HUDSON & MANHATTAN RAILROAD COMPANY

Herman T. Stichman, Trustee

SPECIFICATIONS FOR RAPID TRANSIT CARS

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SPECIFICATIONS FOR RAPID TRANSIT CARS

SECTION 1

DEFINITIONS, SCOPE, INSPECTIONS AND TESTS

1.01 Definition of Terms

As used in these Specifications:

"Railroad" means the purchasing organization or its authorized representatives.

"Builder" means the builder of the car body and assembler of the complete car.

"Truck Builder" means the manufacturer of the car trucks.

"Manufacturer" means the manufacturer supplying materials, equipment or apparatus for installation on the car.

"T.R.C." means Transit Research Corporation.

"P.C.C." refers to Electric Railway President's Conference Committee which developed the general specifications and design of the P.C.C. car, and various improvements incorporated therein, and which has been succeeded by the Transit Research Corporation.

"A.A.R." means Association of American Railroads.

"I.C.C." means Interstate Commerce Commission.

"Approved Type" means type, material and design as approved by the Railroad.

1.02 Scope and Purpose

(a) These specifications are intended to cover a general description of proposed P.C.C. rapid transit passenger motor cars, including equipment, for high-speed, multiple unit operation on the lines operated by the Hudson & Manhattan Railroad Company.

(b) These specifications cover:

(1) Single-car units, with operating cabs at both ends, and

completely equipped for independent operation, and

(2) Two-car units, comprising an "A" and a "B" car, with operating cabs at one end of each unit, each two-car unit equipped for independent operation.

(c) Both single-car and two-car units shall be arranged for multiple-unit operation in trains of from one to ten cars, comprised of single-car units, two-car units, or a combination of both.

(d) The cars are to be generally similar to the P.C.C. rapid transit type car designed by Transit Research Corporation, modified as necessary to meet the operating requirements of the Railroad, and requirements of the I.C.C., and other governmental regulations where applicable.

(e) The cars must comply with all applicable I.C.C. regulations and Safety Appliance Act regulations.

(f) These specifications are intended to cover all labor, tools, materials, parts, apparatus and equipment required for the construction and assembly of the number of single-car and two-car units indicated in the Railroad's contract, completely tested and ready for service when accepted by the Railroad.

1.03 Responsibilities

(a) It is understood that the Builder shall do all work necessary for the detailed design of the car, and prepare all necessary detail drawings. He shall submit all drawings and schedules of equipment, material and specialties to the Railroad for approval before ordering or manufacturing any parts. It is understood that approval of the Railroad does not in any way relieve the Builder of responsibility for the adequacy of the design.

(b) The car body, trucks and equipment supplied must be of the best engineered design for the service intended. The Builder will use his best judgment and experience, consistent with compliance with I.C.C. and other governmental regulations, in determining the stresses imposed by the type of operation, and in the structure and equipment he supplies, he shall provide for these stresses with an adequate margin of safety. In the selection of the type of material to be used, the Builder will be guided by the necessity for obtaining the maximum strength and reliability with the minimum weight which is obtainable at reasonable cost.

(c) Each item of equipment or apparatus, including trucks and completely equipped car body, shall be designed and built strictly in accordance with these Specifications.

(d) The Builder shall furnish all labor, tools, materials, parts and apparatus necessary for constructing a complete car, and shall assume responsibility for the proper working and fitting together of all parts and specialties, with necessary clearances for successful operation.

(e) It shall be specifically understood that the omission of any reference to any part or item from these Specifications, which is required to make the car complete and suitable for successful performance of the function intended, shall not relieve the Builder from furnishing the required parts or items under these Specifications.

(f) Reproducible tracings on cloth of all drawings must be supplied by the Builder to the Railroad, for the Railroad's files. All drawings must be on Railroad standard drawing sizes.

(g) The Builder shall furnish 100 copies of all Service Manuals and Parts Catalogs. The originals shall be maintained, including all

current revisions by the Builder, for the life of the cars, and he shall furnish additional copies therefrom at a nominal cost.

1.04 Substitutes and Changes

(a) When the Builder desires to offer substitute items, parts, materials or equipment for those designated herein, in accordance with the term "or equal", he shall obtain approval in writing from the Railroad.

(b) No departure shall be made from these Specifications, nor any change made in items, parts, materials, equipment or design approved hereunder, without written approval of the Railroad.

(c) In the event that changes are agreed upon in items, parts, materials, equipment or design that will affect the price of the completed units, the price shall be adjusted upward or downward accordingly at the time the change is agreed upon.

(d) All approvals and authorizations on behalf of the Railroad shall be made by Herman T. Stichman, Trustee, or designated representative.

1.05 Inspections

(a) Authorized representatives of the Railroad shall have access at all times to those parts of the plants of the Builder and manufacturers who supply materials, equipment or parts for these cars, for the purpose of inspecting materials and workmanship during the progress of the work.

(b) Builders and Manufacturers shall extend to the Railroad's representative full cooperation and necessary facilities to permit the convenient inspection of all materials, equipment and parts, including

copies of all drawings, diagrams and other data which may be required properly to inspect and check the design, construction, assembly, installation, workmanship, clearance, tolerance and functioning of the cars and equipment.

(c) The presence of the Railroad's representatives in the plant of the Builder or Manufacturer shall not in any manner lessen the responsibility of said Builder or Manufacturer in respect to meeting all requirements of these Specifications. The Railroad shall have the right to reject all material and workmanship which do not fully conform to these Specifications.

1.06 Tests and Adjustments

(a) Facilities and Requirements

(1) The Builder shall use a suitably level test track of proper gauge, length and alignment to permit the acceleration and deceleration, and other operating tests specified below. This track shall be equipped with suitable means providing not less than 600 volts D.C. potential measured at the car during full acceleration.

(2) All working and moving parts, and all operating devices and controls of each car and its equipment, shall be tested and put in proper operating condition by the Builder and approved by the Railroad before cars are accepted. The Builder shall perform all of the tests and shall make all of the adjustments specified hereinbelow.

(b) Car Wiring Tests

(1) Ring out all wiring circuits to insure continuity and polarity

after assembly and installation of all equipment.

(2) Make a direct current ground insulation test on each car as follows:

(a) Disconnect all ground wires;

(b) Disconnect the storage battery at its terminals;

(c) Connect all circuits together and then connect to a 600 volt D.C. source through a voltmeter. If this test shows freedom from ground connection, the A.C. test specified below shall be applied. If the D.C. test does not show freedom from ground connection, the point or points at which such ground occurs shall be determined and the insulation made satisfactory to the Railroad before the A.C. test is applied.

(3) Make an alternating current ground insulation test on each car after separating the connection between nominal 600 volt circuits and nominal 32 volt circuits required above. Apply for one minute an alternating current of 800 volts to all 32 volt circuits, and of 680 volts with 32 volt apparatus, including the generator of the motor generator set, connected in circuit. Apply for one minute an alternating current of 2200 volts to all 600 volt circuits and apparatus, including the motor of the motor generator set, connected in circuit. In each case a circuit breaker, set to open at a current slightly greater than the charging current, shall be connected in series. If this circuit breaker remains closed, the insulation to ground shall be considered satisfactory. All wires, cables and/or equipment that do not meet the require-

ments of the tests shall be removed and replaced by the Builder. After replacement of any such defective parts, materials or equipment, the car shall be subject to retesting.

(4) Reconnect ground connection and storage battery and then test all 32 volt and all 600 volt circuits on each car for proper functioning.

(c) Motor and Brake Controller

(1) Without the motor current, test the propulsion motor controllers of the unit for correct sequence of operation by operating each master controller and observing the functioning of the various pieces of equipment involved. Rectify any failure to function in proper sequence before proceeding with the remaining tests.

(2) Without the motor current, operate each brake controller and check functioning of brake controller and equipment for both proper sequence and the relationships between braking systems.

(d) Air Brakes

(1) Adjust the governor of the air compressor on each unit to the pressure range specified in Section 11.03 (e) of these Specifications.

(2) Adjust feed valve to the setting specified in (1) above.

(3) With all drain valves closed and the brake valve in "full service" position, pump up the air pressure to the cutout pressure of the governor. Allow at least five minutes for the temperature equalization and reduce the main reservoir pressure to 135 lbs. If the pressure drops within a period of 15 minutes, system shall be tightened.

(4) Determine the pump-up time by reducing the pressure in the main reservoirs to atmospheric. With the brake handle in the "handle-off" position, close the compressor switch and measure

the time which elapses between the closing of the switch and the build-up of air pressure on the main reservoir gauge to 140 lbs. The time required shall not exceed 4 minutes at 550 volts.

(e) Car Performance Tests

(1) On each unit, make acceleration tests over the test track with a recording accelerometer, indicating ammeters in the main motor circuits, and an indicating voltmeter across the motor circuit. If adjustments are required to obtain the current values corresponding to the rates of acceleration specified, these adjustments shall be made by a representative of the electrical manufacturer. Accelerometer charts shall become the property of the Railroad.

(2) On each unit, make deceleration tests over the test track with such meters, including recording accelerometer, as may be needed to measure separate and combined friction and dynamic brakes. Make all necessary adjustments to obtain proper synchronization of the various forms of braking and the rates of deceleration, except that if adjustments of the dynamic brake control should be found necessary, these adjustments shall be made by a representative of the electrical manufacturer. Accelerometer charts shall become the property of the Railroad.

(3) All performance characteristics shall comply with the requirements of these Specifications and shall be held within such limitations as to prevent undue surging in train operation. If the car or any equipment fails to satisfy these objectives, the necessary adjustments shall be made and the car shall be subjected to retest

as directed by the Railroad.

(4) Performance charts shall be furnished, showing traction motor characteristic curves, including tractive effort, speed-distance-current vs. time, schedule speed and energy consumption.

(f) Miscellaneous Body Tests and Adjustments

(1) Check one or more completed units, as may be determined by the Railroad, for truck clearance on a curve having a radius as specified in Section 2.02 (b). This shall be done by running the unit around a curve of that radius or by other equivalent means.

(2) Test roof and windows of each car for weather tightness, with motor generator set operating, by subjecting them to a jet of water at 40 lb. pressure from an open end 3/4" I.D. hose at a distance of 6' for a duration of 15 minutes. Any leaking parts shall be made weather-tight to the satisfaction of the Railroad.

(3) Check and adjust the doors and their operating mechanism on each unit to assure smooth functioning, attainment of the speed specified in Section 3.12 (d), and proper functioning of interlocks and door signals.

(4) Adjust the headlights of each unit to meet the beam characteristics specified in Section 5.03 (b).

(5) Check heating, ventilating and air-conditioning controls on each car to give the desired functions as specified in Section 4.03 and for even distribution of heat and re-circulated air.

SPECIFICATIONS FOR RAPID TRANSIT CARS

SECTION 2

GENERAL DIMENSIONS

2.01 General

(a) The general dimensions as listed below will obtain with the understanding that the Builder will furnish general outline drawings, having all necessary dimensions, so that clearances may be checked by the Railroad before construction is started.

2.02 Dimensions and Design Considerations

(a) Dimensions of a single car unit are as follows:

Length over Coupling Faces		51' 3"
Length over Anti-Climbers at center line		51' 0"
Width over Side Posts		8' 7½"
Width over Thresholds		8' 10½"
Width at Eaves		8' 7"
Height - Rail to top of Floor,		
New wheels, ¼" settlement of springs		3' 9 3/8"
Height - Rail to Top of Floor,		
Worn wheels, 22,800 lb. passenger load		3' 6 3/8"
Height - Rail to Top of Roof		
New Wheels, ¼" settlement of springs		11' 8½"
Height - Rail to Center Line of Coupler		
New Wheels, ¼" settlement of springs		2' 4½"
Height - Rail to Top of Anti-Climber		
New Wheels, ¼" settlement of springs		3' 8"
Height of door opening over floor	Minimum	6' 4"

Distance - Center to Center of Trucks	33' 0"

(b) Cars must be designed to negotiate curves in accordance with following:

Shortest lateral radius at center line of track	90'
Maximum super elevation	4"
Radius of shortest reverse curve at center line of track	299.22'
Tangent between reverse curves	8.87'
Radius of shortest vertical curve	900'
Track Gauge	4' 8½"
Wheel Gauge	4' 7 11/16".
Heights of Guard Rail above Running Rail - Max.	1"

(c) Clearances to fixed objects must be in accordance with Railroad Drawing No. 3181, Sheet F-61, and Drawing No. 2398-BC 13.

