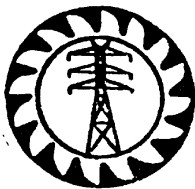


044 - 3 : 1996

CEB
STANDARD

ACCEPTANCE TEST OF CONCRETE POLES



CEYLON ELECTRICITY BOARD
SRI LANKA

Specification

for

ACCEPTANCE TEST OF CONCRETE POLES

CEB Standard 044-3: 1996

CEYLON ELECTRICITY BOARD

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SPECIFICATION FOR ACCEPTANCE TEST OF CONCRETE POLES

1.0 SCOPE

This Standard covers the testing of **reinforced** and **pre-stressed** concrete poles:

2.0 WITNESSING OF TEST:

2.1 Inspection Officer (Engineer)

The witnessing of test shall be carried out by a suitable officer nominated by the Ceylon Electricity Board (CEB) herein after called the "**Engineer**". The Engineer who witnesses the tests shall totally satisfy himself that the poles are tested strictly in accordance with the guidelines given in this Standard.

The Engineer shall have the right to inspect the manufacturing plant, machinery and raw materials used for manufacture of poles at any time which is deemed to be necessary.

2.2 Test Apparatus

Testing of poles shall be done in a testing bench using contractors' own testing equipment/apparatus. The Engineer should thoroughly inspect the testing equipment **before any testing commences** and totally satisfy himself that all the equipment is in perfect order and as per the requirements given in Clause 5.1.3 to 5.1.6. The contractor shall rectify any inaccuracy in the test apparatus and replace unsuitable test equipment to the satisfaction of the Engineer before any test commences. The Engineer has the right to request for the calibration reports of the equipment involved in the testing. However Engineer reserves the right to use a dynamometer belonging to the CEB, if deem to be necessary.

3.0 SELECTION OF SAMPLES FOR TESTING :

3.1 Batch of Pole

Every **100** poles or part thereof is considered a batch of poles. the contractor shall submit the following details of the batch of poles at least two weeks before the testing is arranged :

- 1) Type of Poles
- 2) Lot Number
- 3) Dates of Casting
- 4) Serial Numbers

3.2 Inspection of Batch of Pole

The contractor shall arrange the batch of Poles ready for testing in such a manner that visual examination is easy and markings, serial numbers etc. with hole positions are easily seen. Whole batch of poles shall be fully matured and even the last pole of that particular batch should have passed the 28th day of maturing before testing.

Following visual inspection shall be carried out by the Engineer before selecting a test pole.

- a) Random overall, dimensions shall be checked and the hole positions, hole size and straightness shall be in accordance with the CEB Standard 044-1:1996 and 044-2 : 1996 for RC Poles and Pre-stressed Poles respectively. Dimensional tolerances for the above shall comply with the values given in Clause 3.2.1 below for both RC and Pre-stressed Poles.
- b) Reinforcement bars or stirrups shall not be exposed.
- c) The poles shall be of a good finish and free from honey combing and shall be of a neat appearance.
- d) The poles shall be properly marked as per Clause 3.3 below.

Any individual Pole/Poles which are not complying with one of the above physical parameters shall be rejected. However, this will not affect the acceptance/rejection of the remaining poles in the particular batch of poles to be tested.

3.2.1 Dimensional Tolerances

The permitted variation from a stated dimension or cross sectional shape of the finished pole and hole positions shall be as follows:

Length	± 15 mm
Cross Section	Overall dimensions and dimensions of parts such as webs etc. + 4mm, - 2mm
Straightness	Deviation from a straight line joining the top and the widest dimensions at the butt ± 15 mm
Holes	Size - 0, + 2 mm relative position ± 5 mm
Location of Reinforcement	± 3 mm but specified covers shall not be reduced

3.3 Markings

The following markings in accordance with CEB Standard 044-1:1996 & 044-2:1996 for both Reinforced and Pre-stressed Poles shall have been embossed on each pole during casting.

