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Level 2

Maintenance of Mark 3A overhead line equipment

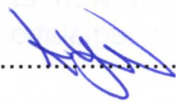
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Issue record

Issue	Date	Comments
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2	April 2006	Re-issued as a SAF3 Business Process Document (<i>formerly RT/E/S/27213</i>)
3	August 2008	Responsibilities amended under phase 2A re-organisation

Compliance

This Network Rail standard is mandatory and shall be complied with by Network Rail and its contractors if applicable from 26 August 2008.

When this standard is implemented, it is permissible for all projects that have formally completed GRIP Stage 4 to continue to comply with the Issue of any relevant Network Rail Standards current when GRIP Stage 4 was reached and not to comply with requirements contained herein, unless the designated Standard Owner has stipulated otherwise in the accompanying Briefing Note.

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1 Introduction

This Specification details the maintenance tolerances for Mark 3A design Overhead Line Equipment and shows the background information and method of formulation.

2 Definitions

Blow-off

Blow-off is the maximum distance through which the contact wire is blown-off across track at mid-span under full wind conditions with no mast deflection. (See Appendix A sketch 3)

Contact wire sag

The amount by which the contact wire of automatically tensioned equipment is lower at mid-span than at the ends, measured in accordance with Section 3.4.1.

Design contact wire wind speed

In exposed areas, with automatically tensioned equipment, a design contact wire wind speed has been assigned. This takes into account area of the country, topographical details, ground surface roughness and embankment height. If further assessments become necessary, they shall be made in accordance with NR/L3/ELP/27039 *Wind Loading on Overhead Line Equipment and Structures*.

Electrical clearance - Passing

Passing clearance is the minimum distance required between live parts of the overhead equipment and any earthed material or rail vehicle, or between pantograph and any earthed material, under any permissible conditions of operation and maintenance of vehicles, track and overhead equipment.

Electrical clearance - Static

Static clearance is the minimum distance required between the live parts of the overhead equipment (under any permissible conditions of maintenance and when not subject to uplift from a pantograph) and structure or earthed parts of the overhead equipment.

Encumbrance or system height

This is the vertical distance between the nominal contact wire level and centre line of the catenary at any location.

Nominal contact wire level

Nominal contact wire level is the level at a registration location of a line between the underside of the contact wire at the first dropper on each side of the location. This is usually different from the actual contact wire level on account of either steady arm weight or radial load.

Permissible deviation

Permissible deviation is the maximum allowable distance which the contact wire may be from the centre line of the static pantograph at any point in the span, under full wind conditions with no mast deflection. (See Appendix A sketch 2)

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Permissible mid-span offset

Permissible mid-span offset is the maximum allowable distance which the contact wire may be from the centre line of the static pantograph under still air conditions at mid-span. (See Appendix A sketch 1)

Stagger effect

Due to stagger the maximum contact wire deviation may not occur at mid-span. Stagger effect is the distance that should be added to the value of "blow-off" measured at mid-span, to determine the maximum distance through which the contact wire is blown-off across track in span under full wind conditions. (See Appendix A sketch 4)

Sweep

Sweep is the lateral movement of the contact wire across the pantograph in the course of its travel between any two registration points and is the total of such movement, either from one side to the other, or from one side towards the centre and back towards the same side. (See Appendix A sketches 5 and 6)

3 Technical data covering the position of the contact wire

3.1 Contact wire stagger, deviation and offset

Permissible Deviation in span:

400 mm for automatically tensioned equipment

480 mm for fixed termination equipment

(These figures are to be reduced by 35 mm per metre rise in contact wire height above 4.72 m).

For Maximum Deviation formulae - see Section 7.2.

For Permissible Mid-Span Offsets see Section 7.3.

3.2 Contact wire stagger, deviation and offset

The staggers for the equipment are:

- a) Tangent Track 230 mm (normal)
- b) Curved Track 380 mm maximum, to be reduced by 50 mm per metre rise in contact wire height above 4.72 m.

(In certain locations, the Principal Maintenance Support Engineer (M&E) or nominated representative has assigned a special stagger of 400mm).

The adjustment criterion shall be Mid-Span Offset under still air conditions rather than nominal staggers at structures.

A working tolerance of ± 15 mm will be permissible on the above figures.

3.3 Blow-off

Blow-off values for automatically tensioned equipment depend on wind speed, span length, contact wire tension and type of termination. Where design contact wire wind speeds have been assigned, these shall be used, otherwise a speed of 27 m/s shall

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be applied. Blow-off values for fixed termination and tramway type equipment shall be taken from the appropriate columns, regardless of location. For Blow-off tables, see Section 7.1.

