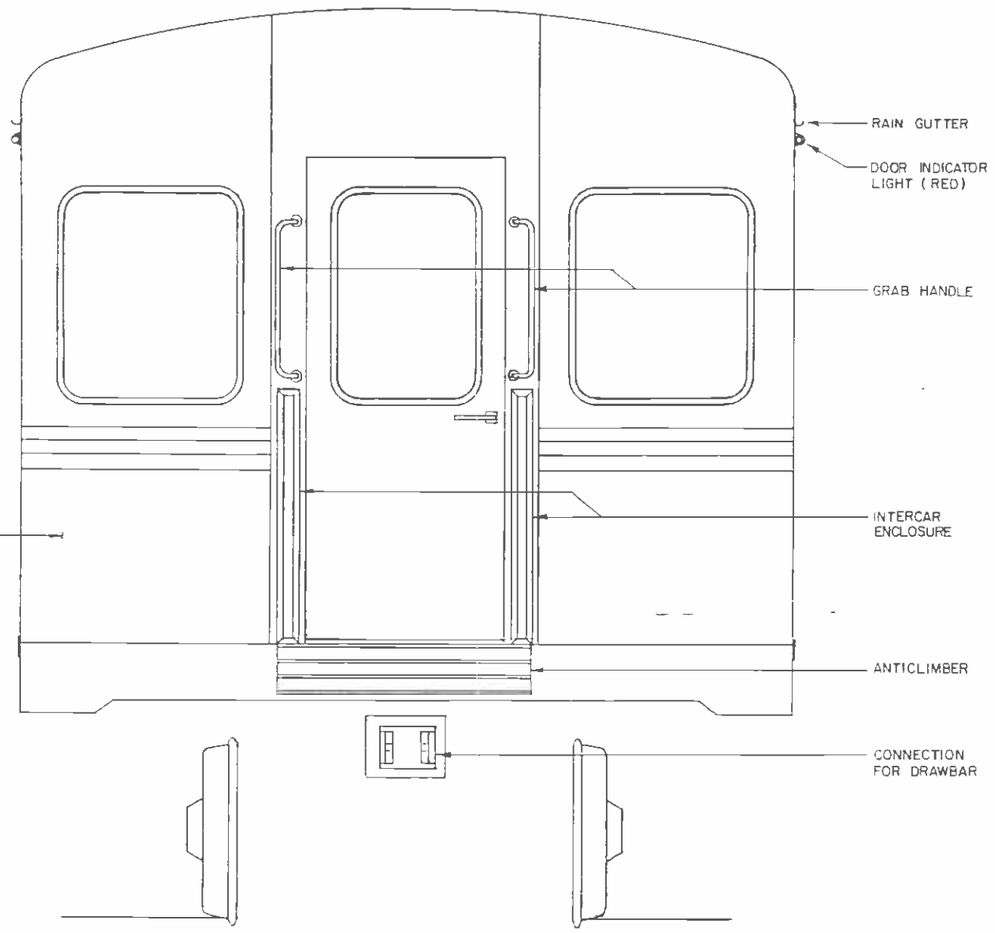


R - END

HALF SIZE

REV.	DATE	BY	SUB.	APP.	DESCRIPTION
0	3/16/87				PROPOSAL ISSUE

THE PREPARATION OF THIS DRAWING HAS BEEN FINANCED IN PART THROUGH A GRANT FROM THE U. S. DEPARTMENT OF TRANSPORTATION, URBAN MASS TRANSPORTATION ADMINISTRATION, UNDER THE URBAN MASS TRANSPORTATION ACT OF 1964, AS AMENDED, AND IN PART BY THE TAXES OF THE CITIZENS OF LOS ANGELES COUNTY AND OF THE STATE OF CALIFORNIA

DESIGNED BY
DRAWN BY
CHECKED BY
IN CHARGE
DATE 11 DEC 84

REGISTERED PROFESSIONAL ENGINEER JOHN NICHOLAS EXP 9/30/88 MECHANICAL STATE OF CALIFORNIA

SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT
METRO RAIL PROJECT
RTD

SUBMITTED J. N. Brunn

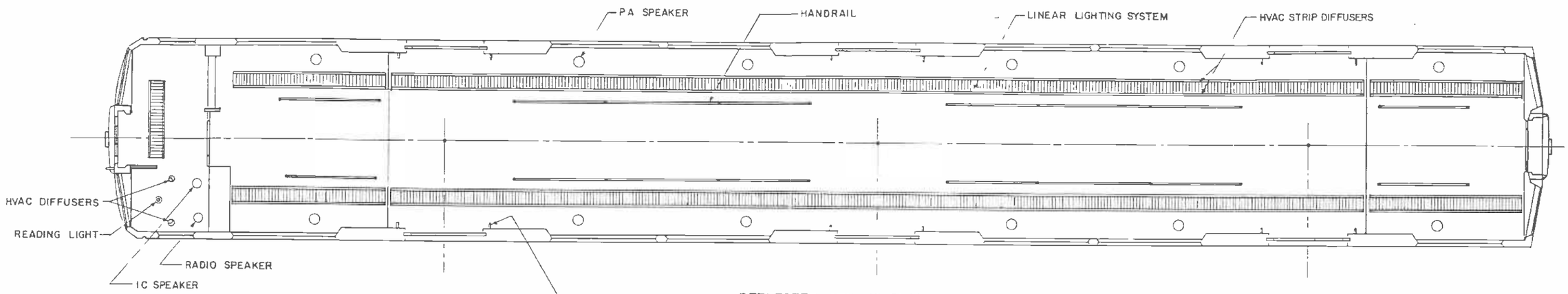
DMJM/PBQD/KE/HWA
A JOINT VENTURE
GENERAL CONSULTANTS

APPROVED Howard L. Chadoff

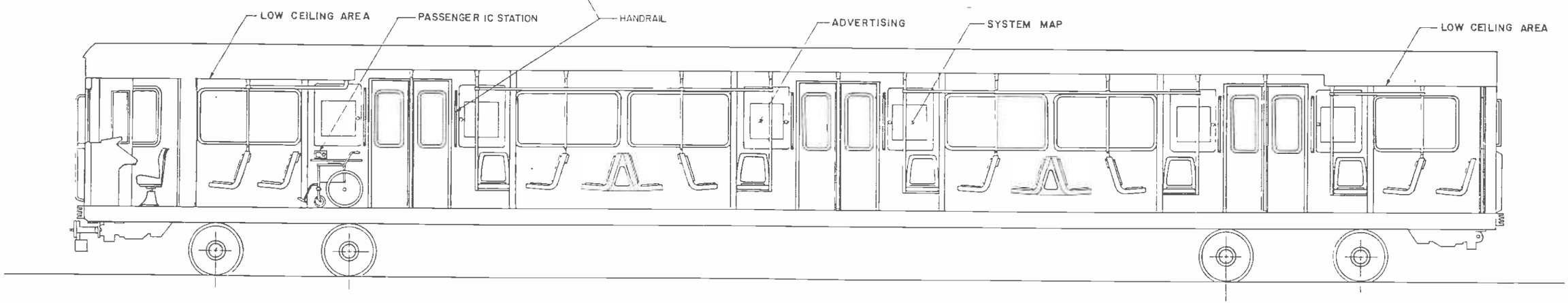
PASSENGER VEHICLE F-END / R-END ELEVATIONS

CONTRACT NO A 650
DRAWING NO. V-005
REV 0
SCALE 1" = 1'-0
SHEET NO. 5

This drawing displays the contemplated vehicle general arrangement requested to meet the Technical Provisions. Other configurations which are also in conformance may be proposed, for approval of the District.



REFLECTED CEILING PLAN



LONGITUDINAL SECTION

PRINT HALF SIZE

REV.	DATE	BY	SUB.	APP.	DESCRIPTION
0	3/16/87				PROPOSAL ISSUE

THE PREPARATION OF THIS DRAWING HAS BEEN FINANCED IN PART THROUGH A GRANT FROM THE U. S. DEPARTMENT OF TRANSPORTATION, URBAN MASS TRANSPORTATION ADMINISTRATION, UNDER THE URBAN MASS TRANSPORTATION ACT OF 1964, AS AMENDED, AND IN PART BY THE TAXES OF THE CITIZENS OF LOS ANGELES COUNTY AND OF THE STATE OF CALIFORNIA

DESIGNED BY
DRAWN BY
CHECKED BY
IN CHARGE
DATE 30 JAN 85

SEAL NOT APPLICABLE

SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT
METRO RAIL PROJECT
RTD

SUBMITTED J. N. Brown

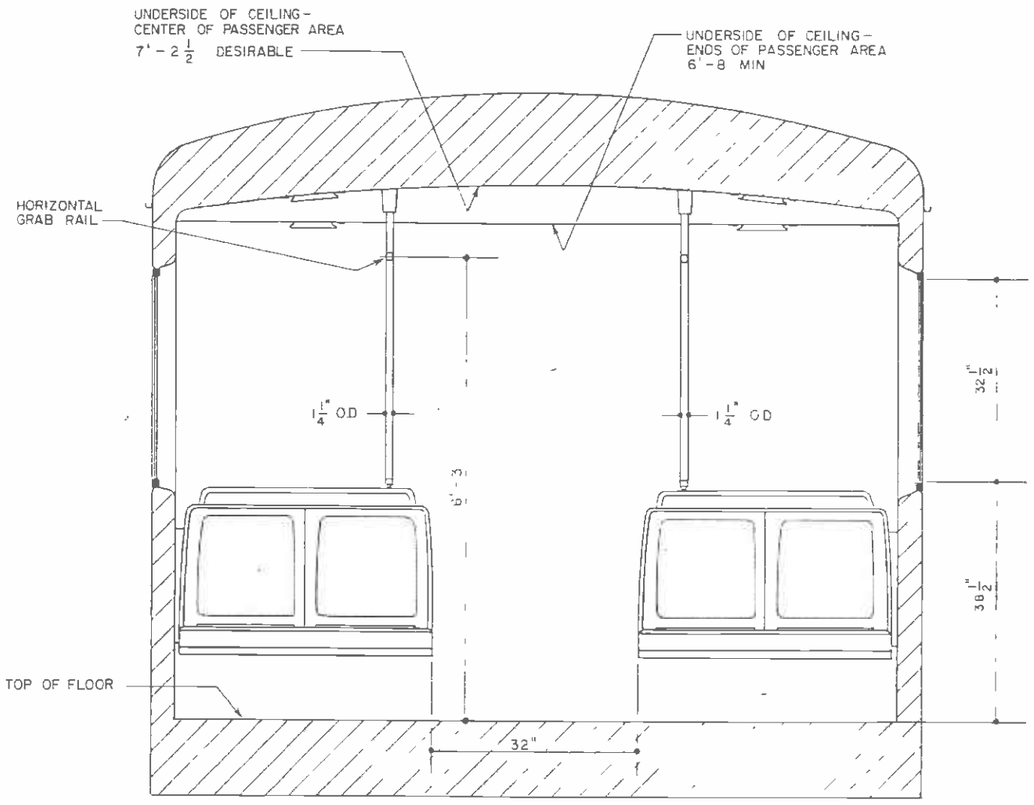
DMJM/PBQD/KE/HWA
A JOINT VENTURE
GENERAL CONSULTANTS

APPROVED

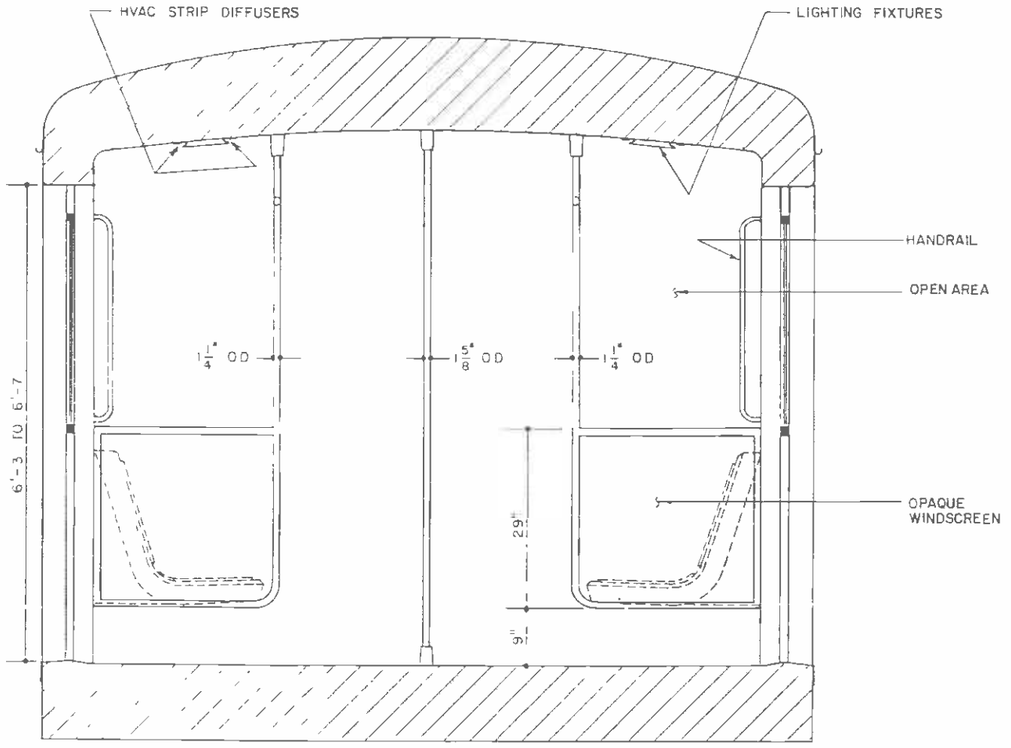
PASSENGER VEHICLE LONGITUDINAL SECTION / REFLECTED CEILING PLAN

CONTRACT NO A 650
DRAWING NO. V-006
REV. 0
SCALE 3/8" = 1'-0
SHEET NO 6

This drawing displays the contemplated vehicle general arrangement required to meet the Technical Provisions. Other configurations which are also in conformance may be proposed, for approval of the District.



SECTION AT WINDOWS



SECTION AT DOORS

HALF SIZE

REV.	DATE	BY	SUB	APP	DESCRIPTION
0	3/16/87				PROPOSAL ISSUE

THE PREPARATION OF THIS DRAWING HAS BEEN FINANCED IN PART THROUGH A GRANT FROM THE U. S. DEPARTMENT OF TRANSPORTATION, URBAN MASS TRANSPORTATION ADMINISTRATION, UNDER THE URBAN MASS TRANSPORTATION ACT OF 1964, AS AMENDED, AND IN PART BY THE TAXES OF THE CITIZENS OF LOS ANGELES COUNTY AND OF THE STATE OF CALIFORNIA

DESIGNED BY
DRAWN BY
CHECKED BY
IN CHARGE
DATE 12 DEC 84

REGISTERED PROFESSIONAL ENGINEER – JOHN MICHAEL BROWN – NO. 12 11 – EXP 9/30/88 – MECHANICAL – STATE OF CALIFORNIA

SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT
METRO RAIL PROJECT
RTD

SUBMITTED J. M. Brown

DMJM/PBQD/KE/HWA
A JOINT VENTURE
GENERAL CONSULTANTS

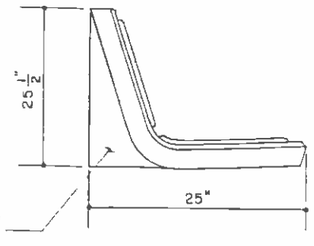
APPROVED Howard Hallisey

PASSENGER VEHICLE INTERIOR CROSS – SECTIONS

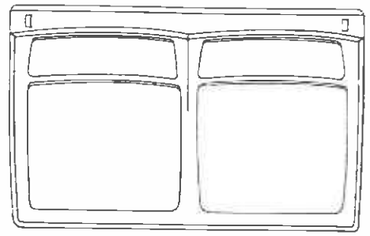
CONTRACT NO. A 650
DRAWING NO V-007
REV 0
SCALE 1" = 1'-0
SHEET NO. 7

This drawing displays the contemplated vehicle general arrangement required to meet the Technical Provisions. Other configurations which are also in conformance may be proposed, for approval of the District.

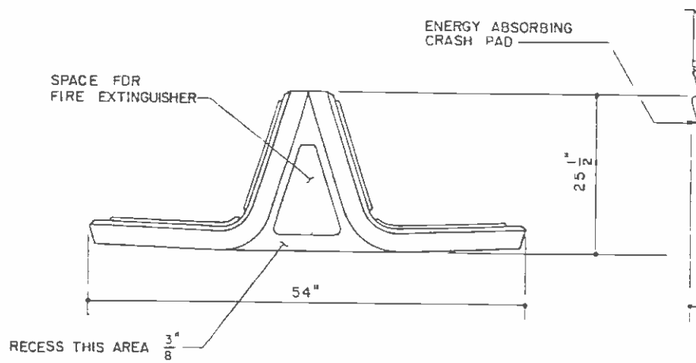
END VIEW



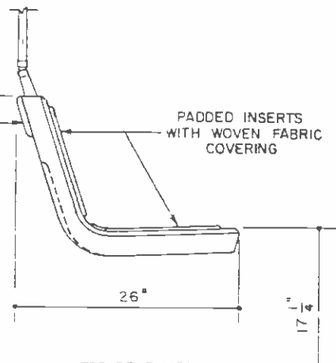
LONGITUDINAL SEAT



PLAN VIEW

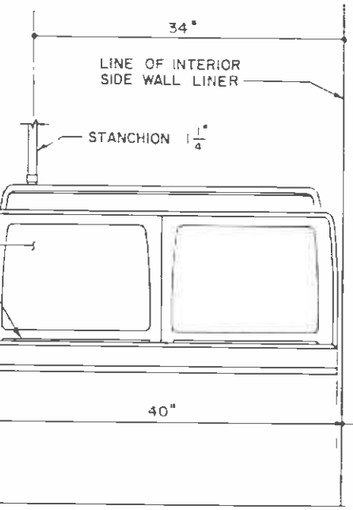


END VIEW

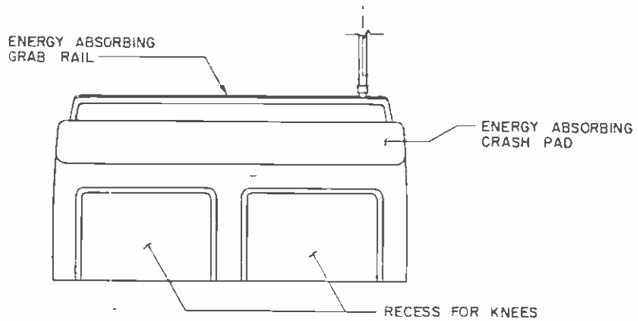


END VIEW

BACK-TO-BACK SEAT



FRONT VIEW



BACK VIEW

TRANSVERSE SEAT

HALF SIZE

REV	DATE	BY	SUB.	APP	DESCRIPTION
0	5/16/87				PROPOSAL ISSUE

THE PREPARATION OF THIS DRAWING HAS BEEN FINANCED IN PART THROUGH A GRANT FROM THE U. S. DEPARTMENT OF TRANSPORTATION, URBAN MASS TRANSPORTATION ADMINISTRATION, UNDER THE URBAN MASS TRANSPORTATION ACT OF 1964, AS AMENDED, AND IN PART BY THE TAXES OF THE CITIZENS OF LOS ANGELES COUNTY AND OF THE STATE OF CALIFORNIA

