Exhibit 14.

AAR Standard S-034-69 “Specifications of the Construction of New Passenger Equipment Cars”

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[151] note - this document is no longer maintained by the source organization.

Association of American Railroads
Mechanical Division
Manual of Standards and Recommended Practices

(Former Section C)
S-034

SPECIFICATIONS FOR THE CONSTRUCTION OF NEW PASSENGER EQUIPMENT CARS

Standard

S-034-69

Adopted, 1939; Advanced to Standard, 1945; Revised, 1967, 1969

PREFACE

The specifications have been prepared on the basis that they will be used for structural design of future new equipment and that the requirements laid down therein will not be retroactive into equipment now in service which has been built to former accepted specifications.

BASIC FUNDAMENTALS, NEW SPECIFICATIONS

The Railway Mail Service Specifications as revised July 20, 1938, were used as the basis for these specifications which provide for cars which may be used in trains of over 600,000 pounds light weight made up of cars of any type of construction now being operated.

The Committee's review of the latest Railway Mail Service Specifications resulted in the preparation of these specifications in such a way as to more definitely establish the strength values at various locations in the car, as follows:

(a) Trucks are required to be locked to the car body. This is for the purpose of obtaining the value of the weight of the truck plus the shear value of the truck attachments to the car body under abnormal accidental impacts.

(b) A car structure which resists minimum static end load of 800,000 lbs. applied on center line of draft without developing any permanent deformation in any member of the car structure. The minimum static end load of 800,000 lbs. was derived from a 400,000 lb. design load with an approximate factor of safety of 2. In meeting this requirement, it is important that vertical deflection be kept to a minimum.

Note:—As a guide in design, it is recommended that, for materials and forms of construction now used, the maximum vertical deflection measured at center of car and based on distance between truck centers should not exceed 1 inch. Normal vertical deflections for cars having approximately 60 ft. distance between truck centers from ½ to ¾ in. for steels and different forms of steel constructions.

(c) Cars must be designed to resist a horizontal load of 500,000 lbs. applied on the buffer beam at a point 12 in. above the center line of draft. This static load was derived from a 250,000 lb. design load employed in cars built to Railway Mail Service Specifications with an approximate factor of safety of 2.

(d) Vertical strength requirements have been assigned to the buffer beam construction, the anti-climbing arrangement, and the coupler carrier arrangement. All these parts are to be designed to resist vertical loads of 100,000 lbs. These requirements are to resist coupled car ends from moving vertically with respect to each other under abnormal accidental impacts.

(e) The two main vertical end members are required to have an ultimate shear value of not less than 300,000 lbs. each at a point even with the top of the underframe to which they are attached. This requirements was included to establish definite strength values at these points.

SECTION 1—SCOPE

Application

(a) These specifications have been prepared on the basis that they will produce passenger cars suitable for use with cars of all types of construction now in service and built in accordance with Railway Mail Service Specifications, with the result that new and existing cars will satisfactorily operate together with maximum protection under all conditions of service. These specifications provide that static end loading shall be applied through center line of draft but must not be construed as requiring the application of end loading on the center line of draft of existing cars constructed to Railway Mail Service Specifications.

(b) These specifications shall cover all new passenger equipment cars to operate in trains of over 600,000 pounds light weight.

SECTION 2—MATERIALS

(a) All strength members of cars shall be of all-metal construction.

(b) Where steel is specified, other approved materials producing equivalent strength of design may be used.

(c) Where "approved materials" are referred to in this specification, it shall be understood same refers to Association of American Railroads' standards or equivalent.

(d) Castings may be used as parts of the strength members. Such castings having a carbon content of .25% and over must be annealed.

(e) Where built-up welded metal parts are substituted in place of castings the unit is to be stress relieved before application.

(f) Any structural material in which the yield strength exceeds 80% of the tensile strength shall not be used except structural material not meeting this criterion and approved by the A.A.R. Committee on Freight and Passenger Car Construction may be used.