Where, however, the Principal Maintenance Support Engineer (M&E) or nominated representative has assigned staggers and mid-span offsets, calculation of blow-off or mid-span offset is unnecessary.

3.4 Sweep ratio

Sweep Ratio may vary between the limits 1:50 and 1:400, where the Sweep Ratio = (sweep/span length). Values beyond these limits shall be reported to the Principal Maintenance Support Engineer (M&E) or nominated representative.

3.5 Contact wire height - relative to a 3.99 m static load gauge

Location	Conditions	Contact Wire Height
Open Route	Nominal	4.72m
Overbridges and Tunnels	"Normal Clearance" "Reduced Clearance" "Special Reduced Clearance"	4.215m* 4.165m* 4.14m*
Level Crossings	Minimum - unless other – wise authorised by the Department of Transport Maximum	5.60m* 5.94m+

* The above values are the absolute minimum with the track "high" and contact wire "low", i.e., lower figures are never acceptable.

+ This value is the absolute maximum, i.e., track "low" and contact wire "high".

"Reduced" and "Special Reduced" clearances must not be adopted without the authority of the Principal Maintenance Support Engineer (M&E) or nominated representative.

NOTE When employing low contact wire heights and at level crossings, overbridges and tunnels the degree of tolerance is limited and the wire must be maintained so that it lies within the specified limits under all conditions. See Section 4.4 for electrical clearances, and Section 7.4 for rise and fall of contact wire at mid-span and structure due to ice loading and the temperature variations.

Between maximum and minimum height a tolerance of 75 mm, on open route, can be accepted for normal wire height providing that contact wire gradient between registration points is no steeper than 1 in (3 x maximum speed in km/h) or 1 in (5 x maximum speed in mile/h). The best possible grading shall be achieved at bridges, with no sudden changes in gradient.

When carrying out any adjustment to contact wire height, the aim shall be to maintain standard catenary/contact wire separation and standard dropper lengths.

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3.6 Contact wire height - In span and at structures

3.6.1 Automatically tensioned equipment

Contact wire height is to be checked when no wind or ice is present and as far as possible when the ambient temperature is between 0° and 20°C, and preferably between 5° and 15°C.

For Contact Wire Sag see Section 7.4. The allowed tolerances on sag are:

Spans of 50 m or less: ± 15 mm

Spans of more than 50 m : ± 35 mm

On tangent track and light curves, sag may normally be determined by measuring wire height at mid-span and structures. In spans with an odd number of droppers the figures must be corrected by adding 15 mm to the actual sags. If the value is not within the specified limits, the sag must be determined more accurately, by obtaining the average wire height at the first and last droppers and comparing this with the height at the dropper nearest mid-span.

On curves sharper than 900 m radius, the sag must be determined in the more precise way given above.

3.6.2 Fixed termination equipment

Contact wire height is to be checked preferably at an ambient temperature of 10°C, at which the contact wire is nominally level.

The allowed tolerances on sag or hog of contact wire with respect to its nominal level condition at 10°C are:

Spans of 50 m or less: ± 25 mm

Spans of more than 50 m : ± 50 mm

Sag or hog is to be determined by measuring the wire height at mid-span and structures, and the equipment adjusted if necessary to be within the specified limits.

3.6.3 Sag and hog on canted track

Where track cant is present, in many cases the dropper lengths will have been increased so that the measured values are within tolerance.

Where this compensation has not been made, measured values of sag are to be increased by the following:

$[(V/1432).c]$ mm

where V is the versine in mm and c is the cant in mm

Similarly when measuring hog, the values are to be reduced by the above amount.

3.7 Wires converging or diverging laterally

Wires coming into or going out of running to either side of the reference wire, which is the in-running contact wire on the track subject to the highest speed, must be adjusted so that under all static conditions they are at a higher level than this wire, at points where they come within or leave range of a pantograph running on it.

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When measured with a pantograph gauge, placed upon the reference track and tilted in accordance with cant, if any, and resting against the reference wire but not pressing on it, the static difference in level between the gauge at a distance of 500 mm from its centre and the converging or diverging wire should be a minimum of 100 mm, or such lower figure so that the crossing wire is just not bearing against the cross contact bridge piece.