(d) Cars shall afford ample clearance with reference to equipment and right-of-way when operated at maximum scheduled speed, maximum operating conditions, train length and wear limits.

2.03 Weights

(a) Equipment shall be so arranged that the weight on each end of the car shall be approximately equal, insofar as practicable.

(b) With respect to two-car units, the equipment shall be arranged, insofar as practicable, so that the weight of each car of the unit shall be approximately equal.

(c) Builder shall furnish data relative to weight of the principal component parts or assemblies; total car weight and weight per axle.

SPECIFICATIONS FOR RAPID TRANSIT CARS

SECTION 3

CAR BODY

3.01 General

(a) The car body units shall be constructed and assembled in conformity with the general arrangement and dimensions of the finished car as specified in Section 2 of these Specifications.

(b) The car body and attached equipment shall be designed to provide the necessary clearances for the trucks.

(c) These Specifications cover both single-car and two-car units.

Single-car units shall contain all equipment necessary for independent single-car operation, and shall be equipped with motormen's cabs and control equipment at both ends.

Two-car units shall comprise two cars, the first designated an "A" car, and the second a "B" car, and shall be equipped with one motorman's cab and control equipment in one end of each unit.

It will not be possible to operate "A" or "B" units independently as single-car units, but "A" or "B" units shall be so arranged that any "A" or "B" unit will operate when coupled with either a single-car unit, or with a two-car unit.

(d) Both single-car units and two-car units shall be arranged for multiple unit operation of two to ten cars, comprised of either single-car units; two-car units, or a combination of both. The design shall provide for maximum possible ease and safety of passage from car to car through the end doors.

(e) The car body structure shall provide ducts for an underframe

traction motor ventilating system, as required.

(f) Equipment supports and housings shall be incorporated into the underframe so that the maximum usefulness of metal can be obtained.

(g) The car body shall be a steel welded structure of approved copper-bearing steel, except that screwed or bolted fastenings shall be used for removable parts and that rivets may be used at locations where it is agreed that welding is impracticable.

(h) The car body structure shall be designed so that jacks or cradles may be used for lifting from any point along each side or under end sills. The center section of side sill shall not be required to lift both ends of the car simultaneously. Jacking pads shall be provided at approved locations under the car body.

(i) Camber of car between bolsters, fully equipped ready to run, plus simulated maximum passenger load, shall be minus 0", plus 1/8".

(j) No part or appliance on car body shall be less than 2½ inches above the top of rail.

3.02 Motorman's Cab

(a) On single-car units, a motorman's cab shall be located at the right hand corner at each end.

On two-car units, a motorman's cab shall be located at the right hand corner at one end of each car, providing an operating cab at each end of the two-car unit.

(b) The cab door shall be hung with a piano hinge and shall be so designed as to enclose the operating equipment when the door is closed and the cab is not made up. When latched in the made-up position, the door shall complete the operating cab enclosure. In the made-up position, the cab door shall be designed to open either into the cab, or further

open into the car, to permit ingress or egress to the cab, necessary stops and latches being provided. Cab door shall be equipped with a lock operable with Railroad's existing standard key. Cab door shall not be equipped with a window, but must be provided with an adjustable louvre of approved type for ventilation.

(c) The back of the cab shall be formed by a partition which shall house the switch panels, cable ducts and other equipment as described in Section 12 of these Specifications. A hinged panel shall provide access to the rear of the switch panel, and shall be provided with a lock operable with Railroad's existing standard key.

3.03 Framing Structure

(a) All metal used in the fabrication of the car body structure and its associated parts shall be of an approved type and quality.

(b) The framing and sheathing of the car body shall form an integrated structure capable of resisting, without destructive deformation, the buffing and other stresses inherent in the type of service for which the cars are designed. The unit structure shall resist a minimum static end load of 400,000 pounds 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 unit structure.

(c) The sides shall be as smooth as possible on the outside and the overall thickness of the sides shall be the minimum, consistent with the necessary strength, to provide the maximum room inside the car.

(d) An anti-climbing arrangement shall be applied to each end of the car, designed so that coupled units under full compression shall mate in a manner which will resist one unit from climbing the other. This arrangement shall resist a vertical load of 75,000 pounds without

exceeding the yield point of its various parts or its attachments to the unit structure. Anti-climbers shall be riveted or welded firmly to structural members of the end sills. Anti-climbers shall be so designed as to properly contact opposing anti-climbers of existing Railroad equipment.

(e) The outside end of each unit shall be provided with two main vertical members, one at each side of the end doors. Each main member shall have an ultimate shear value of not less than 200,000 pounds at a point even with the top of the underframe members to which it is attached. The attachments of these members at bottom shall be sufficient to develop their full shear value. If reinforcement is used to provide the shear value, such reinforcement shall have full value for a distance of 18 inches up from the underframe connection, then taper to a point approximately 30 inches above the underframe connection.

3.04 Bolster

(a) The car body bolster shall be a built-up structure of formed and welded steel plates, carrying a cast steel center bearing member, and means shall be provided for locking car body bolster to the truck.

(b) The Builder shall provide an approved wear plate between the center bearing surfaces. Means shall be provided for lubricating these surfaces, if required.

3.05 Ventilating Ducts

(a) Provision shall be made in the design of the bolster and body framing for adequate air ducts and connections thereto.

(b) The connections from the body air ducts to the motors shall be of an approved design.

(c) An approved means shall be provided for ventilating traction motors.

(d) Suitable screens or louvres, or both, shall be provided to prevent admission of rain, snow or dirt at the intake openings of ventilating ducts. Intake screens or louvres shall be easily removable for cleaning of ducts. Ducts shall be free from noise or rattle and covers shall be provided to give suitable access to equipment as well as for cleaning ducts.

3.06 Roof

(a) The design of the roof shall be adequate to carry the imposed load. The end of the roof shall be sufficiently strong to withstand the reaction from the end posts. The roof shall be reinforced with purlines attached to carlines. Eaves and side girder top chords shall be designed to promote maximum resistance to collision impact and to provide efficient connection of roof to the side structure. An anti-telescoping plate with necessary reinforcement shall be included in roof structure at ends.

All members of the roof framing shall be so designed and disposed as to facilitate the fastening of stanchions and roof covering, and the installation of air-conditioning ducts, roof wiring, lighting, fixtures, and other required equipment in a secure, convenient and workmanlike manner.

(b) Water deflecting gutters shall be installed on roof over entire side and ends of car.

3.07 Ceiling and Side Lining

(a) The ceiling shall be arranged to receive and support the lighting fixtures and shall form a part of the roof ventilating system.

(b) The ceiling shall be made of Formica, or approval equal. The underside of carlines shall be covered with approved cork adhesive tape, or approved equal, before fastening the lining, and shall be so supported

as to prevent sagging. The longitudinal dimension of the material shall not exceed eight feet.

(c) Area between bottom of side windows and back of seats shall be so shaped as to eliminate window-sills and other dirt collecting projections, and shall be of Formica or approved equal, applied and fastened in an approved manner so as to permit ready removal for maintenance.

(d) Scuffing plates of rigidized stainless steel shall be provided at areas on ends of cars adjacent to doors, and on rear panels of motormen's cabs adjacent to side doors. Kick plates of the same material shall be applied to bottom of interior of side and end doors, and on seat ends at door openings.

3.08 Floor

(a) Floor sheets shall be "Trussplate" or approved equal of No. 20 US gauge galvanized copper-steel, laid across and securely fastened to floor supports of the underframe with rivets or self-threading screws. The formed floor sheet shall be ½" in depth. Floor sheets shall be given a coat of approved preservative on both sides.

(b) An underlayment of latex shall be applied to the "Trussplate" floor sheets, to a depth of ¼" above top of formed section.

(c) The floor covering shall be of 1/8" vinyl-asbestos tile of design and color scheme to be specified by the Railroad. Floor covering shall be attached to sub-floor as recommended by the supplier.

(d) Where the floor covering reaches the walls of the car body it is to be finished with a suitable sanitary cove. Sanitary corner coves shall be fitted at all corners.

(e) At all door openings the floor shall connect properly with the threshold plates.

(f) At car ends, the platform shall be covered with a diamond-plate non-skid material, or approved equal.

(g) Floors of motormen's cabs shall be heat insulated.

3.09 Windows

(a) All windows shall be unit assemblies. The units shall be of stainless steel or anodized aluminum and shall be of the minimum rail dimension to provide maximum vision. Units shall be Adams-Westlake or approved equal. The frames shall be mounted in the sheets as flush as possible and shall form the exterior and interior trim.

(b) All frames and sash shall be so arranged that they are easily removable for repairs or replacement.

(c) All sash shall have internally-rounded corners, both inside and outside the car, to facilitate cleaning.

(d) Four side windows, as designated on Railroad Drawing No._____File_____, shall be drop sash, and shall include the necessary locks, racks and effective weather strip. Locks shall be operable with a special key. All other side windows, except at motorman's cab and at conductor's operating position at opposite end of two-car units, shall be stationary sash arranged to be kicked out in an emergency.

(e) End windows shall be stationary glass so located that motorman will have a clear view of track and signals from his usual position while operating unit.

(f) Side window in motorman's cab, and at conductor's operating position at diagonally opposite end of two-car units, shall be a movable sash dropping into a pocket in the car body. The drop sash shall be effectively weather-stripped

and designed to facilitate operation and to withstand hard usage. Drop sash shall be equipped with a rotary window operator equipped with a detachable handle of approved design.

(g) All glass shall be 7/32" safety sheet of an approved type. The glass shall be mounted in rubber in an approved manner.

(h) Door windows and destination sign openings shall be glazed and mounted with a rubber moulding of an approved type directly in the sheet.

3.10 Seats

(a) Longitudinal seats shall be installed in accordance with Railroad Drawing No. 9980 File 67.

(b) Space under longitudinal seats shall be entirely enclosed. Seat risers shall be curved back to avoid scuffing.

(c) Seats shall have removable seat cushions and backs, upholstered with foam-plastic.

(d) Seats shall be covered with Koroseal or approved equal, color to be specified by the Railroad.

(e) A motorman's seat shall be provided in each cab and shall be so designed as to provide satisfactory comfort and proper access to equipment with good visibility. The seat shall be upholstered with foam-plastic, and shall be so arranged that it may be moved to permit movement of the cab door. Adjustment as to height and distance from operating

controls shall be provided, and the seat shall be securely positioned in either the operating or non-operating position. Seat shall also be suitable for use by the conductor when he is stationed in the cab.

(f) A hinged seat shall be provided at each conductor's operating position in two-car units. When folded, it shall be recessed within the end of car body, and shall be securely positioned in either the operating or non-operating positions. The seat cushion shall be upholstered with foam-plastic.

3.11 Doors

(a) The doors shall be constructed of aluminum.

(b) Side doors shall be single-leaf, sliding into a pocket in the car body. Doors and jambs shall be equipped with formed rubber bumpers and shall have a total compression of 1/8" when doors are closed and shall insure a possible space of 6" should an object become caught in a door. Inside and outside door pocket posts shall be designed so as to prevent passengers' fingers being pinched between the post and the sliding door. A deflecting plate of aluminum shall be placed in the door pocket to prevent the water that drops from the doors from lodging in the side sills and to deflect the water through suitable holes in the floor.

(c) Doors shall be hung on ball bearing hangers and track of an approved type. Hangers and track shall be accessible

for inspection and removal of doors. Suitable rubber stops shall be provided at both top and bottom of door open position to prevent undue noise and cocking of doors.

(d) Threshold and door track castings shall be of an approved type, and the surface of the threshold shall be designed to minimize slipping. The design of both threshold and door track shall provide for free drainage of water and for minimizing the opportunity of foreign matter obstructing door motion. Provision shall be made for an anti-rattle device for the bottom of sliding doors.

(e) End doors shall slide into a pocket in the car body. They shall be provided with locks and the Railroad's existing key shall be used. End doors shall be provided with a gravity door check of suitable design which will hold the door 3" from the striking post in case it rolls shut at high speed. A back latch shall be provided to hold the door in the open position when required.

(f) Doors shall be effectively weather-stripped to prevent entrace of wind, rain and snow.

3.12 Door Operating Mechanism

(a) An electric mechanism shall be provided to operate side doors and shall hold the door firmly in the closed and open positions respectively. In the closed position, a remote-control positive lock to prevent opening of the door shall be provided.

(b) Each door shall be operated by a door engine located

under the seat.

