RLS^{TM} Meter User Manual

Scribe RLS^{TM} Loss of Section Meter*

Version 1.4 Final: November 2014 – General

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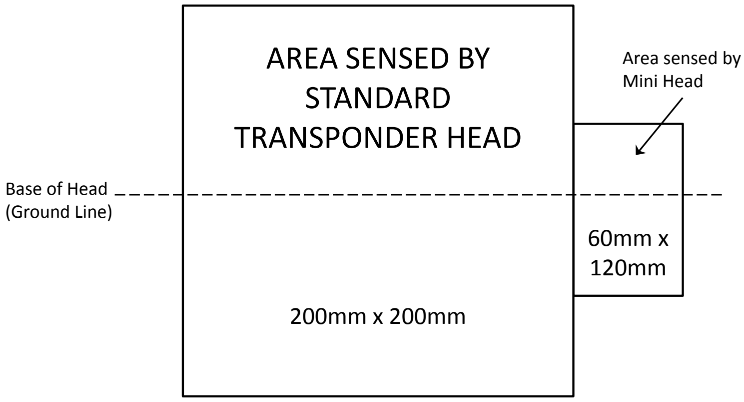
1. Introduction to the RLS Meter

The SCRIBE Relative Loss of Section Meter, type 5-D is for comparing the 'relative apparent loss of mean sectional wall thicknesses' at different areas of steel lighting columns. Its main purpose is to compare the relative section of an area above and below the ground level with a same sized area at a higher level.

Using the standard head, the test area extends approximately 200mm high (100mm above to 100mm below ground level) and x 200mm wide. The mini head test area extends 60mm wide and 120mm high – about 60mm below ground level.



The mini head is used to pinpoint locations of greatest loss on the most vulnerable zone and where narrow bands of corrosion exist.

The equipment comprises:

- The battery powered RLS 5-D Mk 2 meter
- An interconnection cable
- A standard 'transponder head'
- A mini transponder head
- A robust, watertight resin carrying case

The RLS Meter is controlled by computer, including the input and output from the transponder head. It also provides the step by step instructions to the operator on a LCD screen.

As the values are received by the on-board computer it also processes and stores this information with a display of the results for the operator to record.

Two nylon stand-offs fixed to the standard transponder head ensures a constant stand-off distance for all column sizes and a spirit level fixed to the top of the head enables correct vertical alignment. Most of the operation steps are controlled by either the "HOLD" or "CLEAR" buttons, including the initial reference measurement and the storage of a result. In addition to the "HOLD" button on the instrumentation panel the standard transponder head also includes a yellow button on the right-hand handle for ease of operation.

There are three main steps prior to operation and these are *assembly*, *warm up* and *calibration*.

Each time a REFerence value is saved on the RLS Meter, it consumes a 'credit'. The RLS Meter must be loaded with credits prior to the commencement of testing and may need to topped up as per Section 12. As credits are used the available number drops accordingly and the overall credits used are displayed on start up.

2. Principle of the RLS Meter

The instrument uses very low frequency 'shaped' magnetic fields induced by the transponder unit. The mini head uses lower frequency, higher intensity profiled flux pattern for more localised results. The waveform is profiled such that any magnetic flux pattern and magnetic flux density distortions induced by conductive and/or magnetic material within the confines of the radiated magnetic field can be sensed.

Where variations occur in the 'shaped' magnetic field, these are sensed by the transponder head and processed to produce a displayed reading that is *relative* to the degree of field distortion.

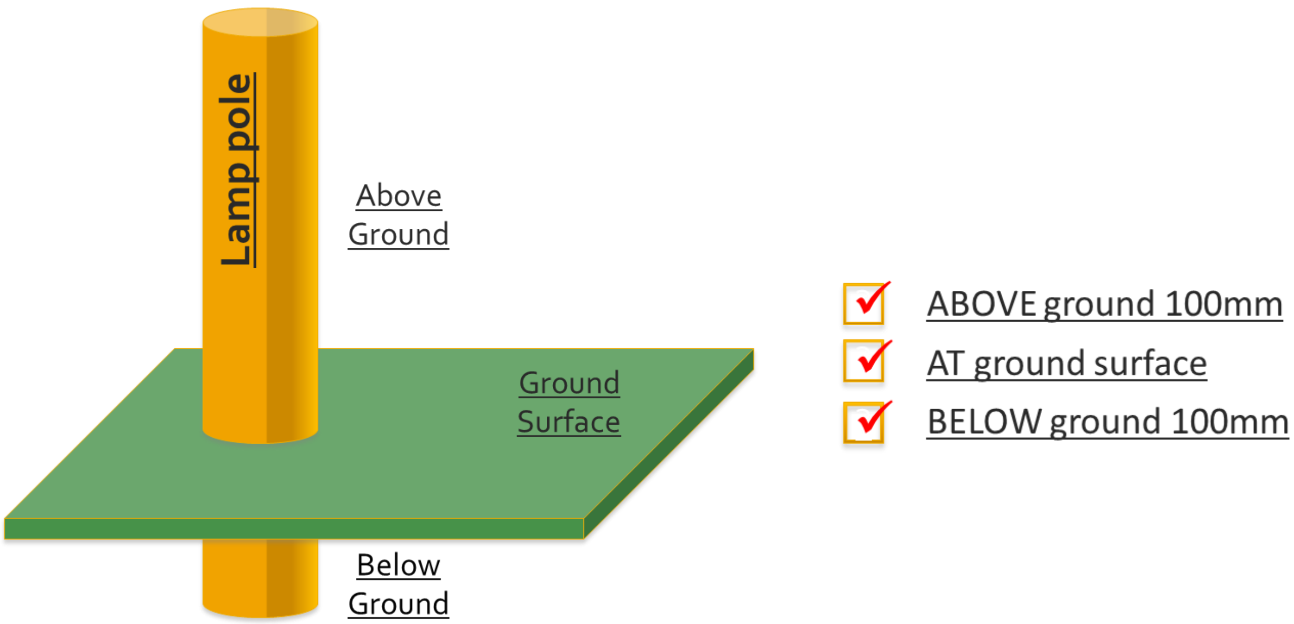
When the transponder head is placed against the metal structure at a fixed stand-off distance the distortion measured is relative to the overall area of the metal in the sensing zone. This includes thickness and area. Sprayed metal coatings have negligible effect on the signal.

