Standardized Technical Specification

Bi-Level Passenger Rail Cars
for
Intercity Corridor Service

Chapter 4

Carbody

Revision J

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Revision Status

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4.0 Carbody

4.1 Overview

This chapter describes the characteristics for the design and manufacture of the carshell, and the installation of major components associated with the carshell including glazing, safety appliances, diaphragms, equipment room components and access doors, wheelchair lifts and exterior graphics. The major structural elements of the carshell are described, and the requirements for the performance of the carshell structure are defined.

The carshell shall be manufactured of stainless steel, with end underframes constructed of Low-Alloy High-Tensile steel (LAHT). The design of the carshell shall comply with all strength and testing requirements as identified, and shall keep the carshell weight to a minimum subject to the car maximum weight limitations.

4.2 General Requirements

The carbody shall be designed to the normal and expected base set of requirements established by 49CFR Part 238, APTA Standard SS-C&S-034-99 and this specification.

The completed carbody structure shall be designed and constructed in full accordance with all applicable Federal and State rules, regulations and requirements for cars operating in trains, at speeds of up to 125 miles per hour (mph).

Apparatus requiring frequent inspection or attention shall be readily accessible and replaceable. The frequency of required service shall govern the degree of accessibility. Apparatus requiring attention more frequently than every 120 days, or in emergencies, shall be accessible from the side of the car or from the inside of the car unless specifically approved by the Customer. All other underfloor apparatus shall be arranged to provide ready access from maintenance pits and/or from the side of the car. Large apparatus shall be capable of ready replacement by forklift truck from the side of the car. The general arrangement shall be similar to the existing carbody. Proposed arrangement shall be submitted to the Customer for approval at the design review. **DR**

The general arrangement of the subcomponents shall be approved by the Customer during the mockup and design review process described in Chapter 3. Apparatus supports and housings shall be incorporated into the underframe structure, equipment compartments and equipment lockers so that the apparatus, as supplied by the manufacturers, may be mounted interchangeably.

All specified equipment on the car shall be arranged so that the proportion of the vehicle tare weight carried by each truck of the car shall be within 5% of each other. Similarly, the lateral imbalance shall not exceed 30,000 inch-pounds.

A sufficient number of jigs, fixtures and templates shall be used to assure interchangeability of components and uniformity of structure throughout the fleet. Such parts of the bodies as underframes, side frames, end frames and roofs shall be built on jigs. All weld and bolt patterns shall be identical on all cars. All equipment hangers shall be interchangeable on all cars without the use of shims or elongated holes.

The vehicle shall be designed for at least, but not necessarily limited to, the worst loading case arising out of the possible simultaneous combinations of the following loads acting on the vehicle:

- Car tare weight (AW0)
- Crush passenger load (AW3)
- Vertical, lateral and torsional dynamic load due to wheel/rail interaction
- Loads due to vehicle pitching caused by braking
- Snow or ice loads
- Aerodynamic load
- Train passing wind loads: Compressive and lateral loads caused by another train passing in the opposite direction on an adjacent track with relative speeds of 220 mph
- Buff load

4.2.1 Dimensions, Weights and Under Car Clearance

The completed car shall have the following overall dimensions:

Length (over coupler pulling faces)	85 ft 0 in.
Height (maximum) (ATOR)	16 ft 2 in.
Width (maximum)	10 ft 6 in.
Truck Centers	59 ft 6 in.
Upper floor height (ATOR)	8 ft 6 in.
Lower floor height (ATOR)	1 ft 6.5 in.

The completed car shall fully conform to Amtrak Clearance Drawing B-066-00050, rev 1.

The final car dry weight shall not exceed the following weight restrictions:

Coach Car	150,000 lbs
Cab/Baggage Car	154,000 lbs
Café/Lounge Car	153,000 lbs

Except for the pilot, the completed car shall comply with the minimum allowable clearance above top of rail for the carbody and all associated components under the worst combination of conditions, including fully worn wheels, solidly compressed or broken springs, AW3 passenger load, carbody deflection below zero camber, and environmental conditions including wind, snow and ice.

4.2.2 Physical Requirements

The carbody structure shall be designed to prevent water, snow or dust ingress when operating at any permissible speed under all weather conditions consistent with Caltrans Specification 1-106.

The carbody shall be designed to provide watertight performance without requiring topically applied sealant. Where sealant is used to enhance the watertight performance, it shall be applied in compression between assembled parts. Sealants shall have a service life of at least 30 years.

Housings for externally mounted equipment shall be completely watertight when covers are in place, excluding battery boxes, which are ventilated. Drain holes shall be provided in underframe shear plates.

4.2.3 Carbody Materials

Unless otherwise specified, the car structure shall be constructed of stainless steel. AISI Types 301L or 201L shall be used for visible parts: Types 201L, 301L, 302L or 202L shall be used for concealed parts. Non-structural stainless steel parts may be constructed of Type 304.

Cross sectional views shall be provided on carshell drawings and must be submitted for approval at the design review. **DR**

Carshell drawings shall show the location of all principal framing members, their cross sectional area, material and metal thickness. Thickness of all sheathing materials shall be provided. The information shall be sufficient to manufacture structural parts for the repair of any damage to a car.

Where welded stainless steel fabrication is required, only austenitic stainless steels (AISI type 201L or 301L stainless steel) with a carbon content not exceeding 0.03% shall be used.

The Contractor shall submit for Customer approval the types of materials and respective locations to be used in the components of the carbody.

LAHT steel, per APTA Standard SS-C&S-034-99, shall be used for the end underframe assembly. The LAHT steel shall be primed and painted for additional corrosion protection. The method used by the Contractor to prevent corrosion from the inside surfaces of closed structural sections (i.e. inside of tubular sections) shall be reviewed at the design review. At a minimum, each element shall include a drain hole. **DR**

The use of LAHT steel shall comply with all requirements of Chapter 18. Dissimilar metals shall not be used at connections requiring disassembly for removal and replacement of equipment without corrosion protection.

4.2.4 Carbody Exterior Finish

All external surfaces, unless otherwise specified, shall be unpainted stainless steel. Side sheets shall have a horizontal, 36 grit sanded finish. End sheets shall have a vertical, 36 grit sanded finish. All sanded surfaces shall have the same finish whether applied by hand or machine. Corrugated stainless steel shall have a 2B finish. All stainless steel parts shall

undergo a process of passivation in order to maximize the inherent corrosion resistance of stainless steel as per ASTM Standard A380-06.

