

~~1975~~  
1972

MELBOURNE AND METROPOLITAN TRAMWAYS BOARD

VICTORIA, AUSTRALIA



TENDER SCHEDULE FOR

**ALL-ELECTRIC TRAMS**

# Melbourne and Metropolitan Tramways Board

11th July, 1972.

MEMO. FROM DEPUTY CHAIRMAN  
TO TESTING ENGINEER

## TRAM SPECIFICATION.

The Board has issued Tender Schedules to a number of registered tenderers calling for the supply of 100 trams.

At this stage it is important that the project receives the least possible publicity. I enclose one copy of the Tender Schedule for your information.

Would you please refer queries on the specification to this office so that the answers to questions can be made consistent.



DEPUTY CHAIRMAN.

*Howard Smith*

LABORATORY

2

10 FEB 1975

**Melbourne and Metropolitan Tramways Board  
Victoria, Australia**

**MANUFACTURE  
SUPPLY and DELIVERY  
OF  
100 ALL-ELECTRIC TRAMS**

**Contract No. 2500**

SEALED TENDERS, endorsed as above, are to be addressed to "The Secretary, Melbourne and Metropolitan Tramways Board", and must be delivered at the Office of the Board, 616 Little Collins Street, Melbourne, Victoria, 3000, Australia, not later than 2 p.m. on Monday, 2nd October, 1972.

# Melbourne & Metropolitan Tramways Board

Melbourne, Australia

## MANUFACTURE, SUPPLY AND DELIVERY

OF

### 100 ALL-ELECTRIC TRAMS.

CONTRACT No. 2500.

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# Melbourne & Metropolitan Tramways Board

Melbourne, Victoria

MANUFACTURE, SUPPLY AND DELIVERY

OF

100 ALL-ELECTRIC TRAMS.

CONTRACT No. 2500.

CONDITIONS OF TENDERING.

1. Tenders are to be sealed and legibly endorsed with the name of the work for which the tender is submitted, and the number of the Contract.
2. Tenders shall be addressed to the Secretary of the Melbourne and Metropolitan Tramways Board, 616 Little Collins Street, Melbourne, 3000, Victoria, Australia.
3. No tender shall be received after 2 p.m. on the day named for the receipt of such tender unless there are circumstances which, in the opinion of the Board, render it desirable to do so.
4. The Board shall not be bound to accept the lowest or any tender and shall have the right to accept any tender or tenders in respect of any item or items offered, and reserves the right to accept two or more tenders for machinery, plant, materials, goods or services of the same kind and to make concurrent Contracts accordingly.
5. In the event of any successful Tenderer failing to take up his tender, lodge the required Security Deposit, complete the necessary Contract documents, and proceed with the Contract within the time specified in the Contract, or any Tenderer withdrawing his tender after it shall have been opened, whether such tender shall have been accepted or not, all moneys deposited on account thereof or in connection therewith shall be forfeited to the Board.
6. In submitting a tender other than a tender by a Corporation, the full Christian name, surname, and place of residence of the Tenderer must be inserted in the tender form, or when the tender is submitted by a firm, the name in full of each member of the firm must be so inserted. The omission of this information will render the tender liable to be declared informal and rejected.
7. Each Tenderer shall specify in his tender any goods, machinery or materials and the value thereof which he proposes to sell to the Board or to purchase for any works which he proposes to undertake for the Board, which are not manufactured or produced in the Commonwealth of Australia.
8. Tenderers shall send in their tender on the form of tender applicable to the machinery, plant, materials, goods or services in respect of which the tender is made. The rates tendered must be clearly set out in the appropriate places in the schedule attached to the tender and any other information asked for in the schedule must be supplied by the Tenderer. All signatures and entries shall be made in ink. Any tender which does not comply with this condition may be considered informal and be rejected.

These are Conditions of Tendering marked “A” referred to in the annexed Contract with the Board.

WITNESS..... CONTRACTOR.....

# Melbourne & Metropolitan Tramways Board

Melbourne, Victoria

## MANUFACTURE, SUPPLY AND DELIVERY

OF

100 ALL-ELECTRIC TRAMS.

CONTRACT No. 2500.

## CONDITIONS OF CONTRACT.

### 1. INTERPRETATION OF TERMS.

Whenever the terms hereafter defined in the present clause occur in the Contract as hereinafter defined, they shall, unless inconsistent with the Contract, be construed as follows:—

"BOARD" shall mean Melbourne and Metropolitan Tramways Board.

"CHAIRMAN" shall mean the Chairman of the Board, or the person discharging the duties of the Chairman.

"SECRETARY" shall mean the Secretary of the Board, or the person acting as such for the time being.

"INSPECTOR" or "INSPECTING ENGINEER" shall mean the person from time to time duly authorised and appointed by the Board to supervise the carrying out of the Contract.

"CONTRACTOR" shall mean the person whose tender is accepted by the Board, and who executes the Contract referred to therein, his executors or administrators, successors and assigns.

"SUB-CONTRACTOR" shall mean the person named in the Contract as such for any part of the work, or any person to whom any part of the Contract has been sub-let with the consent, in writing, of the Board, and the executors or administrators, successors and assigns of such person.

"WORK" or "WORKS" shall mean and include all or any machinery, plant, materials or goods to be provided, or services to be performed under the Contract.

"CONTRACT" shall mean the documents comprising the Agreement between the Board and the Contractor to provide or perform the work including these General Conditions, the Specification, Schedules, Drawings, Form of Tender, and any other document or letter varying or amending the same and the Form of Agreement to be entered into under the General Conditions.

"SCHEDULE OF PRICES" shall mean the rates at which the Contractor has agreed to execute the Contract.

"ITEM" shall mean any of the items enumerated in the Schedule of Prices.

"SPECIFICATION" shall mean the Specification annexed to these General Conditions.

"TENDER DRAWINGS" shall mean all Drawings issued with the Board's Specification, together with all Drawings submitted by the Tenderer with his tender to illustrate the type and general arrangement of the work and which are approved by the Board.

"CONTRACT DRAWINGS" shall mean such Drawings as the Contractor is required under the provisions of the Contract to supply to the Board.

"TESTS ON COMPLETION" shall mean such tests as are prescribed by the Specification to be made by the Contractor before the work is taken over by the Board.

"TOTAL AMOUNT OF THE TENDER" shall mean the total cost to the Board of the works to be provided or performed under the Contract.

Each of the words "SPECIFICATION" and "DRAWING" shall be respectively construed to comprise both.

"MONTH" shall mean a calendar month.

Words importing the singular number shall include the plural number, and words importing the plural number shall include the singular number.

"PERSON" shall include a company, corporation or partnership.

Words importing the masculine gender shall include the feminine.

### 2. CONTRACT DRAWINGS.

The Contractor shall supply two sets of copies of contract drawings, giving full dimensions and details of the work for the information and use of the Board.

These contract drawings shall become the property of the Board and be deposited with the Secretary, and shall not be departed from in any way whatsoever, except with the written permission of the Board.

The Inspector or his duly authorised representative shall have the right at all reasonable times to inspect, at the Contractor's premises, contract drawings which are in course of preparation for any portion of the work.

The Contractor shall be responsible for any discrepancies, errors, or omissions in contract, tender or other drawings or other particulars supplied by him, whether such drawings or particulars have been approved by the Inspector or not, provided such discrepancies, errors or omissions be not due to inaccurate information or particulars supplied to the Contractor by the Inspector; but the Board shall be responsible for drawings and information supplied by the Inspector relating to special details supplied by him.

### 3. EXTENT OF CONTRACT.

The Contractor, in consideration of the Contract Price as hereinafter stated, will supply and deliver to or perform for the Board all the work set out and described in the Specification or implied in or by the same.

The whole of the work shall be of the best quality, and the manufacture or performance of the same in strict accordance with the Conditions of Contract and the Specification, to the full extent and meaning of the same and shall be provided or performed to the entire satisfaction and approval of the Inspector and under the supervision and subject to the inspection of such representative or representatives as the Inspector may nominate for the purpose.

### 4. COUNTRY OF MANUFACTURE.

In the event of the Board accepting a tender for goods, machinery or materials not manufactured or produced in the Commonwealth, such acceptance shall be conditional upon the Board obtaining from the Minister the certificate referred to in Section 4 (1) of the Public Contracts Act 1958.

### 5. CONTRACTOR TO INFORM HIMSELF FULLY.

The Contractor shall be deemed to have carefully examined the General Conditions, Specification, Schedules, and tender drawings. If he shall have any doubt as to the meaning of any portion of these General Conditions, or of the Specification, he shall, before tendering, set forth the particulars thereof, and submit them to the Secretary in writing, in order that such doubt may be removed, and he shall be deemed to have entered into the Contract upon the basis that the meaning attributed to any such portion by the Secretary in a written reply to such submission is the meaning of the same.

### 6. PATENT RIGHTS.

The Contractor shall fully indemnify the Board against any action, claim, or demand, costs, or expenses, arising from or incurred by reason of any infringement or alleged infringement of any letters patent, design, trade mark or name, copyright, or other protected right, in respect of any work or any system or method of using, fixing or working the same or any arrangement used in connection therewith or fixed or supplied by the Contractor to or with the same; but such indemnity shall not cover any user of any work by the Board otherwise than in accordance with the provisions of the Specification. All payments and royalties payable in one sum or by instalments or otherwise shall be included by the Contractor in the prices named in his tender, and shall be paid by him to those to whom the same may be due or payable.

In the event of any claim being made or action brought against the Board in respect of any such matters as aforesaid, the Contractor shall be immediately notified thereof, and he shall, with the assistance, if he so require, of the Board, but at the sole expense of the Contractor, conduct all negotiations for the settlement of the same, or wherever practicable, any litigation that may arise therefrom or be occasioned thereby.

### 7. SECURITY.

Within 7 days after the notice of the acceptance of this tender has been given to the Contractor, he shall deposit at some approved bank in Melbourne, upon Fixed Deposit in the name of the Board, or lodge with the Secretary a Bank cheque or other approved security representing a sum calculated at the rate of 1% of the Contract Price; which sum so deposited shall be held by the Board as security for the proper completion of this Contract.

The Contractor shall be entitled to receive any interest as it becomes payable upon money so placed on Fixed Deposit; but it is expressly declared that the Board, its Chairman, or Secretary shall not be liable or answerable in any way for any loss occasioned by such deposit, or for any loss of interest arising from such Fixed Deposit not being renewed.

### 8. INSPECTION AND TESTING.

The Inspector, or his duly authorised representative, shall have, at all reasonable times, access to the Contractor's premises, and shall have the power, at all reasonable times during the manufacture or construction of any work by the Contractor, to inspect, examine, and test the materials used and quality of workmanship performed in or in relation to the manufacture or construction of any work, and if such work is being manufactured or constructed on other premises, the Contractor shall obtain for the Inspector or his duly authorised representative, permission to have access to such other premises and to inspect, examine and test as aforesaid.

As to any work with respect to which tests on completion are prescribed, the Contractor shall give to the Secretary notice when the same is ready for testing. Unless otherwise agreed, the Inspector or his representative shall, within seven days of the receipt of such notice and after not less than twenty-four hours' notice from the Board to the Contractor, be entitled to attend at the Contractor's premises or the premises of any Sub-Contractor for the purpose of witnessing such tests. If no such notice is given by the Board, or the Inspector does not attend at the said premises within the said period of seven days, the Contractor may proceed with such tests which shall be deemed to have been made in the Inspector's presence, and the Contractor shall forthwith forward to the Board duly certified copies of the records of such tests in duplicate.

In all cases where the Contract provides for tests by the Inspector before delivery at the premises of the Contractor or of any Sub-Contractor, the Contractor, except where otherwise specified, shall provide free of charge, such labour, materials, electricity, fuel, stores, apparatus and instruments as the Inspector may consider requisite from time to time, and as may reasonably be demanded, efficiently to carry out such tests, in accordance with the Contract, and shall, at all times, give facilities to the Inspector or his authorised representative to carry out such tests.

In all cases where the Contract provides for tests after delivery but before such work is put into service by the Board, the Board, except where otherwise specified, shall provide, free of charge, such labour, materials, fuel, stores, apparatus, and such instruments as it has in its possession, as may be requisite from time to time, and as may reasonably be demanded, efficiently to carry out such tests of the work in accordance with the Contract. All special instruments shall be provided by the Contractor.

In the case of Contracts requiring electricity for such last mentioned tests, such electricity as is available shall be supplied free to the Contractor at the pressure of the ordinary supply.

#### 9. CONTRACTOR NOT TO ASSIGN OR SUB-LET CONTRACT.

The Contractor shall not assign or sub-let this Contract or any part thereof without the consent in writing of the Board. Any consent to assign or sub-let work to be done under this Contract shall not discharge the Contractor from any liability in respect to such work, and shall extend only to the work specified in such consent.

#### 10. RATES OF WAGES.

In the carrying out of the Contract, the Contractor shall pay to his employees engaged in carrying out this Contract, for the work performed by them, wages at rates not less than those prescribed by any relevant Arbitration Court Award or Wages Board Determination applicable in relation to the work so performed.

#### 11. REPLACEMENT OF DEFECTIVE WORK OR MATERIALS.

If during the progress of the work, or upon its completion or delivery, the Inspector shall decide that the Contractor has performed any unsound or imperfect work, or has provided any work inferior in quality or quantity to that specified and the Board notifies the Contractor in writing of such decision together with particulars of the work to which the same relates, the Contractor shall at his own expense, within seven days of his receiving such notice, proceed to put such work into sound and proper condition, or remove the same, or provide fresh work up to the standard specified, and in case the Contractor shall fail so to do the Secretary may, on giving the Contractor seven days' notice in writing of his intention so to do, proceed to remove the work complained of, and at the cost of the Contractor, perform or provide all such work provided that nothing in this Clause shall be deemed to deprive the Board of or affect any other rights under the Contract which it may have in respect of such work.

#### 12. MAINTENANCE OF WORK.

For a period of 24 months after delivery of any work to the Board, the Contractor shall be responsible for any defect that may develop or become apparent therein in the course of the proper use of the same, arising from faulty materials, design, or workmanship in manufacture or construction of the same, but not otherwise, and shall remedy such defect when so required by the Board, by notice in writing, which notice shall specify the nature of such defect.

If it shall be necessary for the Contractor to replace or renew totally or in part any defective work or portion thereof under this Clause, the provisions of this Clause shall apply to the work or portion of the work so replaced or renewed until the expiration of 12 months from the date of such replacement or renewal or until the end of the abovementioned period of 24 months, whichever may be the later. If any defect be not remedied within a reasonable time after such notice from the Board, the Board may proceed to remedy the same at the risk and expense of the Contractor but without prejudice to any other rights which the Board may have against the Contractor in respect of such defect.

All inspections, adjustments, replacements, or renewals carried out by the Contractor during the maintenance period shall be subject to these General Conditions.

Until the final Certificate shall have been issued, the Contractor shall have the right to enter, at his own risk and expense, by himself or his duly authorised representatives, whose names shall have previously been communicated in writing to the Secretary, at all reasonable times, upon all necessary parts of the premises of the Board for the purpose of inspecting any work provided by him, and if he desire, at his own risk and expense, making any tests, subject to the approval of the Board, which shall not be unreasonably withheld. Upon the issue of the final Certificate, the security provided pursuant to Clause 7 shall be surrendered to the Contractor.

### 13. INSURANCE.

The Contractor shall, from time to time, insure against fire in the name of the Melbourne and Metropolitan Tramways Board in some approved Insurance Office, all work upon which any progress certificate has been granted by the Board, and also all materials which may be supplied by the Board to the Contractor for use in connection with the work, and shall lodge with the Secretary, policies and receipts for such insurance, and shall maintain such policies in force until the possession of the work is given up to and accepted by the Board.

The amount of the said insurance shall be not less than the full cost of the labour employed and materials provided by the Contractor or the Board in relation to the same as shown in the accounts of the Contractor or the Board as the case may be.

If the Contractor shall fail or omit to insure such work as aforesaid, or to pay any premium or premiums thereon, the Board may insure the same and pay any such premium or premiums and the cost and charges of such insurances and all sums expended on or about the same shall be repaid by the Contractor to the Board which shall be at liberty to deduct the same from any sum or sums due to the Contractor under this or any other Contract with him.

### 14. TIME FIXED FOR COMPLETION.

The time fixed for the completion of the Contract is that named in the Contract, and on that day the Contractor shall hand over to the Board, the work completed and finished in every respect, provided always that the Board may by writing extend the time for completion, and then the Contractor shall so complete and hand over the work on the day fixed in such writing.

### 15. DAMAGES FOR DELAY IN COMPLETION.

If the Contractor fail in the due performance of this Contract within the time fixed by the Contract or any extension thereof granted under Clause 14, the Contractor hereby agrees to pay to the Board by way of liquidated damages, a sum calculated at the rate of one per centum per week on the Contract price for each week between the fixed or extended time and the actual time of delivery, and the Board may deduct such sum from any money in its hands due or to become due to the Contractor. The payment or deduction of such sum shall not relieve the Contractor from his obligations and liabilities thereunder.

### 16. CANCELLATION OF CONTRACT.

If the Contractor shall become bankrupt or insolvent, or shall make any arrangement with or assignment in favour of his creditors, or his estate shall become subject to the Bankruptcy laws, or if (in the case of the Contractor being a Company), any proceedings either voluntary or compulsory be taken to wind up the Contractor, or if the Contractor shall assign or sub-let the Contract contrary to the provisions hereof, or if execution be levied against any property of the Contractor, or if the Inspector shall certify under his hand to the Board that in his opinion the Contractor:

- (a) Has abandoned the Contract, or
- (b) Has failed to give the Board's Inspector, Engineers or Officers proper facilities for inspection and testing of the work, or
- (c) Has failed to effect delivery within a reasonable time of the dates fixed for delivery, or
- (d) Has delivered material of such a quality that more than 25 per cent thereof has been rejected under the terms of the Contract,

then the Board may by notice in writing to the Contractor determine the Contract and the same shall be determined accordingly save as to the rights and powers conferred upon the Board and the Inspector thereby and save as otherwise provided in Clause 17.

The Inspector's certificate under this Clause shall be conclusive proof as between the Board and the Contractor of the statements contained in it.

Upon this Contract being determined the whole of the security provided under Clause 7 hereof or such portion thereof as the Board shall determine shall vest in and become the absolute property of the Board.

### 17. SETTLEMENT OF DISPUTES.

In the event of any dispute arising under or in connection with this Contract or the execution thereof, including any dispute as to the construction of the Contract or arising on or by reason of its determination, either party may forthwith give to the other notice in writing of the existence of such dispute, and the same shall be referred to arbitration. The Contract shall be deemed to be a submission to arbitration within the meaning of the Arbitration Acts for the time being in force in the State of Victoria.

The award of the Arbitrator shall be final and binding on the parties. Upon every or any such reference, the cost of and incidental to the reference and award respectively shall be in the discretion of the Arbitrator, who may determine the amount thereof or direct the same to be taxed as between solicitor and client, or as between party and party, and shall direct by whom and to whom and in what manner the same shall be borne and paid.

Work and deliveries of goods under the Contract shall, if reasonably possible, continue during any such arbitration proceedings, and no payment due or payable by the Board shall be withheld on account only of such proceedings.

**18. NOTICES AND CERTIFICATES.**

All notices, consents, certificates, approvals, disapprovals, permissions, decisions, applications and extensions provided for by these Conditions shall be in writing, and, if given or made by or on behalf of the Board, shall be signed by the Secretary and shall be deemed to be given to or served on the Contractor if delivered to the Contractor, or posted in the ordinary course of post, addressed to the Contractor at the address given in the tender, and if given or made by or on behalf of the Contractor shall be deemed to be given to or served on the Board if delivered to or posted in the ordinary course of post addressed to the Secretary.

**19. TERMS OF PAYMENT.**

Subject to any deductions which the Board may be authorised to make under the Contract, the Contractor shall be entitled upon obtaining the certificates of the Inspector or other authorised representative of the Board to payments by the Board in accordance with the following provisions:—

- (a) Within three days of delivery of any work, or due performance of any services, an invoice shall be furnished by the Contractor to the Secretary at the Board's Head Office. Invoices shall clearly show the amount claimed, the date or dates of delivery or deliveries, the place or places of delivery or deliveries, and a description of the work delivered or services performed. The invoice must show full particulars of the work or services. In all cases the Board's official order number shall be shown.

With the exception of invoices for spare parts and any special equipment ordered, invoices shall be for one or more complete trams. The invoiced value of one tram shall be one per cent of the contract price for one hundred trams.

- (b) Such payments as are authorised under Clause (c) shall be made, where possible, 28 days after the relevant certificate of the Inspector or other authorised representative of the Board shall have been issued.
- (c) 90 per cent of the invoiced value of material delivered and accepted will be paid within 28 days.

10 per cent of the invoiced value will be paid 28 days after the final accepted delivery.

The Contractor's Security Deposit will be returned on the expiration of the maintenance period for the last tram delivered.

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These are the Conditions of Contract marked "B" referred to in the annexed Contract with the Board.

WITNESS.....

CONTRACTOR.....

# Melbourne & Metropolitan Tramways Board

Melbourne, Victoria

## MANUFACTURE, SUPPLY AND DELIVERY

OF

100 ALL-ELECTRIC TRAMS.

CONTRACT No. 2500.

NOTES FOR TENDERERS.

### A. ISSUE OF SPECIFICATION.

A copy of these Documents will be issued to prospective Tenderers on payment of a deposit of \$A10. A refund will be made for all copies issued to the Tenderer — up to a maximum of five copies — on receipt of a valid tender.

### B. CONDITIONS OF TENDERING AND OF CONTRACT.

Before inserting prices, the Tenderer should read carefully the Conditions of Tendering and the Conditions of Contract.

### C. SALES TAX.

When submitting tenders, Commonwealth of Australia Sales Tax should not be included in the prices tendered. Materials used on all operations of the Melbourne and Metropolitan Tramways Board are exempt from such tax. Certificates of exemption will be quoted on the official order issued by the Board to the Contractor.

### D. SUBMISSION OF TENDER INFORMATION.

Tender information shall be presented in the sequence indicated by clause numbering in Section III of Schedule "C" (Specification).

Attention is drawn to the necessity to provide all of the specific information requested in Schedule "G" — in the sequence shown in the Schedule.

### E. TERMS OF PAYMENT.

Clause 19 of Schedule "B" (Conditions of Contract) indicates the Board's proposed terms of payment.

However, Tenderers are invited to submit for consideration alternative offers, fully inclusive of interest charges, providing for full payment for each tram to be spread over a period of three years (or longer should the Tenderer so submit) and repayable in twelve (or more) equal quarterly instalments from the quarter in which each tram has been passed and accepted.

Tenderers are invited to comment on such a proposal and to offer details of any other spread payment conditions which are acceptable to them.

### F. RATE OF DELIVERY.

Schedule "D" (Prices) calls for the supply of information relative to rates of delivery.

It is the Board's desire to obtain experience (over a brief period — three to six months) by operating the first five trams delivered before accepting delivery of further units.

Tenderers are invited to comment on this proposal insofar as it may affect their offer to supply.

### G. CONTRACTOR'S STORAGE AND/OR INSPECTION AREA.

Should the Contractor so desire, the Board will make available — for the duration of the Contract — an area which may be suitable for storage, inspection and minor construction purposes.

This area (approximately 11,500 square feet — 1,070 square metres) is under cover and is equipped with tram tracks and inspection pits. All tracks are connected to the main tramway system.

The rental for the use of this facility will be \$A40 per week.

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## SECTION I — NATURE OF CONTRACT.

### 1-1. CONTRACT.

The Contract for which the Board now calls tenders (and to which this Schedule refers) includes the design, manufacture and delivery of One Hundred (100) All-Electric Trams to an established and well-proven basic design. Tenders submitted on any other grounds will not be considered. Each tender shall be for complete vehicles. The right is reserved to negotiate with the successful tenderer for the Board to supply components or carry out a proportion of the body assembly in its own workshops.

### 1-2. ACCEPTANCE.

Trams shall be constructed and delivered subject to the inspection, approval and acceptance of the Board and of such Inspectors as it (the Board) may appoint for this Contract. The Board will inform the Contractor of the appointment of all inspection staff.

### 1-3. OPERATIONAL REQUIREMENTS.

The type of tram offered shall be suitable for operation from either end of the vehicle and for expeditiously loading and unloading passengers from either side (at any one time) on any and all sections of tramway routes operated by the Board within the metropolitan area of Melbourne. The following Sections of this Schedule contain information relative to those factors which will assist in determining dimensions and design of the vehicle.

