Comeng

Z3 TRAM

Comeng

COMENG HOLDINGS LIMITED
(Parent Company)

VICTORIA
COMMONWEALTH
ENGINEERING
(VICTORIA) PTY. LTD.

NEW SOUTH WALES
COMMONWEALTH
ENGINEERING
(N.S.W.) PTY. LTD.

MITTAGONG ENGINEERING
PTY. LTD.

COMENG INDUSTRIAL
EQUIPMENT PTY. LTD.

COMENG ARCHITECTURAL
INDUSTRIES PTY. LTD.

COMENG GREGORY
PTY. LTD.

WESSBERG MARTIN
PTY. LTD.

QUEENSLAND
COMMONWEALTH
ENGINEERING
(QLD) PTY. LTD.

SOUTH AUSTRALIA
COMENG ARESCO PTY. LTD.

WESTERN AUSTRALIA
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W.A. BRANCH

SOUTH AFRICA
ASSOCIATED COMPANY
UNION CARRIAGE AND WAGON
CO. (PROPRIETARY) LTD. –
GROUP

Z3~Sophistication from Comeng

COMENG, one of the largest rolling stock manufacturers in the southern hemisphere, are in the forefront of world-wide light rail vehicle development and manufacture.

With the benefit of some fifty year's experience in passenger transportation, **COMENG** have produced a series of "Z" Class tramcars for Melbourne, Australia, culminating in this superb vehicle—the "Z3" model.

Melbourne has one of the world's largest fleets of light rail vehicles with around 800 trams, on a total network of 220 kilometres.

The cars are designed by Commonwealth Engineering (Victoria) Pty. Limited, who are the main contractor and supplier of the body. A.E.G. of Germany supply the electrical propulsion system. Trucks are manufactured by Commonwealth Engineering under licence from Duwag of Germany.

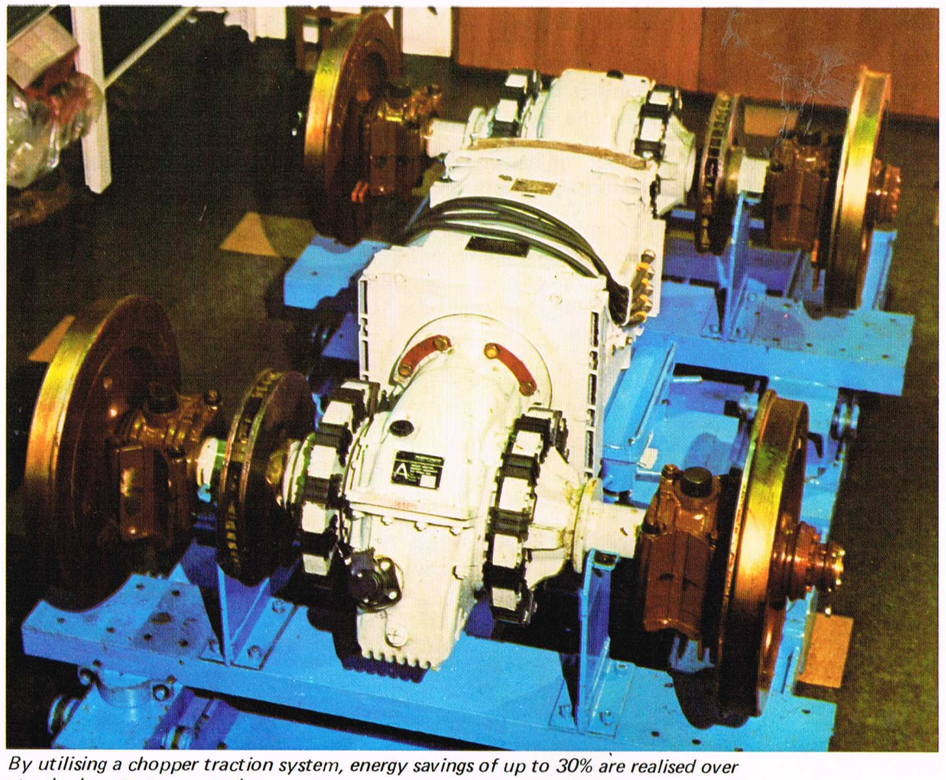
This new "Z3" car incorporates "Chopper" with regenerative braking control. With the sharp escalation in energy costs throughout the world, the savings realised are particularly attractive to the vehicle operators.