All sheet metal, exposed to view, shall be as smooth as possible on the outside with a maximum variation from a straight line on flat surfaces, measured in any direction, of 0.125 in. and 0.0625 in. over a distance of 36 in. and 12 in., respectively, on the sides of the car and 0.1875 in. and 0.125 in. over a distance of 36 in. and 12 in., respectively, on the roof. The slope of any such deviation shall not exceed 0.1875 in. in 12 in. Dents, gashes or other surface imperfections shall not be permitted.

4.3 Structural Design Details

4.3.1 Level

The difference in height Above Top of Rail (ATOR) of the four corners of the finished car shall not exceed 0.375 in. measured at the end sills. The measurement shall be made on the completely assembled and equipped car mounted on its completed trucks. The measurement may be made from any suitable structural member of the underframe, and shall be documented in each vehicle history book.

4.3.2 Camber

Carbody camber shall be defined as its vertical curved shape as viewed in side elevation, and shall be a smooth arc from end-to-end of the carbody. Camber shall be measured from a datum line drawn between the intersections of the arc with the centerline of the body bolsters to a line tangent to the arc midway between bolsters.

The car shall have a positive camber not to exceed 0.5 in. under AW1 conditions and must be designed so that under full load, AW3, (and for the life of the car) a negative camber shall never occur. The maximum difference between the cambers of each side sill, measured at the location of maximum deflection, shall not exceed 0.125 in. The Contractor shall evaluate and submit camber values at AW0, AW1 and AW3 load for approval at the design review. **DR**

Under an end compression load equal to 800,000 lbs applied longitudinally to the line of draft of a carbody loaded to AW0 as required in APTA Standard SS-C&S-034-99, the vertical deflection of each side of the carbody with respect to the body bolsters shall not differ from the analytically determined value by more than 10%. The points to be measured shall be at the outer-bottom edge of the side sill.

4.3.3 Carbody Strength

The strength of the carbody shall equal or exceed the requirements of 49CFR Part 238, Subpart C and APTA Standard SS-C&S-034-99.

The carbody strength shall be sufficient to permit operation with up to AW3 loading for the design life of the car (40 years) without structural damage, including fatigue cracks. The carbody shell shall meet the static and dynamic strength requirements stated in this section.

Allowable fatigue stress of welded elements shall be determined from AWS Standard D1.1, for steel. Where insufficient information is available due to the lack of published data on this

subject, the allowable fatigue stress shall be determined experimentally through testing by the Contractor.

The completely equipped carbody shall be designed to carry its AW0 carbody weight (not including truck weight) plus a uniformly distributed passenger load equal to the passenger portion of AW3. The stresses in the carbody, under an applied AW3 load less the truck weight load, shall not exceed the lesser of 50% of the guaranteed minimum material yield strength, or the buckling strength. The inelastic buckling strength of structural members subjected to any combination of compression and shear shall be calculated. The variation in the stainless steel compression modulus with stress shall be addressed in calculating compressive stability of stainless steel members. The buckling values shall be used as the basis for the allowable stress values for the specified load cases. Any structural member in any of the elastic static analyses with a calculated compressive stress equal to, or greater than, 35% of its material's yield strength shall be included.

Notwithstanding the previous paragraph, for each joint design, the static stress at the AW3 carbody load shall be less than the stress that determines the allowable fatigue stress range. The allowable fatigue stress range shall be computed by multiplying the static stress at the AW3 load by the dynamic factor (fatigue load range). This stress range shall be within the design fatigue stress range (fatigue limit) obtained from AAR Standard C-II, Section 7.2, or AWS Standard D1.1, and as approved by the Customer.

The Contractor shall conduct fatigue tests to determine allowable fatigue stresses for joint designs not covered by AAR Standard C-II, Section 7.2, or AWS Standard D1.1.

The dynamic factor shall be determined by the Contractor and shall not be less than 20%. The fatigue design shall be based on applied and allowable fatigue stress ranges at 10 million cycles.

Structural analysis must be submitted for approval at the design review. **DR**

4.3.4 Underframe Structure

The underframe shall be composed of the center sill, if used, end underframes, floor stringers, subfloor, cross bearers and side sills. All parts of the underframe shall be constructed of stainless steel or LAHT, except the end underframe which shall be constructed of LAHT steel.

Side and center sills shall connect the end underframe assemblies and support the transverse floor members. Side sill materials shall be compatible with the side sheet materials.

4.3.4.1 End Underframe

The end underframe assembly, at each end of the car, shall be a weldment comprising the body bolster, draft sill, end sill, coupler support structure, buffers and other adjacent structure.

The coupler and draft gear carriers shall be included in the assembly. The end underframe shall be constructed of LAHT steel.

Fusion welding of one sided joints in the fabrication of the end underframe shall incorporate the use of back-up strips where 100% penetration of a single beveled weld is desired. The single bevel weld shall be reinforced by the application of an additional fillet weld where joint

strength requires it. All welds in the end underframe assembly shall be non-destructively tested in conformance with AWS.

4.3.4.2 End Sill

The end sill shall include the buffer beams, the anti-climbing arrangement and the collision post stubs and shall be securely attached to the collision posts, side sills and the draft sill. The collision post stubs shall extend down to the bottom plate of the end sill and shall be securely welded to both the top and the bottom plates.

4.3.4.3 Anti-climbing Mechanism

The carbody design shall provide an anti-climbing arrangement at each end of each car. The analysis of the anti-climbing mechanism shall include an analysis of the attachment of the coupler/draft gear and draft gear carrier plate to the underframe.

4.3.4.4 Coupler Carrier

A coupler carrier shall be provided as part of each end underframe assembly. The coupler carrier, and those portions of the carbody to which it is attached, shall be designed to withstand the loads caused by supporting one end of the car on the coupler carrier, with the truck attached, such might occur during emergency jacking or lifting with a crane in the event of a derailment. Under this coupler carrier load, the allowable design stress of the coupler carrier, or any part of the carbody structure to which it is attached, shall be the yield strength, the critical buckling stress or 80% of ultimate tensile strength, whichever is lower.

4.3.4.5 Body Bolster

The body bolster shall be designed to transmit loads between the truck and the carbody, and between the draft sill and the body and side sills. The design shall provide clearance for the truck in all positions and accessibility for truck maintenance and de-trucking. Positive stops shall be provided on the carbody and truck bolsters to limit the vertical and transverse movement of suspended trucks when the carbody is lifted.

The design and construction of the bolster shall consider the high fatigue environment in which it will be operating. Welding shall be as per AWS Standard D1.1.

