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**GOVERNMENT OF INDIA  
MINISTRY OF RAILWAYS**

**Technical Specification  
For  
Cold Roll Formed Mast  
For  
Railway Electrification**

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**Specification No. ETI/C/4 (8/90)**

**Research Designs & Standards Organisation  
Manak Nagar, Lucknow-226011**

Govt. of India : Ministry of Rlys  
Research Designs & Standards Organisation  
Manak Nagar : Lucknow 226 011

Specification No. ETI/C/4(8/90)

Draft Indian Railway Standard Specification  
for  
Cold Roll Formed Mast  
for  
Railway Electrification

1 SCOPE

1.1 This specification covers the manufacture, testing and supply of mast for railway electrification, manufactured from cold roll formed channel sections out of hot rolled carbon steel sheet, strip or plate.

1.1.1 This specification does not cover square and hollow box sections.

1.2 The components of the mast shall be formed by cold forming process approved by the purchaser.

1.3 While formulating this specification, assistance has been derived from the following specifications/codes:

- i) IS: 801-1975: Code of Practice for use of cold formed light gauge steel structural members in general building construction.
- ii) IS: 811-1965: Specification for cold formed light gauge structural steel sections.
- iii) IS: 1079-1973: Specification for hot rolled carbon steel sheet and strip
- iv) ETI/OHE/13(4/84) Specification for hot dip galvanisation of steel masts (Rolled & Fabricated).

1.4 Wherever reference to any Indian Standard has been indicated it shall be to its latest version. Wherever there is a conflict between the contents of the above specifications and this specification the latter shall prevail.

2. MATERIAL

2.1 Structural steel sheet or steel strip shall conform to grade St42 - 1079 of IS: 1079-1973.

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2.2 Mechanical Properties:

The mechanical properties of the virgin steel shall conform to Clauses 6 and 7 of IS:1079-1973.

2.3 Chemical Composition:

The ladle analysis of the material when analysed in accordance with \*IS:228-1959 shall conform to Table-1 of IS:1079-1973.

3. GALVANISING

3.1 After fabrication and drilling, the masts shall be galvanised in accordance with Research Designs & Standards Organisation (RDSO) Specification No. ETI/OHE/13(4/84).

4. TOLERANCES

4.1 Tolerances for structural steel sections on straightness and thickness shall conform to Clause-6.1 and 6.3 respectively of IS: 811.

The permissible tolerances on the finished masts shall be as follows:

4.2 Square-ness of corners:

The deviation from the angle of 90° shall not exceed  $\pm 1^\circ$ .

4.3 Length:  $\pm 5\text{mm}$

4.4 Sectional dimensions:  $\pm 3\text{mm}$   
 $\pm 1\text{mm}$

4.5 Uprightness:  $\pm 0.1\%$  of length of mast.

5. INSPECTION & TESTING

5.1 The manufacturer shall arrange for all the specified tests being carried out at his own cost, as required by the purchaser or his nominated Inspecting Authority.

5.2 In case facilities for testing materials and the prototype are not available with the manufacturer, the test may be arranged at any reputed laboratory/test house with the prior approval of purchaser.

5.3 Tests on virgin material: In addition to tensile test as per Clause-6.1 and bend test as per Clause-7.1 specified in IS:1079, impact test shall be carried out as agreed between the purchaser and supplier.

\* IS:228-1959: Methods for chemical analysis for pig iron, cast iron and plain carbon and low alloy steels.

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5.4 Test on prototype :

5.4.1 The prototype of the mast shall undergo the following tests: Two ~~number of~~ masts shall be tested for prototype testing. Both the masts are required to pass the following tests:

5.4.1.1 Visual Examination: The mast shall be examined visually for good finish and freedom from surface defects.

5.4.1.2 Dimensional Check: The dimensions shall be in accordance with Clause-4 hereof.

5.4.1.3 The <sup>chem</sup>ical and mechanical properties for the material when tested as per Clauses 5,6 and 7 of IS:1079, shall conform to the values given under Tables - 2,3 & 4 therein, respectively.

5.4.1.4 Test for quality of Galvanising : The zinc coating on the mast shall be tested for adherence, uniformity and mass of coating. The mass of zinc coating shall be measured by the stripping method or by a previously calibrated elcometer. The thickness of zinc coating measured as per the tests described above shall conform to the stipulation as per Clause-4.1 of RDSO's specification no. ETI/OHE/13(4/84).

5.4.1.5 Bending test :

5.4.1.5.1 The loads on the mast shall simulate the loading conditions so as to produce the designed bending moments at the top of the foundation.

5.4.1.5.2 The mast shall be tested either in the vertical or in the horizontal position as found convenient. The fixing arrangement shall provide full fixity over a length of 1.35m. from the base end of the mast. To enable smooth movement of the mast due to application of the load, there should not be any frictional resistance by any supporting structures.