SECTION 3—WORKMANSHIP

All workmanship throughout the car shall conform to the best state of the art.

SECTION 4—LOADS

The car body shall be designed to carry its own dead weight in addition to the maximum specified live load under service conditions.

SECTION 5—TRUCKS

(a) Trucks may have either built-up metal or cast frames and may be either four or six-wheel type. All truck details and requirements shall be in accordance with the practice of the Association of American Railroads and the railroad for whose service the cars are built.

(b) The trucks shall be locked to car body. Strength of locking means shall be not less than the equivalent of an ultimate shear value of 250,000 lbs. and so arranged that the entire truck will lift with the car body without disengaging the center plates. The details of the attachments shall be such as to develop the full tensile strength of the connection.

SECTION 6—BUFFING

(a) The car structure shall resist a minimum static end load of 800,000 lbs. at the rear draft stops ahead of the bolster on the center line of draft, without developing any permanent deformation in any member of the car structure. In meeting this requirement, it is important that vertical deflection be kept to a minimum.

Note:—As a guide in design, it is recommended that, for materials and forms of construction now used, the maximum vertical deflection measured at center of car and based on distance between truck centers should not exceed 1 in.

Normal vertical deflections for cars having approximately 60 ft. distance between truck centers range from ½ to ¾ in. for steels and different forms of steel constructions.

(b) The resistance of the center sills shall be based on a design end load of 400,000 lbs. applied along the longitudinal center line of the car at a point midway between the center line of draft and the center line of buffer. This resistance shall be taken by the center sill construction only.

(c) The center sill construction may be considered as supported against deflection vertically and horizontally by the car body to the extent that the strength of the superstructure, cross-bearers and attachments are available for this purpose.

(d) The design stress in the center sill construction shall be determined by the following formula and shall not exceed that shown in Section 20 and modified by column and stability formulae in Section 20:

$$\text{Stress (Lbs. per sq. in.)} = \frac{400{,}000 \text{ lbs.}}{\text{Area (sq. in.)}} + \text{ or } - \frac{\text{eccentricity (inches)} \times 400{,}000 \text{ lbs.}}{\text{Section modulus}}$$

(e) The stress due to eccentric moment from the above formula may be reduced to the extent that the car body is made available to resist this moment.

(f) Cars must be designed to resist a horizontal load of 500,000 lbs. applied along the longitudinal center line of car at a point on the buffer beam construction 12 inches above the center line of draft without developing any permanent deformation in any member of the car structure. The application of this load must not be distributed over an area greater than 6 inches x 24 inches.

(g) The buffer beam construction shall be designed to resist a vertical upward thrust from the coupler shank of 100,000 lbs. for any horizontal position of the coupler without exceeding the yield point of the construction or of its connections to the car structure.

(h) An anti-climbing arrangement shall be applied at each end, designed so that coupled cars under full compression shall mate in a manner which will resist one car from climbing the other. This arrangement shall resist a vertical load of 100,000 lbs. without exceeding the yield point of its various parts or its attachments to the car structure. Tight-lock couplers, if used, shall be considered as meeting this requirement.

(j) The coupler carrier and its connections to the car structure shall be designed to resist a vertical downward thrust from the coupler shank of 100,000 lbs. for any horizontal position of the coupler. without exceeding the yield points of the materials used. When a yielding type of coupler carrier is used an auxiliary arrangement shall be provided, designed in accordance with these requirements.

SECTION 7—DETAILS

(a) All connections, except those specified in Section 18 for end construction, shall be designed for the combined loads imposed upon them with stresses not to exceed those specified in Section 20.

(b) The distance between centers of rivet holes shall be not less than 3 diameters of the rivet and not more than twenty-four times the thickness of the thinnest outside member. In all cases, care should be exercised to provide sufficient shearing and bearing area for the stresses involved and to guard against local failure between rivets. The minimum distance between the center of the rivet hole and a sheared edge shall be not less than one and one-half times the diameter of the rivet, or where the load acts against the edge of the sheet this edge distance shall be increased, if necessary, to develop the strength of the rivet.