4.3.4.6 Draft Sill

The draft sill shall extend longitudinally from the end sill to the body bolster and shall include the coupler support structure. It shall be designed to transmit the specified loadings from the anti-climber and coupler into the body bolster.

4.3.4.7 Side Sill

Side sills shall be provided on both sides of the car and form a structurally continuous bottom chord for the side frame.

4.3.4.8 Cross Bearers, Floor Beams, Sub-Floors and Floor Pans/Flooring

Cross bearers shall be provided to transfer the applied vertical loading from the center sill (if used) to the side framing. Floor beams shall be provided to transfer the vertical floor loads to the side sill and side framing. The cross bearers and floor beams shall be fastened to the center sill, if used, so that they stabilize the center sill against column failure, both vertically and laterally.

With the vehicle floor loaded to simulate a uniformly distributed AW3 passenger load, plus loads of all interior equipment, such as seats, interior liners and equipment boxes, the floor beams shall not deflect more than 0.004 of the span between supports, up to a maximum of 0.0625 in., and the maximum stress in the floor beams shall be less than the critical buckling stress or 50% of the yield strength of the material, whichever is less.

A stainless steel sub-floor shall be provided as a lower floor pan throughout the length and width of the car and in the equipment room. On the upper and lower level, the honeycomb sub-floor and its attachments to adjacent structural members shall be capable of resisting the shear resulting from the specified compression loading without permanent deformation. The sub-floor pans shall be securely fastened to the bottom flanges of the floor beams and to the draft sills and side sills. The sub-floor shall be sealed, in a manner approved by the Customer. Between the carbody bolsters, the sub-floor shall be attached to the above mentioned members in a manner to allow for easy replacement of damaged panels and yet provide the attachment and sealing required to meet the structural, car pressurization and fire safety requirements.

The sub-floor pan shall contain the underfloor thermal and acoustic insulation. The pans shall be suitably reinforced for structural rigidity and to prevent resonant noise and vibration and "oil canning" under any operating condition.

Plymetal panels 0.75 in. thick with butt joints shall be used for the lower floor. The sub-floor for upper and lower floors shall be aluminum honeycomb core or phenolic composite panels 0.75 in. thick. These panels will be constructed in a "clean room". The insulation core on each panel will be tested for dryness prior to hot pressing to insure proper bonding. Prior to installation each panel will undergo a thorough inspection to determine that no delamination has occurred. All exposed edges shall be waterproofed and sealed.

All joints shall lie on supporting structure. The ends of the panel shall be sealed against moisture. Anti-squeak tape shall be applied between floor panels and supporting structure.

If the floor pans are separate sheets, they shall be securely fastened to the car structure. A weatherproofing sealant shall be applied to the edges of the sheets immediately before installation. The fastening and sealing system shall prevent moisture, dirt, dust and debris entry into the sub-floor for the life of the vehicle and shall be approved by the Customer.

One-eighth inch elastomeric anti-squeak tape shall be applied between floor panels and supporting structure. Panels shall be attached to floor structure using approved flathead fasteners in formed countersunk holes. Tapping plates for above-floor equipment shall be suitably attached. The floor material shall have shear strength not less than 250 pounds per square inch (psi) and shall be capable of passing the ASTM E119 fire test.

4.3.5 End Frames

The car end frames shall consist of two corner posts, one each at the juncture of the front end and side frames, two collision posts located at the approximate third points of the end frame width, but in any case not more than 40 in. apart, an end door, a structural shelf, framing posts and sheet metal sheathing connected to the structural framing members as necessary.

The door posts and header shall be designed to carry the end door while maintaining weather tightness. Corner posts shall be continuous from the end underframe to the side rail at the side frame/roof connection.

The A and B-end sheets shall be of the same material as the side sheets and securely framed to the car structure.

The F-end sheet on the cab/baggage car shall provide projective resistance equal to or greater than that specified for FRA Part 223 Type I glazing where adjacent to the cab control compartment.

4.3.5.1 Collision Posts

The car end structures shall be provided with vertical collision posts at both sides of the end openings, fastened securely into the roof structure at the top and welded to the top and bottom plates of the end underframe. The collision posts shall be constructed of stainless steel or LAHT.

The collision posts shall be continuous closed sections from the bottom of the end sill to the top of the roof.

If reinforcement is used to provide the specified collision post shear strength at the floor, it shall be designed to transmit the specified shear and other loads into the end underframe. At a minimum, the cab end reinforcement shall be continuous from the bottom of the end sill up to at least 30 in. above the top of the underframe, then gradually taper to a point not less than 42 in. above the top of the end sill. The non-cab end reinforcement shall, at a minimum, be continuous from the bottom of the end sill up to at least 18 in. and then taper to a point at 30 in. If shear reinforcement is not used, the post shall be arranged to penetrate the end underframe unit and weld to the top and bottom plates of the end underframe unit.

The connections and supporting structure at the tops of the collision posts shall be designed to develop sufficient horizontal, vertical and bending strength, so that if one or both posts, whichever is more critical, is overloaded in bending to ultimate strength, the post top connections and supporting structure, if stressed beyond their yield strengths by the resulting horizontal, vertical and bending loadings, shall deform plastically by buckling and bending of the members to accommodate the post plastic bending failure. The ultimate strength of the connection fasteners and welds shall be sufficient to prevent their failure, even with severe plastic deformation of the collision posts and of the top connecting and supporting structural elements.

Overload of collision post bottom connections shall result in buckling and crushing of the underframe structural members to which the collision posts and any collision post reinforcements are attached, rather than by shearing or fracturing of the posts.

4.3.5.2 Corner Post

A structural post shall be installed at each corner of the car. The posts shall be continuous closed sections from the bottom plate of the end sill to the roof. The posts shall be connected to the top and bottom plate of the end sill, side frame, roof structure and intervening structural shelves. The attachment of each corner post at the bottom shall be sufficient to develop its full shear value.

4.3.5.3 Structural Shelf

A structural shelf shall be provided just below the cab end windows, connected securely to the corner post and the collision post. The shelf may be integrated with the control console on the cab side.

