

# Developing Equipment Standards for the Vintage Trolley Field

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## ABSTRACT

Vintage Trolleys offer a combination of transportation and nostalgia, and have also proven to be a successful economic development sparkplug in many US cities. The year 2005 begins with about 19 active Vintage Trolley operations around the country, and many more in the planning process.

Like contemporary Light Rail vehicles, Vintage Trolleys transport people, operate on rails, and typically utilize electric propulsion, but in most cases the similarities end there. The types of vehicles employed by today's Vintage Trolley operations range from "restored original" equipment dating to the early 1900s to newly built "replica" vintage cars. In addition, the service conditions under which these Vintage Trolley vehicles are operated are often quite different than those found on a typical Light Rail or other rail transit system.

While the rail transit industry has been steadily generating consensus standards covering many technical aspects of its present generation of equipment and infrastructure, these standards do not typically make provision for the unique vehicles found in Vintage Trolley operations. For this reason, the APTA Vintage Trolley and Streetcar Task Force created a unique document to establish appropriate standards for equipping and operating Vintage Trolley vehicles in an urban public transit environment.

This paper presents a summary of the contents of the Vintage Trolley Vehicle Equipment Standard, along with background on the process used to assemble it. A brief survey of Vintage Trolley equipment currently in operation in the US is also presented, further illustrating the diversity of the equipment now in operation and highlighting the importance of the Standard.

## BACKGROUND

The APTA Vintage Trolley & Streetcar Task Force was formed in 2000 with a mission to "promote the development of vintage/heritage trolley lines and modern streetcar lines in urban centers, to foster information exchange among those planning or operating such lines,

and to encourage reasonable technical and safety standards"

The Task Force defines a Vintage Trolley (a.k.a. Heritage Trolley) as: "An electrically propelled rail vehicle for the conveyance of passengers, originally manufactured prior to January 1, 1956, or a new vehicle designed to replicate the appearance and function of such vehicles. Term also used to describe similar rail vehicles which are not electrically propelled, but have the same appearance and function."



*Figure 1. Australian trolleys in operation in Seattle, Washington*

## PART 1- INITIAL RESEARCH

### Equipment and Operating Environments Vary Widely

In its early meetings, the Task Force examined the tremendous variety of equipment and operating environments on the nation's Vintage Trolley systems. It recognized that the systems ranged from full scale transit operations with large fleets of vintage vehicles to small non-profit groups operating only one or two cars on a part time schedule. The vehicles themselves ranged from "restored original" equipment dating to the early 1900s to newly built "replica" vintage cars. It was also noted that

regulatory requirements affecting rail transit operations varied from state to state, and few had any provision for operation of Vintage Trolleys.

The Task Force also identified the need to differentiate between railway museum operations which might also operate similar equipment, and Vintage Trolleys systems operating in an urban public transit environment. Specific text was added to the Standard that excludes railway museums / trolley museums from its scope. Although a museum has the same obligation to conduct safe operations, there are also significant differences in the nature of museum operations verses that of a Vintage Trolley. The requirements of historical accuracy and preservation of original materials are recognized as legitimate museum concerns, and rebuilding or modifying original artifacts for the comparatively heavy service that can be seen on a Vintage Trolley raises issues that fall outside the scope of the Standard.

As a result of these initial fact-finding efforts, the Task Force identified the need for consistent equipment standards among Vintage Trolley operations, and decided to make this one of their first formal work projects.

### **Not Covered by Other Standards Efforts**

A look at other Standards efforts underway around the rail transit industry revealed a great deal of work in progress. While the industry has been steadily generating consensus standards covering many technical aspects of its present generation of equipment, these standards do not typically make provision for the unique vehicles found in Vintage Trolley operations. In contrast the rest of transit field, Vintage Trolley operators are in the unusual position of intentionally seeking something that is not “modern” or “state of the art”. Instead they seek a decidedly “retro” vehicle that is still safe and sustainable.