By comparing the value at a non-corroded 'Reference Area' with the reading at ground level a 'relative' reading for the apparent loss of sound material from the column is determined. This is displayed as apparent Relative Loss of Section with respect to the reference area in a "Loss of Section Unit" or (LSU) specific to the RLS Meter.

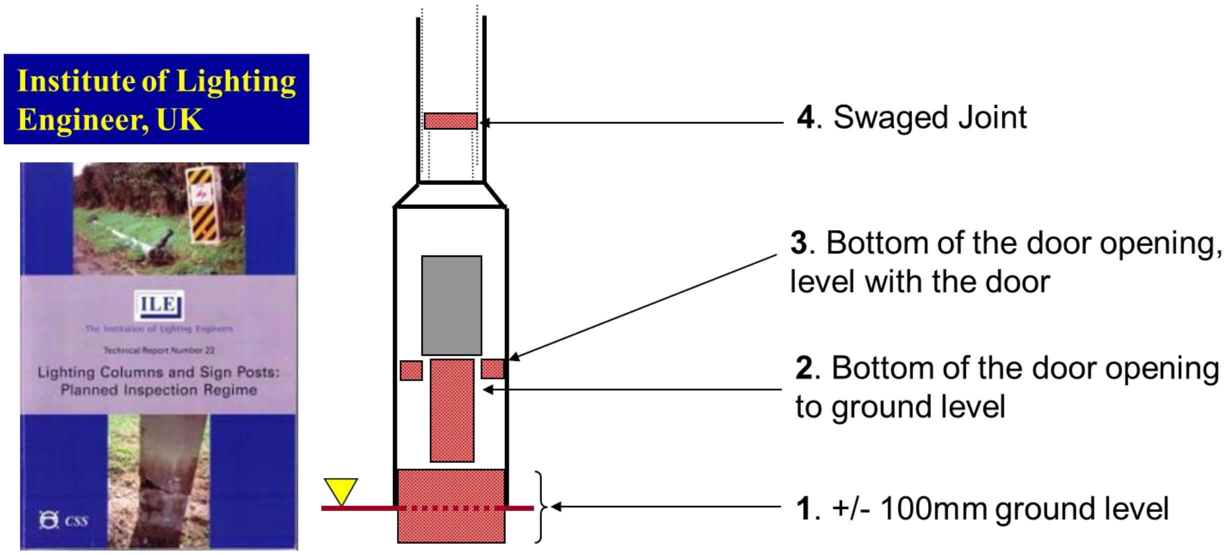
As the final reading is proportional, the system can cater for a wide range of column diameters, thicknesses and core materials.

The RLS technique measures ferrous (iron) material adjacent to or near to the transponder head, which means that it can 'see through' virtually any ground material such as soil, concrete, coated macadam, asphalt, etc.

This makes it ideal for the testing of direct buried columns or poles for street lighting, power, etc. as quite often these are buried within concrete or bitumen. The areas it tests happen to be the parts of a pole most prone to corrosion and are indicated below:



Evidence supporting this is published by the Institute of Lighting Engineers, UK who highlighted the four **critical zones** as show in the following diagram:



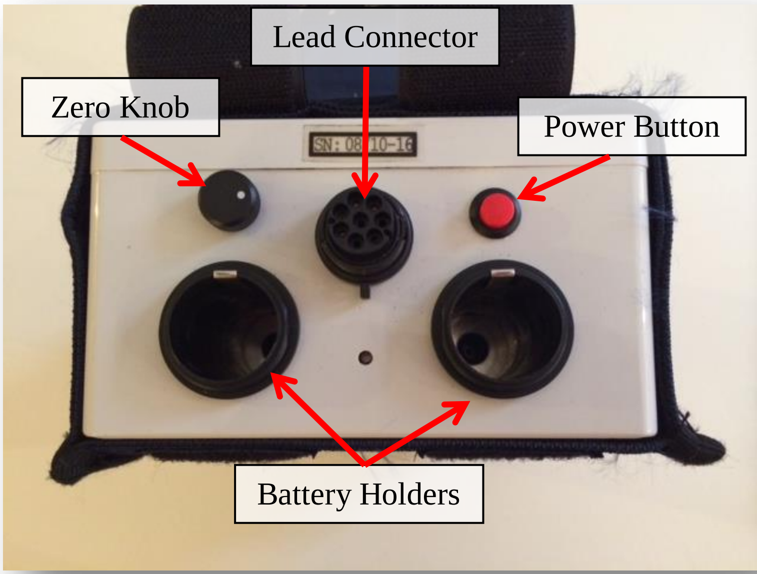
Manufacturers of round, hexagonal and octagonal section steel lighting columns have produced four basic types:

1. Plain steel (with paint protection system)
2. Aluminium spray coated
3. Zinc spray coated
4. Zinc galvanised

Regardless of any applied non-metallic protective paint system, readings obtained on plain steel and aluminium or zinc metal spray coated columns are scaled to *approximate the relative percentage* difference in the bulk average mass of steel relative to the reference area for most corrosion conditions.