4.3.6 Side Structure

Side frames shall consist of vertical members such as window posts and door posts, and longitudinal members such as roof rails, side sills, window top rails and belt rails. It shall include sheathing and internal skin stiffening members. Structural posts shall be located at the sides of door and window openings and elsewhere as required, to limit deflection and fatigue stresses. Structural posts shall be continuous between side sill and roof rail if the upper level floor support side rail is not designed to be a primary load carrying member. All posts shall be formed sections. If the upper level floor support side rail is designed to be a primary load carrying member, the side posts shall be continuous from the lower side sill to the upper side sill and continuous from the upper side sill to the roof rail. At the upper side sill, gussets shall be used to reinforce connections to effectively make the posts continuous between the lower side sill and the roof rail. Where longitudinal rails are interrupted by posts, gussets shall be used to reinforce connections to effectively make the rails continuous. All gussets shall be full height. The side frame posts or stub posts (between side sills and belt rails) shall transmit applied vertical loadings from the body bolster ends, cross bearer ends and jack pads into the side frame sheathing.

The belt rail on both upper and lower levels (the horizontal rail member at the bottom of the window openings in the side frame) and its supports shall be designed to resist the specified side load in accordance with APTA Standard SS-C&S-034-99 and shall comply with the requirements of 49CFR Section 238.217.

Intermediate structural elements between the side frames shall transfer all seat and floor loads to the side frame posts. Passenger seats shall be supported on the wall side by continuous structural members fastened to the side frame posts. The carbody side and side frame posts shall be capable of supporting AW3 loads with a minimum safety factor of 2.0, based on yield strength, without permanent deformation, at a deflection not to exceed 0.125 in.

4.3.6.1 Side Sheets

All the exterior surfaces of the carbody shall be stainless steel. The required appearance of exposed welds shall be as described in Chapter 18. Three samples of all exterior finishes shall be submitted to the Customer for approval; this includes samples of 2B (bright cold rolled) and brush finishes and samples of all exposed resistance welding conditions illustrating the various metal build ups and configurations. These samples shall be used throughout the program to maintain quality. Dents, gashes or other surface imperfections shall not be permitted. Samples of the exterior finish specifying the direction of the grain and the flatness shall be submitted for approval at the design review. **DR**

Side sheathing shall be resistance spot welded to the outside of the side frame posts between the side sill and the roof. Smooth side sheets shall be stiffened by corrugations or similar sections resistance welded to the inside face of the side sheet. Weld spacing shall be in accordance to Chapter 18. Flat side sheathing shall be a minimum of 0.059 in. thick. Sheets under the windows, if corrugated, shall be of 0.042 in. thickness.

Horizontal lap joints shall be permitted where flat side sheets are connected to corrugated side sheets provided the direction of the joint sheds water and the joint is seam welded.

The ends of corrugations shall be permanently sealed against air and water by capping or controlled crushing. Additionally, they must be sealed with an approved sealing compound. Samples of the method must be submitted for approval at the design review, and maintained until notified otherwise by the Customer. **DR**

Side sheets below the windows shall be continuous sheets or longitudinal corrugated sections running the entire length of the car.

The side sheet shall be attached to the side sill by a continuous fillet weld or by a series of resistance welds. If resistance welds are used, they shall develop the same strength as a continuous fillet weld. Strength in tension and shear shall be reviewed in the stress analysis.

Smooth side sheets stiffened with corrugations welded to the hidden surface shall be provided in the window area. Flatness standards previously defined shall be met.

There shall be no less than two spot welds per node of corrugation or where attaching corrugated panels to framing members.

4.3.6.2 Upper Level Floor

The upper level floor shall be supported by a suitable system of longitudinal and cross members. The allowable deflection of the upper level floor under its dead weight plus the maximum passenger load including seats and work tables shall not exceed 0.0625 in. Additional support for the upper level floor system shall be provided by the permanent partitions available in the lower level floor area. The stresses in any member of the upper level floor, or its support structure under maximum passenger loading (AW3) shall not exceed half the yield strength of the material.

All members of the upper level floor shall permit the fastening of equipment and the installation of the air distribution system, wiring, lighting fixtures and other equipment for the lower level ceiling appurtenances in a secure manner. The framing shall be arranged so that lower level equipment can be replaced and maintained through removable panels without disturbing carbody structural members. Ducting for circulation of conditioned air for the lower level shall be fastened to the upper level floor framing arrangement, consistent with the air distribution requirements of the Heating, Ventilation and Air Conditioning (HVAC) system. Clip nuts shall not be used.

4.3.7 Roof

The roof shall be constructed with corrugated sheets. The car roof framing shall consist of carlines (transverse) and purlins (longitudinal), all suitably fastened to the side and end framing to provide a strong, rigid, integrated structure. The roof shall meet 49CFR Section 238.123, APTA Recommended Practice RP-C&S-001-98 and APTA Standard SS-C&S-034-99. All members of the roof framing shall be designed and arranged to permit the installation and fastening of roof wiring, lighting fixtures, equipment, ventilation ducts and other required apparatus in a secure manner. Ducting for the circulation of conditioned air shall be coordinated with the roof framing arrangement and configured to be consistent with the air distribution requirements of the heating and air conditioning system.

The roof shall be framed and reinforced around openings. All reinforcement shall be welded stainless steel. Reinforcements and joints on the roof shall be made watertight by welding or soldering. Horizontal lap joints shall be permitted where flat side sheets are connected to corrugated side sheets provided the direction of the joint sheds water and the joint is seam welded. No through-roof mechanical fastening is permitted. The roof sheathing and structure shall be designed to support the specified roof loads. Both ends of the roof shall be designed to support the tops of collision posts and distribute the specified collision and corner post loads.

Flat surfaces or plates shall be provided on the roof for all roof-mounted appliances such as antennae. Roof penetrations for wiring or piping to roof-mounted equipment shall be suitably sealed, and all wiring and piping shall be routed to roof-mounted equipment through conduit. All roof-mounted equipment shall be mounted on the longitudinal centerline of the car unless otherwise specified.

All parts of the roof structure, sheets, equipment covers, roof walkway, screens and other guards shall have sufficient strength to withstand, without exceeding the yield strength, 80% of ultimate strength and critical buckling stress under any of the following conditions:

- Concentrated loads of 250 lbs applied over a 3 in. by 3 in. area and
- A uniform load of 15 psi over any region of the roof.

Equipment mounted under the roof suspended from the roof structure shall be bolted to the framing members. The framing members shall be reinforced in subassembly to accept the equipment load.

4.3.7.1 Emergency Access "Cut Zone"

Roof emergency access shall be in accordance with FRA 49CFR Section 238.123 and APTA Recommended Practice RP-C&S-001-98. Perimeter of the cut-zone shall have a retro-reflective sign demarcating the opening, and clearly indicating the purpose, instructions and other emergency signage per APTA Standard SS-PS-002-98.

