SYDNEY TRAMWAY MUSEUM

TROLLEY WIRE INSPECTION PROCEDURE

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Document Control Record

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2. Version History:

Version Number	Date	Reason/Comments
1.0	14/01/2007	Initial issue
1.1	20/08/2008	Revised names of reports
1.2	30/07/2009	Added Worn Trolley Wire Data Sheet
1.3	15/03/2010	Added details to show the *appropriate level of recording and reporting the status of defects.*
1.4	30/06/2010	Added reference to STM6124-Working on Poles
1.5	30/06/2014	Updated to remove Inspection schedules
1.6	22/04/2016	Amended Distribution List format
1.7	8/05/2020	Corrected errors in form numbers.

Approved by ..... **Signature & Date** .....

3. Distribution List

Position	Date	Location of Documents
Rail Safety Manager		Original held on GOOGLE secure Website
STM WEB SITE		Updated regularly and put onto the STM Web site.
STM Office		STM Office Computer
STM Office		STM Office cupboard

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1. Purpose

To explain the Trolley Wire Inspection procedures at STM and the forms to be completed.

2. Scope

This procedure applies to all tramway overhead installed by the Sydney Tramway Museum.

3. Responsibilities

The Infrastructure and Traffic staff at STM must follow the processes in this procedure.

4. References

STM6025 – Overhead Traction Wire Standard.

STM6028 – Track Inspection Procedure

STM6033 - Occurrence Report

STM6107 – Pole Inspection Report.

STM6108 – Trolley Wire Inspection Check Sheets.

STM6109 –Trolley Wire Inspection/Maintenance Report.

~~STM6124~~ STM6086 - Safety Inspection Procedure for Working on Poles

STM6063 – Vegetation Control Procedure

APPENDIX 1 – Drawing for Worn Trolley Wire Data

5. Definitions

RSM	Rail Safety Manager
STM	Sydney Tramway Museum: the trading name of South Pacific Electric Railway Co-Operative Society Limited for tram activities, therefore references to STM.

6. Process

6.1 Overhead Inspection Schedule - Generally

The overhead wiring shall be visually examined at intervals from the tram driver's view point and tram drivers are to report after each trip to the Officer-in-Charge any apparent defect in the overhead wire and the location and circumstances of dewirements to allow any defect to be examined as soon as possible.

Appendix A of the Track Inspection Procedure (STM6028) shows the checklist of items to be checked on the first trip of the day.

Any such defects found by the driver should be recorded on the Occurrence report (*STM6033*) upon returning to the depot

6.2 Pole Maintenance and Replacement

a) **Before starting work on any poles, a worker MUST understand and have studied the Safety Inspection Procedure for Working on Poles (STM6124) to ensure that the poles are safe to be worked upon.**

b) Existing Timber Poles

Existing poles are to be inspected on a regular basis at which time the pole is to be examined for insect attack, decay and mechanical damage. Poles which exhibit major defects are to be listed for prompt replacement.

On a 3 year cycle poles are to be excavated for a depth of 300 mm below the surrounding surface and this excavated length of the pole and for 450 mm above the ground is to be liberally coated with wood preservative. The excavation is then to be filled with sand, well rammed and rakes at the top away from the pole.

Poles which have become splintered shall have the loose material carefully adzed away to allow the extent of mechanical damage to be assessed and to assist in shedding rainwater.

c) Timber Pole Replacement

Where a timber pole is to be replaced, a pole of similar size is to be obtained and erected about 1 metre to the side of the existing pole.

If there is any likelihood of the new pole tipping towards the excavation then a temporary guy wire shall be installed on the new pole before the old pole is removed.

d) Existing Steel Poles

Existing poles are to be inspected on an regular basis at which time the pole is to be examined for rust decay and mechanical damage. Poles which exhibit structural deficiency must be listed for immediate replacement.

6.3 Trolley Wire

The wire is to be examined annually from a purpose made road tower wagon or tower tram to ensure that no significant damage has occurred. The wire should be measured at selected locations to determine the annual wear. Control locations should be identified and examined at each annual inspection. Suitable control locations include the approach side and the exit side of overhead fittings such as frog pans and section insulators, major change of grade of the wire and at each end and at the centre of major curves.

6.4 Wire Fittings, etc.

a) Ears/Grips

Each ear is to be examined for excessive wear, damage and loose clamping screws, the screws must be tightened as required. Examination of previous inspection schedules shall be made to ascertain whether any fittings are giving a poor performance.

b) Span Wires and Insulators

Each span wire and pull-off wire is to be examined for its full length and repairs or replacements effected as necessary. All wire clamps are to be checked for tightness and swages and wire ties examined to ensure integrity of the joint.

Insulators are to be examined and where electrical or mechanical integrity is lost they must be scheduled for replacement as soon as possible.

c) Terminations

Eye bolts in timber poles, collars to steel poles, turnbuckles and shackles at span wire and trolley wire terminations are to be examined and tightened where necessary. Where adjustments reach the limit of the fitting without achieving the desired tension then the fitting and as much of the associated wiring as necessary are to be replaced with a new assembly.

