APPENDIX A
Key FRA Regulations (Affecting Joint Use)

The following is a listing of key FRA regulations taken from the Code of Federal Regulations (49 CFR 200-299), Federal Railroad Administration, that may affect joint operation of light rail transit or diesel multiple unit vehicles with railroads. The selected regulations concern operational procedures, standards, and certain design specifications. This listing is intended as a general identification of the operative code sections, along with a general description of the requirements. This identification code section should not imply or impute that the code provision will need to be modified to operate light rail transit or DMU with railroads.

Regulation Number and Section	**Comment**
§209: Railroad Safety Enforcement Procedures	Policy procedures for assessing penalties and for appealing penalties. Also includes, fitness-for-duty and follow-up on FRA recommendations.
§210: Railroad Noise Emission Compliance Regulations	Covers total sound emitted by moving rail cars and locomotives. Does not apply to: • Steam engines; • Street, suburban, or interurban electric railways, unless operated as a part of the general railroad system of transportation; • Sound emitted by warning devices such as horns, whistles, or bells when operated for the purpose of safety; • Special-purpose equipment that may be located on or operated from rail cars.
§211: Rules of Practice Subpart C - Waivers §211.41: Processing of petitions for waiver of safety rules	Rules of practice that apply to rulemaking and waiver proceedings, review of emergency orders issued under 45 U.S.C. 432, and miscellaneous safety-related proceedings and informal safety inquiries.

Regulation Number and Section	Comment
§212: State Safety Participation Regulations	Establishes standards and procedures for State participation in investigative and surveillance activities under Federal railroad safety laws and regulations. FRA encourages State agencies to participate and contribute to the national railroad safety program. Implications to joint operation of light rail transit or DMU vehicles with the railroad may require coordination between safety oversight agencies.
§217: Railroad Operating Rules	Requires each railroad to provide FRA with its operating rules and practices and requires each railroad to instruct its employees in operating practices.
§218: Railroad Operating Practices	Prescribes minimum requirements for railroad operating practices. This part includes minimum requirements for protection of railroad employees engaged in inspection, maintenance, and operation of rolling equipment.
§219: Control of Drug and Alcohol Use	Minimum Federal safety standards for control of alcohol and drug use, such as drug and alcohol prohibitions and testing.
§220: Radio Standards and Procedures	Minimum Federal requirements for operation of radio communications in connection with railroad operations. These requirements govern basic railroad operating rules, radio communications, record-keeping, and transmission of train orders by radio.
§221: Rear End Marking Devices – Passenger, Commuter, and Freight Trains	Minimum Federal requirements for rear end marking devices for passenger, commuter, and freight trains.
§223: Safety Glazing Standards	Minimum Federal requirements for glazing materials to protect railroad employees and railroad passengers from injury as a result of objects striking windows of locomotives, caboose, and passenger cars.

Regulation Number and Section		Comment
§225:	Railroad Accidents/Incidents: Reports, Classification, and Investigations	Requirements governing provision of accident/incident reports to FRA. §225.23: Joint Operations is of particular relevance to TCRP A-17.
§228:	Hours of Service of Railroad Employees	Federal requirements for reporting and record-keeping with respect to hours of service for certain railroad employees and standards and procedures concerning construction or reconstruction of employee sleeping quarters.
§229:	Railroad Locomotive Safety Standards	Minimum Federal requirements for locomotives, excluding steam-powered locomotives. This part includes inspection and testing procedures and safety requirements of the various systems of the locomotive—brake, draft, gear, buff strength/crashworthiness, suspension, and electrical systems, as well as cab equipment. Design requirements for MU "locomotives" are also included.
§231:	Railroad Safety Appliance Standards - (Passenger Cars)	Requirements dictating various "appliances" in a railroad car, such as the number of handholds, hand-brakes, and sill steps.
§233:	Signal Systems Reporting Requirements	Prescribed reporting requirements with respect to methods of train operation, block signal systems, interlockings, traffic control systems, automatic train stop, train control, and cab signal systems, or other similar appliances, methods, and systems.
§234:	Grade Crossing Signal System Safety	Minimum standards for maintenance, inspection, and testing of highway-rail grade crossing warning systems.

Regulation Number and Section		Comment
§235:	Instructions Governing Applications for Approval of a Discontinuance or Material Modification of a Signal System or Relief from the Requirements of Part 236	"Prescribes application for approval to discontinue or materially modify block signal systems, interlockings, traffic control systems, automatic train stop, train control, or cab signal systems, or other similar appliances, devices, methods, or systems, and provides for relief from part 236 of this title."
§236:	Rules, Standards, and Instructions	Governing Installation, Inspection, Maintenance, and Repair of Signal and Train Control Systems, Devices, and Appliances. Includes requirements concerning roadway signals, cab signals, track circuits, automatic block signal systems, interlockings, automatic train stop, and train control systems.
§240:	Qualification and Certification of Locomotive Engineers	Minimum Federal requirements for eligibility, training, testing, certification, and monitoring of locomotive engineers. This part requires each railroad to have a FRA-approved certification program and includes criteria for the certification process, as well as implementation and administration of the program.
§245:	Railroad User Fees	Implements §216 of the Federal Railroad Safety Act of 1970 (45 U.S.C. 446) that requires the Secretary of Transportation to establish a schedule of fees to be assessed equitably to railroads to cover costs incurred by FRA in administering the Safety Act. Each railroad subject to this part shall pay an annual user fee to FRA.

APPENDIX B
WAIVER CONDITIONS FOR NON-COMPLIANT DMU
(FRA Waiver #H-96-2)

It is important to note that this particular waiver was for a completely non-conforming vehicle operating on the general railroad system. As an example of the type of waiver and types of conditions applicable to the waiver, the following conditions (listed below) were attached to FRA waiver #H-96-2. This waiver allowed for the operation of the Siemens Transportation Systems, Inc., "RegioSprinter" DMU (a non-conforming vehicle) during a demonstration tour throughout the United States and Canada. This waiver provides that Amtrak will assume responsibility for the RegioSprinter tour and for adherence to conditions set forth in the waiver. (Note that these conditions have been abbreviated from the original letter.)

The waiver applies only to demonstration runs and has a set expiration date (May 1, 1997).

- Amtrak will provide a copy of the waiver to Siemens and all other railroads and transit authorities over which the vehicle will operate.

- Amtrak will provide the FRA with a schedule and final agenda for the vehicle no later than 15 days prior to its operation.

- Amtrak will identify to the FRA the single individual responsible for the planning and implementation of safety measures necessary to assure a safe demonstration.

- Amtrak must use a systematic approach to identify significant safety risks at each location where the vehicle will operate.

- Amtrak will develop a safety plan for each location where the vehicle will operate, and submit said plan to the FRA at least 15 days prior to operation. The plan must identify the steps to be taken to eliminate or mitigate each safety risk, identify the responsibility of each organization involved in the demonstration, and identify the daily safety process to be implemented. It also must describe in detail the positive steps to be taken – derails, positive blocks, or some other physical barrier – to assure that no opportunity will exist for the vehicle to share the right-of-way with conventional heavy freight or passenger rail equipment.

- All personnel involved with operation of the vehicle shall be informed that it is operating under a FRA waiver for: glazing material, lack of handholds, automatic couplers, uncoupling lever, and magnetic track brake being less than 2-1/2 inches above the top of rail.

- Amtrak shall coordinate all activities regarding operation of the vehicle with participating transit authorities and railroads.

- The vehicle will only be operated in demonstration runs on secondary branch lines and lightly-used switching lines where other rail traffic is physically blocked from entering the segment of tracks over which the vehicle is operating.

- If the vehicle is to be used on a railroad's main track, Amtrak shall arrange to halt all other traffic within the limits of the demonstration, including adjacent tracks, until completion of the demonstration runs.
- The vehicle will be operated at a speed not to exceed 35 mph on lines with highway/rail grade crossings.
- Where grade crossings equipped with automatic warning devices are to be traversed by the vehicle, Amtrak will ascertain at each location that the vehicle will shunt the track circuit prior to passing over them.

APPENDIX C
SAMPLE STATE REGULATIONS

The Pennsylvania Department of Transportation Rail Safety Review Program

The PennDOT Rail Transit Safety Review Program (RTSRP) is an on-going state safety oversight program that falls approximately in the middle between minimum FTA requirements and a traditional regulatory program.

The RTSRP, instituted by the Pennsylvania Department of Transportation (PennDOT), is a comprehensive safety analysis of the fixed guideway systems in the Commonwealth of Pennsylvania. Fixed guideway systems constitute rapid transit, light rail, busway, and inclined planes in the Commonwealth. The program does not include commuter rail systems under jurisdiction of the Federal Railroad Administration. It has been formulated and intended as a review of operational, administrative, and support functions that impact the safety of rail systems. Objectives of this effort are to increase awareness of safety, assess safety programs and practices, and implement efforts to reduce potential for accidents and incidents. The program is in its sixth year of operation and is also the entity authorized by the Commonwealth to operate as the designated State Safety Oversight agency.

Transit systems included in this effort are the Southeastern Pennsylvania Transportation Authority (SEPTA) in Philadelphia, the Port Authority of Allegheny County (PAT) in Pittsburgh, and the Cambria County Transit Authority (CCTA) in Johnstown. The City of Philadelphia, which is owner of the fixed guideway concourse network in Philadelphia, while not an operating transit authority, is also covered under the auspices of the RTSRP.

The PennDOT RTSRP preceded FTA-mandated programs by five years. As such, and based upon the needs of the Commonwealth, the PennDOT Program is much more extensive in both its scope and methodology. To give one example, while FTA requires an independent "on-site" review of the transit system at least once every three years, the PennDOT program utilizes a continuing on-site presence throughout the year. In addition, there are continuing independent assessments on a wide variety of operational and maintenance issues.

The PennDOT RTSRP is similar, however, to the FTA-mandated "minimum" style program in that it also does not promulgate safety or operational regulations. It relies on transit systems to develop reasonable and appropriate rules and procedures, and for the most part evaluates actual compliance with these rules. In rare instances where rules may not exist or are deemed to be "inappropriate" for conditions, transit systems are charged with completing appropriate corrections. As with the FTA-style program, under the PennDOT approach it is highly unlikely that the state would issue regulations covering design, operation, and maintenance of rail transit systems. This situation would also apply to operation of any LRT/DMU service. Each transit system that utilized this technology would be required to develop its own rules, and would be evaluated based upon compliance with these rules.

The Public Utilities Commission of the State of California Program

The State of California Public Utilities Commission (the California PUC) is charged with FTA safety oversight of non-

FRA rail transit agencies in the State of California. Unlike the previous example of state safety oversight programs, the California PUC approach is a more "traditional" safety regulatory approach wherein the agency (the PUC) promulgates safety rules and regulations for some rail transit services, and has been engaged in this activity since prior to the FTA requirement. For purposes of this report, the study team examined the California PUC Safety Rules and Regulations Governing Light-Rail Transit (General Order 143-A).

In many regards, General Order 143-A is similar to FRA regulations, both in terms of scope and methodology. It exerts a strong influence over management of the new generation of light rail properties in California. In addition to covering accident reporting requirements and other miscellaneous mandates, the Order contains mandatory regulatory language regarding:

- Equipment of Light Rail Vehicles (LRVs)
- Brakes on LRVs
- Lighting on LRVs
- Operating Speeds
- Train Protection Requirements
- Right-of-Way Standards
- Traction Power Requirements
- Operating Rules
- Inspection Requirements

This type of state safety oversight program is structured in a similar fashion to the FRA, in that it is the oversight agency (the PUC) that decides the rules and regulations and then monitors compliance. While the PUC's methodology utilized to assess and enforce compliance with the rules may differ from FRA's, they are closer in style than the other two state oversight models described above. In addition, under the California model, the PUC has authority to issue specific financial penalties (similar to FRA) for rule infractions. The other two state safety oversight models, as envisioned by FTA or operated by PennDOT, do not explicitly provide for financial penalties. However, regardless of the absence of specific regulatory language, severe and continuing violation of oversight rules under the two previously-described state oversight programs would result in some form of negative financial impact, most likely the loss of state funding or specific funding programs.

The California oversight program is the only one of the 19 FTA-mandated states that operates in this particular regulatory manner. While it is likely that some other states will designate their own Public Utilities Commissions to manage rail transit safety oversight efforts (as Oregon has done), whether they will utilize the same form of regulatory process as the California PUC is unknown. Discussions with rail transit safety oversight offices in several states (Ohio, New Jersey, Pennsylvania, Illinois, and New York) indicate a general reticence to operate a traditional regulatory program analogous to FRA. While the rationale for this thinking varies from state to state, one recurrent theme is the belief that a non-traditional regulatory approach may be more appropriate, especially given the unique operational and physical characteristics of older rail transit systems.

Another important note is that while the California PUC has promulgated rules and regulations for Light Rail Transit, it has not done so for heavy rail rapid transit. As such, what rules and regulations would apply if the California PUC were to address the issue of DMU operation in a light rail setting are uncertain. This distinction between light and heavy rail suggests that light rail is more intimate with its environment (grade crossings, operating in mixed traffic, and pedestrians). In contrast, heavy rail is isolated and therefore perhaps less in need of regulation.

A review of General Order 143-A suggests that its rules and regulations would also be applicable to DMU operation, with some exceptions or modification required relative to brakes and traction power; it might well develop a set of rules specifically for DMU.