DESIGNED BY
DRAWN BY
CHECKED BY
IN CHARGE J.M. Brown
DATE 3 SEPT 86

REGISTERED PROFESSIONAL ENGINEER JOHN NICHOLAS BROWN EXP 9/30/88 NO. 22614 MECHANICAL

SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT
METRO RAIL PROJECT
RTD

SUBMITTED J.M. Brown

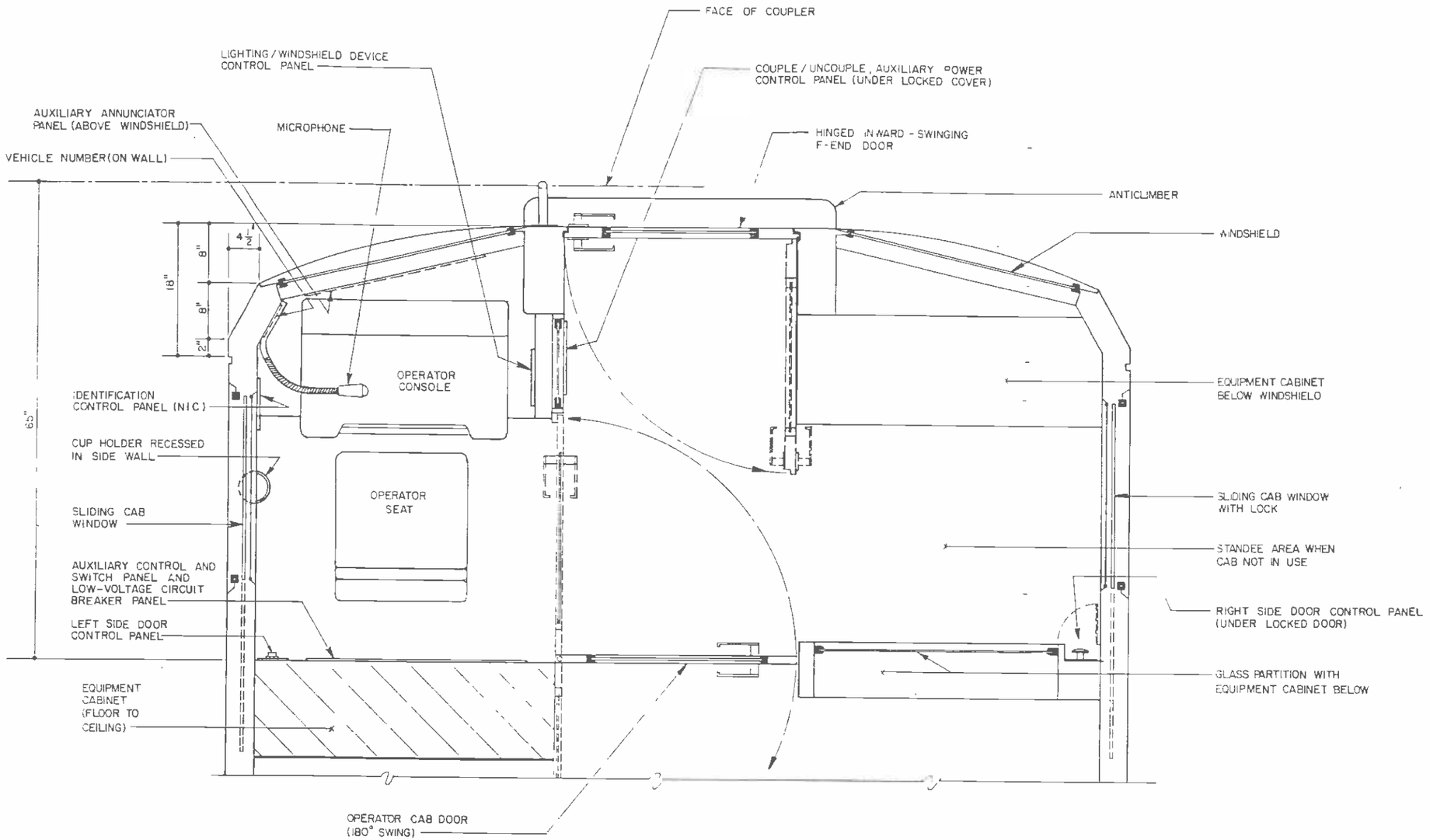
DMJM/PBQD/KE/HWA
A JOINT VENTURE
GENERAL CONSULTANTS

APPROVED Howard J. Chadick

PASSENGER VEHICLE MOLDED FIBERGLASS PASSENGER SEAT DETAILS

CONTRACT NO. A650
DRAWING NO. V-008
REV.
SCALE NO SCALE
SHEET NO 8

This drawing declares the contemplated vehicle general arrangement required to meet the Technical Provisions. Other configurations which are also in conformance may be proposed, for approval of the District.



HALF SIZE

REV.	DATE	BY	SUB.	APP	DESCRIPTION
0	3/16/77				PROPOSAL ISSUE

THE PREPARATION OF THIS DRAWING HAS BEEN FINANCED IN PART THROUGH A GRANT FROM THE U.S. DEPARTMENT OF TRANSPORTATION, URBAN MASS TRANSPORTATION ADMINISTRATION, UNDER THE URBAN MASS TRANSPORTATION ACT OF 1964, AS AMENDED, AND IN PART BY THE TAXES OF THE CITIZENS OF LOS ANGELES COUNTY AND OF THE STATE OF CALIFORNIA

DESIGNED BY
DRAWN BY
CHECKED BY
IN CHARGE
DATE 9 JAN 85

JOHN NICHOLAS BROWN — EXP 9/30/86 — No. 22144 — MECHANICAL — STATE OF CALIFORNIA

SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT
METRO RAIL PROJECT
RTD

SUBMITTED J.N. Brown

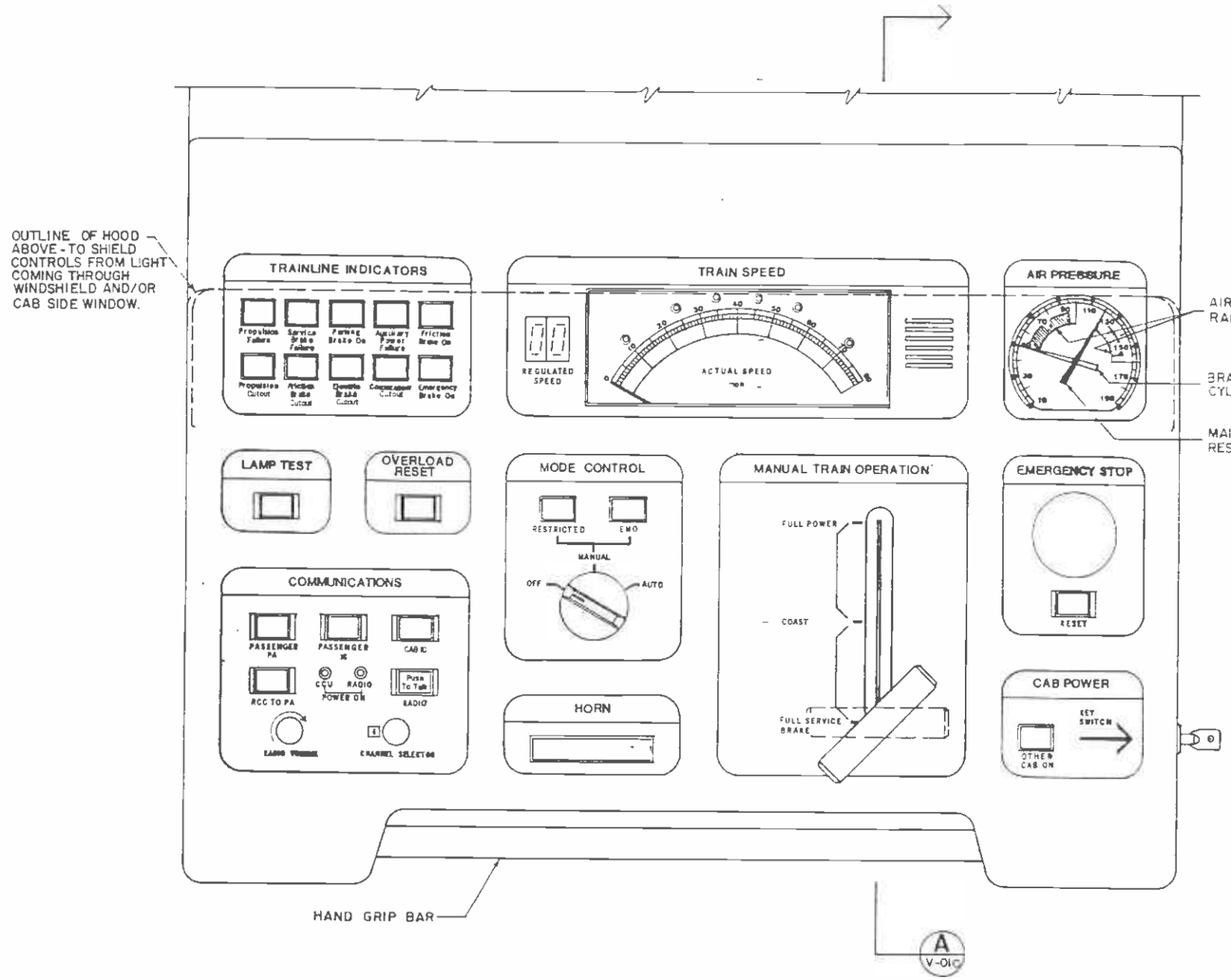
DMJM/PBQD/KE/HWA
A JOINT VENTURE
GENERAL CONSULTANTS

APPROVED

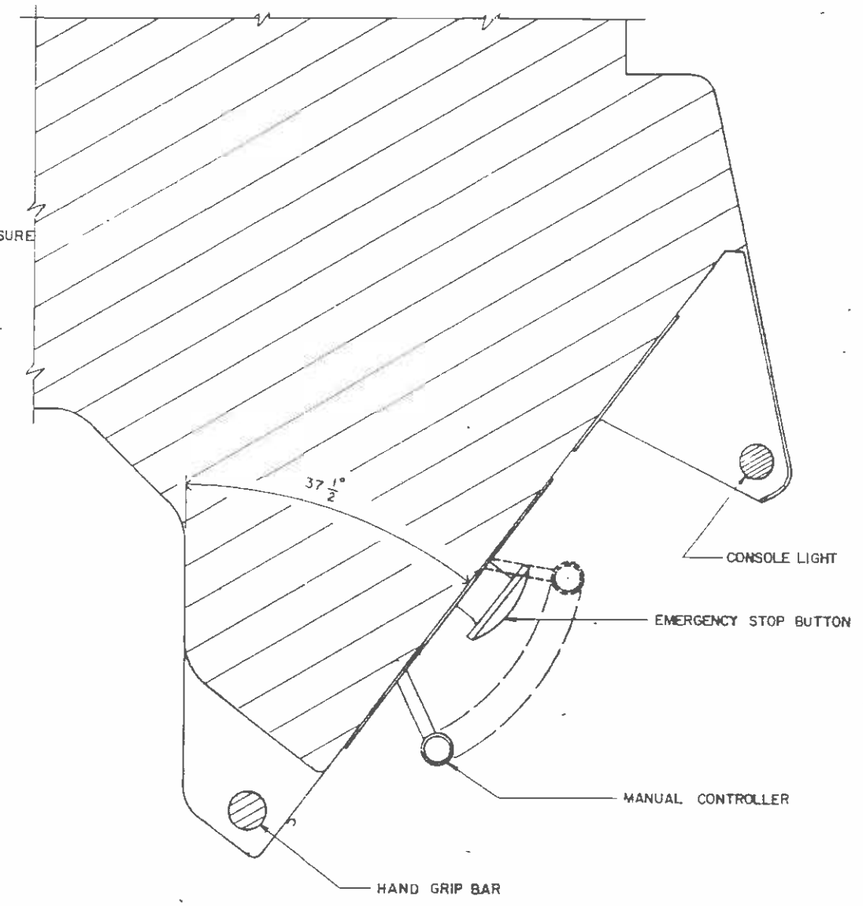
PASSENGER VEHICLE OPERATOR CAB PLAN

CONTRACT NO. A 650
DRAWING NO. V-009
REV. 0
SCALE NO SCALE
SHEET NO. 9

This drawing discloses the contemplated vehicle general arrangement required to meet the Technical Provisions. Other configurations which are also in conformance may be proposed, for approval of the District.



PLAN VIEW



SECTION A V-010

HALF SIZE

REV.	DATE	BY	SUB.	APP.	DESCRIPTION
0	3/16/87				PROPOSAL ISSUE

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DESIGNED BY
DRAWN BY
CHECKED BY
IN CHARGE
DATE 12 FEB 85

SEAL NOT APPLICABLE

SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT
METRO RAIL PROJECT

SUBMITTED J. N. Brown

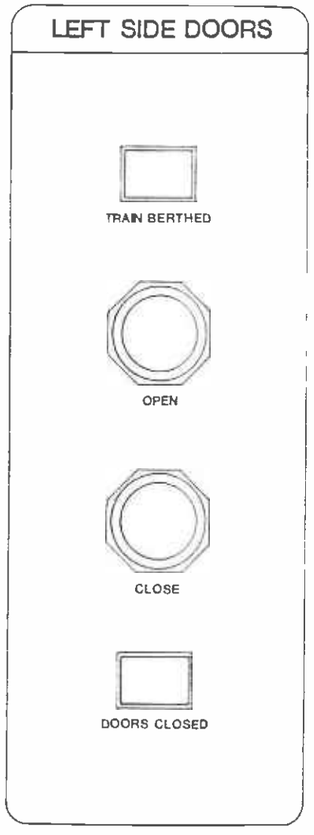
DMJM/PBQD/KE/HWA
A JOINT VENTURE
GENERAL CONSULTANTS

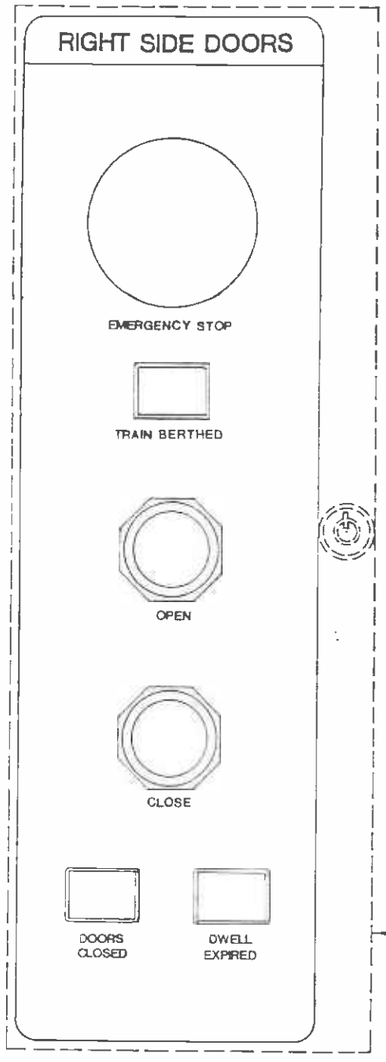
APPROVED

PASSENGER VEHICLE OPERATOR CONSOLE

CONTRACT NO. A 650
DRAWING NO. V-010 REV. 0
SCALE HALF SIZE
SHEET NO. 10

This drawing discloses the contemplated vehicle general arrangement required to meet the Technical Provisions. Other configurations which are also in conformance may be proposed, for approval of the District.





HALF SIZE

REV.	DATE	BY	SUB.	APP.	DESCRIPTION
0	3/16/87				PROPOSAL ISSUE

THE PREPARATION OF THIS DRAWING HAS BEEN FINANCED IN PART THROUGH A GRANT FROM THE U. S. DEPARTMENT OF TRANSPORTATION, URBAN MASS TRANSPORTATION ADMINISTRATION, UNDER THE URBAN MASS TRANSPORTATION ACT OF 1964, AS AMENDED, AND IN PART BY THE TAXES OF THE CITIZENS OF LOS ANGELES COUNTY AND OF THE STATE OF CALIFORNIA

DESIGNED BY
DRAWN BY
CHECKED BY
IN CHARGE
DATE 14 FEB 85

SEAL NOT APPLICABLE

SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT
METRO RAIL PROJECT

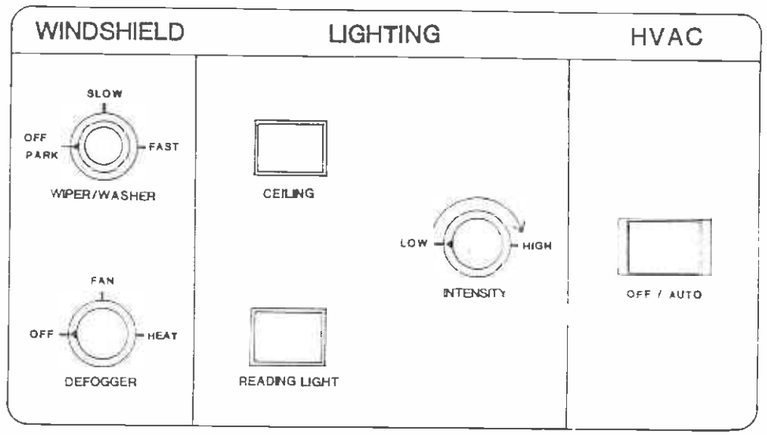
SUBMITTED J. N. Brown

DMJM/PBQD/KE/HWA
A JOINT VENTURE
GENERAL CONSULTANTS
APPROVED Howard Hadcliff

PASSENGER VEHICLE LEFT / RIGHT SIDE DOOR CONTROL PANELS

CONTRACT NO. A 650
DRAWING NO. V-012
REV. 0
SCALE FULL SIZE
SHEET NO. 12

This drawing depicts the contemplated vehicle general arrangement designed to meet the Technical Provisions. Other configurations which are also in conformance may be proposed, for approval at the District.



HALF SIZE

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REV.	DATE	BY	SUB.	APP.	DESCRIPTION
0	3/15/87				PROPOSAL ISSUE

DESIGNED BY P. Karlen
DRAWN BY P. Karlen
CHECKED BY
IN CHARGE
DATE 14 FEB 85

SEAL NOT APPLICABLE

SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT
METRO RAIL PROJECT
RTD

SUBMITTED J. M. Brown

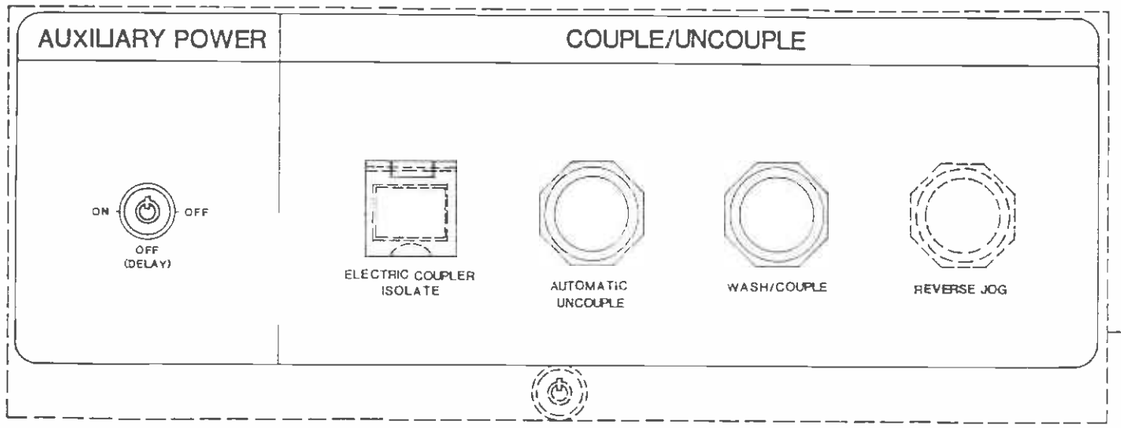
DMJM/PBQD/KE/HWA
A JOINT VENTURE
GENERAL CONSULTANTS

APPROVED

PASSENGER VEHICLE LIGHTING / WINDSHIELD DEVICE CONTROL PANEL

CONTRACT NO. A 650
DRAWING NO. V-013
REV. 0
SCALE FULL SIZE
SHEET NO. 13

This drawing displays the contemplated vehicle general arrangement required to meet the Technical Provisions. Other configurations which are also in conformance may be proposed, for approval of the District.