3. Setting Up

The main elements to the RLS Meter electronics box are shown in the images below:



The setting up operating procedure is as follows:

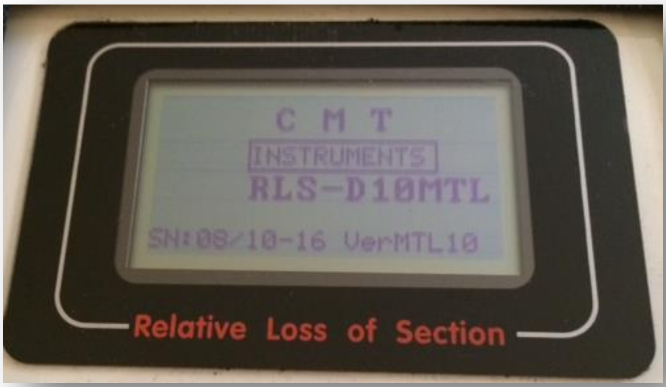
1. After unscrewing the battery holder caps, place four batteries into the battery holders with the positive side to the top (2 on either side). You must use **Duracell 'C' type** batteries due to their voltage stability. Do not use rechargeable batteries.

2. Replace the battery caps being careful not to screw them back on unevenly otherwise the threads may misalign. Pressing a finger in the middle of the cap, slowly turning anti-clockwise until it sits into the start of the thread is a helpful way of ensuring the threads align.

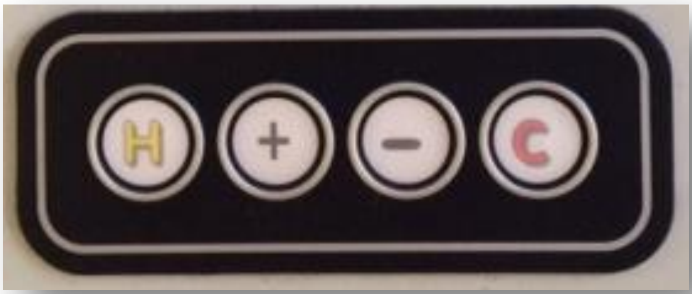
The battery cap only needs to be gently tightened and should look like the image above.

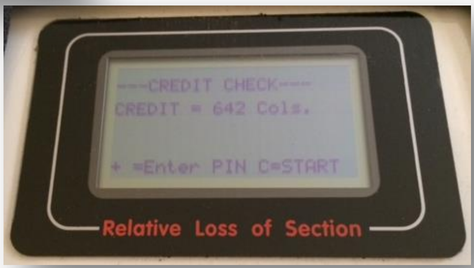
3. Plug lead into standard transponder head then into the instrument, similarly either end of the cable only needs to be gently tightened.

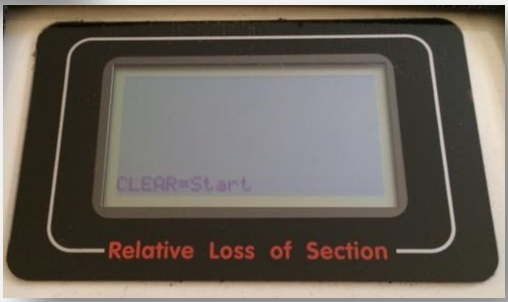
4. Switch on by pressing the red button (instrument automatically turns on if unit has no power button) and the start-up screen will show on the LCD.



5. Press "C" (Clear) three times to start.

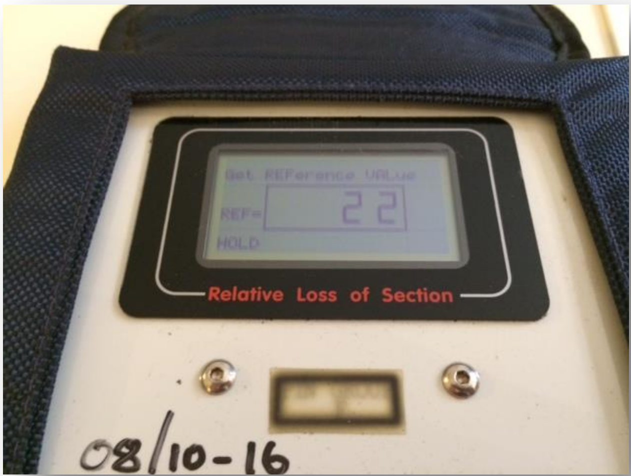






6. Adjust Z (zero) knob to stabilise display between **2 and 30** but be aware it is very sensitive. Adjust clockwise to increase positive (at this point it only shows zero or positive numbers).

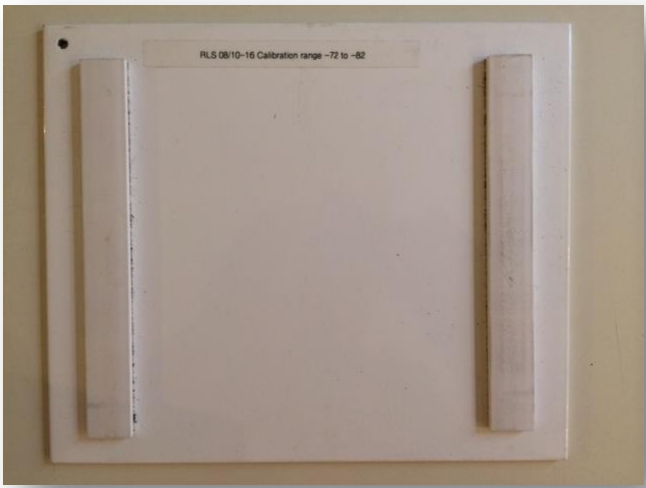
7. Display reads "Get REFerence VALue" and will continue to vary every second or so.