Again, as with the other forms of state safety oversight efforts identified above, the California PUC does not exert jurisdiction over railroad operations that are under FRA jurisdiction. As such, a joint operation of DMU/LRT with a rail line connected to the "general railroad system" would fall under FRA jurisdiction.

APPENDIX D
TWO EXAMPLES OF JOINT RAIL OPERATIONS PRACTICE IN THE U.S.

Conrail and Baltimore MTA LRT (BCLR)

There are two distinct operating scenarios that define Conrail's access to the BCLR. The first situation involves the necessity for a Conrail freight switcher to simply cross over the BCLR line in order to provide service to the Flexiflo operation on the opposite side near the North Avenue Station in Baltimore. The Agreement of Sale between BCLR and Conrail provides Conrail with unlimited access to this Flexiflo facility. Since the freight train movement across the BCLR main track is effectively an "interlocking move" and only consumes five minutes or less, this type of freight movement can be made during the period of time that the BCLR system is operating revenue service. This simple freight train move normally takes place without delaying light rail service. Train separation between the light rail trains and the freight train is accomplished by electrically-operated unlocks on the Conrail trackage and interlocking signals on the BCLR trackage.

Another operating scenario involves a Conrail local freight train entering upon BCLR trackage at North Avenue and proceeding north approximately 12.4 miles to Timonium, MD, serving freight shippers to that point and beyond. The Agreement of Sale provides Conrail with the right to perform such service three days per week between 11:50 p.m. and 4:25 a.m. During this period, the BCLR is not operating any commuter service.

Cooperating toward the goal of better coordination between their joint operations, local BCLR and Conrail managers have modified the formal agreement. The BCLR service requirements have now extended beyond the 11:50 p.m. starting time to 1:00 a.m. Although this further restriction shortens Conrail's available "time window," Conrail has advised that this modification has not adversely impacted service to their current freight customers (but might hamper expansion of freight service).

In an effort to better understand the facility sharing agreement between Conrail and the BCLR, control procedures pertaining to the freight train operation were reviewed. Freight train operations take place under the jurisdiction of a BCLR supervisor stationed at the light rail control center. Through the use of two-way radio, freight train crews must verbally request permission to occupy the BCLR and obtain the necessary paper clearances and operating authorities from light rail control. The attached operating authorities are used to insure that freight trains are properly dispatched over the BCLR.

In addition to formally granting the freight train crew permission to operate over the BCLR main tracks, the above operating authorities also convey essential information pertaining to BCLR operating rules and physical characteristics from light rail control to the freight train's crew.

Therefore, Conrail freight trains operate according to BCLR operating and safety rules. These rules are tailored to fit specific conditions pertaining to the BCLR physical characteristics, such as track speeds, signal indication, grade crossing locations, and other safety considerations.

When the freight train has reached its destination at Timonium, the crew reports clear of the BCLR to light rail control. It then proceeds further beyond the LRT terminal. When the train is ready to return,

the crew must again request permission to re-enter the BCLR from the supervisor at light rail control. The supervisor on duty maintains a radio log, which makes note of the time, the locomotive number, and the messages pertinent to all radio communications with the freight trains.

San Diego and Imperial Valley Railroad(SD&IV RR) and San Diego Trolley, Inc.(SDTI)

The SDTI operates over a former Southern Pacific Railroad-owned San Diego & Arizona Eastern line that is now owned by Metropolitan Transportation Development Board, the SDTI parent. The San Diego and Imperial Valley Railroad, a short line carrier in the area, assumed freight train operating rights.

The operating agreement initially provided for freight trains to co-mingle with light rail service. Since the initial operating headways for light rail service was every 30 minutes, the co-mingling of freight trains and light rail operations was feasible from an operations standpoint. This 30-minute headway created a "designated window" in which freight was permitted to operate. Limitations were imposed, such as the freight trains could not perform any mid-route switching, their runs being restricted to nonstop terminal-to-terminal operation.

The SD&IV RR operates freight trains over most of two different lines that have light rail service: the South Line and the East Line. The intensity of freight operation is greater on the 19.1-mile North-South (Blue) Line for six nights a week, as compared to two or three 3 nights per week on the 21.6-mile East (Orange) Line. However, freight train operations are separated from light rail operations by time of day in the same way as the Baltimore system. The SD&IV Railroad is limited to operating freight trains during the hours from 1:30 a.m. to 4:00 a.m. As demands for more services are imposed on both operators, the freight and passenger track occupancy windows are adjusted. As track capacity is reached, capital measures to handle increased demand become more feasible.

Although some field automation establishes routes at the points where freight trains enter and leave the light rail line, permission to enter the system is made by radio communication and is formalized using paper authorities and clearance forms, in a nearly identical manner as in the BCLR system. When a freight train exits the light rail system, it must report to the "controller" at the light rail control center, who keeps communication logs of the conversations.

The San Diego Trolley is a double-track operation on both the Blue Line and the Orange Line, making it somewhat easier to coordinate the operation of freight trains and maintenance of activities during the 1:30 a.m. to 4:00 a.m. period.

An important note is that since the SD&IV freight train crews operate six days per week on the Blue Line, it is not possible to simply restrict the freight train from operating on any given night. However, the fact that the SDTI is a double-track system makes it possible for track or catenary maintenance crews to work on one track while freight trains pass on the other track. This is a much more flexible arrangement than the BCLR system, where the single track requires that freight trains change their nights of operation to accommodate the maintenance work whenever track outage is required.

Comparisons

As in the BCLR system, the SDTI has no formal FRA "waiver" that officially sanctions the operation. At the time of system start-up in 1981, the SDTI was operating on 30-minute headways, which allowed the co-mingling of freight trains

with light rail operations. Although the FRA allowed this practice, they had significant concerns as to the overall safety of the co-mingled operation.

Both the BCLR and the SDTI systems use an overhead catenary or trolley wire system for traction power. These traction power systems create limits on the vertical clearances for operation of railroad freight cars with excessively high dimensions.

The SDTI system features 22' high contact wires over all locations having joint operations. This provides total clearance for all standard railroad equipment moves. Almost any variation of equipment can be moved, except special high and wide loads. Although overhead electric traction power systems restrict the maximum height of freight trains, this has not proven to be an operating impediment to either Conrail or the SD&IV Railroads.

APPENDIX E

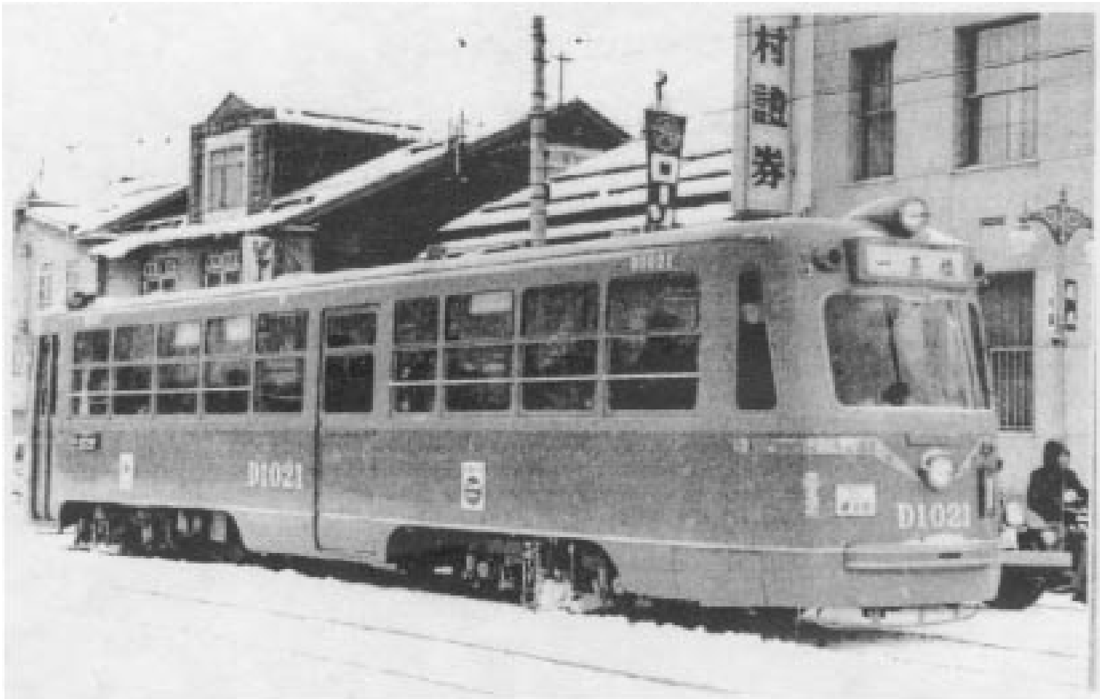
Illustrations of Overseas Joint Use

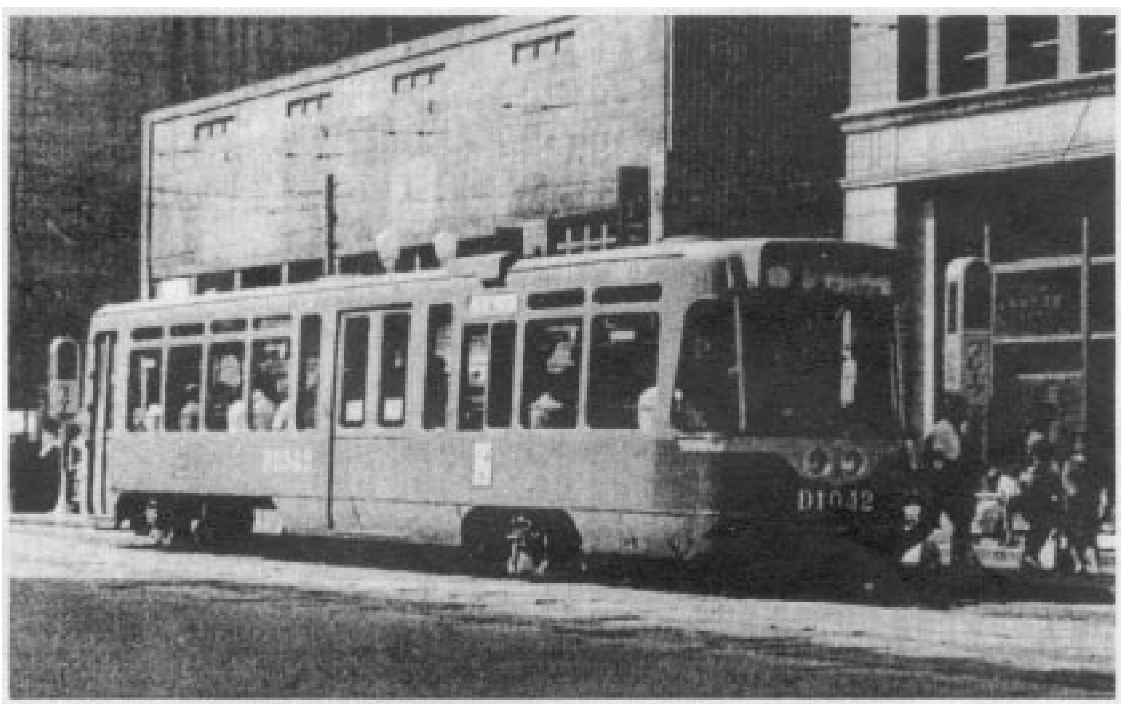
Sapporo, Japan Diesel LRVs in Street - Illustration E1

Odakyu Ry. and Hakone - Tozan Ry. Contrasting Gauge & Dimension
Illustration E2

Sapporo, Japan Diesel LRVs in Street

Illustration E1





Diesel electric (note: absence of poles or pantographs) LRVs of two generations operating on Sapporo streets in mixed traffic. These were not dual power but were later converted to all-electric LRVs

(Above - T. Unoguchi/Rail #21)
(Below - Y. Nakata/Romendensha)

Odakyu Ry. and Hakone - Tozan Ry. Contrasting Gauge & Dimension

Illustration E2

This portrays the diagram in Figure 8.8. The 3.6' gauge Okakya wide dimension train on the left operates in several operating environments including rapid transit. The standard gauge (but) narrow body) Hakone Ry. train on right is the host property. The gauge difference provides, in effect, a continuous gauntlet rail for wide and narrow rail cars. (H. Kageyama/<u>Tetsudo Fuan</u>.)