6.5 Electrical Safety

Work on live tramway overhead wiring may be carried out from insulated platforms such as on a tower wagon, where live and earthed metal cannot be touched simultaneously, i.e. there must exist a vertical separation of 2.5m and a horizontal separation of 1.2m.

If this cannot be achieved then the work shall be undertaken with the traction power isolated from the section under examination. In this case, the overhead wire shall be earthed with a heavy duty strap clamped to the overhead trolley wire(s) and clamped to a running rail or to a heavy block laid along the head of fully paved rail. The earthing device must be maintained within the view of the overhead line crew supervisor.

On the active side of the overhead section insulators red flags (or red lamp at night) are to be positioned in the four foot warn any approaching tram driver not to proceed into the section.

If, for any reason, a tram must pass the section insulator, the driver must ensure that all power collectors are removed from the overhead wire when the tram may be coasted past the section insulator.

This is necessary to prevent the brief bridging by the current collector between live and dead wires and the possibility of electric shock to the overhead crew or damage to the power supply through short circuit.

When, for any reason, it is necessary to work on overhead wiring which is energised, special care must be taken to ensure that members of the overhead crew do not receive an electric shock. Work should not be undertaken in rain or mist and all equipment must be kept as dry and clean as possible.

It should be noted that a new timber poles may contain enough moisture to conduct sufficient electricity to give a severe shock and a similar situation exists with span wires and pull-offs which come in contact with trees located between the track and the overhead poles.

Insulation sleeves shall be installed on earthed wires when there is any likelihood of the overhead crew touching such wires while in contact with an energised section of the overhead wiring.

METAL LADDERS MUST NOT BE USED in electrical work associated with overhead wiring. Timber ladders must be of the type reinforced with nylon rope; ladders with metal wire reinforcing shall not be used.

Persons not immediately engaged in the overhead wiring work shall be directed to remain well away from the area to reduce the risk of electric shock.

6.6 Pole vs Pan Collector

Trolley wire set for sliding shoe collectors will usually accommodate wheels without any modification. When a mixture of poles and collector pans is to be run then complications arise due to the difficulty in ensuring the location of the wire is suitable for both. On straight track the wire collector pans must run in a zig-zag fashion between adjacent supports to avoid excessive wear in the centre of the pan. This offset in the wire must not be excessive when trolley poles are to use the same wire.

On curves, the offset required for the trolley pole collector to work efficiently may well cause the wire to move beyond the limit of the collector pan. In such cases, a secondary contact wire may be required on curves. Frog pans and crossing pans are generally required for pole operation but need not be used for collector pans. When dual operation is required, special runner wires are necessary set parallel to the special work to depress the collector pan below the fitting.

In trolley pole operation, curves are usually restrained by the use of bow and half bow hangers. These are designed to have the span wire attached at the level of the trolley wire. They are therefore likely to foul the collector pan in most instances. Extended cones would provide extra clearance but cause the fitting to tilt on sharper curves, thus defeating the object of providing clearances.

Special adjustable wire clamps are therefore required to compensate for the overturning factor on curves but still provide sufficient clearance for the pan collector to clear the clamp and the span wire.

6.7 Pull-Off Wires

Where a significant components of the load of the trolley wire at fittings is horizontal i.e. generally curves, the trolley wire must be held in position with diagonal pull-off wires.

On sharp curves, the pull-offs and fittings are required to reduce wire offset to about 7½º. On gradual curves, pull-offs may be required to reduce the distance of the centre of the chord to within acceptable limits although the angle of the wire through the suspension fittings does not exceed 7½º.

Pull-offs which join the trolley wire at greater than 60° are usually acceptable as a direct connection. Where then angle between the trolley wire and the pull-off is less than 60° or where a number of pull-offs are provided between span wires then they should be connected to a bridle wire inserted about 600mm outside the proposed curve of the trolley wire. The bridle is constructed with rings opposite the hangers, the hangers being connected with short pull-off wires.

The use of the jointed bridle equalises the tensions in the curve wiring making adjustment of individual pull-offs easier and reducing the possibility of the curve working out of line.

6.8 Insulation and Insulators

The overhead system is generally designed so that no earthed metal is in an overhead worker's reach of live wire. This is achieved by use of timber poles, triple insulation of metal parts, timber sheathing of the ornamental pole brackets and insulated trough within buildings.

Insulators shall be of porcelain or other approved material designed to provide effective insulation for a nominal 600 volts DC.

6.9 Hangers

Purpose made hangers shall be used to connect the trolley wire ears to span wires or other suspension. Simple "straight wire" hangers shall be used where the trolley wire is subject only to its own weight. On curves or at other places where the wire is subject to lateral tension special "bow hangers" shall be used to hold the ear vertical.

Purpose made hangers incorporating an insulated bolt may be used to provide one level of required insulation. Hangers which do not include an insulated bolt shall require one insulator each side of the fitting.

