

<b>Ref:</b>	<b>NR/SMS/Part/Z</b>
<b>Issue:</b>	16
<b>Date:</b>	02 December 2023
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**NR/L3/SIG/10663**

**NR/SMS/Part/Z**

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NR/SMS/Part/Z		
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## 1. Signals

### 1.1 Signal Lamp and Module Voltages.

Conventional SL35 Filament Lamps	
Heads & PLJIs all areas except SIMIS-W interlockings.	10.5V to 12.1V
Heads & PLJIs SIMIS-W interlockings only.	10.5V to 10.8V
MSL/MWL Light Units.	11.3V to 11.7V

**No conventional SL35 lamp shall be left with a voltage of less than the minimum listed.**

Change lamps running on auxiliary filaments as soon as possible.

The setting of all auxiliary filament voltages should be approximately the same as the main filament to retain the same light output.

The preferred maximum voltage for a conventional SL35 lamp is 10.9V, although it might not be practicable in areas where the mains supply is prone to variation.

In these areas, a higher voltage setting could be required to check the minimum voltage does not drop below 10.5V. If you are in any doubt, ask your SM(S).

In SIMIS-W interlocking areas the target voltage for conventional SL35 lamps is 10.7V. Due to the transformer tapings the exact voltage might not be achievable, in this case a slightly higher voltage can be used.

The target voltage for 10V 50W QH lamps is 10V.

8000 Hour SL35 Filament Lamps	
Main filament only, all areas except SIMIS-W interlockings.	11V to 12.1V
Main filament, SIMIS-W interlocking areas only.	10.5V to 10.8V
Where BR942 spec relays are used as a UEER on PLJIs.	10.5V to 12.1V

**No 8000hr SL35 lamp shall be left with a voltage of less than the minimum listed.**

**The auxiliary filament of an 8000hr lamp is not long life therefore this shall be set to the range listed for a conventional SL35.**

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The main filament in long life lamps shall be set to the higher range of the limits to check correct operation of the filament. In areas that are prone to voltage variations this is sometimes not possible. If you are in any doubt, ask your SM(S).  
Change lamps running on auxiliary filaments as soon as possible.

The setting of all auxiliary filament voltages should be approximately the same as the main filament to retain the same light output.

In SIMIS-W interlocking areas the target voltage for 8000hr SL35 lamps is 10.7V. Due to the transformer tapings the exact voltage might not be achievable, in this case a slightly higher voltage can be used.

The target voltage for 10V 50W QH lamps is 10V.

Ansaldo Interlocking Areas (Manchester South only)	
SD321 Colour light Signal (Quartz Halogen Lamps)	11.6V to 12.2V

If the voltage on any unlit SD321 lamp exceeds 0.8V, report the situation to your SM(S) immediately.

Other Filament Lamps	
12V lamps ( <b>Except</b> electric lit semaphores).	11.3V to 11.7V
12V lamps (Electric lit semaphores only).	10.3V to 11.7V
10V 50W QH Lamps (SIMIS-W interlocking's only)	9.8V to 10.2V
4V lamps (Electric lit semaphores)	3.7V to 3.9V
4.5V lamps (Electric lit semaphores)	4.4V to 4.6V
6V lamps (Electric lit semaphores)	5.7V to 6V
110V lamps (All signals & indicators <b>not</b> fed direct from a bus bar)	100V to 110V
110V lamps (All signals & indicators fed direct from a bus bar)	99V to 121V

In some areas electric lit semaphore signals have series resistors in the B12 lamp feed; this is to provide a lamp voltage of 10.7V.

This is to provide a light output similar in hue to an oil lamp which cannot be distorted by the hue of the coloured lenses.

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<b>Quartz Halogen Lamps</b>	
12V QH lamps (Except fibre optic heads)	11.7V to 12.3V
10V QH lamps (All applications)	9.7V to 10.3V

12V quartz halogen lamps fitted in a signal head with a 110/10V transformer can blacken. Technicians shall replace them with a 10V rated quartz halogen lamp or advise their SM(S).

Replacement of the 110/10V signal head transformer should be considered by the SM(S), if 10V quartz halogen lamps are not available.

Set Quartz Halogen lamps to run as close as possible to their rated voltage.

<b>LED Light Engines</b>	
Howells LED SL35 Light Engine (MK1 Light Engine)	11V to 13V
Howells LED SL35 Light Engine (MK2 Light Engine)	10.5V to 11.5V
Howells LED SL35 Light Engine (MK3 Light Engine)	11.5V to 12.5V

<b>LED Universal Semaphore Lamp</b>	
LED Universal Semaphore Lamp	4V to 18V

<b>LED Signal Module</b>	
Input to SLM	90V to 120V

<b>LED Semaphore Signal Modules</b>	
Low Intensity	Low Intensity
High Intensity	High Intensity

## 2. SIMIS-W INTERLOCKING AREAS

### 2.1 Current Ranges.

Type of Lamp and SOM	Current
SL35 lamps Som /Som 5	140mA – 170 mA
SL35 lamps Som 6	140mA – 175 mA
10V QH Lamps Som / Som 5	350mA – 457 mA
10V QH Lamps Som 6	350mA – 470 mA

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**3. Signal Arm**

3.1 Balance Lever and Light Repeater Contact Settings.

Arm Position	Contact Detail
Arm / Slot ON	-5 to 5 degrees
Arm / Slot WRONG	5 to 35 degrees
Arm / Slot OFF	35 to 65 degrees
Arm / Slot WRONG	65 or more degrees
AWS energised	25 to 65 degrees

Lower quadrant signals have the same measurements below the horizontal (0° being the horizontal).

**4. SPEED & DISTANCE MEASUREMENTS.**

4.1 The Formula for working out Speed & Distance Measurements is as follows.

- a) Miles per hour \* 0.489 for the distance in **yards** covered in one second.
- b) Miles per hour \* 0.447 for the distance in **metres** covered in one second.

**5. SIGNAL VISIBILITY CHARTS**

2 Seconds		
Permissible Speed (mph)	Viewing Distance	
	(Yds.)	(M.)
20	20	18
25	24	22
30	29	27
35	34	31
40	39	36
45	44	40
50	49	45
55	54	49
60	59	54
65	64	58
70	68	63

2 Seconds		
Permissible Speed (mph)	Viewing Distance	
	(Yds.)	(M.)
75	73	67
80	78	72
85	83	76
90	88	80
95	93	85
100	98	89
105	103	94
110	108	98
115	112	103
120	117	107
125	122	112

4 Seconds		
Permissible Speed (mph)	Viewing Distance	
	(Yds.)	(M.)
20	39	36
25	49	45
30	59	54
35	68	63
40	78	72
45	88	80
50	98	89
55	108	98
60	117	107
65	127	116
70	137	125

4 Seconds		
Permissible Speed (mph)	Viewing Distance	
	(Yds.)	(M.)
75	147	134
80	156	143
85	166	152
90	176	161
95	186	170
100	196	179
105	205	188
110	215	197
115	225	206
120	235	215
125	244	224

5 Seconds		
Permissible Speed (mph)	Viewing Distance	
	(Yds.)	(M.)
20	49	45
25	61	56
30	73	67
35	86	78
40	98	89
45	110	101
50	122	112
55	134	123
60	147	134
65	159	145
70	171	156

5 Seconds		
Permissible Speed (mph)	Viewing Distance	
	(Yds.)	(M.)
75	183	168
80	196	179
85	208	190
90	220	201
95	232	212
100	244	224
105	257	235
110	269	246
115	281	257
120	293	268
125	306	279

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10 Seconds		
Permissible Speed (mph)	Viewing Distance	
	(Yds.)	(M.)
20	98	89
25	122	112
30	147	134
35	171	156
40	196	179
45	220	201
50	244	224
55	269	246
60	293	268
65	318	291
70	342	313

10 Seconds		
Permissible Speed (mph)	Viewing Distance	
	(Yds.)	(M.)
75	367	335
80	391	358
85	416	380
90	440	402
95	464	425
100	489	447
105	513	469
110	538	492
115	562	514
120	587	536
125	611	559

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## 1. Track Gauge

Type of switch	Measurement
Plain Line	1435mm nominal (1432mm – 1438mm depending on sleeper type) Gauge widening may be applied on tight curves
Vertical S&C	1432mm (gauge widening on tight curves only permitted on tight curves)
Inclined S&C	1435mm (gauge widening on tight curves only permitted on tight curves)

Further details on track gauge can be found in NR/L2/TRK/001.

## 2. Switch Openings

Points Type		At Lock Arm	At Toe
RCPL Plain Lead		105mm to 110mm (Optimum 108mm)	105mm to 110mm (Optimum 108mm)
IBCL Plain Lead		105mm to 110mm (Optimum 108mm)	105mm to 110mm (Optimum 108mm)
IBCL Mk3 Plain Lead	Where fitted to NR60 Mk2 with mechanical back drive:	128mm to 132mm (Optimum 130mm)	128mm to 132mm (Optimum 130mm)
	elsewhere	105mm to 110mm (Optimum 108mm)	105mm to 110mm (Optimum 108mm)
HPSS		N/A	112mm to 114mm
RCPL Switch Diamonds		82mm to 87mm (Optimum 82mm)	85mm to 90mm (Optimum 85mm)
Mechanical or Machine (All types)		N/A	102mm to 120mm (Optimum 108mm)
Unistar		150mm	150mm to 165mm (Optimum 160mm)
Unistar Switch Diamonds		90mm	85mm to 95mm (Optimum 90mm)

**NOTE:** Unistar measured at Drive/Lock Rod.

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### 3. Residual Switch Opening (except Unistar, HPSS)

Position of gauge	Measurement	
	Nominal	Maximum
From first to last stretcher bar (all permutations)	1.5mm	4.0mm

### 4. Residual Switch Opening Unistar

Position of gauge	Measurement	
	Nominal	Maximum
NR56 V Turnouts. Toe to final supplementary drive	1.5mm	4.0mm
NR60 Mk2 Switch Diamonds Toe to end of switch planing (head cut)	1.5mm	8mm

### 5. Residual Switch Opening HPSS

Position of gauge	Measurement
at the toe of the switch (in-line with the toe sensor)	0mm
at the end of the switch rail Planning (head cut)	2.5mm to 3mm
at all supplementary sensor positions shall be less than	2.0mm #1
from the first to the last stretcher (excl. supp, sensors pos'n)	0mm to 3mm

#1 - except for CEN54 'C' switches which can be 2mm to 3mm.