Detailed DMU and LRV Vehicle Compliance Matrix

COMPLIANCE (WITH FRA, AAR, ADA, NFPA)	Siemens VT-628/610	Goninan Sprinter	Siemens RegioSprinter	Nippon Sharyo RDC	ADtranz Regio Shuttle	Bombardier Talent	GEC Lint	ABB Flexliner IC3D	Bombardier DMU	ABB Class 166/158	ABB Express DMU	SLM Futuro	Adtranz GTW 2/6	GEC Alice 203/4	ADtranz/ABB Balt. LRV	Breda	Tokyu	Siemens-Duewag	Bombardier	Nippon Sharyo	Siemens Duewag	Siemens Duewag	Bombardier
VEHICLE TYPE/CATEGORY	A1	A1	A1	A1	B2	B3	A2	A1	A1	A1	A	B3	BC3	A1	C	C	C	C	C	C	C	C	C
STATIC END LOAD	H	L	L	H	L	L	L	H	M	L	L	L	L	H	L	L	L	L	L	L	L	L	L
ROLLOVER STRENGTH	H	L	M	H	L	L	L	H	M	L	L	L	L	H	L	L	L	L	L	L	L	L	L
CAB CRASH REFUGE	H	L	L	L	L	L	L	H	M	L	L	M	L	H	L	L	L	L	L	L	L	L	L
GLAZING - WINDSHIELD STRENGTH	H	H	H	H	H	H	H	H	H	H	H	L	L	H	H	H	H	H	H	H	H	H	H
ANTICLIMBER FORCE	H	L	L	H	L	L	L	H	M	L	L	L	L	H	L	L	L	L	L	L	L	L	L
COUPLER FORCE	H	L	L	H	L	L	L	H	M	L	L	M	L	H	L	L	L	L	L	L	L	L	L
VERTICAL MEMBER SHEAR STRENGTH	H	M	L	M	L	L	M	H	M	L	L	L	L	H	L	L	L	L	L	L	L	L	L
TRUCK TO BODY SHEAR STRENGTH	H	M	L	M	L	L	L	H	M	L	L	L	L	H	L	L	L	L	L	L	L	L	L
HORIZONTAL LOAD	H	L	L	H	L	L	L	H	M	L	L	L	L	H	L	L	L	L	L	L	L	L	L
SEAT SECURING STRENGTH	H	M	M	H	M	M	M	H	M	M	M	L	M	M	M	M	M	M	M	M	M	M	M
EXTERIOR NOISE AT 50FT	H	H	H	H	H	H	H	H	H	H	H	H	H	M	H	H	H	H	H	H	H	H	H
SMOKE & FLAMMABILITY	H	M	H	H	M	M	M	H	H	M	M	M	M	H	M	M	M	M	M	M	M	M	M
WHEELCHAIR ACCESSABILITY	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H
COUPLER TYPE	H	M	H	H	M	M	M	H	H	M	M	H	H	H	M	L	L	L	L	L	L	L	L
TRACK GAUGE & CLEARANCE	H	H	H	H	H	H	H	H	M	H	L	H	H	H	M	H	H	H	H	H	H	H	H
EMISSIONS	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H

VEHICLE TYPE/CATEGORY A = HIGH FLOOR DIESEL VEHICLE, B = LOW FLOOR DIESEL VEHICLE, C = ELECTRIC LIGHT RAIL VEHICLE

COMPLIANCE EVALUATION H = MEETS MOST REQUIREMENTS, M = MARGINALLY MEETS MOST REQUIREMENTS , L = DOES NOT MEET MOST REQUIREMENTS

COMPLIANCE CHARACTERISTICS	Relevant US Industry Standard	Siemens VT-628	Goninan Sprinter	Siemens RegioSprinter	Nippon Sharyo RDC	ADtranz Regio Shuttle	Bombardier Talent	GEC Lint	ADtranz IC3 Flexliner
VEHICLE TYPE/CATEGORY	HIGH FLOOR DMU - TYPE A	A 1	A 1	A 2	A 1	B 2	B,C,2,3	A 2	A 1
STATIC END LOAD (&. VERT DEFLECTION) - lbs-f	800,000 lbs-f (1" vert deflection)	800,000 lbs	220,000 lbs	321,000 lbs	800,000 lbs	340,000 lbs	337,000 lbs	337,200 lbs	800,000 lbs
ROLLOVER STRENGTH - lbs-f	500,000 lbs-f	500,000 lbs	N/A	250,000 lbs		N/A	N/A		fulfil tier proposal
CAB CRASH REFUGE	Yes	Yes	No	No	No	N/A	N/A		if required
GLAZING - WINDSHIELD STRENGTH	24 lbs block at 44 ft/sec velocity (FRA)	FRA Compliant	UIC 651 Complaint	UIC 651 Compliant	FRA Compliant	N/A	N/A	UIC 651 Compliant	FRA Compliant
ANTICLIMBER - lbs-f vertical	100,000 lbs-f	FRA Compliant	118,800 lbs	N/A	100,000 lbs	N/A	N/A	168,000 lbs	100,000 lbs
COUPLER - lbs-f - downward	100,000 lbs-f	FRA Compliant		N/A	100,000 lbs	N/A	N/A	337,200 lbs	100,000 lbs
VERTICAL MEMBER SHEAR STRENGTH - lbs-f	300,000 lbs-f	300,000 lbs	224,000 lbs	N/A	300,000 lbs	N/A	N/A	UIC 651	300,000 lbs
TRUCK TO BODY SHEAR STRENGTH - lbs-f	250,000 lbs-f	250,000 lbs	N/A	N/A	250,000 lbs	N/A	N/A	UIC 651	250,000 lbs
HORIZONTAL LOAD - lbs-f	500,000 lbs-f	FRA Compliant	N/A	N/A	N/A	N/A	N/A		247,000 lbs
SEAT SECURING STRENGTH - lbs-f	100,000 lbs-f	FRA Compliant	N/A	N/A	N/A	N/A	N/A	UIC 651	
EXTERIOR NOISE AT 50FT - dB		84 dB AT 28yds	85 dB at 50ft (50mph)	76 dB at 20ft	N/A	82 dB	N/A	85dB at 82ft (max v)	77 dB @ 24ft zero v
SMOKE & FLAMMABILITY	NFPA 130 **	NFPA Compliant	Local Aus Stds	NFPA Complaint	NFPA Compliant	N/A	N/A	DIN 5510	NFPA 130
WHEELCHAIR ACCESSABILITY	Yes	Yes - via lift	Yes	Yes	Yes	Yes	Yes	Yes	Yes
COUPLER TYPE	Tight Lock	AAR or Tight Lock	Fully automatic	Tight Lock	Tight Lock		N/A	Full automatic	Tight Lock, Auto
TRACK GAUGE & CLEARANCE Ft	4.71 ft	4.71 ft	5.25 or 4.71 ft	4.71 ft	4.71 ft	4.71 ft	4.71 ft	4.71 ft	4.71 ft
EMISSIONS g/kwh	CO = 4.00, NOx = 7.00 and HC = 1.10	CO=.38, NOx=9.8, HC=1.4		CO=.52, NOx=6.35, HC=0.26	CO=4.0, NOx=7.0, HC=1.2	Euro II	N/A	Euro II	CO=.223,NOx=6.6,HC=.3
PHYSICAL ATTRIBUTES	Industry Average	Siemens VT-628	Goninan Sprinter	Siemens RegioSprinter	Nippon Sharyo	ADtranz Regio Shuttle	Bombardier Talent	GEC Lint	ADtranz IC3 Flexliner
STRENGTH MEMBER MATERIAL	SS/LAHT	LAHT	Stainless Steel	Aluminium	SS, LAHT			Steel	SS /S/LAHT
HVAC - CONFIGURATION & CAPACITY	13 Tons Cooling	10 Ton, 35 kW	2 genr. rect. invt	2 x 8 Ton, 50 HP	12.3 Tons, 480 VAC	13 kW	N/A	60kW Cooling	170 kW Cooling
MIN NEGOTIABLE VERT CURVE RAD - Ft	1640 ft	2000 ft	984 ft	2000	N/A	1640 ft	N/A	1,641 ft	
MIN NEGOTIABLE HORIZ CURVE RAD - Ft	300 ft (one car)	328	328	263	300	295 ft	295	328	300 ft
AXLE WEIGHT -lbs	30,000 lbs	33,000	25,500 lbs	26,840		30,900 lbs	N/A	30,870 lbs	42,000 lbs
CARBODY WIDTH - Ft	10 ft	10 ft	9.65 ft	10'	10'6"	9.51 ft	9.22 ft	9 ft	10 ft
CARBODY HEIGHT - Ft	13ft	12ft	12.81 ft	11'6"	13'1"	12.14 ft	N/A	12.75 ft	12.6 ft
CARBODY LENGTH Ft	80 ft (one car)	150 ft	82 ft	84'	85'	80 ft	91 ft	87.64	194 ft (3 cars/1 trainset)
FLOOR HEIGHT (ABOVE TOR)	24 Inches Low/45 Inches High	50 Inches	51 Inches	21 Inches	52 Inches	24 Inches	21/31 Inches	24/45 Inches	4.25 ft
MAXIMUM CAR CONSIST	4 cars	3 x 2 = 6 cars	8 cars	4 Cars	10 Cars	5 cars	3x4 = 12	3	5 sets (15 coaches)
NUMBER OF INTERIOR STEPS	3 Steps	3	none	3	none	2	N/A	3	3
NUMBER OF SEATS	85	146	90	74	87	76	72	73	152
STANDING CAPACITY (4 PASSENGERS/sq M)	90	200	15	100	66	88	84	90	120
TOTAL TRAIN CAPACITY	175	346	105	174	153	164	N/A	163	272
WHEEL CHAIR SPACE	1 Space	2 Spaces	1 Space	2 Spaces	2 Spaces	1 Space	1 Space	1 Space	1 Space
AISLE WIDTH Ft	2 ft	2.8 ft	1.3 ft	2.3 ft	2.5 ft	N/A	N/A	2.13 ft	
SEAT SPACING (FACING SEATS)	2.5 ft	2 ft	4.56 ft		2.9 ft facing one way	N/A	N/A	2.46 ft	3.33 ft
VEHICLE TARE WEIGHT - lbs	85,000 lbs	264000 lbs	110,000 lbs	68200 lbs	128,970 lbs	72,334 lbs	1/74, 400 lbs	81,585 lbs	240,000 lbs
VEHICLE AW1 WEIGHT - lbs	100,000 lbs	286,484	127,600 lbs	79,600	N/A		1/93, 200 lbs		310,000 lbs
AXLE NOTATION	Power-Trailer-Trailer - Power	2-2 Bo-2	1 A A 1	A 2A	2-A1	Bo-Bo	Bo Bo/Bo2 Bo	A-Bo-A	Bo Bo
FRICTION BRAKE TYPE	All axle dual disk	All axle dual disk	All axle dual disk	All axle disk	All axle tread brake	N/A	N/A	Disk/cast steel	All axle dual disk
WHEEL TYPE	Solid Block	Solid Block	Solid Block	Solid Block	AAR	N/A	N/A	DIN 5573	N/A
WHEEL SIZE	2.75 ft	2.75 ft/2.5ft	3.02 ft/2.75 ft	30/27.5" P, 20.5/18.9" T	2.75 ft	N/A	N/A	2.53 ft/2.34 ft	2.79 ft/2.66 ft
GENERAL PERFORMANCE	Industry Average	Siemens VT-628	Goninan Sprinter	Siemens RegioSprinter	Nippon Sharyo	ADtranz Regio Shuttle	Bombardier Talent	GEC Lint	ADtranz IC3 Flexliner
MAX SPEED - MPH	75 mph	100 mph	80 mph	60 mph	80 mph	75 mph	75 mph	75mph	110 mph
ACCELERATION - MPH/S	1.2 mphps	2.2 mph/s	0.9 mph/s	2.5 mph/s	0.78 mph/sec	2.35 mph/s	0.96 mph/s	1.13 mph/s	2.0 mph/s
SERVICE DECELERATION - MPH/S	2.15 mphps	2.6 mph/s	1.64 mph/s	2.88 mph/s	2.1 mph/s	2.13 mph/s	N/A	2.15 mph/s	2.2 mph/s
EMERG. DECELERATION - MPH/S	2.8 mphps	4.85 mph/s	1.86 mph/s	6.0 mph/s	2.8 mph/s	2.73 mph/s	N/A	2.8 mph/s	2.2 mph/s
POWER TO WEIGHT RATIO - KW/T	8.8	11	10.3	12.2	8.8	8.46	13.82	8.5 kW/t	
TOTAL MOTOR POWER - KW	470	772	470	452	N/A	456	689 HP	315	1240 kW
TOTAL TRACTIVE POWER - KW	400	494	408	271	N/A	456	N/A	265 = UIC	930 kW
RANGE MILES	750	1056	700	750	N/A	620	1200	650	1500
RELIABILITY - MDBSF	100,000 miles	300,000	25,000	100,000 miles	N/A		N/A	185,000	75,000
AVAILABILITY - MDBSF/(MDBSF+MTTR)	98%	97%	87%	96%	N/A	95%	N/A	96%	99.80%
INTERIOR NOISE - dB	70 dB	69.3 dB	70 dB	76.5 dB	N/A	70 dB	N/A	70 dB	68 dB
OPERATIONAL DETAILS	Industry Average	Siemens VT-628	Goninan Sprinter	Siemens RegioSprinter	Nippon Sharyo	ADtranz Regio Shuttle	Bombardier Talent	GEC Lint	ADtranz IC3 Flexliner
VEHICLE DEVELOPMENT STATUS		Dwg Board	In Service	In Service	Dwg Board	prototype	prototype	Dwg Board	In Service
COST PER CAR $	$2.5 million	$2.85 - $3.2 million	$A2.9 million	$1.6 million	N/A	N/A	N/A	N/A	N/A
OPERATING COST PER MILE $	80c/mile	$0.86 per mile	N/A	$0.3 per mile	N/A	N/A	N/A	N/A	$3.79/mile

