MELBOURNE AND METROPOLITAN TRAMWAYS BOARD.

CLASS W.7. TRAMCARS.

The last additions to the Board's fleet of tramcars, known as the W.7. class, have several improvements over previous types, particularly as regards ventilation, seating and noise reduction. Designed and built at the Board's Workshops situated at Miller Street, Preston, Victoria, these tramcars were required when the Bourke Street - Northcote and Bourke Street - East Brunswick routes were converted for electric traction.

In all, forty (40) W.7. class tramcars were built. Numbered serially from 1001 to 1040, inclusive, they were put into service between March, 1955 and August, 1956. Figure 1 in the accompanying photograph shows a typical class W.7. tramcar.

In external appearance, the class W.7. tramcar is not easily distinguished from its predecessors, the class S.W.6. (tramcars numbered 850 to 969 inclusive) and the class W.6. (tramcars numbered 970 to 1000 inclusive, except No.980, the Board's only P.C.C. type tramcar). The superior comfort of the W.7. is, however, quite obvious to the passenger. The ventilation is better, smoking compartment seats are upholstered and the tramcar is much quieter in operation. Noise reducing features are resilient wheels, double helical gears, carbon insert trolley shoes and body insulation.

General Design:

The W.7. tramcar has a double ended, drop centre body mounted on two equal wheeled bogies or trucks. Built to the same general design of the S.W.6 class, with straight and simple lines, the body consists of two saloons separated from a centre smoking compartment by loading platforms with two doorways in each side at the platforms. There is an enclosed motorman's compartment at each end. Seating is provided for 48 passengers, 18 in each saloon and 12 in the smoking compartment. The normal "crush" load is 150 passengers.

Body Construction:

The all steel framework of the body is fabricated in sections to simplify construction and to permit quick replacement of portions which may be damaged in collisions. The light but strong sections are assembled and riveted and/or welded together to form a complete unit integral with the underframe. Commercial rolled steel sections are used throughout. Saloon side frames are sheathed with 14 gauge mild steel stress panels below the waist rail and 14 gauge pier panels above. Smoking compartment side frames are sheathed with 16 gauge mild steel stress panels. The main drop centre girders have webs of 12 gauge mild steel. Roof carlines and centre bulkhead pieces are pressed from tee sections; bulkhead carlines are pressed from angles.

The roof consists of 2-$\frac{1}{2}$" x $\frac{3}{8}$" oregon boards covered with cotton duck and supported on hardwood roofsticks furred to steel carlines. The ceiling is $\frac{1}{8}$" tempered "Masonite" glued to wooden frames and mounted in three long sections with a clean, smooth appearance, all screws being hidden. T and G hardwood 6" x $\frac{7}{8}$" forms the flooring. Tasmanian mountain ash is used for the end bulkheads and the flush panelled escape doors.

Bulkheads:

To protect passengers in the saloons and smoking compartments and to provide for the breaks in floor level at saloon entrances, bulkheads are constructed on both sides of the doorways. These bulkheads have steel panels from floor to about waist level. Stanchions extending to the ceiling and braced to the sides at cant rail level, are sheathed with "Doverite" over the "grab" length. The saloon bulkheads have safety glass panels between the main glass lines.

Windows:

All side windows are metal framed. Saloon windows and smoking compartment centre windows are half-drop type with hopper type standee windows above. Louvre sun blinds, sliding in extruded brass channels fixed to the pillars, are fitted to the saloon windows.

Doors:

Sliding doors designed to counter the capricious changes of the Melbourne climate are fitted to the 3'5" wide entrances at the loading platforms. Built from Tasmanian mountain ash and glazed with 3/16" safety glass, the doors have their leading edges "softened" with sponge rubber as a safety measure. Each door runs on two sheaves with ball bearing races fitted at the top edge on a loose round track rod supported in a mild steel trough. Gun-metal guides run between step treads to keep the bottom of the door in position; guide rollers are attached to the lower trailing edge of the door and to a pillar at waist level.

The doors are driven by compressed air engines operated by means of valves in the motorman's compartments in conjunction with conductor's valves located in the advertisement panel on each side of the smoking compartment. The doors on the near side only are operated by the motorman; the off side doors are opened or closed by the conductor. The long stroke, differential piston type door engines are fixed to the cant rails behind the advertisement panels. They have been designed for quick opening and closing, with a cushioning action towards the finish to each stroke, and operate at the normal air brake pressure of 60 to 70 lbs. per sq. inch. In operation, constant air pressure is applied to the front end of the door engine cylinder. To open and close the door, air pressure is applied and exhausted at the rear end of the cylinders.

The door engines, as well as the operating valves, track runners and door fittings were designed and manufactured at the Board's Workshops, Preston.