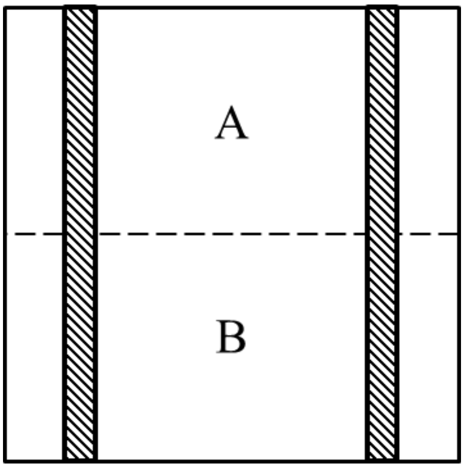


8. Allow the unit to warm up for 2-3 minutes before calibrating each morning as per the following section.

4. Daily Calibration Procedure

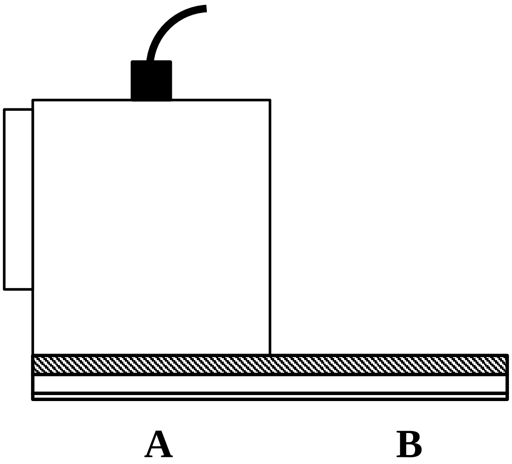
Place calibration plate on a non-metallic surface e.g. the carry case, ensuring that there is no metal at least 100mm below.



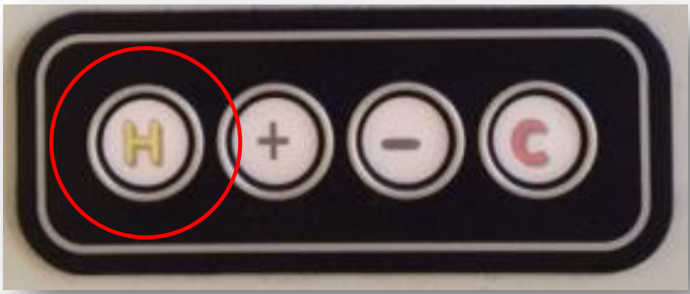


All metal objects should be removed from the carry case and the calibration check carried out on the closed lid.

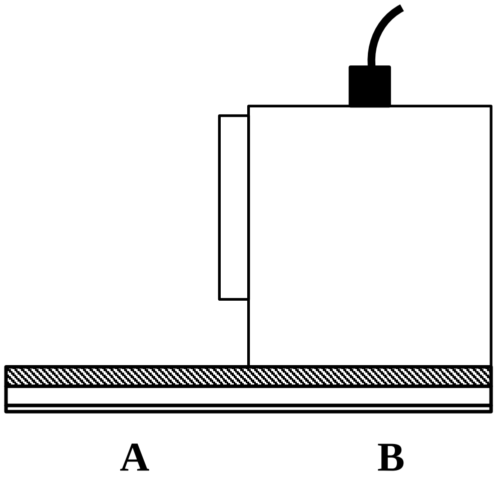
Place the head at position A as illustrated with the top edge exactly in line with the top of the plate.



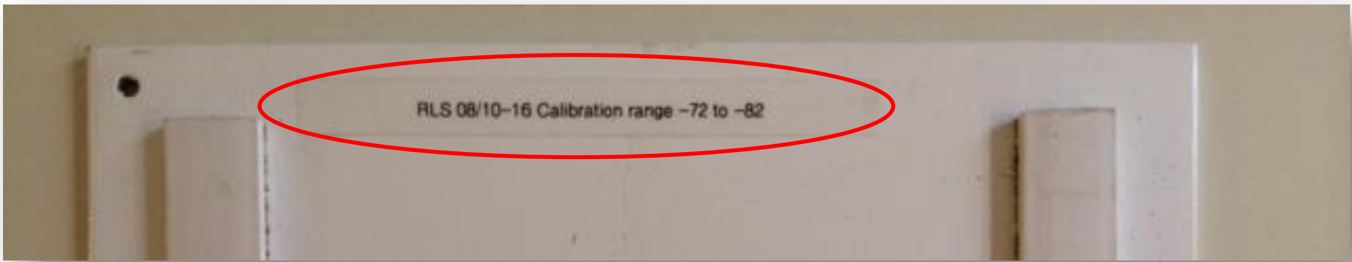
Allow reading to settle leaving the head in position a further few seconds until a value settles. This value should be 0 +/- 1. Press ‘H’ to ‘Hold’ the reference.



Move the Head to position B, ensuring that the bottom face is in line with the bottom edge of the plate.



Record the stable RLS reading value on the record sheet. The value should be within the range shown on the calibration plate.



Press the Hold 'H' button 5 times (will beep after each press) and after hearing 3 successive beeps press the Clear 'C' button.