(c) The use of fillers in the underframe and superstructure shall be avoided, wherever possible.

(d) All holes for rivets or bolts in the underframe, superstructure, or outside finish shall be drilled or punched and reamed to size and fairness. No drifting of holes will be allowed. In deducting rivet or bolt holes to obtain the net area of any section they shall be taken at 1/16 inch larger than the diameter of the rivet or bolt. The effective area of a rivet may be taken as its area after driving.

(e) All rivets when driven must completely fill the holes and have full concentric heads.

(f) Welding which develops the required strength of the member or connection may be used in place of riveting.

SECTION 8—CENTER SILLS

(a) Unit of built-up sills may be composed of rolled, extruded, or pressed shapes, either with or without cover plates.

(b) A center sill of unit construction is defined as a structural member formed of one piece or of two or more pieces joined by an approved method so as to produce the equivalent of a one-piece construction.

(c) Cast draft sills or end construction may be used with any of the above types, with adequate connections at splices. When flange angles are used, they shall be connected to the webs so as to transfer the total shear at any point in a distance equal to the effective depth of the sill at that point. When cover plates are used, they must extend at least two rows of rivets at each end beyond their theoretical length or equivalent when welded.

SECTION 9—BOLSTERS AND CROSS-BEARERS

The body bolsters and cross-bearers must be provided with ample connections at center and side sills to transmit the calculated vertical shear.

SECTION 10—FLOOR BEAMS

Transverse floor beams may be rolled, extruded, pressed, or built-up shapes, with suitable connections at center and side sills.

SECTION 11—FLOOR SUPPORTS

Longitudinal floor supports when used shall be supported at each transverse floor member.

SECTION 12—END SILLS

The end sills may be either of rolled, extruded, or pressed shapes, built-up or cast construction with ample connections at center and side sills. They must be designed for the maximum vertical loads to which they may be subject and also for the assumed horizontal loads transferred from vertical end members as specified in Section 18.

SECTION 13—COUPLERS AND DRAFT GEARS

Details of the coupler and draft gear must conform to the practice of the railroad company for which the cars are built.

SECTION 14—BUFFING MECHANISM

Details of the buffer and buffing mechanism when used shall be in accordance with the practice of the railroad company.

SECTION 15—LONGITUDINAL FRAME OR TRUSS FRAMING MEMBERS

In calculating the stresses in side frame, its effective depth when designed as a truss or girder may be taken either as the distance between centers of gravity of side plate and side sill or as the distance between centers of gravity of bottom and top chords of the girder. In the latter case the bottom member may be taken as the section comprising side sill, belt rail, and intervening side sheet; the top member may include side plate and letter board, provided connections are such that all members will act together. Piers connecting the top and bottom chords above described must be of sufficient strength to withstand the shear loads imposed upon them, with stresses not to exceed those specified in Section 20. At side door openings the bending moment caused by the vertical shear at door posts shall be considered as being resisted by the section above and below door opening, and the sum of the direct stresses and those due to bending at such sections shall not exceed the stresses specified in Section 20. A sufficient proportion of any reinforcing members added to these sections shall be extended far enough beyond the door posts at each side to transmit their reactions to the side frame without exceeding the limit specified for stresses. The roof and underframe systems may be considered as load carrying members to the extent of their connection to the side frame.

SECTION 16—SIDE POSTS AND BRACES

(a) For girder construction or truss construction the sum of the section moduli about a longitudinal axis, taken at the weakest horizontal section between side sill and side plate, of all posts and braces on each side of the car located between the body corner posts shall be not less than 0.30 multiplied by the distance in feet between the centers of end panels.

(b) For girder construction only the sum of the section moduli, about a transverse axis, taken at the weakest horizontal section between side sill and side plate, of all posts, braces and pier panels, to the extent available, on each side of car located between body corner posts shall be not less than 0.20 multiplied by the distance in feet between the centers of end panels.