See NR/L2/SIG/11400 for more details.

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## 6. Free Wheel Clearances

Switch Type	Clearance	Comment
RT60 & NR60	60mm	Minimum gap throughout the moveable length of the switch.
Other types	50mm	Minimum gap throughout the moveable length of the switch in proximity to the rear stretcher bar, the minimum FWC shall be enlarged if track gauge is wider than the nominal value.
Single & double slips	45mm	Minimum gap throughout the moveable length of the switch where the line speed is $\leq 60$ mph
	50mm	Minimum gap throughout the moveable length of the switch where the line speed is $>60$ mph

More details on RSO and FWC can be found in NR/L2/TRK/001.

## 7. Calculating Wheel Free Clearance

Formula for Calculating Required Free Wheel Clearance at Each Stretcher Bar is:

$$RFWC(SB) = NFWC(SB) + MTG(SB) - NTG$$

Acronym	Meaning
RFWC (SB)	Required Free Wheel Clearance at specific stretcher bar
NFWC(SB)	Nominal Free Wheel Clearance at specified stretcher bar
MTG (SB)	Measured Track Gauge (static) at specific stretcher bar
NTG	Nominal Track Gauge

**NOTE:** Further information on calculating FWC can be found in NR/L3/TRK/6100/Mod03 (Installing stretcher bars and setting them to the correct length).

**If you are in doubt about any measurement or calculation of FWC or FWP, ask your SM(S).**

Typically for:

- Plain leads in vertical S&C with designed FWC of 50mm the FWP value would be 1432mm minus 50mm which equals 1382mm.
- Slips in vertical S&C (where there is a permitted 45mm FWC) the FWP would be 1432mm minus 45mm which equals 1387mm.
- CEN60 in inclined S&C with a designed FWC of 60mm the FWP value would equal 1435mm minus 60mm which equals 1375mm.

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### 8. Kicking Strap Clearances

S&C Type	Clearance	
	Minimum	Maximum
S&C with conventional slide chairs	3mm	6mm
S&C fitted with rollers	6mm	9mm
S&C fitted with Unistar POE	N/A	N/A

### 9. Facing Point Lock

Will Lock	Will Not Lock
1.5mm	3.5mm

### 10. Detection

Type of Detection	Detection	
	Made	Broken
RCPL	2.5mm	4mm
IBCL (Mk2 and Mk3)	3.5mm	5mm
HPSS (CEN54)	N/A	8mm
HPSS (NR60/RT60)	N/A	10mm
BR998 & other supp. types	6mm	8mm
SO Hydraulic Supplementary	2mm	4mm
Unistar	1.5mm	3.5mm
Unistar – Supplementary Drives	2.0mm	4.0mm
All Others	3.5mm	5mm

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## 11. POINT FITTINGS

Point fixings are required to be torque tightened/checked to confirm a secure connection.

Some torque wrenches apply a direct torque to the fixing, others utilise an extension piece connected to the wrench, which changes the amount of torque applied to the fixing.

Where an extension piece is required, the relevant tables below include a "Torque Wrench Setting" column.

This is the value the torque wrench should be set to, when using the correct extension piece.

## 12. TUBULAR STRETCHER BARS

### 12.1 Installation Torque Values.

All Bolts on Tubular Stretcher Bar Assemblies (All Locations)		
	Torque Wrench Setting	Applied Torque
All Switch Rail Bolts	340Nm	440Nm
All Motion Unit to Tube Bolts	340Nm	440Nm
Kicking Strap Nuts	200Nm	250Nm
Locking Devices on Tubular Stretcher Bar Assemblies (All types of tubes)		
Primary Locking Collars	340Nm	440Nm
Secondary Cap Screws	Until washers are compressed	

### 12.2 Check Torque Values

All Bolts on Tubular Stretcher Bar Assemblies require to be checked during SMTH Testing		
	Torque Wrench Setting	Applied Torque
All Switch Rail Bolts	270Nm	350Nm
All Motion Unit to Tube Bolts	270Nm	350Nm

See NR/L2/TRK/6100/Mod04 (Tubular Stretcher Bars) for full details of the correct tooling to be used to secure all fastenings on tubular stretcher bars.

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### 13. Fixed Stretcher Bars

#### 13.1 Installation Torque Values.

<b>Hardlock Nuts on Fixed Stretcher Bars (All Locations)</b>	
Male Nut (Convex)	250Nm
Female Nut (Concave)	250Nm
<b>Square and Hex Nuts on Fixed Stretcher Bars (All Locations)</b>	
All Nuts	250Nm

#### 13.2 Check Torque Values.

<b>Hardlock Nuts on Fixed Stretcher Bars (All Locations)</b>	
Male Nut (Convex)	N/A
Female Nut (Concave)	200Nm
<b>Square and Hex Nuts on Fixed Stretcher Bars (All Locations)</b>	
All Nuts	200Nm

See NR/L2/TRK/6100/Mod05 (Fixed Stretcher Bars) for full details of the correct tooling to be used to secure all fastenings on fixed stretcher bars.

### 14. Adjustable Stretcher Bars

#### 14.1 Installation Torque Values.

#### **Hardlock or Full/Half Nuts on 35mm Square Section Adjustable Stretcher Bars (Adjustable Bar only)**

<b>Using LTTK11 (fitted with the 46mm A/F long Extension)</b>		
	Torque Wrench Setting	Applied Torque
Male Nut (Convex)	1/3 turn to compress bush	
Female Nut (Concave)	255Nm	300Nm
Full Nut	1/3 turn to compress bush	
Half Nut	255Nm	300Nm
<b>Using Version 1 of Insulated LTTK16 (fitted with the 46mm A/F long Extension)</b>		
Male Nut (Convex)	1/3 turn to compress bush	
Female Nut (Concave)	140Nm	300Nm
Full Nut	1/3 turn to compress bush	

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Half Nut	140Nm	300Nm
<b>Using Version 2 of Insulated LTTK16 (fitted with the 46mm A/F long Extension)</b>		
Male Nut (Convex)	1/3 turn to compress bush	
Female Nut (Concave)	Position B	300Nm
Full Nut	1/3 turn to compress bush	
Half Nut	Position B	300Nm

14.2 Check Torque Values.

**Hardlock or Full/Half Nuts on 35mm Square Section Adjustable Stretcher Bars (Adjustable Bar only).**

<b>Using LTTK11 (fitted with the 46mm A/F long Extension)</b>		
	Torque Wrench Setting	Applied Torque
Male Nut (Convex)	N/A	
Female Nut (Concave)	160Nm	200Nm
Full Nut		
Half Nut		
<b>Using Version 1 of Insulated LTTK16 (fitted with the 46mm A/F long Extension)</b>		
Male Nut (Convex)	N/A	
Female Nut (Concave)	95Nm	200Nm
Full Nut	N/A	
Half Nut	95Nm	200Nm
<b>Using Version 2 of Insulated LTTK16 (fitted with the 46mm A/F long Extension)</b>		
Male Nut (Convex)	N/A	
Female Nut (Concave)	Position A	200Nm
Full Nut	N/A	
Half Nut	Position A	200Nm

See NR/L2/TRK/6100/Mod06 (Adjustable Stretcher Bars) for full details of the correct tooling to be used to secure all fastenings on adjustable stretcher bars (Non HPSA Point Systems).

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## 15. Torque Prevailing Nuts

### 15.1 Installation Torque Values

<b>Torque Prevailing Nuts (Fixed and 35mm Square Section Adjustable Stretcher Bars, Bracket to Rail Fastenings,) Installation Value</b>	
Torque Prevailing Nut	250Nm

### 15.2 Check Torque Values

<b>Torque Prevailing Nuts Non HPSA Point Systems (Fixed and Adjustable Stretcher Bars, Bracket to Rail Fastenings) Test Value</b>	
Torque Prevailing Nut	200Nm

See NR/L2/TRK/6100/Mod06 (Adjustable Stretcher Bars) for full details of the correct tooling to be used to secure all fastenings on adjustable stretcher bars (Non HPSA Point Systems).