- i) Letters "CEB"
- ii) Pole size and working load
- iii) Date of casting
- iv) Serial No. of the pole
- v) Name/Identification No. of manufacturer

Marking the poles **subsequent** to casting (on freshly applied grout/mortar layers) shall not be allowed. Any pole so marked shall neither be considered for testing, nor be recommended for purchase by CEB.

In addition to the above a horizontal line (testing line) shall be marked at a point 1/9 and 1/6 of the total length of the pole from the butt end, for RC Poles and Pre-stressed poles respectively, as indicated in the particular drawing.

No **two** poles manufactured by one and the same contractor can bear the **same** serial number.

3.4 Selection of Poles for Testing

The contractor shall produce the full batch of poles for inspection by the Engineer who, **himself** has to select **randomly** among the whole batch, the required pole for the test. The batch of poles produced shall be stacked and necessary arrangements shall be made by the Contractor so that **any** pole selected by the Engineer could be drawn out for testing.

In case the test pole fails, the pole to be tested again also shall be selected in the same manner.

4. STANDARDISED TYPES/SIZES OF POLES

4.1 Reinforced Concrete Poles

HEIGHT OF POLE (m)	BURIED LENGTH (m)	WORKING LOAD(kg)	TESTING LINE FROM THE BUTT END (mm)	CEB DRAWING NO.
6.0	1.0	50	670	DS&S/98/7710
8.3	1.40	100	930	DS&S/2002/7709
8.3	1.40	500	930	DS&S/2002/7720
9.0	1.5	115	1000	DS&S/99/7707
10.0	1.7	300	1120	DS&S/98/7705

4.2 Pre-stressed Concrete Poles

HEIGHT OF POLE (m)	RIED LENGTH (m)	WORKING LOAD (kg)	TESTING LINE FROM THE BUTT END (mm)	CEB DRAWING NO.
8.3	1.4	100	930	DS&S/2003/7803
11.0	1.8	350	1800	DS&S/98/7713
11.0	1.8	500	1800	DS&S/2002/7715
11.0	1.8	850	1800	DS&S/98/7730
11.0	1.8	1200	1800	DS&S/2003/7732
13.0	2.2	500	2200	DS&S/98/7714
13.0	2.2	850	2200	DS&S/98/7712
13.0	2.2	1200	2200	DS&S/99/7725

5.0 TESTS TO BE CARRIED OUT :

5.1 Type Test

5.1.1 General

This is a destructive test, carried out to check whether the batch of poles conform to the design requirements, set out in the CEB Standards.

Once the manufacture of poles in a contract has commenced, a minimum of one pole for each batch of **100** poles or part thereof manufactured, has to undergo this test. Selection of pole/additional poles for this test shall be done as stated in Clause 3.4. Acceptance criteria for this test is given in Clause 5.3.

5.1.2 Testing Arrangement

Testing arrangement shall be horizontal where the pole is supported in horizontal position on roller tracks as indicated in the Drawing No. DS&S/2000/44-3 annexed (Annex A). Vertical arrangement is **not** recommended for testing of concrete poles.

5.1.3 Test Apparatus

The contractor shall arrange test apparatus of his own, as per requirements given in Clause 2.2 for horizontal testing arrangement, as shown in the drawing No. DS&S/2000/044-3.

5.1.4 Loading of Pole

The loading of the pole shall be effected by applying suitable standard/calibrated weights, or any other tensioning equipment approved by the Engineer as shown in the Drawing No. DS&S/2000/44-3. However, due to the friction of pulleys and cables, 100% of the actual weight used for loading, will not be transferred to the pole, as such, a **dynamometer shall** be connected to the loading system **just before** the point of loading of the pole, in order to read the exact value of load transferred to the pole. Loading shall be transferred to the pole through a hook made of flat iron not more than 50mm width, going round the pole exactly at 0.6 m below the top end of pole.

It is very important to place the pole in correct orientation, on the test bed, so that the end loading is applied in a **transverse** direction of the pole. The distance of pulley located horizontally away from pole shall not be less than twice the height of pole to ensure an angle of 90° between the rope and test pole, while the pole is subject to deflection.