5.4.1.5.3. Dynamometer method or any other approved method for load measurements may be adopted. The load measuring devices shall be calibrated at regular intervals, as directed by the Inspecting Authority.

5.4.1.5.4 The details of the entire arrangement for testing and the testing schedule therefor shall be got approved from the purchaser by the manufacturer.

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5.4.1.5.5 The procedure for bending tests shall be as follows:

- (1) The transverse load 'D', vertical load 'V' and longitudinal load 'L' will be applied on the mast as shown in Sk. No. ETI/SK/C/249 attached. All the three loadings will be applied simultaneously on the mast. 'D' is the equivalent transverse load to create a bending moment, at the base of mast, equal to the moment of resistance of the mast built-up section, about its central axis parallel to the track. The longitudinal and vertical loads will be kept constant throughout the testing, while the transverse load shall commence at 0.5 D, and then increased in steps of 0.1 D upto the design transverse load 'D'. The load shall be held constant at each step for two minutes and the corresponding deflection at the top of the mast, in the direction of transverse load, shall be measured. At the load of 1.0D, the mast shall be kept in the loaded condition for 24 hours and the deflection shall be measured. This deflection at 1.0D shall not exceed 3.0 cm. The load 'D' shall thereafter be increased to 2 D in steps of 0.1 D. It shall be kept constant at 2 D for two hours and the deflection shall be measured. There shall not be any crack in the mast, upto and equal to a transverse load of '2D'. The load 'D' shall then be brought back to zero gradually and thereafter the loads 'V' and 'L' shall also be removed. There should not be any residual deflection at the top of mast, after removal of the loadings.
- ii) The twist at the top of mast, at load 'D' shall not exceed 0.1 radian

5.4.1.5.6 Destruction Test.

One of the two passed prototype masts shall be tested to destruction by increasing the transverse load gradually. The load just before destruction shall be noted. Study of mast profile, deflection on incremental loading, failure due to cracks, fractures, yielding will be undertaken, in this test.

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5.5 Routine Tests:

The mast for routine tests shall be offered as per the sampling plan in accordance with Clause-6.1 and shall be subjected to the following tests:

- i) Visual Examination
- ii) Dimensional Checks

6 Sampling criterion

6.1 Frequency and number of tests: The number of masts selected from the lot for the tests shall be as indicated below:

Size of lot	Visual & Dimensional	Permissible defective samples	No. of masts For bend test
1	2	3	4
Upto 50	15	1	2

6.2 Test for quality of galvanisation:

This should be done as per Clause -6.2 of specification No. ETI/OHE/13(4/84) on 5 samples selected randomly.

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6.3 The masts shall be selected at random. In order to ensure randomness, all the masts in one lot may be numbered in serial order and starting from any random mast every  $r$ th mast may be included in the sample, ' $r$ ' being the integral part of  $N/n$  where ' $N$ ' is the size of the lot and ' $n$ ' is the sample size.

6.4 A lot shall be considered as conforming to the specification if the conditions of Clause- 6.5 and 6.6 are satisfied.

6.5 The number of masts which do not satisfy the requirements of length, uprightness and dimensions of section, shall not exceed the figure in column (3) of Table under Clause- 6.1. If the number of such masts exceeds this figure, all the masts in the lot shall be tested for these requirements and those not satisfying the requirements shall be rejected. All of the masts shall be checked visually and shall satisfy the requirements as prescribed.

6.6 The mast chosen for bending test shall satisfy the requirement under Clause- 5.4.1.5.5 of the test. If one or more masts fail, twice the number of masts originally tested shall be selected from amongst those already selected for dimensional accuracy and subjected to the test. If there is no failure among these masts, the lot shall be considered to have passed the test. Even if one mast of the second sample fails, the lot represented by the samples shall be considered not to have passed the test and will be rejected.

## 7 EARTHING

7.1 Provision for earthing shall be made as per purchaser's drawing No. EII/SY/C/235.

## 8 MARKING.

8.1 The masts shall be clearly and indelibly marked before galvanisation with the following particulars either during or after manufacture but before testing at a location easily readable after erection in position:

- i) Month and year of manufacture.
- ii) Class of mast as per purchaser's requirement &
- iii) Manufacturer's serial number and mark.