## 16. Unistar HR – Torque Values

Item	Size Fitting	Installation Torque	Check Torque
Switch Rail Bracket Main Bolts - Philidas	M20	230Nm	230Nm
Rod End retainer bracket Tabs	M8	25Nm	25Nm
Mounting Plate Fixation Anchors (Slab)	Spike screw	200Nm	200Nm
DLD to mounting Plate Bolts (Slab)	M20	230Nm	230Nm
Locking Collar Bolts for DLD Plate fasteners	M8	25Nm	25Nm
DLD to Buttress Plate Bolts	M20	230Nm	230Nm
Power Pack Mounting Plate to Concrete Kerb Anchors	M8	30Nm	30Nm
Power Pack Mounting Plate to Roller Stool Nuts and Bolts	M20	35Nm	35Nm
Power Pack to Mounting Plate securing Nuts and Bolts	M16	35Nm	35Nm
Drive Rod End Nut	M27	-	N/A
Detector Rod End Nut	M27	-	N/A
Locking Collar for Drive and Detector Rod Ends securing nut	M8	25Nm	N/A



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**17. Unistar HR Hose fittings - Torque Values**

Item	Size	Installation Torque	Check Torque
All fittings	M18x1,5	110Nm	80Nm

**18. Unistar HR Internal Security Bolts – Torque Values**

Item	Size	Installation Torque	Check Torque
Locking Collars	M8	25Nm	N/A
All other secure screws	M8	25Nm	N/A

**19. In-Bearer Clamp Locks (IBCL) Mk 2 - Torque Values**

Item	Size Fitting	Installation Torque	Check Torque
Lock and Detector Mechanism Retaining Nuts	M20	250Nm	225Nm
Switch Rail Bracket Retaining Nuts	M20	250Nm	225Nm
Detector Blade Lug Retaining Nuts	M16	70Nm	65Nm
Detector Blade Adjuster Lock Nut	M16	70Nm	65Nm
Adjustable Tie Bar Retaining Nuts	M16	150Nm	135Nm
Actuator Socket Mounting Bolts	M16	150Nm	135Nm
Locking Piece Retaining Screws	M12	60Nm	55Nm
Adjustable Tie Bar Lock Nut (Use 39/52030)	-	100Nm	90Nm
Centre Thrust Bracket Retaining Bolts	M16	150Nm	135Nm
Hydraulic Ram Socket Mounting Retaining Bolts	M16	150Nm	135Nm
A9 Pivot Pin retaining nut (where fitted)	M20	30Nm	25Nm

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## 20. In-Bearer Clamp Locks (IBCL) Mk 3 - Torque Values

Item	Size	Installation Torque	Check Torque
Lock and Detector Mechanism Retaining Nuts	M20	250Nm	225Nm
Switch Rail Bracket Retaining Nuts (Vargal)	M20	290Nm	260Nm
Detector Blade Lug Retaining Nuts	M16	70Nm	65Nm
Detector Blade Adjuster Lock Nut	M24	90Nm	75Nm
Detector Blade Adjuster Lock Nut	M16	70Nm	65Nm
Locking Piece Retaining Screws	M12	60Nm	55Nm
Centre Thrust Bracket to Bearer Bolts	M16	150Nm	135Nm
Centre Thrust Bracket to Ram Bolts	M12	60Nm	55Nm
Cylinder Rod Adjuster Lock Nuts	M27	100Nm	90Nm
Cylinder Rod Adjuster Locking Pin	M8	Min 2 clear threads	Min 2 clear threads
A9 Pivot Pin retaining nut (where fitted)	M20	30Nm	25Nm

## 21. Hose fittings (Clamp Lock (All Types)) - Torque Values

Item	Size	Installation Torque	Check Torque
Power Pack Hydraulic Hose Unions	¼" BSSP	16.5Nm	N/A
Hydraulic Ram Hose Unions	¼" BSSP	16.5Nm	N/A
SO Back Drive Manifold Retaining Cap Head Bolt (Hy-Drive only)	M10	60Nm	N/A
SO Back Drive Manifold Hydraulic Hose Union Connections (Hy-Drive only)	½" BSSP	16.5Nm	N/A

## 22. Hy-Drive- Torque Values

### 22.1 Installation Torque Values

Hy-Drive stretcher bar to Switch Rail fastenings	
Torque Prevailing Nut	250Nm
Hy-Drive Kicking Strap fastenings	
Torque Prevailing Nut	250Nm

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## 22.2 Installation Torque Values

<b>Hy-Drive stretcher bar to Switch Rail fastenings</b>	
Torque Prevailing Nut	200Nm
<b>Hy-Drive Kicking Strap fastenings</b>	
Torque Prevailing Nut	200Nm

See NR/L3/SIG/19808 for full details of the correct tooling to be used to secure all fastenings on Hy-Drive stretcher bars.

## 23. High Performance Switch System (HPSS) – Torque Values

### 23.1 High Performance Switch Actuator (HPSA)

Item	No. Bolts	Socket Size	Installation torque	Check Torque
Toe sensor to stock bolts	2	19mm #1	50Nm	30Nm
Motor bolts	4	10mm	#2	#2
Brake bolts	3	10mm	#2	#2
ECU bolts	4	4mm #3	#2	#2
Gearbox mounting bolts	6	17mm	150Nm	80Nm
Gearbox packing plate bolts (where fitted)	6	17mm	150Nm	80Nm#6
Carriage top cap bolts	4	17mm	150Nm	#4
Carriage shaft bolts	2	22mm	300Nm	#4
Switch rail drive bracket fasteners	2	30mm	220Nm	#4

### 23.2 PowerLink Backdrive

Item	Socket Size	Installation torque	Check Torque
Supp. sensor drive bracket bolts (tabbed washer)	13mm	30Nm	20Nm #5
Supp. sensor drive bracket bolts (Durlok) #7	13mm	44Nm	20Nm
Supp. sensor to mounting bracket bolts	19mm	80Nm	#4
Supp. sensor mounting bracket to bearer bolts	19mm	80Nm	#4
Shear pin module mounting bolts	22mm	300Nm	100Nm
Torque tube (serrated joint F/SG only) fasteners	24mm	200Nm	#4
Bearing block (mounting to hollow bearer) fasteners	30mm	420Nm	100Nm

NR/L3/SIG/10663 Signal Maintenance Specifications		
<b>NR/SMS/PartZ/Z02</b>		
<b>Point - Reference Values</b>		
Issue No: 11	Issue Date: 02/12/2023	Compliance Date: 02/03/2024

Bearing block (clamping half) fasteners	19mm	80Nm	#4
Bearing block, bearing journal fasteners	19mm	70Nm	#4
Stretcher bar to dropper bracket fasteners	30mm	300Nm	100Nm
Web drive bracket to switch rail fasteners	30mm	420Nm	100Nm
Covers and end plate bolts	17mm	150Nm	80Nm
Lost motion thimble locknut	36mm	#2	#2
Gauge stop (countersink version)	17mm	250Nm	#4

### 23.3 System Wide Components

Item	Socket Size	Installation torque	Check Torque
CEN54 baseplate bolt	36mm	210Nm	#4
RT60 fast-clip block fastener	17mm	420Nm	#4
Anchor plate fasteners CEN54/RT60	30mm	420Nm	#4

#1: Deep socket required.

#2: Bolts to be secure but not over tightened.

#3: A/F hex key.

#4: Not a Maintenance requirement.

#5: Not required where locking tab washers are installed and correctly folded over.

#6: It is only possible to Check Torque 4x of these fasteners due to the Gearbox covering the other 2x.

See NR/L2/SIG/11400 for full details of the correct tooling to be used to secure all fastenings on HPSA and PowerLink Backdrive (HPSS Point Systems).

NR/L3/SIG/10663 Signal Maintenance Specifications		
NR/SMS/PartZ/Z02		
Point - Reference Values		
Issue No: 11	Issue Date: 02/12/2023	Compliance Date: 02/03/2024

## APPENDIX A - Action Tables

### 1. Gear Box - Broken Bolts

Defect	Minimum Action	Follow Up Actions
<p>4 or more gearbox mounting bolts broken</p> <p><b>Or</b></p> <p>2 or more packing piece bolts broken</p>	<p><b>BLOCK THE LINE</b> and renew the broken bolts</p> <p><b>Or</b></p> <p>If unable to replace the bolts, clip and scotch the points and impose 20mph speed restriction</p> <p><b>Or</b></p> <p>Ban facing moves</p>	<p>Renew all intact gearbox/packing piece bolts and torque tighten to 150Nm within 36 hours</p> <p>Where the broken bolts cannot be removed contact IAD team – Route Services.</p>
<p>3 gearbox mounting bolts broken</p> <p><b>and/or</b></p> <p>1 packing piece bolts broken</p>	<p>Impose 60mph speed restriction and inspect bolts every 12 hours</p> <p><b>Or</b></p> <p>If unable to replace the bolts, clip and scotch the points. Point end shall be in full detection and the clip and/or scotched padlocked.</p> <p><b>Or</b></p> <p>Ban facing moves</p>	<p>Renew all intact gearbox/packing piece mounting bolts and torque tighten to 150Nm within 36 hours</p> <p>Where the broken bolts cannot be removed contact IAD team – Route Services.</p>
<p>1 or 2 gearbox mounting bolts broken</p>	<p>Inform the SM[S]</p>	<p>Contact IAD to arrange for the renewal of the broken bolts</p> <p>Renew the remaining (not broken) Durlok bolts within 72 hours</p>

NR/L3/SIG/10663 Signal Maintenance Specifications		
<b>NR/SMS/PartZ/Z02</b>		
<b>Point - Reference Values</b>		
Issue No: 11	Issue Date: 02/12/2023	Compliance Date: 02/03/2024

2. Gear Box - Loose Bolts

Defect	Minimum Action	Follow Up Actions
3 or more loose gearbox mounting bolts  <b>and/or</b>  2 or more loose packing piece bolts	Re-tighten immediately to 150Nm and inform the SM[S]  <b>Or</b>  Impose 60mph speed restriction and inspect bolts every 12 hours  <b>Or</b>  Ban facing moves  <b>Or</b>  Clip and scotch point	Renew all gearbox/packing piece mounting bolts within 7 days
1 or 2 loose gearbox mounting bolts  <b>and/or</b>  1 loose packing piece bolts	Re-tighten to 150Nm within 12 hours	Renew all gearbox/packing piece mounting bolts within 7 days

**END**

NR/L3/SIG/10663 Signal Maintenance Specifications		
<b>NR/SMS/PartZ/Z03</b>		
<b>Train Detection - Reference Values</b>		
Issue No: 09	Issue Date: 04/09/2021	Compliance Date: 04/12/2020