These economic vehicles have been specifically designed with the emphasis on reliability, passenger safety and comfort, with a high priority on minimising maintenance requirements.

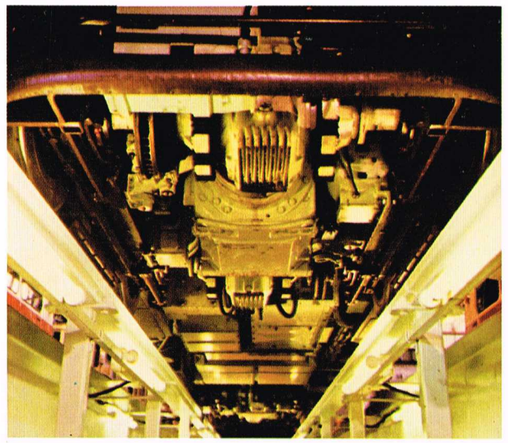
Since their inception, all "Z" Class cars have been readily accepted by the people of Melbourne, and although they may be considered by outsiders as a tourist attraction, it cannot be disputed that they serve as one of the most efficient and economical modes of commuting yet developed. This is reflected in the current trend throughout the world in returning to electrically powered systems and especially to light rail vehicles.

We trust this brochure will highlight for you the quality of this car, and will display the benefits both to the people of Melbourne and the State of Victoria in the selection of this particular concept.

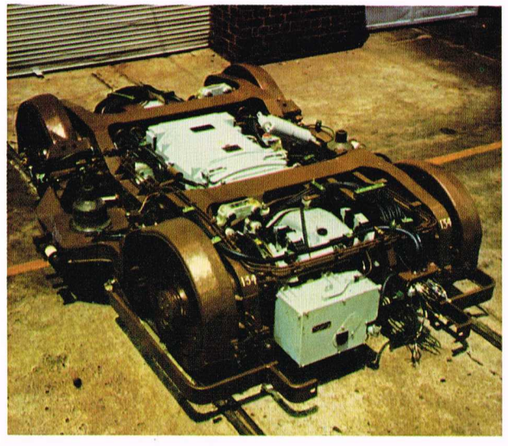
Z3~Economy in motion



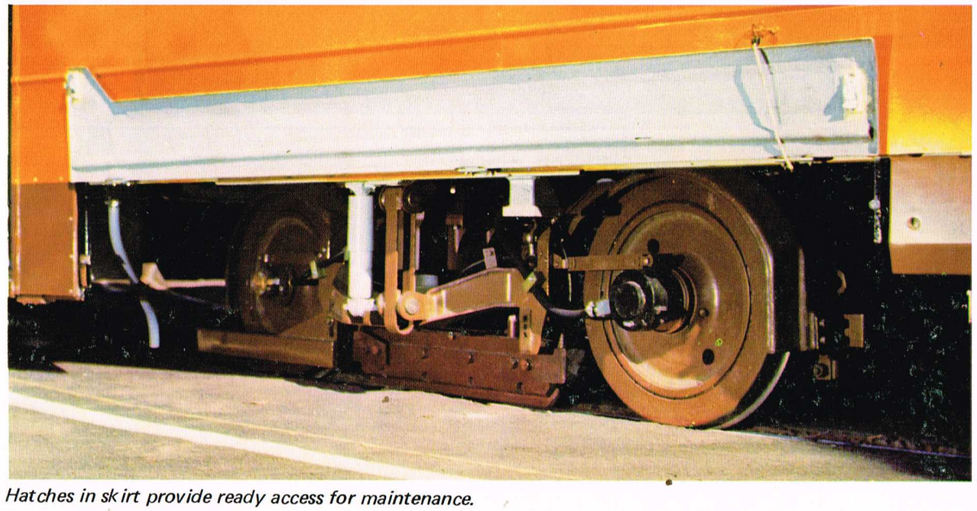
By utilising a chopper traction system, energy savings of up to 30% are realised over standard contactor control.