All equipment, bodies and fittings shall be so designed, manufactured and assembled as to be capable of operation (under the stated conditions) with certainty and reliability and shall be suitable for passenger transport quietly and in comfort on the Board's existing concrete tracks at all speeds up to the stated maximum.

### 1-4. COUNTRY OF ORIGIN.

Tenders shall clearly state the country of origin of each and every major component of the type or types of vehicle offered.

### 1-5. PLACE OF DELIVERY.

Delivery shall be made to the Board's Workshops, Miller Street, Preston, Victoria, Australia.

### 1-6. DATE OF DELIVERY.

Tenderers shall provide the answers to questions relating to time of delivery of the first and subsequent trams as required by Schedule "D". Attention is drawn to Notes for Tenderers.

### 1-7. CONDITION OF DELIVERY.

Trams shall be delivered complete in every respect and ready for service operation.

### 1-8. INFORMATION TO BE SUPPLIED BY TENDERERS.

Tenderers shall submit full details of all equipment offered. These details shall include all information specifically requested herein and such other information considered relevant by the Tenderer. Two copies of correct and correctly scaled outline drawings and full descriptive matter (in English) relating to the equipment offered shall be submitted. The Board can not undertake the work of translation.

Tenderers are invited to pay particular attention to this Clause as initial analysis of tenders received will be undertaken by reference to the information provided in Schedule "G" of this Specification.

### 1-9. INFORMATION TO BE SUPPLIED BY CONTRACTOR.

Within three months after acceptance of the tender, the Contractor shall supply one set of paper transparencies of drawings supplementing those submitted with the tender, particularly drawings of items nominated for approval.

Prior to delivery of the first tram, the Contractor shall supply three sets of complete instructions covering the safe and efficient operation, maintenance and repair of all items of equipment. All relevant wiring diagrams and adjustment dimensions shall be included.

In addition, the Contractor shall deliver a set of linen transparencies or velographs of drawings showing complete and accurate details of the equipment as manufactured for this Contract.

The supply of drawings, details, information and instructions is essential to the Contract and the Contractor shall be responsible for all damage or loss incurred by the Board by reason of late or non delivery of any such or by reason of any error therein.



## SECTION II — BACKGROUND INFORMATION.

### 2-1. GEOGRAPHICAL.

The City of Melbourne is the capital of the State of Victoria. Victoria is situated at the south-eastern extremity of the Australian continent — of which it occupies about one thirty-fourth part. Victoria contains about 88,000 square miles.

Melbourne is a city of approximately 2,000,000 people (including suburban areas). Its population is increasing rapidly — by 1985 it may reach 3,500,000. The City is situated on the coast-line of Port Phillip Bay at latitude 37 degrees 49 minutes South, longitude 144 degrees 58 minutes East and at a height above sea level of 114 feet (34.75 metres).

### 2-2. CLIMATE.

#### (a) Temperatures.

Its proximity to Port Phillip Bay has a direct influence on the City's climate. The hottest months in Melbourne are usually January and February when the average temperature is 78 degrees Fahrenheit. The highest temperature on record in Melbourne is 114.1 degrees Fahrenheit. The average number of days per year when the temperature exceeds 100 degrees Fahrenheit is four, but there have been years with up to twelve. The average annual number of days over 90 degrees Fahrenheit is nineteen.

During the summer months, minimum temperatures never fall below 40 degrees Fahrenheit. In winter, however, wide variations in the frequencies of occurrences of low temperatures are noted throughout the metropolitan area. There are approximately ten occurrences per year of 36 degrees Fahrenheit around the bay coastline; but such temperatures can occur up to thirty times per year further inland. Absolute minimum temperatures for any year are of the order 29 degrees Fahrenheit — 32 degrees Fahrenheit.

#### (b) Rainfall.

The average annual rainfall in the City is 25.91 inches (65.8 centimetres) over 143 days. Monthly variations in rainfall are quite small, averaging 2 inches (about 5 centimetres) each month from January to August, then rising to a maximum of about 2.75 inches (about 7 centimetres) in October.

The largest number of wet days ever recorded in any one month is 27 — in August. A wet day is defined as a day on which 1/100th of an inch or more (0.254 millimetre) of rain falls. It should be noted that there has been recorded only one rainless month in the history of Melbourne's records.

Fogs occur on at least four or five mornings each month in May, June and July. Foggy mornings average 21 days for any one year.

#### (c) Cloud and Sunshine.

Cloudiness varies between a minimum in the summer and a maximum in the winter. The total possible monthly sunshine hours at Melbourne range from 465 hours in December to 289 hours in June. Expressed as a percentage of these possible maxima, the average monthly hours of sunshine range from 55 per cent for January to 34 per cent for June.

#### (d) Wind.

The greatest average wind speed recorded at Melbourne (for a 24-hour period) is 22.8 miles per hour (36.7 kilometres per hour). Average wind speeds exceeding 20 miles per hour (32.2 kilometres per hour) are on record for each winter month. It is important to remember that these are average values — the wind is never steady. Continual oscillations occur ranging from lulls — during which the wind speed may drop to or near zero — to strong surges which may contain extreme gusts (lasting for a few seconds only) up to and more than 60 miles per hour (about 96 kilometres per hour).

At Melbourne, gusts exceeding 60 miles per hour have been registered during every month — with a few gusts near or over 70 miles per hour (about 113 kilometres per hour).

#### (e) Hail and Snow.

Hailstorms have occurred in every month of the year — the most probable time of occurrence being from August to November. In one year there occurred seventeen hailstorms, seven of which were in one month — November.

Snow has fallen in the City only occasionally — and then only very light falls of the order one-half to one inch (1.25 to 2.5 centimetres).

#### (f) Climatological Statistics.

The following statistics are supplied in Appendix A.

- (i) Melbourne — Wind, Evaporation and Lightning Data.
- (ii) Melbourne — Humidity and Rainfall Data.
- (iii) Melbourne — Temperature and Sunshine Data.

## 2-3. MELBOURNE'S STREET TRANSPORT SYSTEM.

### (a) General.

Melbourne's basic public transport system consists of a network of electric railway lines radiating in all possible directions from the central City area and extending distances varying from about 12 to about 30 miles (about 20 to about 50 kilometres).

Supplementing this railway system are the street public transport systems. These consist mainly of the tram system; and, to a lesser extent, the motor bus system. All trams (696) and a proportion of the motor buses (235 — one third of the total number of motor buses in Melbourne) are owned and operated by the Melbourne and Metropolitan Tramways Board. The remainder of the motor buses are owned and operated by a large number of small private companies.

The Melbourne and Metropolitan Tramways Board is a State-owned organisation set up by Act of Parliament to purchase, operate and maintain in good condition those types and numbers of public transport vehicles required to satisfactorily supply the street transport requirements of the greater part of the metropolitan area of the City of Melbourne. The Board comprises a Chairman, a Deputy Chairman and a Board Member — all Government appointees. The following statistical information (for the year ended 30th June, 1971) is given to indicate the size and capacity of the Board's organisation and the extent of its operations:

Item	Tram		Bus		Total	
	Miles	Kilometres	Miles	Kilometres	Miles	Kilometres
Operating Receipts	\$16,424,086		\$3,682,844		\$20,106,930	
Length of double tram track	134.86	223	—	—	134.86	223
Length of single tram track	1.61	2.6	—	—	1.61	2.6
Length of Bus routes	—	—	140.05	225	140.05	225
Total distance travelled by all vehicles	14,899,412	23,977,623	7,018,462	11,294,811	21,917,874	35,272,434
Passengers carried	109,778,768		22,753,263		132,532,031	
Number of vehicles available for operation	696		235		931	
Total number of employees					4,323	

### (b) Tram Routes.

The Board's 134.86 miles (223 kilometres) of double and 1.61 miles (2.6 kilometres) of single tram tracks provide street transport between the main City area and suburbs to the north-west, north, north-east, east and south-east. Most tram routes extend some 7 miles (12 kilometres) from the centre of the City.

The movement of passengers is largely into and out from the central City area; but there are also cross-city and inter-suburban movements. On most routes there are quite pronounced morning and evening peak loads; but some routes — in the inner suburbs — are fairly busy throughout the day. Drawing T.2500-1 shows the extent and disposition of Melbourne's tramway system.

### (c) Terrain.

Melbourne is situated in flat to undulating country. The percentage of tram tracks having a gradient of 1 in 15 (6.7 per cent) or steeper is only about 1.0 per cent. There are about 30 locations where this is so. The maximum continuous length of track at 6.7 per cent grade is about 1,300 feet (about 396 metres).

The longest continuous grade is 4,200 feet (1,280 metres) of 1 in 28 (3.6 per cent) whilst the next longest is 1,600 feet (488 metres) of 1 in 16.5 (6.1 per cent). The steepest grade in the tramways system (climbing to cross a railway line) is 1 in 11.2 (8.9 per cent) over a track length of 35 feet (about 11 metres).

A longitudinal section of a typical City tram route is shown on Drawing T.2500-2.

The Glenferrie Road route may be taken as the route which imposes the most severe suburban operating conditions from traction effort and braking points of view. A longitudinal section of this route is shown on Drawing T.2500-3.

The limiting radius for vertical curves (convex and concave) is 600 feet (about 183 metres).

### (d) Track Design.

Double tracks are laid so that the distance between centre lines of tracks is 11 feet (3.353 metres).

The standard track gauge is 4 feet 8½ inches (1,435 millimetres). The track gauge is reduced to 4 feet 8¼ inches (1,428 millimetres) at rectangular crossings — whilst limiting gauges for track maintenance purposes are 4 feet 9 inches (1,448 millimetres) maximum and 4 feet 8-3/16 inches (1,427 millimetres) minimum.

Drawing T.2500-4 gives details of cross-section and material composition of the standard type of grooved rail in use — together with the condemning line indicating a worn out rail.

Track reconstruction now proceeds at the rate of about 5 miles (8 kilometres) of double track per year. The standard method is as shown on Drawing T.2500-5. The rails are set in concrete (to the surface) without fastenings, anchors or reinforcement of any sort. Tiebars (between rails) are at 10 feet (about 3 metres) spacing. Continuously welded rails are used.

(e) Electrical System.

The Board purchases electrical energy at 6,600 volts (alternating current) and transforms and rectifies it to 600 volts (direct current) in 26 substations. Rotary converters, glass bulb and pumpless steel tank mercury arc rectifiers and silicon rectifiers are used for rectification — capacities of individual units being either 500, 600 or 1,000 kilowatts. Substation capacity varies with location and load distribution. The largest substations are equipped with three 1,000 kilowatt units whilst the smallest have a single 500 kilowatt unit. Most of the converting units are provided with overload protection which inserts load limiting resistors in the direct current circuit in the event of excessive load demand. The latest rectifiers have automatic equipment to reduce the output voltage for load limiting protection. Maximum short circuit currents between overhead trolley wire and rail are of the order 10,000 amperes.

The whole of the direct current distribution system is divided into 85 sections. Sixty-four of these sections are supplied from more than one substation simultaneously. Each of these 64 sections is thus used to interconnect the supply substations on the direct current side. The sections vary in length from 0.5 to 2.0 miles (0.8 to 3.2 kilometres).

Direct current circuits to supply the overhead trolley wires are fitted with contactors which are opened by means of impulse transformers. The circuit contactor will not open under overload conditions provided the overload is applied gradually; but it will open with a sudden increase of load. It is calibrated to open on the sudden application of a non-inductive load of 500 amperes.

When the circuit contactor opens, a resistance of 15 ohms (in series with the current coil of a restraining relay) is inserted across its contacts. The circuit contactor will automatically reclose, after a time delay of 10 to 15 seconds, provided the total fault resistance is not less than 1.5 ohms; but the contactor will not reclose until the fault resistance rises to 1.5 ohms.

In addition to direct connections between substations and trolley wire sections, via circuit (or feeder) contactors, some sections of the trolley wire system are connected to other sections by means of automatic sectionalising switches. These switches function in the same way as do circuit (or feeder) contactors in substations.

Four aspects must therefore be emphasised:

(i) A short circuit on any tram will withhold supply from every other tram on the section unless the fault is automatically cleared by the protective equipment on the tram.

(ii) If a circuit (feeder) contactor opens because of a fault on a tram (or a fault on the feeder system), supply to the section may be withheld if those trams on the section have auxiliary equipment connected to the supply line such that the combined resistance is less than 1.5 ohms.

(iii) Because of the use of automatic points controllers (by way of contactors fitted on the overhead trolley wire) the total current drawn at any time by all auxiliary equipment (that is, excluding the traction motors) cannot be in excess of 18 amperes. If it is, the proper operation of automatic points will not be possible.

(iv) The trolley wires are still alive even when the circuit (feeder) contactor is open. (They are alive via the 15 ohms resistance which is automatically inserted.)

As already stated, the nominal direct current voltage is 600 volts; but the voltage may vary between the limits 450 to 650, depending on load conditions and the location of trams with respect to substations. On occasions when alternating current supply to some substations has failed, the direct current voltage at some line termini has fallen to 330 volts.

Two sizes of overhead grooved trolley wire are in use, namely, 0.2 square inch (129 square millimetres) in cross-sectional area in the City proper (about one mile — 1.6 kilometres — square) and 0.126 square inch (81 square millimetres) in the suburban areas. The trolley wires on each track of a double track line are connected together every 500 feet (152.4 metres).

The nominal height above ground of the trolley wire at points of support is 18 feet 6 inches (5.63 metres); but the trolley wires are lower at major track intersections and at a number of bridges where the tram track passes under railway tracks. The lowest section of trolley wire is at a height (under a bridge) of 12 feet 8 inches (3.86 metres). Thus, the current collector on the tram trolley pole must be suited to these variations in trolley wire height. Trolley wire points of support are spaced distances varying from 100 to 120 feet (30.4 to 36.5 metres).

The overhead trolley wire system is designed to operate satisfactorily with trams equipped with overhead collector poles.

(f) Existing Rolling Stock.

With one exception, all existing trams are fitted with moulded non-metallic brake shoes operated by air pressure (65 pounds per square inch—448 kilopascals). Brake application is made by driver operation of a Westinghouse self-lapping valve Type "W". Excessive braking and frequent emergency stopping produce a great deal of skidding with resultant flats on wheels and, consequently, much noise and increased maintenance work. The brake equipment (air compressor, air cylinder and piston-operated link mechanism) is also noisy and requires excessive maintenance to keep it in good order and reasonably free from noise. Hence, replacement vehicles must be all-electric. Slow speed and/or parking brakes should not be air-operated.

All of Melbourne's trams are fitted for driving from either end. Unlike European tram systems, trams in Melbourne do not traverse a loop at a terminus. They use a cross-over between tracks and shunt from one track to the other. Thus, when they reach a terminus and proceed to return, what was, on the outward journey, the trailing end of the tram becomes the driving end for the return journey. Hence, new trams will require duplication of driving controls—full facilities at each end. This is essential. It then follows, because of this reversing action, that the trams must have doors on both sides.

Melbourne's trams are not equipped with pantographs. They are fitted with two trolley poles (spring loaded, with carbon block current collector slides). When the tram reaches a terminus, the trailing pole is lowered (and placed under a hook) and the other pole raised ready for travel in the reverse direction. It is essential that this method of current collection be retained as alterations to the existing overhead network (special fittings, crossings, turn-outs, bridges) would be too extensive and too costly to permit any consideration being given to a pantograph at this stage.

Existing driving controls are hand operated. It is desired that replacement vehicles be fitted with foot operated controls.

(g) General Comments.

Because of its terrain and street layout, Melbourne is well suited to tram operation. Steep grades are few and City streets are wide (99 feet—about 30 metres), straight and intersect at right angles. The central business district contains an area about one mile (1.6 kilometres) square and tram tracks are laid along the centres of most major City streets in this area. All traffic travels on the left side of a street, not the right as in most European countries.

Traffic in Melbourne is increasing rapidly and peak hour congestion is becoming an ever-increasing problem. For this reason, it is probable that, at some future time, it will be advisable to place underground some, if not all, tram tracks in the central City area. If this is done, such underground tracks would be laid—at shallow depth—more or less at surface grades. It is, therefore, unlikely that undergrounding would amend, in any way, the grade figures quoted.

This probable undergrounding of trams in Melbourne should be kept in mind when Tenderers are preparing designs. It is essential that the type of vehicle offered is suitable for operation on underground routes. Any one underground route would have a length not exceeding 2 miles (3.2 kilometres).

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CITY OF MELBOURNE, VICTORIA, AUSTRALIA.

WIND, EVAPORATION AND LIGHTNING DATA.

Month	Wind Velocity — Height of Anemometer 93 feet (28.35 millimetres)						Average Amount of Evaporation		Number of Days of Lightning	Number of Clear Days
	Average		Highest Average Velocity During One Day		Highest Gust Velocity		Inches	Millimetres		
	Miles Per Hour	Kilometres Per Hour	Miles Per Hour	Kilometres Per Hour	Miles Per Hour	Kilometres Per Hour				
January	8.8	14.2	21.1	34.0	66	106	6.55	166.4	1.8	6.8
February	8.4	13.5	19.0	30.6	74	119	5.10	129.5	2.3	6.4
March	7.8	12.6	18.0	29.0	66	106	4.26	108.2	1.8	5.5
April	7.1	11.4	19.9	32.0	67	108	2.53	64.3	1.2	4.6
May	7.4	11.9	21.8	35.1	72	116	1.57	39.9	0.5	3.4
June	7.2	11.6	22.8	36.7	62	100	1.18	30.0	0.4	2.7
July	8.7	14.0	22.7	36.5	68	109	1.16	29.5	0.3	2.9
August	8.2	13.2	21.3	34.3	65	105	1.54	39.1	0.9	3.1
September	8.5	13.7	21.0	33.8	69	111	2.41	61.2	1.3	3.3
October	8.4	13.5	18.6	30.0	69	111	3.54	89.9	1.8	3.8
November	8.6	13.8	21.2	34.1	71	114	4.62	117.4	2.3	3.6
December	8.7	14.0	21.0	33.8	61	98	5.85	148.6	1.9	4.5
Year {	Totals	—	—	—	—	—	40.31	1024.0	16.5	50.6
	Averages	8.1	13.1	—	—	—	—	—	—	—
	Extremes	—	—	22.8	36.7	74	119	—	—	—

APPENDIX A (i)

Month	Vapour Pressure Average at 9 a.m.		Relative Humidity (per cent) at 9 a.m.			Rainfall				
	Inches	Millimetres	Average	Highest	Lowest	Average Monthly Rainfall		Average Number of Days of Rain	Greatest Rainfall During One Day	
						Inches	Millimetres		Inches	Millimetres
January	0.382	9.70	58	68	50	1.88	47.8	9	2.97	75.4
February	0.417	10.59	62	77	48	2.00	50.8	8	3.44	87.4
March	0.385	9.78	64	79	50	2.22	56.4	9	3.55	90.2
April	0.351	8.92	72	82	66	2.30	58.4	13	3.15	80.0
May	0.311	7.90	79	88	70	1.94	49.3	14	1.85	47.0
June	0.276	7.01	83	92	75	2.06	52.3	16	1.74	44.2
July	0.264	6.71	82	86	75	1.93	49.0	17	2.71	68.8
August	0.271	6.89	76	82	65	2.02	51.3	17	1.94	49.3
September	0.288	7.32	68	76	60	2.20	55.8	15	2.62	66.6
October	0.307	7.80	62	71	52	2.63	66.8	14	3.00	76.2
November	0.336	8.53	60	69	52	2.33	59.1	13	2.86	72.6
December	0.373	9.47	59	69	48	2.38	60.4	11	3.92	99.7
Year	{ Totals Averages Extremes	—	—	—	—	25.89	657.6	156	—	—
		0.330	8.20	69	—	—	—	—	—	—
		—	—	—	92	48	—	—	—	3.92

CITY OF MELBOURNE, VICTORIA, AUSTRALIA.

TEMPERATURE AND SUNSHINE DATA.

Month	Average Temperatures				Extreme Shade Temperatures				Extreme Temperature Range		Highest Temperature (in Sun)		Average Daily Hours of Sunshine	
	Average Maximum		Average Minimum		Highest		Lowest							
	Degree F.	Degree C.	Degree F.	Degree C.	Degree F.	Degree C.	Degree F.	Degree C.	Degree F.	Degree C.	Degree F.	Degree C.		
January	77.7	25.4	56.9	13.8	114.1	45.6	42.0	5.6	72.1	40.0	178.5	81.4	7.8	
February	78.6	25.9	58.0	14.4	109.5	43.1	40.2	4.6	69.3	38.5	167.5	75.3	7.4	
March	74.9	23.8	55.2	12.9	107.0	41.7	37.1	2.8	69.9	38.9	164.5	73.6	6.5	
April	67.9	19.9	50.8	10.4	94.8	34.9	34.8	1.6	60.0	33.3	152.0	66.7	5.0	
May	62.0	16.6	46.9	8.3	83.7	28.7	29.9	-1.2	53.8	29.9	142.6	61.4	4.1	
June	56.8	13.7	43.8	6.6	72.3	22.4	28.0	-2.2	44.3	24.6	129.0	53.9	3.4	
July	56.2	13.4	42.6	5.9	69.3	20.7	27.0	-2.8	42.3	23.5	125.8	52.1	3.7	
August	58.7	14.8	43.7	6.5	77.0	25.0	28.3	-2.1	48.7	27.1	137.4	58.6	4.6	
September	63.3	17.4	46.0	7.8	88.6	31.4	31.0	-0.6	57.6	32.0	142.1	61.2	5.5	
October	67.9	19.9	48.7	9.3	98.4	36.9	32.1	0.1	66.3	36.8	154.3	67.9	5.8	
November	71.3	21.8	51.8	11.0	105.7	40.9	36.5	2.5	69.2	38.4	159.6	70.9	6.2	
December	75.4	24.1	55.3	12.9	110.7	43.7	40.0	4.4	70.7	39.3	170.3	76.8	7.0	
Year	Averages		Extremes		—	—	—	—	—	—	—	—	—	5.6
	67.6	19.7	50.0	10.0	114.1	45.6	27.0	-2.8	87.1	48.4	178.5	81.4	—	

(F. — Fahrenheit: C. — Celsius)

APPENDIX A (iii)

## SECTION III — SPECIFICATION.

### 3. DESIGN PARAMETERS.

#### 3-1. GENERAL.

##### (a) Type of Tram.

The trams shall be of the all-electric type and of the most modern design and construction consistent with a requirement that all components shall have been proven in street traction service.

##### (b) Essential Features.

All designs offered will be subjected to critical examination to determine whether or not they incorporate the following features:

- (i) Quiet, smooth operation on rails set in concrete to street level as shown on Drawing T.2500-5.
- (ii) Effective and reliable braking — both service and emergency.
- (iii) Safe, economic operation.
- (iv) High schedule speed.
- (v) Low maintenance costs.
- (vi) The utmost in crew and passenger comfort and appeal.
- (vii) Low floor height and acceptable step arrangement.
- (viii) Ease of cleaning — internal and external.

##### (c) Method of Operation.

Trams shall be suitable for double ended operation with a seated conductor. Loading shall be through double folding doors at the front, and unloading shall be through double folding doors located forward of the rear truck.

##### (d) Interchangeability.

All parts of each tram shall be strictly interchangeable with any similar part on any other tram supplied under this Contract.

#### 3-2. DIMENSIONS.

##### (a) Clearance Limits.

The maximum overall width of the tram shall not exceed 8 feet 9 inches (2,667 millimetres) at any point (with the exception of flashing turn indicators and retractable rear vision mirrors). It is, however, essential that the tram body be designed to provide the maximum possible floor area subject to the limitation of this overall width and the clearance limits governing length and end shape.

Drawing T.2500-6 shows the arrangement of tracks with the minimum radius of curve used in traffic operation. Any tram offered must be designed so that (with the exception of flashing turn indicators and retractable rear vision mirrors) no part of the body shall, whilst negotiating either curve, encroach on the clearance lines shown on this drawing.

The limits of the loading gauge are shown on Drawing T.2500-7. The cross section of the tram shall not extend beyond these limits.

##### (b) Typical Arrangement.

Drawing T.2500-8 shows one arrangement for a tram which conforms to the clearance requirements and provides the minimum acceptable seating capacity.

Tenderers are not bound to comply with this drawing in all respects but it indicates dimensions which are considered to be critical. If the body design offered departs substantially from these requirements, Tenderers shall submit detailed explanations of the reasons for the departures.

#### 3-3. WEIGHT AND LOADING.

##### (a) Weight.

The tram shall be as light as is practicable without sacrifice of strength or rigidity.