(c) The center of the end panel is to be considered as the point midway between the center of the body corner post and the center of the adjacent side post.

(d) Side frame members shall also meet the stress requirements of Section 20.

SECTION 17—SHEATHING

(a) Outside sheathing of mild open-hearth steel when used flat without reinforcement (other than side posts) in a side frame of girder construction must be not less than 1/8 inch nominal thickness. Other metals may be used of a thickness in inverse proportion to their yield strengths.

(b) Outside metal sheathing of a lesser thickness may be used provided it is reinforced so as to produce at least an equivalent sectional area at right angle to reinforcements as flat sheathing specified above.

(c) For truss construction where sheathing serves no load carrying function, minimum thickness shall be not less than 40% of that specified above.

SECTION 18—VERTICAL END MEMBERS

(a) The sum of the section moduli of all vertical end members at each end of the car shall be not less than 65.

(b) The outside end of each car shall be provided with two main vertical members, one at each side of the diaphragm opening. Each of these members shall have a section modulis of not less than 24.375. Each main member shall also have an ultimate shear value of not less than 300,000 lbs. at a point even with the top of the underframe member to which it is attached. The attachments of these members at bottom shall be sufficient to develop their full shear value.

(c) This shear value shall be based on the area of the web, which is the depth of the member times the web thickness times the shear strength of the material used.

(d) If reinforcement is used to provide the shear value such reinforcement shall have full value for a distance of 18" up from the underframe connection, then taper to a point approximately 30" above the underframe connection.

(e) The attachment of the vertical members at the top shall be adequate to resist without failure the reactions of the members, without shear reinforcements, when assumed to be simple beams with free supports at their ends and loaded at a point 18" above the connection to the underframe member to which they are attached with a load sufficient to develop the yield point of the material.

(f) The remaining vertical end member requirements shall be distributed in the body end of the car. The attachments of these members at bottom shall be sufficient to develop their full shear value. The attachments at the top shall be determined in the same manner as prescribed above for the main end members.

(g) For cars having open end observation platform, the end construction of car body shall be as described above and in addition there shall be two stub end members, located similarly to main vertical members on end of platform extending to top of railing. These members shall have same shear strength value as the two main vertical members.

(h) Cars with large end doors to which the foregoing requirements of this section do not apply, shall be considered to meet these specifications if the doors and attachments are sufficient to develop a shear resistance equivalent to the main members described above.

(j) The top reaction of all vertical end members may be delivered to the roof of car or to a truss, girder or brace construction extending across the car. The structure employed must be adequate to transmit reactions from the posts to the side framing of the car.

SECTION 19—ROOF

(a) The projected area of the portion of the roof in square feet supported by carlines divided by the sum of the section moduli of the carlines at any section must not be more than 60.

(b) Flat roof sheets of mild open-hearth steel without reinforcements shall be of a minimum thickness of .05 inches, adequately attached to the roof framing.

(c) Metal roof sheets of a lesser thickness may be used provided they are reinforced so as to produce at least an equivalent sectional area at right angle to roof sheets specified above.

SECTION 20—STRESSES

(a) All structural members shall be so designed and proportioned that the sum of the direct stresses to which each is subject shall not exceed those stated in table below, except as modified by Section 18:

UNIT DESIGN STRESSES TO BE USED FOR ROLLED MILD OPEN-HEARTH STEEL

Center Sills	Unit Construction	Other than Unit Construction	Side Sills and Framing Members	Bolsters
Tension	19,200	16,000	16,000	12,500
Compression	19,200	16,000	16,000	12,500
Shear	12,000	12,000	10,000	8,000
Rivets Shear	12,000	12,000	10,000	10,000
Bearing	24,000	24,000	20,000	20,000

The total combined stress in any structural members, except center sills, may exceed the above figures by not more than 20%.