COMPLIANCE CHARACTERISTICS	Relevant US Industry Standard	Bombardier DMU	ABB Class 166/158	ADtranz GTW 2/6	ABB Express DMU	SLM Futuro	GEC Alice 203/4
VEHICLE TYPE/CATEGORY	HIGH FLOOR DMU - TYPE A	A 1	A 1	B,C,2,3	A 1	B,C,2,3	A 1
STATIC END LOAD (&. VERT DEFLECTION) - lbs-f	800,000 lbs-f (1" vert deflection)	800,000 lbs	N/A	UIC Main Line	N/A	337,438 lbs	800,000 lbs
ROLLOVER STRENGTH - lbs-f	500,000 lbs-f	FRA	N/A	N/A	N/A	N/A	500,000 lbs
CAB CRASH REFUGE	Yes	N/A	N/A	N/A	N/A	Yes	Yes
GLAZING - WINDSHIELD STRENGTH	24 lbs block at 44 ft/sec velocity (FRA)	FRA	N/A	N/A	N/A	N/A	FRA Compliant
ANTICLIMBER - lbs-f vertical	100,000 lbs-f	FRA	N/A	N/A	N/A	N/A	FRA Compliant
COUPLER - lbs-f - downward	100,000 lbs-f	FRA	N/A	UIC	N/A	N/A	FRA Compliant
VERTICAL MEMBER SHEAR STRENGTH - lbs-f	300,000 lbs-f	FRA	N/A	N/A	N/A	N/A	FRA Compliant
TRUCK TO BODY SHEAR STRENGTH - lbs-f	250,000 lbs-f	FRA	N/A	N/A	N/A	N/A	FRA Compliant
HORIZONTAL LOAD - lbs-f	500,000 lbs-f	FRA	N/A	N/A	N/A	N/A	FRA Compliant
SEAT SECURING STRENGTH - lbs-f	100,000 lbs-f	FRA	N/A	N/A	N/A	N/A	N/A
EXTERIOR NOISE AT 50FT - dB		N/A	N/A	N/A	N/A	N/A	N/A
SMOKE & FLAMMABILITY	NFPA 130 **	N/A	N/A	N/A	N/A	N/A	N/A
WHEELCHAIR ACCESSABILITY	Yes	Yes	Yes	Yes	Yes	Yes	Yes
COUPLER TYPE	Tight Lock	Tight Lock	Buffer	Optional UIC	N/A	Optional UIC	FRA Compliant
TRACK GAUGE & CLEARANCE Ft	4.71 ft	4.75 ft	4.71 ft	4-gauge option	3.2 ft	5-gauge option	Std.
EMISSIONS g/kwh	CO = 4.00, NOx = 7.00 and HC = 1.10	N/A	N/A	Euro II	N/A	Euro II	N/A

PHYSICAL ATTRIBUTES	Industry Average	Bombardier DMU	ABB Class 165	ADtranz GTW 2/6	ABB Express DMU	SLM Futuro	GEC Alice 203/4
STRENGTH MEMBER MATERIAL	SS/LAHT	SS	N/A	Aluminum	N/A	Aluminum	N/A
HVAC - CONFIGURATION & CAPACITY	13 Tons Cooling	2x6.5 ton	N/A	N/A	N/A	N/A	N/A
MIN NEGOTIABLE VERT CURVE RAD - Ft	1640 ft	2000'	N/A	N/A	N/A	N/A	1640'
MIN NEGOTIABLE HORIZ CURVE RAD - Ft	300 ft (one car)	250'	N/A	132'	N/A	264'	264'
AXLE WEIGHT -lbs	30,000 lbs	42,500 lbs	N/A	N/A	N/A	N/A	32,500 lbs
CARBODY WIDTH - Ft	10 ft	10 ft	9.22 ft	9.8 ft./options	9.38 ft	9.88 ft	N/A
CARBODY HEIGHT - Ft	13ft	12.9 ft	12.39 ft	12.8 ft/opt	12.46 ft	N/A	13.1
CARBODY LENGTH Ft	80 ft (one car)	85.3 ft	73.2 ft	121.8 ft/opt	72.7 ft	144'	85'/unit
FLOOR HEIGHT (ABOVE TOR)	24 Inches Low/45 Inches High	51 Inches	45 Inches	23 Inches	45 Inches	22/47 Inches	51"
MAXIMUM CAR CONSIST	4 cars	N/A	N/A	6	N/A	6 cars	4x3 = 12
NUMBER OF INTERIOR STEPS	3 Steps	0	0	2	N/A	3	0
NUMBER OF SEATS	85	113	2x72	104	152	152	62+68
STANDING CAPACITY (4 PASSENGERS/sq M)	90	N/A	N/A	136	N/A	156	N/A
TOTAL TRAIN CAPACITY	175	N/A	N/A	240	N/A	308	N/A
WHEEL CHAIR SPACE	1 Space	2 Spaces	1 Space	5 Spaces	1 Space	4 Spaces	N/A
AISLE WIDTH Ft	2 ft	N/A	N/A	N/A	N/A	N/A	N/A
SEAT SPACING (FACING SEATS)	2.5 ft	N/A	N/A	N/A	N/A	N/A	N/A
VEHICLE TARE WEIGHT - lbs	85,000 lbs	N/A	82,500 lbs	92,600 lbs	81,620 lbs	108,000	N/A
VEHICLE AW1 WEIGHT - lbs	100,000 lbs	127,500	N/A	N/A	N/A	144,000	130,000 lbs
AXLE NOTATION	Power-Trailer-Trailer - Power	1A-A1	2-Bo-Bo-2	2-Bo-2	2-A1 on each car	1 (1+A)(A+1) 1	1A-1A A1-A1
FRICTION BRAKE TYPE	All axle dual disk	Tread/disk/ret.	Tread	N/A	N/A	Disk/ret.	Tread/ret.
WHEEL TYPE	Solid Block	N/A	N/A	N/A	N/A	N/A	N/A
WHEEL SIZE	2.75 ft	N/A	N/A	2.82 ft.	N/A	2.79"/2.21"	36"

GENERAL PERFORMANCE	Industry Average	Bombardier DMU	ABB Class 165	ADtranz GTW 2/6	ABB Express DMU	SLM Futuro	GEC Alice 203/4
MAX SPEED - MPH	75 mph	100 mph	90 mph	75 mph	75 mph	75 (86 opt)	75/100 mph
ACCELERATION - MPH/S	1.2 mphps	1.08 mph/s	N/A	2.15 mph/s	N/A	1 M/S-same size	N/A
SERVICE DECELERATION - MPH/S	2.15 mphps	1.08 mph/s	N/A	2.24 mph/s	N/A	1.1 M/S^2	N/A
EMERG. DECELERATION - MPH/S	2.8 mphps	2.16 mph/s	N/A	N/A	N/A	N/A	N/A
POWER TO WEIGHT RATIO - KW/T	8.8	N/A	6.93	11.6	5.71	N/A	N/A
TOTAL MOTOR POWER - KW	470	2/400 HP/300 kW	N/A	600kW	N/A	2/300kW	N/A
TOTAL TRACTIVE POWER - KW	400	N/A	350 HP	540kW	284 HP	N/A	N/A
RANGE MILES	750	1418	930	N/A	N/A	N/A	N/A
RELIABILITY - MDBSF	100,000 miles	N/A	N/A	N/A	N/A	250,000 miles	N/A
AVAILABILITY - MDBSF/(MDBSF+MTTR)	98%	N/A	N/A	N/A	N/A	N/A	N/A
INTERIOR NOISE - dB	70 dB	N/A	N/A	N/A	N/A	N/A	N/A

OPERATIONAL DETAILS	Industry Average	Bombardier DMU	ABB Class 165	ADtranz GTW 2/6	ABB Express DMU	SLM Futuro	GEC Alice 203/4
VEHICLE DEVELOPMENT STATUS		Concept	In service	In service	In service	Prototype	Concept
COST PER CAR $	$2.5 million	N/A	N/A	N/A	N/A	N/A	N/A
OPERATING COST PER MILE $	80c/mile	N/A	N/A	N/A	N/A	N/A	N/A

APPENDIX H

DIESEL MULTIPLE UNIT (DMU) AND LIGHT RAIL VEHICLE (LRV) RAIL CAR EXHIBITS

(Examples of rail car design proposals or produced offerings by car builders, current and historic)

Dimensional Contrasts (fig. 4-1) Locomotive, LRV, DMU categories 1,2,3

Category 1 DMU (railroad derivatives)

■ Flexliner IC-3	(ADtranz)
■ Diesel Multiple Unit*	(Bombardier)
■ Diesel Rail Car*	(Nippon Sharyo)
■ Type VT-628/610	(Siemens)
■ North American DMU*	(Siemens)
■ "RDC" (historic)*	(Budd)

Category 2 and 3 DMU (light rail derivatives)

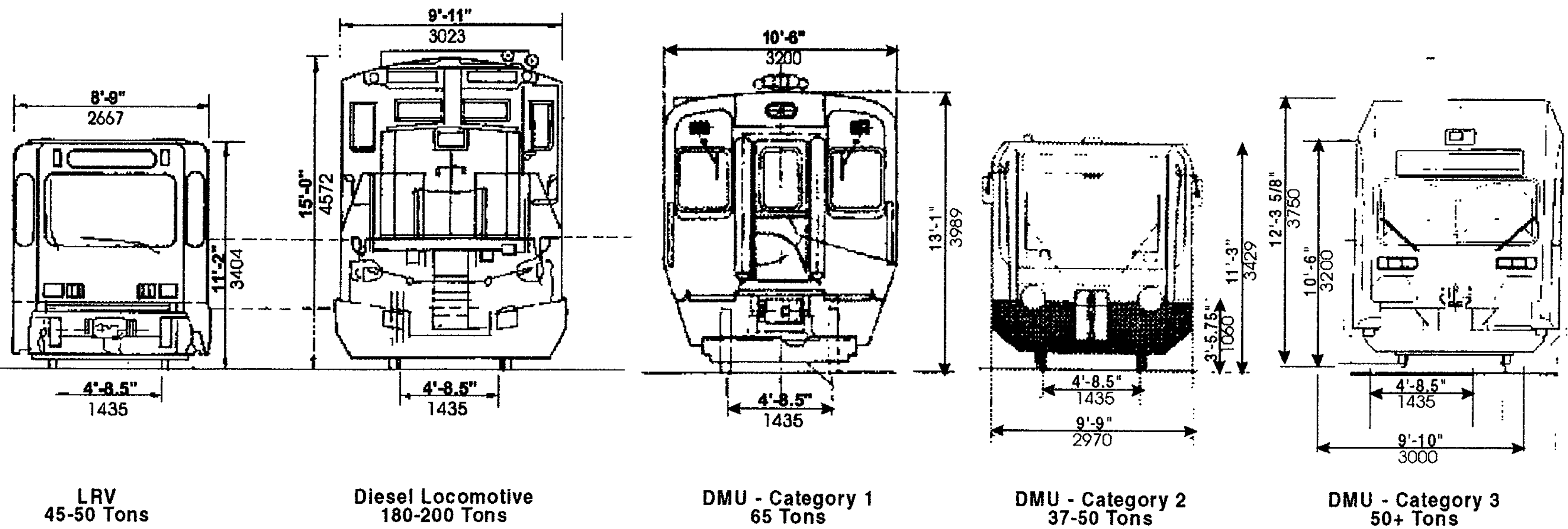
■ GTW 2/6	(ADtranz/Stadler/SLM)
■ Regio Shuttle	(ADtranz)
■ Talent	(Bombardier-Eurorail/Talbot)
■ RegioSprinter	(Siemens)
■ Brel Railbus (historic)*	(Leyland)
■ Futuro	(SLM/Sulzer)

Light Rail LRVs Used in Co-mingled (transit and freight) Service

■ Saarbrücken 8 Axle, dual voltage	(Bombardier-Eurorail/Kiepe Elektrik)
■ North Shore "Electroliner" (historic)*	(Pullman)

* denotes not in current production

Note: Not all vehicles discussed in text are illustrated.



1 meter = 3.2808 ft.