##### (b) Passenger Loading.

When the total load on the vehicle is being considered, the allowance for each passenger shall be 140 pounds (63.5 kilograms). When individual items of equipment (such as seats, grab rails and the like) are designed, the allowance per passenger shall be 200 pounds (90.7 kilograms).

##### (c) Dynamic Loading.

Adequate allowances shall be made for increases in vertical loads caused by suspension movement and for increases in horizontal loads caused by acceleration, deceleration, cornering and minor collisions.



(d) Standing Load.

The standing load capacity of the vehicle shall be calculated on the basis of one passenger for each 16 inches x 16 inches (406.4 millimetres x 406.4 millimetres) or acceptable equivalent rectangular area of floor available.

(e) Over Load.

Notwithstanding the above method of calculating the normal standing load, the tram must occasionally operate with as many passengers as can possibly board. The body and truck structures must be capable of withstanding this occasional load without failure and motors, control equipment and brakes must operate reliably though with reduced performance.

(f) Axle Load.

The maximum axle load under any operating conditions shall not exceed 8 tons (8,128 kilograms).

3-4. OPERATING PERFORMANCE.(a) General.

The tram will be required to operate satisfactorily on all existing routes — where, apart from a small percentage of reserved track, it will be operating (at grade) with motor traffic and existing trams — and on future routes which are expected to include a higher percentage of reserved track and some underground operation.

The tram shall have acceleration and deceleration characteristics which will provide the best possible performance under the following conditions:

- (i) Suburban operation on tracks having separate right-of-way with 3 stops per mile (1.6 kilometres) and an average time of 10 seconds at each stop.
- (ii) Suburban operation on tracks at grade — while mixed with motor vehicles which have a nominal speed limit of 35 miles (56.3 kilometres) per hour — with up to 6 stops per mile (1.6 kilometres) and an average time of 10 seconds at each stop.
- (iii) City operation on tracks at grade with 8 stops per mile (1.6 kilometres) and up to 60 seconds at each stop.

Under existing conditions 10 per cent of normal operation occurs under condition (iii) and 75 to 90 per cent occurs under condition (ii). It is anticipated that operation under condition (i) — now zero to 15 per cent — could increase to 40 per cent in the future with consequent reduction in the operation under condition (ii).

When underground operation is introduced it will occur in the City section and it is probable that 8 stops per mile will be retained but that the time at each stop will be reduced.

(b) Maximum Speed.

The maximum speed of the tram with wheels of design diameter shall be 45 miles (72.4 kilometres) per hour plus or minus 5 per cent when operated with a full seated load on straight level track.

(c) Safe Motor Speed.

The maximum safe motor speed shall be not less than that corresponding to 55 miles (88.5 kilometres) per hour with the tram wheels at condemning diameter.

(d) Acceleration.

The tram shall be fitted with acceleration control equipment capable of providing a smooth increase of acceleration from zero to maximum acceleration in 1 to 1.5 seconds without undue discomfort to standing passengers.

(e) Acceleration Speed-Time Curve.

Tenderers shall submit a speed-time curve for acceleration to maximum speed from a stationary start under the conditions of full seated load on straight level track.

(f) Deceleration.

With full seated load on straight level track the maximum braking rate with normal service braking shall be 5.3 feet (1.6 metres) per second per second. The transition period from first application of brake to maximum dynamic braking shall not exceed 1 second and the rate of change of deceleration should not exceed 7 feet (2.1 metres) per second per second per second.

The maximum emergency braking rate shall not be less than 12 feet (3.66 metres) per second per second.

(g) Deceleration Speed-Time Curve.

Tenderers shall supply speed-time curves for braking from initial speeds of 10, 20, 30 and 40 miles (16.1, 32.2, 48.3 and 64.4 kilometres) per hour and maximum speed with full seated load on level track under each of the following conditions:

- (i) Normal service braking.
- (ii) Full emergency braking.
- (iii) With one motor defective.
- (iv) With mechanical brake only.
- (v) With track brake only.

(h) Low Speed Control.

Provision shall be made for driving the tram for short distances at a fixed low speed, i.e. less than 10 miles (16.1 kilometres) per hour.

(j) Performance Data.

Tenderers shall submit lists showing the running time and energy consumption between each stop for a tram operating in both directions over both the sections of track shown on Drawings T.2500-2 and T.2500-3.

It shall be assumed that trams are required to remain at each stop for 10 seconds and carry a full seated load over the whole journey.

Tenderers shall guarantee the accuracy of these lists to within 5 per cent and the Board reserves the right to use them in an acceptance test of the tram.

3-5. STANDARDS.

(a) General.

All materials and equipment included in the tram offered shall comply with the appropriate Standard Specifications issued by an internationally recognised Standards Authority.

Tenderers shall clearly state the particular Standards which are applicable to the items included in their tender.

(b) Screw Threads.

Tenderers shall advise full details of the screw threads used in construction of the tram. If at all possible it is desirable that the one Standard should be used throughout the vehicle. If this can not be achieved, care shall be taken to ensure that on each unit requiring regular maintenance attention all bolts and studs shall have threads and spanner sizes to the same Standard.

3-6. NOISE LEVEL.

QUIET OPERATION OF THE TRAM IS ESSENTIAL. THE SOUND LEVELS WHICH THE BOARD CONSIDERS TO BE NECESSARY FOR QUIET OPERATION ARE LISTED IN PART 10 OF THIS SPECIFICATION. NOISE LEVEL TESTS WILL BE CONDUCTED ON ALL TRAMS IN ACCORDANCE WITH THE DETAILS SET OUT IN THAT PART. TENDERERS SHALL STATE THE SOUND LEVELS THAT THEY ARE PREPARED TO GUARANTEE. IF THESE GUARANTEED SOUND LEVELS ARE EXCEEDED THE TRAMS SHALL BE MODIFIED AT NO COST TO THE BOARD.

4. BODY.

4-1. GENERAL.

The tram body shall be designed to comply with all of the requirements of Part 3 of this Schedule, and with the critical dimensions shown on Drawing T.2500-8.

It shall be of attractive, modern appearance with continuous glass lines and shall be of light weight consistent with a strength of construction which shall ensure at least 30 years of service without fatigue, corrosion or other failure of body members.

Tenderers are reminded of the requirements for the lowest practicable floor height, low maintenance costs and attractive, comfortable interior.

The body structure shall be designed with adequate strength to meet all of the loading requirements imposed on it by street traction service.

Provision shall be made for lifting (also jacking) facilities at the following locations:

- (i) On each side of the tram — at or near each truck centre.
- (ii) At each end of the tram, preferably on the bumper bar.

For workshop maintenance purposes, the side lifting facilities will be used to lift the vehicle by means of cable suspended hooks and to transfer the body to temporary supports.

For emergency re-railing, the side lifting facilities will be used to raise the tram with jacks.

The end lifting facilities will be used for emergency recovery work when the side of the tram is not accessible.

The trucks shall be raised with the body unless intentionally detached.

The tram shall be provided with smooth exterior panels, free from ripple and wrinkle. The preferred design is one which permits the ready replacement of these panels when damaged in minor collisions. Other designs will receive full consideration. Anti-drum treatment shall be provided wherever necessary to ensure quiet operation.

The roof shall be electrically insulated (over its entire area) to an approved standard. It shall be designed to support trolley poles and bases as described in Part 6 of this Schedule and to support, without damage, the weight of a man walking the entire length of the roof. During maintenance it is necessary to step from one tram to another.

The method of construction, insulation and sealing shall ensure permanent insulation and weather tightness under the above conditions and when subjected to all climatological variations described in Section II of this Schedule.

All equipment and enclosures beneath the body shall be located so that a clearance of 2 inches (51 millimetres) above rail is maintained under all conditions of loading when the wheels are at condemning diameter and the tram is operating on either a concave or convex vertical curve of 600 feet (183 metres) radius.

Tenderers shall provide full information relating to the design of the body structure including dimensioned drawings showing plan, elevations and cross-sections of the complete body. Details of construction such as the methods of joining all major sub-assemblies shall also be provided. Design calculations shall be submitted where applicable.

Tenderers shall also provide complete specifications of the materials used in the body structure and of the methods of assembly used. The method of insulation of the roof shall be described in detail and Tenderers shall provide information relating to the proof tests which may be applied to the insulated roof.

Details shall be given of tests to be applied to all relevant parts of the body structure — to prove design calculations — in the event of acceptance of any tender.

#### 4-2. FLOOR.

##### (a) General.

The floor height shall be as low as is practicable consistent with specified clearance requirements. A level floor throughout the passenger section is preferred. Tenderers may submit alternative proposals if changes in floor height can be provided at acceptable locations, thus making boarding and alighting safer and easier.

##### (b) Type of Construction.

Tenderers shall provide full details of the type of floor construction offered including details of the spacing of supports, thickness of material and the method of fixing the floor. If the type of construction proposed does not have inherent noise-damping properties, arrangements shall be made to provide this feature. The floor shall be treated to ensure that it is water proof and rot (or corrosion) resistant.

The floor shall have ample strength to meet the specified loading requirements. It shall be covered up to meet the walls or a suitable cove moulding shall be provided at all locations where vertical surfaces meet the floor.

##### (c) Floor Covering.

The floor shall be covered by means of an approved floor covering material which shall have the following properties:

- (i) Completely homogeneous in structure and having the same colour throughout the thickness of the material.
- (ii) High resistance to wear, decomposition and cracking.
- (iii) Good flexibility and resilience with a non-slip surface.
- (iv) Complete recovery after repeated indentations by a 5/16 inch (8 millimetres) diameter spike heel with a load of 140 pounds (64 kilograms).
- (v) Completely impervious to water.
- (vi) Unharmful and unchanged in appearance by a lighted cigarette dropped on it and allowed to smoulder.
- (vii) Easily cleaned.

The floor covering shall be supplied in sheet form (tiles are not acceptable) and shall be firmly attached to the floor by means of a fully water proof, permanent adhesive which will prevent lifting or bubbling of the covering even after repeated washings of the floor.

The floor covering may be provided in two thicknesses for use in areas of light and heavy traffic.

Tenderers shall supply full details of the floor covering offered and shall submit samples of the material for inspection and test. The material used for floor covering shall be an item for approval by the Board after the Contract is signed.

(d) Floor Hatches.

Trap doors in the floor are not favoured and shall be limited to those essential for maintenance purposes. Where trap doors are installed, flush fitting non-jamming latch lifts shall be provided.

4-3. INTERIOR LINING.

The interior of the tram shall be designed to have an attractive appearance. Painting shall be used only in those applications where no other surface treatment is practicable. All panelling, including the ceiling, shall have a melamine or other approved satin surface which is easy to clean and resists damage by scuffing, scratching, burning, denting and similar treatment. Joins in the panels shall be covered by adequate cover strips and the panel fixing shall be concealed although the panels shall be readily removable.

All equipment enclosures inside the tram shall be designed to match the interior finish and shall be covered with the selected panel material.

Non-flammable, thermal insulation shall be provided in the spaces between the roof and the ceiling and between the exterior panels and lining.

Samples shall be provided of the materials and cover strips which are offered together with details of the colour range available. The lining materials shall be items for approval by the Board after the Contract is signed.

4-4. WINDOWS.

(a) General.

All glass used in the windows, doors and bulkheads shall be toughened safety glass of the correct weight for the application. The driver's windscreen shall be glazed with clear glass while all other glass in windows and doors shall be of a glare reducing and heat-ray-screening type which transmits 70-78 per cent of visible light and 44-53 per cent of total radiation.

(b) Windscreen.

The windscreen shall be sloped at an angle which will prevent night reflections from interfering with the driver's vision while still retaining upper and lower glass lines to provide adequate vision for the proper operation of the tram. All windscreen elements shall be plane sections and pillars and glazing bars shall be designed to reduce to a minimum the development of blind spots in the driver's field of vision.

(c) Side Windows.

The side windows shall be as large as is practicable consistent with the structural design of tram. Window pillars shall coincide with the centre of the back-to-back seats as shown on Drawing T.2500-8. All side windows shall be of the same size and continuous upper and lower glass lines shall be provided.

The lower section of each of the side windows shall be fixed and shall be glazed directly into the body side panels without the use of a frame. The corners of each window shall have a radius of not less than 4 inches (102 millimetres). The upper section of all side windows — approximately 10 inches (254 millimetres) deep — shall consist of two halves, each of which shall slide horizontally. Special attention shall be given to the sealing between the sliding sections so that the windows are draught proof and water tight when closed, regardless of the direction of travel. The sliding sections shall be free from rattles. Opening and closing shall be simple operations.

Tenderers may submit an alternative top opening provided it does not interfere with the operation of interior blinds, allows equivalent ventilation to the sliding window and does not protrude beyond the vehicle.

Tenderers shall supply full details of the proposed windows including the type and weight of glass to be used, the size and method of construction and the method of sealing the opening section of the windows. The windows shall be an item for approval by the Board after the Contract is signed.

4-5. DOORS.

The doors shall be of the inward folding type arranged in pairs as shown on Drawing T.2500-8. The distance between door pillars at all doorways shall be identical. Each doorway shall be fitted with stanchions and dividing rails to provide two openings. The leading opening of each doorway shall be not less than 2 feet (610 millimetres). The remaining opening shall be 2 feet 3 inches (686 millimetres) wide. Sloping hand rails shall be fitted to the inside of the leading door at each doorway; but no hand rail is required on the trailing door. The hand rail shall provide firm support for passengers entering or leaving the vehicle.

The doors shall be constructed and installed so that they close positively and prevent draughts and rattling. Weather sealing shall be effective for both directions of tram operation. All wearing parts of the door shall be designed for ready replacement of worn sections. Lubrication points shall be readily accessible.

It will be an advantage if the front half of each entrance door can be opened independently of the rear half of that door; but this is not an essential requirement and a proven door mechanism should not be discarded by a Tenderer because this facility is not featured.

The required method of door control is set out in Part 6 of this Specification. The maximum time required for the doors to open or to close shall not exceed 2 seconds. Low voltage electric door motors are favoured. A clutch shall be provided in the door drive to—

- (i) ensure that the motor is not overloaded should the doors be prevented from operating, and
- (ii) permit the doors to be opened manually in the event of motor or supply failure.

The door drive mechanism shall be completely enclosed but shall be readily accessible for maintenance. The hinged access cover shall be provided with a device which positively locates it in the open and in the closed position. Means shall be provided for securing the cover in the closed position.

“Soft” edges shall be fitted to all doors to cause them to re-open if they strike an object while closing. The doors shall reclose after 2 seconds. When the door is closed, the soft edges shall be disconnected from the door-opening circuit.

If portion of the door is slotted to clear a step when the door is open, gravity operated flaps shall be used to form an effective weather proof seal when the door is closed.

Toughened safety glass (glare reducing as defined in 4-4(a)) shall be provided in the upper and lower sections of each door—as shown in Drawing T.2500-8.

Tenderers shall supply full details of the doors offered including illustrations, drawings and description of the methods of construction and of operation. Information shall also be provided of the number of doors of this type already in traction service. The doors shall be an item for approval by the Board after the Contract is signed and the Contractor shall be required to submit one set of doors for inspection and test before commencing quantity production.

#### 4-6. STEPS.

All steps shall be contained within the body of the tram. The step wells shall be constructed from an acceptable material which will provide a water tight, corrosion free structure. The steps shall be so arranged that they shed water off their surface and out of the tram. They shall be covered with a material similar to that used on the tram floors and shall be provided with light coloured non-metallic tread plates suitably located and dimensioned to facilitate cleaning.

Tenderers shall supply full details of the design of the steps including illustrations and dimensioned drawings. The materials used in construction of the step well, the steps, the floor covering and the tread plates shall be specified. The steps shall be an item for approval by the Board after the Contract is signed.

#### 4-7. PASSENGER SEATS.

##### (a) General.

The seating arrangement shall be as shown on Drawing T.2500-8. There shall be fixed seats for 36 passengers and folding seats for 12 passengers (6 at the front and 6 at the rear of the tram). Fixed seats shall be arranged in back-to-back units and shall be dimensioned as shown on the drawing.

##### (b) Seat Frames.

Seat frames shall be designed to carry the loads specified in Part 3 of this Schedule.

Seat bases for fixed seats shall be boxed in as shown and the seat shall be cantilevered from the base to provide a clear space under the front and end of the seat.

Folding seats shall be designed to automatically return to the folded position when they are not in use. The hinge arrangement shall be strong and effectively protected to prevent injury to passengers. When folded, seats shall present a smooth surface to the passenger area. The 6 folding seats at each end of the tram shall be so designed that all can be locked in the folded position by means of a control unit located in the conductor's enclosure at that end of the tram.

Supporting frames for upholstery materials shall be designed to meet the requirements of the upholstery materials to be used and shall be shaped where necessary to provide comfortable seating.

Seat cushions shall be securely fixed in position to prevent movement in service but shall be easily removed when necessary.

##### (c) Upholstery.

Seat cushions shall be upholstered with an approved moulded natural rubber foam. The cushions shall have the following properties—

- (i) Graded resistance to load — that is, soft at first contact with increasing resistance as load increases, thus providing firm support without bottoming.
- (ii) Adequate tensile and compressive strength to withstand heavy duty public transport service without crumbling or failure.

The upholstery material used for folding seats may be thinner than that used for fixed seats if this will increase loading space (when the seats are folded) without seriously reducing passenger comfort.

Seat backs shall be upholstered with an approved foam material which shall be moulded to provide adequate and comfortable support for passengers' backs.

Seat cushions and backs shall be covered with an approved industrial quality material having a smooth, easily cleaned surface with minimum grain. The material shall also have—

- (i) resilience—to resist sagging and wrinkling;
- (ii) high flame resistance—it shall be difficult to ignite and shall be self-extinguishing upon removal of the flame;
- (iii) freedom from—
  - (a) cracking and peeling;
  - (b) softening (and stickiness) in hot weather;
  - (c) damage when scrubbed with warm water and detergent.

The covering material shall be stitched with an approved thread and shall be attached in an approved manner.

Tenderers shall supply full details of the seats offered including drawings and illustrations which show the method of construction. Samples of covering materials and information of the colour range available shall be submitted with the tender. Passenger seats shall be an item for approval by the Board after the Contract is signed. The Contractor will be required to submit a complete fixed seat and a complete folding seat for inspection and test before quantity production commences.

#### 4-8. DRIVER'S COMPARTMENT.

##### (a) General.

Each driver's compartment shall be identical in layout and in furnishing and shall house all equipment and controls specified. The floor of the compartment shall be raised approximately 12 inches (305 millimetres) above the floor of the passenger compartment.

A bulkhead (partition) shall be provided behind the driver's seat. This bulkhead may be used to house equipment but the depth of the bulkhead should not exceed 9 inches (228.6 millimetres). It would be an advantage if a coat locker could be provided in each driver's compartment. Part of the bulkhead may be used for this purpose.

If no equipment is to be housed therein, all or part of the bulkhead above seat back height shall be glazed with toughened safety glass of an approved colour and light transmission grade. Tenderers shall provide details of the glass proposed and alternatives available.

##### (b) Access.

Access to the compartment shall be provided from the passenger compartment by means of a movable section of the hand rail shown on Drawing T.2500-8. It shall be possible for a driver to abandon his position without difficulty if a collision is imminent.

##### (c) Protection.

Limitations on the direct fixing of equipment to the front panels are provided in Part 6 of this Schedule. It is, however, essential that the front of the vehicle be so constructed that protection is provided for the driver and all equipment in the event of a collision. A bar shall be provided in a convenient position in front of the driver as a hand support.

##### (d) Visibility.

Clear visibility for the driver both by day and by night is essential. Tenderers shall provide full details of all measures taken to eliminate windscreen reflections from the interior of the vehicle. Curtains should not be used.

##### (e) Interior Lining.

The interior lining of the driver's compartment shall be identical to that provided in the passenger section of the vehicle. All control enclosures shall be neatly finished and be free from sharp edges. All corners formed by the floor and vertical surfaces shall be coved to assist cleaning.

##### (f) Driver's Seat.

The driver's seat shall be designed to provide maximum comfort and ventilation. It shall be fully adjustable in all directions and shall swivel about the vertical axis.

Tenderers shall provide full details of the seat offered. Drivers' seats shall be an item for approval by the Board after the Contract is signed and the Contractor will be required to submit a complete seat for inspection and test before commencing quantity production.

##### (g) Ventilation.

In addition to the power ventilation system specified in Clause 4-11, the driver's compartment shall be provided with an adjustable means of adequate direct ventilation from an air intake in the front of the tram.

##### (h) Windscreen Wipers.

Twin windscreen wipers shall be fitted to each windscreen. Automatic intermittent operation with a variable cycle time and two speed operation are desirable.

Wiper motors shall be of adequate capacity to operate continuously for extended periods without overheating or failure. Motors and operating mechanism shall be neatly housed but shall be accessible for maintenance. A clutch shall be provided in the drive to protect the motors (and the drive) should the blades stall (or be moved when the motors are not operating). When the windscreen wipers are not operating the arms and blades shall be automatically parked so as not to impede the driver's vision.

Wiper arms shall be of adequate strength to drive the blades but shall be of a section which does not seriously impede visibility. They shall be pivoted from the bottom of the windscreen and shall wipe the maximum area of windscreen with adequate overlap in the upper central section of the windscreen.

Blades shall be of a type and size readily available for replacement.

Full details shall be provided by the Tenderer.

(j) Windscreen Washers.

Power operated windscreen washers shall be provided at each end of the tram to deliver an effective stream of water in the path of the windscreen wipers.

Controls for the washers shall be included in (or be adjacent to) the windscreen wiper controls and be arranged so that water is delivered only while the control is held in the "on" position.

A reservoir of approximately one-half gallon (2.3 litres) capacity shall be provided in a convenient location at each end of the tram. Provision shall be made for filling the reservoir from outside the tram.

(k) Demister.

A heater and fan unit of adequate capacity shall be provided in each driver's compartment and air from this unit shall be ducted on to the windscreen to provide effective demisting.

(l) Rear Vision Mirrors.

Rear vision mirrors shall be provided at each end of the tram to permit the driver to look along the left-hand side of the tram and view the exit doorway. The mirrors shall be rectangular in shape, of the correct size and be edged with black rubber. Reflecting surfaces shall be sealed to ensure long service life.

The mirror shall be mounted on a retractable arm which shall automatically and positively locate itself in both the extended and the retracted positions. The mirror shall be capable of easy adjustment and positive locking at the end of the arm.

(m) Interior Mirrors.

Interior mirrors shall be provided to permit the driver to view the interior of the tram from the normal driving position.

(n) Sun Shield.

A sun shield of approved coloured toughened safety glass or plastic material shall be provided in each driver's compartment. It shall be of suitable size to assist the driver when he is driving towards the sun and shall fold away when not required. Suitable clamps shall be provided to lock the shield in the desired position.

4-9. CONDUCTOR'S ENCLOSURE.

(a) General.

Two enclosures (located generally as shown on Drawing T.2500-8) shall be provided for the seated conductor. Each enclosure shall consist of a hinged desk, an adjustable seat and a platform raised approximately 12 inches (305 millimetres) above the floor of the tram. A clear toughened safety glass screen shall be provided between each conductor's position and the adjacent transverse seat to protect the heads of seated passengers from the conductor's arm movements.

(b) Desk.

Each desk shall house a ticket printing and issuing machine, a cash tray and a change-issuing machine. A cover shall be provided and so arranged that the conductor can readily lock up all money and tickets without removing them from the operating position. It shall be possible for the conductor to work from either position without the need to transfer equipment or money. Locks shall be secure and effective and one key shall fit both desk covers. It shall be possible to remove the key only after the lock is operated.

Details of currency and fare scales in use in Melbourne are set out in Part 7 of this Specification. Tenderers are requested to design the desk to suit the tendered type of ticket and change-issuing equipment. This shall be shown in the tender as a separate cost item (not to be included in general tender price) as the Board may decide to purchase other types of change and ticket issuing equipment.

The desk shall incorporate a small, hand-luggage shelf for use by passengers when tendering fares.

(c) Seat.

The conductor's seat shall be designed to provide the maximum in comfort and ventilation. It shall be fully adjustable in all directions. The conductor's seat shall be an item for approval by the Board after the Contract is signed. The Contractor will be required to submit a complete seat for inspection and test before commencing quantity production.

(d) Locker.

A locker equipped with a key-operated lock shall be provided in each conductor's position to house spare tickets and personal effects.

(e) Controls.

The various controls and public address equipment operated by the conductor and specified elsewhere in this Schedule shall be capable of being locked when the conductor vacates his position.

4-10. STANCHIONS AND HAND RAILS.