Certain APTA Rail Transit Standards / Recommended Practices for periodic inspection were considered to be applicable to Vintage Trolleys as well as modern vehicles, and these were incorporated into the Standard by reference.

### **The Need for Safety**

The Task Force recognized that with the growing popularity of Vintage Trolleys, it was incumbent upon this industry segment to maintain an outstanding safety record. A serious accident could have a negative impact on all Vintage Trolley operations, either in terms of public perception, insurance rates or burdensome regulatory “reaction”. While the Task Force knew instinctively that “old” does not necessarily equate to “unsafe”, it also understood that a 20-ton Vintage Trolley rolling down the tracks has the potential to do as much damage to itself or something it collides with as any of its modern counterparts.

### **Simplicity and Sustainability**

One of the virtues of Vintage Trolleys is their simplicity, and attendant lower costs. While acknowledging the virtue of simplicity, it was also recognized that the technology must also be sustainable. *Simple* is not automatically better; an understanding of the technology is required to make good decisions. The Standard was seen as a way to help potential equipment buyers prioritize their needs. Which safety features are most important? What are the trade-offs involved in implementing vintage versus modern components? Where will upgrades to modern equipment provide the most return on investment, and in what areas might upgrades actually detract from the goal of a sustainable Vintage Trolley? The Standard presents an important resource for understanding and maintaining the older technology typically found in Vintage Trolleys.

### **Not Reinventing the Wheel**

Although trolleys once blanketed cities and towns across the country, most vanished decades ago, and with them the once widespread knowledge of their mechanical and electrical workings. In its day, extensive industry effort was devoted to the perfection of the technology that made the trolley a viable transportation vehicle, but with the end of the trolley era, much first-hand knowledge was lost.

The knowledge and documentation necessary to operate and maintain these older vehicles has, however, been preserved by railway museums, consultants, operators and even by enthusiast collectors. The Standard seeks to compile a large collection of information from the bygone trolley era and translate it into today’s terms, helping users avoid the need to “reinvent the wheel”.

## **PART II- THE STANDARD**

### **Building on Precedent**

The Vintage Trolley Vehicle Equipment Standard began with an adaptation of the Historical Streetcar section of California Public Utilities Commission (CPUC) General Order (GO)143B. When GO 143 was first revised in the early 1980s, the CPUC incorporated content covering “Historical Streetcars” to accommodate operation of historic equipment in San Francisco and San Jose. Building on this precedent, the Task Force began crafting a document to provide a comprehensive set of equipment standards for Vintage Trolleys.

GO 143B defined a Vintage Trolley as “an LRV or streetcar originally manufactured prior to January 1, 1956, which may not meet all the requirements set forth in this General Order for LRVs”.

The CPUC clarified that certain parts of the General Order applied to historic and modern cars alike, including:

- Operating Speeds
- Requirements of Safety Sensitive Employees
- Operating Rules
- Inspections, Tests and Maintenance
- Audible Warning Devices
- Grab Handles
- Safety Bars (pilots/fenders)
- Warning Devices for Stopped Vehicles
- Parking Brakes
- Interior Lighting
- Emergency Exits

Most significantly, the CPUC recognized the inherent differences between Light Rail and Vintage Trolley, and exempted “Historical Streetcars” from many of the requirements applicable to LRVs, creating instead separate standards for vintage cars covering:

- Service Braking System
- Stopping Distance (< 120 feet from 20 mph)
- Headlights
- Taillights
- Windshields and Windows
- Safe Operating Speeds
- Operating Rules

#### **Elements of the Standard**

Early in its development, the Standard quickly evolved into three primary components, grouped together in accordance with where each of the elements would typically be documented by the operating entity.