DIMENSIONAL CONTRASTS -LOCOMOTIVE, LRV, DMU

JOINT USE OF TRACK RESEARCH
H-2

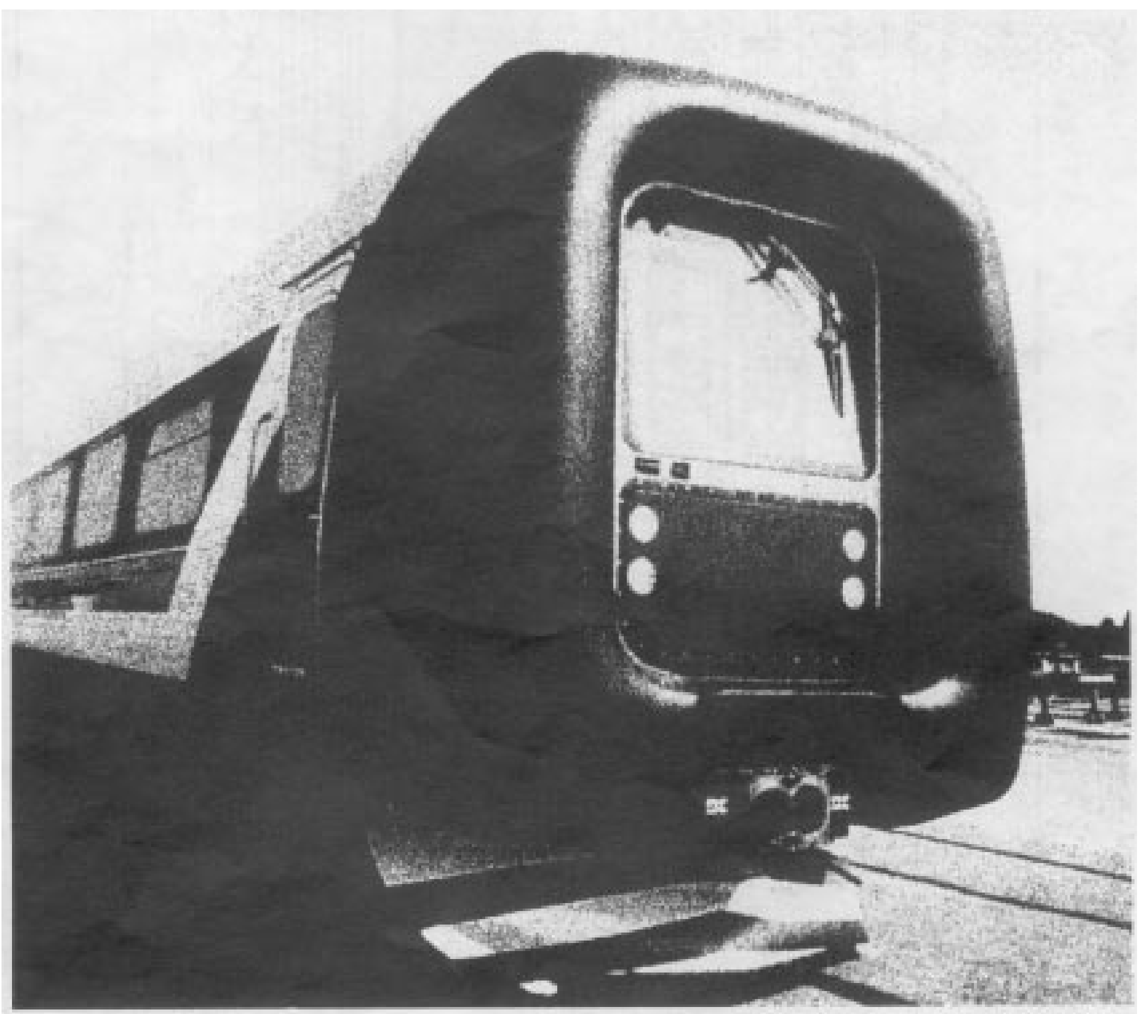
Flexliner Demonstration Train Information

ENVIRONMENT	
Fuel consumption	<2.5 mi/gal.
Closed toilet system	Vacuum
Noise Levels	
Passenger compartment (100 mph)	68 dB(A)
External (0 mph)	77 dB(A)
External (100 mph)	85 dB(A)
Driver's cab (100 mph)	70 dB(A)
Vestibule (100 mph)	77 dB(A)
PASSENGERS	
Entrance doors, per car side	2
Entrance door width	4.4'
Internal automatic doors, type 1	2.8'
Internal automatic doors, type 2	2.3'
Gangway coach to coach	3.0'
Gangway train to train	4.3'
Disabled Passengers	
Wide entrance doors	1
Wheelchair location	1
Air Conditioning	6 systems
Lavatory	2 (One accommodates disabled passengers)
Information system	Dot displays
Entrance displays	4
Passenger area displays	8
Route map	2
Visual information	Dot displays/ Pictogram
Reading Light	1 per seat
Entertainment	
Audio channels	5 channels (3 CD, 2 Radio)
Communication	
Pay Phone	2
110 V AC outlets 50 Hz	1 per 4 seats
Loudspeaker systems	2

TRAIN OPERATION	
Automatic train stop	1
Driver's radio	2
Event recorder	1
Automatic Coupling of Trainsets	
Number of trainsets	Up to 5
Coupling with other Flexliner trainsets	yes*
Redundancy	
Traction	4 engines
EP brake control	2 computers
Control	2 systems
Electric Supply	3 generators
Compressed air	2 systems
Seats	
1st Class seats	32
Coach seats	109
Seat distance	3.4'
Performance	
Acceleration	1.8 mph/sec.
Braking (service)	2.2 mph/sec.
Braking (emergency)	2.8 mph/sec.
Speed (max)	112 mph
Capacity	
Fuel	2 x 300 gal
Water	88 gal
SERVICE/MAINTENANCE	
Service intervals	30,000 miles
Overhaul intervals	750,000 miles
Service/repair	Module exchange
On-board fault logging	2
On-board diagnostic system	2
External connection	
AC power supply	1 x 3 480 V AC, 60 Hz
Compressed air	4
Water	4
Waste dump	4
Fuel	4

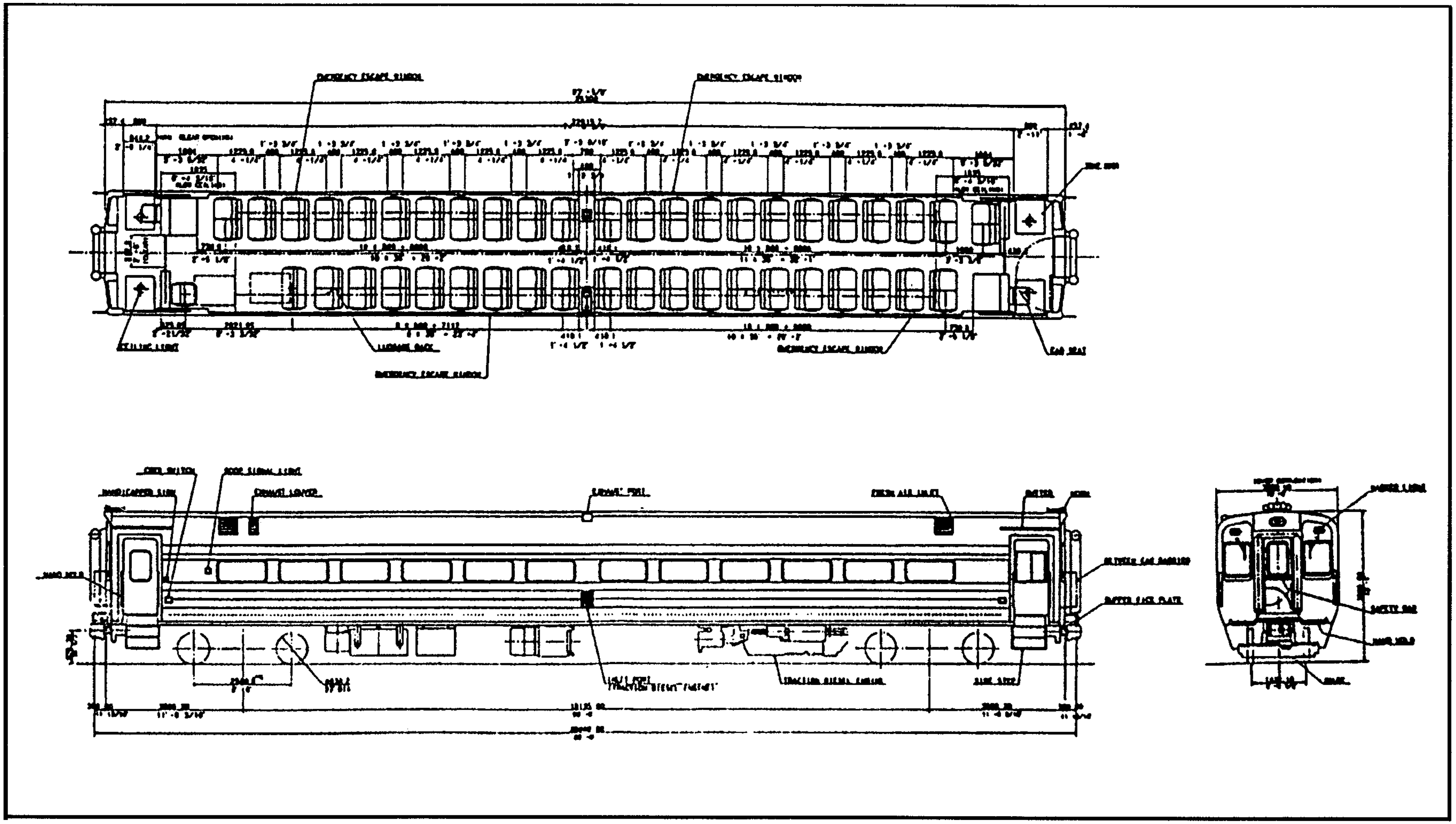
TECHNICAL	
Trainset Data	
Motor coach	2
Middle coach	1
Length	193'
Coach, width	10.2'
Coach, height	12.6'
Weight (tare)	224,000 lbs
Pay load	40,000 lbs
Body shell	Extruded aluminum
Traction	4 axles
Engines	4 x 400 HP air cooled
Tractive start effort	33,000 lbs.
Transmission	Diesel mechanical
Electric Supply	
Generators	3x 380 V AC 50 Hz 150 kW
Battery	24 V DC 300 Ah
Brakes	
Brake Control	2 computers
EP Brake	Electric-pneumatic
IP Brake	Standard air brake
Rail Track brakes	2 at front trucks
Parking brake on gradient	2.6%
Distance (100 mph)	3280'
Emergency (100 mph)	2950'
Slip/Slide protection	yes
Trucks	
Front trucks	2
Articulated trucks	2
Wheel diameter, new wheels	33.5"
Wheel diameter, worn wheels	32"

* DMU & EMU units can be coupled and mixed



(ADtranz)

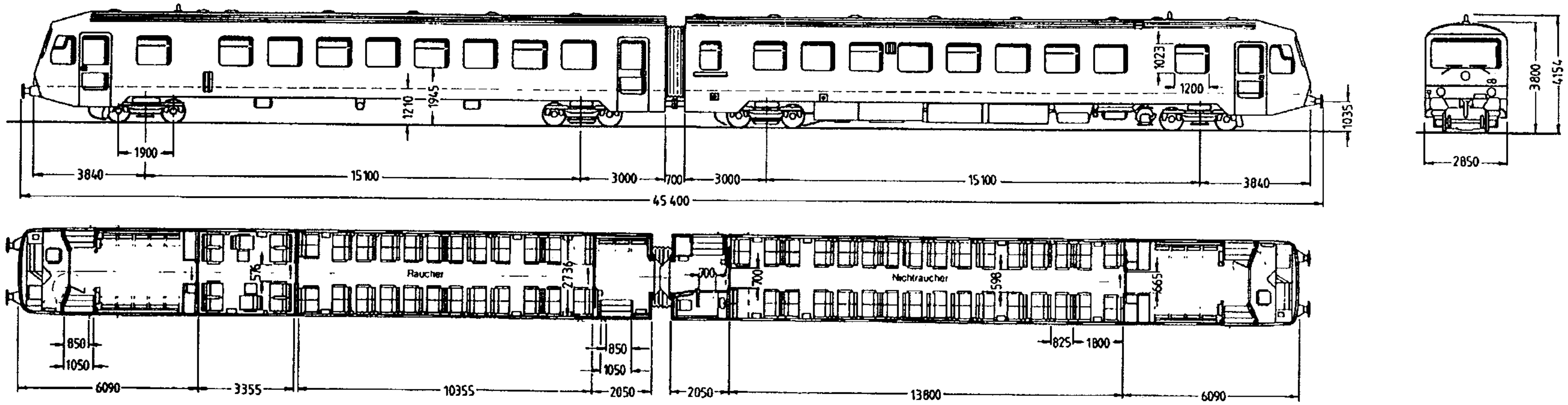
Rail Diesel Car
(Nippon Sharyo)
Category 1 DMU

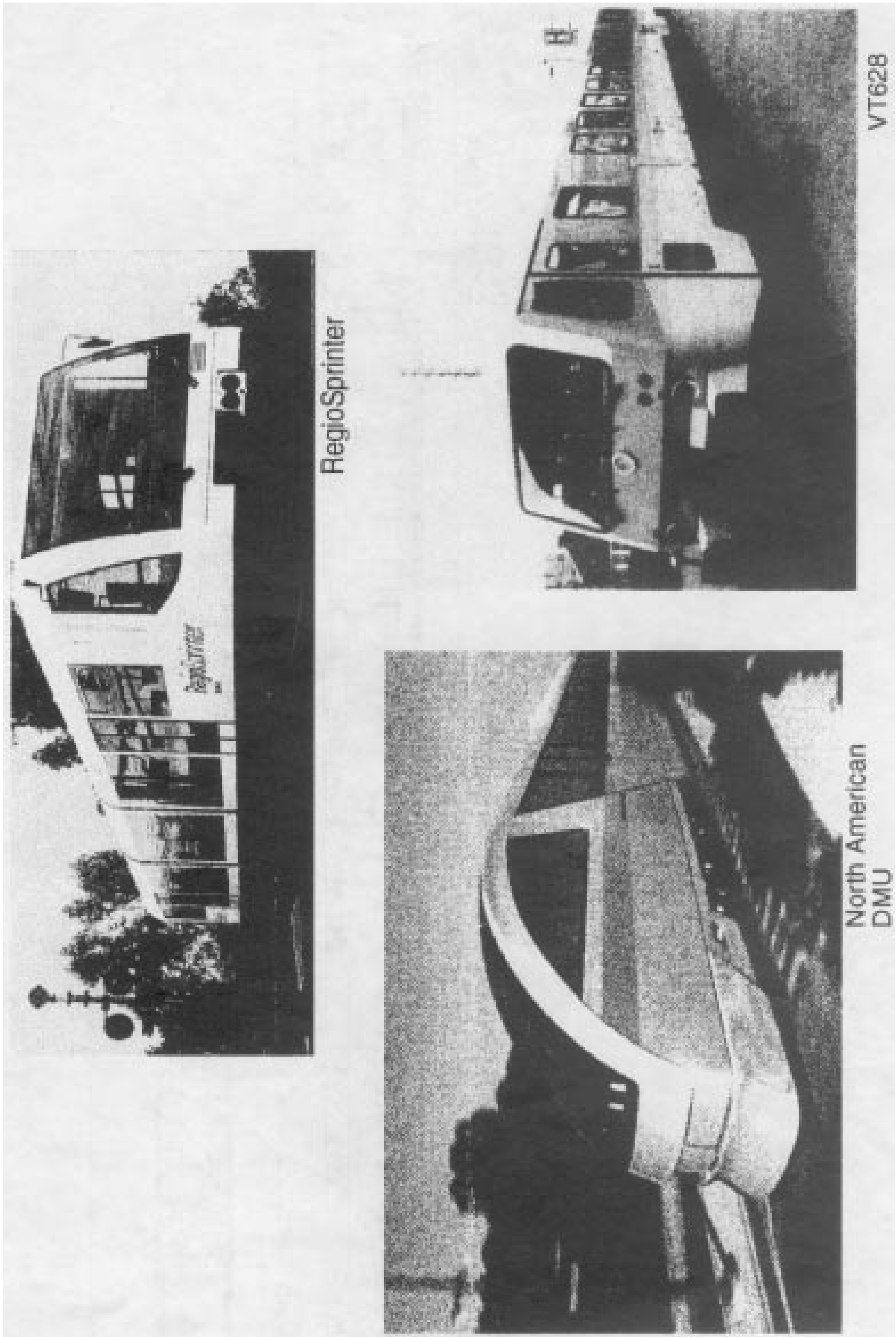


(Courtesy of Siemens)