There shall be no external stanchions. All internal stanchions, guard rails and strap hanger rails shall be manufactured from satin finish stainless steel tube, stainless clad tube or an acceptable alternative. The rails in the vicinity of the driver's compartments may be covered with shrink-on plastic tubing of an approved standard if this assists in reducing reflections.

Stanchions and rails shall be of adequate strength and rigidity and of a suitable diameter for their application. They shall be adequately supported.

Vertical stanchions shall be provided between the back of each transverse seat and the ceiling. They shall be set in 4 to 5 inches (102 to 127 millimetres) from the edge of the seat. Horizontal strap hanger rails shall be provided between these stanchions at a height of 6 feet 3 inches (1,905 millimetres) above the floor. These rails shall be located as shown on Drawing T.2500-8. Beyond the limits of the transverse seats, vertical stanchions and/or roof brackets shall be provided in suitable locations to support the strap hanger rail.

Strap hangers of approved design shall be provided and fixed at intervals along the rail. One strap hanger shall be provided approximately 16 inches (406 millimetres) from each vertical stanchion. Strap hangers shall also be provided in suitable locations beyond the limits of the transverse seats.

Strap hangers shall be provided with a smooth grip—which will comfortably fit a hand 4 inches (102 millimetres) wide—at a height of 5 feet 6 inches (1,676 millimetres) above the floor. Strap hangers shall have a breaking load in excess of 400 pounds (181 kilograms). It shall be possible to replace a defective strap hanger without dismantling the rail.

Provision shall be made for the support of the stop signal cord by means of suitably designed brackets attached to the window side of each strap hanger rail. The brackets shall be spaced to hold the cord clear of the rail at or about rail height.

4-11. VENTILATION AND HEATING.

(a) General.

Details of the power ventilation system and the required heating range are provided in Clause 6-8 of this Schedule.

(b) Ducts.

Ducts shall, wherever possible, be designed as an integral part of the body structure. All interior vents and openings shall have an attractive appearance. External openings shall be located and designed to prevent entry of moisture, dust and other foreign matter. If air is drawn in below floor level, filters shall be provided. These filters shall be designed for ready removal and simple cleaning or cheap replacement.

All ducts shall be designed and constructed to inhibit the transmission of noise to the interior of the tram. They shall be insulated or protected to prevent objectionable local heat transfer or the burning of a passenger by contact with the duct or duct opening.

All removable covers shall be provided with flexible, oil-resistant seals capable of withstanding the temperatures likely to be encountered. Hinges and latches shall be of sturdy construction and be securely attached.

The ventilation system may incorporate outward-opening roof vents. If this type is tendered, open vents shall not foul a lowered trolley pole and shall be completely weather sealed when closed. They shall have a firm, lever-controlled action and be spring loaded in both the open and closed positions. Control levers shall be located to permit ready operation. Vents shall be capable of opening in any direction to suit double-ended tram operation.

4-12. DESTINATION AND ROUTE NUMBER SIGNS.

Requirements for destination and route number signs are detailed in Clause 6-9 of this Schedule. Each end of the tram shall be shaped to accommodate the signs and associated equipment. Care shall be taken to ensure that projections and/or angles do not interfere with the free movement of the trolley rope.

The signs at each side of the tram shall be designed to fit (with minimum projection into the passenger space) into the pillar near the entrance door as shown on Drawing T.2500-8.

All signs shall be sealed to prevent the ingress of water and dust. Ready access shall be provided for sign maintenance and lamp replacement.



**4-13. MISCELLANEOUS BODY ITEMS.****(a) Bulkheads.**

(i) Bulkheads — glazed above seat back height with clear toughened safety glass — shall be provided on each side of each exit doorway.

(ii) Bulkheads — to sill height — shall be provided in front of the first transverse seat (opposite the seated conductor's enclosure) at each end of the tram. These shall be of an approved type.

**(b) Roof Drains.**

Roof water shall be collected in continuous guttering around the perimeter and shall be discharged through four concealed downpipes of adequate cross-sectional area. The guttering shall be at least 1½ inches (32 millimetres) wide and 1½ inches (32 millimetres) deep.

Guttering and downpipes shall be manufactured from corrosion resistant material, care being taken to ensure that junctions between guttering and downpipes are effectively sealed.

Tenderers shall provide full details of the drainage installation proposed as this will be an item for approval by the Board after the Contract is signed.

**(c) Access to Roof.**

Folding steps of the hand grab type shall be provided on each side of the tram — at or near the location shown on Drawing T.2500-8 — to provide access to the roof. The steps shall be arranged to project at least 2 inches (51 millimetres) from the side of the tram when in the lowered position and be flush with the side of the tram body when not in use. Step housings shall be adequately drained.

Two suitably located steel hand grips shall be provided on the roof of the tram above each set of steps to assist a man to climb on to the roof. These grips shall be electrically insulated from the frame of the tram.

Tenderers shall submit full details of the steps and grips offered. These items and their location shall be an item for approval by the Board after the Contract is signed.

**(d) Sand Boxes.**

Sand boxes of adequate capacity shall be provided in suitable locations on the tram. They shall deliver sand in front of the leading wheels for each direction of travel. It is desired that the boxes be arranged for filling through hatches located on the outside of the tram. Visual indication (at the filling point) of the height of the sand in the boxes would be an advantage.

Sand boxes shall be manufactured from non-corrodible material and shall be designed to ensure ready release of sand when required.

As detailed in Part 6 of this Schedule, sand shall be delivered automatically when the emergency brake is applied but on all other occasions sand shall be delivered only when the driver pushes a button on the control panel.

Tenderers shall provide full details of the sand boxes offered and the method of release of sand.

**(e) Bumper Bar.**

A bumper bar of the anti-climber type shall be provided at each end of the tram. It shall be rigidly constructed to absorb impact and attached to the tram in an approved manner. It shall be capable of use as a jacking point (as detailed in Clause 4-1) unless an acceptable alternative arrangement is provided.

The top of the bumper bar shall be 2 feet 6 inches (762 millimetres) above rail level and shall be capable of accepting the Board's standard towing attachment which is 4 inches (102 millimetres) wide and 10 inches (254 millimetres) long. The towing attachments will be made available to the Contractor at the Board's Preston Store and mounting details will be discussed with the Contractor.

**(f) Skirt Height.**

The use of a straight skirt — generally as shown on Drawing T.2500-8 — is favoured but the final choice of skirt arrangement (and height) will be governed by several factors including floor and step heights and required access for maintenance and emergency work.

Tenderers shall submit a body design incorporating a skirt arrangement which they consider to be the most satisfactory for the tram offered and shall state the reasons for their choice. The Board may require the Contractor to modify the skirt line after the Contract is signed.

**(g) Blinds.**

A sun blind shall be fitted to each of the side windows. The blind shall be mounted on a spring roller housed in a neatly covered recess above the window. The lower end of the blind shall be attached to a bar, the ends of which slide in channels fitted to each window pillar.

The blinds shall be manufactured from material with the following properties:

- (i) An open weave which permits the passage of air but absorbs between 50 and 70 per cent of sunlight.
- (ii) Colour fast and unaffected by exposure to sunlight.
- (iii) Strong and resilient — free from sag and wrinkling.

Details of the blinds offered shall be submitted together with samples of the material and details of the colour range. The blinds shall be an item for approval by the Board after the Contract is signed.

(h) Luggage Racks.

Luggage racks — for small cases and parcels — shall be centrally located above each of the side windows (in the section of the tram with transverse seats). The racks shall be approximately 2 feet 6 inches (762 millimetres) long and 12 inches (305 millimetres) wide. The front edge of the racks shall be approximately 6 feet 3 inches (1,905 millimetres) above the floor of the tram. They shall be properly designed and fixed to securely hold parcels under all conditions of tram operation.

Details of the rack offered, including illustrations and/or drawings shall be submitted. The luggage racks shall be an item for approval by the Board after the Contract is signed.

(j) Litter Baskets.

Stainless steel litter baskets shall be provided at each exit doorway. These baskets shall be flush mounted in the bulkheads at the side of the doorways and shall be designed for the ready emptying of their contents.

Tenderers shall supply full details of the litter baskets offered and these baskets shall be an item for approval by the Board after the Contract is signed.

(k) Bumper Access Steps.

A recessed step shall be provided (in front of each entrance doorway as shown on Drawing T.2500-8) to provide access to the bumper bar. Suitably located hand grips and grab rails shall be provided to assist a man to climb on to the bumper bar and support himself while carrying out maintenance or cleaning operations.

4-14. PAINTING.

(a) Corrosion Prevention.

The possibility of corrosion shall receive close attention at all stages of design. Corrosion resistant materials shall be used where practicable. Recesses which could collect water shall be avoided.

In addition, all metal surfaces shall be cleaned by approved methods to remove rust, scale, dirt and other foreign matter. The cleaning process shall be immediately followed by the application of approved protective coatings.

The protective coatings applied to interior surfaces which will not be painted (such as the inside surface of the external panels) shall provide permanent protection from corrosion.

The protective coatings applied to surfaces which will be painted shall be compatible with the paint system to be applied.

(b) Timber Treatment.

Any timber which is exposed to the weather shall be vacuum impregnated with an approved preservative and shall be sealed with an approved paint system.

(c) Exterior Painting.

The colour scheme used on existing trams is green and cream; but the Board may adopt a different colour scheme for the trams purchased under this Contract. Tenderers are invited to design a colour scheme and submit a coloured illustration showing a perspective view of the tram.

The exterior paint system shall have the following properties:

- (i) 10 years' life in street traction service.
- (ii) A tough, scratch-resistant surface.
- (iii) High gloss finish.
- (iv) Colour fast over whole life.
- (v) Easily repaired when damaged.
- (vi) Film thickness at least 2½ times the "peak to trough" height of surface irregularities.
- (vii) At least four coats.

Trucks and all exposed metal under the tram shall be painted to an approved standard to seal protective coatings from attack.

(d) Interior Painting.

Painting of interior surfaces shall be employed only where no other surface treatment is practicable. The application of an organosol (or similar) plastic coating is favoured for surfaces which are subject to wear and which would normally be painted. Where painting is necessary, the system used shall be suitable for the surface to be treated and the finish shall be compatible with the interior lining.

Tenderers shall provide full details of the paint systems to be used — including methods of surface preparation, protective coatings, primers, undercoats and finish coats. The colour range of finish coats shall be indicated. The Standards applicable to the work shall be detailed and the guaranteed film thickness for each coat shall be stated.

The surface treatment, protective coating and painting system shall be items for approval by the Board after the Contract is signed.

5. TRUCKS.5-1. GENERAL.

The tram shall be equipped with two two-axle trucks suitable for operation on 4 feet 8½ inches (1,435 millimetres) track gauge on rails having the profile shown on Drawing T.2500-4. Each axle of the tram shall be a driven axle.

The trucks shall have the following characteristics:

- (i) Quiet, smooth operation on rails set in concrete to street level as shown on Drawing T.2500-5.
- (ii) Long life between overhauls — with no increase in operating noise.
- (iii) Satisfactory riding qualities under all conditions of loading.
- (iv) Low maintenance costs.
- (v) Minimum weight consistent with adequate strength and rigidity.
- (vi) Freedom from vibration.
- (vii) A design which will provide the lowest practicable floor height.

5-2. WHEELS.(a) Dimensions.

The wheel gauge shall be 4 feet 8-3/16 inches (1,427.2 millimetres); the distance between the inside faces of tires shall be 4 feet 6-11/16 inches (1,389 millimetres) and the width of the tire shall be 3½ inches (79.4 millimetres). Tolerances on these dimensions will be discussed with the Contractor.

When the wheel reaches condemning diameter there shall be no projection (beyond either face of the wheel) less than 2 inches (50.8 millimetres) above rail surface.

(b) Type of Wheel.

The wheels shall be of resilient construction unless the Tenderer produces positive evidence that all of the features listed in Clause 5-1 can be provided using a non-resilient wheel.

Tenderers shall provide full details of the type of wheel offered — including fully dimensioned drawings and illustrations of the method of construction. Methods of replacement of tires and resilient elements (together with a full description of the equipment necessary for this work) shall also be illustrated.

There may be advantages in the use of resilient wheels which are designed for the replacement of both tires and resilient elements without the need to lift the tram or to remove the trucks. Tenderers are invited to comment on this aspect.

The wheels shall be so made that there are no problems in maintaining concentricity when new tires and resilient elements are fitted.

The bonding of any rubber elements shall be carried out by the best techniques available. If rubber and steel-bonded sandwich plates are used, the edges of the sandwich shall be maintained in compression to reduce bond failure.

Tenderers shall submit a graph showing the radial deflection of the resilient wheel under all loads from zero to 8,000 pounds (3,630 kilograms).

(c) Wheel Mounting.

The hubs of the wheels shall be suitably drilled and machined to enable a high pressure oil method to be used for dismantling and assembling wheel and axle sets.

(d) Steel Specification.

Tenderers shall submit full specifications for the steel or steels used in each part of the wheel, together with the value of tire hardness recommended and the range of hardnesses which are considered to be acceptable production limits. Drawing T.2500-4 indicates the composition and hardness of rails on which the wheel will operate.

5-3. AXLES.

Tenderers shall provide full details of the axles offered including dimensions, details of the steel used and the heat treatment proposed.

Heat numbers of all axles shall be recorded by the Contractor. Each axle shall be marked on one end with an individual serial number. This number shall identify the heat number from which the axle was made.

All straightening operations shall be completed before final heat treatment.

The axle shall be finished ground over all cylindrical and fillet surfaces. Fillets at all changes of sections shall have a radius of not less than one inch (25.4 millimetres).

5-4. BEARINGS.

All bearings shall be of the anti-friction type. They shall be designed to provide a minimum life of 750,000 miles (1,200,000 kilometres) under normal operating conditions. Adequate seals shall be provided on each bearing to prevent loss of lubricants or ingress of contaminants.

5-5. GEARS.

(a) General.

The gears shall be inaudible under all operating conditions.

Tenderers shall supply full details of gears offered, including:

- (i) Specification of materials.
- (ii) Type of gears.
- (iii) Tooth form.
- (iv) Method of tooth generation.
- (v) Surface finish.
- (vi) Heat treatment.
- (vii) Details of housings.
- (viii) Recommended lubrication.
- (ix) Guaranteed service life.

(b) Lubrication.

Care shall be taken to provide ready access to gear boxes to check oil levels and for topping up. The cover of the filling point shall be so located that dirt can not enter the gear box during topping up operations.

(c) Fixing.

If gears are fitted to shafts by a press fit procedure, the hubs shall be drilled to permit the use of a high pressure oil method of assembly and dismantling.

5-6. SUSPENSION.

The suspension shall be designed to provide a smooth ride without objectionable pitching or sway on tracks with concrete to street surface and on ballast tracks. Whilst a soft ride is desired, the deflection between tare and crush loading shall be a minimum — as a low first step is desired at all stages of loading.

Tenderers shall provide full details of the method of suspension offered and include a graph showing the deflection of a truck under an evenly distributed load varying from zero to 30,000 pounds (13,600 kilograms).

5-7. TRUCK FRAME.

(a) General.

Truck frames shall be designed with sufficient rigidity to accurately locate all components of the truck and properly support the tram body; but shall have adequate resilience to absorb the forces imposed by acceleration, braking and cornering. It shall be possible for a tram to be involved in a low speed derailment on open ballast track without damage to the truck or to the body.

In this regard, Tenderers shall state the height through which any one axle can be raised above the level of a plane passing through the other three axles —

- (i) when the tram is empty, and
- (ii) when the tram has a full standing load.

Tenderers shall provide full details of the design of truck frame (including methods of manufacture) with particular reference to plate preparation, welding, stress-relieving operations and other precautions taken to prevent the formation of cracks.

(b) Attachment to Body.

Trucks shall be attached to the body so that the body and the trucks can be lifted as a single unit.

Tenderers shall supply full details of the method of attachment proposed — including the means provided to disconnect the body from the trucks should the need arise during maintenance work.

(c) Transmission of Load.

Tenderers shall provide full details of the method of transmission of load from the body to the trucks.

(d) Corrosion Prevention.

Truck frames shall be designed to eliminate recesses where moisture could collect and cause corrosion. Details of anti-corrosion treatment of the truck frame shall be provided.

(e) Lubrication.

Provision shall be made for ready access to all lubrication points on the trucks. It is desired to use the one lubricant for all parts of the truck. If this is not practicable, Tenderers shall state the method provided to indicate the correct lubricant for each lubrication point.

(f) Interchangeability.

All truck components shall be so manufactured that any one part of a truck shall be completely interchangeable with the corresponding part of any other truck manufactured under this Contract.

(g) Sanding Equipment.

Provision shall be made on each truck for attachments to guide sand to the correct position in front of the leading wheels of the front truck (for each direction of travel) when the tram is operating on straight and on curved track. Care shall be taken to ensure that sanding is not impeded by the ingress of water.

(h) Mudguards.

Truck wheels shall be protected by mudguards which shall be designed to deflect water and mud from the remainder of the truck. The mudguards shall not propagate noise and shall be so located that maintenance operations are not impeded.

(j) Lifeguards.

A suitably designed structure shall be attached to each truck frame to prevent wheels from running over a human being in the event of an accident.

Tenderers shall supply full details of the type and location of structure proposed and its method of attachment to the truck frame. The structure shall comply with the clearances specified in Section 3 of this Schedule.

5-8. BRAKES.

(a) General.

The braking system shall comprise three integrated types of braking:

- (i) Electro-dynamic — discussed in detail in Part 6 of this Schedule.
- (ii) Mechanical — low speed and parking brake.
- (iii) Track brake.

Any braking system which includes the use of clasp brakes applied to the tread of the wheels will be rejected.

Tenderers shall provide full details of the braking system offered.

(b) Electro-dynamic Brake.

See Part 6 of this Schedule.

(c) Mechanical Brake.

This brake shall be automatically applied when the speed of the tram has been reduced (by electro-dynamic braking) to a speed of approximately 2 miles (3.2 kilometres) per hour and shall bring the tram to rest from that speed without skidding or jerking.

It shall also be capable of effectively stopping the tram (with a full seated load) from full speed should the electro-dynamic braking system fail. This braking effort shall be achieved without brake fade and without distortion of the braking surfaces.

The brake shall be spring applied. It shall be suitable for use as a parking brake for an extended period when all other sources of brake application are absent.

The method of removal of the brake may vary depending on the braking system offered; but the brake shall be designed to ensure that braking surfaces are separated (to reduce wear) as soon as the vehicle is in motion.

A disc type of brake is favoured. Tenderers are invited to comment on alternative types of brake.

Ready means shall be provided for the manual release of the mechanical brake in the event of failure of the release mechanism. The manual release shall be simple to operate and shall be accessible from outside the tram.

Adjustment for wear and replacement of brake linings shall be simple, effective and easily inspected.

**(d) Track Brakes.**

Details of track brake electrical requirements are discussed in detail in Part 6 of this Schedule.

Track brakes shall be suspended between the wheels on each side of the truck so that four track brakes are provided with each tram.

They shall be applied to the rail by magnetic force and held from the rail by springs. The method of support shall provide ready means of adjusting the height above rail to give the most satisfactory operating conditions at all stages of wheel wear.

The fixing of the brake to the truck frame shall be designed to safely transmit the maximum braking effort without damage or failure. When in the released position, the brake shall not be a source of noise.

The parts of the track brake in contact with the rail shall be of materials which ensure maximum practicable life and minimum rail wear. They shall be cheaply and readily replaceable.

**6. ELECTRICAL EQUIPMENT.**

**6-1. GENERAL.**

The electrical equipment on the tram shall be suitable in all respects for use on the electrical system described in Clause 2-3 (e) of this Schedule. It shall comply with the appropriate requirements of I.E.C. Publications 77 (1968) and 349 (1971).

Particular attention is drawn to the paragraph relating to the system voltage. Tenderers shall state the lowest voltage at which the tram can be expected to operate, even at greatly reduced performance.

**6-2. CURRENT COLLECTION.**

**(a) Trolley Poles and Bases.**

The tram shall be fitted with two trolley poles. At this stage the Board proposes to supply, at its Preston (Melbourne) Store, trolley poles and bases for installation by the Contractor. It is, however, prepared to consider alternate equipment offered by tenderers provided full details, including price, are submitted.

Resilient mountings shall be provided on the roof of the tram to accommodate trolley pole bases. The exact position of the bases on the roof of the tram cannot be advised until the Contract is signed; but, for tender design purposes, it may be assumed that the centres of the trolley bases are approximately 26 feet (7,925 millimetres) apart and that the bases are equidistant from the centre of the tram. The trolley poles will be about 12 feet 9 inches (3,886 millimetres) long and will exert a force of 25 pounds (11.34 kilograms) on the trolley wire at a height of 18 feet (5,486 millimetres). Drawing T.2500-9 shows the dimensions and the location of mounting holes of the base plate to be provided by the Board. The height above the base plate of the pivot point of the trolley pole is 2.5 inches (63.5 millimetres).

Each trolley pole shall be so arranged that (in an emergency) it can be used as a trailing pole for either direction of travel. As the tram may pass under bridges (where the trolley wire height above rail is 12 feet 8 inches (3,860 millimetres) with a pole in the reversed position, care shall be taken to ensure that pole operation is not impeded by equipment mounted on the roof of the tram.

The resilient mounting for the trolley pole base shall be designed to avoid distortion or damage to the roof of the tram if the trolley pole is dewatered when the tram is travelling at maximum speed. The method of mounting shall ensure permanent weather tightness of the roof and provide insulation for the trolley pole base (which is alive at trolley voltage).

**(b) Trolley Retriever.**

An approved type of trolley retriever incorporating a handle operated reset device shall be fitted to each end of the tram. The retriever shall be complete with 25 feet (7,620 millimetres) of approved woven nylon cord of one inch (25.4 millimetres) circumference having a breaking strain in excess of 1500 pounds (680 kilograms) and shall be located in the centre of the dash above the headlights.

The preferred location for contactors is in a compartment beneath the floor—between the trucks. Access shall be provided by means of a cover (hinged at the top) in the skirt of the tram. The cover shall be rigidly constructed and shall be equipped with a device which provides positive location of the cover in both the closed and open positions. Means shall be provided for locking the cover in the closed position.

All contactors shall be set back from the outside of the vehicle to avoid damage when minor collisions occur; but shall be so arranged that maintenance work can be easily performed.

(c) Main Contactor.

The main (or line) contactor shall be closed by means of a solenoid or an acceptable equivalent. The contactor shall be equipped with overload protection designed to properly protect the tram circuits. It shall be capable of complying with all breaking capacity requirements of I.E.C. Publication 77 (1968).

As stated in Clause 2-3 (e) of this Schedule, the maximum short circuit current between overhead trolley wire and rail is of the order 10,000 amperes. A fault of this nature can be cleared by the substation equipment in 25 milliseconds. However, the use of rate-of-rise tripping on feeder contactors means that, if the rate of rise of fault current is less than 1,000 amperes per second, a fault of 6,000 amperes may persist at some locations without operating the protective devices in the substations. Thus, the maximum current available from the D.C. network shall be taken as 6,000 amperes for the purposes of testing under short circuit conditions.

Contacts shall be designed to carry continuously the full load current of the tram within the limits of temperature rise set by I.E.C. Publication 77 (1968) and shall be capable of interrupting the full load current of the tram without frequent maintenance.

(d) Auxiliary Contactors.

All auxiliary contactors shall be designed to meet the requirements of the sections of the circuit for which they are intended and, where required to break circuits, shall have a rupturing capacity adequate for the purpose. Contacts of all contactors shall be designed to carry continuously the full load of the circuit which they control within the limits of temperature rise set by I.E.C. Publication 77 (1968). They shall be capable of performing the operating cycle required without the need for frequent maintenance.

(e) Traction Motor Reversing Switch.

The tram shall be designed to be driven (in each direction) from either end. Traction motor circuits shall provide this facility by means of a key-controlled reversing switch at the driver's control panel at each end of the tram. The reversing switch shall indicate three conditions—"Forward", "Off" and "Reverse" and shall require the insertion of a key before the switch can be operated in any way. It shall not be possible to remove the key except when the switch is in the "Off" position. One key shall be provided for each tram and this key shall fit both switches on the tram and all other trams supplied under this Contract.

The switch shall be so designed that the driver cannot accidentally alter the position of the switch while the tram is in motion.

(f) Accelerator and Brake Controls.