4 Limits of mechanical and electrical clearances

4.1 Track tolerances

4.1.1 Full

Alignment ± 25 mm

Vertical ± 25 mm

Cross Level ± 20 mm

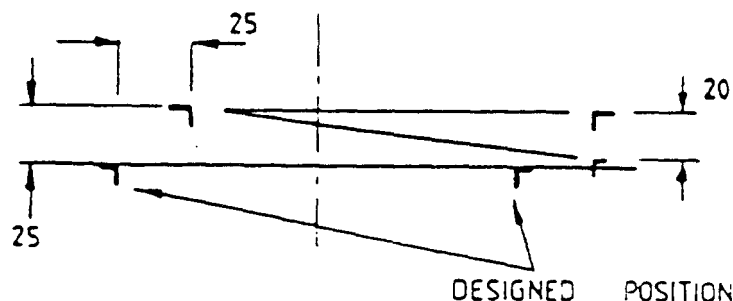
4.1.2 Close

At bridges and tunnels these tolerances are reduced to 15 mm in each case.

Application of full tolerances

The sketch below shows the extreme positions of track, relative to the designed position, for upward and to-the-right movement.

NOTE Where clearances are limited, the vertical tolerance on the high-rail may not be exceeded by the addition of any of the "cross-level" tolerance.



4.2 Pantograph sway allowance for electrical clearance

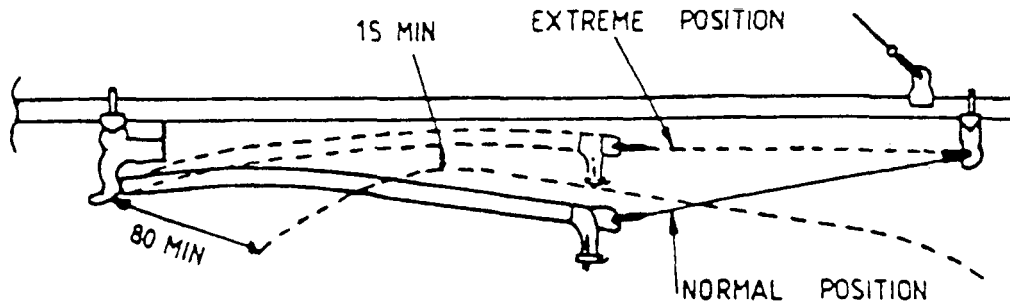
The allowance for sway of the Pantograph is 130 mm at 4.3 m with an increase of 40 mm per metre rise in contact wire height.

4.3 Mechanical clearances

In addition to the allowance for pantograph sway and track tolerances, a minimum mechanical clearance of 80 mm is required between pantograph and any fixed live equipment (e.g. drop bracket).

A minimum clearance of 15 mm between the pantograph and the steady arm is required under all conditions (i.e. worn pantograph and worn contact wire). This requires a minimum of 34 mm for A.T. and 32 mm for F.T. equipment under unworn ("as-new") conditions.

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NOTE Standard wear allowances are 19 mm at pan-head centre and 6 mm and 4 mm on contact wire in A.T. and F.T. equipment, respectively.

At open route structure (see Section 7.5), an allowance for pantograph sway of 190 mm at 4.3 m, with an increase of 40 mm per metre rise in contact wire height, is applied. Where this cannot be achieved, the reduced sway of 130 mm may be used subject to the discretion of the Principal Maintenance Support Engineer (M&E) or nominated representative.

At bridge and tunnel locations (see Section 7.6), the 130 mm figure shall apply.

4.4 Electrical clearance - Live equipment to earth

After allowing for pantograph sway and wear, contact wire wear and uplift, and tolerances the following clearances shall apply:

Type of Clearance	Static Clearance	Passing Clearance
Normal	270 mm	200 mm
Reduced (where authorised by the Principal Maintenance Support Engineer (M&E) or nominated representative)	200 mm	150 mm*
Special Reduced	150 mm+	125 mm*+

* A passing clearance of 80 mm applies to brick and masonry overbridges and tunnels between pantograph and bridge only (not between equipment and bridge) and each case is subject to special dispensation by HMRI.

+ Where stress-graded glass-fibre bridge arms are used, a static clearance of 95 mm and a passing clearance of 70 mm between the insulator live and casting and bridge are allowable, with special dispensation from HMRI.

4.5 Clearance from pantograph to in-span structures and other obstructions

The contact wire height to be used when checking the above passing electrical clearance is:

For automatically tensioned equipment, actual contact wire height plus allowance for uplift as given in Section 7.4.1.

For fixed termination equipment, an allowance of 270 mm for uplift and temperature variation.