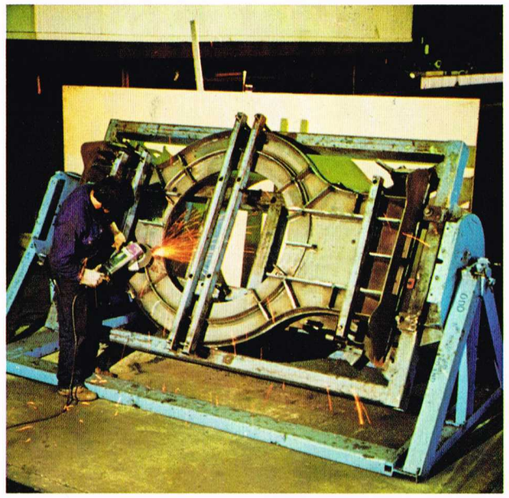
The electrical equipment boxes are arranged to ensure that the weight of the car is well balanced.



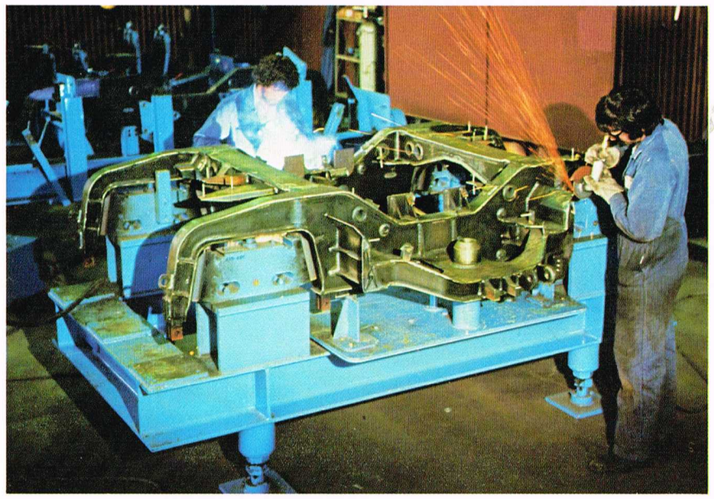
The unique design of the monomoter bogie ensures minimal vulnerability to drive misalignment.
Rubber primary and secondary suspensions guarantee a smooth, even ride.
In addition to dynamic braking, disc brakes and magnetic track brakes are incorporated for maximum safety.



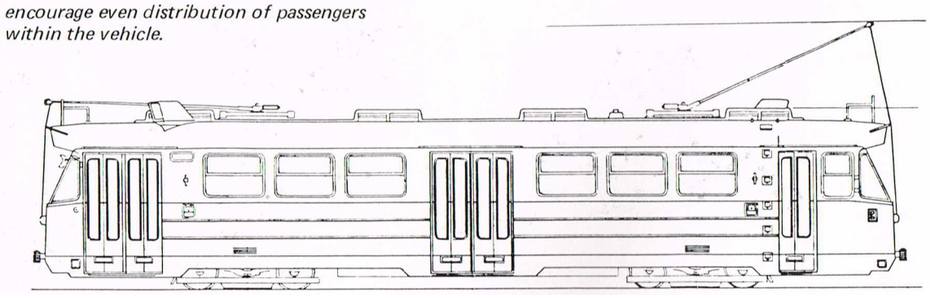
Hatches in skirt provide ready access for maintenance.



Comeng fabricate the truck frames at Dandenong works.



Three doors on each side of the car encourage even distribution of passengers within the vehicle.

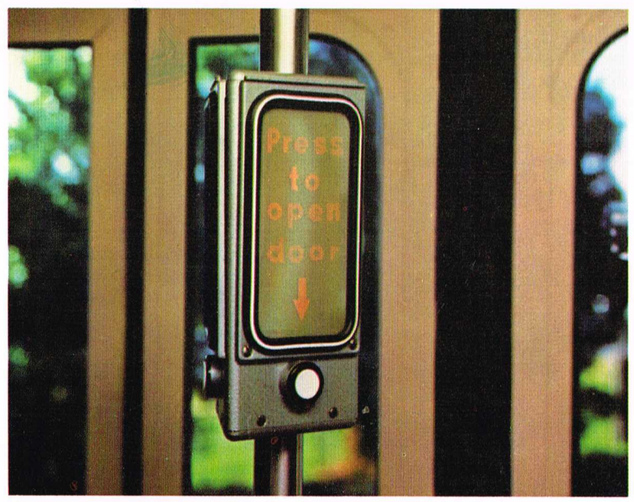


Bright, spacious interior, comfortable seats and plenty of leg room.