(c) Door engines and operating linkage shall be of approved type. Provision shall be made for adjustment of position, cushioning and speed of operation in both directions, and for later take-up in places where significant wear may be expected. Provision shall be made for access to the door engines for maintenance.

(d) The speed of the doors shall be such that from the moment of operating the control switch to the completion of the operation, including cushioning, the time shall be two seconds maximum for opening and four seconds for closing, and shall be adjustable. The maximum pressure on the door edge measured at mid-travel shall not exceed 30 lbs. in case closing travel is obstructed.

(e) Door engines shall be controlled by an electric relay operated from the 32-Volt battery circuit. The relay shall be energized when the doors are in the open position. Provision shall be made to prevent draining of battery through the door control circuits when the car is out of service.

(f) Provision shall be made to open doors manually in case of emergency.

(g) A switch shall be provided adjacent to each door engine to open door-operating and lock circuits and to by-pass door signal interlock in case of failure.

3.13 STANCHION, RAILS, BARRIERS, GRAB HANDLES AND STEPS

(a) Stanchions, hand rails, barriers and hand holds shall be provided as indicated on Railroad Drawing No._____ File_____. Stanchions shall consist of 1¼" O.D. stainless steel veneered tubing with an approved finish, Allegheny architectural tubing or approved equal. It shall have a thickness of not less than 0.026". The insert shall be made of soft steel and shall have a wall thickness of 0.049". Interior hand holds shall be of an approved type and design with stainless steel grips.

(b) Stanchions shall be clamped or otherwise securely held top and bottom in fittings, and joining of stanchions and hand rails shall be with fittings having an approved form of screwed lock. Fittings shall be of stainless steel. All fittings shall provide a permanently tight and rattle-proof fastening.

(c) Hand rails shall be of the same size and material as the stanchions.

(d) A hand rail shall be installed at side window of motorman's cab, and at conductor's operating position at diagonally-opposite end of cars on two-car units. Height of hand rail shall be such as to provide a convenient support for conductors when observing doors.

(e) Forged steel steps and hand holds shall be provided on the exterior of the car as required by Governmental regulations.

SPECIFICATIONS FOR RAPID TRANSIT CARS

SECTION 4

HEATING, VENTILATING AND AIR CONDITIONING

4.01 Car Heating

(a) Electric panel heaters shall be installed in openings in the seat risers. Perforated covers shall be of stainless steel.

(b) Each heater shall comprise two strip heating elements of different capacities, and all heaters in the car shall be connected in series circuits so provide three varied degrees of heat.

(c) Thermostatic control of heaters shall be provided.

(d) Heaters and thermostatic control equipment shall be of Consolidated Metal Products type or approved equal.

4.02 Cab Heating

(a) Cab Heaters shall be provided in each motorman's cab. These units shall maintain therein a temperature of not less than 50 degrees F., and shall be so arranged that the heaters will be disconnected when cab is not made up.

4.03 Ventilating and Air Conditioning

A. General

(a) Each car shall be equipped with an air conditioning system designed to re-circulate air, introduce fresh air, and to refrigerate air as required.

(b) The system shall comprise a compressor, condensor, evaporator, blower unit, filters, heat unit, controlls, refrigerant piping, grilles and necessary motors.

The equipment shall be installed under floor of car, and in ceiling area adjacent to motorman's cabs.

(c) The direct expansion system shall be employed, and refrigerant shall be Freon (F-12).

(d) The system shall be designed and constructed to eliminate objectionable noise and vibration, either with car in motion or standing.

(e) All equipment shall be so arranged as to provide maximum ease of maintenance. Access panels shall be provided as required.

B. Service Requirements

(a) The air conditioning unit shall deliver a minimum refrigeration effect of 120 000 BTU per hour from the evaporator with a total power input not to exceed 15KW under ambient temperature of 90°F. DB, 75° WB. Circulated air shall be 2 400 CFM minimum with 25% fresh air.

C. Air Distribution

(a) A duct shall be provided in the monitor of suitable capacity to convey air from the unit to the distributors. Duct shall be insulated and shall extend the full length of the car in the space between headlining and roof.

(b) An air distributor of the continuous double trough type shall be provided. The distributor shall be mounted on the headlining, and so arranged that air is discharged parallel to the headlining to avoid objectionable downdrafts. Distributors shall be equipped with suitable adjustable deflectors to eliminate the longitudinal velocity component of the air stream in the duct, and to deflect the air stream into the car body. The air distributors

shall be provided with adjustable dampers so that uniform temperature may be maintained throughout the car body.

(c) Re-circulated air shall be drawn into the system through a grille. Fresh air shall be supplied through exterior louvres. Both re-circulated and fresh air shall be drawn through air filters of the reactivated carbon type.

(d) A blower fan assembly shall be provided to deliver 2 400 CFM minimum against a total static pressure of 1.25 inches water gauge.

D. Refrigeration System

(a) The compressor shall be of an approved, air-cooled type, arranged for capacity control for 100%, 75%, 50% and 25% capacity.

(b) An air-cooled condenser shall be provided. Cooling air shall be drawn into the system through exterior louvres, and discharged under floor of car.

(c) The liquid receiver shall be of the all-welded type, and of sufficient capacity to store a full charge of liquid refrigerant when it is condensed, and to have additional volume for normal expansion. Receiver shall be mounted at low point of the system. A liquid line filter drier and charging valve shall be installed in the line. A suction-liquid line heat exchanger shall be provided.

(d) An evaporator section shall be provided comprising an evaporator coil, distributors, blower fans, electric heater, recirculated air grille, filters and necessary valves. A suitable drip pan shall be provided equipped with means to remove condensate.

(e) Piping shall be seamless, hard drawn Type K copper tubing of suitable size. All joints shall be properly soldered.

E. Refrigeration Control

(a) A selector switch shall be provided, arranged for three-positions - "MANUAL-OFF-AUTOMATIC". Automatic operation shall be governed by a thermostat arranged to modulate at 75° and cycle off at 74°.

(b) A high-low pressure cut-out switch, and necessary gauges shall be provided.

F. Heaters

(a) An electric heating unit of 12 KW capacity shall be provided to heat fresh air when required.

(b) Heaters shall be thermostatically-controlled, and equipped with a thermal cut-out to prevent overheating should blowers be inoperative.

G. Motors and Electrical Equipment

(a) All motors and electrical equipment shall be designed to function normally on voltages from 400 volts to 700 volts DC, and of suitable capacity to perform the required service with an adequate overload capacity.

(b) Motors shall be of an approved type and equipped with shielded or sealed type bearings.

(c) Motors and other electrical equipment shall withstand a potential test of 3500 RMS volts AC for one minute with equipment at operating temperatures.

(d) Controls shall operate on 32-Volt battery circuit.

(e) An approved panel shall be provided equipped with controls for the compressor motor, condenser fan motor and blower fan motor. Motor starters are to be of an approved type. The compressor

motor and condenser fan motor shall be interlocked with the blower fan motor so that a failure of the blower fan motor will shut off the unit. Adequate overload protection shall be provided. The blower fan motor shall be arranged for independent operation for heating or ventilating.

SPECIFICATIONS FOR RAPID TRANSIT CARS

SECTION 5

LIGHTING

5.01 Interior Lighting

(a) Incandescent lighting fixtures shall be mounted in two rows, one on each side of the car, and arranged for operation from the 600 volt supply.

(b) Lighting fixtures shall be Electric Service Manufacturing Company's Type TFB, or approved equal, complete with glassware and short-circuiting sockets, operating in series of from 20 to 22 lamps.

(c) One of the series light fixtures shall be located in the motorman's cab. A two-position switch shall be provided in the cab, and circuits shall be so arranged that when the switch is operated, the light in the cab will be disconnected, and two lights in the end destination sign will be connected.

(d) Four emergency lighting fixtures shall be provided in each car, in approved locations. Emergency lighting fixtures shall be Electric Service Manufacturing Company's Type KAL, or approved equal. Emergency lamps shall be operated from the 32-volt battery circuit.

5.02 Control of Interior Lights

(a) Each car shall be equipped with a light relay which controls both the 600-volt series lights and the 32-volt battery emergency lights. In addition, the emergency lights shall be controlled by a light-out relay of approved

type, which is normally energized by the series lighting circuit, so that emergency lights will be automatically lighted when 600 volt circuit is deenergized. A control switch of approved type, with momentary contact, shall be provided and located in each motorman's cab. The control switch shall energize the light relays through a train line. Grounding of the switch shall deenergize the relays.

5.03 Headlights

(a) Headlights of the twin-beam sealed reflector type shall be provided on both ends of single-car units, and on operating ends of two-car units.

(b) Headlights shall afford sufficient illumination to enable a person in the operating compartment who possesses the usual visual capacity required of motormen to see in a clear atmosphere a dark object as large as a man of average size standing erect at least 800 feet ahead and in front of such headlight. Means shall be provided to adjust beam both vertically and horizontally, and headlight shall be designed to permit re-lamping without affecting beam adjustment. Headlights shall be located in a safe and accessible place.

(c) Headlights shall operate from the 32-volt battery circuit and shall be provided with a dimming switch which may be conveniently operated by the motorman, whereby the light may be diminished in yards and at stations or when meeting trains.

5.04 Markers and Tail Lights

(a) Markers and tail lights shall be provided on both ends of single-car units, and on operating ends of two-car

units.

(b) Two marker lights shall be located, one on each side, at the top of the car end. Markers shall be of the semaphore type, and shall be arranged to display red, yellow, green or white aspects. Controls shall be so arranged that aspects can be changed from the motorman's cab, and that any combination of colors can be established.

(c) Two tail lights, each consisting of a red and a white lens, shall be located, one on each side, at the bottom of the car end.

(d) Markers and tail lights shall be energized from the 32-volt battery circuit. Marker light circuits shall be controlled over the draw bar drum switch or coupler electric portion so that they will be lighted only at ends of trains. Tail light circuits shall be controlled over the draw bar drum or coupler electric portion and master controller reverser drum so that they will be lighted only at ends of trains. When controller reverser drum is in the "OFF" position, red lights will be lighted, and when controller reverser drum is in either "FORWARD" or "REVERSE" position, white lights will be lighted.

5.05 Destination Sign Lights

(a) End destination signs shall be illuminated by two lamps in each sign, operated on the 600-volt series body light circuit. Lamps in end destination signs shall be controlled in connection with motormen's cab light as specified in Section 6.01 (c) of these specifications.

5.06 Instrument Lights

(a) Motormen's cabs shall be provided with lights which will provide sufficient illumination for the gauges to enable the motorman to make accurate readings from his usual operating position. These lights shall be so located and constructed that light will shine only on those parts requiring illumination; and shall not interfere with motorman's vision of track and signals.

(b) Motorman's cabs shall be provided with a light conveniently located to enable motormen to easily and accurately read train orders, and so constructed that it may be readily darkened or extinguished.

(c) Instrument lights and train-order lights shall be operated from the 32-volt battery circuit, and circuits shall be controlled over the draw bar drum switch or coupler electric portion in the "UNCOUPLED" position, and the master controller reverser drum in either the "FORWARD" or "REVERSE" position.

SPECIFICATIONS FOR RAPID TRANSIT CARS

SECTION 6

DOOR CONTROL AND SIGNAL SYSTEM

6.01 Door Control

(a) The door control circuits shall provide for multiple unit door control operation. The connections of the door control, bell and buzzer train lines shall be controlled by drum switches of an approved type and shall establish the conductor's operating position and the door zones which he controls.

(b) Door control drum switches shall be provided in each motorman's cab, and, in two-car units, drum switches shall also be provided at the conductor's operating position at diagonally-opposite end of cars. Door control drum switches shall be key-operated, and shall be accessible when cab door is in position to enclose cab operating equipment.

(c) Door control drum switches shall be provided with three positions, marked "ON", "OFF" and "THRU". They shall control the necessary door control, bell and buzzer circuits as follows:

"ON" Position

1. The door control push button switches shall be energized at this location and the door circuits connected so that doors to the front and to the rear of the conductor's position, on the corresponding side only, may be controlled from the respective door control push button switches.

2. The signal push button shall be energized,

and bell and buzzer connected for operation.

3. Bell control train line circuits shall be broken, and buzzer control train line circuits carried through this location.