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5 Heel settings and mechanical clearances to steady arms

5.1 Heel settings

The general tolerance on steady arm heel settings (150 mm) is ± 15 mm for lines with speeds over 75 mile/h and ± 25 mm for lower speeds.

The negative tolerance is only allowable in reduced height cantilevers if their use does not reduce the free-uplift of the steady arm to less than 50 mm.

In cases of high radial load, the heel setting of 150 mm is to be measured from a string line between the first dropper each side of the registration to the drop bracket hook.

5.2 Minimum staggers to obtain clearances to pantographs

For minimum staggers, refer to the following sections:

Section 7.5.1 Cantilever type registration

Section 7.5.2 Headspan type registration

Section 7.5.3 Flying Tail type registration

In the event of the above stagger settings being unobtainable the Principal Maintenance Support Engineer (M&E) or nominated representative should be informed. This should be done with a view to using the stagger settings based on 130 mm sway at 4.3 m, adjacent to, or in, overbridges and tunnels, and where the speed limit of the line is 100 km/h (60 mile/h) or less.

5.3 Registration adjustments and effect on adjacent equipment

It is essential when carrying out adjustments to check that the requirements of Sections 4.3 and 4.4 are not infringed by a pantograph on an adjacent line and/or crossover and/or junction.

5.4 Support and registration arms at overbridges

Section 7.6 gives the minimum stagger setting for the Glass-Fibre Arm.

6 Other requirements

6.1 Catenary clearances - Automatically tensioned equipment

6.1.1 Twin cantilever structure

25 mm is the absolute minimum clearance at any temperature, between catenary and non-associated cantilever assembly.

6.1.2 In-span

Minimum clearance between catenaries is 230 mm mid-span of 73 m span and 75 mm in the case of 18 m span. The clearance may be reduced proportionately when the crossing point is not mid-span but 75 mm is the absolute minimum acceptance figure. "Preformed" line guards shall be fitted to the catenaries when the clearance is within 75 mm of the minimum value for the position in the span concerned.

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6.2 Section insulators

It is desirable that whenever the stagger/in-span permissible deviation allows, the centre of a section insulator is adjusted to zero offset. The maximum permissible offset for each type of section insulator is:-

Brown Boveri Porcelain : 50 mm

B.I.C.C. Glass-Fibre (ceramic bead) : 220 mm

On sidings and lines other than running lines, the permissible offset for the porcelain type may be increased to 120 mm maximum, only if the 50 mm maximum cannot be applied.

Cases outside these tolerances must be referred to the Principal Maintenance Support Engineer (M&E) or nominated representative.

6.3 Clearance to return conductors

The following minimum clearance shall be available after allowing for pantograph movement, track tolerances, blow-off and rise and fall due to temperature change where applicable.

Lateral clearance between Return Conductors and the overhead equipment, including pantographs shall be a minimum of 200 mm.

Clearance between bare Return Conductors and structures, lineside fixtures or other fixed earth installations shall be a minimum of 50 mm.

Where the Return Conductor crosses over live equipment the static vertical clearance shall be a minimum of 600 mm under all temperature conditions.

The Return Conductor shall be insulated at all locations where the clearance to the Return Conductor is suspect, or where it presents a hazard under maintenance (e.g. near signals) or where it crosses live equipment with which it is not associated.

For Blow-off values at mid-span - see Section 7.7.

For Rise and Fall of Return Conductor due to temperature variation - see Section 7.8.

6.4 Setting of overlaps

A tolerance of ± 15 mm can be allowed on staggers and on the minimum horizontal distance between the equipments at mid-span which, at 10°C, is 460 mm.

It is essential that a minimum vertical clearance of 230 mm is maintained between the "in-running" and "out-of-running" equipment at the contact wire cut-in insulation, after making allowance for cant (which will be approximately 1/3 of cant value).

6.5 Balance weight settings

The balance weights should be adjusted if necessary, to enable free movement over the temperature range -18°C to 38°C.

For balance weight adjustment - see Section 7.9.

For balance weight pulley minimum and design distances - see Section 7.10.

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6.6 Catenary stagger

The catenary stagger shall be as nearly as possible the same as that of the contact wire, measured in a vertical line. The tolerance for acceptance to either side of the optimum position shall be ± 75 mm for encumbrances of 600 mm or more.

For encumbrances less than 600 mm, the above tolerance shall be reduced in proportion to the actual encumbrance.

At neutral sections there should be no difference in stagger between the Catenary and the Contact Wire.