5.1.5 Supporting the top part of Pole

When the pole is tested in horizontal position, the length of it beyond the points of fixing (i.e. length above the testing line) shall be properly supported on a bed of roller tracks, so that the effect due to the self-weight of the pole is neutralised. These roller tracks shall be friction free as much as possible and offer no resistance to the lateral movement of the pole.

The length not more than 150mm and the diameter not less than 30mm Galvanised Iron pipes may be used as rollers. Rollers shall be mounted on a channel iron frame using ball bearings. These rollers have to be attached to the above frame in such a way that the top surface of those rollers are located in an exactly horizontal plane, and all the rollers are absolutely free to move. (construction of a roller track is indicated in the drawing). The roller track frames shall be placed on a cement rendered continuous pavement, which shall be exactly horizontal, in order to prevent any relative settlement of them during loading.

A minimum number of 03 roller track units shall be used spaced equally between the pole testing line and a point just before the application of load of the test pole. However, the number may be limited to 2 for poles of 6m. height. Before any testing commences, the Engineer has to inspect the movement of the trolleys and totally satisfy himself that they are friction-free and do not offer any resistance to the horizontal movement of the pole during loading or unloading.

In case of poles which are having a tapering section along the narrow face also, the two roller tracks close to the top end of pole shall be provided with suitable means in order to compensate the height difference arising due to the variable section.

5.1.6 Fixing the Pole at Butt End

Pole shall be properly fixed at the butt-end using a suitable arrangement. Important requirements in these arrangements are given below:

- i) Pole shall be fixed in such a way that there is absolutely no movement during the process of loading, in the bottom part of pole between the butt-end and the line of testing (level of fixity)

- ii) The balance length of pole shall be absolutely free to move in the lateral direction i.e., the fixing shall be done only between the butt end and the line of testing.

A typical arrangement of a horizontal testing apparatus is shown in Drawing annexed. In this arrangement fixing of butt-end is done by resting it on a concrete/steel bed as shown in the drawing. Tightening shall be done using wooden/steel wedges of appropriate size placed in between the pole and the steel/concrete base, in order to fix the pole properly.

The arrangement shown in the drawing shall be used for any of the pole sizes to test RC Poles or to test Pre-stressed Poles as shown in the corresponding figure in the Drawing. It is important to note that, as the position of the pulley through which the load is applied is fixed, any pole which is tested shall be positioned in such a way that the top of the pole is only 0.6m beyond the point of loading. Butt end of poles of different sizes shall be fixed by tightening with wooden/steel wedges. Before the test load is applied, 10% of the ultimate load shall be applied to the pole and released there after tightening the wedges to ensure fixity of the butt end of pole.

5.1.7 Testing Procedure

Pole shall be held rigidly between the butt end and the testing line. specified in the corresponding pole drawing. Method of fixing the butt end is described in Clause 5.1.6.

Before starting the test, Engineer shall inspect the testing arrangement and confirm whether all the requirements mentioned in previous Clauses with regard to the testing arrangements are met with. After this, the loading of the pole shall be commenced.

Loading shall be applied at a point 0.6m below the top of the pole for any type of pole. Initial loading shall be 10% of the ultimate load. Ultimate load is obtained by multiplying the working load indicated in the corresponding drawing of pole by a factor of 2.5. Loading shall be raised by increments of 10% of the ultimate load. Measurement of the deflection of the top end of the pole shall be recorded for each increment of load. these measurements shall be taken with the help of a pointer and ruler. Also pole shall be carefully observed at every 10% increment of loading for formation of hair cracks and it shall be recorded properly (A specimen pole test recording sheet is attached as Annex B). For the purpose of recording hair crack measurements shall be made from the butt-end of the pole.

After applying 40% of the ultimate load, the loading should be reduced to zero, and the permanent set of the top of the pole shall be measured.