PRINT HALF SIZE

REV.	DATE	BY	SUB.	APP.	DESCRIPTION
0	3/16/87				PROPOSAL ISSUE

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DESIGNED BY P. Vaclav
DRAWN BY P. Vaclav
CHECKED BY 9/15 D.T. Cave
IN CHARGE R. Schmidt
DATE 14 FEB 85

SEAL NOT APPLICABLE

SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT
METRO RAIL PROJECT
RTD

SUBMITTED J N Brown

DMJM/PBQD/KE/HWA
A JOINT VENTURE
GENERAL CONSULTANTS

APPROVED Howard Kehl

PASSENGER VEHICLE COUPLE/UNCOUPLE, AUXILIARY POWER CONTROL PANEL

CONTRACT NO. A 650
DRAWING NO. V - 014
REV 0
SCALE FULL SIZE
SHEET NO. 14

This drawing displays the contemplated vehicle general arrangement required to meet the Technical Provisions. Other configurations which are also in conformance may be proposed, for approval of the District.

AUXILIARY ANNUNCIATOR PANEL

PROPULSION

- PROPULSION CUTOUT
- PROPULSION FAILURE
- ELECTRIC BRAKE FAILURE
- SPARE

FRICTION BRAKES

- SERVICE BRAKE FAILURE
- FRICTION BRAKE ON
- COMPRESSOR CUTOUT
- FRICTION BRAKE CUTOUT

AUXILIARIES

- AUXILIARY POWER FAILURE
- LVPS FAILURE
- HVAC FAILURE
- SPARE

MISCELLANEOUS

- ZERO SPEED
- DOOR CUTOUT

PRINT HALF SIZE

REV.	DATE	BY	SUB.	APP.	DESCRIPTION
0	3/16/87				PROPOSAL ISSUE

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DESIGNED BY P. Karlsen
DRAWN BY P. Karlsen
CHECKED BY [illegible]
IN CHARGE [illegible]
DATE 15 FEB 85

SEAL NOT APPLICABLE

SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT
METRO RAIL PROJECT
RTD

SUBMITTED J. N. Brown

DMJM/PBQD/KE/HWA
A JOINT VENTURE
GENERAL CONSULTANTS

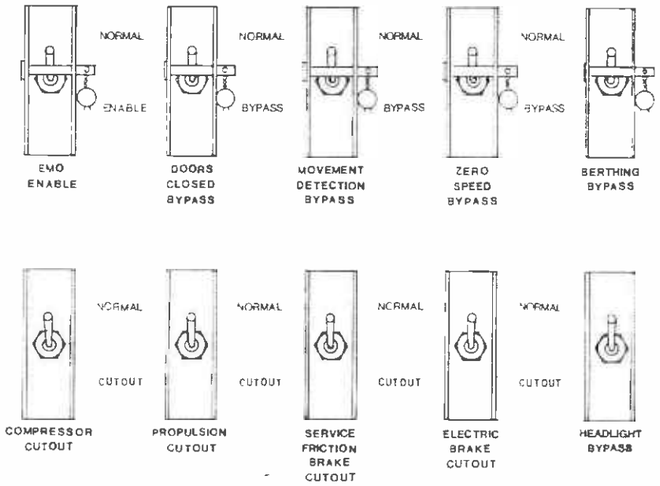
APPROVED [illegible]

PASSENGER VEHICLE AUXILIARY ANNUNCIATOR PANEL

CONTRACT NO. A 650
DRAWING NO. V-015 REV. 0
SCALE FULL SIZE
SHEET NO. 15

This drawing depicts the contemplated vehicle general arrangement required to meet the Technical Provisions. Other configurations which are also in conformance may be proposed for approval of the District.

AUXILIARY CONTROL AND SWITCH PANEL



HALF SIZE

REV.	DATE	BY	SUB	APP.	DESCRIPTION
0	5/6/87				PROPOSAL ISSUE

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DESIGNED BY P. Karlen
DRAWN BY P. Karlen
CHECKED BY T.K. Sabin
IN CHARGE R. Smith
DATE 15 FEB 85

SEAL NOT APPLICABLE

SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT
METRO RAIL PROJECT
RTD

SUBMITTED J.N. Brown

DMJM/PBQD/KE/HWA
A JOINT VENTURE
GENERAL CONSULTANTS

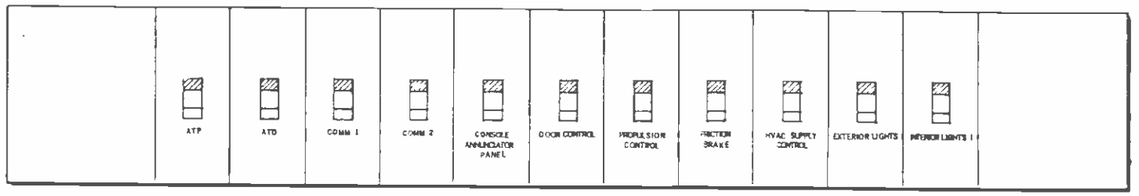
APPROVED Howard Scheid

PASSENGER VEHICLE AUXILIARY CONTROL AND SWITCH PANEL

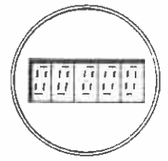
CONTRACT NO. A 650
DRAWING NO. V-016
REV. 0
SCALE FULL SIZE
SHEET NO. 16

This drawing discloys the commercialized vehicle general arrangement required to meet the Technical Provisions. Other configurations which are also in conformance may be proposed, for approval of the District.

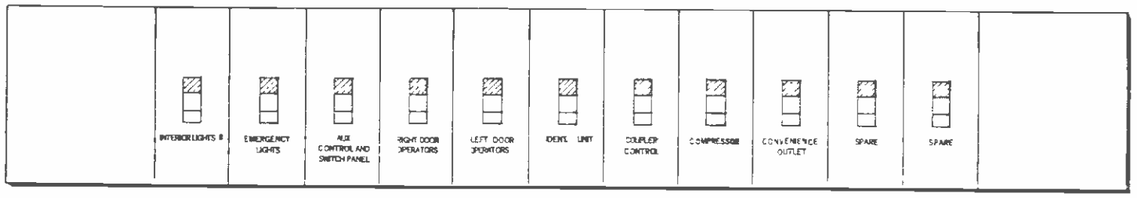
LOW-VOLTAGE CIRCUIT BREAKER PANEL

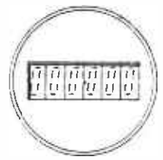


HOUR METER
AT SPEED



HOUR METER
AUXILIARIES





MILEAGE ODOMETER

HALF SIZE

REV.	DATE	BY	SUB	APP.	DESCRIPTION
0	3/16/87				PROPOSAL ISSUE

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DESIGNED BY P Vanlaw
DRAWN BY P Vanlaw
CHECKED BY T.C. McGraw
IN CHARGE R. Scott Ball
DATE 19 FEB 85

SEAL NOT APPLICABLE

SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT
METRO RAIL PROJECT
RTD

SUBMITTED J.N. Brown

DMJM/PBQD/KE/HWA
A JOINT VENTURE
GENERAL CONSULTANTS

APPROVED Ronald Hadcock

PASSENGER VEHICLE LOW-VOLTAGE CIRCUIT BREAKER PANEL

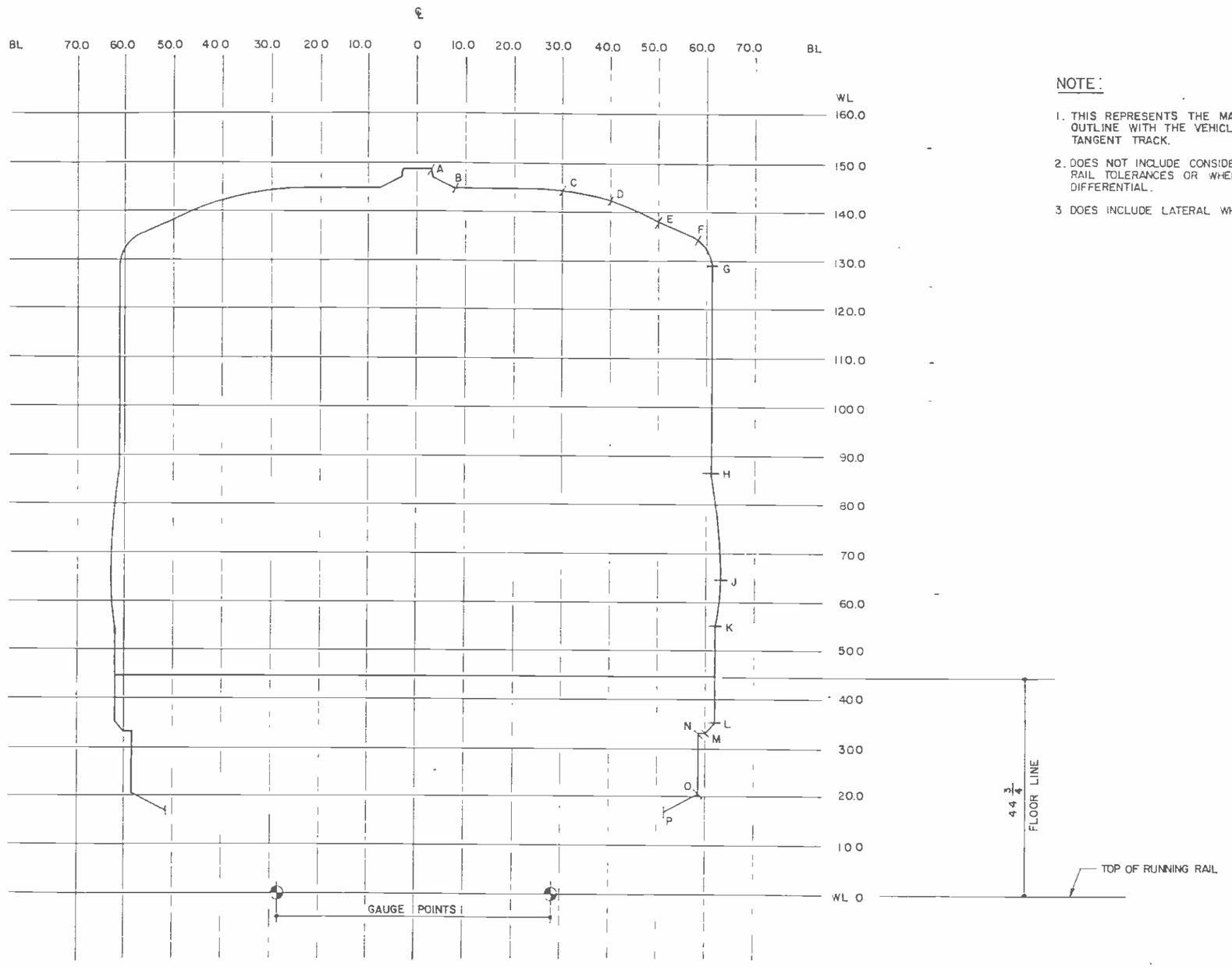
CONTRACT NO. A 650
DRAWING NO. V-017 REV. 0
SCALE FULL SIZE
SHEET NO. 17

COORDINATES		
POINT	BL	WL
A	3.0	148.687
B	8.0	144.75
C	30.0	144.5
D	40.0	142.25
E	50.0	138.0
F	58.0	134.5
G	61.0	129.0
H	61.0	86.5
J	63.0	64.38
K	62.0	55.0
L	62.0	35.37
M	60.187	33.0
N	58.625	33.0
O	58.625	20.25
P	51.56	16.625

ALL DIMENSIONS IN INCHES

BL = BUTT LINE – DISTANCE FROM VEHICLE CENTERLINE

WL = WATER LINE – DISTANCE FROM TOP OF RUNNING RAIL



NOTE:

1. THIS REPRESENTS THE MAXIMUM ALLOWABLE OUTLINE WITH THE VEHICLE STATIONARY ON LEVEL TANGENT TRACK.
2. DOES NOT INCLUDE CONSIDERATION OF RAIL WEAR, RAIL TOLERANCES OR WHEEL GAUGE/RAIL GAUGE DIFFERENTIAL.
3. DOES INCLUDE LATERAL WHEEL WEAR OF $\frac{1}{4}$" INCH.

HALF SIZE

REV.	DATE	BY	SUB.	APP	DESCRIPTION
0	3/6/87				PROPOSAL ISSUE

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DESIGNED BY D. Karlen
DRAWN BY Vrudkovsky
CHECKED BY R. Schmidt
IN CHARGE R. Schmidt
DATE 21 OCT 83

REGISTERED PROFESSIONAL ENGINEER JOHN WILHOLT BROWN EXP 9/30/88 NO. 22744 MECHANICAL STATE OF CALIFORNIA

SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT
METRO RAIL PROJECT
RTD

SUBMITTED J. M. Brown

DMJM/PBQD/KE/HWA
A JOINT VENTURE
GENERAL CONSULTANTS

APPROVED Edward J. Schaefer

PASSENGER VEHICLE MAXIMUM STATIC OUTLINE

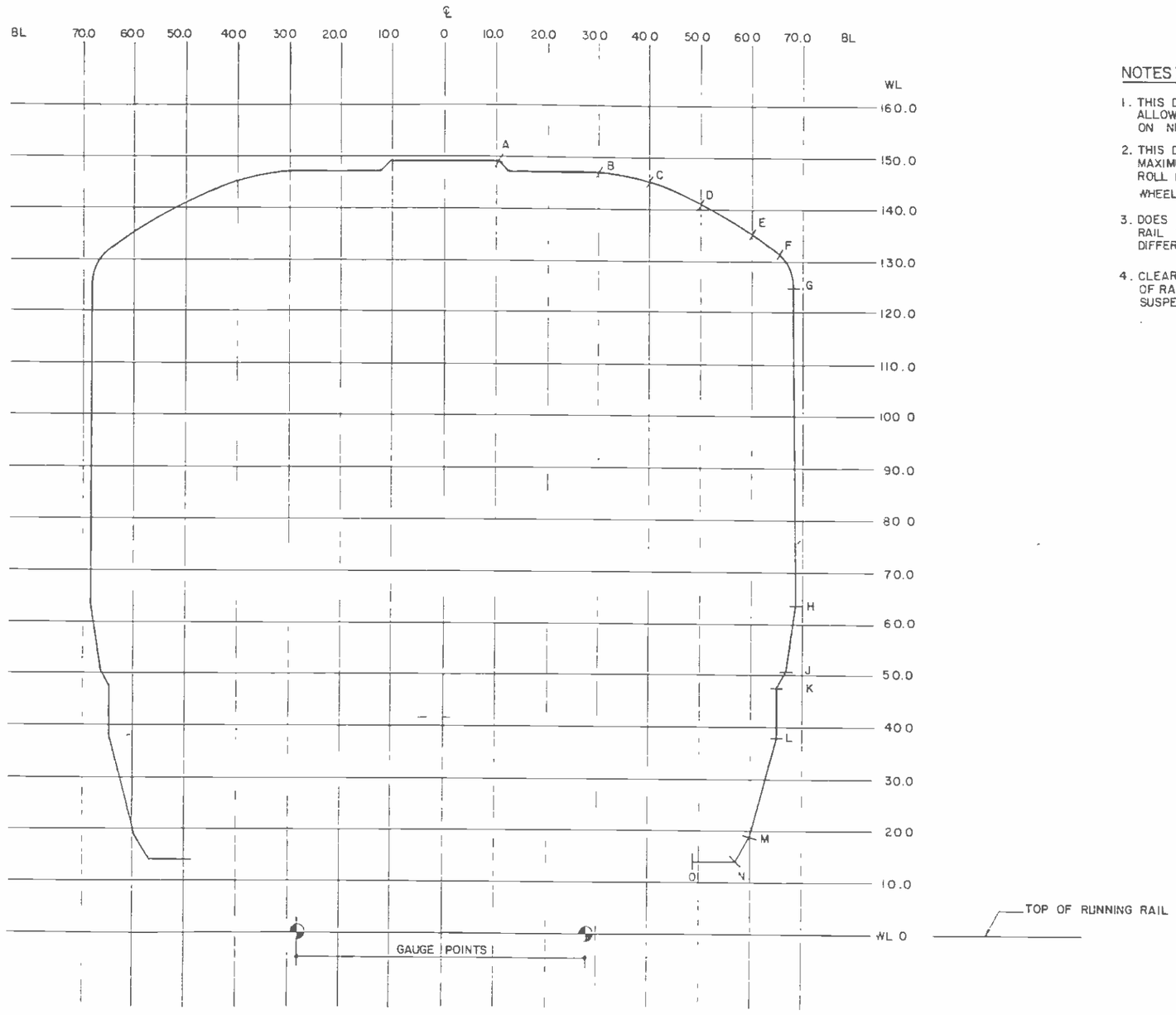
CONTRACT NO. A 650
DRAWING NO. V-018
REV. 0
SCALE 1"=1'-0
SHEET NO. 18

COORDINATES		
POINT	BL	WL
A	10.5	149.625
B	30.0	147.25
C	40.0	145.5
D	50.0	141.0
E	60.0	135.35
F	65.25	131.5
G	68.0	125.0
H	68.5	63.5
J	66.75	51.0
K	65.0	47.5
L	65.0	38.0
M	59.75	18.875
N	57.0	14.130
O	48.8	14.130

ALL DIMENSIONS IN INCHES

BL = BUTT LINE - DISTANCE FROM VEHICLE CENTERLINE

WL = WATER LINE - DISTANCE FROM TOP OF RUNNING RAIL



NOTES:

1. THIS DYNAMIC OUTLINE REPRESENTS THE MAXIMUM ALLOWED EXCURSION WITH MAXIMUM DIAMETER WHEELS ON NEW TANGENT TRACK.
2. THIS DYNAMIC OUTLINE INCLUDES THE SUM OF ALL MAXIMUM VERTICAL (UP AND DOWN), LATERAL, YAW & ROLL MOTIONS OF THE COMPOSITE VEHICLE WITH WHEELS WORN LATERALLY $\frac{1}{4}$ INCH.
3. DOES NOT INCLUDE CONSIDERATION OF RAIL WEAR, RAIL TOLERANCES OR WHEEL GAUGE / RAIL GAUGE DIFFERENTIAL.
4. CLEARANCE (BETWEEN EQUIPMENT AND PLANE OF TOP OF RAILS) FOR WORST CASE FAILURE OF SECONDARY SUSPENSION SHALL BE
   a. UNDER TRUCK 2 IN. MIN.
   b. UNDER VEHICLE 4 IN. MIN.