Conductors (if required) equipped with automatic change issuing machine minimise boarding time.

Automatic destination equipment with push button control.

Robust handrails facilitate entry and exit.



Passenger control of exit doors.

Durable, attractive finish ensures long-lasting colour quality.

Technical Information

BODY

BODYSHELL
Mild steel structure with mild steel inner stress panels

EXTERIOR
Side Panels – Aluminium; Ends – Fibreglass

INTERIOR PANELS

a) Walls	:	Aluminium backed decoral
b) Ceiling	:	Fibreglass & laminate with melamime facing.
Roof	:	Fibreglass
Floor	:	Fire resistant plywood
Floor covering	:	Treadmaster
Stepwells	:	Fibreglass with rubber mats Electric pressure sensitive mats on exits only
Doors	:	Bi-folding, from extruded aluminium with toughened safety glass
Windows	:	Half drop
Blinds	:	Roller type
Method of applying sand to rails	:	Electric sanding valves
Ventilating fans	:	4
Heater fan units	:	10

MASS

1. Mass of complete body at tare		12,500kg
2. Mass of one truck (incl. motor)		4,750kg
	Total	22,000kg

CAPACITY
: Seated – 42, Loaded – 125

TRUCKS

Type of wheel	:	Resilent Bochum 54
Tire steel	:	Krupp Excelsior Grade 90-lb kg/mm^2
Tire hardness	:	255-315 Brinell
Estimated tire life	:	500-600,000 km with 3 machinings
Description of drive	:	Hypoid right-angle hollow shaft with spider type flexible rubber coupling
Gear ratio	:	1:5.667
Bearings	:	Ball & roller
Suspension	:	Primary rubber chevrons; secondary Clouth rubber springs
Method of fixing trucks to body	:	Ball bearing type slewing ring
Shock absorbers	:	Hydraulic, both vertical and horizontal
Mechanical brake	:	Spring applied, hydraulic release

PERFORMANCE (on level track with full seated load)

1. Maximum speed	70 km/h	7. Maximum jerk (during braking)	2.0 m/s^3
2. Transition time from zero to maximum acceleration	1.5 s	8. Maximum deceleration (mechanical brake only)	1.6 m/s^2
3. Maximum acceleration	1.6m/s^2	9. Maximum deceleration (full emergency braking)	3.0 m/s^2
4. Transition time from zero to maximum deceleration (with dynamic brake only)	1.5 s	10. Speed of car, with wheels at condemning diameter, when motors are operating at maximum safe speed	69 km/h
5. Maximum deceleration (dynamic brake only)	1.6 m/s^2	11. Total rolling resistance	150 N/t
6. Maximum jerk (during acceleration)	1.3 m/s^3		

Electrical Equipment for

100 Electric Trams Contract 3000

As supplied to Comeng

by **AEG~TELEFUNKEN**

ELECTRICAL EQUIPMENT

The power equipment of the new "Z3" tramcars of the Melbourne and Metropolitan Tramways Board (MMTB) is in keeping with the latest technological developments in power electronics components. The hitherto-used switchgear (contactors and cam controllers) is being replaced by quick-acting thyristors and suitable quenching devices so that stepless starting and braking is possible. The starting losses in the resistances, hitherto unavoidable, are now eliminated and it will furthermore be possible to feed the energy regenerated during braking of the vehicle back into the supply system, resulting in an appreciable saving in energy. Besides the low maintenance required by the static components and the greater riding comfort due to jerk-free starting and braking, this feature is one of the most important advantages of AEG-TELEFUNKEN chopper technology.

1. Drive

Each of the two bogies is equipped with a longitudinally-mounted type ABS 3322 series-wound traction motor having a continuous rating (IEC 349) of 600 V, 195 kW, 360 A, 2375 rpm at 65% field. All four axles of the tramcar are driven via bevel gears.