Increase the loading again, starting from zero in 10% increments, carefully observing the formation of hair cracks, if any, on the surface of the pole, until 60% of ultimate load is applied, and then again loading shall be reduced to zero, and the permanent set shall be measured, and recorded. For each step of loading, deflection of the top end of pole and the formation of hair cracks on the pole, if any, shall be recorded.

After the removal of 60% of the ultimate load, pole shall be carefully examined and verified whether all the hair cracks formed during loading have been **completely closed** and observations shall be recorded.

Loading shall be increased again from zero in steps of 10% of ultimate load and measurement of deflection shall be taken after each increment, maintaining each load above 60% of ultimate load for at least 02 minutes, until complete failure of the pole occurs. Also hair cracks shall be observed and recorded.

After the failure has occurred, the Pole shall be removed from the test bed, and concrete has to be broken sufficiently from any place/places as required by the Engineer, and the reinforcements and stirrups should be exposed. Reinforcement should be carefully examined and verified whether the following factors are meeting the requirements of relevant drawing/specification.

- i) Type, diameter, length, number of bars and positioning of the main reinforcement.
- ii) Type, diameter, shape and spacing of stirrups.
- iii) Length and correct positioning (staggered) of lap joints.

5.2 Recording of Observations

All testing shall be carried out by the Contractor, but all aspects shall be observed by the Engineer.

A typical format for recording of observations is shown in Annex - 2.

The remarks column of the format generally is meant for the recording of the opening of hair cracks under loading, and their closure under the release of load. However, any other remarks which Engineer, considers worth recording, could be entered in it.

5.3 Acceptance Criteria

5.3.1 Test Results

Any pole subjected to the type test mentioned above, shall satisfy all the five acceptance criteria mentioned below.

- i) During the application of load upto 40% of the ultimate load, the pole shall **not** have developed any hair cracks.
- ii) The permanent set recorded, after removal of a test load of 60% of ultimate load shall **not** exceed 10% of the deflection recorded for same test load.
- iii) The hair cracks produced while loading upto 60% of the ultimate load, shall clearly **close up** on removal of the above test load.
- iv) The test load at failure shall **exceed** the ultimate load.

- v) On breaking the concrete after failure it shall be established that the following requirements are in accordance with the corresponding drawing/specification of Pole.
 - a) Type, diameter, length, number of bars and positioning of the main reinforcement.
 - b) Type, diameter, shape and spacing of stirrups.
 - c) Length and correct positioning (staggered) of lap joints.

5.3.3 Acceptance

If the test pole satisfies **all** the acceptance criteria given in Clause 5.3.1 the batch of 100 poles shall be acceptable, except the test pole and poles rejected at visual inspection (Clause 3.2). Rejected pole/poles shall be marked with a permanent ink in the presence of the Engineer and removed from the site immediately. Engineer has to make note of the serial numbers of the poles rejected in the test report.

If the test pole fails to satisfy any **one** or more of the acceptance criteria, then one more pole from the same batch shall be selected as per Clause 3.2 to be tested again. If that pole satisfies **all** the acceptance criteria, then the batch shall be acceptable except tested poles and rejected poles. If that pole also fails to satisfy any **one** or more of the acceptance criteria, then the entire batch shall be rejected. The entire batch rejected shall be marked with a permanent ink, in the presence of the Engineer, and removed from the site immediately. Engineer has to make a note of the serial numbers of the poles rejected in the test report.

5.4 Cost of Testing

The cost of poles tested as well as all the above testing shall be born by the Contractor.

5.5 Pole Transportation

Depending on the contract, poles which are accepted by the Engineer may be transported to the site or handed over to a CEB Officer at the contractor's work site. Taking Over Officer shall have right to reject any pole/poles that are damaged/which have developed cracks before taking over. Rejected poles shall be removed from the site immediately. CEB Officer has to make a note of the serial numbers of such poles in the delivery note issued by the contractor. Delivery notes shall be dully signed by the CEB Officer after making the necessary remarks.