"OFF" Position

1. The door control push button switches at this location shall be inoperative.

2. The door control circuits shall be disconnected to establish end of door control zone at this point.

3. The signal push button shall be energized, and bell and buzzer connected for operation.

4. Bell and buzzer control train line circuits shall be carried through this location.

"THRU" Position

1. The door control push button switches, signal push button, bell and buzzer at this location shall be inoperative.

2. The door control, bell and buzzer circuits shall be carried through this location.

(d) An auxiliary drum switch shall be provided at each door control drum switch location to provide for independent opening of each door on the car in which the auxiliary drum switch is located and on the adjacent car, on the corresponding side only. The auxiliary drum switches shall be provided with two positions, marked

"NORMAL" and "IND". They shall control the door control circuits as follows:

"NORMAL" Position

1. The normal door control push button switches shall be energized at this location and the door circuits connected so that doors to the front and to the rear of the conductor's position, on the corresponding side only, may be controlled from their respective door control push buttons.

2. The independent door control push button switches shall be disconnected at this location.

"IND" Position

1. The independent door control push button switches shall be energized at this location and the door circuits connected so that individual doors on the car in which the auxiliary drum switch is located, and on the adjacent car, on the corresponding side only, may be opened from their respective door control push buttons.

2. The normal door control push button switches shall be energized at this location, and the door circuits connected so that doors to the front and to the rear of the conductor's position, on the corresponding side only, may be controlled from their respective door control push buttons, except that, normal door opening push button will not control doors on the car in which the auxiliary drum switch is located, nor on the adjacent car.

6.02 Door Control Push Buttons

(a) A door control push button box of approved type shall be provided at each motorman's cab, and at conductor's operating position at diagonally opposite end of two-car units, in an approved location. Door control push button boxes shall be enclosed when cab doors are in the non-operating position. At conductor's operating locations where cabs are not provided, a locked compartment shall be provided to enclose door control push buttons. Lock shall be operable with Railroad's standard key.

(b) Each door control push button box shall contain ten door control push button switches to control doors on corresponding side of train as follows:

No. 1 Open all doors to front of location.
No. 2 Open all doors to rear of location.
No. 3 Close all doors to front of location.
No. 4 Close all doors to rear of location.
No. 5 Open Door #1 - Operating Car
No. 6 Open Door #2 - Operating Car
No. 7 Open Door #3 - Operating Car
No. 8 Open Door #1 - Adjacent Car
No. 9 Open Door #2 - Adjacent Car
No.10 Open Door #3 - Adjacent Car

(c) All door-open push buttons shall be adequately shielded to prevent accidental operation.

(d) Door control push button switches shall be of an approved type. Access shall be provided to contacts without disarranging wire connections.

(e) A signal push button switch shall be contained in the door control push button box.

6.03 Door Control Circuits

(a) Door control circuits shall be protected with circuit

breakers arranged to open under overload. Circuit breakers shall be located so that they can be reset conveiently from the conductor's operatihg location.

(b) Circuits controlling end doors opposite motorman's cabs shall be controlled over the draw bar drum switch or coupler electric portion so that doors at both ends of trains will be inoperative.

6.04 Door Control Key Switches

(a) Key switches shall be provided at doors adjacent to motormen's cabs, and at diagonally-opposite ends of two-car units. Key switches shall be operable with the Railroad's standard key from either interior or exterior of the car. Operation of key switch shall control adjacent doors only.

(b) Key switches shall be designed so that key may be withdrawn after key switch has been operated to open door, and the door will remain open. Means shall be provided to close doors that have been opened by use of the key switch by normal operation of the door closing buttons at the conductor's operating location.

6.05 Motorman's Foot Switch

(a) A spring-return foot switch shall be installed in each motorman's cab, which when depressed, will prevent opening of all doors on the train in the event that the train is stopped short or over-runs station platforms.

(b) When depressed, the foot switch shall also energize the buzzer at the conductor's operating position to serve as a warning.

(c) Foot switch shall be operative only at locations where drum switch is in the "OFF" position.

6.06 Door Signals

(a) A door signal light shall be provided in each motorman's cab. When lighted, it shall indicate that all side doors on the train are closed and locked.

(b) Circuits shall be so arranged that motorman's door signal light shall be operative only when controller reverser handle is in either the "FORWARD" or "REVERSE" position.

(c) Door signal light circuit shall be energized at rear end of train through contacts on the drawbar drum switch or coupler electric portion in the "UNCOUPLED" position.

(d) The door signal light circuit shall be interlocked with the traction motor control circuits so that power cannot be applied to the traction motors with the doors open. A sealed release switch of approved type shall be provided in each motorman's cab to nullify action of the interlocking circuit in an emergency.

(e) Door pilot lights shall be provided on each side of each car adjacent to center door. Pilot lights shall be equipped with red lenses facing to front and rear, and shall be lighted when any side door in the car is open.

6.07 Bell and Buzzer Signal System

(a) Each car shall be equipped with a bell and buzzer signal system, operated on the 32-volt battery circuit. From the push button located in the door control push button box, the rear trainman may signal by means of a bell to the conductor's position, and the conductor may signal by means of a bell to the motorman's position. From the push button located in the door control switch box, the motorman may signal to the conductor and to the rear

trainman by means of a buzzer. The buzzer system will also function in connection with the motorman's foot switch as described in Section 7.05 of these specifications.

(b) Bells and buzzers shall be located at each motorman's cab, and in addition at conductor's operating locations in two-car units.

(c) Circuits shall be so arranged that conductor's signal push buttons, bells and buzzers shall be operative at locations where door control drum switches are in either the "ON" or "OFF" position, and inoperative at locations where drum switches are in the "THRU" position.

(d) Bell control train line circuits shall be broken at locations where door control drum switches are in the "ON" position, and carried through locations where drum switches are in either "OFF" or "THRU" positions.

(e) Buzzer control train line circuits shall be carried through all locations, irrespective of position of drum switches.

(f) Bells shall be of the single-stroke type. Bells and buzzers shall be of approved type and suitable for railway service.

SPECIFICATIONS FOR RAPID TRANSIT CARS

SECTION 7

MISCELLANEOUS CAR BODY ITEMS

7.01 Coil Springs and Safety Chains

(a) Three coiled wire safety springs shall be attached to one of the vestibule corner posts on each end of the car. They shall be of such length that they may be hooked to the adjacent corner post on a car coupled to that end. The other corner post shall have suitable brackets to which these springs may be hooked. Means shall also be provided to prevent these springs from swinging when not attached to an adjacent car.

(b) Chains of a suitable design shall be provided between cars in the proper position to safeguard the passage of passengers. These chains shall form a barrier across the end door when the cars are not coupled.

7.02 Destination and Route Signs

(a) An illuminated end destination sign shall be provided at each end of single-car units, and at operating ends of two-car units, and shall be adjustable from the motorman's cab, with provision for indication of setting.

(b) A side route sign shall be provided on each side of each car, located adjacent to diagonally opposite doors. Curtain designations shall be visible from inside and outside of cars. Sign box and mechanism shall be furnished as a unit and shall permit ready removal.

(c) End destination signs shall be illuminated with two lamps each, operated on the 600-volt series body light circuit as

specified in Section 5.05 of these specifications. Adequate ventilation shall be provided for heat dissipated by the lamps.

(d) The curtains for end destination signs shall have translucent letters on an opaque background. The cloth shall be of approved quality and shall not deteriorate under the heat of the sign lamps.

(e) The curtains for side route signs shall have white letters on a black background.

(f) Destination and route signs shall be of an approved type, and shall permit easy access to lamps and for cleaning.

(g) Lettering of sign curtains shall be as specified by the Railroad.

7.03 Windshield Wiper and Defroster

(a) An automatic power-operated windshield wiper shall be provided and installed on the cab front window. The wiper shall be of rugged design, air-operated and of the pantograph type, and its motion shall cover practically the entire glass. The wiper operating mechanism and the control shall be easily accessible and located in the cab. Provision shall be made for variation of speed of operation, and for a "parking position."

(b) A defrosting device of approved type shall be provided in each motorman's cab.

7.04 Horn

(a) A pneumatic horn of approved type shall be provided at the cab end of each car. Horn shall be located in a safe and

accessible position, and shall provide adequate warning to front of train, and to serve as a recall signal to rear of train.

(b) Horn control valve shall be located at a convenient location in motorman's cab.

7.05 Fire Extinguishers

(a) A fire extinguisher of approved type and capacity shall be furnished and mounted in a flush steel case with a glazed door located in the outer side of the cab partition.

7.06 Advertising Card Racks

(a) Advertising card racks shall be provided in the car interior and shall accommodate a standard advertising card 11" high.

(b) Additional advertising card racks shall be provided as specified by the Railroad.

7.07 Car Numbers

(a) The car number shall be applied by an approved method on the car in approved locations.

(b) The car number shall be applied in the interior of the car at approved locations.

(c) The letter "F" shall be applied by an approved method on each side of the car, above the floor level and adjacent to the corner post, at the panel-board end.

7.08 Miscellaneous Signs

(a) Miscellaneous signs shall be provided as specified by the Railroad.

SPECIFICATIONS FOR RAPID TRANSIT CARS

SECTION 8

DRAWBAR AND COUPLING EQUIPMENT

8.01 Coupling Drawbar

(a) The coupling equipment shall be Ohio Brass Company's, Westinghouse Air Brake Company's, Type H-2-C or approved equal, automatic, tightlock type.

(b) Automatic car, air and electric couplers shall be provided at both ends of all cars, both single car and two-car units.

(c) The draft gear shall be rubber cushioned of approved type. It shall be capable, within reasonable margins of safety, of withstanding loads resulting from the type of service for which the cars are designed, and in an emergency by the operation of a maximum of twenty cars. The draft gear deflection shall not exceed 1-1/8" under a 120,000 lb. load.

(d) The draft gear shall be furnished with an emergency release feature which permits, in case of a collision, the anti-climbers of the cars to come together instead of having the impact transmitted through the coupler and anchorage to the car frame.

(e) The body and tail piece of draft gear shall be of annealed cast steel and shall withstand loads and stresses as specified in this section of the specifications.

(f) The coupler carrier and its connections to the car structure shall be designed to resist a vertical downward thrust from the coupler shank of 75,000 lbs. for any horizontal position of the coupler, without exceeding the yield point of the materials used.

(g) The coupler shall be supported at its outside end in a spring drawbar carrier that shall slide on a radial steel bar of ample length to provide for the lateral swing of the coupler on the cars when operated on 90-ft. radius curves. The spring carrier shall be provided with renewable, hardened, high carbon steel wearing shoes where it slides on the radial bar. It shall provide for a vertical movement of the coupler of 5", measured at the face of the coupler. The coupler supporting member shall provide for positive vertical adjustment of the couplers to compensate for wheel wear. Provision shall be made to prevent radial bar mounting bolts from dropping and limiting movement of the drawbar in the event of breakage of a mounting bolt.

(h) The coupler shall have a vertical gathering range at the face of the coupler to permit automatic coupling if the coupling on one car is at standard height, and the coupler on the opposing car is 2½" above or below standard height. The coupler shall have a horizontal gathering range at the face of the coupler to permit automatic coupling if the center line of one coupler is 3½" to the left or right of the centerline of the opposing coupler.

(i) Anchorage of the drawbar to the car shall be of the ball and socket or other approved type. If the socket

type is used, sockets attached to the draft gear stem of the coupler shall be provided with shims between their clamping faces so that adjustment can be made to compensate for wear. Anchorage housings shall be of annealed cast steel or forging.

8.02 Unlocking Cylinders

(a) Unlocking of couplers shall be accomplished pneumatically by means of a pneumatic cylinder. Control of the unlocking cylinder shall be as specified in Section 8.06 of these specifications.

8.03 Manual Unlocking

(a) Provision shall be made for manual unlocking in case of emergency.

(b) Manual unlocking of couplers shall be accomplished by means of handles located under motorman's cabs and at diagonally opposite side at non-operating ends on two-car units.

8.04 Electric Coupler

(a) The electric coupler shall provide for the number of contacts necessary to carry the required number of train line wires.

(b) Contacts shall be of the spring-loaded type, and shall be silver-faced and provide a wiping contact upon closing.

(c) The electric coupler shall be provided with a mechanically-operated cover to protect contacts in the uncoupled position.

(d) Design of electric coupler shall insure positive contact, and shall withstand coupling impacts to which the coupler will be subjected in service.

8.05 Drawbar Drum Switch

(a) A drawbar drum switch, if required, shall be of approved design and shall be pneumatically operated.