Interior Finish:

The interior of the saloons up to window level is lined with 3/16" "Masonite" painted to match the upholstery. Modern shades of light grey and green have been chosen to improve the appearance. The pillar facing strips and mouldings are of blackwood finished in natural colour, while the ceiling is finished in semi gloss ivory enamel.

The saloon floors are covered with 5-ply Malthoid cemented down and finished with paving paint, while the smoking compartment floor has 3-ply Malthoid finished as above and fitted with hardwood wearing slats. Cast aluminium alloy anti-slip tread plates are fitted to the steps.

Seats:

A combination of transverse and longitudinal seats is provided in the saloons. To permit freer circulation in the smoking compartment, which is the portion of the tramcar most favoured by short distance riders, the transverse wooden seats of previous types have been replaced with longitudinal upholstered seats.

The seating throughout is fitted with latex rubber cushions and backs covered with either light coloured blue-gray or green leather.

Exterior Finish:

The Board's standard colours for exterior finish are green and cream enamel decorated with gold lining, with the monogram and numbers in gold, shaded black. The roof is of stone colour and the trucks are sprayed with black bituminous paint. Exterior grab rails are "Doverite" covered.

Motorman's Compartment:

The motorman's compartment is totally enclosed and is fitted with hinged doors on both sides with an emergency door between the compartment and saloon. The centre window of the windscreen is fixed and fitted with an air operated windscreen wiper. The side windows on the windscreen are fitted with half drop sashes. A rear vision mirror is placed on the left hand corner pillar enabling the motorman to see the car entrances and stepboard.

Ventilation:

Although half-drop and hopper windows in saloons and smoking compartment may be opened as required, the ventilation seemed inadequate in the humid weather. Accordingly a perforated grille ventilator is provided in the ceiling, running the full length of the tramcar and connecting with the clerestory roof.

Sound Insulation:

Sound insulating material consisting of two layers of $\frac{7}{8}$" hair felt encased in aluminium sheet has been attached to the underside of the flooring, above each of the tracks. The material is expected to withstand vibration, dust and mud and is non-inflammable. A single layer of hair felt has also been cemented on the inside of the steel sheet side panels. The effect of this sound insulation is a marked reduction to the sound level in the saloons.

Two trams were, in addition, provided with sound insulated ceilings consisting of perforated "Masonite" backed by a $\frac{7}{8}$" layer of hair felt. This experimental treatment caused some improvement, particularly when the tramcars were relatively empty, but was not sufficient to justify the expenditure.

Lighting:

In the ceiling twelve lamps in specially designed fittings provided with polished stainless steel reflectors and 8" diameter flashed opal bowls, made with a hole in the centre for the removal of the lamp without disturbance of the fittings, ensure direct vertical lighting.

All horizontal and angular lighting is diffused, protecting the passengers from direct glare, and at the same time permitting efficient reflection from the light coloured ceiling.

Two headlights are provided and fitted, one to each dash, and all lamps are 100 volt 60 watt gas filled traction type wired in series.

Signalling and Destination Signs:

The conductor's signalling system consists of an electric buzzer working from the 600 volt supply and operated by leather "cords" along each side of the ceiling.

The destination and route number mechanisms are of the Board's own design and manufacture. They are equipped with white cloth curtains on which the destination names and rcute numbers appear in white on a black background. At night the curtains are illuminated from behind.

Trucks:

The trucks following the lines of the Board's recent design, which has been found in service to possess many favourable features, have steel H section side frames supported on long semi-elliptic springs rigidly attached to the axle boxes, and joined to the side frame by a pin on one end and with a sliding shoe and rubber pad on the other end. The bolster is a box section built up of mild steel plate, electrically welded and supported on helical springs carried on a spring plank swung on links 12-5/16" long.

Wheels:

The wheels are 28" diameter mounted on $4\frac{1}{8}$" - $4\frac{1}{2}$" diameter axles, with axle boxes of the standard railway journal type. To improve the riding qualities of the trucks it was decided to follow American practice and fit resilient wheels thus reducing the unsprung weight. By the use of rubber, wear on track work, particularly at points and crossings, is reduced and impact loading on the truck frame is lessened with reduction of noise and an improvement of passenger comfort. There is noticeable softening in the riding quality of the vehicle; the acceleration steps are smoothed out and the harsh feel of the external brake shoes is greatly reduced.

Two distinct designs have been used for the resilient wheel on the new trucks. One is that manufactured by Industrial Steels Ltd. of Sydney and is known as the "National" design "O" wheels. Photograph No.3 shows an exploded view of this wheel.

The centrifugally cast tire fits on the outside of the outer cheek plate and these are bolted through the holes in the hub plate to the inner cheek plate. The hub and cheek plates are separated by two sets of eight rubber blocks having a Durometer hardness of 65-70, one set on each side of the hub plate. The rubber is kept in compression.