5. Testing Procedure

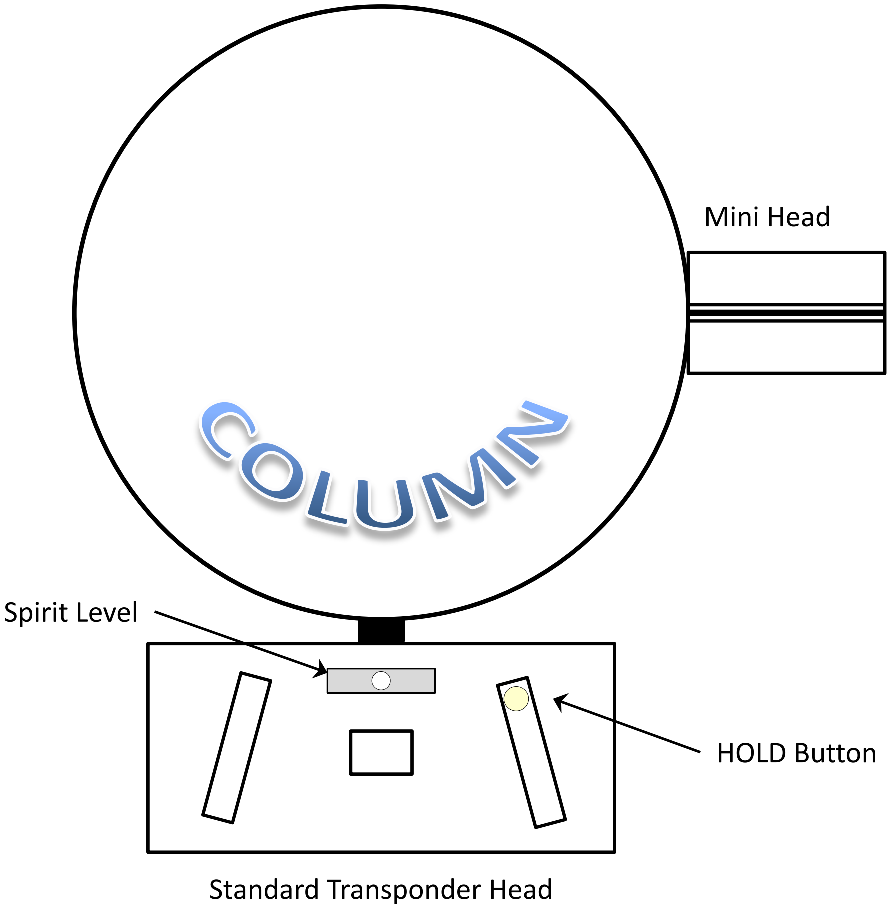
For routine testing follow below operating procedure:

1. Prior to testing the next pole ensure the display settles between **2 and 30** and adjust Z (zero) knob accordingly.
2. Select reference area as shown in Section 7.

3. Ensure the reference and testing areas have any flaking or debris scraped down. Use of a grinder is not required, just a uniform surface established.
4. Once the reading is stabilised (see Application section) then press “H” to store the REFerence value. The screen value should return to zero (0) but the reference value is not displayed.
5. Commence testing at ground level (GL) at position P3 for steel standard light poles and P1 for other poles.

6. When reading has settled, press "H". The LSUs are displayed in small type on the right of the display (LCD).
7. Move the head 90° clockwise around the base of the column to the next position; allow the reading to settle and press "H". The LSUs are also displayed.
8. Repeat the procedure at the required positions.
9. After "holding" the LSUs 5 times, the instrument bleeps 3 times.
10. Record the displayed LSUs at the measured positions and re-set the instrument ready for the next column by pressing "C" (Clear).

Note: If fewer than five readings are required, record the actual values on the report sheet and press "H" until the 3 beeps are heard then press "C". This will recommence the reference and testing cycle.



6. Application

Once the calibration is completed in the morning, approach a pole and make sure the calibration readings are cleared. Determine which transponder head is appropriate for the test and ‘zero’ to between **2 and 30**.

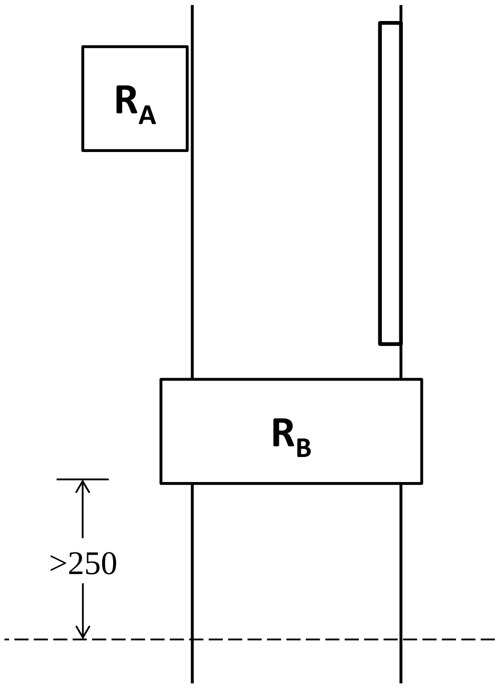
When using the standard head, position the stand-off spacers against the column at the area to be referenced. Wait for the reading to settle to ±10 (±20 when using the mini head) until the value steadies then press **HOLD**. This is the **REF**erence value. The number is held in the memory but not displayed and uses a ‘credit’ on the unit.

The apparent relative loss of section can then be assessed at another area on the column or several different areas at ground level around its circumference can be examined. Up to five readings may be displayed by pressing the HOLD button when steady readings are obtained.

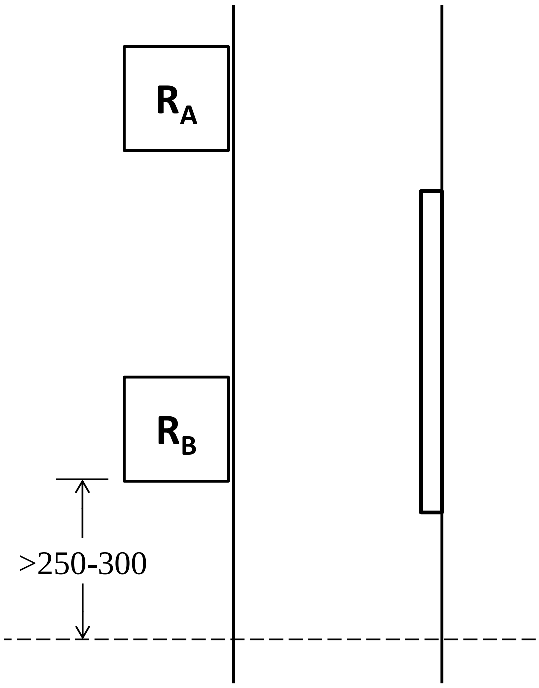
As part of the procedure, make sure that the steel surface is cleaned down so that the test head has uniform contact with the metal.