## 1. TRACK CIRCUITS

### 1.1 Drop Shunt Values

TC Type	Minimum	Desired
50Hz AC Double Rail with Impedance Bonding	0.3Ω	0.6Ω to 1.0Ω
50Hz AC Single Rail with Impedance Bonding	0.5Ω	0.8Ω to 1.2Ω
50Hz AC Single or Double Rail Without Impedance Bonding	0.5Ω	0.8Ω to 1.2Ω
50Hz AC VT1(SP) (Single rail)	0.5Ω	1.5Ω to 2.5Ω
DC (basic configuration)	0.5Ω	0.8Ω
DC (With feed end relay)	0.5Ω	0.8Ω
DC (With relay end adjustable resister)	1Ω	1.3Ω to 1.5Ω
DC (With relay end adjustable resister & 60Ω relay)	1.2Ω	1.5Ω to 1.7Ω
DC Coded Track	0.5Ω	0.8Ω to 1.0Ω
Rectified AC (Diode)	0.5Ω	1.5Ω
Westrak/Relay End Fed	0.5Ω	0.8Ω
Reed Type RT Without Impedance Bonding	0.5Ω	1-1.2Ω
Reed Type RT With Impedance Bonding	0.3Ω	1-1.2Ω
Aster U Type	0.5Ω #1	0.8Ω
ET200 Low Power/Low Power Plus Without Impedance Bonding	0.5Ω	1.5Ω to 1.9Ω
ET200 Low Power/Low Power Plus with Impedance Bonding	0.3Ω	1.5Ω to 1.9Ω
ET200 Normal Power Without Impedance Bonding	0.5Ω	1.0Ω to 2.8Ω
ET200 Normal Power with Impedance Bonding	0.3Ω	1.0Ω to 2.8Ω
ET400 Open Line Frequencies (fA to fH)	0.5Ω	1.0Ω to 2.8Ω
ET400 Station Area Frequencies (f1 to f8)	1.0Ω at TX 1.4Ω at RXs	1.5Ω
FS2600 (Double rail)	0.6 Ω	1Ω
HVI (relay end rails, electrified. area)	1.0Ω	3.0Ω #2
HVI (relay end rails, non-electrified areas.)	0.5Ω	2.5Ω #2
BR-WR Quick Release	0.5Ω	0.8Ω

**Table 1 - 1.1 Drop Shunt Values**

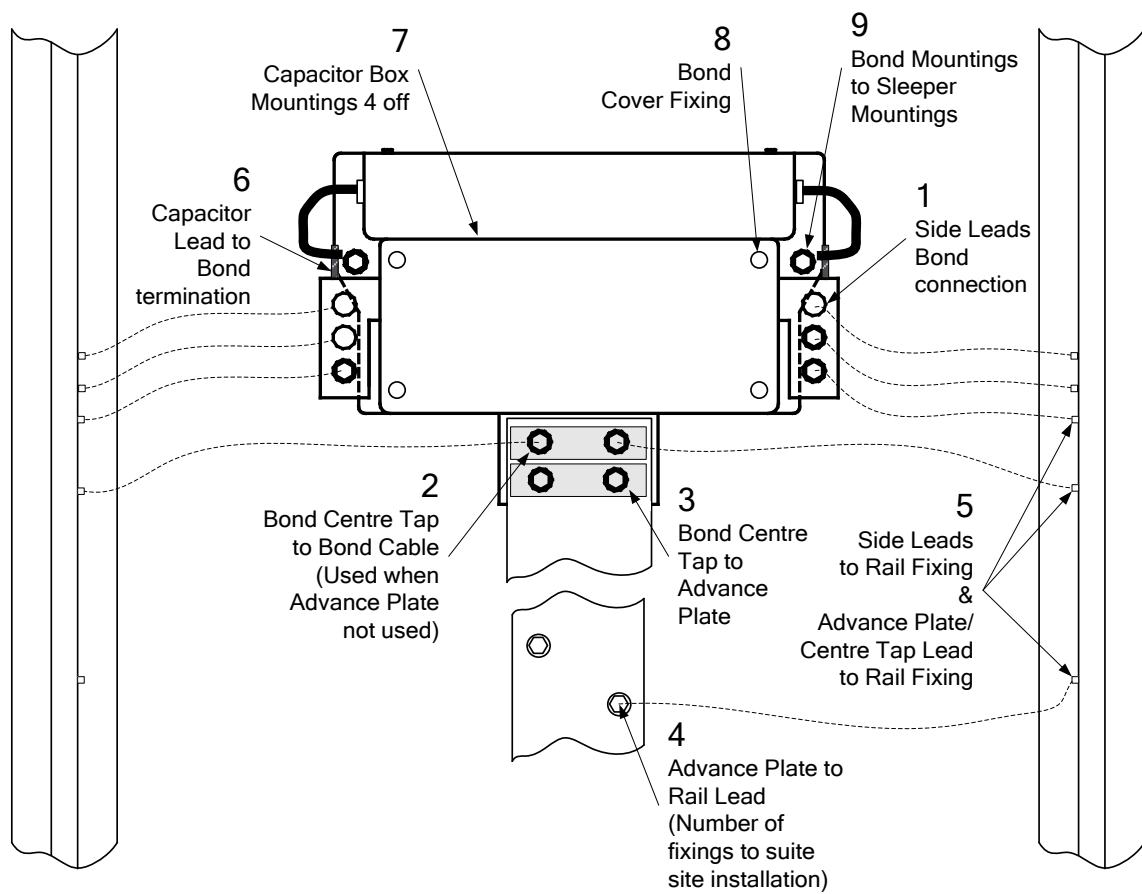
NR/L3/SIG/10663 Signal Maintenance Specifications		
<b>NR/SMS/PartZ/Z03</b>		
<b>Train Detection - Reference Values</b>		
Issue No: 09	Issue Date: 04/09/2021	Compliance Date: 04/12/2020

- #1: The minimum drop shunt value with the train shunt applied across the rails at the TX-tuning unit is 0.3Ω.
- #2: This is a maximum value.

1.2 50Hz AC Double Rail Track Capacitance Value

See [NR/SMS/PartB/Test/260](#) for details.

**2. IMPEDANCE BOND TORQUE SETTINGS**



**Figure 1 – Fixing Identification Diagram**

Figure 1 Ref Number	Item Description	Fixing Size	Torque Nm
1	Side Leads Bond connection (Copper crimps)	M16	Install : 110 Check : 90
1	Side Leads Bond connection (Aluminium crimps)	M16	Install : 90 Check : 70



NR/L3/SIG/10663 Signal Maintenance Specifications		
NR/SMS/PartZ/Z03		
Train Detection - Reference Values		
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Figure 1 Ref Number	Item Description	Fixing Size	Torque Nm
2	Bond Centre Tap to Bond cable (Copper Crimp)	M16	Install : 110 Check : 90
2	Bond Centre Tap to Bond cable (Aluminium Crimp)	M16	Install : 90 Check : 70
3	Bond Centre Tap to Advance Plate (Aluminium) Note the Correct Installation procedure shall be used incorporating the spreader plates for all new installations.	M16	Pre Tighten : 70 Install : 140 Check : 120
3	Bond Centre Tap to Advance Plate (Aluminium) Non-Preferred Solution	M16	Install : 90 Check : 70
7	Capacitor Box Mountings 4 off	M6	7
6	Capacitor Lead to Bond termination #5 (Copper crimp)	M10	Install : 35 Check : 25
4	Advance Plate to Rail Lead Connection (Copper crimp)	M16	Install : 90 Check : 70
4	Advance Plate to Rail Lead Connection (Aluminium crimp)	M16	Install : 90 Check : 70
4	Advance Plate to Rail Lead Connection (Copper crimp)	M12	Install : 72 Check : 60
4	Advance Plate to Rail Lead Connection (Aluminium crimp)	M12	Install : 72 Check : 60
5	Side Leads to Rail Fixing and Advance Plate / Centre Tap Leads to Rail Fixing (Copper crimp) Uses Cembre or Glenaire rail fixings	M12	Install : 72 Check : 60
5	Side Leads to Rail Fixing and Advance Plate / Centre Tap Leads to Rail Fixing (Aluminium crimp) Uses Cembre or Glenaire rail fixings	M12	Install : 72 Check : 60
5	Side Leads to Rail Fixing and Advance Plate / Centre Tap Leads to Rail Fixing (Copper crimp)	Bolt	Install : 110 Check : 90
8	Bond Cover Fixing (Uses lifting bolt holes)	M10	Tighten manually using best judgement
9	B3 3000 Bond to concrete sleeper fixing including Bond Bottom Packing Covers.	M16 #1	110 Nm to fix bolt. 80 Nm to fix Bond
9	B3 3000 Bond to timber sleeper fixing including Bond Bottom Packing Covers.	M16 / <sup>5</sup> / <sub>8</sub> inch #2	60

NR/L3/SIG/10663 Signal Maintenance Specifications		
NR/SMS/PartZ/Z03		
Train Detection - Reference Values		
Issue No: 09	Issue Date: 04/09/2021	Compliance Date: 04/12/2020

Figure 1 Ref Number	Item Description	Fixing Size	Torque Nm
9	B3 3000 Bond to timber sleeper fixing including Bond Bottom Packing Covers.  Blind Bolt #3, Jam nut, Philidas nut	M12	Jam Nut 17 Nm  Philidas nut 50Nm
	WH3/HR3 Bond to concrete sleeper fixing.  2 off Hilti HAS 12 x 110 (66337) used at the plate end only	M12	50Nm in accordance with Hilti installation instructions
	WH3/HR3 Bond to timber sleeper fixing.  6-inch coach screw with gimlet point	2 off M16 / 5/8inch.	As required to install coach screws  #4

**Table 2 – Fixing Details**

⋮ Traction Bonding connections are not covered in this table.