- Programs and procedures applicable to all vintage trolley operations (documented in the SSPP)

- Minimum vehicle equipment requirements (documented in the Vehicle Safety Certification Process)
- Additional equipment, applicable where conditions warrant (documented in the Vehicle Safety Certification Process)

#### ***Programs and Procedures Applicable to all Vintage Trolley Operations***

This first section establishes the core components of the system that will be necessary to support the safe operation of Vintage Trolleys, namely:

- Operating Rules
- Program of Instruction
- Maintenance Procedures and Instruction
- Maintenance Facility

These programs and procedures follow the concepts laid out in GO 143B. The Standard specifies that they are to be documented in the system’s System Safety Program Plan (SSPP). Although inclusion of these criteria in an equipment standard might seem a little out of place, the Task Force felt that this would place the appropriate emphasis on the critical importance of operating rules and training as part of overall vehicle safety, particularly where the vehicles can be so different from present day transit equipment.

#### ***Minimum Vehicle Equipment Standards***

The Standard addresses numerous specific equipment requirements for Vintage Trolleys:

- Service Braking System \*
- Redundant Braking
- Parking Brakes \*
- Air Gauge & Low-Air Alarm
- Stopping Distance \*
- Sanders
- Electrical Systems
- Wheel-to-Rail Interface
- Tamper Resistant Controls
- Emergency Exits \*

- Door Interlocks
- On Board Safety Equipment
- Audible Warning Devices \*
- Interior Lighting \*
- Headlights \*
- Taillights \*
- Battery Backup / Emergency Lighting
- Grab Handles \*
- Pilot or Fender \*
- Windshields and Windows \*
- Mirrors

\* designates items required by the Historical Streetcar section of GO 143B

This section forms the heart of the document, addressing a comprehensive range of basic equipment needs. It also provides numerous advisory footnotes to address common situations involved with Vintage Trolley equipment selection. A lengthy dialogue was held on these topics with operators of existing systems, agencies constructing and planning such systems, vehicle manufacturers and equipment suppliers. The Task Force spent significant time evaluating and discussing different viewpoints on each of the equipment recommendations.

As might be expected given the diversity of the different operations, not all of the Vintage Trolleys in operation today presently have each and every item listed above. In some cases, operators may need to consider retrofitting additional equipment to update their vehicles. As with all APTA Rail Transit Safety Standards, the operating entity is also given the option of designating alternate methods of achieving an equivalent level of safety through their SSPP.

One of the biggest challenges was attempting to prepare a Standard that would be applicable to such a wide variety of equipment and operations. A case in point was door interlocks; not all Vintage Trolleys even have doors in their doorways! In areas such as these, an explanation is provided of the concepts involved, followed by specific language advising the operating entity to utilize a hazard analysis process to determine equipment requirements for their specific operation.

In the case of requirements for basic equipment like headlights and audible warnings, several Task Force members pointed out that they were required to conform with locally specific regulations. In these areas, the

Standard provides simple language clarifying the requirement that all Vintage Trolleys include these basic safety devices, but notes that the performance requirements are subject to local jurisdiction. Examples include the decibel level of audible warnings and the intensity of lighting. In the case of stopping distance, the CPUC standard of 120 feet from 20 mph was included for application “in the absence of superseding local requirements”, thus adopting an established baseline for this critical performance measurement.

As noted earlier, it was found that modern rail transit standards were not generally being written to cover vintage vehicles. A good example is NFPA 130 (Standard for Fixed Guideway Transit and Passenger Rail Systems). Although Vintage Trolleys clearly fell outside the scope of this standard in terms of their basic construction, NFPA 130 does definitively cover some of the basics of electrical equipment safety on transit vehicles. This language was thus utilized as the basis for the Electrical Systems section of the Vintage Trolley Standard. Additional data was added where necessary to common practices on Vintage Trolleys including high-voltage lighting, arrangement of propulsion controls, and the necessity for crew training in the importance of removing the trolley pole or pantograph from the wire in the event of overheated equipment or fire.