The RLS reading indicates in scaled LSUs (Loss of Section Units®) to give a ‘proportional’ guide value for the area relative to the REFerence area stored reading.

7. Procedure for Round Pole



Door >300 above GL



Door <300 above GL

Where there is a pole door, this is always position P1

In the case of no pole door, P1 position is the side facing the road

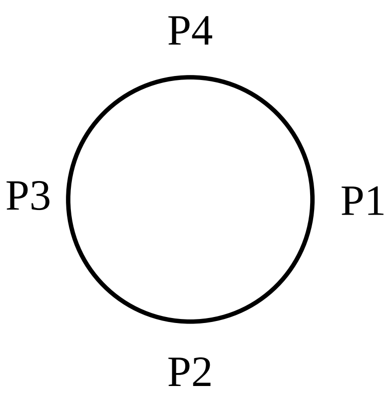
Set REFerence at R_A (P2 or P3)

Where the pole door is low to the ground check RLS in positions P1, P2 & P4 at level R_B

If >±3 set new reference at R_B

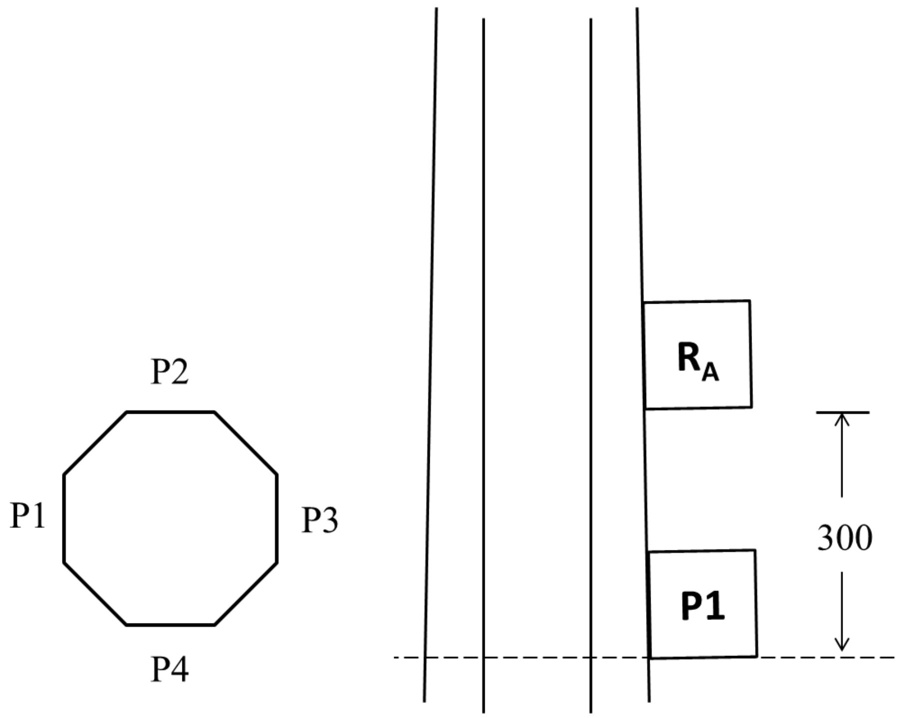
Hold head in position R_B

If display ≤ ±3 lower head to GL and commence testing.



8. Procedure for Standard Light Pole

Tapered pole usually of hexagonal or octagonal section:



Where there is a pole door, this is always position P1

In the case of no pole door, P1 position is the side facing the road

Set REFerence at R_A

Hold head in position at R_A

If display >±3 repeat reference set

If display <±3 lower head to GL and commence testing

Repeat REFerence/test routine on each flat face selected

9. Understanding the Loss of Section

Relative differences in the apparent mean section can be due to a number of causes other than corrosion. Those causes include: -

- Cable aperture with the sensed zone
- Deformation due to impact
- Manufacturing variation in column diameter and thickness
- Metallic inclusions/objects beneath or near to the search head

These causes should be identified where possible during the inspection.

Column root corrosion may be "general and uniform" or "localised" depending upon the surrounding material in the vulnerable zone and the primary cause. Trials to date suggest that the following severity of loss occurs at the ***individual*** test zones (see below) for plain steel/metal sprayed columns:

Class	LSUs	Diagnosis
1	0 to -10	Little relative loss of section
2	-11 to -16	Moderate loss of section/pitting
3	-17 to -24	Significant loss of section
4	-25 to -50	Severe loss of section
5	Loss <-50	Very severe loss of section

- If all loss of section is limited to the zone below ground, the LSUs approximate the relative percentage loss of steel within that zone relative to the reference area.

  N.B. High negative readings may also indicate "thin band" of total penetration with little actual percentage loss of metal around the circumference of the column. In such cases, the above criteria apply in respect of potential risk.

10. Classifying the Loss of Section

The overall root condition classification is dependent upon the range and magnitude of the loss of section at the four test positions. For instance, if only one quadrant fails in category 4 (>24 LSUs) and the remaining three readings in category 1, the overall classification would be less than severe than all four readings being in category 3.

The recommended procedure to arrive at an overall classification is to first calculate the ***average*** of the four test results (P1 to P4) and apply numeric weightings of -4 and -8 where one or more measurements fall within category 3 and 4/5 respectively.

Step 1: Take an average of all of the readings. On standard light poles and round power poles at least 3 readings are required.
Step 2: Determine if any one reading is within Classification 3, 4 or 5. If so, choose the highest.
Step 3: If the highest LSU reading is in Classification 3 then add **-4** to the average, if the highest reading is in Classification 4 or 5 then add **–8** to the average. This value is known as the *weighted average*.
Step 4: Choose the appropriate Visual Category – this is the worst visual condition on the pole.
Step 5: Select the overall Classification row then the Visual Category column and identify the asset outcome from the Classification Matrix
Step 6: If the pole has impact damage sufficient to not allow the required readings, then classify as G.