Number	Comment	Installation
#1	M16 bolt or stud. Expanding metal sleeve type	Expanding bolt/stud shall be fixed to sleeper using following procedure: <ul style="list-style-type: none"> <li>• Fix bolt/stud to sleeper with Torque of 110 Nm</li> <li>• Remove nut/washer, install bond/ Bond Bottom Packing Covers and replace with new Face Washer / Spring Washer / Full Depth Nut.</li> <li>• Torque Full Depth Nut to 80 Nm</li> </ul>
#2	Use special M16 (5/8") coach screws with gimlet point.	Intermediate Bond Cover bottom packing covers shall be installed between sleeper and Bond.
#3	Supplied by The Blind Bolt Company or accepted equivalent	
#4	Coach screws shall not be tightened down, leaving 25mm clear and fixed at the plate end only (2 screws).	
#5	Torque values to be applied if ETU also terminated on M10 stud depending on application design.	

**Table 3 – Key to hash comments in Table 2**

NR/L3/SIG/10663 Signal Maintenance Specifications		
<b>NR/SMS/PartZ/Z03</b>		
<b>Train Detection - Reference Values</b>		
Issue No: 09	Issue Date: 04/09/2021	Compliance Date: 04/12/2020

### 3. IRJ CLEARANCES

Detail	Clearance	Notes
Clearance Point	4880mm	Beyond 1970mm vehicle fouling point (1970mm is measured between running edges at right angles to diverging line).
Maximum IRJ physical stagger	2600mm	Between adjacent insulated joints
	2100mm	For single rail overlap on electrified lines
Minimum effective length	18.3m	
Maximum parallel bonded	13.0m	
Minimum distance between 2 sets of IRJs	18.3m	Conventional
	11.0m	Where both staggers are less than 1600mm

**Table 4 - IRJ Clearances**

### 4. MECHANICAL TREADLES

Type	Detail	Measurement
59	Arm top to rail top	11mm ±1mm
69		16mm ±1mm
Both	Arm to running edge	10mm + 2mm to - 5mm

**Table 5 - Mechanical treadles**

### 5. AXLE COUNTER THALES (AZL SERIES) SYSTEM

Torque Settings for Rail Contact Fittings AzL Series		
Location	Nut Size	Torque
Rail Fixings	19mm	40-45Nm
Contact Head Adjustment	13mm	12-15Nm

Torque Settings for Rail Contact Fittings AzLM / AzLE Series		
Location	Nut Size	Torque
Rail Fixings (SK30 & SK30H)	19mm	45Nm
TX Contact Head Adjustment (SK30 & SK30H)	13mm	25Nm

NR/L3/SIG/10663 Signal Maintenance Specifications		
<b>NR/SMS/PartZ/Z03</b>		
<b>Train Detection - Reference Values</b>		
Issue No: 09	Issue Date: 04/09/2021	Compliance Date: 04/12/2020

Location	Drive Size	Torque
Rail Fixings (SK30K)	10mm Hex Drive	58Nm
Rail Clamp (SK30K)	10mm Hex Drive	58Nm

**Table 6 – Torque settings**

5.1 EAK H - TORQUEING POINTS

- a) Lid to base - M8 bolts set to 10Nm.



**Figure 2 - Lid**

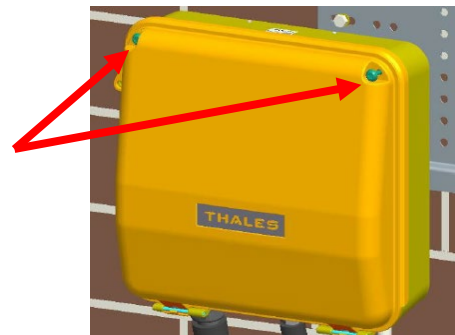
- b) Base to post - M12 bolts set to 90Nm.



**Figure 3 - Base plate to Post**

5.2 EAK K - TORQUEING POINTS

- a) The cover securing bolts shall be torqued to 8 Nm. This is to guarantee the unit does not suffer water ingress issues.



**Figure 4 – Front cover**

NR/L3/SIG/10663 Signal Maintenance Specifications		
<b>NR/SMS/PartZ/Z03</b>		
<b>Train Detection - Reference Values</b>		
Issue No: 09	Issue Date: 04/09/2021	Compliance Date: 04/12/2020

5.3 EAK K – EARTHING POINT

- a) Earth Bonding point - 35Nm

Only use the bolt provided, use of a threaded bar or longer bolt can damage the casing leading to water ingress. Extension lugs are available to allow larger crimps to be fitted.



Figure 5 – Earthing point

5.4 Locking fittings

If self-locking nuts are fitted (e.g. Nyloc), and a nut is removed it shall not be reused.

If Nord lock washers are used, they shall be fitted correctly as shown in Figure 6.

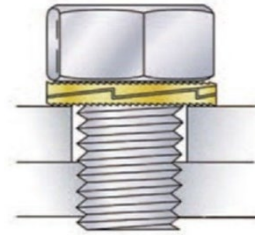


Figure 6 – Nord lock washers

6. AXLE COUNTER SIEMENS (AZS SERIES) SYSTEMS

6.1 Torque Settings for Rail Contact Fittings ZP43V series

Location	Nut Size	Torque
Rail Fixings	12mm	70-80Nm

6.2 Expected Readings from the PEGA 1121 Test Box

Function	Indication	Value	Range
Supply U60	U60=	60 V DC	30V to 72 V

▪ For external power supply, measure across terminals K10, K11 as required

Function	Indication	Value	Range
Operating voltage	U24=	22 V DC	21.3V to 22.4V
Wheel detector frequency	FS	43 kHz	42.8 kHz to 43.2 kHz

Adjust to 43 kHz as precisely as possible using the rotary switch on the back plane.

NR/L3/SIG/10663 Signal Maintenance Specifications		
<b>NR/SMS/PartZ/Z03</b>		
<b>Train Detection - Reference Values</b>		
Issue No: 09	Issue Date: 04/09/2021	Compliance Date: 04/12/2020

Function	Indication	Value	Range
Standard voltage UR1	Ur 1	5.5 V DC	5.3V to 6.0V
Standard voltage UR2	Ur 2	5.5 V DC	5.2V to 5.9V

Using a 0.6 x 2.8 mm screwdriver, adjust the potentiometer marked f1 on the front of the generator board until a voltage of approx. 5.5 V DC is reached.

Function	Indication	Value	Range
frequency f1	F 1	3.60 kHz	3.55 kHz to 3.65 kHz
frequency f2	F 2	6.52 kHz	6.42 kHz to 6.62 kHz

Using a 0.6 x 2.8 mm screwdriver, gradually adjust the potentiometer marked f1 or f2 on the front of the generator board to the signal frequency of 3.60 kHz (f1) 6.52kHz (f2).

Function	Indication	Value	Range
Receive voltage UE1	uE 1	NA	60mV to 150mV
Receive voltage UE2	uE 2	NA	60mV to 150mV

For very small rail profiles, up to 200 mV

Function	Indication	Value	Range
WDE output voltage UL	uL	Min1.0 V AC	Direct feeding: 0.48V to 1.8V; external supply 0.7V to 2.7 V

If a Double usage board is in use then a measurement across terminals K18, K19 is required.

**END**

NR/L3/SIG/10663 Signal Maintenance Specifications		
<b>NR/SMS/PartZ/Z04</b>		
<b>Level Crossing - Reference Values</b>		
Issue No: 05	Issue Date: 07/03/2020	Compliance Date: 06/06/2020

### 1. Boom and Road Light Tolerances.

Barrier Position	Setting
Fully raised (AHBC)	80° min, 85° max
Fully raised (other)	83° min, 85° max
Boom lights lit at	80°

**NOTE:** Red road lights (flashes per min) 70 to 90

### 2. Circuit Controller Band Settings.

Band	Made Between
DN KR	0° and 4°
HJPR	42° and 90° (#)
MR	0° and 83°
UP KR	81° and 90°

#: The HJPR band on early installations can be set to make sooner than 42°. Check the diagrams for the correct setting for the installation you are at.

It is important to obtain the overlap between the UP KR band making and the MR band breaking. So, if a barrier drops slightly, it drives up again without the red road lights operating.

On barrier units that use limit switches in place of circuit controllers, make reference to the diagrams for the positions of the cams.

### 3. Out of Balance (Tip) Force

Barrier Type	Barrier Length (pivot to tip)	Out of Balance (tip) Force
BR 843 (Metal)	3600 to 4100	7.6 ±0.5kg
	4600 to 7600	6.1 ±0.5kg
Barrier Type	Barrier Length (pivot to tip)	Out of Balance (tip) Force
BRB AHB Mk1 & Mk2 (timber)	3990 to 6020	2.4 ±0.1kg

**Table 1 - Out of Balance (Tip) Force**

NR/L3/SIG/10663 Signal Maintenance Specifications		
<b>NR/SMS/PartZ/Z04</b>		
<b>Level Crossing - Reference Values</b>		
Issue No: 05	Issue Date: 07/03/2020	Compliance Date: 06/06/2020

The out of balance (tip) force is measured with a weight measuring device by using the following method:

- a) At the tip end slowly lift the boom until it is approximately 4° to 5° from the horizontal.
- b) Connect the weight measuring device to the tip end of the boom.
- c) Release the boom onto the measuring device checking that the boom has not fully lowered then take a reading.

To obtain the correct out of balance (tip) force, the approximate number of counter balance weights required are detailed in the tables 1, 2 & 3.