The Task Force also reviewed other APTA Rail Transit Safety Standards and Recommended Practices, and in several cases, particularly inspection procedures, found that existing documents were as applicable to vintage vehicles as to modern ones. These documents were incorporated by Reference into the Standard, with an understanding that portions covering equipment not used on vintage vehicles are simply “not applicable”. The Standard also adopts the approach used in other Rail Transit Safety Standards documents of specifying that where conflicts may arise, the Standard takes precedence over referenced documents.

#### ***Additional Equipment, Applicable Where Conditions Warrant***

Five equipment options were placed in the “Applicable Where Conditions Warrant” category. Users are presented with guidance on using the hazard analysis process to determine the requirement for:

- Deadman
- Low Air Interlock
- Speedometer
- Turn & Stop Indicators
- Windshield Wiper / Defrosters

This section of the Standard also calls out the requirement for all new “replica” trolleys to be built with a deadman system and, where airbrakes are used, a low-air interlock. While it was recognized that certain restored original cars might not be practical to retrofit with a deadman system, it was strongly felt that the construction of new cars would present an opportunity to design in the appropriate technology.

In summary, Sections Two and Three form a critical checklist for operating entities in the process of specifying equipment for new “replica” vehicles or for restoration projects.

### Appendices

The process of refining the specifics of the equipment issues also led to long discussions on some very “big picture” issues that affect all rail transit operations, namely:

- Vehicle Structural Requirements
- Fire Safety
- ADA Issues

In these cases, the Task Force concluded that the diversity of the equipment covered by the Standard precluded offering universal standards. However, it was decided that these important issues should still be raised in the document. Therefore, in lieu of universal standards, guidance is offered on overall strategy for approaching these important issues.

## PART III- A BRIEF SURVEY OF VINTAGE TROLLEY EQUIPMENT IN USE IN 2005

### Restored Original Cars

There are approximately 130 restored original Vintage Trolleys in operation in 2005 on 19 Vintage Trolley systems. While a large number of similar vehicles also exist in railway and trolley museums, as noted earlier, these are considered to be outside the scope of this standards development effort.

#### *American Cars (pre-1940)*

There are approximately 50 pre-1940 restored original cars from American cities- 35 of which are in New Orleans. Only the Crescent City kept a large fleet of “classic” (pre-PCC) trolleys, and these 35 cars continue rolling along on the St. Charles Line with a bright future ahead. Other than the New Orleans fleet, the pool of original equipment surviving intact from America's trolley era is relatively small, and any that remain “in the wild” are without running gear and other vital operational

components. Most of the cars that survived in complete form are preserved by railway and trolley museums around the country. Depending on the trolley’s condition, museums may be unwilling to expose these rare pieces to the potentially consumptive use of daily service on a busy transit operation.



Figure 2. Restored PCC-type car, San Francisco

#### *American Cars (PCC-Type)*

There are approximately 40 PCC-type cars in service in 2005, as well as a large number of unrestored cars which may ultimately be rebuilt for service. This long-lived American design has been in continuous operation in US cities in one form or another for almost seventy years. PCC’s have been restored, rebuilt, and in some cases turned into almost new cars complete with modern technology. The car’s streamlined appearance may not be what everyone desires in terms of a vintage appearance, but it is an extraordinarily well designed vehicle and its numbers speak to its positive qualities.



Figure 3. One of 11 trolleys imported to San Francisco from Milan



### Imported Cars

As an alternative to domestic vehicles, some systems have acquired trolleys from overseas. Approximately 40 such cars are in service in 2005 on US Vintage Trolley systems. The largest sources of overseas trolleys have been Melbourne, Australia (17 cars in service), Oporto, Portugal (7 cars), and Milan, Italy (12 cars). Exports from Melbourne were put on indefinite hold in the late 1980's, and it does not appear that many additional Portuguese cars will become available. Trolleys are still available from Milan, although the fact that they are single-ended limits their utility.