Classification Matrix: For typical street lighting poles and any planted steel structures

<table>
<tr><th rowspan="2">Classification</th><th rowspan="2">Average LSU</th><th colspan="6">Visual Categories</th></tr>
<tr><th>A</th><th>B</th><th>C</th><th>D</th><th>E</th><th>F</th></tr>
<tr><td>1</td><td>0 to -10</td><td colspan="2">Retest in 4 years</td><td>Retest in 2 years</td><td>Retest in 1 year</td><td colspan="2" rowspan="3">Replace within 1 month</td></tr>
<tr><td>2</td><td>-11 to -16</td><td colspan="2">Retest in 2 years</td><td colspan="2">Retest in 1 year</td></tr>
<tr><td>3</td><td>-17 to -24</td><td colspan="4">Replace within 3 months</td></tr>
<tr><td>4</td><td>-25 to -50</td><td colspan="6">Replace within 1 month</td></tr>
<tr><td>5</td><td>>-50</td><td colspan="6">Immediate removal or making safe the unit</td></tr>
</table>

Visual Categories

A Free from defects
B Visible loss of paint/coating only
C Surface corrosion
D Pitting/flaking
E Extensive corrosion. Major loss of section/Uniform narrow band corrosion
F Holes visible within the base/root of unit
G Impact Damage

CMT (Testing) Pte Ltd reserves the right to amend the recommendation.

Notes

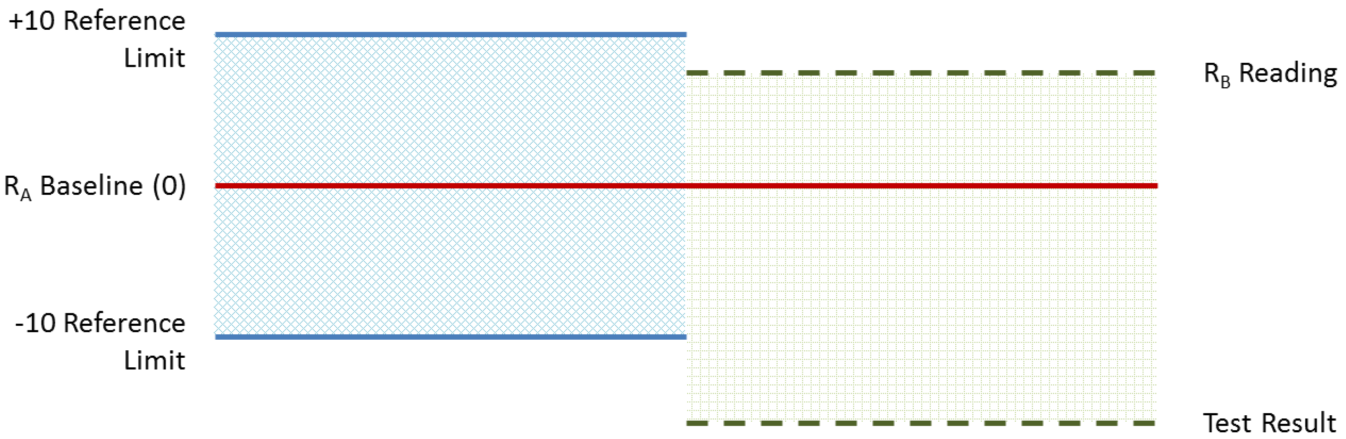
1. Non-metallic coatings do not affect measurements and no surface preparation or preliminary digging out below ground level is necessary because the transponder penetrates soil, concrete and coated macadam. Where necessary corrosion products or debris standing proud of the original profile should be removed to allow the plastic spacers to be vertical and in intimate contact along its length with the column.
2. It is suggested that the REFerence reading is taken above ground level on an area that appears to be sound. This area could also be spot checked with a thickness gauge instrument for absolute reference. It is recommended that comparative RLS readings are then taken at ground level on four sides to scan the full circumference of the column although the standard Transponder Head scans around half the circumference on smaller diameter columns.
3. The mini head is recommended when narrow band or shallow loss is anticipated and on multi-faceted columns e.g. octagonal street lights, 'H' irons or box-rail configurations.
4. Extraneous metallic objects that are close to the column under test or lie within the field of view beneath the search head may affect the displayed value for the reference reading and/or the "Loss of Section" values. In such cases, the numbers displayed may be erratic, unusually high or both. The more usual items are drink cans or metallic paper from cigarette packets present in the -100mm zone.
5. If the problem is associate with the proximity of barriers it may be overcome by using the mini head and taking a reference as far as practically possible from the object.
6. The leads to the standard and mini heads are interchangeable
7. When "LO-BATT" is displayed at "switch-on" or during operation, all four batteries should be replaced as soon as possible to avoid anomalous results.

11. Advanced Use of Reference

To assist in a more economical use of the credits on the RLS Meter, under certain circumstances operators can use an initial REFerence position (R_A) with a subsequent REFerence position (R_B). If the REFerence measured at other positions are within +/- 10 LSU from the initial measurement, this can still be used by applying to difference between (R_A) and (R_B) to the result received at the test result point (T_R).