Boom length is the dimension when measured from the main shaft pivot centre to the tip of the boom.

#### 4. Mk.1 Barrier (GWE Style) – Barrier Details

Boom Length	No/ Thickness of Weights (mm)									
	With Skirt					Without skirt				
	8	12	15	25	30	8	12	15	25	30
3.6m	To be determined on site					1	-	-	-	-
4.1m						-	-	-	1	-
4.6m						-	-	-	2	-
5.1m						1	1	-	2	-
5.6m	-	1	-	5	-	-	-	4	-	
6.1m	1	-	-	8	-	1	1	-	4	-
6.6m	1	1	-	8	-	-	-	-	6	-
7.1m	-	2	-	12	-	-	2	-	8	-
7.6m	-	1	-	14	-	-	-	-	10	-
8.1m	1	-	-	16	-	-	2	-	10	-
8.6m	-	1	-	18	-	1	-	-	12	-
9.1m	-	2	-	20	-	1	1	-	13	-

**Table 2 - Mk.1 Barrier (GWE Style) – Barrier Details**



NR/L3/SIG/10663 Signal Maintenance Specifications		
<b>NR/SMS/PartZ/Z04</b>		
<b>Level Crossing - Reference Values</b>		
Issue No: 05	Issue Date: 07/03/2020	Compliance Date: 06/06/2020

**5. Mk.2 Barrier SPX (Formally Smiths) – Barrier Details**

Boom Length	No/ Thickness of Weights (mm)									
	With Skirt					Without skirt				
	8	12	15	25	30	8	12	15	25	30
3.6m	-	-	1	-	2	-	-	1	-	1
4.1m	-	-	1	-	3	-	-	1	-	2
4.6m	-	-	-	3	-	-	-	-	1	-
5.1m	1	-	-	3	-	1	1	-	1	-
5.6m	-	1	-	4	-	-	-	-	3	-
6.1m	-	1	-	6	-	1	1	-	3	-
6.6m	1	1	-	7	-	-	1	-	5	-
7.1m	1	2	-	10	-	-	2	-	8	-
7.6m	1	-	-	13	-	-	-	-	10	-
8.1m	1	-	-	15	-	-	2	-	11	-
8.6m	-	1	-	17	-	1	-	-	12	-
9.1m	-	2	-	19	-	1	1	-	13	-

**Table 3 -Mk.2 Barrier SPX (Formally Smiths) – Barrier Details**

**6. Audible Warning Devices (AWD)**

The audible warning is measured at a 3m radius from the source, in normal daytime operating conditions. It should be between 60 dB(A) and 80 dB(A), normally at the higher end of the range.

A site-specific assessment determines the level required at each level crossing, taking into account local conditions, noise nuisance etc.

NR/L3/SIG/10663 Signal Maintenance Specifications		
<b>NR/SMS/PartZ/Z04</b>		
<b>Level Crossing - Reference Values</b>		
Issue No: 05	Issue Date: 07/03/2020	Compliance Date: 06/06/2020

## 7. Predictor HPX-3

### 7.1 Frequency Settings Based on the Approach Length Tolerances for HPX-3.

Channel	Freq.	Approach Length (based on a ballast of 4 $\Omega$ per 1,000 feet of track)		Approach Length (based on a ballast of 2 $\Omega$ per 1,000 feet of track)	
		Min	Max	Min	Max
1	86 Hz	720	7500	720	5000
2	114 Hz	615	6000	615	4250
3	151 Hz	560	5200	560	3700
4	156 Hz	550	5150	550	3675
5	172 Hz	535	4900	535	3550
6	210 Hz	485	4400	485	3100
7	211 Hz	485	4400	485	3100
8	267 Hz	440	4000	440	2800
9	285 Hz	425	3850	425	2700
10	326 Hz	400	3550	400	2500
11	348 Hz	380	3450	380	2425
12	392 Hz	360	3250	360	2300
13	430 Hz	340	3100	340	2200
14	452 Hz	330	3050	330	2150
15	522 Hz	315	2850	315	2000
16	525 Hz	315	2850	315	2000
17	560 Hz	305	2700	305	1925
18	630 Hz	290	2550	290	1800
19	645 Hz	290	2500	290	1770
20	686 Hz	275	2450	275	1750
21	753 Hz	265	2350	265	1675
22	790 Hz	260	2300	260	1630
23	816 Hz	255	2250	255	1600
24	881 Hz	250	2200	250	1550
25	970 Hz	240	2050	240	1455
26	979 Hz	240	2050	240	1450

**Table 4 - Frequency settings**

**END**

NR/L3/SIG/10663 Signal Maintenance Specifications		
<b>NR/SMS/PartZ/Z05</b>		
<b>Cable - Reference Values</b>		
Issue No: 05	Issue Date: 07/03/2020	Compliance Date: 06/06/2020

## 1. Cable Resistance

### 1.1 Typical Cable Values

Type	Strands/Size	Length	Loop Resistance
Tail	50/0.25	20m to 100m	0.33Ω to 1.64Ω
Type	Core/Size	Length	Loop Resistance
Lineside	1/0.85	100m to 500m	6.64Ω to 33.2Ω
	1/1.53	100m to 500m	1.99Ω to 9.96Ω

**Table 1 - Typical Cable Values**

## 2. Specific Cable Resistances

### 2.1 Metric Signalling Cables (Copper Conductor)

Group	Cores/Size	Nominal Area (mm <sup>2</sup> )	Resistance Ω / Km #
A	1/0.85	0.6	33.20
	9/0.30	0.65	31.70
	N/A	<b>0.75</b>	24.80
B	1/1.13	1.0	18.20
	16/0.30	<b>1.15</b>	17.80
	N/A	<b>1.5</b>	12.20
C	1/1.53	1.85	9.96
	50/0.25	2.45	8.21
	7/0.67	<b>2.5</b>	7.56
	1/1.78	<b>2.5</b>	7.56
D	7/0.85	4.0	4.70
	7/1.04	6.0	3.11
	7/1.35	<b>10.0</b>	1.84
E	7/1.70	<b>16.0</b>	1.16
F	7/2.14	25.0	0.73
	19/1.53	35.0	0.53

NR/L3/SIG/10663 Signal Maintenance Specifications		
<b>NR/SMS/PartZ/Z05</b>		
<b>Cable - Reference Values</b>		
Issue No: 05	Issue Date: 07/03/2020	Compliance Date: 06/06/2020

Group	Cores/Size	Nominal Area (mm <sup>2</sup> )	Resistance Ω / Km #
	N/A	<b>0.75</b>	24.80
G	19/1.78	<b>50.0</b>	0.39
	19/2.14	<b>70.0</b>	0.27
H	19/2.52	<b>95.0</b>	0.20
J	37/2.03	120.0	0.15
K	37/2.25	150.0	0.13

**Table 2 - Metric Signalling Cables**

• The table 2 shows by group (A to K) cables which are considered operationally equivalent (with a greater or equal number of cores).

• The replacement of obsolete types is defined in NR/GN/SIG/11213

## 2.2 Imperial Signalling Cables (Obsolete)

Group	Cores/Size (inch)	Nominal Area (inch <sup>2</sup> )	Resistance Ω / Km #
A	9/0.12	0.001	25.60
	1/0.036	0.001	24.97
B	1/0.044	0.0015	16.71
	16/0.012	0.0018	14.45
C	3/0.029	0.002	13.08
	1/0.064	0.003	7.90
	3/0.036	0.003	8.41
	7/0.029	0.0045	5.59
D	7/0.036	0.007	3.59
	7/0.044	0.010	2.41
E	7/0.052	0.0145	1.72
	7/0.064	0.0225	1.14

NR/L3/SIG/10663 Signal Maintenance Specifications		
<b>NR/SMS/PartZ/Z05</b>		
<b>Cable - Reference Values</b>		
Issue No: 05	Issue Date: 07/03/2020	Compliance Date: 06/06/2020

Group	Cores/Size (inch)	Nominal Area (inch <sup>2</sup> )	Resistance $\Omega$ / Km #
F	19/0.044	0.03	0.89
	19/0.052	0.04	0.64
	19/0.064	0.06	0.42
G	19/0.083	0.10	0.25
H	37/0.072	0.15	0.17
J	37/0.083	0.20	0.13
K	37/0.103	0.30	0.08

**Table 3 - Imperial Signalling Cables (Obsolete)**

See the Metric Table for the preferred NR/PS/SIG/00005 operational equivalent(s) in each group.

### 2.3 Telecoms Cables

Conductor Strands	Diameter (mm)	Resistance $\Omega$ / Km #
1	0.63	58.00
1	0.90	27.50
1	1.27	13.75
Aluminium Conductors		
1	16.0	1.89
1	25.0	1.20
1	35.0	0.87
1	50.0	0.65
1	70.0	0.44
1	95.0	0.33

# The resistance values are for one core at 20°C; double for loop resistance.

NR/L3/SIG/10663 Signal Maintenance Specifications		
NR/SMS/PartZ/Z05		
Cable - Reference Values		
Issue No: 05	Issue Date: 07/03/2020	Compliance Date: 06/06/2020

### 3. Cable Insulation Resistance

#### 3.1 Signalling Cables

Cable Description	Core to Core Resistance (MΩ/km)	Core to Earth Resistance (MΩ/km)
New lineside	50	50
New tail	30	30
Existing lineside	1 (#)	1 (#)
Existing tail	1 (#)	1 (#)

Test at 1000V with 600/1100V grade insulation; test at 250V with 250/440V grade insulation.

#### # Values under 1M ohm but above 500k ohms

It is permissible for an on-call manager with SFI Level 2 competency to give authority for cables and wires to continue in service with readings under 1M ohm, but above 500k ohms.