*Figure 4. The first replica Vintage Trolleys- Two open cars built in 1984 for the Lowell State Historic Park, Lowell, Massachusetts..*

### Replica Cars

One of the most exciting aspects of today's Vintage Trolley systems are the new cars being built as "replicas" of vintage designs. 62 cars have been built between 1984 and 2005. Building on the traditions of America's streetcar shops of the past, these new vehicles strive to incorporate the classic looks of vintage streetcar designs, with the reliability and durability of a new vehicle. Although not all Vintage Trolley systems have the need, or the funding, to acquire new vehicles, a strong market has nonetheless developed. While they demand a higher price tag than restored original cars (beginning around \$700,000 for a double-truck replica car), new vehicles also come with the advantage of lower maintenance costs, higher reliability, a more predictable price and delivery schedule, as well as the ability to incorporate modern features such as air conditioning and ADA accommodations.

It should also be noted that about half of the replica cars built to date have used some percentage of refurbished vintage components, typically trucks, motors, controllers, and some air brake system components. The extent to which refurbished components are used depends

on the requirements of the individual customer, and the types of parts the car builder has access to. A number of cars have utilized parts from retired Melbourne trolleys, although the export ban effectively cut off this source. Milan has also proven to be an excellent resource, and a great many parts have been obtained there. PCC-type rapid transit running gear was also used for a quartet of cars built for Portland, which also provided a means to meet the customer's requirements for a higher-performance trolley capable of keeping up a schedule in a corridor with light rail service.

New Orleans is notable as being an exception to the use of refurbished parts, opting instead to purchase everything new for its 23 Canal St. replica trolleys in 2001, including the trucks and motors. The New Orleans cars use modern PCC-derivative running gear and chopper control.

While refurbishing vintage components can help keep vehicle costs down, there are practical limits to its application. Vehicle size and weight presents a limit to the utility of the Melbourne and Milan running gear, and rebuilding old equipment always has the potential for unwelcome surprises. As noted above, the requirements of an individual order will determine their suitability for a particular application. As an alternative to refurbishing vintage parts, or using ultra-modern equipment, three cars built in 2002 for Los Angeles utilized a magnetic contactor control system built to one of the "classic" designs of the past, but with new, off-the-shelf parts. There has also been much discussion within the industry about new production of "classic" running gear, but to date no such project has been undertaken.

Tables 1 and 2 detail all of the restored original and replica trolleys in operation in American cities in 2005.



*Figure 5. Replica car in Little Rock, Arkansas*

## PART IV- CONCLUSION

The Vintage Trolley field continues to grow along with other forms of rail transit. Looking at the numbers of

Vintage Trolley cars in service over the past twenty-five years:

- **1980-** 44 cars (35 in New Orleans, 9 in Detroit)
- **1990-** 71 cars
- **2000-** 143 cars
- **2005-** 192 cars

Recognizing this continuing pattern of growth, the Vintage Trolley Vehicle Equipment Standard was created to fill a unique void in the rail transit industry's standards development effort. Its goals are multi-fold:

- Address the Unique Needs of Vintage Trolleys
- Promote Safety
- Ensure Sustainability
- Avoid Reinventing the Wheel

As with any Standards effort, the content reflects a consensus built amongst a wide range of stakeholders. It was realized that sufficient differences existed between Vintage Trolleys and modern rail transit equipment that attempting to only apply existing standards would not be practical, and that any new standard would need to avoid a "one size fits all" approach. The ultimate result is necessarily a compromise of multiple viewpoints, but the Task Force feels strongly that it is based on input from the best practitioners in the industry and will provide an overall benefit to Vintage Trolley operators everywhere.



***Figure 6. Port of Los Angeles replica car in San Pedro, California***



***Figure 7. Prototype of the New Orleans Canal St. replica cars***

Table 1.