PRINT HALF SIZE

REV.	DATE	BY	SUB.	APP.	DESCRIPTION
0	3/16/87				PROPOSAL ISSUE

THE PREPARATION OF THIS DRAWING HAS BEEN FINANCED IN PART THROUGH A GRANT FROM THE U. S. DEPARTMENT OF TRANSPORTATION, URBAN MASS TRANSPORTATION ADMINISTRATION, UNDER THE URBAN MASS TRANSPORTATION ACT OF 1964, AS AMENDED, AND IN PART BY THE TAXES OF THE CITIZENS OF LOS ANGELES COUNTY AND OF THE STATE OF CALIFORNIA

DESIGNED BY P. Kaden
DRAWN BY P. Vinokurov
CHECKED BY J. Gottwald
IN CHARGE J. Gottwald
DATE 12 SEPT 84

REGISTERED PROFESSIONAL ENGINEER JOHN NICHOLAS BROWN EXP 7/30/88 NO. 32744 MECHANICAL STATE OF CALIFORNIA

SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT
METRO RAIL PROJECT
RTD

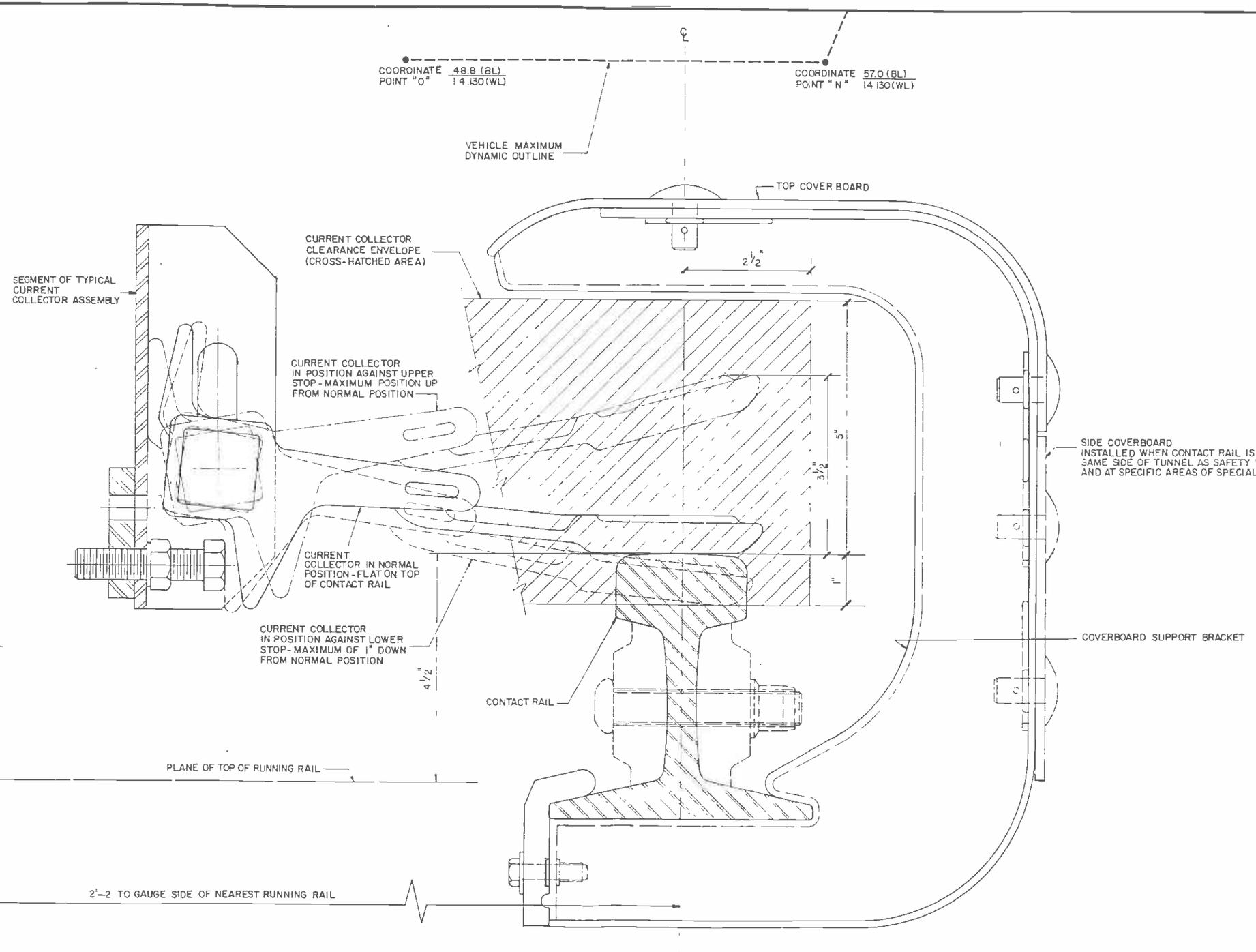
SUBMITTED J. N. Brown

DMJM/PBQD/KE/HWA
A JOINT VENTURE
GENERAL CONSULTANTS

APPROVED Howard H. Cahill

PASSENGER VEHICLE MAXIMUM DYNAMIC OUTLINE

CONTRACT NO. A 650
DRAWING NO. V-019
REV 0
SCALE 1"=1'-0"
SHEET NO 19



PRINT HALF SIZE

REV.	DATE	BY	SUB.	APP.	DESCRIPTION
0	3/16/87				PROPOSAL ISSUE

THE PREPARATION OF THIS DRAWING HAS BEEN FINANCED IN PART THROUGH A GRANT FROM THE U. S. DEPARTMENT OF TRANSPORTATION, URBAN MASS TRANSPORTATION ADMINISTRATION, UNDER THE URBAN MASS TRANSPORTATION ACT OF 1964, AS AMENDED, AND IN PART BY THE TAXES OF THE CITIZENS OF LOS ANGELES COUNTY AND OF THE STATE OF CALIFORNIA

DESIGNED BY P. Karlen
DRAWN BY P. Karlen
CHECKED BY T. Sive
IN CHARGE J. N. Brown
DATE 7 OCT 85

REGISTERED PROFESSIONAL ENGINEER JOHN NICHOLAS BROWN 669 9/30/88 NO. 22744 J. N. Brown MECHANICAL STATE OF CALIFORNIA

SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT
METRO RAIL PROJECT
RTD

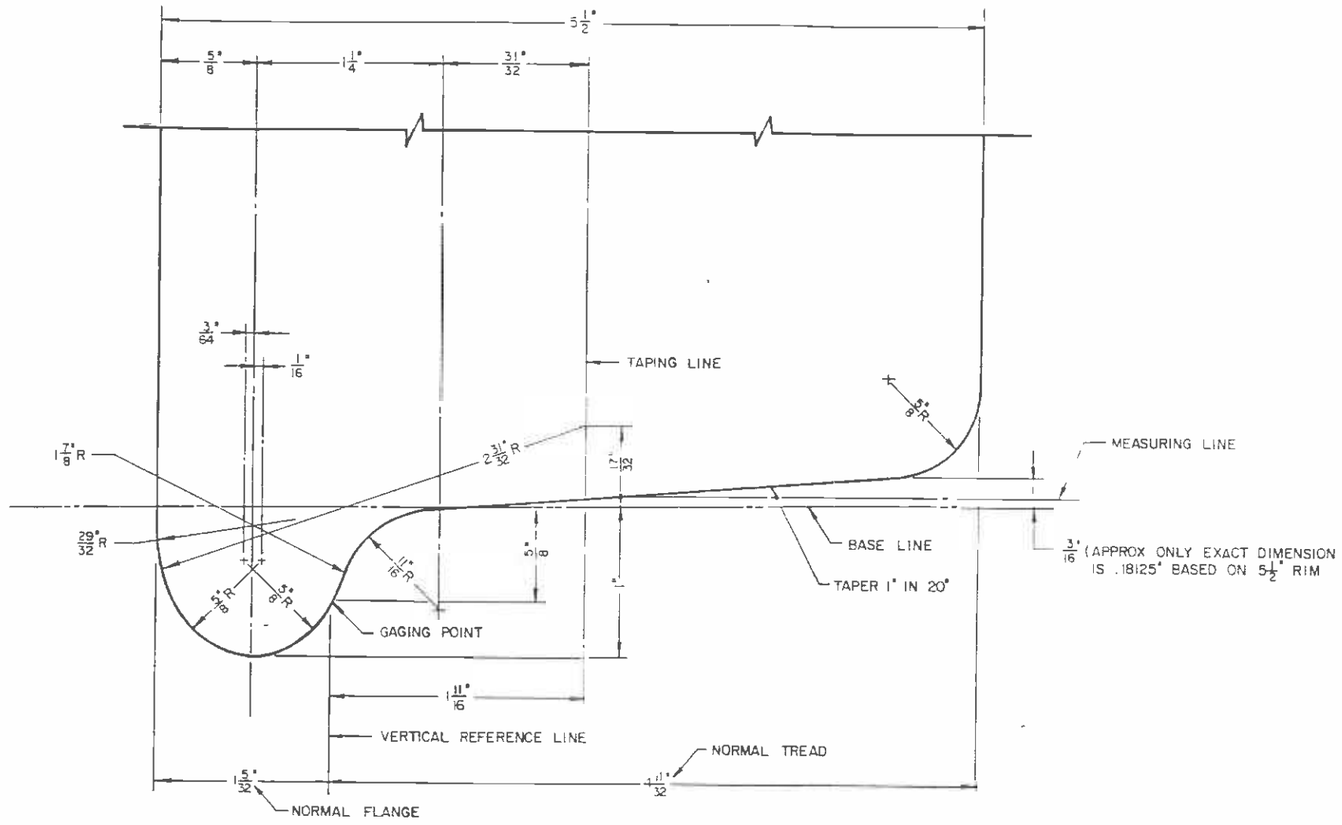
SUBMITTED J. N. Brown

DMJM/PBQD/KE/HWA
A JOINT VENTURE
GENERAL CONSULTANTS

APPROVED Howard Whitehill

PASSENGER VEHICLE
CURRENT COLLECTOR/COVERBOARD RELATIONSHIP

CONTRACT NO. A 650
DRAWING NO. V-020 REV. 0
SCALE FULL SIZE
SHEET NO. 20



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REV.	DATE	BY	SUB.	APP.	DESCRIPTION
0	3/16/87				PROPOSAL ISSUE

DESIGNED BY C. E. Vaun
DRAWN BY Y. M. Oh
CHECKED BY Paul Bendekgey
IN CHARGE W. J. Paddon
DATE 17 OCT 84

SEAL NOT APPLICABLE

SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT
METRO RAIL PROJECT

SUBMITTED U. M. Brown

DMJM/PBQD/KE/HWA
A JOINT VENTURE
GENERAL CONSULTANTS

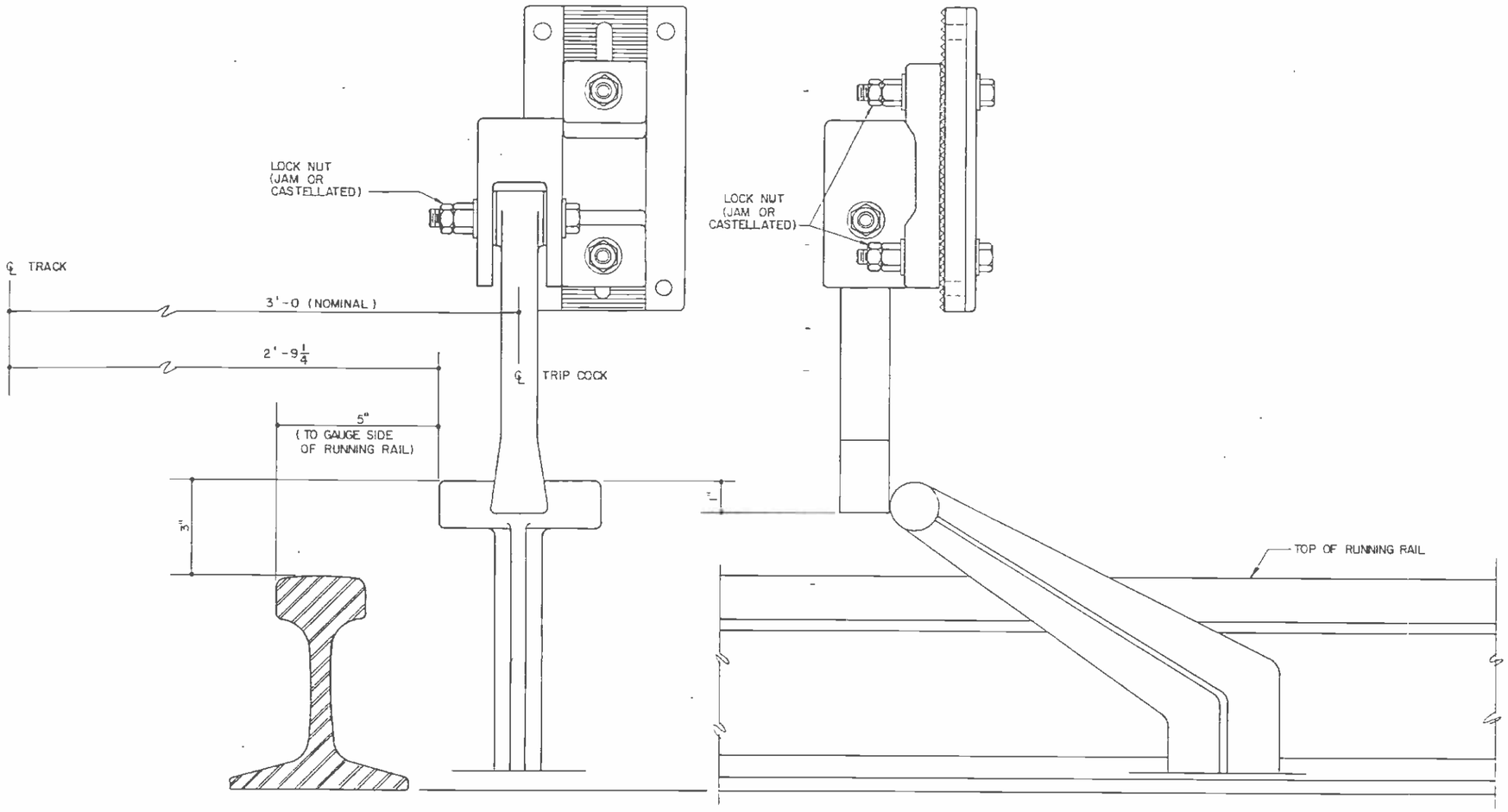
APPROVED Edward J. Kaminski

PASSENGER VEHICLE WHEEL TREAD CONTOUR

CONTRACT NO. A 650
DRAWING NO. V-021
REV. 0
SCALE NO SCALE
SHEET NO 21

HALF SIZE

This drawing displays the commercialized vehicle general arrangement required to meet the Technical Provisions. Other configurations which are also in conformance may be proposed, for approval at the District.



VIEW LOOKING IN DIRECTION OF TRAVEL

DIRECTION OF TRAVEL

HALF SIZE

REV.	DATE	BY	SUB.	APP.	DESCRIPTION
0	3/16/93				PROPOSAL ISSUE

THE PREPARATION OF THIS DRAWING HAS BEEN FINANCED IN PART THROUGH A GRANT FROM THE U. S. DEPARTMENT OF TRANSPORTATION, URBAN MASS TRANSPORTATION ADMINISTRATION, UNDER THE URBAN MASS TRANSPORTATION ACT OF 1964, AS AMENDED, AND IN PART BY THE TAXES OF THE CITIZENS OF LOS ANGELES COUNTY AND OF THE STATE OF CALIFORNIA

DESIGNED BY P. Farlow
DRAWN BY R.D. Vega
CHECKED BY
IN CHARGE
DATE 21 OCT 93

SEAL NOT APPLICABLE

SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT
METRO RAIL PROJECT
RTD

SUBMITTED J.N. Brown

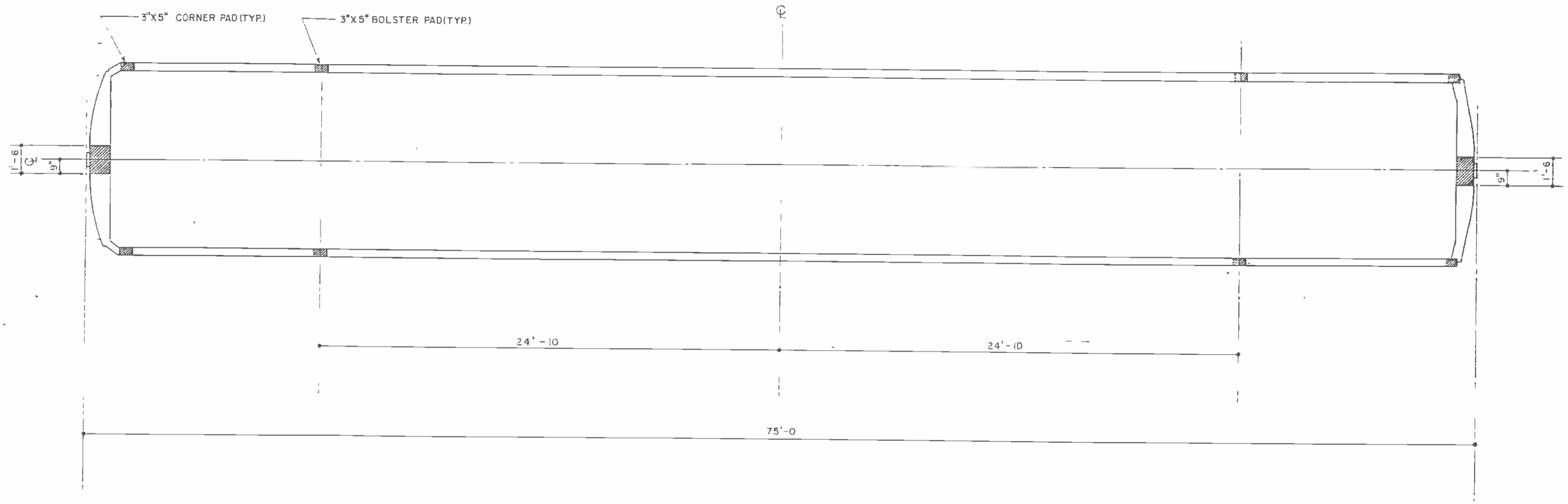
DMJM/PBQD/KE/HWA
A JOINT VENTURE
GENERAL CONSULTANTS

APPROVED Howard Hadcliff

PASSENGER VEHICLE TRIP COCK INSTALLATION

CONTRACT NO. A 650
DRAWING NO V-022
REV 0.
SCALE NO SCALE
SHEET NO. 22

This drawing displays the contemplated vehicle general arrangement
required to meet the Technical Provisions. Other configurations which
are also in conformance may be proposed, for approval of the District.