Accelerator and brake controls shall be foot operated. These pedals shall be located and arranged for convenient operation with the right foot, the brake pedal being placed to the left of the accelerator pedal. The pressure required for full depression of the accelerator pedal shall be of the order 25 pounds (11.3 kilograms), and that for full depression of the brake pedal shall be of the order 35 pounds (15.9 kilograms). The variation in pressure from zero to full depression of each pedal shall be uniform.

In addition, there shall be a safety interlock pedal located for operation with the left foot. The pressure necessary to operate this pedal shall be of the order 10 pounds (4.5 kilograms). A hand operated push button shall be provided on the control panel. This push button shall be connected in parallel with the safety interlock pedal.

Pedal location and arrangement shall be an item for approval by the Board after the Contract is signed.

The following method of operation is favoured. (Tenderers may submit alternative proposals for consideration provided they are based on foot operation.)

(i) When the safety interlock pedal (or the push button) is depressed and the reversing switch is in the forward position, the tram may be driven by depressing the accelerator pedal. The design shall be such that acceleration is automatically controlled to ensure a smooth increase in speed as specified in Clause 3-4 of this Schedule. The driver shall, at all times, control the rate of acceleration by limiting the travel of the accelerator pedal. When pressure on the accelerator pedal is released, the motors shall be disconnected from electric supply until the pedal is returned to zero depression and pressure is re-applied. This operation shall be cushioned to eliminate jerking.

(ii) The brake pedal shall over-ride the accelerator pedal at all times. When the brake pedal is depressed (even if the accelerator pedal is depressed because of a mechanical failure), the motors shall be disconnected from electric supply and dynamic braking shall commence. The rate of dynamic braking shall increase as pressure on the brake pedal is increased up to the maximum dynamic braking rate. The braking rate shall then remain constant until the tram speed falls to below 2 miles (3.2 kilometres) per hour, when the mechanical brake shall be automatically applied to bring the tram to rest.

(iii) An over-travel position (latched) shall be provided on the brake pedal so that the track brake is energised when the driver depresses the pedal beyond this position. Sand shall be automatically applied to the tracks and an electric gong shall sound when track braking is engaged.

(iv) If dynamic braking fades at any stage in the braking cycle, the mechanical brake shall be engaged.

(v) If, while the tram is in motion, the driver removes his foot from the safety interlock pedal (and has not depressed the push button), the motors shall be disconnected from electric supply, the mechanical brake and the magnetic track brake shall be applied and the gong shall sound.

(vi) The safety interlock pedal (and button) shall be inoperative when the tram is stationary; that is, the track brake is not applied. The mechanical brake shall be so designed that the tram may be safely parked for an extended period with all power disconnected. Tenderers are reminded that brakes acting on the wheel treads are not acceptable.

(vii) Failure of external electric supply to the tram shall not cause the loss of any of the means of braking, nor shall it cause the automatic application of emergency braking.

(viii) Facilities shall be provided to permit the application of sand to the rails—at any braking stage—by means of a push button on each driver's control panel. Sanding shall cease when the button is released.

(ix) It shall be possible to start the tram up the steepest grade without the tram rolling back.

(g) Prevention of Wheel Skid.

Quiet operation of the tram on tracks set in concrete to street surface is an essential requirement. Wheel flats, caused by skidding during braking, are a major noise-generating source. Tenders shall include acceptable means of detecting and correcting wheel skidding.

The tram shall be provided with speed monitoring equipment which shall detect a significant variation in the speed of any axle relative to the remaining axles. It shall then influence the brake control equipment so that braking rate is reduced until the difference in axle speeds is acceptable. When this occurs, the braking rate shall return to normal. The installation shall fail safe—in that failure of the speed monitoring equipment shall not be capable of causing brake failure.

It would be an advantage if the equipment offered is also capable of correcting wheel spin during acceleration.

Tenderers shall provide full details of the equipment offered including:

- (i) the method of monitoring axle speeds;
- (ii) the nature and effect of the signal;
- (iii) the percentage relative variation in axle speed which can be detected and used as a signal;
- (iv) evidence of tests conducted;
- (v) details of Transport Authorities using the equipment and the time each equipment has been in service.

The speed monitoring equipment shall be an item for approval by the Board after the Contract is signed.

(h) Door Control Equipment.

The method of controlling opening and closing of doors shall be as follows:

(i) Controls shall be provided on each driver's control panel for the entrance (front) and exit (rear) doors for that direction of travel. Controls shall also be provided (in a separate position on the control panel because they will be rarely used) for the exit doors on the other side of the tram.

(ii) The entrance doors shall be directly controlled by the driver for both opening and closing—except that an interlock shall provide that the doors remain closed until the speed of the tram is reduced below 2 miles (3.2 kilometres) per hour. The entrance doors shall also be interlocked so that the tram cannot be started whilst they are open. A manually operated over-ride switch shall be provided to permit the tram to be driven with the entrance door open. An acceptable method of sealing this over-ride switch shall be provided—to prevent unauthorised use.

(iii) It will be an advantage if each half of the entrance doors can be operated independently.

(iv) Sensitive edges shall be provided on each set of doors and so arranged that the doors will automatically reverse if they are obstructed whilst closing.

(v) The exit doors shall be normally unlocked by the driver. They shall be passenger operated (by push button, tread switch or similar means) and automatically reclosed (with an adjustable time delay) after the last passenger leaves the control point.

(vi) It shall also be possible for the driver to open (and, if necessary, lock open) the exit doors.

(vii) The exit doors shall be interlocked in a manner similar to the entrance doors. Another over-ride switch shall be provided to permit the tram to be driven with the exit door open. An acceptable method of sealing this over-ride switch shall be provided—to prevent unauthorised use.



Tenderers shall provide full details of the method of controlling the doors including a schematic diagram of electrical circuits. Door control circuits shall be items for approval by the Board after the Contract is signed.

(j) Mounting of Components

The components of the various control circuits shall be arranged in logical equipment groups and mounted on sub-frames fitted into racks on the vehicle. Connections to the appropriate circuits shall be by means of plugs and sockets or jacks.

Sub-frames shall be properly designed to eliminate movement in service and circuit connections shall be unaffected by vibration or jolting.

It shall not be possible to connect the equipment for one part of a circuit in any other part of the circuit. Correct connections shall always be made if a plug can be properly inserted in its socket.

(k) Control Resistors.

Acceleration and deceleration control resistors (if used) shall be of lightweight design yet be of adequate capacity to meet all acceleration and deceleration cycles.

The resistors shall be mounted in convenient locations beneath the tram and shall be adequately ventilated; but protected from the ingress of dust and moisture. Thermal insulation shall be provided between resistors and floor.

If fans are necessary for ventilation of resistors, air shall be drawn from a location clear of dust or shall pass through readily cleaned filters. The fans shall be quiet in operation.

(l) Resistor Switching.

The resistors shall be provided with sufficient tappings to provide the specified acceleration and deceleration characteristics. The method of switching the sections of the resistors shall be described in detail.

6-5. AUXILIARY SUPPLY.

(a) General.

Attention is drawn to Clause 2-3 (e) of this Schedule. This Clause specifies the maximum auxiliary power which may be drawn from the trolley wire.

(b) Battery.

A battery (or batteries) with adequate ampere-hour capacity to meet requirements shall be provided. (One requirement is sufficient capacity to supply—for an 8-hour period—all emergency lights.)

The battery shall be of robust construction suitable for use in traction vehicles. Provided the battery offered is suitable for the service required (under Melbourne's climatic conditions), Tenderers may offer either acid or alkaline type and shall state reasons for their choice.

Tappings shall not be taken from part of the battery to supply a circuit which operates at a voltage different to that of the battery. If more than one battery is necessary, all batteries shall be of the same type.

The battery shall be securely held in a non-corrodible box properly vented to atmosphere; but designed to prevent the ingress of dust and moisture. The box shall be located in a readily accessible position and so arranged that the battery may be inspected without removing it from the box. If the box is mounted on slides, a simple, automatic locking device shall be provided to prevent movement in service.

(c) Motor Generator. (Either Alternating or Direct Current.)

The motor generator shall be of adequate capacity to supply the power requirements of all equipment connected to it; and to maintain the battery at the correct state of charge. It shall be of a modern, proven design with Class 'F' or 'H' type insulation. The unit shall be dynamically balanced to eliminate vibration; and shall be free from objectionable windage and commutator noises.

Tenderers shall supply full details of the generator offered including illustrations, dimensioned drawings and performance data. The means adopted to provide a regulated output voltage regardless of variations in supply voltage and load shall be described and illustrated with circuit diagrams.

Alternative proposals using an acceptable form of static inverter for the supply of auxiliary power will be considered if full details are supplied.

(d) Automatic Battery Charger.

Provision shall be made for charging the battery by means of an automatic regulator which shall provide the correct charging rate at all battery conditions from flat to fully charged.

Details of the operation of the battery charging equipment (including characteristic curves) shall be submitted. The equipment shall be capable of passing all tests set out in Clause 25 of I.E.C. Publication 165-1963.

**6-6. ELECTRICAL CONDUCTORS.****(a) General.**

The location and arrangement of all electrical conductors shall be designed and submitted for approval before installation. If groups of conductors are assembled in looms, all conductors in any one-loom shall be at the same voltage.

Where conductors are installed in the body of the tram—between items or groups of equipment—they shall be enclosed in approved, non-metallic ducts or tubes which shall protect the cables from damage. If other methods of installation are proposed, full details shall be submitted.

Access shall be provided at ends of cable runs to permit the drawing in of replacement cables.

**(b) Insulation.**

Conductors shall have fire-resistant insulation suitable for the circuit voltage. All insulation shall be suitable for operation at temperatures up to 185 degrees Fahrenheit.

Where connections from circuits of different voltages are made to the one piece of equipment, acceptable separation and insulation shall be provided. Alternatively, all connections to the equipment shall be insulated for the highest voltage applied thereto.

Tenderers shall provide full details of the grades and types of insulation to be used and the Standards applicable to all insulation materials.

**(c) Conductor Sizes.**

All conductors shall consist of not less than 7 strands of annealed copper wire. The cross-sectional area of each cable shall be sufficient to carry safely the maximum rated current of the circuit with a voltage drop not greater than 5 per cent of circuit voltage. In lightly loaded circuits (where voltage drop is not significant) the mechanical strength of the conductor shall determine the correct size to be used.

**(d) Circuit Protection.**

All circuits shall be adequately protected by fuses and/or circuit breakers.

**(e) Conductor Terminations.**

Each conductor shall terminate in an approved pre-insulated, crimp-on termination. The arrangement of connections to terminal strips shall be logical and consistent.

Any connection to the frame of the vehicle shall be bolted and brazed (or welded).

**(f) Cable Identification.**

A system of permanent numbering—or similar method of identification of cables—shall be developed. The numbers shall be allotted in a logical way so that parts of the circuit can be readily identified and the purpose and destination of any wire can be determined from the wiring diagram. The numbering system shall be identical for all trams supplied under this Contract.

The numbers shall be securely attached to the cables and be easily readable.

If a colour code is used as part of the cable identification system, green and black shall be used for negative cables only.

**6-7. LIGHTING.****(a) Saloon Lighting.**

The interior illumination of the tram shall be by means of two rows of fluorescent lights mounted in the ceiling above the passenger seats. A level of illumination of not less than 5 lumens per square foot shall be provided throughout the nominal life of the lamps. The level of illumination shall be measured in the reading plane at each passenger seat with the target of the light meter at 45 degrees and located 32 inches (813 millimetres) above the floor of the tram.

The lighting installation shall be designed to eliminate reflections in the driver's windows.

Fluorescent lights may be supplied either from transistor inverters operated from the battery supply or from an alternating current source (50, 200 or 400 cycles). They shall not be supplied direct from the 600 volt traction supply.

The fluorescent fittings shall be continuous throughout the length of the tram. They shall be recessed where practicable.

Diffusers shall be captive when open. Their interior and exterior surfaces shall be smooth; but shall be sufficiently opaque to reduce to an acceptable level the apparent brightness of the lamp. All mating surfaces between the diffuser and the frame of the fitting shall be designed so that the diffuser is accurately located and the fitting is effectively sealed.

The fluorescent lamps shall be of a readily available type and size. Ready means of access shall be provided for lamp replacement.

A two-way switch shall be provided so that the driver may switch the interior lights from either end; but the lights shall be connected in more than one circuit.

Tenderers shall supply full details of the equipment offered including dimensions, arrangement, operating voltage and frequency and method of sealing against ingress of dust.

**(b) Head Lights.**

Twin head lights of an automotive type shall be provided at each end of the tram. They shall be mounted in a single fitting located as shown on Drawing T.2500-8 and supplied from a low voltage source. Single filament lamps arranged for operation in a permanently dipped position shall be provided.

It shall not be possible to switch on head lights at both ends of the tram at any one time.

**(c) Tail and Stop Lights.**

Two combined tail and stop lights (colour — red) shall be provided at each end of the tram. Tail lights shall be interconnected with head light circuits so that, when the head lights at one end of the tram are illuminated, the tail lights at the other end of the tram are also illuminated.

The fittings shall not incorporate reflectors in the lens.

A warning light shall be provided on each driver's control panel to indicate the need to change over head and tail lights when reversing at a terminus.

Two-way switching shall be provided in head and tail light circuits so that these lights can be operated from either driving position.

Stop lights shall be so connected that they are illuminated when the brake pedal at the remote driving position is depressed. They shall operate independently of the tail lights.

**(d) Emergency Lighting.**

Emergency lights shall be provided and located as follows:

- (i) Interior—four lights, one adjacent to each entrance and exit.
- (ii) Exterior—four red lights, preferably incorporated in the tail light fittings.

These lights shall be supplied from the battery and shall be automatically illuminated when interior lighting is switched on but external electric supply to the tram is interrupted.

**(e) Turn Indicators.**

Flashing turn indicators shall be provided generally as shown on Drawing T.2500-8.

The lights shall be connected (in pairs) so that they can be controlled from each driver's control panel. They shall be automatically switched off after 60 seconds. If the switch is then turned to the "On" position a further flashing period of 60 seconds shall be available. A light on each control panel shall flash when the turn indicator lights are flashing; but shall not flash if any lamp is defective. In addition, audible indication shall be given that the lights are flashing.

**(f) Exterior Light Fittings.**

All exterior light fittings shall be secured by screwing to the structure (or to nuts fixed to panels) so that units can be readily and completely removed.

**(g) Driver's Lights.**

A light, controlled by a separate switch on the control panel, shall be provided in the ceiling of the driver's compartments.

**(h) Step Lights.**

Step lights shall be provided in each doorway. The lights shall be located to adequately illuminate each step well and shall be so connected that they are automatically switched on each time the door is opened—if the saloon lights are switched on.

**(j) Destination and Route Number Lighting.**

Each destination and route number box shall be illuminated to an approved standard by means of fluorescent lamps. These shall be so located that they may be readily maintained without restricting access to the destination equipment.

Tenderers shall provide full details of the proposed method of illumination.

**(k) Inspection Lights.**

Inspection lights (or outlets for portable lights) shall be provided in suitable locations for maintenance purposes. The lights (or outlets) shall be supplied from the battery and shall be switched from convenient locations. They shall be available for use when all other circuits on the tram are disconnected.

Tenderers shall provide full details of the proposed installation.

**(l) Approval of Lighting Installations.**

All lighting installations shall be items for approval by the Board after the Contract is signed.

6-8. VENTILATION AND HEATING.(a) General.

The trams shall be provided with a ventilation system of variable output. The system shall have ample capacity for the required service and shall be so controlled that maximum output is automatically provided whenever the temperature of the air inside the vehicle exceeds 80 degrees Fahrenheit. The output shall be progressively reduced (with falling temperatures) until the minimum output is reached when the air temperature inside the vehicle is 65 degrees Fahrenheit.

Mild heating is required to improve passenger comfort during winter months (when ambient temperatures are in the range 29 degrees to 55 degrees Fahrenheit). It is desired that the temperature inside the tram shall be maintained between 60 degrees and 65 degrees Fahrenheit under these conditions.

The entire ventilation and heating system shall be automatically disconnected when external electric supply to the tram is interrupted.

(b) Waste Heat.

Waste heat from motors and resistors may be used to provide some or all of the required heating; but care shall be taken to ensure that all heated air is discharged to atmosphere when the temperature inside the vehicle exceeds the selected range.

(c) Heaters.

If auxiliary heaters are required (or if the Tenderer considers that a better installation can be provided by separating the equipment ventilation system from the interior ventilation system) the heaters shall be designed with a large surface area which heats ducted air and distributes it throughout the tram. High temperature radiant heaters and individual blower type heaters are not favoured.

(d) Fans.

All fans shall be designed for quiet operation and shall be free from whine.

Fans suspended from the ceiling of the tram are not an acceptable method of ventilation.

(e) Access for Maintenance.

The entire heating and ventilation system shall be so designed that maintenance requirements are a minimum. Any necessary maintenance shall be facilitated by ready access to the equipment.

Tenderers shall provide full details of the heating and ventilation system offered, including the methods of fan and temperature control, location of fans, heaters and ducts and an air flow diagram.

The ventilation and heating system shall be an item for approval by the Board after the Contract is signed.

6-9. DESTINATION AND ROUTE NUMBER SIGNS.(a) General.

Destination and route number signs shall be provided as shown on Drawing T.2500-8.

(b) Destination Signs.

The destination signs shall have capacity for 50 destinations (displayed singly). The letters displayed at the front and at the rear shall be not less than 5 inches (127 millimetres) high. Smaller letters may be used in destination signs on the sides of the tram.

(c) Route Number Signs.

The route number signs shall have capacity for all numbers from 0 to 199. Blank spaces shall also be provided.

The numbers displayed at the front and at the rear shall be as large as is practicable up to a maximum of 9 inches (228.6 millimetres). Smaller numbers may be used in route number signs on the sides of the tram.

(d) Control of Signs.

All signs shall be electrically operated and accurately indexed so that the driver can operate (from either driving position) all route number signs by one set of controls, and all destination signs by a second set of controls. The method of control shall be simple and reliable, and indication shall be provided to the driver so that the signs displayed can be checked.

(e) Type of Signs.

It has been the Board's practice to use silk screened curtains as route number and destination signs. More effective methods of display may be available and Tenderers are invited to submit details of designs which will provide an acceptable standard — both by day and by night. It is, however, important that route numbers and destinations are displayed and operated separately.

Tenderers shall include (in their tender price for the tram) the price of the units complete with blank display material.

Destination and route number signs shall be items for approval by the Board after the Contract is signed.

## 6-10. SIGNALS.

### (a) General.

A series of audible and visual signals shall be provided on the tram. They shall be so designed that there is no possibility of confusing the signals once the sounds and methods of display are known.

### (b) Stop Signal.

Cords manufactured from an approved, strong, light-coloured, easily cleaned material shall be provided on each side of the tram as shown on Drawing T.2500-8. When the left hand cord (facing in the direction of travel) is pulled a buzzer shall sound once, a sign at the front of the tram (bearing the words "NEXT STOP") shall be illuminated and a light shall appear on the appropriate driver's panel.

Regardless of the number of times the cord is pulled the buzzer shall not sound again until the tram has been stopped and the exit doors have been unlocked.

The other cord shall not operate the equipment for this direction of travel.

Buttons at each seated conductor's position shall perform all of the functions of the operating cord. In addition, they shall operate the buzzer repeatedly if necessary.

### (c) Door Operation Signals.

When the driver unlocks the exit door, a sign above that door shall be illuminated to indicate to passengers that the door is unlocked. This sign shall also indicate the method of opening the door.

The condition of all doors (whether open, closed and/or locked) shall be indicated by signal lights located on the driver's control panel.

### (d) Warning Bell.

Suitable electrically operated bells (one at each end of the tram) shall be provided to warn other road users of the approach of the tram. The appropriate bell shall be operated by depressing a spring-loaded button on the driver's panel and be automatically switched on when the emergency brake is applied.

### (e) Recording Speedometer.

The tram shall be equipped with a recording speedometer which shall record the speed of the tram in kilometres per hour and shall retain a record of this speed until the tram has travelled at least 1500 feet (457 metres). The trace shall be automatically and progressively erased by further passage of the tram so that a record of the speed over the last 1,500 feet (457 metres) is always available. The instrument shall be locked to prevent unauthorised access and provision shall be made for the ready removal of the plate carrying the trace and the fixing of the record should this be required.

The recording speedometer is required to record the speed in each direction of travel. If the instrument offered is not capable of providing this facility, two instruments shall be fitted and each shall be connected in circuit only for the direction of travel to which it applies.

### (f) Indicating Speedometer.

An indicating speedometer shall be provided at each driver's position and shall indicate the speed of the tram in kilometres per hour within the limits of accuracy of plus or minus 2 per cent. It may be supplied as part of the recording instrument or as a separate device.

### (g) Odometer.

An odometer shall be fitted to provide an accurate record of the total distance travelled by the tram. The register capacity shall be 999,999 kilometres.

Tenderers shall provide full details of all instruments offered.

## 6-11. PUBLIC ADDRESS SYSTEM.

### (a) General.

A public address system shall be provided on the tram to enable the driver and/or conductor to speak to passengers inside the tram and to intending passengers outside the tram.

### (b) Location of Microphones.

Suitable directional dynamic microphones shall be provided at the following locations:

(i) One microphone (mounted on a flexible arm) at each driver's position. Microphone switches shall be located on the driver's control panel and shall be of the press-to-talk type.

(ii) One microphone at each seated conductor's position. Microphone switches shall be located on the conductor's control panel and shall be of the press-to-talk type.

(c) Location of Speakers.

Interior speakers shall be mounted in the ceiling of the tram and located to give the most effective distribution of sound without microphone feed-back or interference between speakers. The fittings shall be attractively designed.

Exterior speakers shall be located adjacent to entrance doors.

(d) Amplifier.

A suitable amplifier (supplied from the tram battery) shall be provided. Volume controls shall meet all requirements of the installation.

6-12. CONTROL PANELS.(a) Driver.

All necessary controls and indicating lights shall be provided in the driver's compartment. They shall be arranged in a logical manner so that those controls which are most frequently operated are located nearest to the driver. Indicating lights shall be so located that they are readily identified with associated controls.

A variety of operating devices (that is, of different shapes) shall be provided to assist the driver in performing the correct operation. The use of internally illuminated push buttons may be an advantage in some applications.

The surface of the control panel shall be non-reflecting and an approved hood shall be provided to eliminate windscreen reflections.

A cover shall be provided at each driver's position so that all controls can be securely and readily locked. One key shall control both covers, and locks shall be so arranged that it is not possible to have both covers open at the same time.

Tenderers shall provide full details of the proposed arrangement of controls. The detailed arrangement of the driver's compartment shall be an item for approval by the Board after the Contract is signed.

(b) Conductor.

All of the controls and equipment required by the conductor shall be assembled in a convenient unit which shall be duplicated at each location. Provision shall be made for controls at the position not in use to be covered and locked.

7. FARE COLLECTION EQUIPMENT.7-1. DECIMAL CURRENCY.

The Australian decimal currency system employs 6 coins of the following denominations: 1 cent, 2 cents, 5 cents, 10 cents, 20 cents and 50 cents. The dimensions, manufacturing tolerances and weights of the coins are provided in detail in the following table. (The 50 cent coin is not used in quantity and it is not proposed to make provision for this coin in the change issuing machine.)

Coin Cent	Item	Maximum		Minimum		Weight	
		Inches	Milli-metres	Inches	Milli-metres	Grains	Grammes
1	Diameter	0.693	17.60	0.687	17.45	40	2.592
	Thickness	0.063	1.600	0.056	1.422		
	Stack of 50	2.907	73.84	2.841	72.16		
2	Diameter	0.854	21.69	0.850	21.59	80	5.184
	Thickness	0.079	2.007	0.073	1.854		
	Stack of 50	3.778	95.96	3.771	95.78		
5	Diameter	0.767	19.48	0.762	19.35	43.6	2.825
	Thickness	0.055	1.397	0.051	1.295		
	Stack of 50	2.650	67.31	2.637	66.98		
10	Diameter	0.932	23.67	0.927	23.55	87.3	5.657
	Thickness	0.072	1.829	0.067	1.702		
	Stack of 50	3.493	88.72	3.480	88.39		
20	Diameter	1.124	28.55	1.120	28.45	174.6	11.314
	Thickness	0.094	2.388	0.087	2.210		
	Stack of 50	4.518	114.76	4.496	114.20		

7-2. FARES AND SECTIONS.

The existing tram fare scale is set out in the following table:

Number of Sections Travelled	Adult Fare	Child's Fare
1	10 Cents	5 Cents
2	20 "	10 "
3	25 "	10 "
4 or 5	30 "	15 "
6 or 7	35 "	15 "
8 or 9	35 "	20 "
10 or 11	40 "	20 "

The majority of passengers pay a cash fare. Provision is made for special tickets for passengers travelling within the central City area who are issued with 10 cent "City" tickets and pensioners who receive concessions and are issued with tickets in denominations of 5, 10, 15 and 20 cents all designated "P".