(b) Drawbar drum switch or electric portion of coupler shall provide for the required number of train line wires, and contacts shall be of adequate capacity. Contacts shall also be provided to control marker, tail light and instrument light circuits as specified in Section 5.04 (d) and 5.06 (b), and door signal light circuit as specified in Section 6.06 (c) of these specifications.

(c) Provision shall be made for opening and closing the two air brake train lines automatically when cars are coupled and uncoupled.

8.06 Uncoupling Valves

(a) Uncoupling valves shall be provided in each motorman's cab, and on the underside of car body under the cabs. Valves shall control operation of coupler unlocking cylinder and drawbar drum switch cylinders, if provided. Uncoupling valves shall be equipped with detachable handles.

SPECIFICATIONS FOR RAPID TRANSIT CARS

SECTION 9

TRUCKS

9.01 General

(a) Each car shall be equipped with two four-wheel cast steel trucks in accordance with General Steel Casting Corporation drawing No. 5537B, with two motors mounted on each truck.

9.02 Weights and Dimensions

(a) Trucks shall be designed to carry a center plate load as required by maximum passenger load with an ample factor of safety, and to resist all tresses which may develop in service when operated with maximum center plate load, and at maximum speed on level tangent track.

(b) Truck dimensions shall be as follows:

Wheelbase	6' 6"
Guage (Track)	4' 8½"
Journal Bearings	5" x 9"

(c) The completely assembled trucks with motors, brakes and other equipment must not exceed the clearance limits required between truck and car body, or between truck and track, third rail or right-of-way equipment.

(d) The minimum clearance above top of rail for all parts of the truck and equipment, with the exception of wheels, contact shoes and train stop trips, under maximum load and wear conditions, shall be not less than 2½".

9.03 Center Plate

(a) Truck center plates shall fit properly and be securely fastened. The male center plate shall extend into the female center plate not less than 1½ inches.

(b) Truck center plates shall have not less than an ultimate shear value of 125,000 pounds.

(c) The truck shall be locked to the car body so that the entire truck will lift with the car body without disengaging the center plates. Strength of locking means shall be not less than the equivalent of an ultimate shear value of 250,000 pounds.

(d) The truck center plate shall be arranged for a minimum vertical adjustment to compensate for wheel wear in adjustment of coupler heights.

9.04 Bolster

(a) The car body shall be carried on a bolster. Free lateral motion shall be provided by approved means, but motion must be limited to prevent car striking station platforms.

(b) Bolster wear plates shall be spring steel.

9.05 Springs

(a) Springs shall all be helical type of size and material to suit loads and stresses.

(b) When carbody is placed on the trucks, a straight edge resting on door thresholds shall be parallel to level of the track within ¼" measured at the sides of the car.

9.06 Damping Means

(a) The truck shall be designed and constructed throughout in a manner to provide the maximum suppression of shocks, noise and vibration and to prevent their transmission to the car body.

(b) Approved means shall be provided to dampen vertical spring deflections, and to control lateral motion.

9.07 Journal Bearings

(a) Journal bearings shall be 5" x 9" anti-friction type with cast steel pedestal type boxes with hardened steel wear plates.

9.08 Wheels

(a) Wheels shall be 28" diameter rolled steel in accordance with AAR specifications, with AAR alternate cylindrical tread and flange.

(b) Axle turning and wheel fit limits shall be in accordance with AAR recommendations.

(c) Circumference of wheels on the same axle shall not vary more than 1/16 inch.

(d) Inside gauge of flanges, measured on base line, shall not be less than 53 inches nor more than 53½ inches.

(e) The distance back to back of flanges of wheels mounted on the same axle shall not vary more than ¼".

(f) Total lateral motion between wheels and journal boxes shall not exceed ¼".

9.09 Axles

(a) Axles shall be in accordance with AAR specifications.

(b) Wheels and gears shall be mounted on axles at AAR approved tonnage, and pressure graphs of such mountings shall be

furnished to the Railroad.

(c) Axles shall be permanently marked on ends with manufacturer's heat number and Railroad serial number.

9.10 Motors and Transmission

(a) Motors shall be entirely spring borne, and shall be mounted longitudinally in the trucks and rigidly secured to transoms.

(b) Adequate provision shall be made for proper support on the truck of all flexible leads to motors.

(c) The drive shall be of the right angle hypoid type with single reduction, and ratio as specified by motor manufacturer. Bearings used in transmission shall be sealed anti-friction type.

9.11 Brakes

(a) Brakes shall be inside hung single shoe type. Four brake cylinders and automatic slack adjusters shall be mounted on each truck.

(b) Brake shoes shall be of the "Cobra" type, or approved equal.

(c) Provision shall be made for attachment of hand brake.

9.12 Power Rail Contact Shoes and Fuses

(a) Power rail contact shoes and fuses shall be provided on each truck in accordance with Sections 12.04 and 12.05 of these Specifications.

9.13 Automatic Train Stop Trip Cocks

(a) Automatic train stop trip cocks shall be provided on one side of each truck in accordance with Section 11.06 of these Specifications.

SPECIFICATIONS FOR RAPID TRANSIT CARS

SECTION 10

TRACTION MOTORS AND CONTROL

10.01 **Traction Motors**

(a) Four traction motors per car of 100 HP nominal capacity, designed for series-parallel operation shall be provided. Traction motors shall be General Electric Type 1247 or approved equal.

10.02 **Traction Motor Control**

(a) Control equipment for traction motors shall provide for multiple unit control of trains made up of from one to ten cars, at acceleration rates selected by the motorman.

(b) Control equipment shall be of the electrically operated cam type, General Electric Type MCM or approved equal.

(c) Master controller shall be equipped with dead-man feature, without foot pedal.

(d) Provision shall be made to cut out each pair of motors independently.

The control equipment shall provide for blending of dynamic and air brakes.

10.03 **Control Accessories**

(a) The control of each car shall be interlocked with the motor-generator set or blower motor so that neither power nor dynamic braking current can continue to be applied to the motors in case of failure of the blower system of that car.

(b) Automatic provisions shall be made on each car to prevent undesired braking currents.

(c) An ammeter shunt shall be permanently installed in each

motor circuit in a convenient location to provide easily accessible means of connecting test equipment.

SPECIFICATIONS FOR RAPID TRANSIT CARS

SECTION 11

BRAKES

11.01 General

(a) An Electro-pneumatic air brake system shall be provided.

(b) Air brake control shall provide for interlocking and blending of air and dynamic brakes.

(c) A handbrake shall be provided on one end of each car.

(d) Air brakes and hand brakes shall comply with all applicable ICC regulations.

11.02 Air Brakes

(a) An air brake system of the Westinghouse Air Brake Company's "SMEE" electro-pneumatic type with ME-42 brake valve shall be provided, including self-lapping, automatic emergency and variable load features.

(b) An initial predetermined amount of air shall be admitted to the brake cylinders when the dynamic brake is operating to assist in synchronizing and blending of the air with the dynamic brake when the latter fades at the end of the normal service stop.

(c) An emergency application shall result from operation of the brake valve to the emergency position; functioning of the master controller dead-man feature; operation of the conductor's emergency valve or the

automatic train stop valve, or from any rapid reduction of brake pipe pressure in the train. Any emergency application from any car of the train shall promptly apply the emergency brakes on all cars in the train and shall be so arranged as to shut off the power on all cars simultaneously when the emergency application reaches the operating car. It shall be possible to obtain a full emergency application or release regardless of the degree of service application.

(d) A pneumatic brake shall be provided which shall cut in automatically when the electro-pneumatic brakes fail without further movement of the brake valve.

11.03 Air Supply System

(a) An adequate motor-driven air compressor operated on the 600-volt supply shall be provided on all single-car units, and on the "B" car of two-car units. Compressors on single-car and two-car units shall be interchangeable.

(b) A suitable governor shall be provided that will start and stop the air compressor within 5 lbs. per square inch above or below the pressure fixed.

(c) A pneumatic governor synchronizing system shall provide means to distribute compressor duty to all of the compressors in the train.

(d) The main reservoir system of each unit shall be equipped with at least one safety valve, so located as not to be subject to freezing, the capacity of which shall be sufficient to prevent the accumulation of more than 10 lbs. per square inch above maximum working pressure.

(e) The nominal maximum pressures in the air brake system shall be 155 lbs. per square inch (main reservoir safety valve setting) with the governor set at 130 - 140 lbs. Brake pipe pressure shall be 110 lbs. and the pressure in the brake cylinders shall be regulated through the variable load device between the empty and fully-loaded car.

(f) A supply reservoir shall be provided to prevent auxiliary devices from draining the air from the brake system, thereby assuring air reserved for braking.

(g) A cut-out cock shall be provided in the brake cylinder line for cutting out the brake cylinders and shall be located inside the car under a seat.

(h) Cut-out cocks shall be provided in the train lines at the end of the car.

(i) An automatic drain valve of approved type shall be provided on the No. 1 main reservoir.

(j) An air gauge shall be provided in each cab and shall have an illuminated dial graduated from 0 to 160 lbs. The gauge shall have two indicating hands, RED

for main reservoir pressure, and BLACK for brake pipe pressure.

11.04 Brake Cylinders

(a) Four brake cylinders and automatic slack adjusters shall be mounted on each truck. Single brake shoes of the "Cobra" type, or approved equal, shall be inside-mounted on the trucks and shall provide for a maximum braking rate of 4 MPHPS.

11.05 Emergency Valve

(a) An emergency valve shall be located in each motorman's cab, and at the conductor's position at diagonally-opposite end of two-car units. A suitable cord and handle shall be provided on the rear of the cab partition to permit operation of the emergency valve from the interior of the car.

11.06 Automatic Train Stop Trip Cocks

(a) A self-resetting type trip cock shall be provided on each truck, opposite the motorman's cab, and diagonally opposite on the other end of car on two-car units. Trip cocks shall be mounted to gauge and adjustable as to height in accordance with Railroad Drawing No. _____ File _____.

11.07 Air Piping

(a) Car body air lines shall be of suitable capacity

and shall be seamless copper tubing Class "L", securely fastened. Fittings shall be long-sleeve type of wrought copper or cast brass. Piping shall be installed so as to provide proper drainage to prevent freezing.

(b) Truck air lines shall be AAR standard air brake piping. Truck piping shall be installed on the frame to reduce hose connections to a minimum.

(c) Flexible connections shall be provided on piping between the compressor unit and the car body.

11.08 Hand Brakes

(a) A hand brake, Peacock No. 840 or approved equal shall be provided at the rear end of single-car units, and at the end opposite the motorman's cab on two-car units.

(b) Hand brakes shall be located in the platform post, opposite motorman's cab on single-car units, and opposite conductor's position on two-car units.

(c) Hand brakes shall be connected to the adjacent #2 truck mechanically, and together with necessary car body brake rigging, shall be capable of holding the fully-loaded car on a 5% grade with a force of not more than 125 lbs. on the hand lever.

SPECIFICATIONS FOR RAPID TRANSIT CARS

SECTION 12

MISCELLANEOUS ELECTRICAL EQUIPMENT AND WIRING

12.01 Motor-Generator-Blower

(a) A motor-generator set shall be provided on each single-car unit, and on the "A" car only of two-car units.

(b) Two centrifugal type blowers, of approved type, shall be mounted on the motor-generator set with rotors directly assembled on extensions of the armature shaft. Each blower shall discharge into the adjacent resistor compartment 1000 cfm. or a total of 2000 cfm. of air and shall operate without objectionable noise. The rotor shall be divided into two sections and so arranged as to blow an additional 1000 cfm. of air into the duct systems directed towards the traction motors.

(c) The motor-generator set and blowers shall each be dynamically balanced and shall be mounted on a common base, supported on rubber bushings and securely fastened in place. The set, when operating under full load shall have a nominal speed of 1750 r.p.m. at 600 volts, and shall be capable of safe and ample performance at any supply voltage between 450 and 650. The motor-generator set shall be arranged for ready removal and replacement, for inspection, servicing and adjustment.

(d) The motor of the motor-generator set shall have sufficient capacity to simultaneously drive the generator delivering all power required for controls and other auxiliary equipment; for charging the storage battery described in Section 12.02 of these specifications; and to drive the blowers at rated capacity.

(e) The generator of the motor-generator set shall have sufficient capacity to charge the battery described in Section 12.02 of these specifications, and to maintain substantially constant voltage on the various auxiliary car circuits connected to the battery. The terminal voltage under operating conditions shall not exceed 40 volts with any power rail voltage between 450 and 650 volts.