HALF SIZE

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REV.	DATE	BY	SUB.	APP.	DESCRIPTION
0	8/16/84				PROPOSAL ISSUE

DESIGNED BY
DRAWN BY
CHECKED BY
IN CHARGE
DATE 5 OCT 84

REGISTERED PROFESSIONAL ENGINEER — JOHN NICHOLAS BROWN — Exp 9/30/86 — No. 22744 — MECHANICAL — STATE OF CALIFORNIA

SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT
METRO RAIL PROJECT

RTD

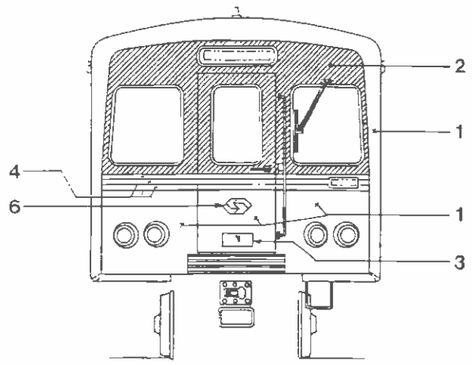
DMJM/PBQD/KE/HWA
A JOINT VENTURE
GENERAL CONSULTANTS

SUBMITTED J.N. Brown

APPROVED Howard H. Ledyard

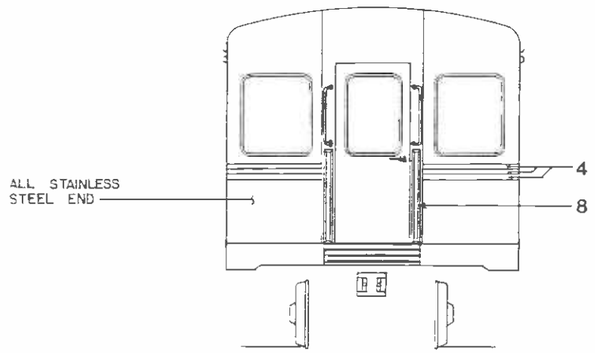
PASSENGER VEHICLE JACKING PAD LOCATIONS

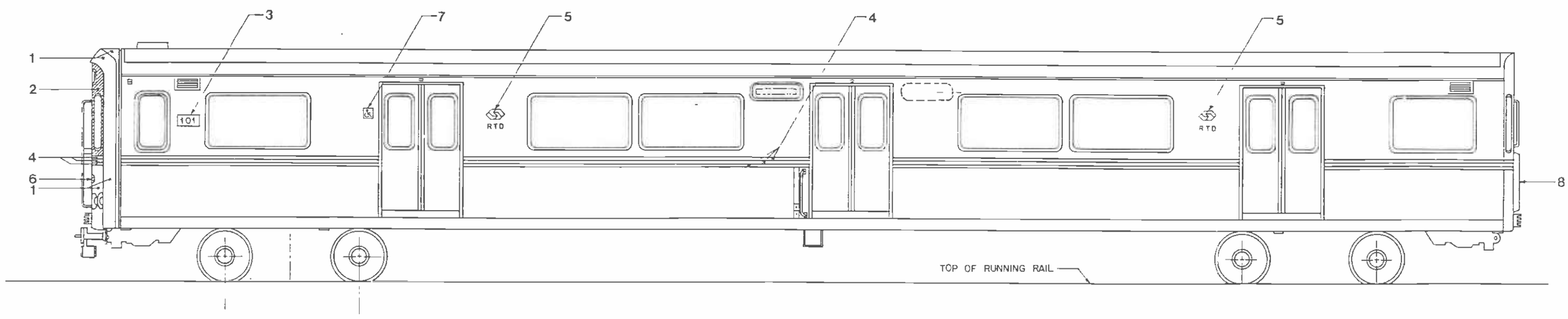
CONTRACT NO. A 650
DRAWING NO. V-023
REV. 0
SCALE NO SCALE
SHEET NO. 23



LOCATION	MATERIAL	COLOR
1 F-END FIBERGLASS SHELL	GELCOAT	WHITE
2 F-END FIBERGLASS SHELL	GELCOAT	BLACK
3 CAR NUMBER	STAINLESS STEEL PLATE	4" HIGH HELVETICA MEDIUM NUMERALS - DEEP ETCHED AND BLACK FILLED
4 SCRTD STRIPING	PRESSURE SENSITIVE 3-M SCOTCHCAL	TOP STRIPE - RED MIDDLE STRIPE - ORANGE BOTTOM STRIPE - YELLOW
5 SCRTD LOGO (WITH "RTD")	PRESSURE SENSITIVE 3-M SCOTCHCAL	RED ON WHITE BACKGROUND, WITH BLACK LETTERS
6 SCRTD LOGO (WITHOUT "RTD")	PRESSURE SENSITIVE 3-M SCOTCHCAL	RED ON WHITE BACKGROUND
7 INTERNATIONAL WHEELCHAIR SYMBOL	ANODIZED ALUMINUM (TYPE "M" SATIN FINISH)	BLUE ON SATIN FINISH ALUMINUM
8 INTERCAR ENCLOSURE	HARD RUBBER	BLACK

NOTE: LOGO MASTER ART AND COLOR SPECIFICATIONS WILL BE PROVIDED BY THE DISTRICT.





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REV.	DATE	BY	SUB.	APP.	DESCRIPTION
0	3/6/87				PROPOSAL ISSUE

DESIGNED BY
DRAWN BY
CHECKED BY
IN CHARGE
DATE 28 JAN 85

SEAL NOT APPLICABLE

SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT
METRO RAIL PROJECT
RTD

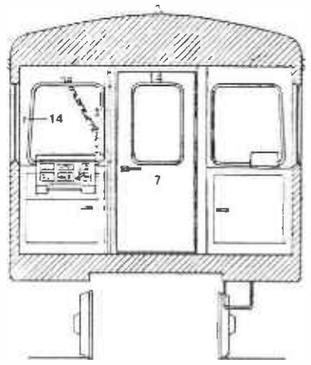
SUBMITTED J. N. Brown

DMJM/PBQD/KE/HWA
A JOINT VENTURE
GENERAL CONSULTANTS

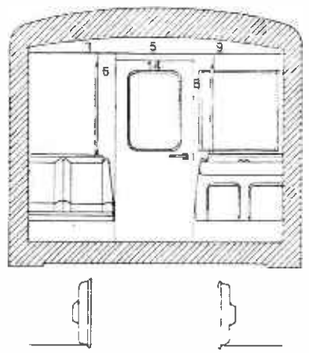
APPROVED

PASSENGER VEHICLE EXTERIOR GRAPHICS/COLOR SCHEME

CONTRACT NO. A 650
DRAWING NO. V-024
REV. 0
SCALE NO SCALE
SHEET NO. 24

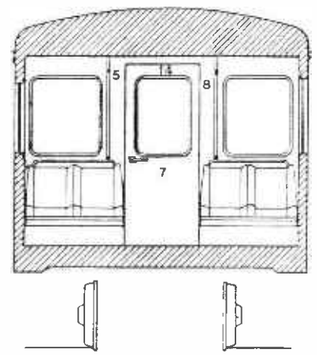


SECTION A

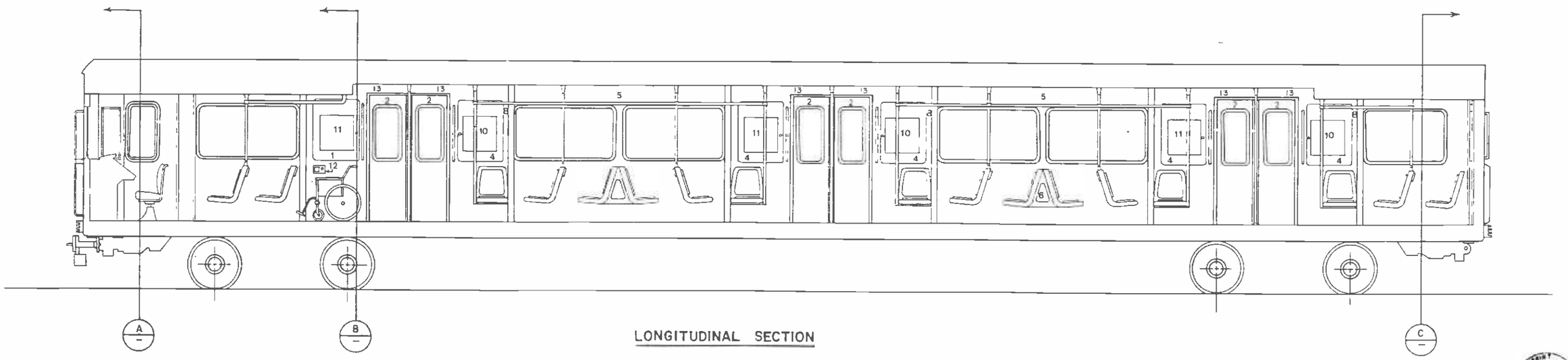


SECTION B

LOCATION	SIGN TEXT (OR SYMBOL)
1	WHEELCHAIR
2	"DO NOT LEAN AGAINST DOORS"
3	"EATING AND DRINKING PROHIBITED"
4	"PRIORITY SEATING FOR ELDERLY AND HANDICAPPED"
5	"NO SMOKING"
6	"FIRE EXTINGUISHER"
7	"NO PASSAGE THROUGH END DOOR - EMERGENCY ONLY"
8	"EMERGENCY DOOR RELEASE (PULL HANDLE)"
9	"RADIO PLAYING PROHIBITED WITHOUT USE OF EARPHONES"
10	SYSTEM MAP
11	ADVERTISING
12	"FOR EMERGENCY ONLY - PUSH TO TALK - THIS IS CAR #____."
13	DOOR LEAF NUMBER (1 THROUGH 12), AS SHOWN IN DWG V-004
14	VEHICLE NUMBER



SECTION C



LONGITUDINAL SECTION

HALF SIZE

REV.	DATE	BY	SUB.	APP.	DESCRIPTION
0	3/16/87				PROPOSAL ISSUE

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DESIGNED BY
DRAWN BY
CHECKED BY
IN CHARGE
DATE 31 JAN 85

SEAL NOT APPLICABLE

SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT
METRO RAIL PROJECT
RTD

SUBMITTED

DMJM/PBQD/KE/HWA
A JOINT VENTURE
GENERAL CONSULTANTS
APPROVED

PASSENGER VEHICLE INTERIOR GRAPHICS/COLOR SCHEME

CONTRACT NO. A 650
DRAWING NO. V-025
REV. 0
SCALE NO SCALE
SHEET NO. 25

SCRTD METRO RAIL PROJECT

CHECKLIST OF DESIGN PROVISIONS VERSUS ◊1 PUC REQUIREMENTS

PASSENGER VEHICLE CONTRACT A650 VERSUS GENERAL ORDER NO. 127

G.O. NO. 127 REQUIREMENT		A650 CONTRACT DOCUMENTS				* CONTRACTOR DESIGN DOCUMENTS
		TECHNICAL PROVISIONS		CONTRACT DRAWINGS		
NO.	DESCRIPTION	SECTION NO. / TITLE	ARTICLE	NO.	TITLE	
SECTION 2	GENERAL REQUIREMENTS				-	
2.2	PLANS TO BE FILED					
2.2(a)	FUNCTIONAL DESCRIPTION & BLOCK DIAGRAM OF ATP	16/AUTOMATIC TRAIN CONTROL	16.2	N/A	N/A	
		20/MANAGEMENT PROGRAM	20.6.11			
		SEE ALSO A620 CONTRACT (AUTOMATIC TRAIN CONTROL) DOCUMENTS				
2.2(b)	SCHEDULE OF WORK	20/MANAGEMENT PROGRAM	20.2.2	N/A	N/A	
		SEE ALSO A620 CONTRACT (AUTOMATIC TRAIN CONTROL) DOCUMENTS				
		SEE ALSO A640 CONTRACT (COMMUNICATIONS) DOCUMENTS			-	
2.2(c)	SCHEMATIC DIAGRAMS OF ATP EQUIPMENT & CIRCUITS	4/INTERFACES	4.2.1	Q-087 **	AUTOMATIC TRAIN CONTROL PASSENGER VEHICLE INTERFACE	
		20/MANAGEMENT PROGRAM	20.6.10	Q-088 **	AUTOMATIC TRAIN CONTROL PASSENGER VEHICLE INTERFACE	
				Q-089 **	AUTOMATIC TRAIN CONTROL PASSENGER VEHICLE INTERFACE	
		SEE ALSO A620 CONTRACT (AUTOMATIC TRAIN CONTROL) DOCUMENTS				
2.2(d)	EQUIPMENT ARRANGEMENT DRAWINGS	20/MANAGEMENT PROGRAM	20.6.10	V-004	GENERAL ARRANGEMENT / SIDE ELEVATION	
				V-005	F-END / R-END ELEVATIONS	-
				V-006	LONGITUDINAL SECTION / REFLECTED CEILING PLAN	
				V-009	OPERATOR CAB PLAN	
				V-010	OPERATOR CONSOLE	
				V-012	LEFT / RIGHT SIDE DOOR CONTROL PANELS	
				V-015	AUXILIARY ANNUNCIATOR PANEL	
				V-016	AUXILIARY CONTROL AND SWITCH PANEL	

CONTINUES AT RIGHT

G.O. NO. 127 REQUIREMENT		A650 CONTRACT DOCUMENTS				* CONTRACTOR DESIGN DOCUMENTS
		TECHNICAL PROVISIONS		CONTRACT DRAWINGS		
NO.	DESCRIPTION	SECTION NO. / TITLE	ARTICLE	NO.	TITLE	
				V-017	LOW-VOLTAGE CIRCUIT BREAKER PANEL	
				V-022	TRIP COCK INSTALLATION	
				V-025	INTERIOR GRAPHICS & COLOR SCHEME	
				Q-119 **	AUTOMATIC TRAIN CONTROL, LAYOUT OF ALL ELECTRIC TRAIN STOP, TIE AND BALLAST AREA.	
				Q-120 **	AUTOMATIC TRAIN CONTROL, LAYOUT OF ALL ELECTRIC TRAIN STOP, EMBEDDED TIE AREA	
		SEE ALSO A620 CONTRACT (AUTOMATIC TRAIN CONTROL) DOCUMENTS				
2.2(e)	TRACK PLAN	REFER TO A620 CONTRACT (AUTOMATIC TRAIN CONTROL) DOCUMENTS				
2.3	PREPARATION OF EXHIBITS -	20/MANAGEMENT PROGRAM	20.6.10	Q-087 **	AUTOMATIC TRAIN CONTROL, PASSENGER VEHICLE INTERFACE	
		SEE ALSO A620 CONTRACT (AUTOMATIC TRAIN CONTROL) DOCUMENTS				
		SEE ALSO A640 CONTRACT (COMMUNICATIONS) DOCUMENTS				
2.5	REQUEST FOR INSPECTION					
2.5(b)	AS-BUILT PLANS REQUIRED FOR INSPECTION	4/INTERFACES	4.2.1	N/A	N/A	
		19/SYSTEM ASSURANCE PROGRAM	19.5.10			
		20/MANAGEMENT PROGRAM	20.6.10			
		SEE ALSO A620 CONTRACT (AUTOMATIC TRAIN CONTROL) DOCUMENTS				
		SEE ALSO A640 CONTRACT (COMMUNICATIONS) DOCUMENTS				
2.7	TEST AND INSPECTION RECORD	19/SYSTEM ASSURANCE PROGRAM	19.5.5	N/A	N/A	
		21/TEST PROGRAM	21.2.4			
		SEE ALSO A620 CONTRACT (AUTOMATIC TRAIN CONTROL) DOCUMENTS				
		SEE ALSO A640 CONTRACT (COMMUNICATIONS) DOCUMENTS				

* CONTRACTOR SHALL COMPLETE CHECKLIST, IDENTIFYING THE DOCUMENTS WHICH VERIFY CONFORMANCE TO EACH REQUIREMENT.

** REFERENCE DRAWINGS.

FOR CONTINUATION SEE DWG. V-027

PRINT HALF SIZE

REV	DATE	BY	SUB	APP	DESCRIPTION
◊1	5-7-87				REVISED PER ACR 650-2
0	3/6/87				PROPOSAL ISSUE

THE PREPARATION OF THIS DRAWING HAS BEEN FINANCED IN PART THROUGH A GRANT FROM THE U.S. DEPARTMENT OF TRANSPORTATION, URBAN MASS TRANSPORTATION ADMINISTRATION, UNDER THE URBAN MASS TRANSPORTATION ACT OF 1964, AS AMENDED, AND IN PART BY THE TAXES OF THE CITIZENS OF LOS ANGELES COUNTY AND OF THE STATE OF CALIFORNIA

DESIGNED BY G.L. WASZ
DRAWN BY A. Vonokurot
CHECKED BY
IN CHARGE J.N. Bruton
DATE 7 NOV 86

JOHN NICHOLAS BRUTON, Civil Engineer, No. 22748, 9/30/88, Exp., Technical, California

SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT
METRO RAIL PROJECT

SUBMITTED J.N. Bruton

DMJM/PBQD/KE/HWA
A JOINT VENTURE
GENERAL CONSULTANTS

APPROVED Harold Challoff

PASSENGER VEHICLE
CHECKLIST OF REQUIREMENTS
◊1 PUC G.O. NO.127
SHEET 1 OF 3

CONTRACT NO A650
DRAWING NO V-026
REV /
SCALE NO SCALE
SHEET NO. 26

SCRTD METRO RAIL PROJECT

CHECKLIST OF DESIGN PROVISIONS VERSUS ① PUC REQUIREMENTS

PASSENGER VEHICLE CONTRACT A650 VERSUS GENERAL ORDER NO. 127

CONTINUES FROM DWG. V-026

G.O. NO. 127 REQUIREMENT		A650 CONTRACT DOCUMENTS				* CONTRACTOR DESIGN DOCUMENTS
		TECHNICAL PROVISIONS		CONTRACT DRAWINGS		
NO.	DESCRIPTION	SECTION NO. / TITLE	ARTICLE	NO.	TITLE	
SECTION 3	GENERAL SPECIFICATIONS					
3.1	AUTOMATIC PROTECTION AGAINST :	16 / AUTOMATIC TRAIN OPERATION	16. 2	N/A	N/A	
3.1(a)	REAR END COLLISIONS	16/ AUTOMATIC TRAIN OPERATION	16. 2	N/A	N/A	
		SEE ALSO A620 CONTRACT (AUTOMATIC TRAIN CONTROL) DOCUMENTS				
3.1(b)	HEAD - ON OR SIDESWIPE COLLISIONS	16 / AUTOMATIC TRAIN OPERATION	16.2	N/A	N/A	
		SEE ALSO A620 CONTRACT (AUTOMATIC TRAIN CONTROL) DOCUMENTS				
3.1(c)	DERAILMENT OR COLLISION RESULTING FROM MOVING TRACK SWITCH	16 / AUTOMATIC TRAIN OPERATION	16.2	N/A	N/A	
		SEE ALSO A620 CONTRACT (AUTOMATIC TRAIN CONTROL) DOCUMENTS				
3.1(e)	DETECTABLE RIGHT - OF - WAY HAZARDS	16 / AUTOMATIC TRAIN OPERATION	16.2	N/A	N/A	
		SEE ALSO A620 CONTRACT (AUTOMATIC TRAIN CONTROL) DOCUMENTS				
		SEE ALSO A640 CONTRACT (COMMUNICATIONS) DOCUMENTS				
3.2	SUBORDINATION OF OTHER ATC FUNCTIONS TO ATP	2 / ABBREVIATIONS AND DEFINITIONS	2.1.2.B	N/A	N/A	
		16 / AUTOMATIC TRAIN OPERATION	16 1.1			
		SEE ALSO A620 CONTRACT (AUTOMATIC TRAIN CONTROL) DOCUMENTS				
3.3	TRAIN DETECTION REQUIREMENTS	16/ AUTOMATIC TRAIN OPERATION	16. 2	N/A	N/A	
		SEE ALSO A620 CONTRACT (AUTOMATIC TRAIN CONTROL) DOCUMENTS				

CONTINUES AT RIGHT

G.O. NO. 127 REQUIREMENT		A650 CONTRACT DOCUMENTS				* CONTRACTOR DESIGN DOCUMENTS
		TECHNICAL PROVISIONS		CONTRACT DRAWINGS		
NO.	DESCRIPTION	SECTION NO. / TITLE	ARTICLE	NO	TITLE	
SECTION 3.4	VEHICLE ATP BYPASS	16/AUTOMATIC TRAIN OPERATION	16.3.2B	Q-087 **	AUTOMATIC TRAIN CONTROL, PASSENGER VEHICLE INTERFACE	
				Q-088 **	AUTOMATIC TRAIN CONTROL, PASSENGER VEHICLE INTERFACE	
		SEE ALSO A620 CONTRACT (AUTOMATIC TRAIN CONTROL) DOCUMENTS				
3.5	SAFE BRAKING DISTANCES	16 / AUTOMATIC TRAIN OPERATION	16.2	N/A	N/A	
		SEE ALSO A620 CONTRACT (AUTOMATIC TRAIN CONTROL) DOCUMENTS				
3.6	ROUTE INTERLOCKING REQUIREMENTS	REFER TO A620 CONTRACT (AUTOMATIC TRAIN CONTROL) DOCUMENTS				
3.6(a)	INTERLOCKING CIRCUIT SEQUENCE	REFER TO A620 CONTRACT (AUTOMATIC TRAIN CONTROL) DOCUMENTS				
3.6(b)	SWITCH POINT DETECTION	REFER TO A620 CONTRACT (AUTOMATIC TRAIN CONTROL) DOCUMENTS				
3.6(c)	TRAIN DETECTION IN INTERLOCKINGS	REFER TO A620 CONTRACT (AUTOMATIC TRAIN CONTROL) DOCUMENTS				
3.6(d)	CONTROLLED INTERLOCKING APPROACH AND ENTRY	16 / AUTOMATIC TRAIN OPERATION	16.2	N/A	N/A	
		SEE ALSO A620 CONTRACT (AUTOMATIC TRAIN CONTROL) DOCUMENTS				
3.6(e)	TIME LOCKING	REFER TO A620 CONTRACT (AUTOMATIC TRAIN CONTROL) DOCUMENTS				
3.6(f)	ROUTE LOCKING	REFER TO A620 CONTRACT (AUTOMATIC TRAIN CONTROL) DOCUMENTS				