Type 628.2/928.2

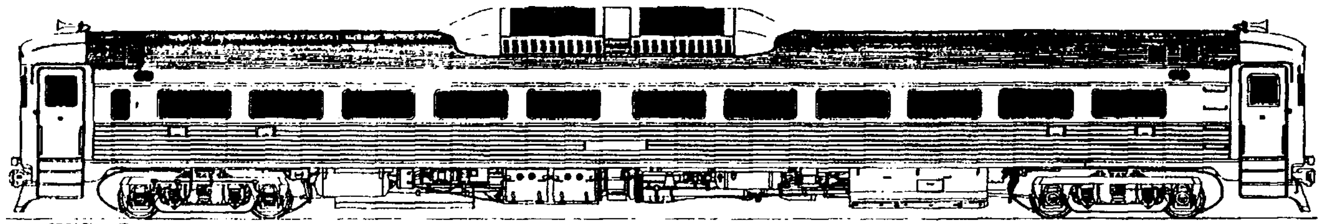
Type VT-628
(Siemens)
Category 1 DMU





(Courtesy of Siemens)

RDC Evolutionary Phases



RDC1 Phase IB

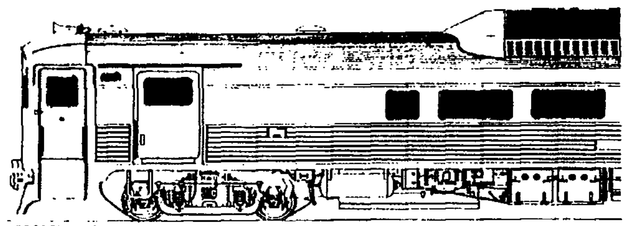
The Carbody:

RDC phase study and drawings
by J.C.Smith, Jr.

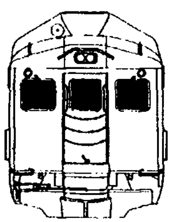
PHASE I
Demonstrator 2960 is sole occupant of class. Unique features are endsheets extended below buffer with recesses for M U. receptacles, windshield wiper mounted on collision post and paired lift-open panes set in four corner picture windows

PHASE IA
Encompassing first ten production cars, group shared several traits with 2960 which later cars did not, including a five-tread stepwell, a ladder hanger/grabiron set near roof radiator housing and a convex circular hatch on center end panels of housing

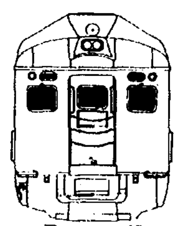
PHASE IB
Stepwells change to four treads, (most, if not all, earlier cars so modified) grabiron ladder, (adjacent to engineer's door at long, or "A" end, of car) replaces ladder hanger, rain gutter added over headlight, circular hatches deleted on radiator housing. Within this phase, engine covers went from two rows of 13 louvre sets, to one row, then to none. (Since engine covers are interchangeable, they are an unreliable spotting feature.)



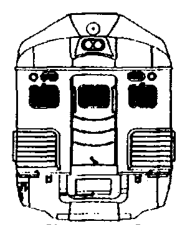
RDC2 Phase IC



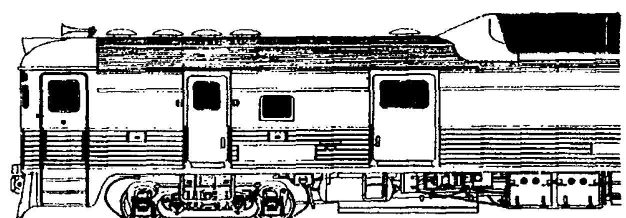
Phase IB & IC



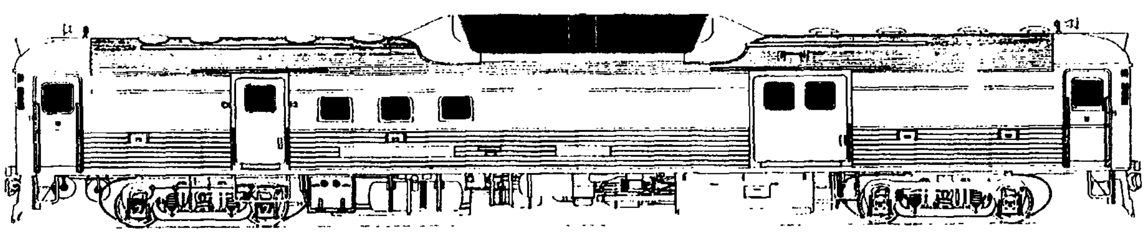
Phase IIA
(Larger windows, RDG only)



Phase II
(Optional wraparound fluting)

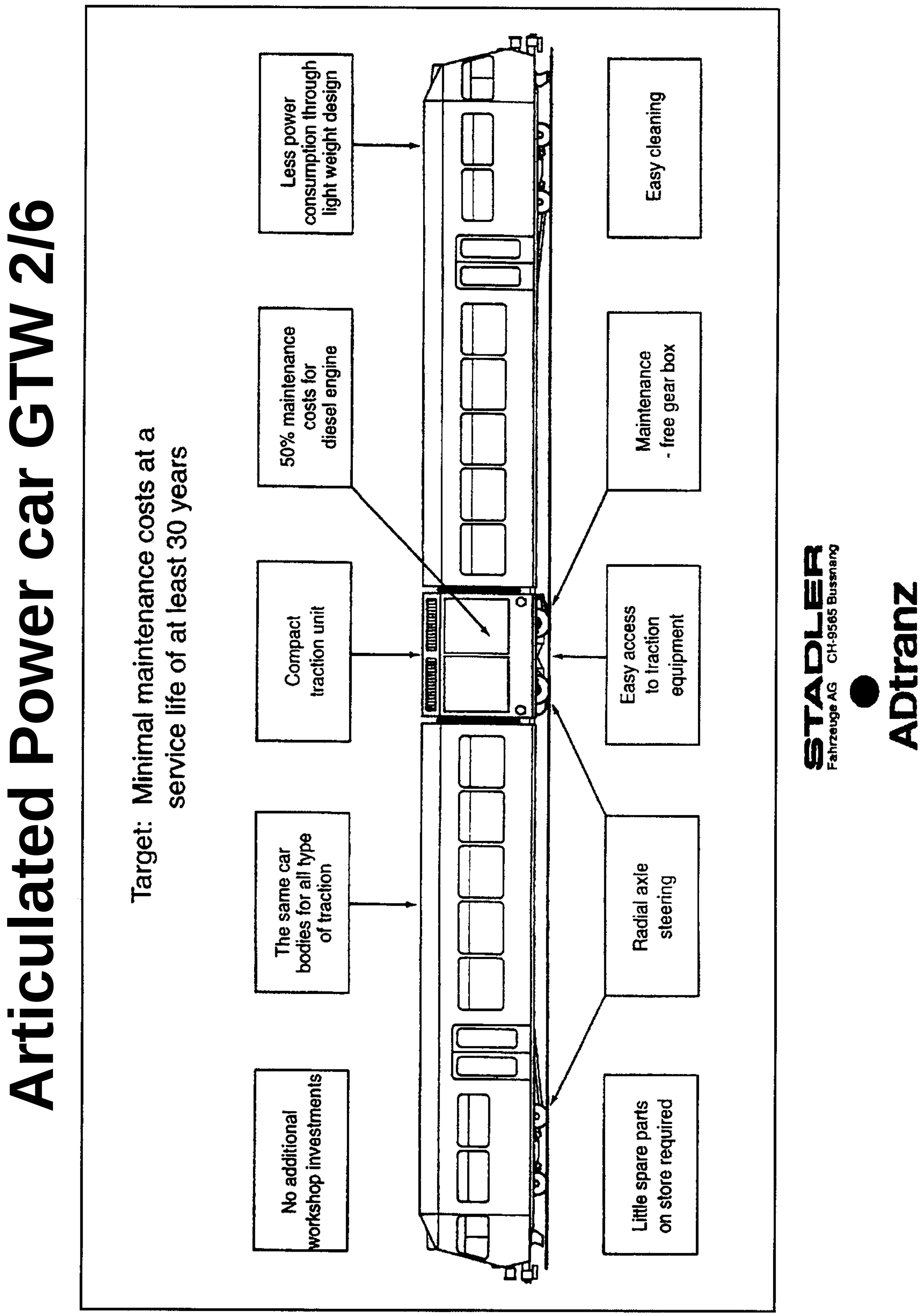


RDC3 Phase II (Optional wraparound fluting)

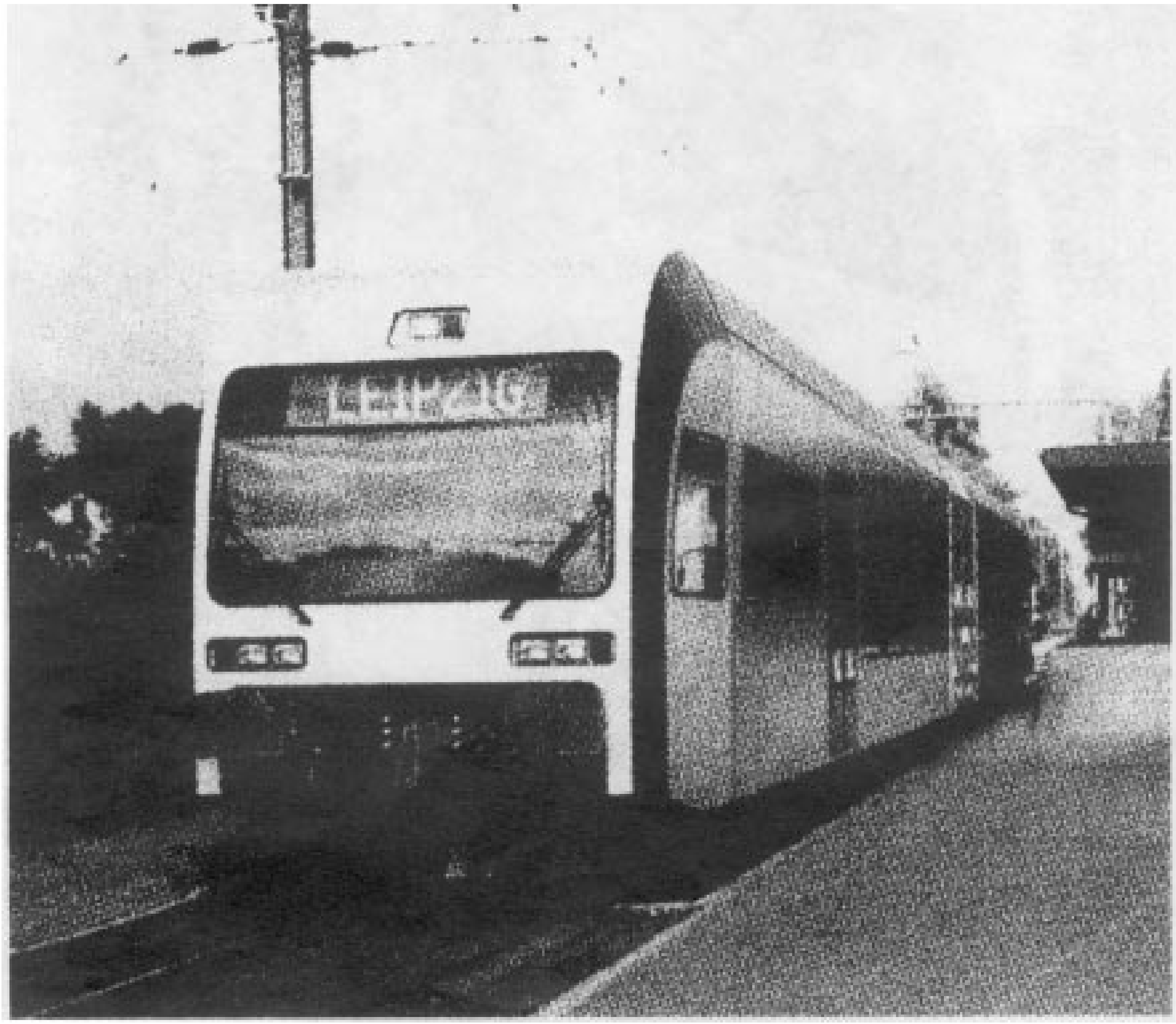


(Budd Car - The RDC Story, C. Crouse)