The formula is Loss of Section = $T_R – ((R_B) - (R_A))$

Examples:



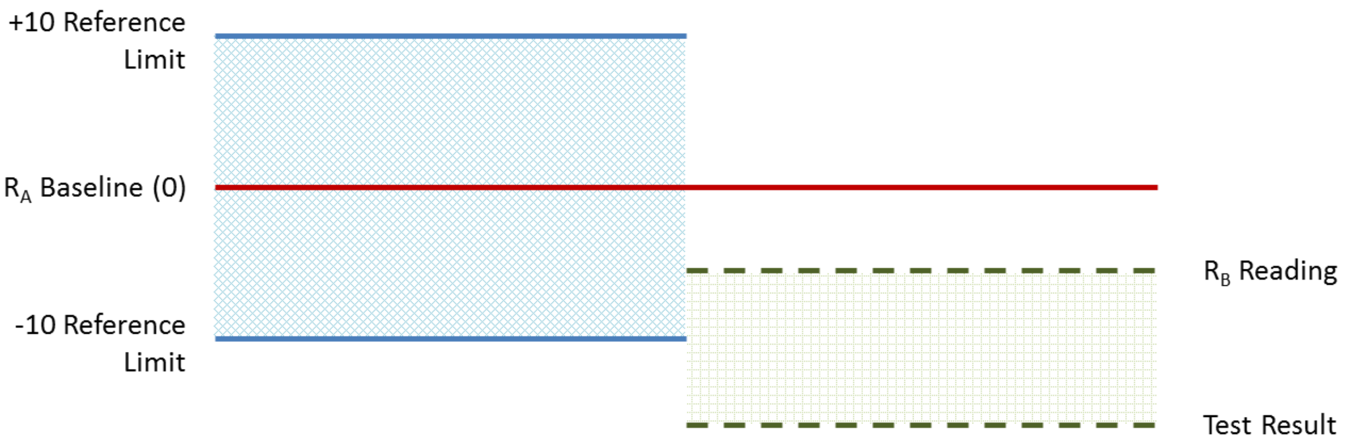
1. If the REFerence at P4 is $^{+}8$ (R_B) compared to the REFerence at P3 then for a test value of $^{-}14$:

   The difference between the readings is $^{+}8$ to baseline and -14 from the baseline to the test value. Therefore the difference is $^{-}14$ LSU – $^{+}8$ LSU or $^{-}22$ LSU as the result.

2. If the REFerence at P4 is $^{+}8$ (R_B) compared to the REFerence at P3 then for a test value of $^{+}4$:

   The difference between the readings is $^{+}8$ to baseline and $^{+}4$ as the test value. Therefore the difference is $^{+}4$ LSU – $^{+}8$ LSU or $^{-}4$ LSU as the result.

Examples:



1. If the REFerence at P3 is $^{-}5$ compared to the REFerence at P1 then for a test value of $^{-}14$:

   The difference between the readings is $^{-}5$ to baseline and $^{-}14$ from the baseline to the test value. Therefore the difference is $^{-}14$ LSU – $^{-}5$ LSU or $^{-}9$ LSU as the result

Where the difference between (R_A) and (R_B) is +/-3 then treat as 0 (zero).

12. Probability of Corrosion Activity

The presence and rate of corrosion is dependent upon a range of conditions.

A high probability exists where the root is exposed to canine urine and de-icing salts and where ground conditions are aggressive such as in ash or burnt shale bedding material.

The type of material in which the root is installed influences the rate of external corrosion. A summary of the most common materials and their possible affect upon the nature of corrosion is given below:

Soft ground – free draining. Corrosion rate slow and uniform in width and depth.

Soft ground – low permeability. Corrosion rate high. Uniform around circumference and limited in depth below ground.

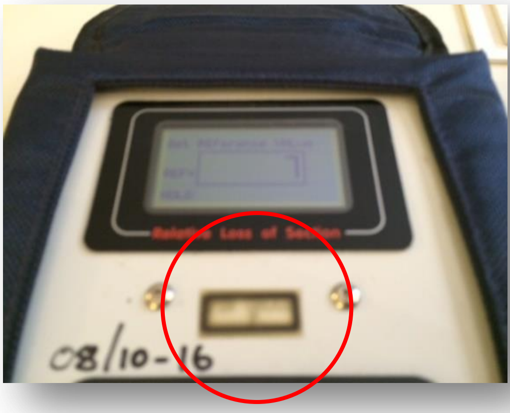
Asphalt/coated macadam – when installed the bitumen adheres to the column to ground level but the movement of the column plus loss of plasticity of the bitumen with time creates a finite gap between the column and asphalt that extends 20-30mm in which corrosive solutions may be trapped. Corrosion may be rapid and limited in depth of up to 50mm below ground level.

Concrete – good quality well-compacted concrete is alkaline (pH approximately 12) and provides an environment that inhibits corrosion. With time, atmospheric carbon dioxide causes the exposed surface of the concrete to carbonate and this carbonated front gradually penetrates the concrete. Steel that lies within the carbonated zone (pH10 or lower) is susceptible to corrosion in the presence of moisture. Chloride induced corrosion attributable to the use of de-icing salts can, however, take place in non-carbonated concrete. In this case the depth of chloride ion penetration controls the zone in which the corrosion can occur.

Concrete flags – a finite gap is usually present between the flag and the column. The presence and rate of corrosion is dependent upon the nature of the substrate and whether it retains the corrosive solutions or allows them to dissipate.

13. Procedure for Adding More Credits

When the number of credits on the RLS Meter drops below 100, it starts to advise you that there are a limited number of credits remaining. To add more credits, you need to request them from your supplier and advise the RLS Meter serial number, the PIN Code (found on the electronics box as shown below) and the how many times credits have been issued to that unit.



The format of advice would be something like RLS 08/10-16, PIN Group F3 (where 3 is the number of times credits were issued to that unit). When you step through the initial setup screens, it will display one as follows:

When you first press on the "+" button (below the display) from this screen it will provide you with the PIN Group code e.g. "F3".

Hold down the '+' or '-' buttons to cycle through 4 digits necessary to achieve the PIN code value on the screen. Once you have reached the PIN code on the display, press the "H" button to submit the code. If there is an error you will be advised otherwise the total credits remaining increases by 1,000.