(f) The motor-generator set shall be equipped with regulating devices as required to perform all its functions properly and safely. The regulated voltage shall be continuously adjustable between 35 and 40 volts and shall hold the adjustment under all operating conditions, including operation over gaps in power rail.

(g) The "B" car of two-car units shall be provided with a motor-driven blower set with blowers attached, and shall comply with all applicable provisions of this section of the Specifications.

(h) The driving units of the motor-generator-blowers

and blowers shall be so interlocked with the traction motor control so that when blowers cease to operate, power cannot be applied to the traction motors.

12.02 Storage Battery

(a) Each car equipped with a motor-generator set shall be provided with a 32-volt storage battery of approved nickle-iron-alkaline type having sufficient capacity to meet the load requirements and duty cycle for the type of service described.

(b) All bateries shall be connected in parallel through the B+ train line with a 0.1 Ohm resistance in series with each battery.

(c) A battery cut-out switch of approved design shall be provided and installed in a suitable location.

(d) Battery containers shall be properly vented.

12.03 Cab Switch Panels

(a) Switch boxes with hinged covers shall be built into the side and rear of each motorman's cab to house the electrical apparatus as described below. The panels shall be made of a material of approved quality suitable for switchboards. Each panel shall carry the necessary apparatus, so arranged as to be easily accessible to connections, and designed to prevent an operator from coming into contact with live parts when operating switches or replacing fuses. All switches and fuses shall be provided with a name plate clearly identifying the circuit which each controls.

(b) Switches for 600 volts shall be of the toggle-action, indicating type. Switches which must not be operated under load shall be plainly marked with words "Must not be operated under load - 600 volts".

(c) Fuses for 600 volts shall be so mounted as to require the 600-volt line to be disconnected from the fuse before renewal

(d) All 32-volt battery circuits shall be provided with circuit breaker type switches as manufactured by General Electrical Company, or approved equal, and shall clearly indicate "OFF" and "ON" positions.

(e) Separate switch panels shall be provided for 32-volt and 600-volt apparatus.

(f) All control switches in the motorman's cab shall be grouped in a switch box located adjacent to the control equipment. Switch boxes shall be arranged so that only the operating handles of the switches extend through the cover, which shall be plainly marked to indicate the position of the switch, and to identify the circuits controlled.

(g) A voltmeter to indicate battery voltage, and all indication lights except the motorman's door signal light, shall be grouped on a panel and mounted in the motorman's cab at a location that

may conveniently be seen by the motorman. Indication lights shall be plainly marked.

(h) Both control switch box and signal light panel shall be arranged for easy access for maintenance.

12.04 Power Rail Contact Shoes and Fuses

(a) Each truck shall be provided with a power rail contact shoe on each side of the truck. Shoes shall be of Railroad standard design or approved equal, and shall be mounted to gauge and adjustable as to height in accordance with Railroad drawing.

(b) Contact shoes shall be properly insulated from the truck frame for 650 volts, and mounting shall be of an approved type.

(c) Each contact shoe shall be provided with a fuse box of moulded composition type, Horne Company or approved equal. Contact shoe fuse boxes shall be properly insulated from truck frames to prevent flashover, and so mounted to facilitate removal of fuses.

(d) A flexible shunt of approved type shall be provided between contact shoe and fuse. Approved terminals shall be provided for making connection to truck trolley lead.

(e) The truck trolley lead shall be securely fastened to the truck frame and car body, and so

designed to provide adequate flexing without contact with wayside structures.

12.05 Grounding and Guarding

(a) A flexible ground lead shall be provided from the car body to each truck, and from the frame supporting the motor to the ground brushes of each axle. The car body and ground lead connection shall be of the spark plug type or approved equal.

(b) All unguarded non-current-carrying metal parts subject to becoming charged which are not thoroughly insulated shall be grounded.

(c) All current-carrying parts connected to circuits with potential of more than 150 volts, except power rail shoes, shall be insulated, or located or guarded to prevent accidental contact.

(d) All doors and cover plates guarding current-carrying equipment in circuits having a potential of more than 150 volts shall be securely fastened in place, and the inside kept marked with the word "DANGER - 600 VOLTS".

12.06 Wiring and Conduit

(a) All car wiring circuits shall conform to the latest revision of the "National Board of Fire Underwriters Regulations for Electric Cars and Trolley Buses". All wire used shall be of approved type and quality and shall carry

Underwriter's Laboratory approval.

(b) The layout of wiring shall be designed in advance of its installation and in cooperation with manufacturers of connected equipment. Insofar as practicable, all wiring shall be fabricated on the bench into convenient units and installed in prefabricated groupings and standardized locations. Wiring installed in conduits shall not be cabled. Grounding connections shall be brazed and bolted or welded and bolted to car body steel.

(c) 600-volt wiring and 32-volt battery wiring shall not be placed in same conduit, ducts or cables. Wiring connected to apparatus shall be insulated for maximum voltage carried by any part of the apparatus.

(d) All wiring shall be run in conduit of adequate size in an approved manner. Conduit shall be approved aluminum alloy tubing and securely fastened. Compression fittings shall be used.

(e) All wires and terminal studs shall be plainly and suitably marked so that circuits may be easily identified, and these markings shall conform to standard wire numbering system shown on TRC drawing, No. 9-1.

(f) Diagramatic drawings of all circuits shall be submitted to the Railroad for approval prior to installation.

SPECIFICATIONS FOR RAPID TRANSIT CARS

SECTION 13

MATERIALS AND WORKMANSHIP

13.01 General

(a) All materials entering into the construction of these cars shall be of first class quality. All workmanship shall be of high grade and shall conform to the best manufacturing practices in all respects.

(b) Unless otherwise specified, all materials shall conform to A.S.A. and/or A.S.T.M. specifications.

(c) All materials intended for use in these cars shall be marked or stored so as to be readily identified, and shall be adequately protected during handling and storage.

(d) All interior unpainted metal trim shall be satin finish, and all exterior unpainted metal trim shall be bright finish unless otherwise specified.

(e) Lumber shall be thoroughly air seasoned or kiln dried before using and shall be dressed on all surfaces to full dimensions.

(f) Plywood, other than flooring, shall be three-ply popler, with phenolic resin glue, or equal.

(g) Cotter pins, screws, bolts and nuts shall conform to American National standards and shall be cadmium plated or approved equivalent, unless otherwise specified. Cadmium plating is to conform to the latest revision of A.S.T.M. specification A 165, Type N.S.

(h) All interior exposed screws, #10 or larger, shall be Phillips Head, Reed & Prince or equivalent.

(i) Bolts, nuts, cap screws, machine screws and self-tapping screws shall be suitably locked.

(j) Rivet holes and bolt holes shall be accurately located and aligned, and when necessary during assembly, holes shall be reamed round to specified size in position. Hand driven steel rivets shall be driven hot and shall completely fill the holes. Rivets may be cold driven when adequate mechanical equipment is available therefor. Heads shall be concentric with the shank of the rivet. Exposed heads shall be free from rings, fins, pits and burns.

(k) Huck rivets may be used in locations approved by the Railroad.

(l) Joints shall be properly fitted, whether exposed or concealed.

(m) Where metal is riveted or bolted to metal in the car structure, contact surfaces shall be free of dirt, grease, rust and scale and shall be coated with a suitable metal base primer which will not interfere with later enamel or lacquer applications.

(n) Where wood and metal surfaces are placed together, the wood is to be coated with white lead and oil or approved aluminum paint and the metal is to be coated with a primer of the type specified in (m) above.

(o) Where wood and wood are placed together both abutting surfaces shall be coated with white lead and oil or approved aluminum paint.

(p) All hidden metal shall be given one heavy coat of approved metal base primer and one coat of approved sealer. All hidden wood shall be given two coats of white lead and oil, or two coats of approved aluminum paint.

(q) All bolts or rods passing through wood shall be coated with white lead and oil or approved aluminum paint over those parts imbedded in the wood.

(r) Where roller guides are required for control rods they shall be made of Micarta with the layers of reinforcing fabric at right angles to the axis of the rollers, or approved equal.

(s) Chromium plating shall conform to the latest revision of A.S.T.M. specification A 166, Type F.S.

13.02 Steel

(a) Structural and Sheet Steel

1. The underframe and other parts of the body structure (including equipment compartments) shall be made of the materials known commercially as Corten, Yolroy, Armco HT 50 or Mayari R, or approved equal, except those parts elsewhere specified to be made of aluminum alloy.

2. Side and roof sheets, posts, steps and ducts therein shall be made of material having greater corrosion resisting properties than copper steel, unless otherwise specified by the Railroad.

(b) Axles

1. Axles shall be made of S.A.E. steel of approved quality heat treated to develop a minimum tensile strength of 100,000 lb. per sq. in.; elongation of not less than 20% in 2"; reduction of area of not less than 50%. The endurance limit shall not be less than 50,000 lb. per sq. in. computed in the outermost fiber. The Railroad reserves the right to make fatigue tests on a reasonable number of axles to determine the endurance limit.

2. If such axles are taken from the production line and prove to have the required endurance limit, the Railroad shall reimburse the Manufacturer therefor. If such axles fail, all axles of that heat shall be rejected.

3. Axles which show any sign of surface cracking after finishing shall not be accepted.

4. Heat numbers of all axles shall be recorded by the truck Manufacturer and he

shall mark each axle on one end with an individual serial number which shall identify the heat number from which the axle was made.

(c) Steel Castings

1. Steel castings shall be commercially sound throughout. The Railroad reserves the right to cut up one or more of each shape from time to time to determine the character of metal in parts not exposed by the various machining operations. If castings are found to be porous or otherwise commercially unsound, the material destroyed shall be at Manufacturer's expense.

2. All steel castings used in the truck structure shall be made of electric furnace steel, heat treated to produce the following physical properties or better:

Tensile strength - 80,000 lb. per sq.in.min.
Yield point - 50,000 " " " " "
Elongation in 2" - 22%
Reduction of area - 30%

3. The king pin and the base thereof which form part of the body bolster structure shall be made of electric furnace steel conforming to the physical characteristics in (2) above.

4. The upper member of the center bearings shall be made of cast steel corresponding to S.A.E. 1035 in composition and shall be heat treated for Brinell hardness of about 225. It shall be finish ground after heat treatment on the bearing surface.

5. Steel castings used in locations not referred to herein shall be selected for composition and characteristics best suited to the application, by the Manufacturer or Builder concerned, but shall be subject to approval by the Railroad.

(d) Stainless Steel

1. Stainless steel shall conform to the latest revision of those parts of A.S.T.M. specification A 167 covering Grade 3, type 302 material with an approved finish.

2. Buffing and polishing of stainless steel, where required, shall be done in an approved manner and without the use of any composition containing iron or iron oxide.

13.05 Aluminum

(a) Aluminum shall be used only when and as specified within these Specifications or by the Railroad.

(b) The aluminum materials shall be identified by

the designations used by Aluminum Company of America and shall conform to the specifications given therefor in the latest revision of the publication "Alcoa Aluminum and Its Alloys."

(c) The forming of aluminum parts, joining by riveting and welding, and the protection of contact surfaces shall follow instructions given by Aluminum Company of America for specific alloys and specific parts.

13.04 Rubber

(a) General

1. All rubber specified shall be so compounded and cured that it will perform satisfactorily in car operation at any temperature between -40°F and 120°F. and shall have the longest possible commercial life consistent with obtaining the other characteristics specified.

2. Unless otherwise specifically stated herein, all tests shall be conducted according to the latest revisions of A.S.T.M. test procedures for rubber goods. Certified copies of results of all tests shall be furnished to the Railroad.

3. Specimens shall be tested two to ten days after manufacture.

4. When tests are specified to be made at any particular temperature, the Railroad and Manufacturer shall agree in advance on the factor to be applied to readings obtained at any other temperature.

5. When tests for drift under load are specified they may be made at any convenient temperature between 50°F. and 80°F. provided that the temperature at the beginning and end of the test is the same. The test shall be made under conditions subjecting the rubber specimen to continuous vibration. This may be obtained from vibration of the building caused by operating machinery, or it may be produced artifically by a small motor carrying an off-center weight, or by equivalent means. If produced artifically the frequency of vibration shall be between 1000 and 2000 cycles per minute.

6. The Manufacturer shall guarantee all rubber parts to be free from defects of material and workmanship. For all parts made by curing rubber to metal, any premature failure between metal and cement or cement and rubber occurring when the part is used in normal service and according to the provisions of this specification, shall be considered as caused by a defect of material

and/or workmanship.