GTW 2/6
(ADtranz/Stadler/SLM)
Category 2/3 DMU

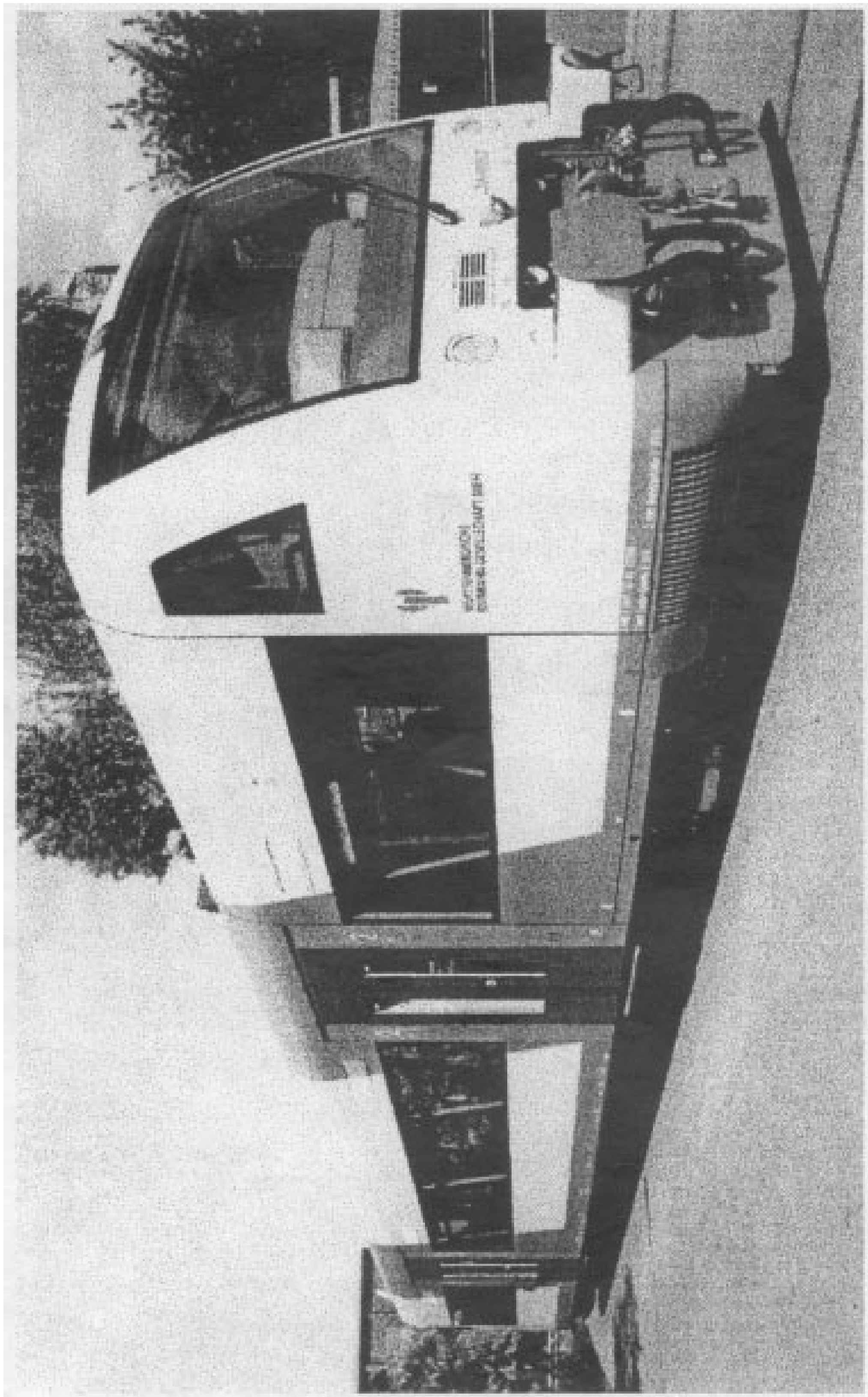


GTW 2/6
(ADtranz/Stadler/SLM)
Category 2/3 DMU

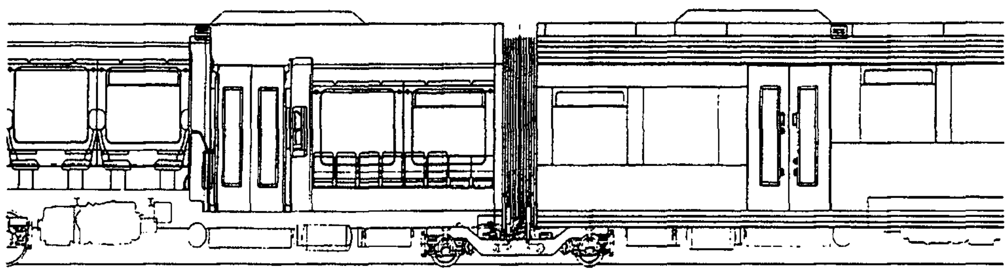


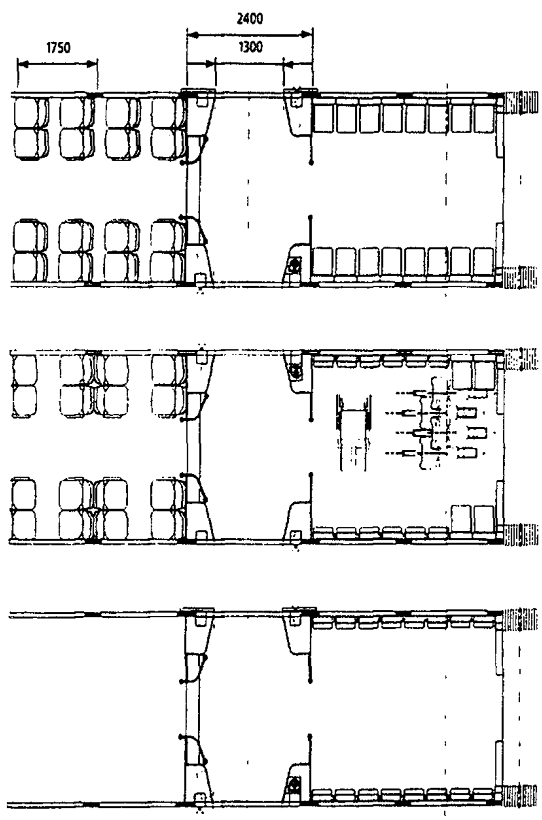
note high/low platform station

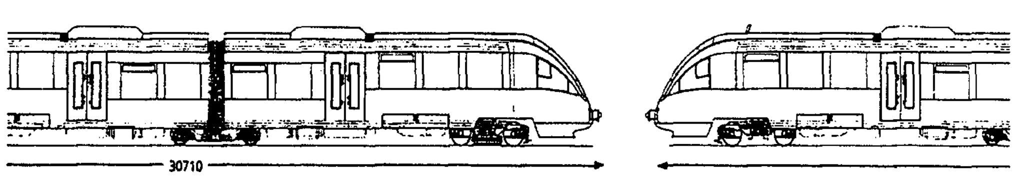
"RegioShuttle"
(ADtranz)
Category 2 DMU



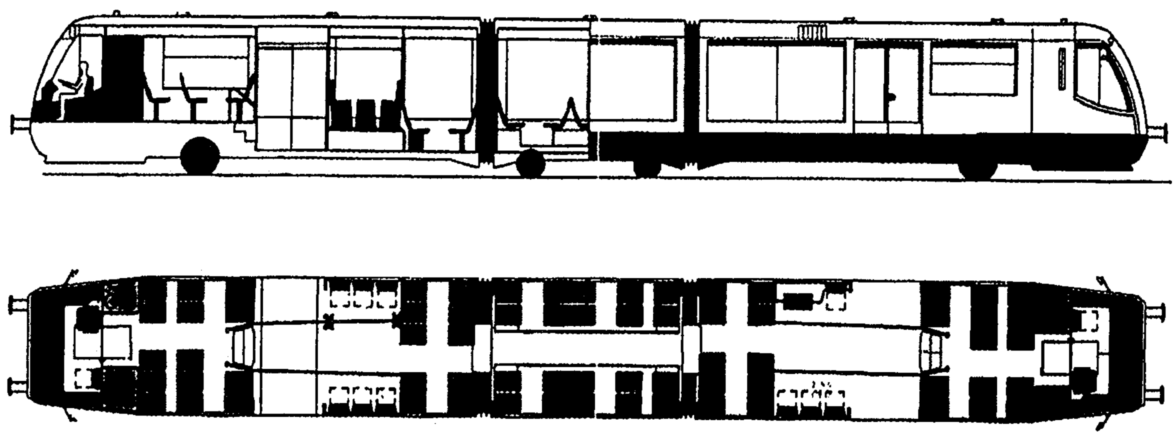
"Talent"
(Bombardier-Eurorail/Talbot)
Category 2/3 DMU





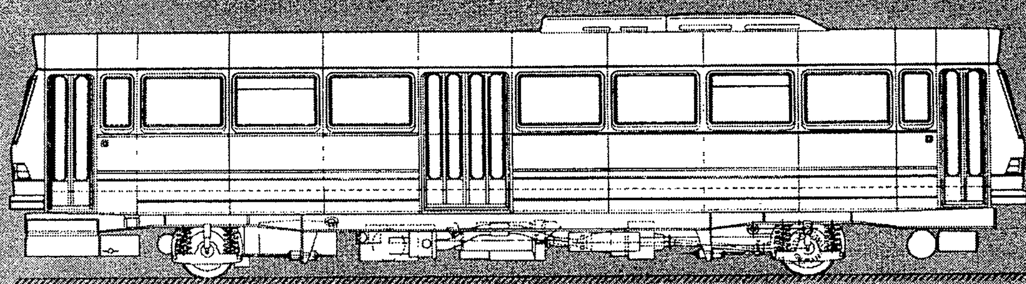


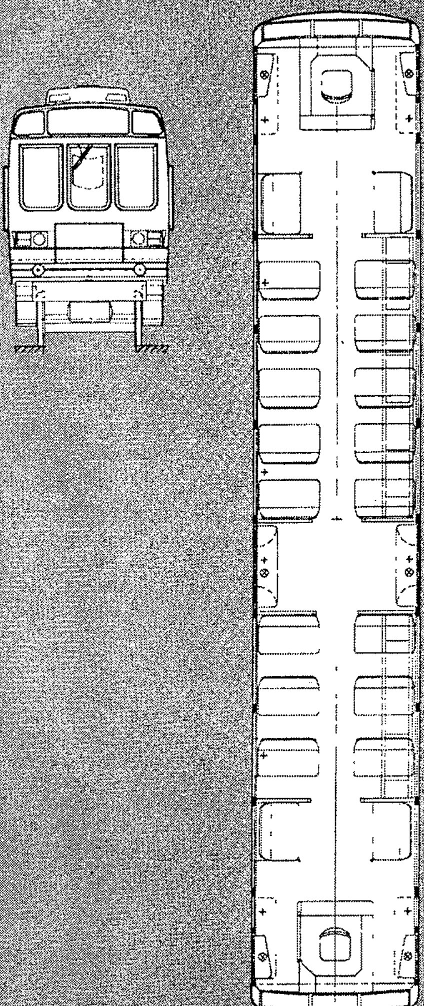
"Regio Sprinter"
(Courtesy of Siemens)
Category 2 DMU



AN INNOVATIVE DIESEL RAILCAR has been developed by Dueweg, Germany, for service on the Dürener District Railway, near Aachen, and the Vogtland region of Saxony on Deutsche Bahn AG (German Rail). The RVT is a lightweight, low-floor vehicle designed for operation on routes about 30 miles in length with relatively short distances between stations. It consists of two 31.6-foot outer sections mounted on single-axle power trucks, and a 13.5-foot central section mounted on two single-axle trailer trucks. About two-thirds of the passenger area is low-floor. The carbody is of lightweight aluminum construction, and features four sets of double doors, all located in the low-floor area. Weight is 33 tons, unloaded. Powered by two underfloor, five-cyclinder, water-cooled, 390-hp diesel engines, the RVT's top speed is 62 mph.

Railbus (bus derivative technology
(British Leyland)
Category 2 DMU





	Single Car Unit
Unit Length (over bodyends):	50'2⅜"
Body width:	8'2½"
Wheelbase:	29'6⅜"
Wheel Diameter (new):	2'7½"
Height over roof above rail level (Tare):	12'1⅜"
Height over Air Conditioning pod above:	13'0"
Floor height (Tare):	4'3⅜"
Nominal coupler height (Tare):	34½"
Minimum Curve (Sidings and Depot):	229'7"
Engine power output (Gross):	210 bhp
Nominal maximum speed:	70 mph
*Operating range up to:	600 miles
*Fuel consumption up to:	7.5 mpg

*Dependent on service route and operating conditions and fuel quality.