4.3.7.2 Gutters and Deflecting Plates

Water deflecting gutters shall be installed on the entire length of the roof on both sides of the car. They shall prevent water from dripping into or in front of the side door opening when the car is stopped. Gutters shall also deflect water off the entire end of the car.

Deflecting plates shall be installed at the ends of the roof to direct water between cars. The design arrangement and installation of roof equipment shall not permit accumulation of water. Drainage provisions must be submitted for approval at the design review. **DR**

Gutters and deflecting plates shall withstand regular passage through a car wash. Gutters shall be made from the same material as the shell, roof and side sheets.

4.3.8 Jacking Pads

Eight jacking pads, with anti-skid plates, shall be provided in approved locations to lift the car, with trucks attached, at or inboard of the bolster for maintenance and at the extreme ends of the car in the event of a derailment. The car shall be designed to permit jacking for truck removal or re-railing with one end of the car resting on its truck, without damage to the truck

attachments, underframes or any of the underfloor equipment. The jack pads shall be a minimum of 32 in. ATOR.

The jack pads shall be 8 in. wide and 5 in. deep (width is parallel to car's side sheet) with a suitable surface to avoid slippage. It shall be possible to jack up a complete car, or either end of a car, utilizing portable jacking devices and to subsequently support the car with portable stands with trucks remaining on the rails and remove the portable jacks. It shall be possible to manually roll the trucks from under the end of the car when supported on jack pads.

The design vertical load for each jacking pad shall not be less than one half the empty weight of a ready to run (AW0) car. The design horizontal load shall be 10% of the design vertical load. The horizontal load shall be applied simultaneously with the vertical load in any direction to produce the worst stress condition. The allowable design stress shall be yield or 80% of ultimate, whichever is lower or the critical buckling stress of any part of the jack pad or the structure to which it is attached. Jacking pads shall extend a minimum of 0.50 in. below the bottom of the side sill. There shall be no permanent deformation when the car is symmetrically jacked from any combination of pads with the car at AW0 with the trucks attached.

The empty carbody, with trucks attached (AW0), shall be capable of being lifted on the outboard most diagonally opposite jack pads without resultant permanent deformation on any element of the carbody structure. An analysis of the carbody structure under torsional loading of the diagonal jacking, all symmetric jacking, and all lifting conditions shall be included in the stress analysis.

4.3.9 Lifting Eyes

Lifting eyes shall be installed at the extreme top edge of each collision post of both ends of all cars to allow lifting the car with overhead cranes or a boom. It shall be possible to lift the car at AW0 load with an overhead crane or boom at only one end with trucks attached and supported by the opposite end truck, without exceeding 50% of the yield strength of the material. Procedures and designs shall be submitted to the Customer for approval during the design review of the car. The lifting eyes shall be arranged such that they are readily accessible. The top of the collision posts, including lifting eyes, shall not extend above the surface of the roof. **DR**

The stress analysis shall include an analysis of the collision post lifting eyes under all torsional loading showing all stresses on the carbody and all attachments during lifting of the car in, AW0 condition, from either end or both ends when ready-to-run in the following conditions:

- Car upright
- Car lying on left hand side
- Car lying on right hand side

For lifting from either the left hand side or the right hand side, the car shall be analyzed with equal lifting load applied to one collision post lifting eye on each end of the car.

4.3.10 Stairways

Two stairways, parallel to the carbody, shall be provided adjacent to each entranceway to connect the lower and upper levels of the car, (except the café/lounge car, see Chapter 14). Stairwell framing treads and risers shall be constructed of stainless steel and mounted securely to upper and lower floor. Open risers shall not be permitted. The Contractor shall

design for safety and ergonomics when determining the riser height, tread depth, slope of the stairway and headroom. The step tread width shall be a minimum of 32 in.

4.4 Truck–to-Carbody Attachment

An approved truck safety mechanism and truck rotation stops shall be provided.

The construction shall also provide a connection between the carbody and trucks so that the trucks are raised with the carbody, unless intentionally detached. The truck safety mechanism shall not interfere with normal suspension elements for any possible condition of shimming to accommodate for wheel wear variances.

4.5 Bolster Anchor Rods and Brackets

Bolster anchor rods and brackets shall be provided to transmit the longitudinal loads between the carbody and the truck. The anchor rods shall be positioned to minimize longitudinal vibration to the carbody. Two bolster anchor rods and brackets shall be provided, one on each side of the truck connecting the carbody to the bolster.

The rods shall extend horizontally from brackets attached to the side sills to brackets attached to the ends of the truck bolster. Elastomeric pads shall be installed between the radius rod assembly and anchor brackets to permit relative movement.

The anchor rod bracket or bracket mounting bolts shall be frangible. Any horizontal load which develops the ultimate load carrying capacity of the anchor rod bracket shall not develop a stress greater than yield, 80% of ultimate strength, or the critical buckling stress in the side sill or other car structure. The longitudinal load shall be applied in either direction in the horizontal plane of any part of the anchor rod bracket below the side sill. A specially designed anchor rod bracket bolt, which breaks at a predetermined load, shall be permitted subject to the approval of the Customer.

The attachment of the anchor bracket to the carbody shall be by mechanical fasteners, designed and constructed to permit interchangeability among cars, and arranged to permit removal of the bracket from outside of the carbody without interference from the car structure.

Each of the rods shall, as a minimum, withstand a longitudinal load equal to two times the weight of the complete truck, including brakes, and other apparatus mounted thereon, without exceeding the yield strength of the materials used. Each of the brackets, by which the bolster anchor rods are attached to the truck, the truck bolster and/or the carbody, and the members to which these brackets are attached, shall, as a minimum, withstand a longitudinal load equal to three times the weight of the complete truck assembly without exceeding the yield strength of the material used. Both anchor rods together must also support the longitudinal dynamic load created under maximum braking rates at all speeds and under maximum loading conditions.

4.6 Doorways and Passageways

4.6.1 Doorways

All cars shall include four sets of side entry doorways (two per side) and two end-frame doorways (one at each end). Location and dimensions of these doorways shall be in accordance with Caltrans Drawing A-8-902.

4.6.2 Side Entrance Area

Four lower level side entrance areas, in accordance with ADA standards, shall be provided. A minimum 52 in. wide clear passage shall be provided through all side entrance area doorways.

Floor height at the side entrance doors shall be 18.5 in. ATOR under AW0 conditions.