The existing pattern of ticket sales is as follows:

Ticket	Percentage of Total Ticket Sales
5 Cents	3
10 "	18
15 "	2
20 "	23
25 "	12
30 "	13
35 "	7
40 "	Less than 1
10 Cents City	15
5 " "P"	2
10 " "P"	2
15 " "P"	2
20 " "P"	Less than 1

7-3. CHANGE ISSUING MACHINE.

The change issuing machine shall be capable of delivering any required change between 1 cent and 1 dollar (100 cents) by the operation of the minimum number of keys or buttons. While the existing fare scale is based on multiples of 5 cents it may not be practicable to maintain this scale, so that provision should be made for change which includes 1 and 2 cent coins. To issue change of say 97 cents the conductor should only be required to press two keys—90 cents and 7 cents. The keyboard shall be so arranged that any required combination of keys can be depressed in one operation.

It would be an advantage if the design of the coin magazine provides for it to be readily removed and transferred to an identical machine at the second conductor's enclosure on the tram or to another tram.

The coins held in the magazine shall always be visible to the conductor and it would be an advantage if the change issued by the machine could be displayed to the conductor before it is delivered to the passenger.

7-4. FARE COLLECTION TRAY.

A tray shall be provided on the desk so that the conductor can inspect the money offered and readily sort it into separate compartments for each coin denomination. It will be an advantage if the money is automatically stacked ready for transfer to the change issuing machine.

7-5. TICKET PRINTING AND ISSUING MACHINE.

The ticket printing and issuing machine shall have the following features:

- (i) It shall print tickets on a roll of plain paper which may be readily replaced in less than 20 seconds.
- (ii) The printed ticket shall show the following information:
 

Machine number	
Serial number of ticket	( 0 to 9999 )
Fare	( 0 to 100 cents)
Route code	( 0 to 999 )
Fare stage	(00 to 99 )
Type of transaction	Ordinary, City or Pensioner (O, C or P)

Melbourne and Metropolitan Tramways Board.  
Ticket must be shown on demand.  
Not transferable.
- (iii) The machine shall display the serial number of the last ticket issued and total cash value of tickets issued up to 99,999 cents.
- (iv) The machine shall be designed to be fool-proof in operation and shall be sealed to prevent tampering with registration of serial number or cash value of tickets issued.
- (v) The method of altering the fare scale shall be simple yet positive and the fare chosen shall be displayed to the conductor.
- (vi) Acceptable means of removing the printed ticket from the machine shall be provided.

A means of recording the details of tickets issued, on printed, punched or magnetic tape, will be an advantage.

8. ITEMS FOR APPROVAL.

Schedule "D" nominates those items for approval by the Board after the Contract is signed.

Tenderers shall supply the price per tram included in the tender price for each and every nominated item.

Tenderers are invited to also include in Schedule "D" any other items (or alternatives) which they consider should be nominated for separate pricing.

9. SPARE AND SPECIAL EQUIPMENT.9-1. SPARE PARTS.

Tenderers shall include, in Schedule "D", a complete list of those spare parts which are considered to be necessary for the successful operation of 100 trams for a period of 5 years at an average mileage of 30,000 to 40,000 (48,000 to 64,000 kilometres) per year.

The spare parts shall include complete sub-assemblies and the components necessary to effect repairs to sub-assemblies.

Prices of all spare parts shall be calculated on the assumption that they will be ordered with the complete vehicles. Tenderers shall indicate those items which will be significantly more expensive if they are ordered at a later date.

9-2. SPECIAL EQUIPMENT.(a) Test Equipment.

Tenderers shall offer (as separate items) all test equipment necessary for proper testing and maintenance purposes. A full description of the operation and the function of each item of equipment shall be included in the tender.

Provision of a unit which will provide a ready means of testing all or any of the plug-in components of the control circuits is desired.

(b) Training Equipment.

Tenderers shall offer (as a separate item) one complete set of electrical equipment and trucks so that the Board can assemble this equipment and use it for the training of maintenance personnel. Tenderers shall state in detail the equipment included in this item. Early delivery of the training equipment is essential.

(c) Maintenance Equipment.

Tenderers shall offer (as separate items) all necessary special maintenance equipment. This equipment shall include any special jigs or assemblies for the proper dismantling and assembly of tram components.

(d) Tools.

Tenderers shall list the full range of special tools which will be supplied, including the numbers of each type of tool.



### 9-3. MOULDS.

All moulds necessary for the manufacture of replacement parts for fibre glass sections of the body shall be made available to the Board at the completion of the Contract. The price of these moulds shall be included in the total tender price for the trams. It shall be the Contractor's responsibility to ensure that the moulds are delivered to the Board in good order and condition.

Fibre glass body sections may be one of the items which the Board would undertake to supply after negotiations with the Contractor.

## 10. INSPECTION AND TESTS.

### 10-1. INSPECTION.

Inspections may be undertaken during construction periods to ensure that all work is carried out in accordance with the requirements of this Specification. Details of inspections will be arranged with the Contractor.

### 10-2. TESTS.

#### (a) General.

Tests shall be conducted to determine whether or not the tram (including its components and all materials of construction) complies with the requirements of this Specification and the design and performance data submitted with the tender.

Three classes of tests will be applied — type, routine and investigation.

(Note: Facilities will be made available to the Contractor should he wish to carry out adjustment tests after delivery.)

The locations at which the various tests shall be conducted shall be a matter for agreement between the Board and the Contractor.

Tests on the complete tram shall be carried out in accordance with International Electrotechnical Commission Publication 165 — "Rules for testing rolling stock on completion of construction and before entry into service".

Tests on traction motors, auxiliary motors and generators shall be those specified in I.E.C. Publication 349 (1971) — "Rules for rotating electrical machines for rail and road vehicles".

Tests on electrical control equipment shall be those specified in I.E.C. Publication 77 (1968) — "Rules for electric traction equipment".

Tests on materials of construction and items of equipment shall be those specified by the approved Standards to which they are manufactured. If the Standard which applies to an item of equipment is not specified by the Contractor, the tests on that item of equipment shall be those specified by an appropriate, internationally recognised Standard selected by the Board.

Sound level tests on the complete tram shall be carried out in accordance with details set out in Clause 10-3 of this Schedule.

#### (b) Type Tests.

Type tests shall be carried out on the first tram delivered and on such other trams as the Board may decide.

Type tests shall include all relevant tests specified in I.E.C. Publication 165 (1963) and in the Standards to which the various components are manufactured.

The Board may agree to accept components on the evidence of Certified Reports of type tests conducted on equipment similar to that offered; but reserves the right to require the Contractor to arrange for type tests on any components.

#### (c) Routine Tests.

The Board will undertake routine tests on each tram delivered. These routine tests will include those specified in I.E.C. Publication 165 (1963).

#### (d) Investigation Tests.

Special investigation tests to determine vehicle characteristics, such as rolling resistance and energy consumption, may be conducted as agreed between the Board and the Contractor.

### 10-3. SOUND LEVEL TESTS.

#### (a) General.

Sound level tests shall be conducted on each tram before acceptance. Any tram which does not comply with the following requirements shall be modified or adjusted by the Contractor at no cost to the Board. In addition trams may be selected at random for type tests in which frequency analyses of the noise will be carried out.

**(b) Acoustical Environment.**

Tests of sound levels external to the tram will be conducted in an acoustical environment complying with Clause 3 of British Standard 3425 (1966).

**(c) Measuring Instrument.**

Noise will be measured by means of a sound level meter complying with British Standard 3489 (1967). All results will be in decibels (dB) above the standard reference pressure of 0.00002 Newtons per square metre. Octave band analyses will be conducted using octave band filters complying with British Standard 2475 (1964).

**(d) Test Conditions.**

The sound generated by trams will be tested under three conditions:

- (i) Inside the tram while it is at rest—with all auxiliary equipment operating. All doors and windows shall be closed. The microphone shall be located 1.2 metres above the floor.
- (ii) Inside the tram while it is travelling under power at a speed of 25 miles (40 kilometres) per hour, on a section of track with concrete to street surface construction (as shown in Drawing T.2500-5). All doors and windows shall be closed. The microphone shall be located 1.2 metres above the floor.
- (iii) Outside the tram while it is travelling under power, at a speed of 25 miles (40 kilometres) per hour, over a section of track with concrete to street surface construction (as shown on Drawing T.2500-5). The microphone shall be located 7.5 metres from the centre line of the track and 1.2 metres above the ground.

**(e) Maximum Sound Levels.**

The maximum sound levels which the Board considers should apply to a quiet tram are set out in the following tables. Unless the Tenderer submits alternative proposals relating to sound levels which are acceptable to the Board and which are incorporated in the contract, the following sound levels will be used in all testing and trams which fail to meet these standards will be rejected by the Board until modified.

Condition	Maximum Sound Level at "A weighting" (dBA)
(i)	55
(ii)	70
(iii)	77

All noise shall be broad band with no audible pure tone components.

When type tests are carried out on selected trams the maximum permissible levels measured under each of the above conditions shall be as follows:

Condition	Maximum Sound Level at "A weighting" (dBA)	Maximum Sound Level at "C weighting" (dBC)	Maximum Speech Interference Level (dB)
(i)	55	73	48
(ii)	70	80	62
(iii)	77	85	70

Levels of this order are obtainable when the noise has a frequency spectrum which, with increasing frequency, falls at a rate of at least 6 dB per octave.

For the purpose of this Contract, Speech Interference Level shall be defined as the arithmetic average of the sound pressure levels in the three octave bands centred at 500, 1000 and 2000 hertz.

**(f) Gear Noise.**

When the tram is being driven at 25 miles (40 kilometres) per hour and power is cut off, there shall be no sustained change in sound level.

**(g) Internal Sound Level.**

In addition to the sound level tests set out in Clause (d) (ii) above, the sound level inside the tram shall be measured while the tram is driven at varying speeds. The increase in sound level with increase in speed shall be uniform and at a rate not exceeding + 5 dB for every doubling of the speed.

11. GUARANTEES.

Tenderers shall state the period for which the tram is guaranteed against failure or excessive wear. Fair wear and tear and negligence on the part of the Board's servants are excepted from the guarantee.

Any repairs or replacements which, in the Board's opinion, are necessary under the terms of guarantee shall be carried out by the Contractor free of cost to the Board.

Where the guarantee periods for specific items of equipment do not coincide with the general guarantee, tenders shall include the nominated guarantee period for each item.

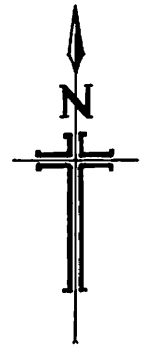
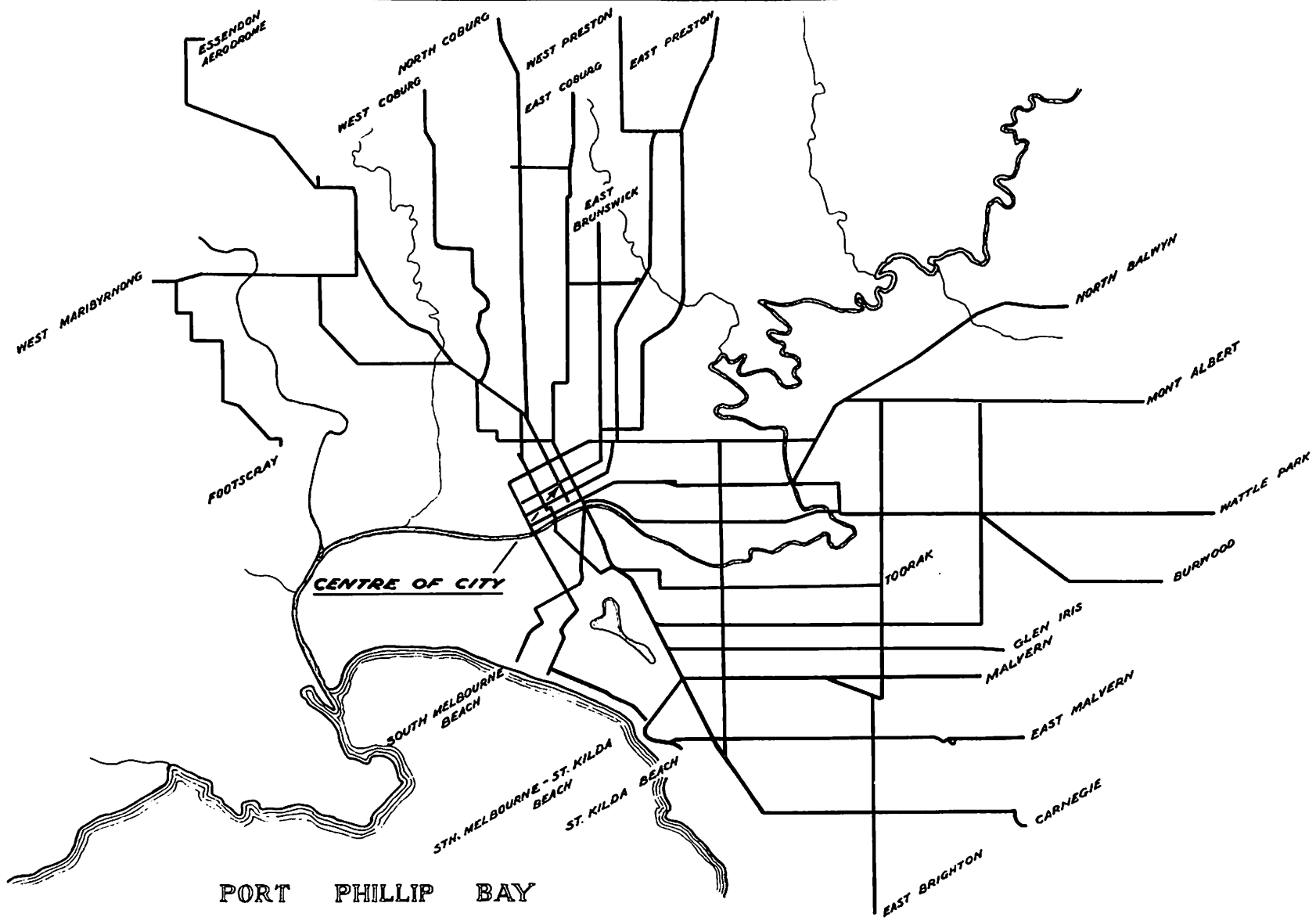
12. SCHEDULES.

The whole of the information called for in Schedules "D" and "G" of this Specification shall be supplied by the Tenderer.

WITNESS..... DATE.....

This is the Specification marked "C" referred to in the annexed Agreement with the Board.

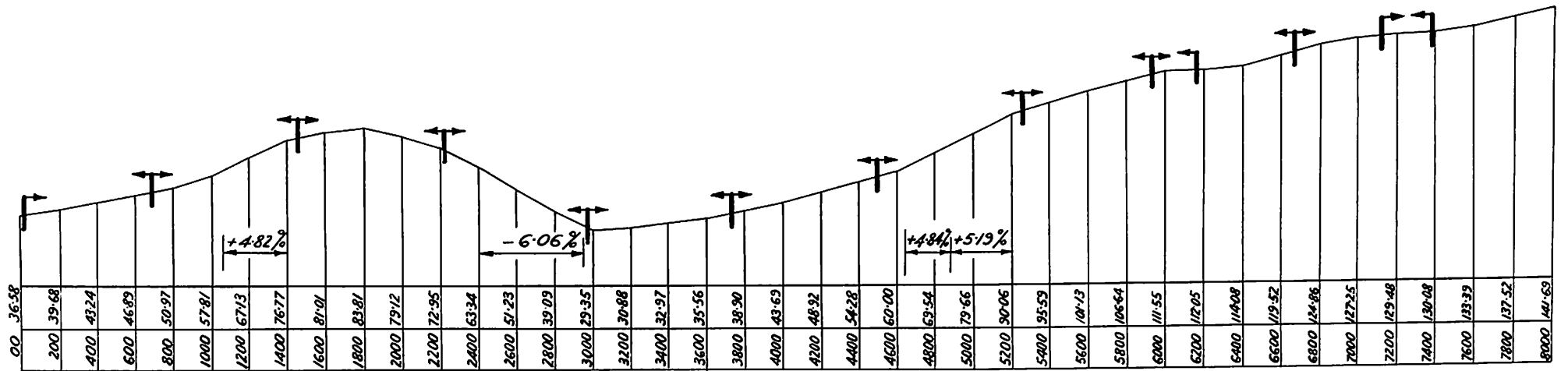
WITNESS..... CONTRACTOR.....



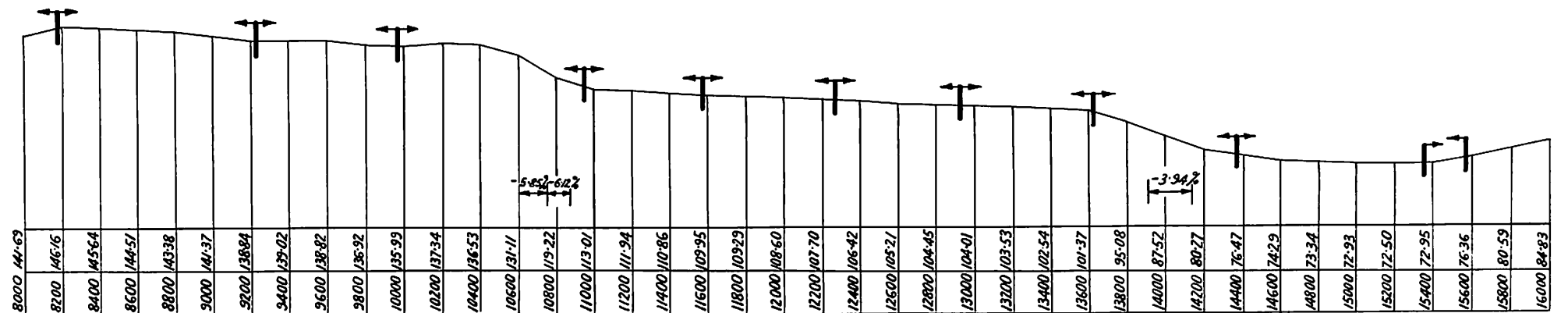
# MELBOURNE'S TRAMWAY SYSTEM

MELBOURNE & METROPOLITAN TRAMWAYS BOARD				
DATE	<i>F. B. Fisher</i> DEPUTY CHAIRMAN			
2-3-66				
DRAWN	TRACED	CHECKED	PASSED	APPROVED
J.R.G.	10/2/66	<i>[Signature]</i> 17.2.66	R.C.P. 18.2.66	<i>[Signature]</i>
SCALE: 1/26,720 to 1				T.2500-1

DATUM 00'  
TRACK ELEVATION IN FEET  
TRACK DISTANCE IN FEET



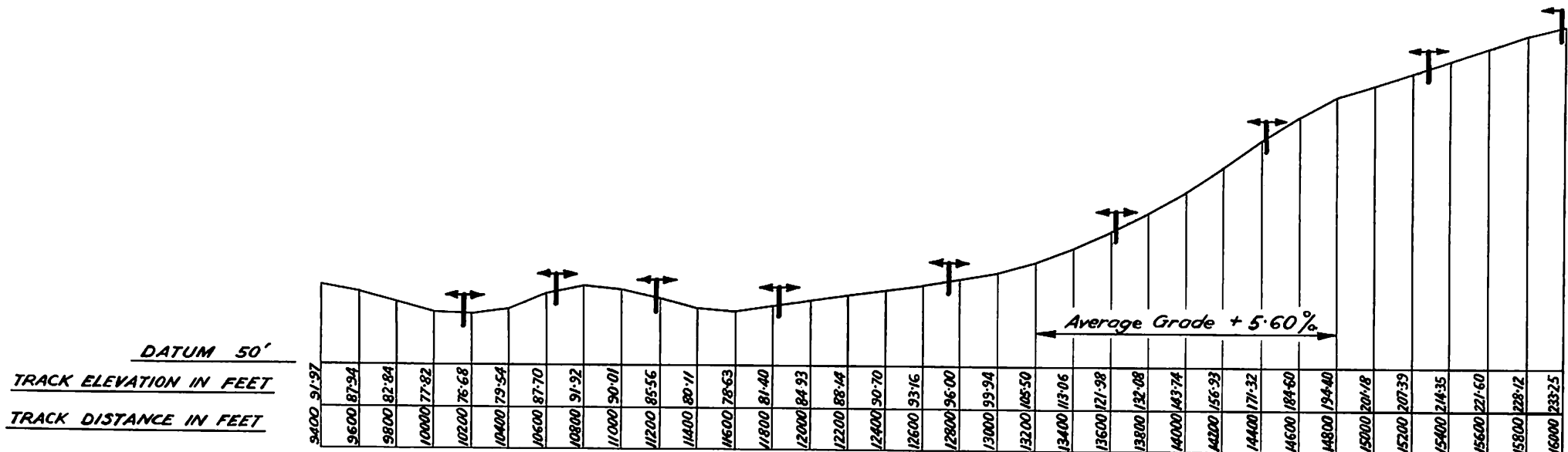
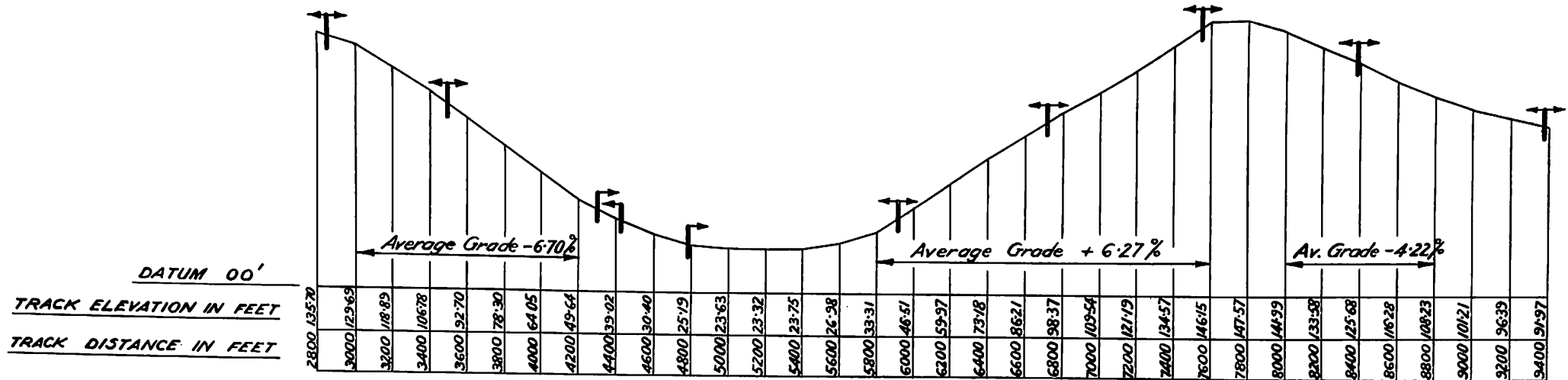
DATUM 40'  
TRACK ELEVATION IN FEET  
TRACK DISTANCE IN FEET



Note: Stopping places and direction of travel shown thus ↑

# TYPICAL CITY ROUTE LONGITUDINAL SECTION

MELBOURNE & METROPOLITAN TRAMWAYS BOARD				
DATE 2-3-66		<i>J. B. Kelly</i> DEPUTY CHAIRMAN		
DRAWN J.R.G.	TRACED 8/2/66	CHECKED W.L.L.	PASSED K.C.P. 18.2.66	APPROVED <i>[Signature]</i>
SCALE: HOR. 5600 ft / 1 VER. 960 ft / 1				<b>T.2500-2</b>