FOR CONTINUATION SEE DWG. V-028

* CONTRACTOR SHALL COMPLETE CHECKLIST, IDENTIFYING THE DOCUMENTS WHICH VERIFY CONFORMANCE TO EACH REQUIREMENT

** REFERENCE DRAWINGS.

HALF SIZE

THE PREPARATION OF THIS DRAWING HAS BEEN FINANCED IN PART THROUGH A GRANT FROM THE U. S. DEPARTMENT OF TRANSPORTATION, URBAN MASS TRANSPORTATION ADMINISTRATION, UNDER THE URBAN MASS TRANSPORTATION ACT OF 1964, AS AMENDED, AND IN PART BY THE TAXES OF THE CITIZENS OF LOS ANGELES COUNTY AND OF THE STATE OF CALIFORNIA

REV.	DATE	BY	SUB.	APP	DESCRIPTION
①2	5-7-87	PKM	VMB	GP	REVISED PER ACR 650-2
0	3/16/87				PROPOSAL ISSUE

DESIGNED BY G L. WASZ
DRAWN BY A. Vrnakurovic
CHECKED BY
IN CHARGE J. N. Brown
DATE 11 NOV 86

SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT
METRO RAIL PROJECT
RTD

SUBMITTED J. N. Brown

DMJM/PBQD/KE/HWA
JOINT VENTURE
GENERAL CONSULTANTS

APPROVED Howard Kholoff

PASSENGER VEHICLE
CHECKLIST OF REQUIREMENTS
① PUC G.O. NO.127
SHEET 2 OF 3

CONTRACT NO A650
DRAWING NO. V-027 REV. 1
SCALE NO SCALE
SHEET NO 27

SCRTD METRO RAIL PROJECT

CHECKLIST OF DESIGN PROVISIONS VERSUS ⟨1⟩ PUC REQUIREMENTS

PASSENGER VEHICLE CONTRACT A650 VERSUS GENERAL ORDER NO. 127

CONTINUES FROM DWG V-027

G.O. NO. 127 REQUIREMENT		A650 CONTRACT DOCUMENTS				* CONTRACTOR DESIGN DOCUMENTS
		TECHNICAL PROVISIONS		CONTRACT DRAWINGS		
NO.	DESCRIPTION	SECTION NO. / TITLE	ARTICLE	NO.	TITLE	
SECTION 3.7	CIVIL SPEED LIMITS	16 / AUTOMATIC TRAIN OPERATION	16.2.3 A 16.4.1	N/A	N/A	
		SEE ALSO A620 CONTRACT (AUTOMATIC TRAIN CONTROL) DOCUMENTS				
3.8	SAFE SPEED — DISTANCE PROFILE	16 / AUTOMATIC TRAIN OPERATION	16.2	N/A	N/A	
		SEE ALSO A620 CONTRACT (AUTOMATIC TRAIN CONTROL) DOCUMENTS				
3.8 (a)	REACTION TO OVERSPEED	16 / AUTOMATIC TRAIN OPERATION	16.2.1.B 16.2.1.C	N/A	N/A	
		SEE ALSO A620 CONTRACT (AUTOMATIC TRAIN CONTROL) DOCUMENTS				
3.8 (b)	SAFE SPEED — DISTANCE PROFILE	16 / AUTOMATIC TRAIN OPERATION	16.2	N/A	N/A	
		SEE ALSO A620 CONTRACT (AUTOMATIC TRAIN CONTROL) DOCUMENTS				
3.8 (c)	BRAKING WITH ZERO SPEED COMMANDED	16 / AUTOMATIC TRAIN OPERATION	16.4.1.B	N/A	N/A	
3.8 (d)	TRAIN SPEED DETECTION	14 / PROPULSION SUBSYSTEM	14.6.1	N/A	N/A	
		SEE ALSO A620 CONTRACT (AUTOMATIC TRAIN CONTROL) DOCUMENTS				
3.8 (e)	ZERO SPEED DETECTION	10 / SIDE DOOR OPERATORS AND CONTROLS	10.3.4.A 10.3.4.D	N/A	N/A	
		16 / AUTOMATIC TRAIN OPERATION	16.2.1.F 16.2.3.E 16.7.1 16.7.2			
		SEE ALSO A620 CONTRACT (AUTOMATIC TRAIN CONTROL) DOCUMENTS				
3.8 (f)	ROLL-BACK DETECTION AND REACTION	16 / AUTOMATIC TRAIN OPERATION	16.2.3.F 16.7	N/A	N/A	
		SEE ALSO A620 CONTRACT (AUTOMATIC TRAIN CONTROL) DOCUMENTS				
3.9	REACTION TO ABSENCE OF SPEED LIMIT SIGNALS	16 / AUTOMATIC TRAIN OPERATION	16.4.2	N/A	N/A	
		SEE ALSO A620 CONTRACT (AUTOMATIC TRAIN CONTROL) DOCUMENTS				

CONTINUES AT RIGHT

G.O. NO. 127 REQUIREMENT		A650 CONTRACT DOCUMENTS				* CONTRACTOR DESIGN DOCUMENTS
		TECHNICAL PROVISIONS		CONTRACT DRAWINGS		
NO.	DESCRIPTION	SECTION NO. / TITLE	ARTICLE	NO.	TITLE	
3.10	RIGHT-OF-WAY HAZARD PROTECTION	16 / AUTOMATIC TRAIN OPERATION	16.2	N/A	N/A	
		SEE ALSO A620 CONTRACT (AUTOMATIC TRAIN CONTROL) DOCUMENTS				
		SEE ALSO A640 CONTRACT (COMMUNICATIONS) DOCUMENTS				
3.12	SECURITY FOR EQUIPMENT	7 / CARBODY	7.9.2	N/A	N/A	
		8 / OUTFITTINGS AND FURNISHINGS	8.6.1			
		SEE ALSO A112 CONTRACT (YARD MAIN SHOP BUILDING CONSTRUCTION) DOCUMENTS				
		SEE ALSO A136 CONTRACT (UNION STATION CONSTRUCTION, STAGE II) DOCUMENTS				
		SEE ALSO A147 CONTRACT (CIVIC CENTER STATION CONSTRUCTION, STAGE II) DOCUMENTS				
		SEE ALSO A157 CONTRACT (5TH/HILL STATION CONSTRUCTION, STAGE II) DOCUMENTS				
		SEE ALSO A167 CONTRACT (7TH/FLOWER STATION CONSTRUCTION, STAGE II) DOCUMENTS				
		SEE ALSO A187 CONTRACT (WILSHIRE/ALVARADO STATION CONSTRUCTION, STAGE II) DOCUMENTS				
		SEE ALSO A620 CONTRACT (AUTOMATIC TRAIN CONTROL) DOCUMENTS				
		SEE ALSO A640 CONTRACT (COMMUNICATIONS) DOCUMENTS				
3.13	CROSS AND GROUND PROTECTION	13 / POWER SUPPLY AND ELECTRICAL EQUIPMENT	13.7	N/A	N/A	
		SEE ALSO A620 CONTRACT (AUTOMATIC TRAIN CONTROL) DOCUMENTS				
		SEE ALSO A640 CONTRACT (COMMUNICATIONS) DOCUMENTS				
3.15	MAINTENANCE AND OPERATION	22 / SYSTEM SUPPORT	22.2 22.3	N/A	N/A	
		SEE ALSO A620 CONTRACT (AUTOMATIC TRAIN CONTROL) DOCUMENTS				
		SEE ALSO A640 CONTRACT (COMMUNICATIONS) DOCUMENTS				

* CONTRACTOR SHALL COMPLETE CHECKLIST, IDENTIFYING THE DOCUMENTS WHICH VERIFY CONFORMANCE TO EACH REQUIREMENT.

THE END

HALF SIZE

REV	DATE	BY	SUB	APP	DESCRIPTION
⟨1⟩	5-7-87	JHM	WHB	CR	REVISED PER ACR 650-2
0	5/16/87				PROPOSAL ISSUE

THE PREPARATION OF THIS DRAWING HAS BEEN FINANCED IN PART THROUGH A GRANT FROM THE U. S. DEPARTMENT OF TRANSPORTATION, URBAN MASS TRANSPORTATION ADMINISTRATION, UNDER THE URBAN MASS TRANSPORTATION ACT OF 1964, AS AMENDED, AND IN PART BY THE TAXES OF THE CITIZENS OF LOS ANGELES COUNTY AND OF THE STATE OF CALIFORNIA

DESIGNED BY G.L. WASZ
DRAWN BY A. Vrodenburg
CHECKED BY J.M. Brown
IN CHARGE J.M. Brown
DATE 13 NOV 86

REGISTERED PROFESSIONAL ENGINEER JOHN NICHOLAS BROWN EXP 9/30/88 NO. 22744 MECHANICAL STATE OF CALIFORNIA

SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT
METRO RAIL PROJECT
RTD

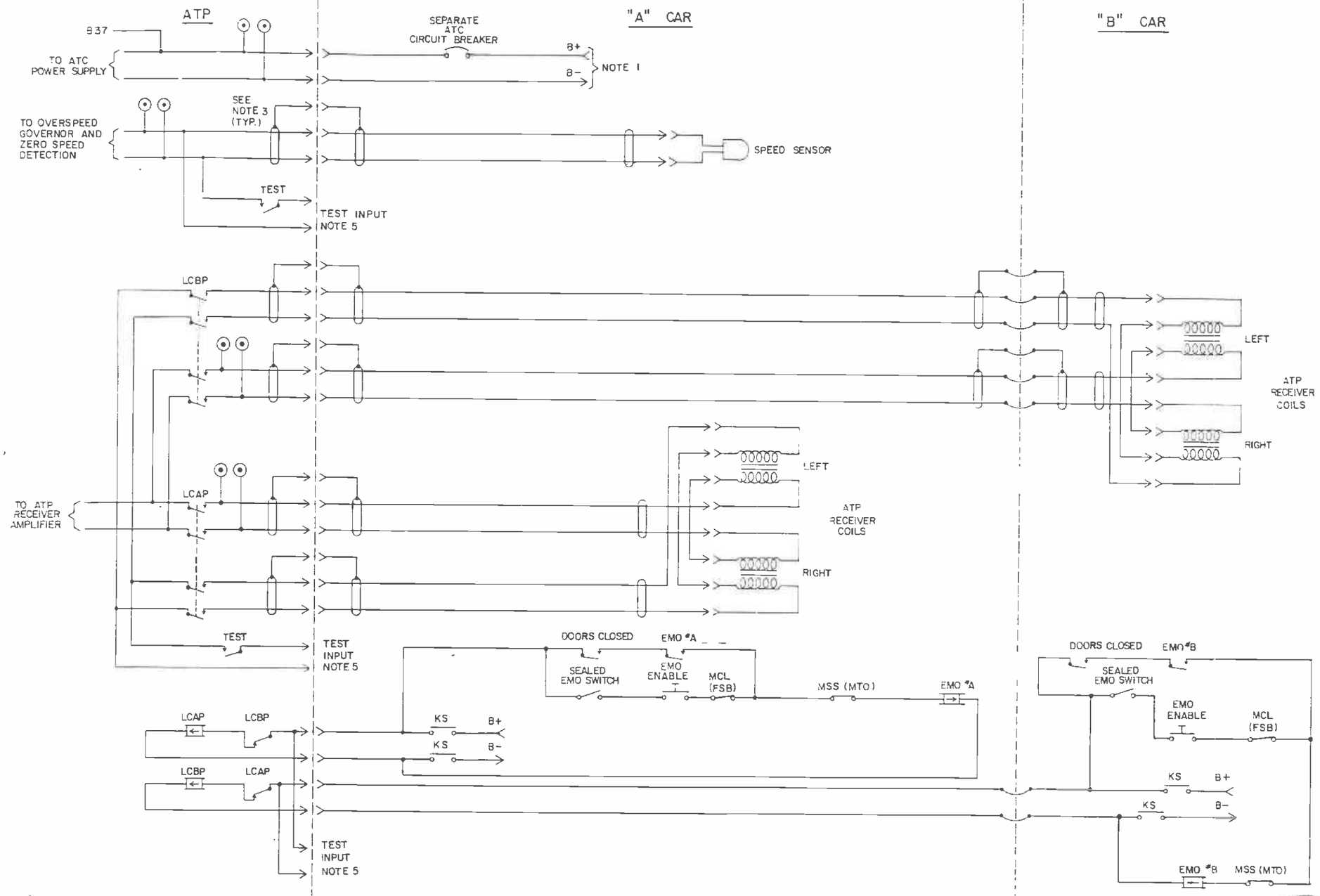
SUBMITTED J.M. Brown

DMJM/PBQD/KE/HWA
A JOINT VENTURE
GENERAL CONSULTANTS

APPROVED Howard A. Chaliff

PASSENGER VEHICLE
CHECKLIST OF REQUIREMENTS
⟨1⟩ PUC G.O. NO.127
SHEET 3 OF 3

CONTRACT NO A650
DRAWING NO V-028
REV 1
SCALE NO SCALE
SHEET NO 28



SYMBOLS:

- TWISTED PAIR CABLE
- VITAL RELAY
- NONVITAL RELAY
- PUSH-ON, PULL-OFF PUSHBUTTON
- MOMENTARY SWITCH
- DOUBLE BREAK SWITCH CONTACT
- SINGLE BREAK SWITCH CONTACT
- ANTENNA OR RECEIVER COIL
- TEST POINT
- CONTACT OF RELAY CLOSED WHEN ENERGIZED
- CLOSED WHEN DE-ENERGIZED
- AUDIBLE ALARM
- CONSOLE INDICATING LIGHT (W) WHITE, (G) GREEN, (A) AMBER, (R) RED

ATO	AUTOMATIC TRAIN OPERATION
ATP	AUTOMATIC TRAIN PROTECTION
BRK	MODE ASSURANCE TRAINLINE
EBR	EMERGENCY BRAKE RELAY
EMO	EMERGENCY MANUAL OPERATION
FSB	FULL SERVICE BRAKE POSITION
DMSW	DEAD MAN SWITCH
KS	KEY SWITCH
US	UNDER SPEED RELAY
LCAP	LEAD CAR "A" REPEATER
LCBP	LEAD CAR "B" REPEATER
MCL	MANUAL CONTROLLER
MCBP	MANUAL CONTROLLER BRAKE POSITION
MSS	MODE SELECTION SWITCH
MTO	MANUAL TRAIN OPERATION
OSA	OVERSPEED ALARM
RMO	RESTRICTED MANUAL OPERATION
VZ	VELOCITY ZERO RELAY
ZSR	ZERO SPEED RELAY
DM	DEAD MAN RELAY
UMR	UNINTENTIONAL MOVEMENT RELAY

NOTES:

1. THESE CIRCUITS ARE BASED ON THE B- CONNECTED TO THE CAR BODY AND THE B+ TO BATTERY TO PREVENT SHORTS TO CAR BODY FROM CAUSING UNSAFE CONDITIONS. POLARITY REVERSAL REQUIRES CIRCUIT ALTERATIONS.
2. ALL CONTACTS IN THESE CIRCUITS SHOWN WITH RELAYS DE-ENERGIZED.
3. ATC CONTRACTOR TO GROUND ALL SHIELDS.
4. ALL ITEMS SHOWN ON "A"-CAR AND "B"-CAR, EXCEPT ATP RECEIVER COILS, ARE VEHICLE CONTRACTOR FURNISHED.
5. CONNECTOR FOR ATP PORTABLE TEST SET. PROVIDE ADDITIONAL TEST POINTS, TEST INPUTS, OR PARALLEL CONNECTIONS TO THESE INTERFACE CIRCUITS AS NECESSARY TO ACHIEVE THE REQUIRED TEST FUNCTIONS.

PRINT HALF SIZE

REV	DATE	BY	SUB.	APP	DESCRIPTION
C	11-10-86	EA			GENERAL REVISIONS
B	11-30-84				GENERAL REVISIONS
A	7/6/84				GENERAL REVISIONS
1	1-5-86	PK	JWB	RP	REVISED PER ACR 650-5
D	5-6 87				RADIO EMO ENABLE DELETED

THE PREPARATION OF THIS DRAWING HAS BEEN FINANCED IN PART THROUGH A GRANT FROM THE U. S. DEPARTMENT OF TRANSPORTATION, URBAN MASS TRANSPORTATION ADMINISTRATION, UNDER THE URBAN MASS TRANSPORTATION ACT OF 1964, AS AMENDED, AND IN PART BY THE TAXES OF THE CITIZENS OF LOS ANGELES COUNTY AND OF THE STATE OF CALIFORNIA

DESIGNED BY R. Boerwinkle
DRAWN BY K.L. Fairchild
CHECKED BY D J Conroy
IN CHARGE Mahlon S Pell
DATE 2 APR 84

P.M. Burgess

SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT
METRO RAIL PROJECT
RTD

SUBMITTED P.M. Burgess

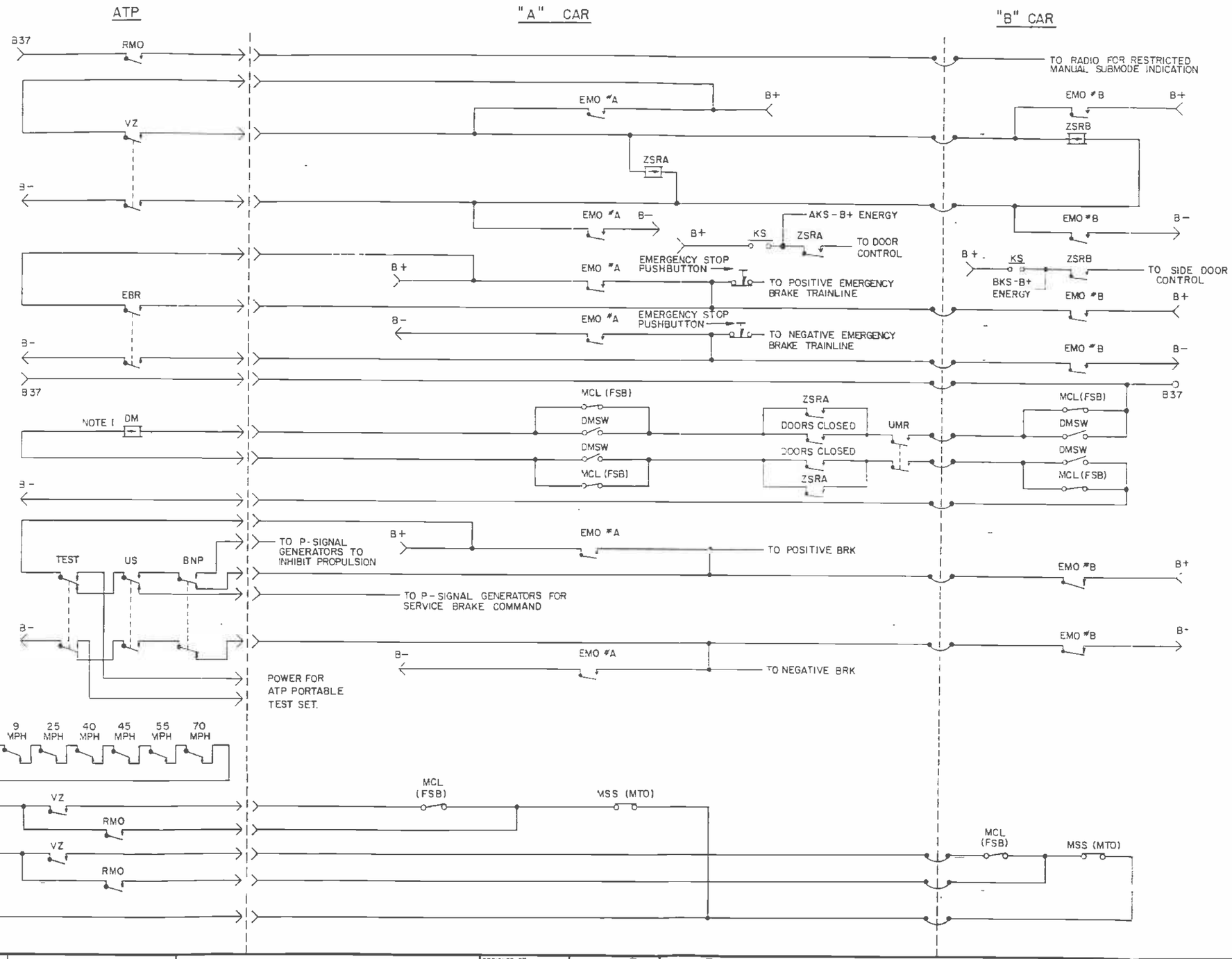
DMJM/PBQD/KE/HWA
A JOINT VENTURE
GENERAL CONSULTANTS

APPROVED

AUTOMATIC TRAIN CONTROL PASSENGER VEHICLE INTERFACE

SHEET 1 OF 3

CONTRACT NO A620
DRAWING NO Q-087 D
REV 1
SCALE NO SCALE
SHEET NO. A650/101



NOTES:

1 DM INITIATES BRAKE ASSURANCE FUNCTION WHEN THE DEADMAN SWITCH IS RELEASED, DOORS OPEN WITH TRAIN MOVING, OR ROLLBACK DETECTED. DM RELAY MAY BE REPLACED BY CIRCUITRY THAT SERVES THE SAME PURPOSE.