Tare weight:	27.8 tons
Estimated Gross Laden weight:	37.3 tons
Transmission:	SCG fully auto gearbox and SCG final drive unit mounted on one axle of Power Car.
Seating Capacity:	40
Nominal standing capacity (7 pass/m):	76
Track gauge:	4'8½"

Saarbrucken Dual Voltage LRV
(Bombardier-Eurorail)
LRV

General data

Track gauge	1.435 m
Length	37.070 m
Width	2.650 m
Height	3.500 m
Floor height	0.400 m/0.595 m/0.800 m
Wheel diameter	0.660 m
Tare	53.8 t
Seated	108
Standees (6 pers./m^2)	198
Total capacity	306
Doors: number per side	4 (double) + 1 (single)
type	sliding plug
width double doors	1.300 m

Performances

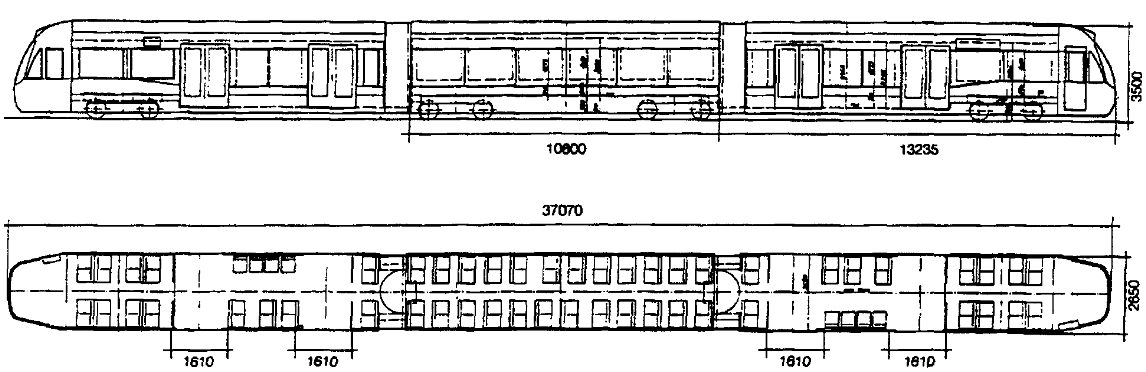
Maximum speed	100 km/h
Acceleration	1.1 m/s^2
Service brake	1.6 m/s^2
Emergency brake	2.8 m/s^2
Minimum curve radius	25 m
Maximum gradient	8%

Traction
Asynchronous
GTO controlled inverter
Duo voltage: 750 Vdc and 15 kVac
Motor power: 8 × 120 kW/80 Hz
Auxiliaries: 24 Vdc

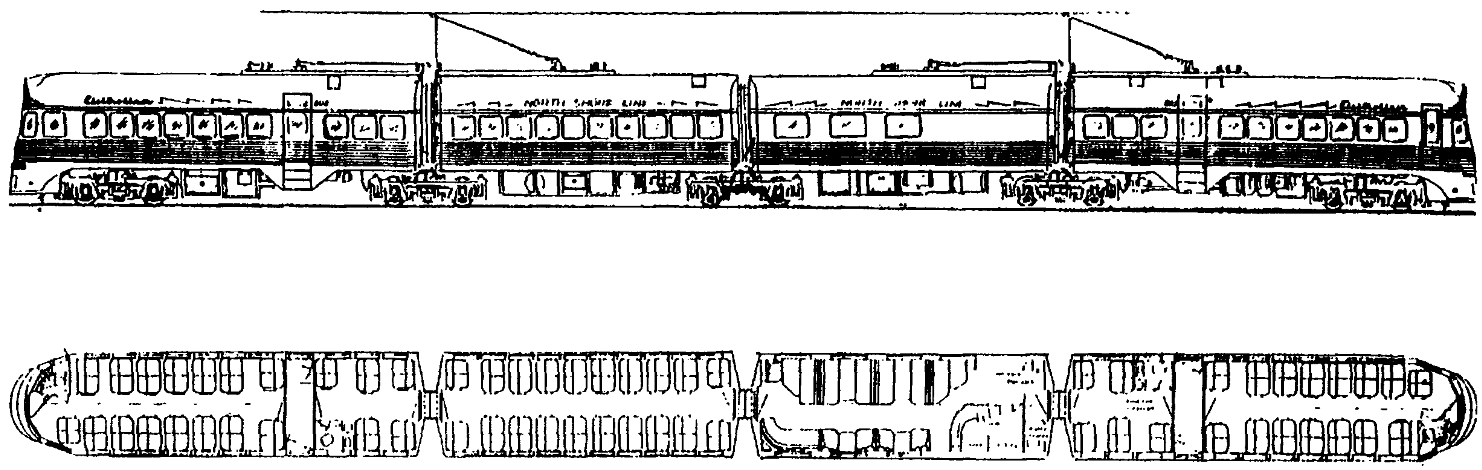
Bogies BM (bi-motor)
- 2 asynchronous motors totally suspended
- Suspension: - primary: rubber/steel
  - secondary: coil spring with hydraulic levelling

Carbody
Modular stainless steel and aluminium construction with customizable panelling.

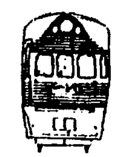
A dual voltage light metro capable of running on tramway networks of 750 Vdc electrical supply and on "heavy" rail 15 kVac suburban systems, the changeover between the electrical supplies being totally unnoticed by both the passenger and the operating staff. This vehicle can be adapted to utilise voltage supplies and signalisation system required by the individual European networks (e.g. SNCF, SNCB, British Rail) or alternatively it can utilise an on-board diesel motor to generate its own traction supply. This new flexible concept realises the valuable infrastructure economy and provides a smooth seamless transition between the town centre and suburban area, independent of different system voltages.
15 vehicles are on order for the Stadtbahn Saar GmbH.



North Shore "Electroliner"
(St. Louis Car Co.)
LRV/Interurban



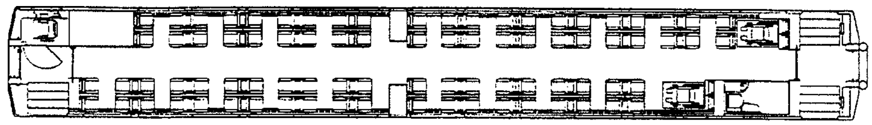
801-804



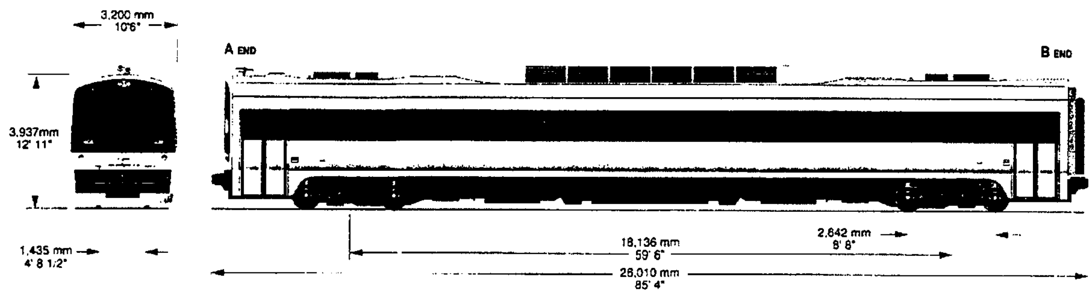
HISTORICAL EXAMPLE OF JOINT USE VEHICLE

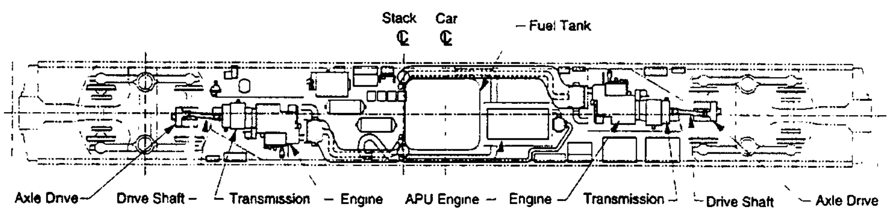
The Chicago North Shore and Milwaukee Railroad, a midwestern interurban, operated high-speed Electroliner, four-unit articulated cars in the 1940s 1950s and early 1960s. These cars operated daily in streets mixed with vehicular and streetcar traffic, on high speed intercity tracks competing with parallel railroads, with interchange freight service, in suburban commuter service and on elevated rapid infrastructure, mixed with subway and elevated trains. Electroliners drew 600 VDC traction power from third rail shoes and overhead trolley. Two trains were built and both are preserved and restored

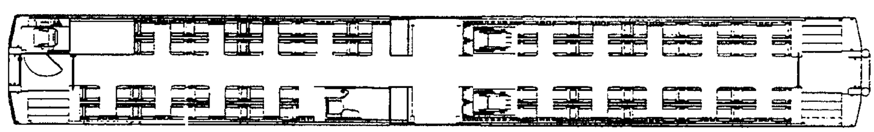
Diesel Multiple Unit
(Bombardier)
Category 1 DMU



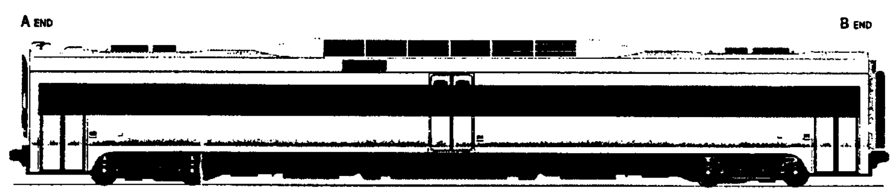
Low Level Boarding - 86 Seated Passengers (92 without toilet)



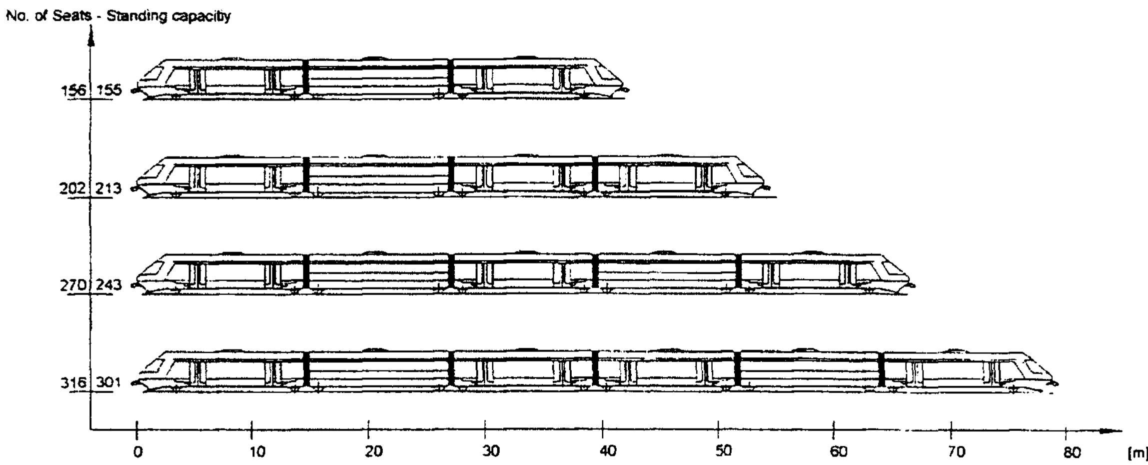


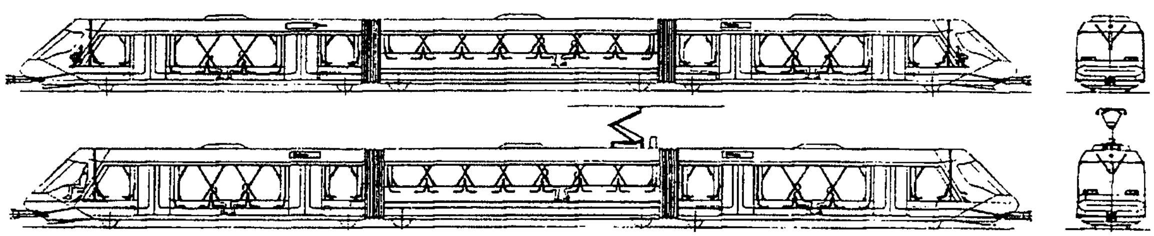


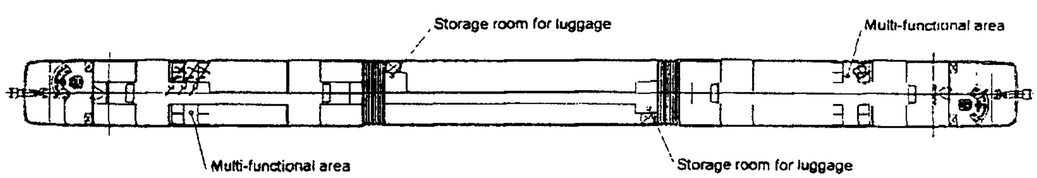
Low/High Level Boarding - 78 Seated Passengers (84 without toilet)



The following illustrations explain the modullarity of the Futuro concept. They show in succession the 3- to 6- car variations as well as the layout drawings of a diesel- and an electrical vertsion of the Futuro.







No. of seats 152 (incl. folding seats)
No of folding seats: 16
Standing capacity: 156 (4 Passengers/m^2)

Subject to change