4.7 Diaphragm

A non-metallic modular diaphragm shall be provided at each end of each car. Diaphragms shall provide a safe, stable, weatherproof passageway between two coupled multi-level cars, and shall exclude water ingress and drafts under all normal operating conditions. Easily replaceable wear plates shall be provided on diaphragm faceplates. A minimum clear horizontal opening of 32 in. through the diaphragm parallel to the end door panel shall be provided when the car is at rest on level tangent track.

Hinged stainless steel walkway plates, equipped with a safety tread surface, shall be provided at each end of the car to provide a continuous flat and level walkway between coupled cars.

The construction of the walkway plates, buffer and side stems shall be such that there shall be no metal to metal contact between moving parts, in order to prevent noise, minimize wear between all parts, and require no lubrication.

The walkway plates, buffer and side stems shall be so designed to permit coupled cars to negotiate minimum radius curves and crossovers, without any binding of the mechanism.

Retractable curtains with restraining devices shall be provided on either side in the diaphragm passage. The curtains shall be directly interchangeable, without adapters, with existing curtains on bi-level equipment as specified, and shall include "automatic retraction or break away" feature and diaphragm size, arrangement and installation shall be compatible with other bi-level equipment as required.

A safety gate/bar(s) shall be provided to prevent passage through the body end door opening when the door is open and the car is at the end of the train. It shall be used to form a transverse barrier between collision posts. It shall be secured to one post on a pivot pin and shall latch securely in both the horizontal and stored (vertical down) positions.

4.8 F-End Pilot

A pilot which meets the requirements of 49CFR Section 229.123 shall be provided at the F-end of the cab/baggage car. See Chapter 16 for details.

4.9 Safety Appliances

4.9.1 Exterior

Railroad safety appliances shall be in accordance with 49CFR Part 238 and/or 49CFR Part 231. The Contractor shall be responsible for obtaining from the FRA a determination of compliance with all applicable FRA safety appliance regulations. All car types should have the same safety appliances.

Handrails shall be provided on the exterior of the carbody on each side of each entrance doors to assist passengers when boarding or alighting from the car. Design and assembly of handholds and handrails shall be submitted to the Customer for review and approval at the design review. **DR**

Sill steps shall be provided near each end on each side of the car.

Two handholds, mounted either vertically or horizontally shall be provided above each sill step. The handholds shall be located at an optimum location to assist the crew during car moving operations. Location of the handholds shall be subject to Customer approval.

End handholds shall be provided near each side on each end of the car.

Suitable warning signs shall be provided where appropriate.

All safety appliances shall be within the clearance envelope.

The Contractor shall arrange for an FRA sample car inspection of the safety appliance applications and shall provide the Customer with a copy of the FRA “no exceptions taken” letter prior to release of the first car of each type. **CDRL**

4.9.2 Interior Passenger Grab Handles

Passenger grab handles shall be provided as follows:

- At the side of the entrance area to allow crew to stand safely in the open doorway; and
- In the end passageway adjacent to the end door, on both sides of the passageway and between the end door and the diaphragm.

4.10 Mobility Aid Accessibility

4.10.1 Wheelchair Lift

Each car shall be equipped with two permanently mounted powered wheelchair lifts, one for each side of the car located adjacent to the B-end side doors. The wheelchair lifts shall meet all requirements of ADA.

The wheelchair lift design shall ensure reliable operation under the following conditions:

- Uneven station platform edge;
- Uneven station platform: slope in both lateral and longitudinal directions;
- Car lean from up to and including 7 in. of super elevation (toward and away from the platform);
- Platform height ranging from 8 in. inches below top of rail to 18 in. ATOR, in addition to effects of super elevation, both toward and away from platform;
- Operation in all types of weather conditions, as defined in Caltrans Specification 1-106.

The wheelchair lifts shall be designed for safe and reliable operation, and shall be free of sharp corners or edges, pinch points, heavy components that may drop suddenly, or other unsafe designs. The lifts shall require the use of an Amtrak standard coach key to deploy, and shall be unpowered when not activated with the coach key. The wheelchair lift shall be easy to operable manually in case of hydraulic, pneumatic or electrical failure.

The wheelchair lifts shall be electrically or hydraulically powered, and shall stow out of the way when not in use. If powered hydraulically, the hydraulic lines shall be leak-proof and located for ease of access and maintenance. The hydraulic fluid reservoir shall be located to facilitate checking the fluid level and replenishing as necessary. The lift shall not require any kind of preparation or priming to operate after an extended period of disuse. A means of purging the hydraulic system of trapped air shall be provided.

The wheelchair shall not require maintenance or adjustment more frequently than annually.

The wheelchair lift controls shall provide safety interlocks as follows:

- The lift shall be interlocked with the car air brakes so that deployment of the lift when less than 30 psi brake cylinder pressure is present on the car, a magnet valve will vent the brake pipe. Deployment of the lift with 30 psi or greater brake cylinder pressure will not result in brake pipe venting. A means of closing the brake pipe in the event of a magnet valve failure shall be provided.
- The lifts shall be interlocked with the adjacent side doors so that the side doors will not attempt to close if the lift is not fully stowed. This will provide a traction inhibit function through the door closed summary circuit.
- An interlock bypass shall be provided that will allow a train to continue in operation in the event of a wheelchair lift failure that affects the ability to release the air brakes or close the doors. Utilizing the bypass feature shall isolate the lift and prevent its use. The bypass device shall be sealable with an Amtrak seal to deter misuse.

A mockup of the wheelchair lift unit and installation shall be built to verify the function of the design, and shall be submitted for approval at the design review. **DR**

4.11 Underfloor, Roof Equipment Enclosures and Equipment Access Doors

4.11.1 Enclosures

Stainless steel enclosures shall be provided for all underfloor and roof mounted equipment without violating the clearance envelope requirements. Hinged access doors shall be designed to provide adequate access for servicing of apparatus contained therein. Enclosures shall be

water and dust tight under normal railroad operating and environmental conditions. Enclosures shall be supported on horizontal flanges of side, center or body sills, where possible. The enclosure shall inhibit vibration and meet the strength requirements defined herein.

4.11.2 Doors and Hardware

Equipment access doors and hardware shall be of T304 stainless steel construction. Access door shall form a positive seal to keep the enclosure water and dust tight under normal railroad operating and environmental conditions. Top-hinged doors with gas strut for underfloor equipment shall be used. Hardware shall be of stainless steel and not require special tools. To the extent possible, captive hardware shall be used. The mechanism to secure the door closed shall be simple and require minimal maintenance.