6.0 ANNEUXRES

- A - Horizontal arrangement for pole testing - Drawing No. DS&S/2000/44-3
- B - Pole Test Report

TEST POLE : a) SERIAL NO. :

b) DATE OF MANUFACTURE :

STAGE	LOAD APPLIED IN kg.	% OF ULTIMATE LOAD	DEFLECTION IN mm	REMARKS
1		0		
2		10		
3		20		
4		30		
5		40		
6		0		
7		10		
8		20		
9		30		
10		40		
11		50		
12		60		
13		0		
14		10		
15		20		
16		30		
17		40		
18		50		
19		60		
20		70		
21		80		
22		90		
23		100		
24		110		
25		120		
26		130		
27		140		
28		150		
29		160		
30		170		

31		180		
32		190		
33		200		

1. Whether any hair crack/cracks developed during the application of load upto 40% of the ultimate load :
2. Whether the hair cracks, produced while loading upto 60% of the ultimate load, have closed. :.....
3. Permanent set after 60% of the ultimate load :mm
4. Test load at the destruction of the pole :kg.
5. Verification of reinforcement after breaking of the concrete of the tested pole
 - a) Main Reinforcement
 - (1) Type (2) Diametermm (3) Lap lengthmm
 - (4) Lap positioning
 - b) Stirrups
 - (1) Diametermm (2) Spacingmm

Whether the tested pole satisfied the acceptance criteria :

If not what is the pole No. selected for second test :

In view of the above this batch of poles is accepted/rejected with the exception of the rejected pole/poles mentioned in page 01 of this report and the tested pole

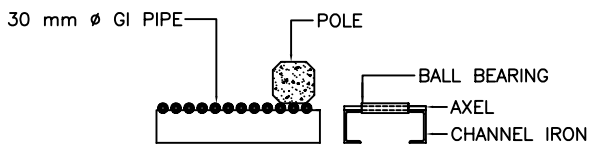
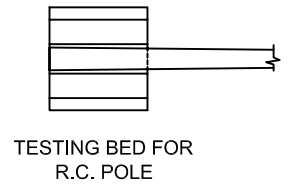
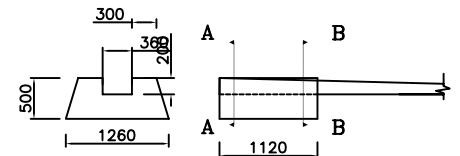
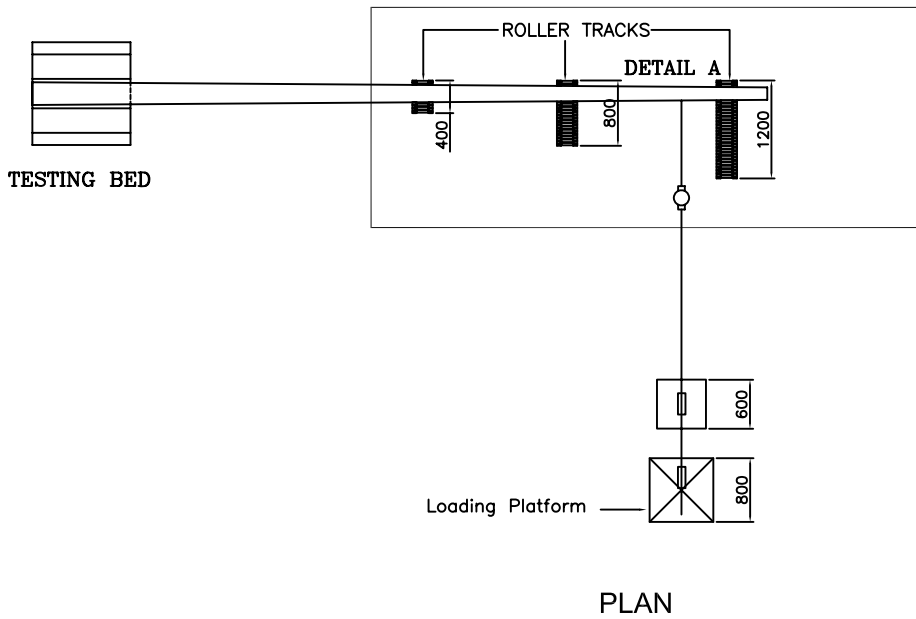
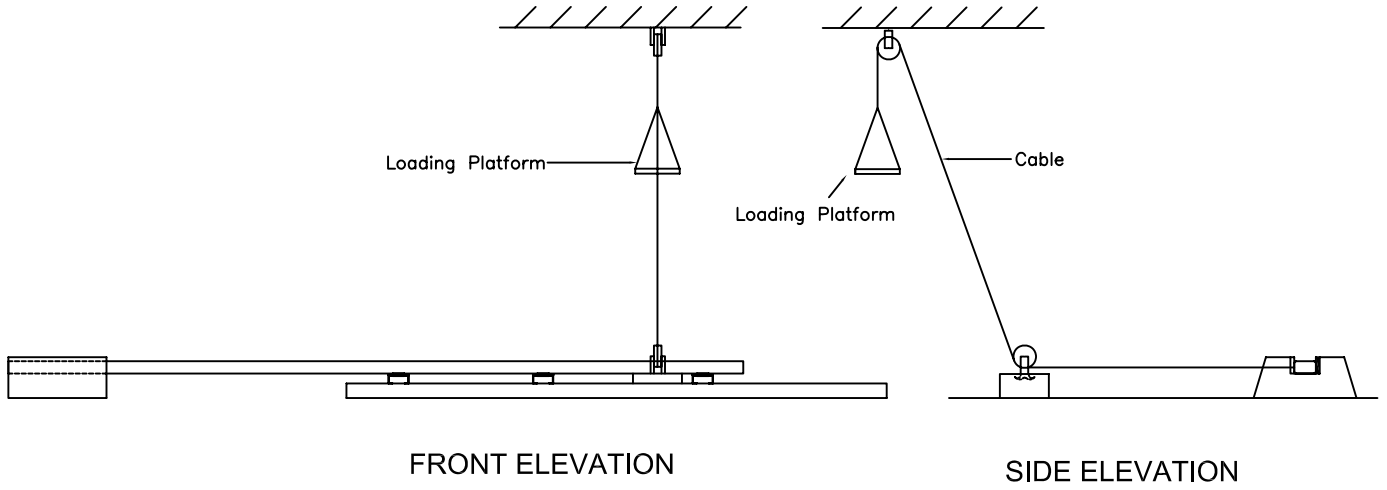
Name and Designation of CEB
Testing Officer/Engineer :