When this authority is used the name of the person giving the authority shall be recorded, along with the date and time on the cable testing record sheet.

When this authority is used the Signal & Telecom Maintenance Engineer shall be advised at a convenient time.

#### # Values below 500k ohms but above 200k ohms

It is permissible for an on-call manager with SFI Level 3 competency to give authority for cables and wires to continue in service with values below 500k ohms but above 200k ohms while repair/replacement is arranged.

This requires an assessment of the risks of leaving the cable in service, it shall include as a minimum;

- The signalling functions running through the cable.
- If single cut circuits or earth return circuits run through the cable.
- The type of signalling relay technology employed.
- The condition of the cable route.

NR/L3/SIG/10663 Signal Maintenance Specifications		
<b>NR/SMS/PartZ/Z05</b>		
<b>Cable - Reference Values</b>		
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- The weather conditions at the point of testing and if they are likely to deteriorate.

As part of the risk assessment, possible mitigation measures can include:

- Implementing special block working measures.
- Imposition of a speed restriction.
- Restricting signalling equipment.
- Temporary monitoring earths or relay states.
- Additional earth testing and/or cable testing.
- Control of work in the area which could disturb cable routes.

When this authority is used the Route Asset Manager (S) shall be advised at a convenient time.

When this authority is used the name of the person giving the authority shall be recorded, along with the date and time on the cable testing record sheet.

### **# Values below 200k ohms but above 20k ohms**

It is permissible for the Route Asset Manager (S) to give authority for cables and wires to continue in service with values below 200k ohms but above 20k ohms while repair/replacement is arranged.

This requires an assessment of the risks as described above.

When this authority is used the name of the person giving the authority shall be recorded, along with the date and time on the cable testing record sheet.

**Under NO circumstances shall cables or wires with an insulation value of less than 20k ohms remain in service.**

NR/L3/SIG/10663 Signal Maintenance Specifications		
<b>NR/SMS/PartZ/Z05</b>		
<b>Cable - Reference Values</b>		
Issue No: 05	Issue Date: 07/03/2020	Compliance Date: 06/06/2020

### 3.2 Telecom Cables

Cable Description	Core to Core (MΩ/km)	Core to Earth (MΩ/km)	Moisture Barrier Earth Res. (MΩ/km)
New lineside	1500	1500	150
New tail	1500	1500	150
Existing lineside	50	10 (#)	10 (#)
Existing tail	50	10 (#)	10 (#)

Test at a voltage commensurate with the grade of insulation (e.g. 250V).

# Under special arrangements authorised by the S&TME, cables with a resistance value less than 10MΩ but not below 1MΩ can be reinstated when found during faulting, or remain in use when identified under testing.

When this authority is used the name of the person giving the authority shall be recorded, along with the date and time on the cable testing record sheet.

A plan of action shall be agreed with the Telecoms Engineer for the restoration of the cable to the agreed minimum value of 10MΩ.

**END**



NR/L3/SIG/10663 Signal Maintenance Specifications		
NR/SMS/PartZ/Z06		
Cell - Reference Values		
Issue No: 02	Issue Date: 07/03/2020	Compliance Date: 06/06/2020

## 1. Primary Cells

Minimum Voltage using a 1Ω Shunt	0.9V
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**NOTE:** In some cases, it is advisable to replace the cell at a higher threshold (e.g. 1.1V) if there is a possibility due to the loading of the cell of it failing before the next maintenance visit.

## 2. Secondary Cells

### 2.1 Voltages (Per Cell)

Cell Type	Minimum	Nominal
Lead Acid	2V	2.2V
Alkaline	1V	1.1V

Cell Type	Nominal
Cyclon	2.2V

Cell Type	Nominal	Maximum
Vantage	1.42V to 1.43V	1.43V

### 2.2 Specific Gravity

Lead Acid Cells	1.220 minimum
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## 3. Voltages for Vantage Batteries

No. of Cells in Battery	Nominal Voltage	Maximum Voltage
1	1.42V	1.43V
2	2.84V	2.86V
3	4.26V	4.29V
5	7.1V	7.15V
10	14.2V	14.3V
15	21.3V	21.45V
20 #1	28.4V	28.6V
25	35.5V	35.75V

NR/L3/SIG/10663 Signal Maintenance Specifications		
NR/SMS/PartZ/Z06		
Cell - Reference Values		
Issue No: 02	Issue Date: 07/03/2020	Compliance Date: 06/06/2020

No. of Cells in Battery	Nominal Voltage	Maximum Voltage
30	42.6V	42.9V
35	49.7V	50.05V
40 #2	56.8V	57.2V
45	63.9V	64.35V
50	71V	671.5V
55	71.8V	78.65V
60	85.2V	85.8V
65	92.3V	92.95V
70	99.4V	100.1V
75	106.5V	107.25V
80	113.6V	114.4V
85 #3	120V	121.55V
90	127.8V	128.7V
95	134.9V	135.85V
100	142V	143V

- #1: 24V Battery.
- #2: 50V Battery.
- #3: 110V Battery.

#### 4. Modular Power Box Voltage Tolerances

##### 4.1 Voltage Matrix

Voltage	Minimum	Nominal	Maximum
24V dc	20V dc	24V dc	30Vdc
36V dc	30V dc	36V dc	45V dc
110V ac	92V ac	110V ac	137Vac
120V dc	100Vdc	120V dc	150V dc

END

NR/L3/SIG/10663 Signal Maintenance Specifications		
NR/SMS/PartZ/Z07		
Earth Leakage - Reference Values		
Issue No: 03	Issue Date: 05/12/2020	Compliance Date: 05/06/2021

## 1. DC BUSBAR EARTH LEAKAGE VALUES

Bus Bar Volts	Reportable		Maximum Acceptable		Safety Maximum	
	V1 or V2	V1 + V2	V1 or V2	V1 + V2	V1 or V2	V1 + V2
10	5	7	6	8	7.5	9
11	5.5	7.7	6.6	8.8	8.2	9.9
12	6	8.4	7.2	9.6	9	10.8
20	10	14	12	16	15	18
22	11	15.4	13.2	17.6	16.5	19.8
24	12	16.8	14.4	19.2	18	21.6
42	21	29.4	25.2	33.6	31.5	37.8
46	23	32.2	27.6	36.8	34.5	41.4
50	25	35	30	40	37.5	45
100	50	70	60	80	75	90
110	55	77	66	88	82	99
120	60	84	72	96	90	108

## 2. AC BUSBAR EARTH LEAKAGE VALUES

Volts (Vb)	Reportable		Maximum Acceptable		Safety Maximum	
	V1 + V2	V1 - V2 #	V1 + V2	V1 - V2 #	V1 + V2	V1 - V2 #
9	7.2	1	8.1	1	13.5	1
8.5	6.8	0.95	7.6	0.95	12.7	0.95
8	6.4	0.9	7.2	0.9	12	0.9

#: or V2-V1 if V2 is greater than V1.

NR/L3/SIG/10663 Signal Maintenance Specifications		
<b>NR/SMS/PartZ/Z07</b>		
<b>Earth Leakage - Reference Values</b>		
Issue No: 03	Issue Date: 05/12/2020	Compliance Date: 05/06/2021

### 3. Electronic Monitoring Device Parameters

#### 3.1 Bender IR425 and IR425-D4 (excluding the FAWRS and NYL schemes).

Alarm Levels	DC	AC
Alarm Level 1	100KΩ	20KΩ
Alarm Level 2	50KΩ	11KΩ

#### 3.2 Bender IR425-D4 - FAWRS and NYL schemes ONLY

The alarm levels are customised for each location/site, and the details of these levels can be found on the wiring diagrams.

#### 3.3 Busbar Monitoring Device.

Severity Level	DC	AC
Reportable	150KΩ	50KΩ
Minimum Acceptable	100KΩ	20KΩ
Safety Minimum	50KΩ	11KΩ

**END**

NR/L3/SIG/10663 Signal Maintenance Specifications		
NR/SMS/PartZ/Z08		
Train Protection - Reference Values		
Issue No: 01	Issue Date: 07/03/2020	Compliance Date: 06/06/2020

## AUTOMATIC WARNING SYSTEM (AWS)

### 1. "BR" and Howells Style AWS Magnets

#### 1.1 Height

Above/below rail level	±12mm
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#### 1.2 Inductor Wiring

Yellow Inductor: 12V Operation (Parallel Coils)				
Magnet Type	Connections			
	Strap		B12	N12
Old Pattern	1 and 2	3 and 4	4	1
New Pattern (First Issue)	1 and 2	3 and 4	1	4
New Pattern (Latest Issue)	1 and 2	3 and 4	4	1

Yellow Inductor: 24V Operation (Series Coils)				
Magnet Type	Connections			
	Strap		B12	N12
Old Pattern	2 and 3		4	1
New Pattern (First Issue)	2 and 3		1	4
New Pattern (Latest Issue)	2 and 3		4	1

Green Inductor: 60V Operation (Extra Strength)				
Magnet Type	Connections			
	Strap		B12	N12
Green	None		4	1

#### 1.3 Voltage & Current Readings

Electro-Magnet Voltages/Current Permutations						
Inductor	Coils Parallel /Series	Voltage Nominal	Voltage Min	Voltage Max	Current Nominal	Casing Extends Below Sleeper Level?
Yellow Electro Mk1	P	12V	10.5V	-	0.75A	Yes
	S	24V	21V	-	0.38A	
Yellow Electro Mk2	P	12V	10.8V		0.85A	No
	S	24V	21.6V	24V	0.45A	No

NR/L3/SIG/10663 Signal Maintenance Specifications		
NR/SMS/PartZ/Z08		
Train Protection - Reference Values		
Issue No: 01	Issue Date: 07/03/2020	Compliance Date: 06/06/2020

Electro-Magnet Voltages/Current Permutations						
Inductor	Coils Parallel /Series	Voltage Nominal	Voltage Min	Voltage Max	Current Nominal	Casing Extends Below Sleeper Level?
Green Electro Mk1	P	24V	-	-	2.3A	Yes
	S	48V	-	-	1.15A	Yes
Green Electro Mk2	-	60V	51V	60V	1.5A	No
Yellow Supp.	-	24V	22.8V	25.8V	1.26A	Yes
Yellow Supp. (Vortok Hardwired Variant 062/006813)	-	24V	22.8V	26.4V#	1.5A	No
Green Supp. Mk2	-	110V	93.5V	121V	2.3A	No

# It is acceptable for this voltage to be as high as 32V DC where the AWS is fed via a full wave rectification T/J, and the multimeter used is not a True RMS meter.