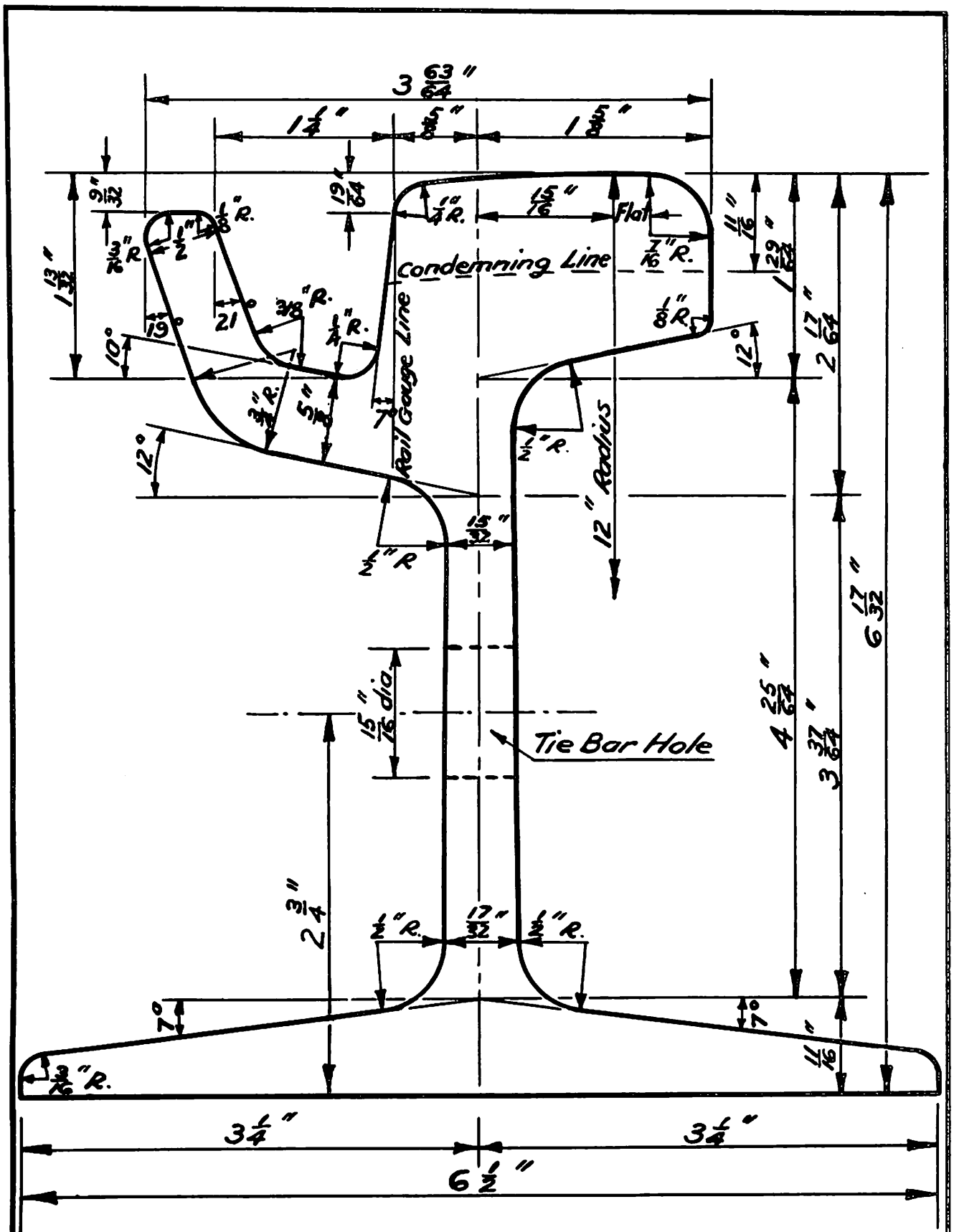


Note:  
Stopping places and direction  
of travel shown thus ↗

# GLENFERRIE ROAD ROUTE - LONGITUDINAL SECTION

## TOORAK ROAD TO COTHAM ROAD

MELBOURNE & METROPOLITAN TRAMWAYS BOARD				
DATE	<i>J. R. Kelly</i>			
2-3-66	DEPUTY CHAIRMAN			
DRAWN	TRACED	CHECKED	PASSED	APPROVED
J.R.G.	26/1/66	W.H.L. 17-3-66	K.C.P. 18-3-66	<i>[Signature]</i>
SCALE: HOR. 9600 to 1 VER. 960 to 1				T.2500-3



Material

Medium Manganese Steel,  
Carbon 0.40 to 0.55%  
Manganese 1.20 to 1.50%.

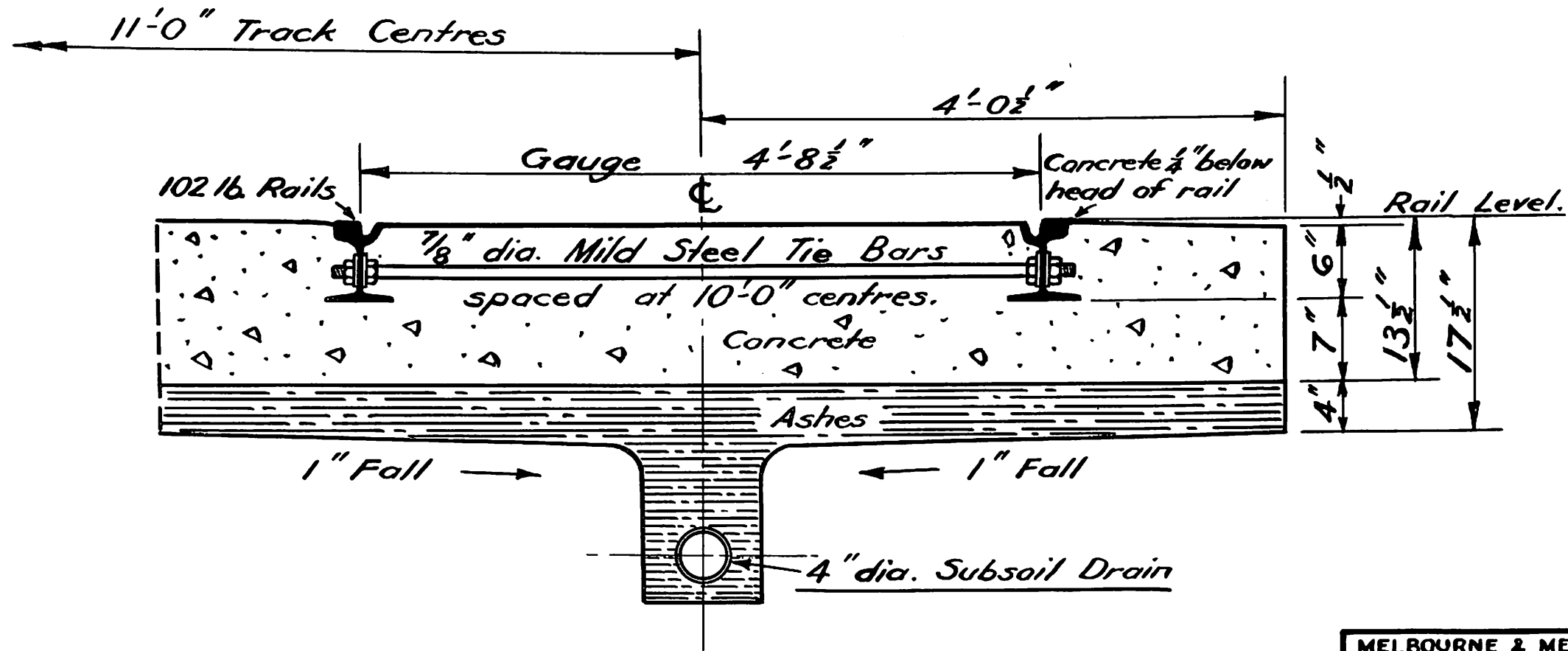
**GROOVED RAIL**  
**102 LB. PER YARD**

MELBOURNE & METROPOLITAN  
 — TRAMWAYS BOARD —

DATE 23/3/66	<i>F. N. Kirby</i> DEPUTY CHAIRMAN			
DRAWN J.R.G.	TRACED 25/1/66	CHECKED <i>[Signature]</i> 17.2.66	PASSED K.C.P. 18.2.66	APPROVED <i>[Signature]</i> 18.2.66

SCALE: 1 to 1

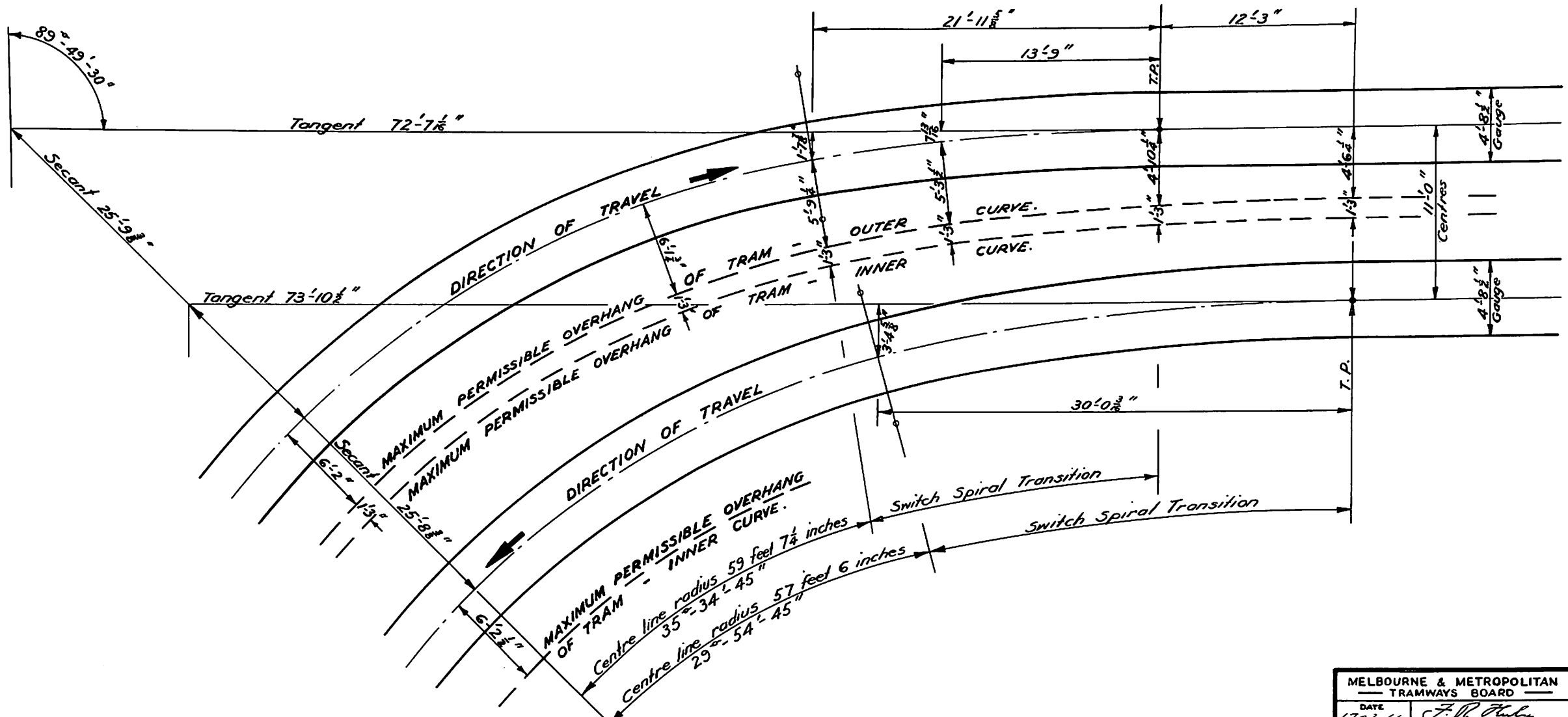
T.2500-4



# CONCRETE TRACK CONSTRUCTION

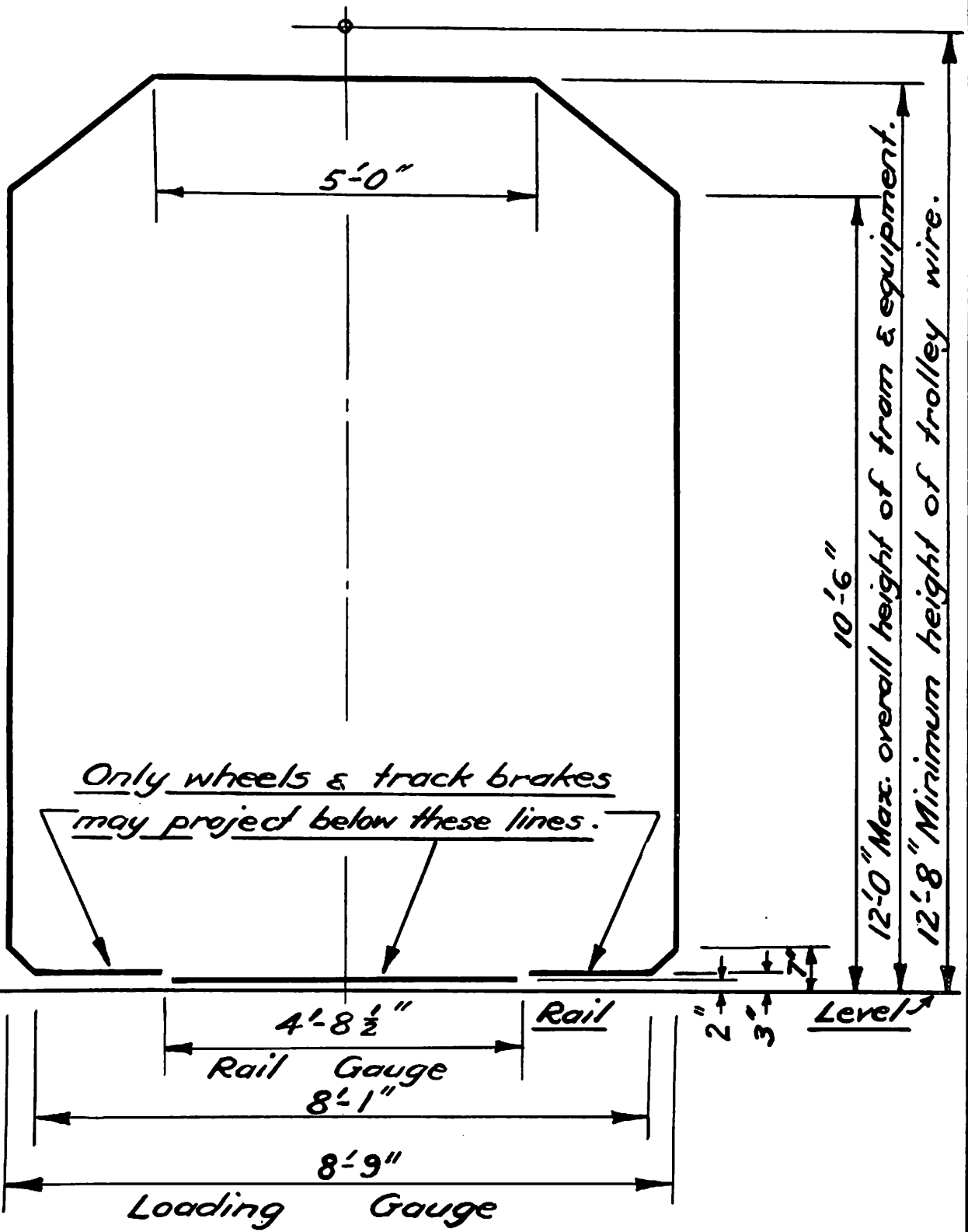
MELBOURNE & METROPOLITAN — TRAMWAYS BOARD —				
DATE 17/3/66	F. B. Kirby DEPUTY CHAIRMAN			
DRAWN J.R.G.	TRACED 19/1/66	CHECKED 20.1.66	PASSED K.C.P. 20.1.66	APPROVED K.C.P.
SCALE: 1/2" = 1'		T.2500-5		





**MINIMUM RADIUS SERVICE CURVES TO GIVE  
MINIMUM CLEARANCE BETWEEN TRAMS**

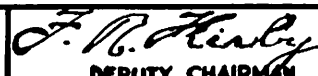

MELBOURNE & METROPOLITAN TRAMWAYS BOARD					
DATE	F. R. Kelly DEPUTY CHAIRMAN				
17-3 66					
DRAWN	TRACED	CHECKED	PASSED	APPROVED	
J.R.G.	1/2/66	17/2/66	R.C.P.	17/2/66	
SCALE:	96 to 1			T.2500-6	

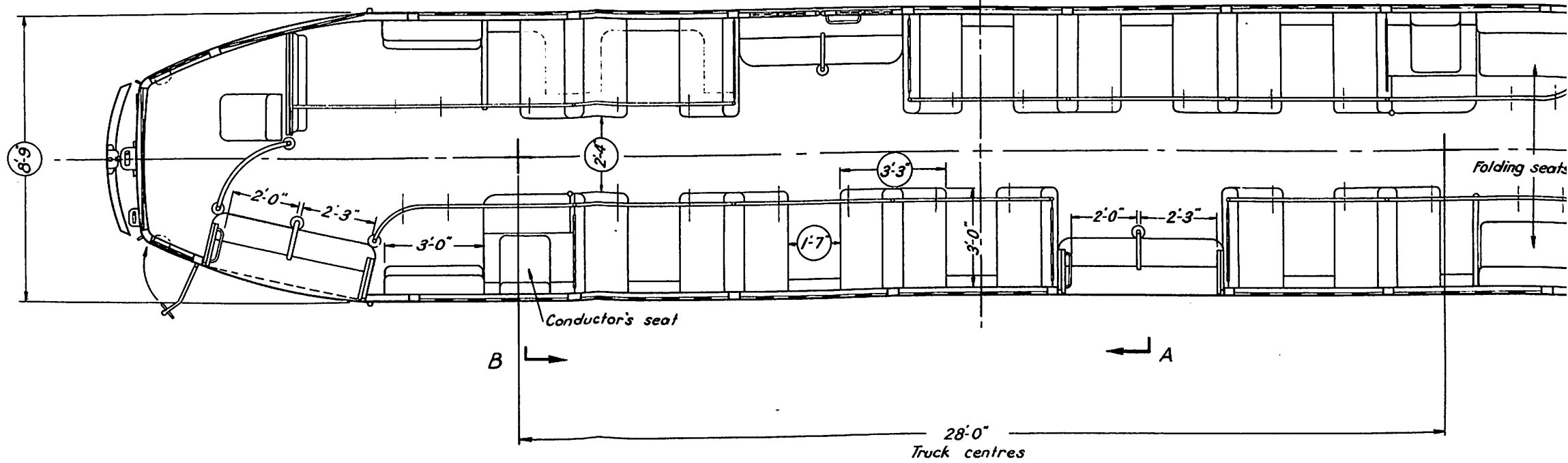
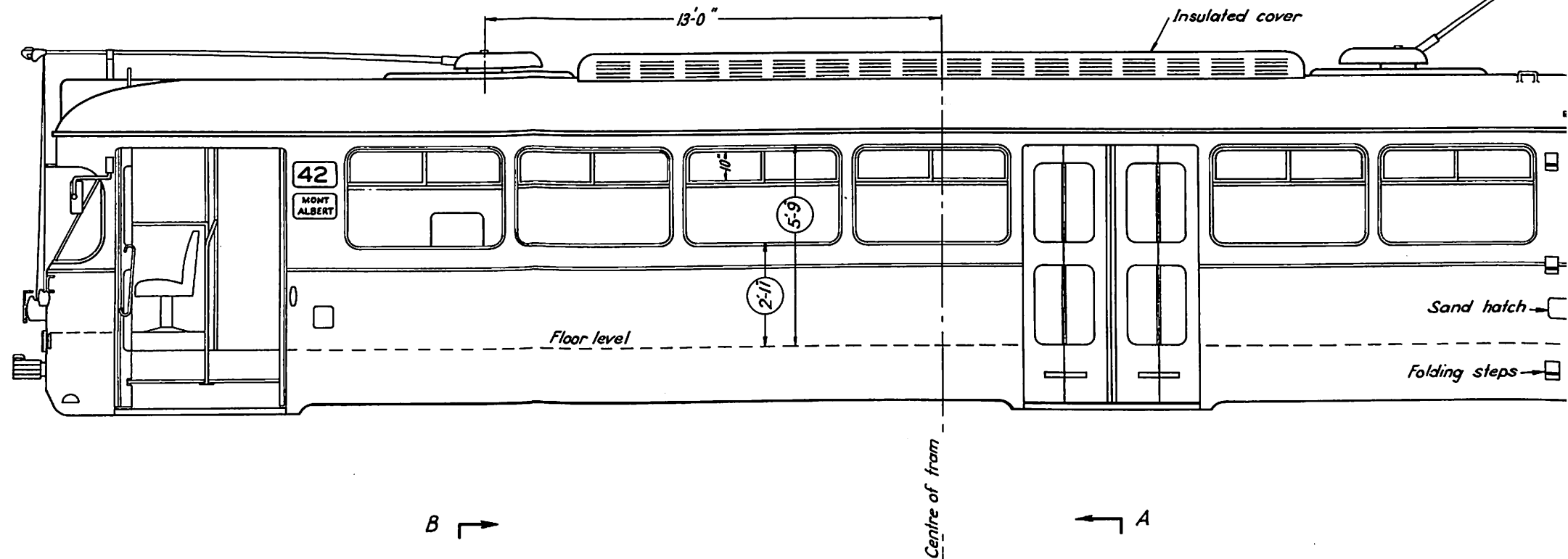
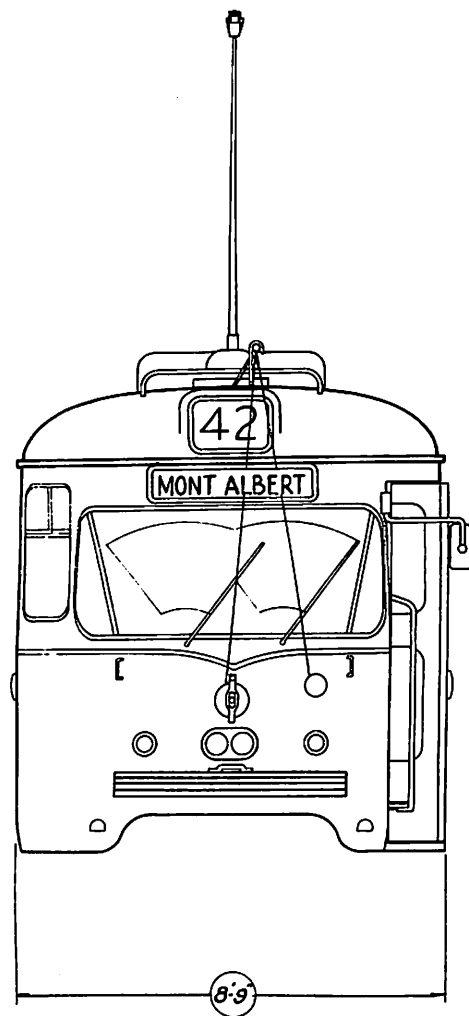