Signature :

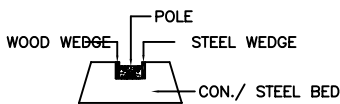
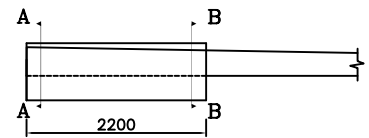
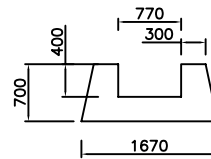
Tested in the presence of
(Name of Contractor or his Agent) :

Signature :

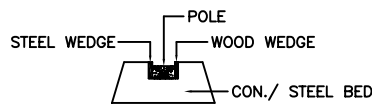
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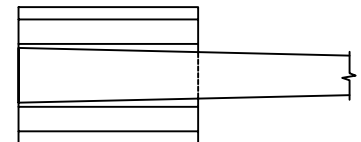
DETAIL A



VIEW B-B



VIEW A-A



TESTING BED FOR PRE-STRESSED POLE

ALL DIMENSIONS ARE IN mm.

DISTRIBUTION STANDARDS & SPECIFICATION

HORIZONTAL ARRANGEMENT FOR POLE TESTING

DESIGNED BY

APPROVED BY

E.E. (DS & S)

CHAIRMAN, SPECIFICATION COMMITTEE

SCALE : NOT TO SCALE

DRAWN : LALANI

DATE : Feb. 2000

DRG. NO : DS&S/2000/044-3

CAD NO :



DIST. PLANNING BRANCH