Where a single track trolley wire is provided at curves, "half bow" hangers are used to restrain the wire. Where double track trolley wires are provided, then a "full bow" hanger is provided on the outer wire in the curve and a short pull-off wire taken across to a "half bow" to restrain the inner wire.

Since the trolley wire will dip when only restrained by side pull-offs, full span wires must be provided at intervals around curves to support the trolley wire generally at the required height. "Full bow" hangers are required to be installed in these span wires.

6.10 Check Sheets

Checklist sheets shall be prepared in accordance with the detail shown on the diagrammatic layout or, alternatively, with provision for the manual insertion in each sheet of this detail. Copies of these sheets shall be provided to the Overhead Inspection Supervisor each day that inspections are to take place.

The sheets shall be filled in as the inspection work progresses and at the end of each day shall be inserted in a "Current" file. When all repair work has been carried out the sheet shall be suitably annotated and transferred to an "Archive" file where it will remain to form history of the examination and maintenance of the tramway overhead.

6.11 Recording Any Inspections, Maintenance and Replacement

All overhead inspections and maintenance performed on the STM network must be recorded in one of the following inspection reports:

a) Overhead Pole Inspection Reports (STM6107).

See reports for layout details

b) Trolley Wire Inspection ~~Lists~~ Check Sheets (STM6108);

There are a number of sheets covering all of the Museum lines. These are:

- 1 Pitt St - North Terminus
- 2 Pitt St - Princess Hwy. Level Crossing
- 3 Princess Hwy Level Crossing. - National Park Terminus
- 4 Depot Junction – Depot
- 5 Cross Street

See reports for layout details

c) Trolley Wire Inspection/Maintenance Reports (STM6109).

There are a number of sheets covering all of the Museum lines. These are:

- Trolley Wire; and
- Support System.

See reports for layout details.

6.12 Recording Any Inspections, Maintenance and Replacement Details

All defects from the Tramway Overhead Inspection Maintenance Reports (STM6109) must be reported using the Occurrence Report (STM6033) (attached to one report) to ensure that the defects are tracked to extinction.

The RSM is responsible for tracking all defects to extinction (close) and all major track defects must be reported to the Board by the RSM in his monthly reports to the Board. Copies of the reports must also be sent to the Chief Engineer. These defects must continually be reported to the Chief Engineer and Board each month until the defect is repaired, inspected and cleared by the Infrastructure Manager or the Chief Engineer.

All records for defects and their repairs must be kept for 5 years

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APPENDIX 1 Drawing of Worn Trolley Wire Data (also scanned in STM's Drawing Register)

Nº 113/46	OVERHEAD WIRING - TRAMWAY MAINTENANCE	WORN TROLLEY WIRE DATA. GROOVED WIRE 0·12566 □" AREA.
MAINS SECTION DATA CARD		13TH MAY 1935

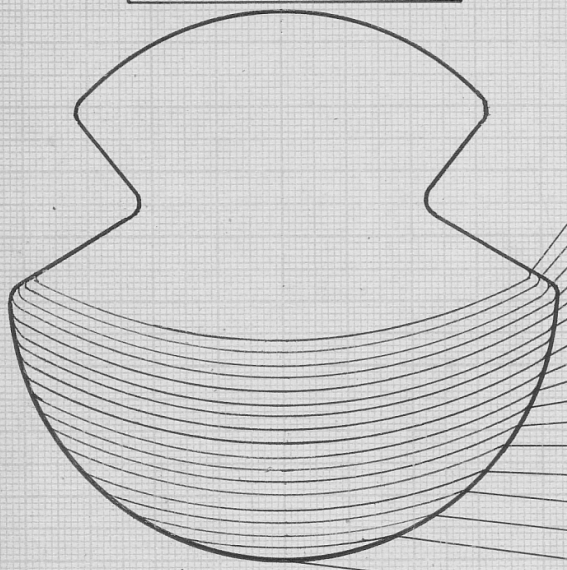
For wires having tensile strengths other than shown use the following multipliers.

60,000 lbs □" × 1·071

65,000 lbs □" × 1·161.

70,000 lbs □" × 1·250.

See Card Nº 013/21 for standard dimensions of wire.



Vertical Axis in INCHES	Sechonal Area in Square Inches	Percentage of Original Area	Tensile Strength in lbs at 56,000 lbs per Sq. Inch
·263	·0654	51·4	3670
·273	·0700	55·2	3940
·283	·0741.	58·4	4140
·293	·0778	61·4	4360
·303	·0823	65·0	4600
·313	·0868	68·6	4860
·323	·0912	72·0	5,100
·333	·0953	75·0	5340
·343	·0991	78·2	5560
·353	·1030	81·4	5780
·363	·1070	84·5	6000
·373	·1107	87·5	6200
·383	·1139	90·0	6380
·393	·1177	93·0	6600
·403	·1208	95·5	6780
·413	·1230	97·0	6900
·423	·1267.	100·0	7100.

For Factors of Safety at various Tensions See Card Nº 013/26.