7. Unless otherwise specifically provided or agreed upon between Manufacturer and Railroad, metal parts to which rubber is cured shall be made of S.A.E. 1020 hot rolled steel and shall be suitable for brass plating after pickling.

8. Synthetic rubber may not be substituted for natural rubber unless so specified hereinafter.

(b) Rubber Truck Springs

1. Rubber truck springs shall be so compounded, designed and cured as to meet the load and other requirements of these Specifications.

2. All rubber truck springs shall be capable of meeting the following drift test: When the spring is subjected to a load corresponding to its maximum static load applied continuously for a period of 240 hours, the increment of deflection between the end of the 24th and the end of the 240th hour shall not be greater than 0.010" per in. of total final deflection. The Manufacturer shall supply test equipment and shall test for drift, at his expense, one spring in each lot of 200 or fraction thereof. Certified copies of the test results shall be furnished to the Railroad.

(c) Rubber Stops for Track Brake Spreader, for Bolster Bumpers and for Rubber Snubbers

1. These stops may be made of natural or synthetic (GRS) rubber.

2. The rubber parts shall be so compounded, fabricated and cured that the durometer hardness, measured with a Shore Type A durometer on the end of stop in the free condition, shall be 60 ± 3 at a temperature between 70°F. and 90°F.

3. The rubber shall have the highest resistance to abrasion which is compatible with the other characteristics herein specified.

(d) Rubber Axle Housing Sleeves

1. The axle housing sleeves, if used, shall be made of natural rubber, 60 durometer, subject to the permanent set test given in (b)(2) above.

(e) Rubber Door Edges

1. All U-shaped door edges must be made of natural rubber.

2. They shall be free of major defects of material and workmanship. A slightly roughened surface shall not be considered a defect.

3. The Manufacturer shall supply test equipment and test specimens, and shall perform at his expense such tests as are specified hereinafter.

4. When fabric insert is omitted, the Manufacturer shall furnish an adequate number of test pieces 6" x 6" x 3/32" of the same material as used in the door edges and with equivalent cure. These pieces shall be so selected that they are representative of each batch of rubber used during the production of the order, and there shall be at least one set of test pieces for every 400 door edges, or part thereof.

5. When using the 6" x 1/2" A.S.T.M. dumbell type test specimen as given in latest revision of A.S.T.M. specification D 15, Methods of Sample Preparation for Phyiscal Testing of Rubber Products (General Requirements)", and in latest revision of A.S.T.M. specification D 412, "Methods of Tension Testing of Vulcanized Rubber", the tensile strength shall not be less than 3500 lb. per sq. in. nor the elongation less than 55%.

6. The tensile strength of the rubber shall not be reduced more than 25% when subjected to 96 hours of accelerated aging in an air oven at 70° C (158°F.), the aging and testing being done as provided in the latest revision of A.S.T.M. specification D 573, "Method of Test for Accelerated Aging of Vulcanized Rubber by the Oven Method".

(f) Rubber for Door and Window Seals and Glazing Strips

1. All rubber for door and window seals and glazing strips shall be extruded and shall be free of major defects of material and workmanship. This must be natural rubber.

2. The durometer hardness measured with a Shore Type A durometer at a temperature between 70° F. and 90° F. shall be not greater than 50.

3. The Manufacturer shall supply test equipment and test specimens and shall perform at his expense such tests as are specified hereinafter.

4. The test specimens shall be cut from the extruded material, and at least one tensile strength and elongation test and one accelerated aging test shall be made on the material used for each car order of 25 cars or part thereof. If the compound or cure, or both, are changed during the production of material for one car order, at least one test of each type shall be made for each different batch.

5. When using the 6" x $\frac{1}{2}$" A.S.T.M. dumbell type test specimen (or smaller size if the size of the part necessitates) by the methods specified in 13.04(e)(5) for rubber door edges, the tensile

strength and elongation shall not be less than the following:

	Tensile Strength	Elongation
Door and window seals	2000 lb/sq. in.	500%
Glazing strips	2700 lb/sq. in.	450%

6. The tensile strength of the rubber shall not be reduced more than 25% when subjected to accelerated aging by the methods specified in 13.04(E)(6) for rubber door edges.

13.05 Safety Glass

(a) All safety glass shall be of the laminated type, consisting of two pieces of glass bonded with "Flexigum" or a plasticized polyvinyl butyral resin membrane approximately 0.015" thick and resistant to ultra-violet light and heat. Glass used in front cab windows must be free of optical strains.

(b) When an individual light is laid on a truly flat surface, the glass shall not indicate a bow of more than 0.030" per lineal foot.

(c) The overlap of one sheet of glass with respect to the other at an edge shall not exceed 1/32". Corners and burrs shall be ground smooth and all edges shall be seamed.

(d) The over-all dimensions of individual lights as supplied shall be held within 1/16" of the dimensions ordered.

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

(f) There shall be no appreciable variation in color in the individual lights of laminated plate or sheet glass when examined over a white background.

(g) All lights of laminated plate shall be so nearly free from haze that the laminated glass shall have approximately the same clarity as a light of the same nominal thickness of plate glass when viewed against a north light.

(h) Occasional specks of foreign material or scratches are permissible provided such specks do not exceed 0.020" in greatest dimensions, or scrathces do not exceed a total of 3" in length, and are not within the central three-quarters of the area of the light.

(i) No lights containing unbonded areas (let-goes) shall be accepted.

(j) Safety sheet glass shall produce no apparent distortion on a line at right angles to the plane of the glass.

(k) All questions regarding the quality of safety glass shall be settled by the test methods prescribed

in the American Standards Association's latest revision of American Standard Z 26.1, "Safety Code for Safety Glass for Glazing Motor Vehicles Operating on Land Highways."

13.06 Wire and Cable

(a) Conductor Material

1. All conductors shall be of soft annealed copper, properly tinned, and shall have the properties and characteristics specified in the latest revision of A.S.T.M. specifications D 27.

2. Wires for control and auxiliary circuits shall not be smaller than No. 12, except for special apparatus such as heat or ventilation control equipment, where special types of wires are recommended for use by the manufacturers for interconnection of their various pieces of equipment.

(b) A paper separator shall be used between copper and rubber insulation, except that the separator may be omitted if a free stripping type of insulation is used. The paper separator is not required on asbestos insulated wire and cable.

(c) Rubber Insulation

1. Rubber insulation shall conform to the latest revision of A.S.T.M. specification D 755, "Insulated Wire and Cables Performance Synthetic Rubber Compound."

2. The thickness of rubber insulation and the number and type of coverings over the insulation shall be as

given or recommended by the electrical manufacturers approved by the Company, but not less than the dimensions indicated by the A.S.T.M. specifications referred to herein.

3. Braids or sheaths used with rubber insulation shall be at least equal to A.S.T.M standard braid or sheath compound as covered in the latest revision of A.S.T.M. specification D 27 or D 752. Braids shall be thoroughly saturated with black flame retarding and moisture resisting compound.

4. Motor lead terminals shall have rubber insulation of the type specified in paragraph (1) above.

5. An oil resistant synthetic jacket which has been approved by the Underwriters' Laboratories for car and trolley bus wiring shall be used for the outer jacket of track brake and motor leads.

6. All insulated wire and cable shall meet the Underwriter's approval.

(d) Asbestos Insulation

1. The thickness of the component parts of asbestos insulation shall be as given or recommended by the electrical manufacturers approved by the Railroad. The minimum thickness shall be not less than 90% of the average thickness.

2. Felted asbestos or braid shall consist of best

quality, long-fibre, chrysotile asbestos commercially free from foreign particles of dirt, cotton seed and metallic oxides. It shall be well carded to prevent lumps and irregularities in the finished cable. After extraction of impregnating compound it shall contain not less than 80% by weight of asbestos. The total iron content shall not exceed 4% by weight of asbestos and the magnetic iron content shall not exceed 2% by weight of asbestos.

3. The felted asbestos shall be applied to form a smooth wall of uniform thickness with the conductor well-centered. It shall be thoroughly dried and completely saturated with a flame, heat and moisture resisting compound. This compound shall retain its initial qualities during the normal life of the cable. The compound shall develop no injurious chemical action within itself or with any component parts of the completed cable.

4. Varnished cambric insulation in asbestos insulated wires and cables shall consist of a high grade varnished cloth, substantially free from blisters or other imperfections, applied with a lubricating compound between layers. It shall comply in all respects with the requirements for varnished cloth outlined in the latest revision of the "Standard for Varnished Cambric Insulated Cable" of Insulated Power Cable Engineers Association.

5. All asbestos insulated wire and cable shall meet the Underwriters' approval.

(e) Varnished cambric insulated cables shall conform to the latest revision of the "Standards for Varnished Cambric Insulated Cables" of the Insulated Power Cable Engineers Association, and shall meet the Underwriters' approval.

(f) The sizes, stranding and types of insulation shall be suitable for the uses and type of service described in these Specifications.

13.07 Wiring

(a) General

1. The work shall be performed by or under the direction of an experienced wireman. The wireman shall be provided with appropriate tools for skinning insulation, cutting, tinning, soldering and attaching mechanical or compression type terminals to the conductors.

2. Care must be taken in removing insulation from the conductor toaavoid nicking of the wire or strands of the conductor cable. Wire in ducts shall be free of kinks.

(b) Solder shall be at least equal in quality to that designated as S.A.E. No. 1, Class B. A flux of non-corrosive type shall be applied before soldering. An automatic temperature controlled solder pot shall be used.

(c) Insulating tape or splicing compound shall consist of a good quality unvulcanized rubber insulation of a minimum thickness

of 0.010" and shall fuse quickly when applied. Friction tape shall be made of a good quality cotton tape filled with a heavy rubber compound that will resist aging. When properly applied, an approved polyvinyl chloride electrical tape with Buna "S" type adhesive, 0.007" overall thickness, may be substituted for the combination of friction and insulating tapes. The above materials shall be suitable for use with the conductor insulation without discoloring or corroding the copper wires and shall provide 600 volt insulation.

(d) Ends of conductors shall be thoroughly cleaned and tinned by immersion in molten solder. Care must be exercised to prevent burning the insulation and excessive flowing of the solder along the conductor. Terminals which are attached by soldering shall be thoroughly cleaned and recently tinned before attachment to the conductor.

(e) Conductors may be soldered to terminals or they may be attached by mechanical means where the use of an approved type of solderless terminal has been authorized. Where possible the terminal used shall be of the type which will securely grip and hold the insulation on the conductor of No. 10 size or smaller. Conductors which will be subjected to motion relative to the terminal shall be protected by suitable means to minimize breakage of the conductor at or near the terminal.

(f) Motor terminals shall be attached to the motor leads either by means of an approved type solderless compression

terminal or with silver-cadmium solder having a melting point of about 740°F. The terminal cup shall contain only sufficient molten solder to fill the cup after the conductor has been inserted.

(g) Splicing and Tapping

1. Splicing of conductors is not recommended. Where it is unavoidable, the spliced joint shall be mechanically as strong as any other part of the conductor, without use of solder. However, the joint shall be soldered to insure electrical continuity and wiped or filed to remove fins and burrs of hard solder. Approved solderless connectors may be used for splicing. The joint shall be insulated with tape so as to be at least equivalent to the insulation on the conductor. The outside diameter of the spliced portion of the cable after the tape insulation is applied shall not exceed the outside diameter of the unspliced portion by more than 40%. The finished splice shall be painted with one coat of approved insulating compound.

2. A conductor shall be tapped on to another conductor only when approved by the Railroad and then the method of attachment and insulation described in (1) above shall apply.

13.08 Welding

(a) The Builder, and each Manufacturer shall be responsible for the quality of the welding done by his organization, and all welders employed in the making of welds on structures or products built under these Specifications shall have been tested to determine their ability to operate the welding equipment to be used in making the types of welds required hereunder and to produce satisfactory welds therewith.

(b) The Railroad shall have the right to require the making of test welds by any operator to determine his ability to produce satisfactory welds of any given type. The Railroad shall also have the right to require the making of test welds to settle any question which may arise as to the suitability of any welding method or procedure used during production. The recommendations of the American Welding Society as contained in the latest revision of their "Standard Qualification Procedure" shall be followed in the making of tests and the settlement of other questions which may arise hereunder regarding welding practice.

(c) Before welding of any sort is started, parts to be joined shall be properly cleaned. All corrosion or rust, oil, water and other foreign material shall be removed by an approved process or method.