4.11.3 Floor and Roof Penetrations

The Contractor shall ensure that all floor and roof penetrations shall be sealed to inhibit pressure differential, and provide for a water tight and dust tight carbody. Floor penetrations shall be sealed with an appropriate material to prevent flame propagation from underfloor flame sources; and shall last the life of the rail car.

4.11.4 Equipment Boxes

The interior of all electrical equipment boxes and terminal boxes shall be primed and shall be given one coat of white insulating coating. A single coat of insulating varnish, enamel, white (or approved color) or epoxy powder coating may also be used. Insulating coatings are not required on fiberglass surfaces.

4.12 Equipment Rooms

4.12.1 Layout

Maintainability shall be the driving criteria in designing the layout of the equipment room. To the extent possible, the Contractor shall design the layout to enable a 95th percentile male crew member to safely navigate within the equipment room. Equipment that needs routine maintenance and inspection shall be located in physically accessible areas. Equipment room compartment walls and access doors shall be stainless steel and both thermally and acoustically insulated. Interior walls of the equipment room shall be painted white or an approved color tone to achieve maximum reflectivity. The layout and type of equipment that shall reside in the equipment room must be submitted for approval at the design review. **DR**

4.12.2 Access Doors

Hinged doors shall be provided for access to the equipment rooms, HVAC units and the battery compartment. Hinged access panels shall be provided for access to the air intake for the HVAC condensers and to permit installation and removal of HVAC units. Fixed access panels shall be removable to provide openings large enough to permit installation and removal of equipment room components. Louvers, where used, shall be removable as an integrated assembly. The equipment compartment access panels and doors shall be constructed so as to harmonize structurally and aesthetically with the car sides. When closed, the access panels shall be held fast with structural bolts to comprise an effective structural segment. The equipment room

doors shall swing outward and have appropriate latching, operable from inside and outside. The access doors shall have a positive seal when closed; effected on the doors by a dog type handle and be lockable with a standard Amtrak coach key. Access panel and door construction shall be stainless steel, to coincide with the carbody. The panels shall be of a rigidity and strength comparable to the adjacent car side areas. All joints and edges shall be watertight. Doors and panels shall be vibration free.

Battery Compartment Doors:

- Hinge shall be secured to the carbody and access door with stainless steel bolts – 0.25 in. – 20 UNC or larger.
- Secured with a standard coach key.
- Self-latching mechanism shall prevent unexpected closure and hold the door open at an angle of no less than 110° from closed.
- Labeled per Amtrak Specification 696.

Fresh Air Intake Door:

- Hinge shall be secured to the carbody and access door with stainless steel bolts – 0.25 in. – 20 UNC or larger.
- Secured with a standard coach key.
- Self-latching mechanism shall prevent unexpected closure and hold the door open at an angle of no less than 110° from closed.
- Fresh air damper shall be mounted on the inside of the door.
- Provides access to HVAC unit air filters.

HVAC Unit:

- Door opening shall enable unobstructed removal of the HVAC unit.
- Hinge shall be secured to the carbody and access door with stainless steel bolts – 0.25 in. – 20 UNC or larger.
- Secured with captive bolts.
- Access door shall incorporate stainless steel screens.
- Mechanism shall hold the door open at an angle of no less than 110° from closed.

4.12.3 Ladders

Each equipment room shall be equipped with a T304 stainless steel ladder that is permanently and securely stowed inside the equipment room. Nylon strap at a convenient height shall be attached to the ladder for deployment from outside the car. Pivot mechanism with a high coefficient of static friction shall prevent the stowed ladder from tipping over and inadvertently deployment. When stowed, the ladder shall rest against a rubber bumper that acts as a vibration damper and motion retardant. When deployed, a rubber bumper installed on the side of the carbody shall cushion the ladder in its fully deployed position. Stainless steel anti-skid steps and tread plates shall provide a safe and secure foot hold for the crew during ingress and egress. The height of the first step, when deployed, shall be no greater than 15 in. ATOR. Ladder frame, pivot mechanism, step and tread plate shall be designed to withstand a static load of 400 lbs at the center of the each step without permanent deformation. The ladder shall meet the requirements outlined in APTA Standard SS-C&S-006-98.

4.12.4 Ventilation

All equipment rooms, except the battery box, shall not be ventilated and shall be positively pressurized to prevent dust and dirt ingress.

4.12.5 Safety

Equipment rooms shall be designed and arranged to provide a safe working environment that is well-lit and free of sharp corners or edges, pinch points or other hazards to maintenance personnel.

4.13 Windows

Frame and glazing rubber of side passenger windows and side door windows shall be designed to securely retain the glazing material under all operating conditions on specified track configurations.

Glazing assembly (frame, rubber and glazing material) shall not leak during carbody water tests. The glazing material shall show no physical damage or degradation of optical qualities when exposed to the environment encountered in rail passenger service.

Construction shall be a double-glazed side window with the exterior light to be tinted laminated safety glass, and the inner light to be untinted.

All glazing assemblies shall meet all applicable requirements of 49CFR Part 223. They shall meet any applicable APTA requirements.

Glazing assemblies (frame, rubber and glazing material) shall be watertight over the entire operating environment. The sash itself shall be free of condensation, watertight and dust tight. The glazing material shall show no physical damage or degradation of optical qualities when exposed to the environment encountered in rail passenger service.

Material selection for glazing rubber and all other materials in all locations must take into account the possible inherit interaction between the material as well as the environment.

4.13.1 Glazing Materials

Glazing material shall conform to the requirements specified in Chapter18.

Material shall be integrally tinted with no appreciable variation in color over the entire area of each glazing and between panel of like color designation and thickness. Color measurements shall be taken with a spectrometer.

A permanent protective veneer shall be applied to the exterior surface of all glazing material. This protective covering shall significantly improve the abrasive resistant qualities of the glazing to abrasive materials, natural atmospheric acids, strong cleaning chemicals and cleaning brushes encountered during normal operating and cleaning conditions

Markings are to be in accordance with current ANSI Standard Z26.1 and 49CFR Part 223. Location of these markings must be visible for identification after installation.

4.13.2 Side Windows

Side windows shall conform to the requirements specified in Chapter 18.

An approved sealant shall be used as the primary vapor sealant on both sides of the desiccant spacer. The edges of the unit shall be sealed with a polyurethane sealant along the entire perimeter, filling all voids. Aluminum tape shall be applied to the perimeter of the glazing assembly.

The window frames shall be extruded aluminum 6063-T5 alloy. The carbody side of the window opening shall be reinforced to keep the opening flat.