The traction motor is of the self-ventilated, four-pole, compensated type and was designed especially for outer suburban traffic and chopper control. Its features are a high characteristic (since the energy losses inherent in rheostatic starting do not occur with chopper operation) and a split stator consisting of a laminated part and a cast frame in order to obtain optimum distribution of the flux.

Full utilization of the available space in the bogie has been achieved. Careful manufacture, including continuous quality control, and high maintenance-free performance of this type of motor in commercial operation, give reason to expect an exceptionally long service life.

2. Driving and Braking Circuit Arrangement

The driving and braking control was redundantly designed in that it has been provided with two circuits in parallel, each motor having a d.c. chopper in push-pull connection. Thus the input filter, consisting of line capacitor and line reactor, is loaded with double the frequency and half the amplitude, and can therefore be made smaller and lighter. The line reactor is an iron-less reactor which is not ventilated. It is mounted underneath the vehicle next to the line capacitor. The capacitor unit consists of two groups in parallel which are separately controlled, and which therefore allow driving on at reduced power if one group should fail.

2.1 Driving

In the driving circuit, the line voltage is fed to the traction motor in pulses. The pulses start with a short duration of voltage application, lasting about 10% of the cycle time of 4 ms, and are gradually lengthened, thus increasing the mean motor voltage continuously to the value of the line voltage. The motor current flows as a direct current having just a slight ripple since, during the non-conducting period of the chopper, the motor current will be driven on by the inductance of the circuit, consisting of the motor, an additional motor reactor and a free-wheeling diode. When the motor voltage reaches the value of the line voltage, the chopper will have the maximum firing time. The high characteristic curve of the motor does not call for additional field weakening to increase the speed further.

When starting from a complete standstill, the line current will at first be relatively small, since the high motor current will be maintained via the free-wheeling circuit. With increasing speed and power consumption, the line current will linearly increase with the motor current remaining constant. This leads to a significant relief of the power supply network during the starting of the vehicle.

2.2 Braking

The brake has been constructed as a self-excited combined regenerative and rheostatic brake for feeding back the regenerated energy into the supply line. After opening the driving contractor and reversing the polarity of the armature via the reverser contactors, the chopper is connected in parallel with the motor. During the conduction period a high current is generated, which is maintained by the inductances of the circuit during the non-conducting period and fed back into the supply system via the free-wheeling diode. If the speed is lower than 40 km/h, it is necessary to bridge the series braking resistance. The intermittently-obtained energy is absorbed by the line filter and continuously fed back into the supply network via the line reactor and the trolley pole. If the supply network is not capable of absorbing the energy—the upper permissible contact line voltage is taken as a criterion—an additional braking thyristor is fired and the braking energy of the tramcar is converted into heat in the underfloor-mounted, forced-air-cooled braking resistors. The absorbing capacity of the supply network at the time in question is checked every 4 ms chopper cycle, making it possible to attain optimum energy feedback.

2.3 Car Control Unit

The roof-arch-mounted CCU 3000 Car Control Unit—mainly equipped with IC components—processes the orders given by the driver and transmits control impulses to the thyristors of the d.c. chopper. In doing so, the unit continuously monitors the current in the two motor circuits, the voltage across the line capacitor and a number of other functions such as the blending brake (spring loaded brake) which operates shortly before the car comes to a complete stop.

2.4 Foot Controller

The foot controller provided for the existing cars has been adapted for equipping the new production series. Acceleration and braking of the vehicle is made as in a motor car with an accelerator and a brake pedal operated with the right foot. Another pedal serves as a dead man's pedal. This has to be pressed halfway down with the left foot, otherwise automatic braking of the running vehicle will occur.

3. Auxiliaries Power Supply

A rotary convertor consisting of a self-ventilated series motor and a totally enclosed claw-pole stationary-field alternator converts the line voltage of 600 V d.c. to two separate supply systems on board the vehicle—a 24 V d.c. circuit and a 220 V 3-phase 100 Hz circuit. The d.c. voltage is used for the controls, the low-voltage lighting and the charging of the battery; the three-phase current is used for supplying the almost maintenance-free squirrel-cage fan motors for equipment cooling and saloon ventilation.