(d) All parts which are to be joined by welding shall be adequately supported in proper interrelation by tables, jigs, or fixtures.

(e) Welding rod or wire or filler metal shall be chosen with respect to make, type and size by Builder or Manufacturer, as the case may be, who shall assume full responsibility for the character of the work produced.

(f) Filler metal shall be purchased in packages of convenient sizes, and shall be marked with the following information:

Make

Specification number

Diameter

Net Weight

This material shall be stored so as to protect it from damage, and so that it can be easily identified. Filler metal shall be issued and handled in such a way as to prevent materials of a given specification being mixed with those of another specification.

(g) In case a question shall arise regarding the suitability of given electrodes, shielding material or filler metal for the work covered by these Specifications, the latest revision of the joint American Welding Society and A.S.T.M. tentative specifications for Filler Metal, Iron and Steel, shall govern.

(h) Current, voltage, distance, flame and other variables shall be so controlled as to give a reasonably smooth weld free of gas pockets, oxide inclusions, excessive variations in width and thickness, excessive wandering, and spattering.

(i) Penetration of weld metal into the bottoms of angles and vees, and fusion at these points shall be complete. Weld metal shall run into the base metal at the finished surface of the weld in a smooth curve approximateing tangency to the surface of the base metal so as to avoid sudden change of section and resultant concentration of stress.

(j) The method used in depositing weld metal shall be chosen so as to minimize warpage and locked-up stresses. To this end, tack welding, skip welding, offset welding and other devices and sequences now well known in the art shall be used where necessary.

(k) Parts rotating at high speed and other parts in which locked-up stresses serve as a source of danger shall be heat treated after welding for stress relief. When the base metal contains .03% carbon or less, this shall be done by heating the structure slowly in a furnace to a temperature of 1100°F. to 1200°F., holding for one hour per inch of thickness at that temperature, and then cooling slowly to at least 250°F. before removal from

the furnace. When the carbon content of the base metal is above 0.3% the annealing temperature shall be 1425°F. to 1475°F.

(l) Finished welds which have a thickness greater than 1/4" shall be made with at least two beads. The scale shall be completely cleaned off the underlying bead and surrounding metal after cooling and before the next bead is deposited.

(m) The following requirements shall be met by welding rod or wire used for the various types of welding indicated:

1. For manual electric fusion welding, electrodes shall be of the heavily coated, shielded arc type, unless otherwise specifically approved by the Railroad.

(2) For automatic electric fusion welding, uncoated electrode wire may be used when necessary.

(n) For carbon arc welding, a shielded carbon arc shall be used. The method and material for shielding and the filler metal, if used, shall be best suited to provide welds of good quality under the conditions encountered.

(o) Manual fusion welding by the gas process may be used in butt welding of sheets 3/32" and less in thickness and, at the option of the Railroad, in other work.

(p) Spot or Plug Welding

1. Spot or plug welding to produce welds which carry structural stresses, as for example those fastening side sheets to structural members, shall be done only with equipment fitted with time, current and pressure control.

2. The Builder or Manufacturer shall determine experimentally, or in other acceptable fashion, the proper setting of the controls and shall then provide against unauthorized changes.

3. The size, shape, and surface conditions of electrodes required to give satisfactory welding and acceptable finish shall be determined similarly and a complete record made thereof. Thereafter the electrodes shall be dressed to these conditions as frequently as the character of the work requires.

4. The Builder or Manufacturer shall so treat surface marks resulting from welding as to eliminate all visible defects in the finished surface.

13.09 Paint and Painting

(a) Materials and General Requirements

1. The interior and exterior of the car body shall be painted in accordance with instructions of the Railroad as to color scheme, striping and lettering, using products supplied or recommended by the paint Manufacturer approved

by the Railroad, unless modified by the written recommendations of said paint Manufacturer, which shall in turn be approved by the Railroad. The preparation of the surfaces, the number of coats, and their method of application shall be as recommended by the paint Manufacturer.

2. The entire metal frame after completion shall be sandblasted, cleaned and immediately painted with the first coat of primer. If pickled and oiled steel is used exclusively, the completed structure may be cleaned with solvent or detergent and primed immediately thereafter.

3. During construction, the requirements of Section 13.01(p) regarding protection of all hidden surfaces, including metal doors, shall be fully met. After erection, the interior shall be given one coat of primer with a sealer coat on the back of the sheets. The underside of the car shall be sprayed with an approved undercoating. This material must retain its plasticity and be resistant to acids, salts, and alkalis. It must be fire resistant and be capable of softening with a torch for removal. Equipment cover latches, hinges and other moving parts shall be masked while the undercoating is applied.

4. Before painting of the finished car body structure, all dents, roughness or other surface imperfections shall be removed by straightening, filing and sanding.

5. Painting materials shall be either brushed or sprayed as provided hereinbelow or as modified therefrom by recommendations of paint Manufacturer. Each coat shall be uniformly applied over all surfaces to be covered and shall be free from runs, sags or other application defects. Painting shall be done by experienced labor, using proper equipment under competent supervision. Painting of the completed body structure shall be done in a clean dry atmosphere at a temperature not less than 68° F.

(b) Exterior Painting

1. The entire exterior, including roof, underframe, underside of flooring and equipment shall be given at least two coats of an approved primer after properly cleaning all surfaces. Exterior surfaces except roof and underframe shall then be given a coat of an approved surfacer after which the surface shall be properly knifed and major imperfections filled and the entire surface properly rubbed. These surfaces shall then receive

at least two coats of an approved synthetic enamel or lacquer. The roof shall be given two or more coats of an approved roof paint.

2. Equipment outside the car end shall be painted the same as the car body. The end sills, underframe, underside of floor and all equipment except control equipment, shall be given one or more coats of an approved paint.

3. The control equipment compartment shall receive at least one coat of an approved insulating varnish and the inside shall be white to reflect light.

4. The battery compartment shall be given one coat of an approved acid resisting paint.

(c) Interior Painting

1. The entire interior, except unpainted hardware and trim, shall be given two coats of primer, proper surfacing and two coats of synthetic enamel or lacquer as described above.

(d) Rust Protection

1. All surfaces shall be completely free of rust, scale, grease and other foreign matters immediately preceding the first priming coat. All joints shall be properly sealed with an approved water-proofing compound. Spot welded connections shall be thoroughly coated with an approved spot weld sealer.

2. Surfaces that are concealed after assembly shall be properly cleaned and painted with two coats of an approved preservative paint especially up to a height of one foot from bottom of side sill.

3. All aluminum surfaces shall be given a coat of an approved zinc chromate paint and all joints between the aluminum and steel shall be suitably insulated with tar paper or an approved compound.

(e) Trucks

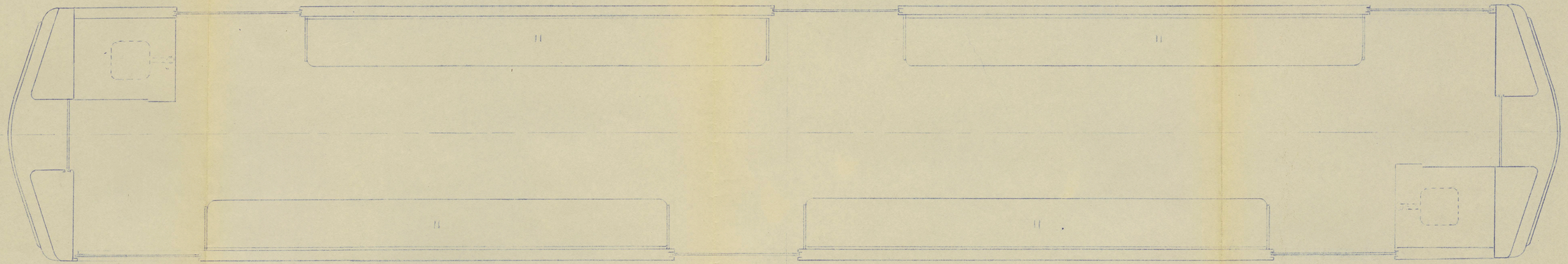
1. The truck Manufacturer shall apply one coat of approved metal primer on all exposed surfaces of trucks.

2. Before installation under the car, the Builder shall clean off all accumulated dust, dirt or other foreign matter by means appropriate to the purpose and shall then spray a final coat of approved truck paint, and air dry.

(f) Lettering and Numbering

1. Lettering and numbering shall be applied to the exterior and interior of the car as directed by the Railroad.

2. Necessary ownership plates with serial numbers and Builder's name plates shall be furnished.



LENGTH OVER ANTI-CLIMBERS	51'-0"
LENGTH OVER COUPLING FACES	51'-3"
WIDTH OVER SIDE POSTS	8'-7¼"

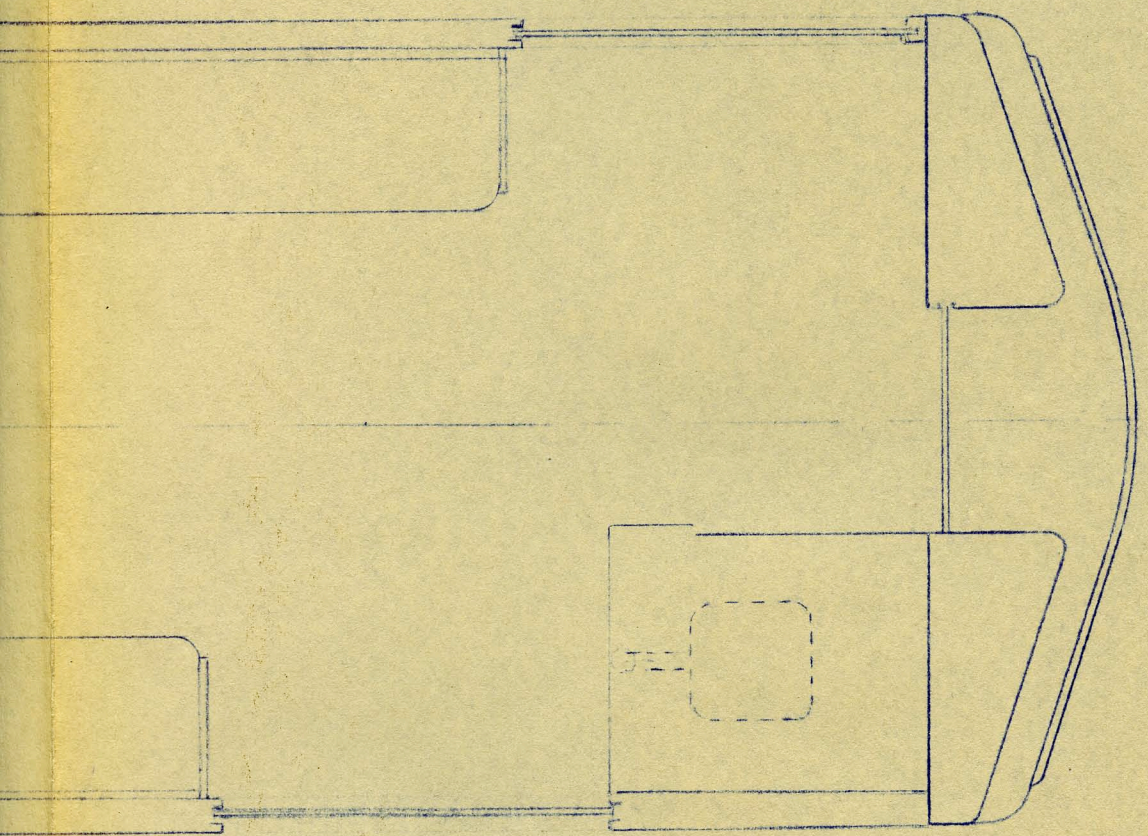
SEATS-LONGITUDINAL	44
-AUXILIARY	2
TOTAL	46
STANDEES -	106
TOTAL -	152

HUDSON & MANHATTAN RAILROAD CO.

PROPOSED RAPID TRANSIT CARS
SEATING AND DOOR ARRANGEMENT

SCALE: ½" = 1' FILE NO. 67

DATE: NOV 23 55 SERIAL NO. 9980



HUDSON & MANHATTAN RAILROAD CO

PROPOSED RAPID TRANSIT CARS

SEATING AND DOOR ARRANGEMENT

SCALE: $\frac{1}{2}$" = 1' FILE NO. 67

DATE: NOV 23 55 SERIAL NO. 9980