The second type was designed incorporating the principles developed for the P.C.C. tramcar and built at the Board's Workshops, Preston. An exploded view of this type is shown in Photograph No.2.

The rolled steel tire is separated by two rubber sandwiches from the cast steel inner and outer cheek plates. A rubber sandwich consists of $\frac{7}{8}$" thick rubber disc bended on both sides to spigoted 10 s.w.g. steel sheet. The rubber has a Durometer hardness of 40-45. Under a passenger crush load of 10 tons the deflection of the centre of the wheel is 5/32". The maximum travel possible before the wheel becomes solid is 11/32". In both designs the main load is taken by rubber in shear being so placed as to absorb shocks - vertical, lateral and rotational.

When running, the rubber sandwiches become hot for two reasons: heat is transmitted from the rim which is subjected to brake show friction, and heat is developed through the hysterosis of the rubber loading cycle. The type of rubber in both cases and the bond used in the sandwiches were selected with all requirements in view.

Brake Gear:

The truck brake gear is of the clasp type, equalised throughout and is hung on hanger links fitted with parallel case hardened pins. Braking is applied through a radial brake beam.

The truck leverage is 6.334 to 1, and the foundation brake gear leverage on the car body 2.114 to 1, giving a total overall leverage of 13.39 to 1. The brakes are operated by compressed air applied by means of a self-lapping type of motorman's brake valve. With this type of valve, the pressure corresponds to the position in which the handle is placed. Any desired pressure up to the maximum can be obtained and held in the brake cylinder. A relay valve is provided to give speedy operation of the brake.

The brake equipment consists of a W.H. D.H. 16 compressor, 8" x 12" brake cylinder, a 60" x 16" air reservoir, W.H. type "W" self-lapping motorman's valve, and a W.H. type "E" relay valve. All the motors, gears, control and brake equipment are manufactured in Australia.

Motors:

The car is equipped with four 40 H.P. General Electric 247 AX2 motors with 15/58 gear ratio. Double helical gear wheels and pinions have been used instead of straight spur gears used hitherto. The new teeth ensure gradual smooth engagement and so greatly reduce the gear noise, particularly evident with worn spur gears. The new gears are centrifugally cast and the teeth flame hardened. A double helical gear wheel, mounted on the axle, is shown in photograph No.4. Lubrication is accomplished by the use of gear shield grease pats having the viscosity of 30-40 penetration bitumen. This equipment is capable of average rates of acceleration and retardation of 3 M.P.H.P.S. from 0 to 12 M.P.H., or 2.12 M.P.H.P.S. from 0 to 15 M.P.H. with a seated load on level tangent track without discomfort. The free running speed is 32 M.P.H. with full wheels, 29.6 M.P.H. with worn wheels (25 in.dia.) and the schedule speed is 12 M.P.H. with six stops of six seconds each per mile.

Current Collection:

One of the worst noises omitted by a tramcar is caused by the trolley wheel which omits a high pitched sound. The new trams have been provided with a shoe which slides along the trolley wire and is provided with a carbon contact. The carbon contact is an insert approximately $2\frac{7}{8}$" long by $1\frac{1}{8}$" wide by 13/16" thick and fits into a gunmetal guide which is secured by a lock screw to the tilting head of the trolley shoe. When in motion the tilting head remains parallel to the trolley wire irrespective of the height of it. The carbon inserts have a life of approximately 800 miles before a replacement. The trolley shoe reduces arcing and results in negligible wear to the trolley wire. It eliminates the overhead noise almost entirely. The trolley shoe with carbon insert is shown in photograph No.5.

Control Equipment:

The electrical control equipment is of the remote contactor control type, arranged for series parallel operation with 7 series and 7 parallel resistance steppings. The master controller has an aluminium case enclosing the control drum, line breaker switch and reverser. The contactors are of magnetic type arranged in two boxes with 5 units in each. The line breaker is also of magnetic type fitted with adjustable over-load device and operates in series with the contactors. The resistors are of the General Electric Co's. light weight edge strip unbreakable type. All electrical equipment with the exception of resistors is designed and manufactured by the Board.

Dimensions:

The principal dimensions of the car are as follows:-

Length over Bumpers	46'6"
" " Saloon Corner Posts	40'1"
Width of car over pillars	8'0"
" " " " footboards	9'0"
Height, Rail to footboards (tare)	1'2"
" footboard to loading platform floor	1'1½"
" loading platform to saloon floor	6"
Truck centres	28'0"
" wheel base	5'2"
Size of Wheels	28"
Seating capacity	48
Crush load capacity	150
Weight (tare)	18 tons 8 cwt.

The foregoing information has been prepared by the Rolling Stock Branch under the authority of Mr. D.H. Eakins, M.C.E., M.I.E.Aust., M.A.P.I.