#### 1.4 Coil Resistances

The Coil Resistances shown below are nominal @20oC, for each 1oC the temperature increases, the resistance increases by approx. 0.4%

Standard Strength - Electro-Magnets	
24V Operation (Coils Wired in Series)	60Ω
12V Operation (Coils Wired in Parallel)	15Ω

Extra Strength Mk1 - Electro-Magnets	
Electro Magnet	Not Available
Suppressor Magnet	Not Available

Extra Strength Mk2 - Electro-Magnets	
Electro Magnet	37Ω
Suppressor Magnet	48Ω

When testing the AWS standard strength suppressor magnet using a calibrated S&P meter it should be noted that in some track circuited areas the 'E' and 'P' indicator can oscillate between the two indications when 'suppression' is active. This is not a fault condition.

NR/L3/SIG/10663 Signal Maintenance Specifications		
NR/SMS/PartZ/Z08		
Train Protection - Reference Values		
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## 2. Vortok AWS Magnets

**NOTE:** There are 2 Series of Vortok AWS magnets. The newer Series 2 range are identified by the words "SERIES II" cast into the top of the magnet cover.

They are plug compatible and fixing compatible with the earlier Series 1 and can be used as functional replacements.

Reference shall be made to the table entries for the Current values for the Series 2 range.

When testing any plug coupled equipment an approved break out device shall be used.

Meter leads or prods shall not be brought into contact with the plug coupled pins or sockets.

### 2.1 Height

The top surface of the Vortok AWS magnet shall be installed with respect to new rail	-2 to -5mm
--	------------

**NOTE:** The RFF mounting kit provides the correct spacers to place the magnet at the required height.

### 2.2 Inductor Wiring

**NOTE:** Plug coupler contact allocations specified in standard drawing T00036.

Magnet Type	Plug coupler contact number	
	Feed	Return
Yellow or Green	1/A	2/B

NR/L3/SIG/10663 Signal Maintenance Specifications		
NR/SMS/PartZ/Z08		
Train Protection - Reference Values		
Issue No: 01	Issue Date: 07/03/2020	Compliance Date: 06/06/2020

### 2.3 Voltage and Current Readings

Voltages/Current Permutations measured at the magnet					
Inductor	Voltage Nominal	Voltage Min (-20% Nom)	Voltage Max (+10% Nom)	Max Current Nominal (Not Drawing More)	Casing Extends Below sleeper level?
Yellow Electro (YE)	24V	19.2VDC	26.4VDC	0.5A	No
Yellow Supp. (YS)	24V	19.2VDC	26.4VDC	1.5A	No
Green Electro (GE)	110VAC	88VAC	121VAC	1.5A	No
Green Supp (GS)	110VAC	88VAC	121VAC	2.5A	No
Yellow Electro (YE) Series 2	24V	19.2VDC	26.4VDC	0.5A	No
Yellow Supp. (YS) Series 2	24V	19.2VDC	26.4VDC	1.4A	No
Green Electro (GE) Series 2	110VAC	88VAC	121VAC	1.25A	No
Green Supp (GS) Series 2	110VAC	88VAC	121VAC	2.0A	No
Yellow Electro (YE110) Series 2	110VAC	88VAC	121VAC	0.5A	No
Yellow Supp (YS110) Series 2	110VAC	88VAC	121VAC	0.75A	No

### 2.4 Coil Resistances

Coil Impedances – All variants	
There are no valid testable Coil Impedance values as the coil is electronically switched and this therefore an effective Open Circuit when not powered.	N/A

### 3. Yardene Single Arm AWS Magnets

- These magnets should not be tested using a “Strength and Polarity Meter”



Figure 1 - Standard Strength Magnet (Yellow)



Figure 2 - Extra Strength Magnet (Green)



NR/L3/SIG/10663 Signal Maintenance Specifications		
NR/SMS/PartZ/Z08		
Train Protection - Reference Values		
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There is no maintenance on this type of magnet, but to allow these magnets to be eliminated during fault or incident investigation, their height may need to be measured.

Height

Above/below rail level	-17mm to -35mm
------------------------	----------------

#### 4. Train Protection and Warning System (TPWS)

##### 4.1 Module types and details

TPWS Interface Module		
Type	Arm freq.	Trigger freq.
Signaling Interface Module (red)	NA	NA

Overspeed Sensor Module		
Type	Arm freq.	Trigger freq.
Normal direction (yellow)	64.25kHz f1	65.25kHz f2
Opposite direction (blue)	64.75kHz f4	65.75kHz f5

Train Stop Module		
Type	Arm freq.	Trigger freq.
Normal direction (green)	66.25kHz f3	65.25kHz f2
Opposite direction (brown)	66.75kHz f6	65.75kHz f5

Table 1 - Module types and details

##### 4.2 TPWS Testing Values

Maintenance Jig Readings (all track types)		
Loop NOT energised	Minimum	Maximum
All Loops	NA	2mV (at the TPWS frequency)
Loop Energised	Minimum	Maximum
Standard Transmitter Loop	29mV	53mV
Buffer Stop Mini-Loop	59mV	107mV (use 500mV AC range)

Table 2 - Maintenance Jig Readings

NR/L3/SIG/10663 Signal Maintenance Specifications		
NR/SMS/PartZ/Z08		
Train Protection - Reference Values		
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Commissioning Jig Readings (Loop Energised)		
Location	Loop Type	Minimum
NOT on concrete slab track	Standard Transmitter Loop	5.65mV
	Buffer Stop Mini-Loop	4.26mV
On concrete slab track	Standard Transmitter Loop	6.70mV
	Buffer Stop Mini-Loop	4.69mV

**Table 3 - Commissioning Jig Readings**

#### 4.3 TPWS Transmitter Loop Heights

Loop Type	Height Below Rail Level	
	Minimum	Maximum
<b>NOT On Concrete Slab Track</b>		
All Loops	60mm	100mm
<b>On Concrete Slab Track (Standard Tx Loop)</b>		
0 to 50m	20mm	60mm #
50 to 150m	20mm	50mm #
150 to 250m	20mm	40mm #
250 to 350m	20mm	30mm #
350 to 500m	20mm	20mm #
Buffer Stop Mini-Loop	20mm	60mm

**Table 4 - Loop Heights**

# Suggested maximum.

To compensate for the attenuation effect caused by the length of TPWS loop feeder cabling, it is suggested that the depth of the standard TPWS transmitter loop on concrete slab track is reduced for longer lengths of loop feeder cabling as above.

## 5. Eurobalise

### 5.1 Centreline Fitment Tolerance

All Balise/Beacons	Tolerance from Centre Line
All types	±15mm

NR/L3/SIG/10663 Signal Maintenance Specifications		
NR/SMS/PartZ/Z08		
Train Protection - Reference Values		
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## 5.2 Torque Values

Alstom Atlas 200	
Mounting method	Torque Values
Vortok installation	20Nm
Direct mounting	30Nm

Ansaldo	
Mounting Method	Torque Values
E-Clip Bracket	10Nm
Fast Clip Bracket	
Timber/concrete Bracket	

Siemens S21	
Mounting Method	Torque Values
Vortok installation	38Nm
Direct mounting	

Tracklink III	
Mounting Method	Torque Values
Concrete or Wooden Sleeper	40Nm ± 5Nm

TASS	
Mounting Method	Torque Values
Bracket mounting bolts	Up to 15Nm
Bracket mounted Balise	5Nm
Concrete mounting	20-25Nm

## 5.3 Bolts and Spacers

Balise	Bolt	Spacer	Washer	Nuts
Alstom Atlas	See Alstom Atlas 200 table below		2 Tab washers 2 Thrust washers	N/a
Ansaldo	M12 x 70mm	Nylon bush	4 M12 Nordlock 4 Tab washers	N/a
Siemens S21	See Siemens S21 table below.		N/a	N/a

NR/L3/SIG/10663 Signal Maintenance Specifications		
<b>NR/SMS/PartZ/Z08</b>		
<b>Train Protection - Reference Values</b>		
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TASS	M12x80mm (Concrete) M6x60mm (Timber)		8x25mm washers	M8 Nylock
Tracklink III	M10 x 75mm (concrete)	n/a	n/a	n/a

For Alstom Atlas 200 Only

Alstom Atlas 200 ONLY	
Height of overall spacer used	Length of M12 bolt required
No Spacer	90mm
20mm	110mm
25mm	115mm
30mm	120mm
35mm	125mm
40mm	130mm

For Siemens S21 Only

Siemens S21 ONLY		
Shim Height	M10 Bolt Length	M12 Woodscrew
0mm	50mm	80mm
10mm	60mm	90mm
20mm	70mm	100mm
30mm	80mm	120mm
40mm	90mm	130mm
50mm	100mm	140mm
60mm	110mm	160mm
70mm	120mm	170mm
80mm	130mm	180mm
90mm	140mm	190mm
100mm	150mm	200mm

END