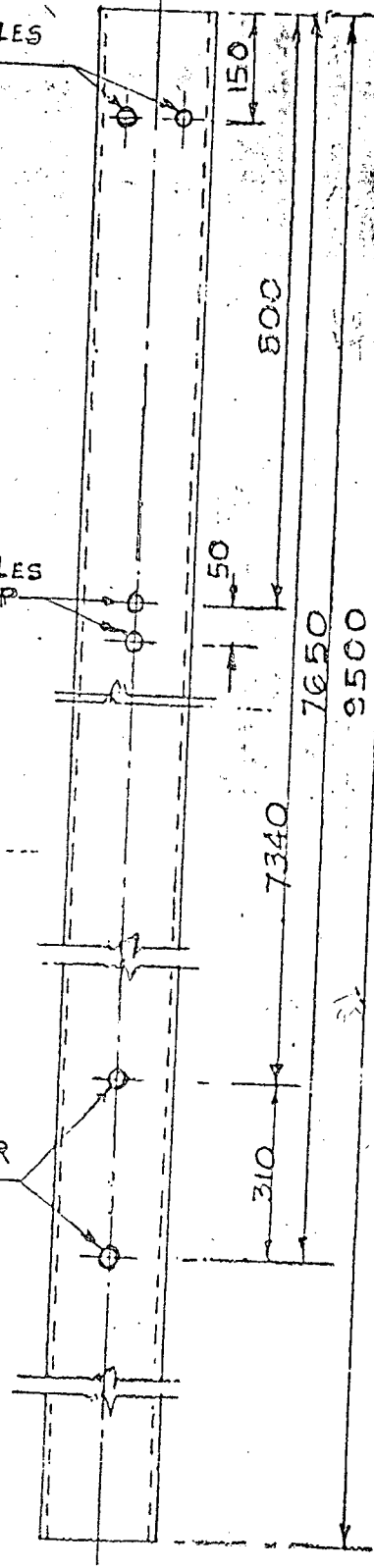
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2 Nos. 17.5  $\phi$  HOLES  
FOR STAY ARM  
(ON BOTH SIDES)

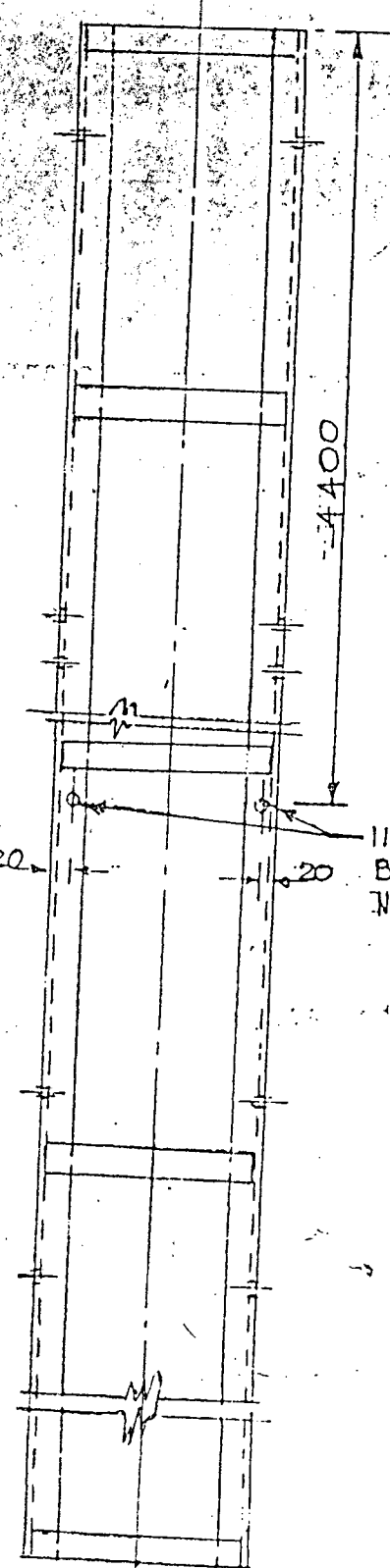
2 Nos. 17.5  $\phi$  HOLES  
FOR EARTH WIRE CLAMP  
(ON BOTH SIDES)

17.5  $\phi$  HOLES FOR  
RAIL BONDING  
(ON BOTH SIDE)

11.5  $\phi$  HOLES ON  
BOTH SIDES FOR  
NUMBER PLATE



ELEVATION



SIDE VIEW

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CRF CHANNELS



C.L. OF TRACK

PLAN

ALL DIMENSIONS ARE IN MILLIMETRE)

DRILLING SCHEDULE FOR THE MAST  
(CRF SECTION)

(REF. DRG. NO. ETI/C/0018-2)