## Restored Original Vintage Trolleys in Service as of 2005

City	#	Description	Year Built	Date in service	config	City	#	Description	Year Built	Date in service	config
<b>American Cars (pre-1940)</b>						<b>American Cars (PCC-Type)</b>					
New Orleans	35	St Charles Line	1923	1923	DE DT	San Francisco	3	PCC- double ended	1948	1995	DE DT
San Francisco	1	Muni 1	1912	1981	DE DT	San Francisco	14	PCC	1946	1995	SE DT
San Francisco	1	Muni 130	1914	1981	DE DT	Kenosha	5	PCC	1951	2000	SE DT
Ft Collins	1	Ft Collins Birney 21	1919	1985	DE ST	Philadelphia	18	PCC II	1947	2005	SE DT
Willamette	1	Portland Traction 813	1932	1987	DE DT		<b>40</b>				
San Jose	1	San Jose 1	1903	1988	DE DT	<b>Imported Cars</b>					
San Jose	1	San Jose 73	1912	1988	DE DT	San Francisco	1	Blackpool Boat 228	1934	1981	DE DT
Dallas	1	Dallas 186	1913	1989	DE DT	Seattle	3	Melbourne W2	1924-30	1982	DE DT
Dallas	1	Dallas Birney 636	1920	1989	DE ST	San Francisco	1	Milan Peter Witt	1928	1984	SE DT
Charlotte	1	Charlotte 85	1927	1996	DE DT	Dallas	1	Melbourne 369	1925	1989	DE DT
San Francisco	1	New Orleans 952	1924	1998	DE DT	Dallas	1	Oporto 122	1909	1989	DE ST
Sacramento	1	PG&E 35	1914	1999	DE DT	San Jose	1	Melbourne W2 531	1928	1990	DE DT
Astoria	1	San Antonio 300	1913	1999	DE DT	Seattle	2	Melbourne W2	1924-30	1990	DE DT
San Pedro	1	Pacific Electric 1058	1907	2003	DE DT	San Jose	1	Milan 2001	1928	1992	DE DT
Tampa	1	Tampa Birney 163	1923	2004	DE ST	Memphis	6	Oporto	1927-40	1993	DE ST
Dallas	1	143 (modified PCC)	1945	2004	DE DT	Tucson	1	Kyoto 869	1953	1993	DE DT
<b>50</b>						Memphis	1	Rio De Janiero	1907	1994	DE DT
Configuration Key						Memphis	7	Melbourne W2	1924-30	1997	DE DT
DE = Double Ended						San Francisco	10	Milan Peter Witt	1928	1998	SE DT
SE = Single Ended						Tucson	1	Belgium 1511	1936	2002	DE DT
DT = Double Truck						Memphis	3	Melbourne W2	1924-30	2004	DE DT
ST = Single Truck						<b>40</b>					



Table 2.

**Replica Vintage Trolleys in Service as of 2005**

<b>City</b>	<b>#</b>	<b>Description</b>	<b>Year Built</b>	<b>Date in service</b>	<b>config</b>
Lowell	2	Lowell 1601-1602	1984	1984	DE DT
Tampa	1	1976	1986	1986	DE DT
Lowell	1	Lowell 4131	1987	1987	DE DT
Galveston	4	Island Transit 500-503	1987	1987	DE DT
Denver	1	1977	1988	1988	DE DT
Portland	4	Portland 511-514	1991	1991	DE DT
Memphis	1	MATA 1979	1993	1993	DE ST
New Orleans	6	Riverfront	1997	1997	DE DT
New Orleans	1	Riverfront	1999	1999	DE DT
Tampa	8	TECO 428-435	2000	2000	DE DT
San Pedro	2	PE 500-501	2001	2003	DE DT
Little Rock	3	River Rail 408-410	2001	2004	DE DT
New Orleans	23	Canal St. Cars	2002	2004	DE DT
Memphis	1	MATA 453	2002	2002	DE DT
Tampa	1	TECO 436	2004	2005	DE DT
Charlotte	3	CT 91-93	2003	2004	DE DT
<b>Total</b>	<b>62</b>				