**LOADING GAUGE**

**PROPOSED**

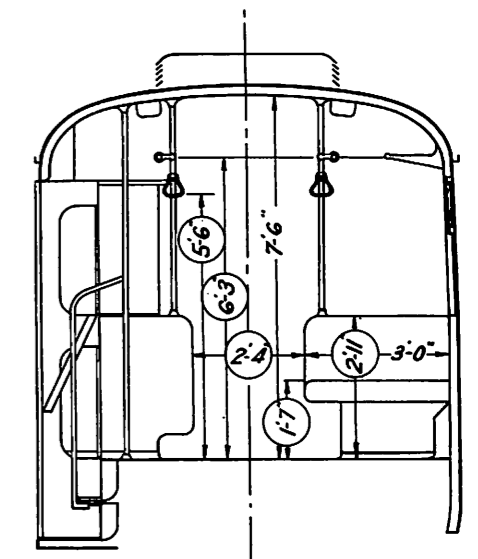
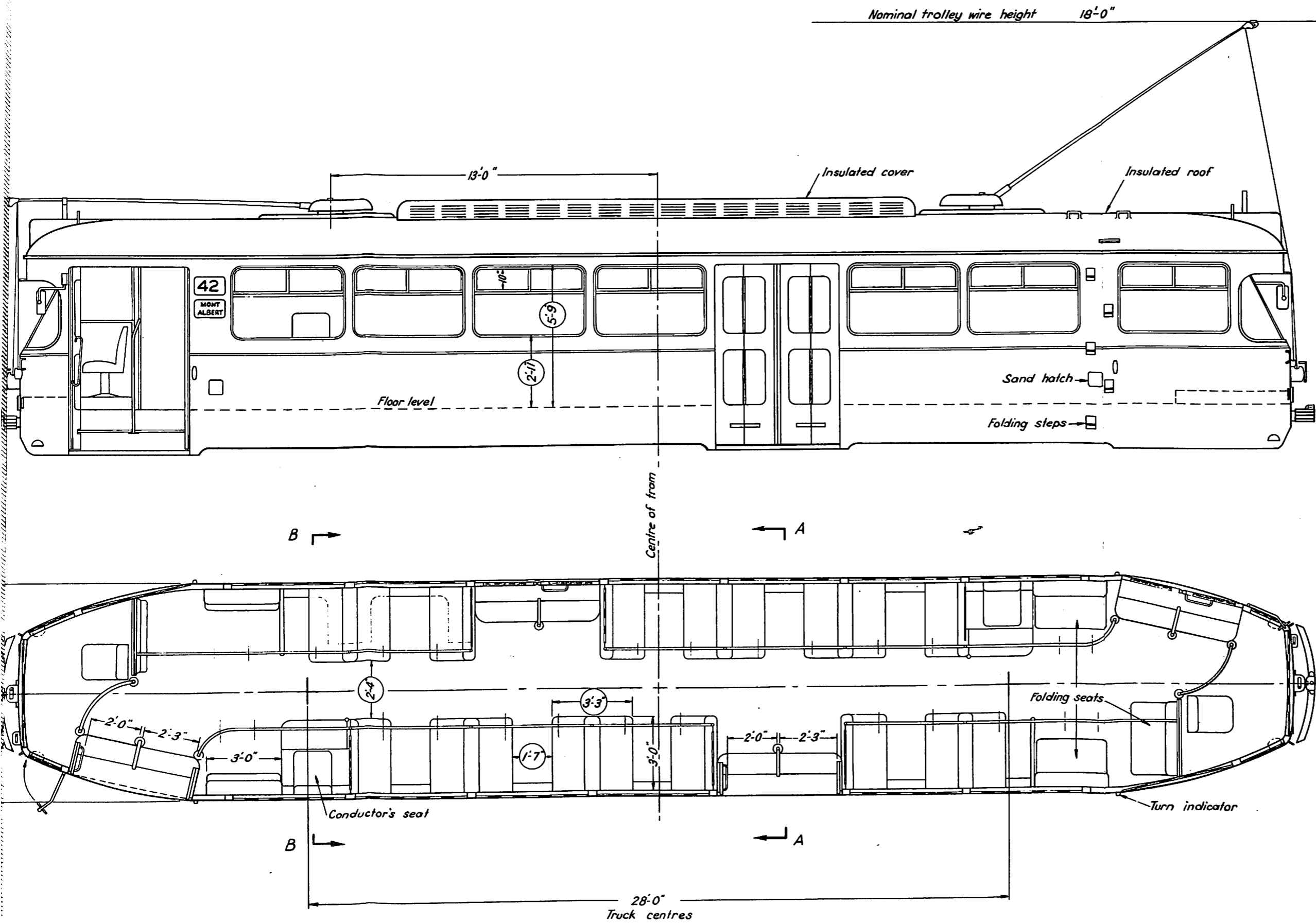
**ELECTRIC TRAMCARS**

MELBOURNE & METROPOLITAN — TRAMWAYS BOARD —				
DATE 17/3/66	 DEPUTY CHAIRMAN			
DRAWN E.H.	TRACED J.R.G. 27/1/66	CHECKED	PASSED 	APPROVED K.F.H.
SCALE: 24 to 1		T.2500-7		

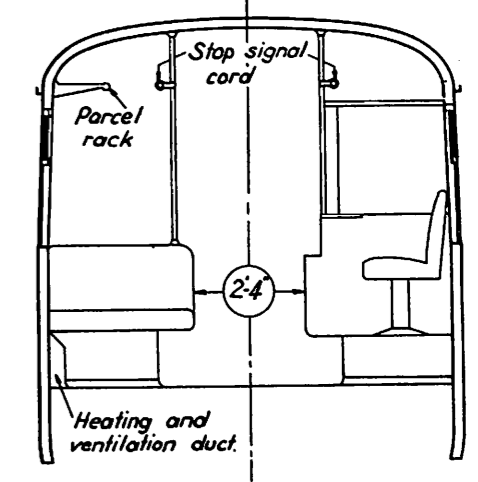


Notes: 1. This drawing illustrates one arrangement which complies with specified clearances. The truck centre dimension is not critical.  
2. Critical dimensions are shown thus: (8-3)

ALL  
A P



SECTION A-A



SECTION B-B

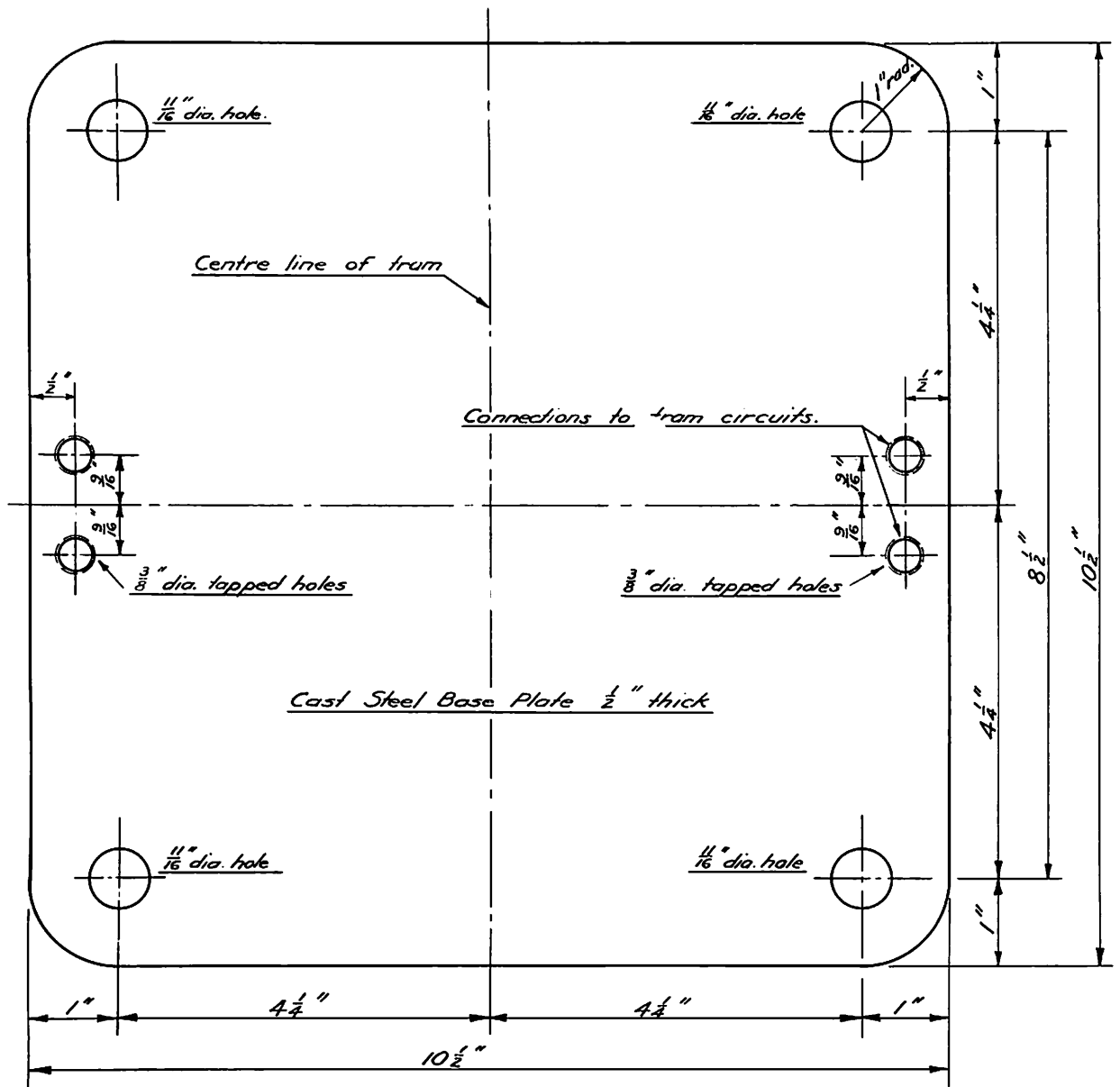
Notes: 1. This drawing illustrates one arrangement which complies with specified clearances. The truck centre dimension is not critical.

2. Critical dimensions are shown thus: (8-3)

# ALL-ELECTRIC TRAM

## A POSSIBLE ARRANGEMENT

MELBOURNE & METROPOLITAN TRAMWAYS BOARD					
DATE	15-4-66				
DRAWN	TRACED	CHECKED	DASED	APPROVED	
K.T.H.	B.T.W.	21		DEPUTY CHAIRMAN	
SCALE: 48 to 1				7.2500-8	



**MOUNTING DETAILS**  
**FOR**  
**TROLLEY POLE BASE**

MELBOURNE & METROPOLITAN TRAMWAYS BOARD				
DATE	F. P. Kelly DEPUTY CHAIRMAN			
2/3/66				
DRAWN	TRACED	CHECKED	PASSED	APPROVED
K. C.	J. R. G. 2/3/66		DE 2/3/66	K. J. H.
SCALE: 2 to 1			7.2500-9	

# Melbourne & Metropolitan Tramways Board

Melbourne, Victoria

## MANUFACTURE, SUPPLY AND DELIVERY

OF

100 ALL-ELECTRIC TRAMS.

CONTRACT No. 2500.

SCHEDULE OF PRICES.

Price of 100 All-electric Trams complete as specified \$A.....

Amount included for duty \$A.....

Is payment on extended terms offered? .....  
(If 'Yes' append full details) YES/NO

Guaranteed time for delivery of first tram (number of weeks after firm order is placed). .....

Guaranteed time for delivery of fifth tram (number of weeks after delivery of first tram). .....

Time required for delivery of sixth tram (after advice that first 5 trams have passed tests). .....

Guaranteed delivery rate for remaining trams. ....

ITEMS FOR APPROVAL. (Price per tram included in tender price.)

Item	Price per Tram \$A	Amount Included for Duty \$A
Floor covering material	.....	.....
Lining material	.....	.....
Interior cover strips	.....	.....
Windows — (a) Windscreen (b) Side windows	.....	.....
Doors	.....	.....
Steps and step well	.....	.....
Passengers' seats — (a) Fixed (b) Folding	.....	.....
Driver's seats	.....	.....
Conductor's seats	.....	.....
Rear vision mirrors	.....	.....
Strap hangers	.....	.....
Roof drainage system	.....	.....
Roof access steps	.....	.....
Sun blinds	.....	.....
Luggage racks	.....	.....
Litter baskets	.....	.....
Exterior painting	.....	.....
Interior painting	.....	.....
Trolley retriever	.....	.....

Item	Price per Tram \$A	Amount Included for Duty \$A
Axle speed monitoring equipment	.....	.....
Door control equipment	.....	.....
Lighting installation —	.....	.....
(a) Fluorescent lights	.....	.....
(b) Exterior lights	.....	.....
(c) Emergency lights	.....	.....
(d) Destination and route number lights	.....	.....
Battery	.....	.....
Ventilation and heating system	.....	.....
Destination and route number signs	.....	.....
Public address system	.....	.....

EQUIPMENT EXCLUDED FROM TENDER PRICE.

Price of one conductor's desk (excluding fare and ticket equipment)

\$A .....

Amount included for duty

Price of one ticket printing and issuing machine

\$A .....

Amount included for duty

Price of one change issuing machine

\$A .....

Amount included for duty

Price of one fare collection tray

\$A .....

Amount included for duty

Price of one complete set of electrical equipment and trucks (for training purposes)

\$A .....

Amount included for duty

Tenderers shall set out in separate tables (under the headings shown below) the prices of:

Test equipment — as specified in Clause 9-2 (a)

Maintenance equipment — as specified in Clause 9-2 (c)

Spare parts — as specified in Clause 9-1

Item	Recommended Number	Price for One Item \$A	Amount Included for Duty \$A
.....	.....	.....	.....
.....	.....	.....	.....
.....	.....	.....	.....

Guarantee period.....

Country or State of origin of—

(a) Mechanical equipment.....

(b) Electrical equipment.....

(c) Body.....

TENDERER'S NAME AND ADDRESS.....  
.....

WITNESS..... DATE.....

Board. This is the Schedule of Prices marked "D" referred to in the annexed Agreement with the

WITNESS..... CONTRACTOR.....



# Melbourne & Metropolitan Tramways Board

Melbourne, Victoria

MANUFACTURE, SUPPLY AND DELIVERY

OF

100 ALL-ELECTRIC TRAMS.

CONTRACT No. 2500.

TENDER FORM.

TO THE SECRETARY,  
MELBOURNE AND METROPOLITAN TRAMWAYS BOARD,  
MELBOURNE, VICTORIA, 3000. AUSTRALIA.

Under and subject to the Conditions of Tendering, Conditions of Contract, Specification and Schedule of Prices herein attached, I/we the undersigned hereby tender and offer to supply and deliver to the Melbourne and Metropolitan Tramways Board, Victoria, Australia, the material described in the Specification hereto attached.

I/We undertake, in the event of this tender being accepted, to execute when called upon by you to do so, a formal Contract for the due supply and delivery of such material in the terms of the Form of Contract hereto attached.

I/We further undertake that this tender shall not be withdrawn before ninety days from the date specified for opening the tenders, and may be accepted by you at any time within such a period.

Witness my/our hand this \_\_\_\_\_ day of \_\_\_\_\_ 19\_\_

TENDERER'S NAME AND ADDRESS.....

WITNESS.....

This is the Form of Tender marked “E” referred to in the annexed Contract with the Board.

WITNESS..... CONTRACTOR.....

# Melbourne & Metropolitan Tramways Board

Melbourne, Victoria

## MANUFACTURE, SUPPLY AND DELIVERY

OF

### 100 ALL-ELECTRIC TRAMS.

CONTRACT No. 2500.

FORM OF CONTRACT.

THIS CONTRACT made the \_\_\_\_\_ day of \_\_\_\_\_ 19\_\_\_\_

between

(in this Contract and in the Specifications and General Conditions respectively this day signed by the parties called “the Contractor”) of the one part and THE MELBOURNE AND METROPOLITAN TRAMWAYS BOARD (in this Contract and in the said Specifications and General Conditions of Contract called “the Board”) of the other part WITNESSETH that the Contractor covenants with the Board to execute perform and deliver to the Board the works matters and things shown described and referred to in the Tender and Schedule of Prices Specifications Drawings and Conditions of Contract hereto respectively annexed and signed by the parties hereto for identification in conformity with the said Schedule of Prices Specifications and Drawings for the price or prices and at the time or within the time or times set out in the said Tender and Schedule of Prices and such price or prices being payable at the times and in manner and in the events mentioned in the said General Conditions of Contract AND each of the parties hereto covenants with the other of them to perform fulfil observe and comply with and submit to all and singular the conditions stipulations and requisitions and all matters and things on the part of each of them respectively contained expressed and shown in or reasonably to be inferred from the said Tender Schedule of Prices Specifications Drawings and Conditions of Contract and by and on the part of each of them respectively to be performed fulfilled and observed.

IN WITNESS whereof the parties hereto have executed these presents the day and year first above written.

.....  
.....  
.....  
.....

Secretary.

This is the document marked “F” referred to in the annexed Table of Contents.

WITNESS.....

CONTRACTOR.....

# Melbourne & Metropolitan Tramways Board

Melbourne, Victoria

## MANUFACTURE, SUPPLY AND DELIVERY

OF

## 100 ALL-ELECTRIC TRAMS.

CONTRACT No. 2500.

### SCHEDULE OF INFORMATION TO BE PROVIDED BY TENDERER.

The information requested in this Schedule will be used to assess tenders. Tenderers shall also provide all of the detailed information specified in Schedule "C". Dimensions may be expressed in British or Metric units provided the system used is clearly indicated.

Any alternative proposal for a major item of equipment requires a separate Schedule of Information.

#### A. DIMENSIONS.

1. Length over bumper bars.
2. Length over body.
3. Length of parallel sides.
4. Length of passenger loading space (between driver's bulkheads).
5. Overall width (excluding mirrors and turn indicators).
6. Interior width (between interior panels).
7. Height of trolley base mounting above rail (tare weight).
8. Height above rail excluding trolley pole and base (tare weight).
9. Height of floor above rail — (a) full standing load  
(b) tare weight.
10. Heights of first steps above rail (tare weight).
11. Heights of subsequent steps — (a) entrance  
(b) exit.
12. Depth of tread of first step — (a) entrance  
(b) exit.
13. Depths of tread of subsequent steps — (a) entrance  
(b) exit.
14. Height of bottom of first step framing above rail (tare weight).
15. Height of skirt above rail (tare weight).
16. Height of window sill above floor.
17. Height of lower glass line above floor.
18. Height of top glass line above floor.
19. Window pillar spacing.
20. Dimensions of glass in side windows — (a) fixed section (i) width  
(ii) height  
(iii) thickness  
(b) moving section (i) width  
(ii) height  
(iii) thickness.
21. Distance between door pillars.
22. Clear opening of doors (hand rail to face of door).
23. Clear opening of front half of door (hand rail to centre stanchion).
24. Clear opening of rear half of door (centre stanchion to face of door).
25. Height of doorway (top of first step to bottom of door head).
26. Depth of door motor enclosure (outside of tram to inside face of enclosure).
27. Width of aisle at top of seat back.
28. Width of aisle at seat cushion or frame.
29. Height of front of seat cushion above floor.
30. Width of seat cushions.
31. Length of seat cushions.

A. DIMENSIONS — Continued

32. Distance between centres of seat backs.
33. Height of seat backs above floor.
34. Height of grab rail above floor.
35. Height of stop cord bracket above floor.
36. Diameter of grab rail.
37. Diameter of stanchions.
38. Height of driver's compartment floor above tram floor.
39. Height of conductor's enclosure floor above tram floor.
40. Angle of windscreen.
41. Thickness of exterior panels — (a) ends  
(b) sides.
42. Distance between truck centres.
43. Distance between axle centres.
44. Diameter of wheels (new).
45. Diameter of wheels (condemning size).
46. Overall length of truck.
47. Overall width of truck.
48. Diagonal dimension of truck.
49. Clearance of truck above rail (wheels at condemning diameter, full standing load on tram).
50. Clearance of motor case above rail (wheels at condemning diameter, full standing load on tram).

B. WEIGHTS.

1. Weight of complete tram ready for service.
2. Weight of complete body.
3. Weight of one truck.
4. Weight of one traction motor.
5. Weight of one wheel and axle set.
6. Weight of one resilient wheel.

C. CAPACITY.

1. Number of fixed passenger seats.
2. Number of folding passenger seats.
3. Number of standing passengers — calculated as in Clause 3-2 (d) —
  - (a) in front of conductor's enclosure
  - (b) in fixed seat section
  - (c) at rear.

D. PERFORMANCE.

All information listed in items 1 to 10 applies to a tram fitted with wheels of design diameter operating on level track with full seated load.

1. Maximum speed.
2. Transition time from zero to maximum acceleration.
3. Maximum acceleration.
4. Average acceleration.
5. Transition time from zero to maximum deceleration (with dynamic brake only).
6. Maximum deceleration (dynamic brake only).
7. Average deceleration (dynamic brake only).
8. Maximum rate of change of deceleration (dynamic brake only).
9. Maximum deceleration (mechanical brake only).
10. Maximum deceleration (full emergency braking).

In addition, the following information shall be supplied:

11. Speed of tram (with wheels at condemning diameter when motors are operating at maximum safe speed).
12. Total rolling resistance.
13. Rolling resistance of one resilient wheel.

**E. SOUND LEVELS.**

Sound levels which the Tenderer guarantees will not be exceeded when the trams are tested in accordance with Clause 10-3 of this specification.

Test	Maximum Sound Level at "A weighting" (dBA)	Maximum Sound Level at "C weighting" (dBC)	Maximum Speech Interference Level (dB)
(i)			
(ii)			
(iii)			

**F. BODY.**

1. Description of method of body construction.
2. Material proposed for structural members.
3. Material proposed for exterior panels.
4. Method of fixing exterior panels.
5. Material proposed for interior lining.
6. Method of fixing interior lining.
7. Material proposed for interior cover strips.
8. Material proposed for roof.
9. Method of electrical insulation of roof.
10. Proof tests which may be applied to the insulated roof.
11. Material proposed for thermal insulation.
12. Material proposed for floor.
13. Material proposed for floor covering.
14. Method of fixing floor covering (including details of adhesive).
15. Material proposed for seat covers.
16. Material proposed for upholstery.
17. Material proposed for stanchions and grab rails.
18. Strap hangers — (a) type  
(b) number.
19. Material proposed for step wells.
20. Type of doors.
21. Method of door construction.
22. Side window glass specification — (a) visible light transmitted  
(b) total radiation transmitted.
23. Description of side window construction.
24. Material proposed for sand boxes.
25. Location of sand filling points.

**G. TRUCKS.**

1. Type of wheel.
2. Specification for tire steel.
3. Recommended tire hardness.
4. Acceptable range of tire hardness.
5. Estimated tire life.
6. Can tire be changed while axle is in truck?
7. Description of drive.
8. Gear ratio.
9. Type of bearings.
10. Description of method of suspension.
11. Method of fixing trucks to body.
12. Method of applying sand to rails.
13. Material proposed for sand hoses.
14. Description of mechanical brake.
15. Method of mounting track brake.

## H. ELECTRICAL EQUIPMENT.

1. Type of traction motor.
2. Number of motors per tram.
3. Motor voltage.
4. Kilowatt rating of motor.
5. Method of ventilating motor.
6. Type of insulation — (a) stator  
(b) rotor.
7. Motor speed at maximum tram speed (new wheels, full seated load, level track).
8. Maximum safe motor speed.
9. Can motor be removed without removing tram from its trucks?
10. Method of motor isolation.
11. Type of drive proposed.
12. Description of acceleration and braking controls.
13. Number of acceleration steps.
14. Number of braking steps.
15. Is control equipment mounted in plug-in units?
16. Description of axle speed monitoring equipment.
17. Motor generator — (a) output voltage  
(b) output current  
(c) output frequency  
(d) input current  
(e) range of input voltages over which output voltage can be maintained within 5 per cent of nominal voltage.
18. Batteries — (a) type  
(b) number.
19. Battery voltages.
20. Battery capacities (in ampere hours at 10 hour rate).
21. Auxiliary supply details.

Tenderers shall supply for each of the following items —

- (i) voltage
  - (ii) frequency
  - (iii) current rating
  - (a) Control equipment
  - (b) Track brake
  - (c) Door motors
  - (d) Fluorescent lights
  - (e) Exterior lights
  - (f) Emergency lights
  - (g) Windscreen wiper
  - (h) Ventilating fans
  - (j) Auxiliary heaters.
22. Maximum current drawn from overhead trolley wire with accelerator in “off” position and all auxiliary equipment operating.
  23. Description of method of operation of destination control equipment.
  24. Minimum supply voltage at which tram can operate on a level track with a seated load.
  25. Rupturing capacity of main contactor.
  26. Description of ventilation and heating system.

## J. MAINTENANCE SCHEDULE.

Tenderers shall append a maintenance schedule recommended for the tram based on an annual operating mileage of 30,000 to 40,000 miles (48,000 to 64,000 kilometres) per year. This shall include an accurate estimate of manhour content of each scheduled operation; and shall indicate that work which should be undertaken in the depot and that work which should be undertaken at a base workshop.

## K. LIST OF EQUIPMENT MANUFACTURERS.

Tenderers shall supply for each of the following items —

- (a) name of manufacturer
  - (b) location of manufacturer's works
1. Body
  2. Doors
  3. Windows
  4. Glass
  5. Interior lining
  6. Floor covering
  7. Seat covering
  8. Windscreen wipers
  9. Windscreen washers
  10. Paint

- 11. Driver's seat
- 12. Trucks
- 13. Wheels
- 14. Axles
- 15. Bearings
- 16. Gears
- 17. Traction Motors
- 18. Electrical control equipment
- 19. Axle speed monitoring equipment
- 20. Door control equipment

- 21. Motor generator
- 22. Battery
- 23. Battery charger
- 24. Light fittings — (a) internal  
(b) external
- 25. Destination signs
- 26. Ventilation system
- 27. Public address system
- 28. Recording speedometer
- 29. Trolley retriever

L. EQUIPMENT NOW IN SERVICE.

Tenderers shall supply for each of the following items —

- (a) name of Transport Undertaking operating the equipment now tendered
- (b) number of units in service
- (c) date first unit was placed in service.

- 1. Trucks
- 2. Traction motors
- 3. Motor control equipment
- 4. Axle speed monitoring equipment
- 5. Motor generator
- 6. Doors and door operating equipment
- 7. Destination and route number signs.

WITNESS..... DATE.....

This is the Schedule marked "G" referred to in the annexed Agreement with the Board.

WITNESS..... CONTRACTOR.....