HALF SIZE

REV.	DATE	BY	SUB.	APP.	DESCRIPTION
C	10-10-85	EA			GENERAL REVISIONS
B	9-30-85				GENERAL REVISIONS
A	7/6/85				GENERAL REVISIONS
1	1-5-88	PE	JMB		REVISED PER ACR 650-5

THE PREPARATION OF THIS DRAWING HAS BEEN FINANCED IN PART THROUGH A GRANT FROM THE U. S. DEPARTMENT OF TRANSPORTATION, URBAN MASS TRANSPORTATION ADMINISTRATION, UNDER THE URBAN MASS TRANSPORTATION ACT OF 1964, AS AMENDED, AND IN PART BY THE TAXES OF THE CITIZENS OF LOS ANGELES COUNTY AND OF THE STATE OF CALIFORNIA

DESIGNED BY R. Bosworth
DRAWN BY O Vinokurov
CHECKED BY D Flory
IN CHARGE Mahdi S Gold
DATE 9 APR 84

SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT
METRO RAIL PROJECT
RTD

SUBMITTED P M Bureyan

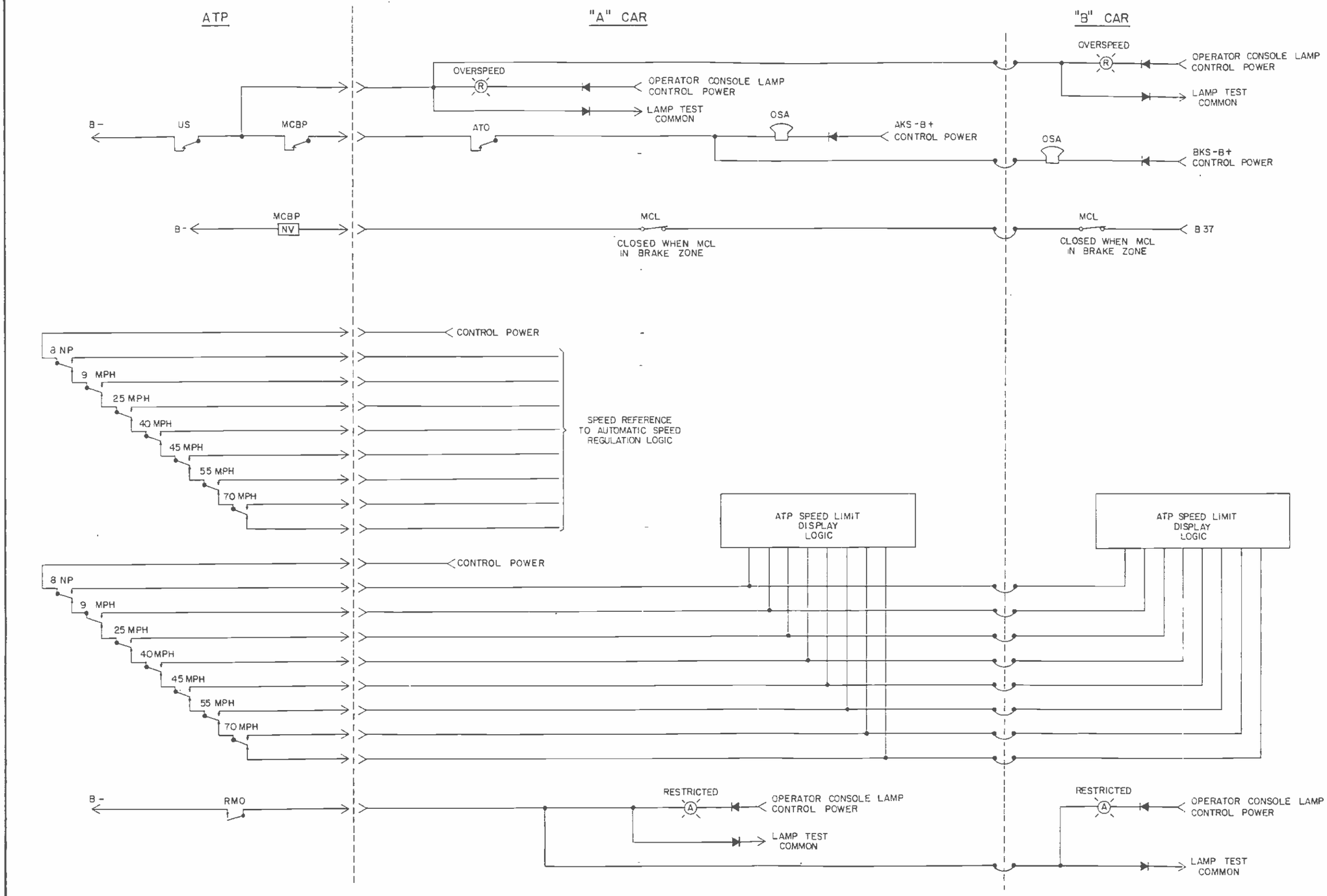
DMJM/PBQD/KE/HWA
A JOINT VENTURE
GENERAL CONSULTANTS

APPROVED

AUTOMATIC TRAIN CONTROL PASSENGER VEHICLE INTERFACE

SHEET 2 OF 3

CONTRACT NO. A620
DRAWING NO. Q-088 C REV. 1
SCALE NO SCALE
SHEET NO A650/102



REV.	DATE	BY	SUB.	APP.	DESCRIPTION
1	11-5-84	PK	JMB	@	REVISED PER ACR 650-5
C	10-10-84	EA			GENERAL REVISIONS
B	7/30/85				GENERAL REVISIONS
A	7/16/85				GENERAL REVISIONS

THE PREPARATION OF THIS DRAWING HAS BEEN FINANCED IN PART THROUGH A GRANT FROM THE U. S. DEPARTMENT OF TRANSPORTATION, URBAN MASS TRANSPORTATION ADMINISTRATION, UNDER THE URBAN MASS TRANSPORTATION ACT OF 1964, AS AMENDED, AND IN PART BY THE TAXES OF THE CITIZENS OF LOS ANGELES COUNTY AND OF THE STATE OF CALIFORNIA

DESIGNED BY R. Baerwald
DRAWN BY A. Rodarsa
CHECKED BY D. Levy
IN CHARGE Mahat S Patel
DATE 10 APR 84

SUBMITTED P.M. Burgess

SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT
METRO RAIL PROJECT
ATD

DMJM/PBQD/KE/HWA
A JOINT VENTURE
GENERAL CONSULTANTS

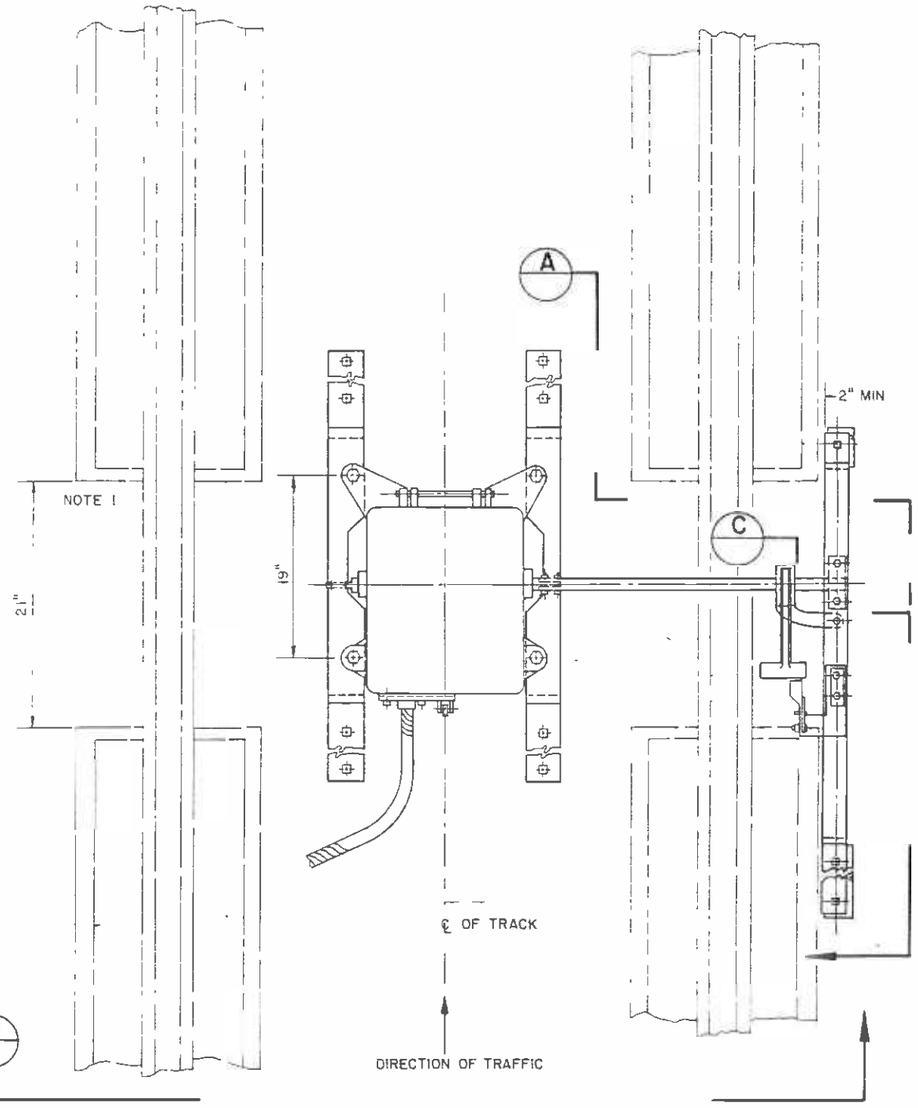
APPROVED _____

AUTOMATIC TRAIN CONTROL PASSENGER VEHICLE INTERFACE
SHEET 3 OF 3

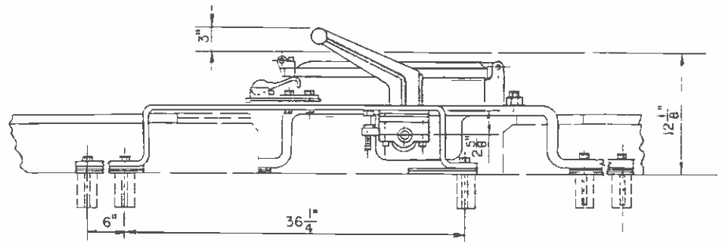
CONTRACT NO. A620
DRAWING NO. Q-089 C
REV. 1
SCALE NO SCALE
SHEET NO. A650 / 103

NOTE:

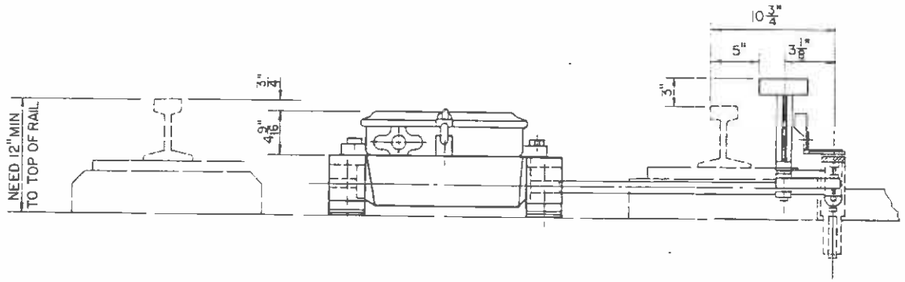
1. OPENINGS IN CONCRETE PROVIDED BY DISTRICT AS REQUIRED.



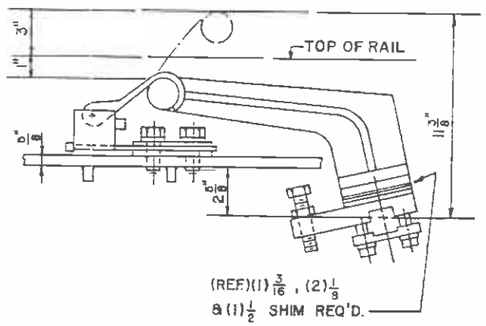
PLAN
SCALE: $1\frac{1}{2}$" = 1'-0



SECTION A
N.T.S.



SECTION B
N.T.S.



ENLARGED TRIPPER ARM SECTION C
SHOWN IN HOOKED POSITION
N.T.S.

HALF SIZE

REV.	DATE	BY	SUB.	APP.	DESCRIPTION
1	11-5-85	PK	JMB	AR	REVISED PER ACR650-5

REV.	DATE	BY	SUB.	APP.	DESCRIPTION
C	8-18-80	EA			GENERAL REVISIONS
B	9-30-75				GENERAL REVISIONS
A	7/6/15				GENERAL REVISIONS

THE PREPARATION OF THIS DRAWING HAS BEEN FINANCED IN PART THROUGH A GRANT FROM THE U. S. DEPARTMENT OF TRANSPORTATION, URBAN MASS TRANSPORTATION ADMINISTRATION, UNDER THE URBAN MASS TRANSPORTATION ACT OF 1964, AS AMENDED, AND IN PART BY THE TAXES OF THE CITIZENS OF LOS ANGELES COUNTY AND OF THE STATE OF CALIFORNIA

DESIGNED BY
DRAWN BY
CHECKED BY
IN CHARGE
DATE 25 MAY 84

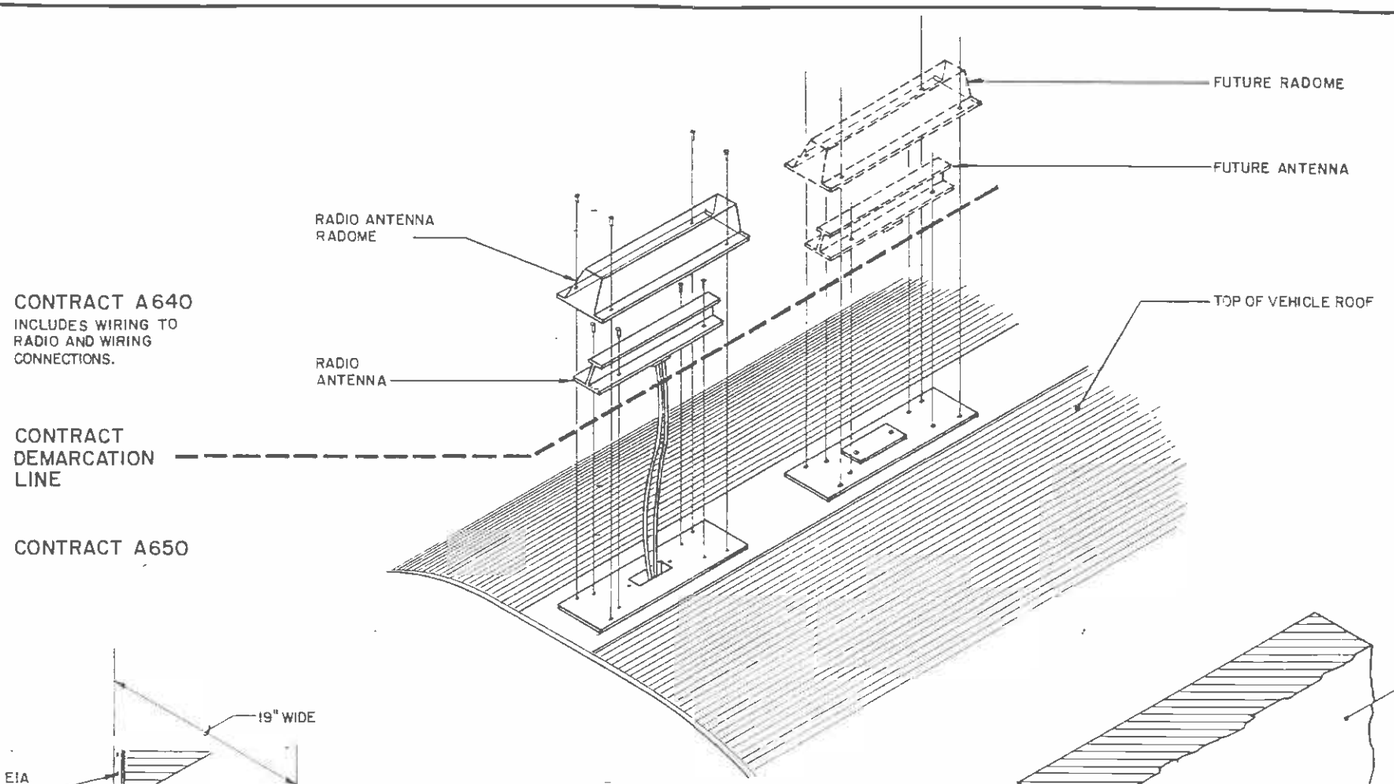
SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT
METRO RAIL PROJECT
RTD

DMJM/PBQD/KE/HWA
A JOINT VENTURE
GENERAL CONSULTANTS

SUBMITTED
APPROVED

AUTOMATIC TRAIN CONTROL
LAYOUT OF ALL-ELECTRIC TRAIN STOP
EMBEDDED TIE AREA

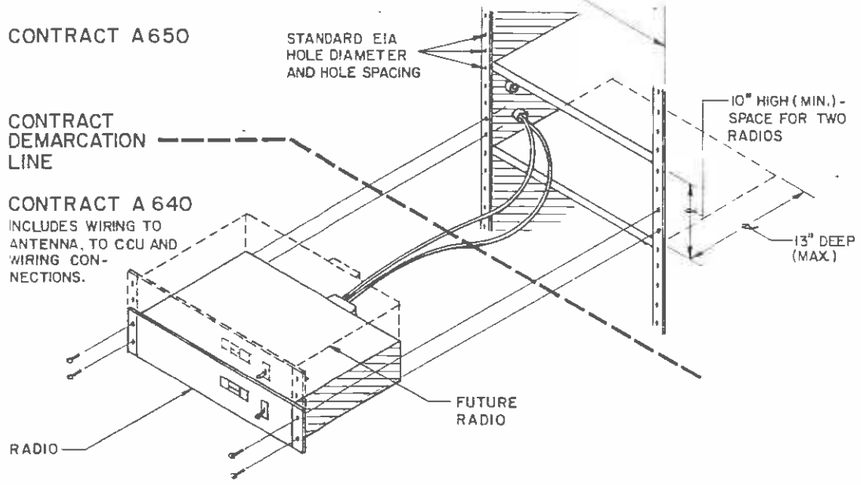
CONTRACT NO. A620
DRAWING NO. Q-120 C
REV. 1
SCALE AS NOTED
SHEET NO. A650/104