(b) Axial compression stresses in members, or elements of members, must not exceed those allowed by the following column and stability formulae:

For $\frac{L}{r} \leqq \pi\sqrt{\frac{2E'}{F}}$ then

$$\frac{P}{A} = F - \frac{F^2}{4\pi^2E'}(L/r)^2 \text{ pounds per square inch}$$

For $\frac{L}{r} > \pi\sqrt{\frac{2E'}{F}}$ then

$$\frac{P}{A}\ \frac{\pi^2E'}{(L/r)^2} \text{ pounds per square inch}$$

These formulae give a nominal safety factor of 2.0 for reasonably restrained end condition.

L = length of column center to center of connections, inches.
r = least radius of gyration of column cross section, inches.
E' = Secant modulus of elasticity as derived from the tensile stress-strain curve.
F = maximum allowable unit stress from table above.
P = axial load (concentric), pounds.
A = area of column cross section, square inches.
π = 3.1416, constant.

Stresses described above as maximum allowable are contingent upon the ability of webs and flanges to resist these stresses without buckling.

(c) For compression in the plane of any flat plate used as an element in the section the ability to resist buckling shall be checked and determined by substituting the following equivalent slenderness ratios in the formula applicable to the entire column:

For outstanding flanges: (Flat plates supported along one edge in the direction of stress) L/r = 5.0 b/t.

For other than outstanding flanges: (Flat plates supported along both edges in the direction of stress) L/4 = 1.8 b/t.

b = flat width at right angle to direction of stress, inches.
t = thickness, inches.

The constants 5.0 and 1.8 in the above expression for the equivalent L/r give a nominal safety factor of 2.0 on reasonably restrained edge condition. Constants between these may be selected depending upon the shape of the member and connections used.

(d) Where metals other than mild rolled open-hearth steel are used, the car structure must be at least equal in strength to the stated specification requirements. The maximum allowable stresses shall bear the same relation to the stresses tabulated in this Section, as the yield strength of the metal used has to the yield strength of mild open-hearth steel, which for this comparison shall be taken as 32,000 pounds per square inch, but in no case, except bearing, shall the maximum allowable stress exceed 40% of the minimum tensile strength of such material. Cast metals shall be compared on same basis as structural metals; but the allowable tensile stress shall be limited to 80% of that allowable for rolled materials.

(e) Where minimum section meduli or thickness are specified they shall be adjusted in proportion to the ratio of the yield strength of the metal used, to that mild open-hearth steel.

(f) Where yield and shear loads are specified the size of members shall be based on the yield or ultimate shear strength of the materials employed.

SECTION 21—SUBFLOOR

The entire car shall have metal subfloor, flat or corrugated.

SECTION 22—INSULATION

Insulation used must be such that it will not support combustion, will not absorb moisture beyond its own weight, and when wet will not cause corrosion.

SECTION 23—VESTIBULE DOORS

Vestibule doors, exterior and interior, must be of sliding or other types which do not open inwardly or outwardly and can be operated in emergency from inside of car.

SECTION 24—EMERGENCY SASH UNITS

Emergency escape sash, minimum of four per car and 18" x 24" minimum size, to be provided in each car at readily accessible locations, designed so that sash cannot be dislodged except by manual operation.

SECTION 25—WRECKING TOOLS

Wrecking tool cabinet, one per car, to be located in a conspicuous place in the main body of the car and to be easily accessible, avoiding location behind doors, etc. Cabinet to have ¼" thick glass in door and to be equipped with one (1) six pound sledge and one (1) four and one quarter pound axe.

SECTION 26—EMERGENCY LIGHTING

Emergency lighting must be provided in vestibules and throughout aisles and passageways, of sufficient number and wattage to adequately illuminate car interior for safe exit. Emergency lighting to consist of an auxiliary light housed in standard lighting fixtures or in supplementary fixture and is to come on automatically if the main power fails. Power source for emergency lighting to be car or other batteries.

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