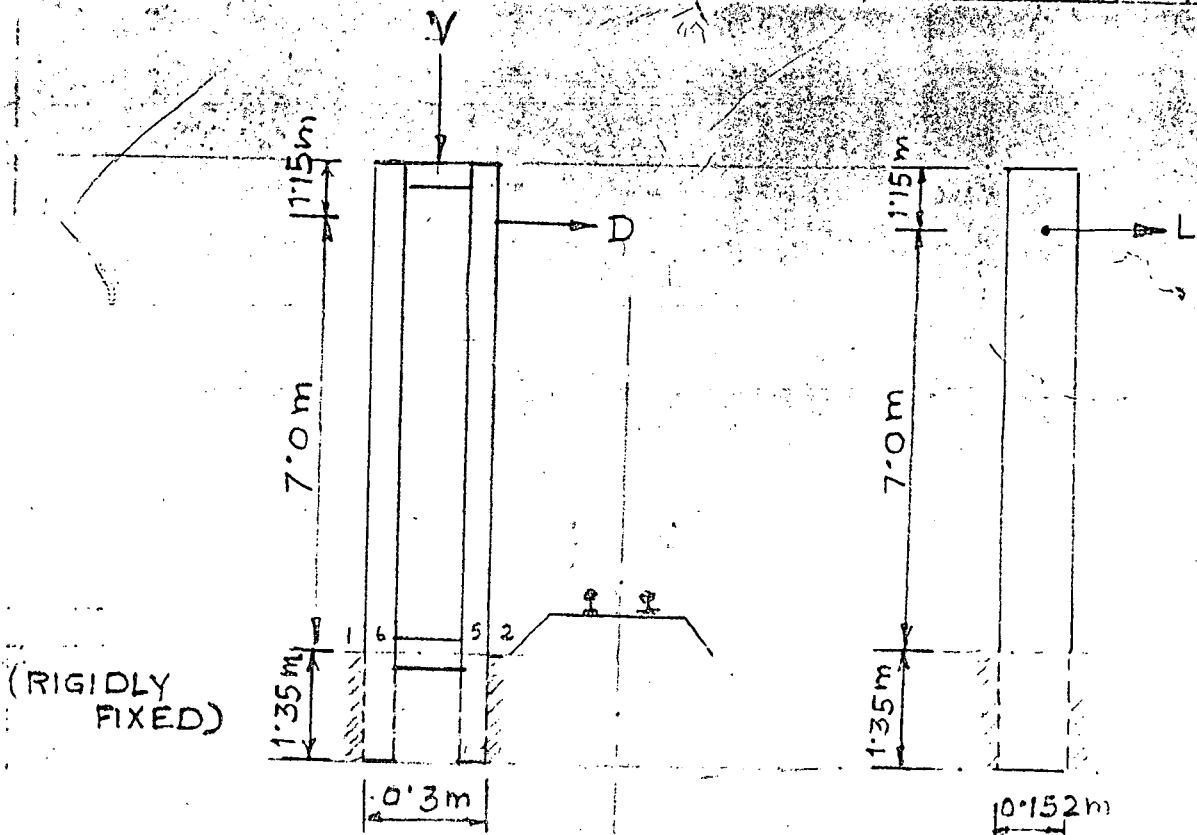
DBTI/CIVIL *3/6/07*

ETI/SK/C/235

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13.8.70	A	<i>[Signature]</i>

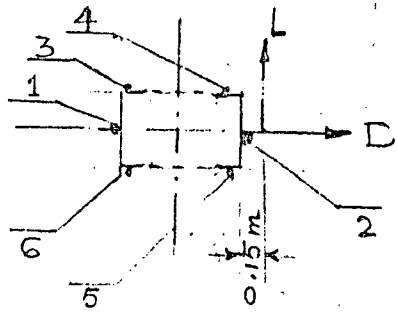


# CRF OHE MAST PROTOTYPE TESTING

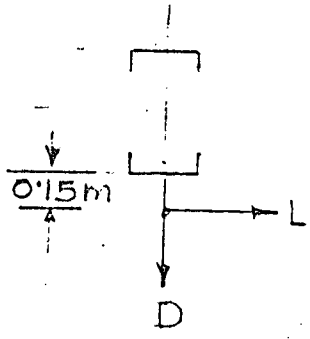


ELEVATION

SIDE VIEW



PLAN



PLAN

NOTE :-

- 1) V = VERTICAL LOAD IN Kg.  
D = TRANSVERSE LOAD ACROSS TRACK IN Kg.  
L = LONGITUDINAL LOAD ALONG TRACK IN Kg.
- 2) STRAINS ARE MEASURED AT POINTS JUST ABOVE TOP OF FOUNDATION AT 1, 2, 3, 4, 5 & 6.
- 3) DEFLECTION IS MEASURED AT TOP OF MAST, IN THE DIRECTION OF LOAD 'D', AT ALL LOADINGS INDICATED IN THE LOADING CHART.
- 4) TWIST IS MEASURED AT TOP OF MAST. IT SHOULD NOT EXCEED 0.1 RADIAN AT DESIGN LOAD.

[REFERENCE: M/S NSL DRAWING NO SK/057 AND RDSO SPEC. NO. E11/C/1/1991]

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JDTI-CIVIL  
13/3/90

ETI/SK/1/140