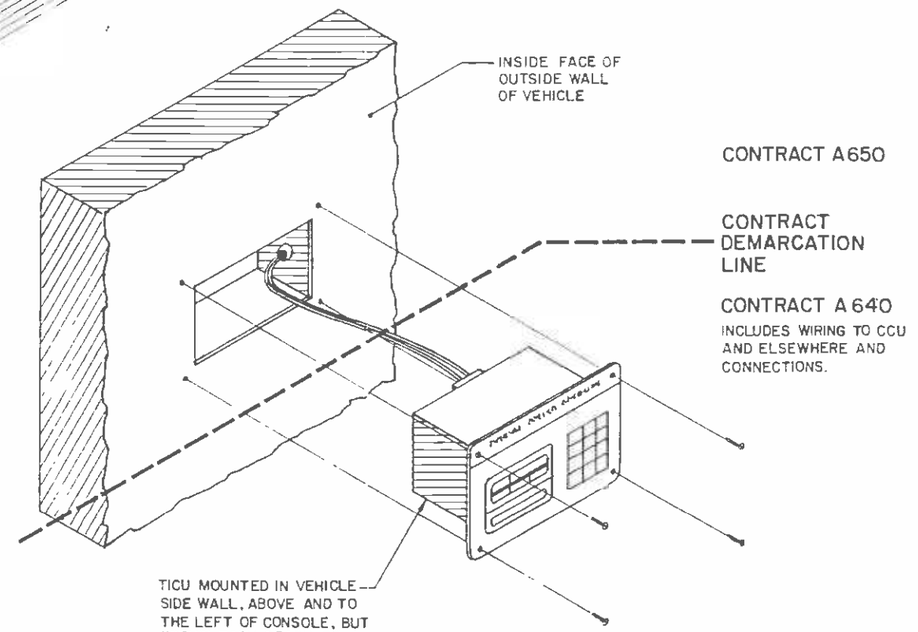
RADIO ANTENNA MOUNT

NOTE:

1. ALL VEHICLE BORNE EQUIPMENT SHALL BE INSTALLED BY CONTRACT A650.



RADIO MOUNT



TRAIN IDENTIFICATION CONTROL UNIT MOUNT

HALF SIZE

REV.	DATE	BY	SUB.	APP.	DESCRIPTION
1	1-5-88	PK	JMD		REVISED PER ACR650-5
A	12-85				SIGNATURE ISSUE

THE PREPARATION OF THIS DRAWING HAS BEEN FINANCED IN PART THROUGH A GRANT FROM THE U. S. DEPARTMENT OF TRANSPORTATION, URBAN MASS TRANSPORTATION ADMINISTRATION, UNDER THE URBAN MASS TRANSPORTATION ACT OF 1964, AS AMENDED, AND IN PART BY THE TAXES OF THE CITIZENS OF LOS ANGELES COUNTY AND OF THE STATE OF CALIFORNIA

DESIGNED BY
DRAWN BY
CHECKED BY
IN CHARGE
DATE JAN 85

REGISTERED PROFESSIONAL ENGINEER CHARLES K. KIM No. E011980 Exp. 9-30-87 ELECTRICAL STATE OF CALIFORNIA

SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT
METRO RAIL PROJECT
RTD

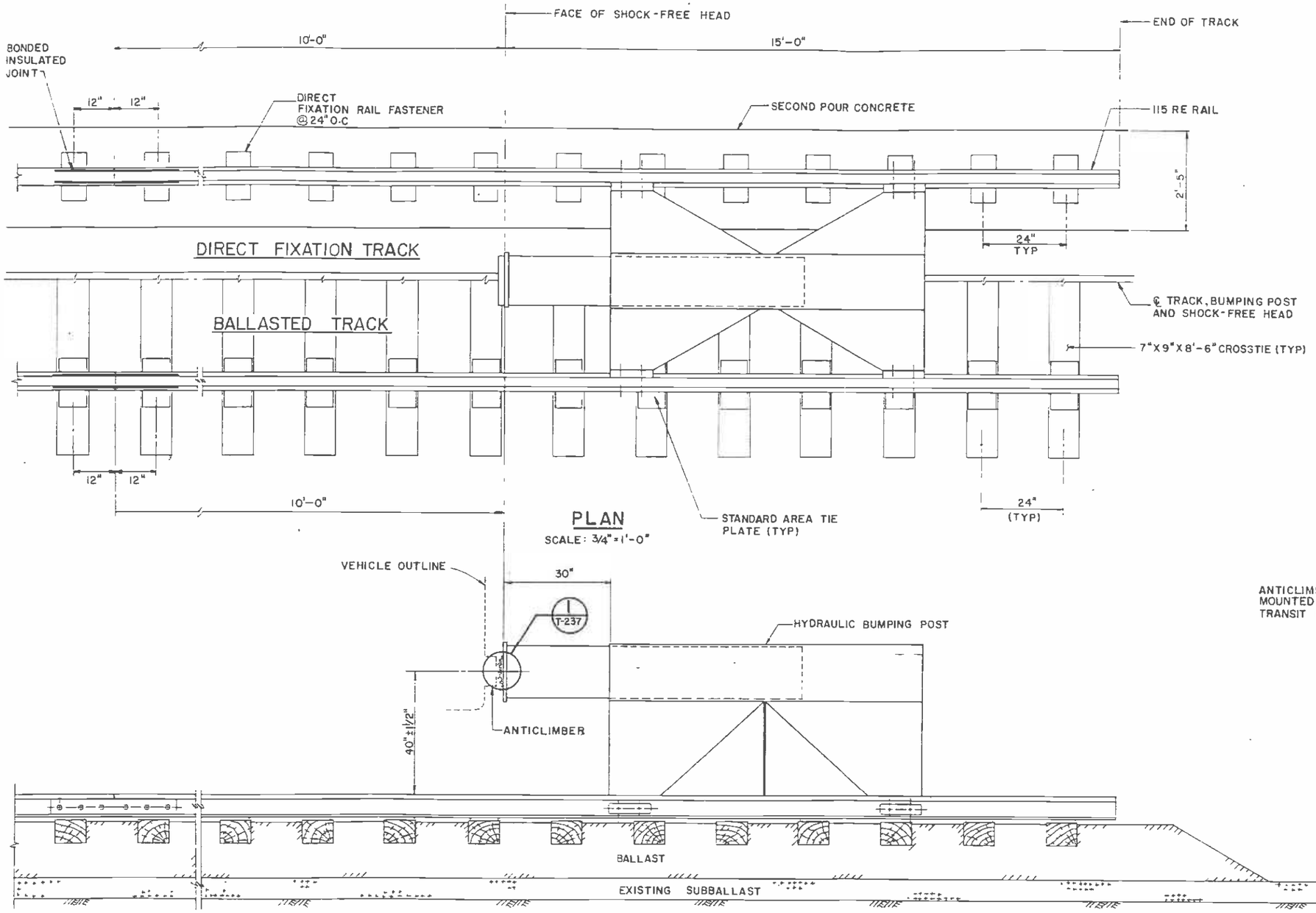
SUBMITTED

DMJM/PBQD/KE/HWA
A JOINT VENTURE
GENERAL CONSULTANTS

APPROVED

COMMUNICATIONS PASSENGER VEHICLE MECHANICAL INTERFACE

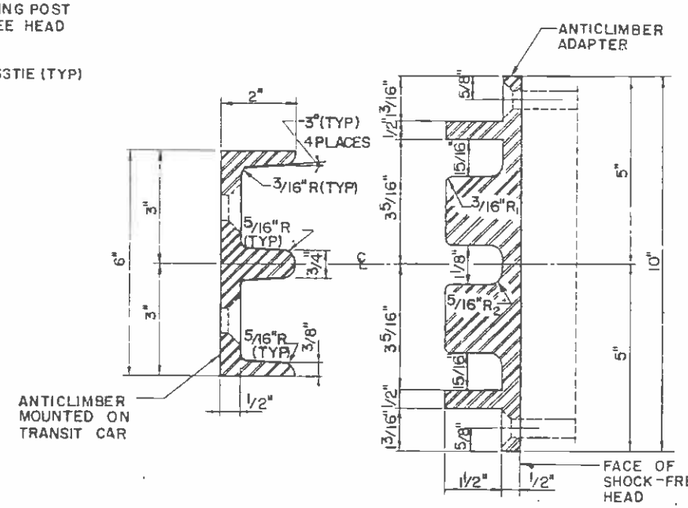
CONTRACT NO. A640
DRAWING NO. N-095 A REV. 1
SCALE NO SCALE
SHEET NO. A650/105



PLAN
SCALE: 3/4"=1'-0"

ELEVATION
SCALE: 3/4"=1'-0"

BILL OF MATERIAL	
QTY.	DESCRIPTION
1	HYDRAULIC BUMPING POST ASSEMBLY, COMPLETE WITH ANTICLIMBER ADAPTER
2	BONDED INSULATED JOINTS



ANTICLIMBER DETAIL (SEE NOTE 2)
HALF SCALE

(1 / T-237)

NOTES:
1. FOR SPECIFIC LOCATIONS OF BUMPING POST SEE CONTRACT DRAWING NO'S. T-123 & T-158.
2. ANTICLIMBER DETAIL IS SHOWN FOR INFORMATION ONLY AND IS SUBJECT TO CHANGE BY VEHICLE MANUFACTURER. VERIFY ACTUAL DESIGN DETAILS WITH THE DISTRICT OR ITS DESIGNEE PRIOR TO PRODUCTION OF ANTICLIMBER ADAPTER.

HALF SIZE

REV.	DATE	BY	SUB.	APP.	DESCRIPTION
1	1-5-88	DK	JNB	R	REVISED PER ACR650-5

THE PREPARATION OF THIS DRAWING HAS BEEN FINANCED IN PART THROUGH A GRANT FROM THE U. S. DEPARTMENT OF TRANSPORTATION, URBAN MASS TRANSPORTATION ADMINISTRATION, UNDER THE URBAN MASS TRANSPORTATION ACT OF 1964, AS AMENDED, AND IN PART BY THE TAXES OF THE CITIZENS OF LOS ANGELES COUNTY AND OF THE STATE OF CALIFORNIA

DESIGNED BY J. Nedair
DRAWN BY L.D.W.
CHECKED BY L.D.W.
IN CHARGE Levi S. Valoun
DATE 15 JUL 85

REGISTERED PROFESSIONAL ENGINEER JOSEPH B. VALOUN C 25753 STATE OF CALIFORNIA

SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT
METRO RAIL PROJECT
RTD

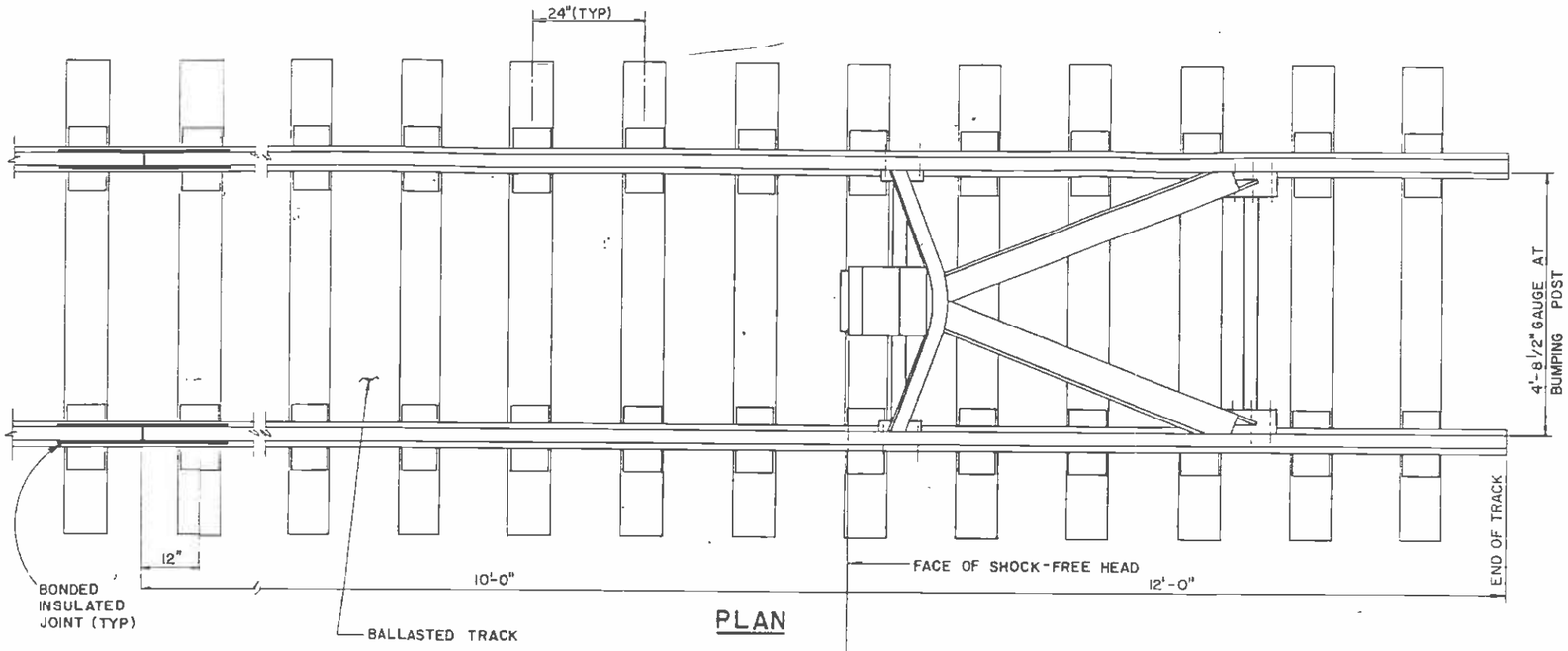
DMJM/PBQD/KE/HWA
A JOINT VENTURE
GENERAL CONSULTANTS

SUBMITTED Levi S. Valoun
APPROVED

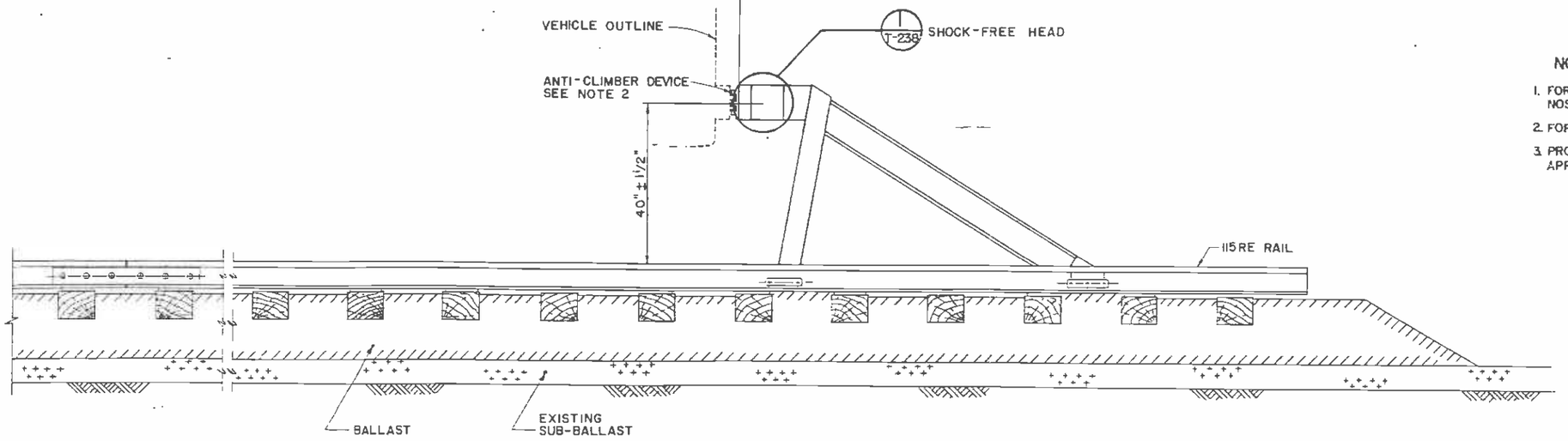
LA CBD TO NORTH HOLLYWOOD
TRACKWORK INSTALLATION

BUMPING POST DETAIL HYDRAULIC

CONTRACT NO. A 610
DRAWING NO. T-237 REV. 1
SCALE AS NOTED
SHEET NO A650/106

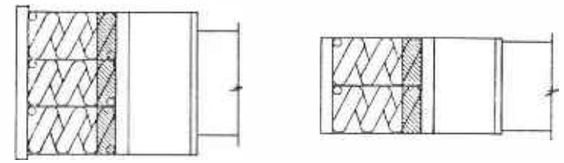


PLAN



ELEVATION

BILL OF MATERIAL	
QTY	DESCRIPTION
1	STANDARD BUMPING POST ASSEMBLY, COMPLETE WITH SHOCK-FREE HEAD AND ANTI-CLIMBER DEVICE
2	BONDED INSULATED JOINTS
A/R	SMOOTH FACE HEAD (SEE NOTE 3)



PLAN ELEVATION

SHOCK-FREE HEAD BUMPING POST (1 / T-238)

SCALE: NTS

NOTES:

1. FOR SPECIFIC LOCATIONS OF STANDARD BUMPING POST, SEE DWG NOS. T-134, T-137 AND T-139.
2. FOR DETAIL OF ANTI-CLIMBER DEVICE, SEE DWG NO. T-237.
3. PROVIDE SMOOTH FACE HEAD FOR BUMPING POST-STANDARD APPEARING ON DWG NOS. T-137 AND T-139

PRINT HALF SIZE

REV.	DATE	BY	SUB.	APP.	DESCRIPTION
1	1-5-86	BVL	UNB	R	REVISED PER ACR650-5

THE PREPARATION OF THIS DRAWING HAS BEEN FINANCED IN PART THROUGH A GRANT FROM THE U. S. DEPARTMENT OF TRANSPORTATION, URBAN MASS TRANSPORTATION ADMINISTRATION, UNDER THE URBAN MASS TRANSPORTATION ACT OF 1964, AS AMENDED, AND IN PART BY THE TAXES OF THE CITIZENS OF LOS ANGELES COUNTY AND OF THE STATE OF CALIFORNIA

DESIGNED BY J. Vecla
DRAWN BY
CHECKED BY Paul J. Baker
IN CHARGE
DATE 15JUL85

REGISTERED PROFESSIONAL ENGINEER PAUL B. FRIEDMAN C 25755 CIVIL STATE OF CALIFORNIA

SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT
METRO RAIL PROJECT
RTD

SUBMITTED

DMJM/PBQD/KE/HWA
A JOINT VENTURE
GENERAL CONSULTANTS

APPROVED

LA CBD TO NORTH HOLLYWOOD TRACKWORK INSTALLATION

BUMPING POST DETAIL - STANDARD

CONTRACT NO. A610
DRAWING NO. T-238 REV. 1
SCALE 3/4" = 1'-0"
SHEET NO. A650 / 107