Retention of glazing material in the frame shall be by means of a rubber extrusion. A "pound-in" strip shall secure the glazing from the inside of the car. A "zip strip" on the outside section of the rubber shall allow installation and/or removal of the main rubber extrusion from the carbody frame.

The window opening in the carbody shall be reinforced to keep the opening flat. A leak proof seal shall be provided.

4.13.2.1 Emergency Side Windows

A two part "Emergency" handle shall be provided at designated "Emergency" windows for removal of the window from inside of the car. The design of the glazing rubber shall also allow removal of the glazing from the outside of the car by emergency responders as described below.

4.13.2.2 Rescue Access Windows

All side windows shall be rescue access windows, and shall be capable of being removed from the outside of the car by prying and pulling a “zip-strip”. Rescue access windows shall provide a means of rescue access by emergency personnel such as, police, fire department, etc. Emergency side windows on each side of the car on each level shall be designated as an emergency and rescue access – dual-function window.

Identification and removal instructions shall be provided in accordance with 49CFR Part 223, 49CFR Section 238.114, APTA Standard SS-PS-002-98 and ASTM Standard D 4956-07 for Type I material sheeting.

4.14 Insulation

4.14.1 Acoustical Insulation

To reduce movement, structurally-borne sound and noise generated by the vibration of the roof, floor and side sheets, panels, air conditioning ducts and other metal surfaces, in particular the doors, damping material shall be applied to the inner side of these surfaces (exterior of the HVAC ducts). The thickness of the damping material shall be such that it shall provide ten percent of critical damping for the treated surface. The damping material shall have a vibration decay rate of not less than 35 decibels per second (dB/sec) as measured by the Geiger-Hamme Thick Plate Test Method. The damping material shall have a hydrodynamically smooth finish, and shall be receptive to painting. It shall be resistant to

dilute acids, alkalis, greases, gasoline, aliphatic oils and vermin. It shall be unaffected by sunlight or ozone, and shall not become brittle with age.

This material shall be applied to the interior of the complete structural carshell including the roof, sides, underfloor, ends and webs of all posts, carlines, floor beams and other structural elements. The sound dampener shall be compatible with the material used at the affected locations in the car structure.

Application of this damping compound and the surfaces to which it shall be applied shall be in accordance with recommendations of the manufacturer of the compound, and as follows:

- Prior to application, the Contractor shall ensure that surface temperature of the base material meets the supplier's recommended temperature settings. Ambient temperature shall not be used to qualify a base material for application of damping material.
- The inner surface of the carbody structural shell, except for the end underframe welds, shall be coated with sound deadening compound. The inside surfaces or structural members shall be sprayed to the extent possible. The compound shall be applied wet to the supplier's recommended thickness.
- Structural members under the floor of the carbody shall not be coated.
- The outside surfaces of the main air duct, the vertical underfloor equipment ventilation duct, and all ventilation cross ducts shall be coated with sound deadening compound. The compound shall be applied wet to the supplier's recommended thickness.
- Duct splitters (if used) shall not be coated.
- The underside of the main air duct, top/bottom of floor beams, inside door pockets and floors of equipment rooms shall not be coated.

4.14.2 Thermal Insulation

The floor, roof, sides and ends of the cars shall be insulated. The heat transfer through the carbody, using only the carbody's own floor heaters, shall not exceed 800 Btu/Hr/ F under Caltrans Specification 1-106 conditions while carbody is stationary. Contractor to supply thermal analysis of completed car for approval at the design review. **DR**

As much as practicable insulation shall have an acoustic barrier and shall not settle in long service under vibrating conditions.

The roof insulation shall be retained by insulation pins of the same metal as the car structure attached to the carlines. Side and end wall insulation shall be retained by insulation pins. On the inside of the end and side powered door pockets the insulation shall be retained by stainless steel sheets.

Side wall insulation located near heater assemblies shall be metal-backed with metal side facing the heater.

A vapor barrier shall be provided between all interior linings and the carbody insulation.

Thermal breaks shall be provided between the main conditioned air supply duct and roof structural members, between interior finish panels and any metal primary or secondary structural members which are thermally grounded to the outside surface of the carbody skin

and at any other location where it is necessary to interrupt an all-metal path between interior of the carbody and outside of the carbody skin.

4.15 Exterior Finish

Generally the stainless steel car exterior will not be painted, however some painting shall be required for aesthetic as well as branding purposes. Refer to the Customer Livery requirements, as specified in Chapter 23 for details.

Painting of the car serves two primary purposes: 1) to protect the metal from corrosion and 2) to contribute to the overall aesthetic quality of the vehicle. Paint coatings should also assist in the overall maintenance of the vehicle by providing easy to clean surfaces. The vehicle must be fully and properly coated to achieve its service life with regular maintenance intervals.

Soon after fabrication, all carbon steel portions of the car body shall be prepared for painting and immediately thereafter painted with the first coat of primer, utilizing the paint supplier's written procedures with trained technicians.

The surface preparation and graphics applications shall ensure that the car can operate at least eight years between major exterior finish repairs or replacement.

4.15.1 Painting-Exterior

The carbody exterior shall be painted in accordance with the Customer instructions as specified in Chapter 23 and Chapter 18.

Care in painting application shall ensure freedom from runs, sags, orange peel and other unsightly paint deficiencies, utilizing the paint supplier's written procedures with trained technicians.

4.15.2 Post Painting

Allow the car to remain inside for a minimum of 8 hours unless outside temperatures are above 60°F, utilizing the paint suppliers written procedures with trained technicians.

4.16 Graphics and Labels

4.16.1 Exterior Graphics

All exterior graphics, lettering and signage, including vehicle numbers and reporting marks, shall be applied to the vehicle in accordance with Customer specifications as identified in Chapter 23.

4.16.2 Labels

Exterior equipment shall be labeled in accordance with Amtrak Specification 696.

4.17 Automatic Equipment Identification (AEI) Tags

Each car shall be equipped with an Automatic Equipment Identification (AEI) transponder tag on each side, located in conformance with Universal Machine Language Equipment Register (UMLER) dimensional and securement requirements and programmed with the reporting marks of the owner, road number of the vehicle and all other technical data required by UMLER.

The Contractor is responsible for ensuring the following:

- Tags are properly installed in accordance with UMLER requirements;
- Tags are properly programmed with all data required by UMLER; and
- The UMLER system is updated with the data for each vehicle as required for shipment.

* End of Chapter 4 *