

SPECIFICATION No. TI/SPC/OHE/3PHTATD/0150



GOVERNMENT OF INDIA
MINISTRY OF RAILWAYS

TECHNICAL SPECIFICATION
FOR
THREE PULLEY TYPE REGULATING EQUIPMENT WITH 2400
Kgf TENSION IN OVERHEAD CONDUCTOR FOR

25 kV AC TRACTION

(For official use only)

Issued by:

TRACTION INSTALLATION DIRECTORATE
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Date	21.9.2016	26.09.16	27.9.2016

SPECIFICATION FOR THREE PULLEY TYPE REGULATING EQUIPMENT WITH 2400 Kgf TENSION IN OVERHEAD CONDUCTOR FOR 25 kV AC TRACTION

1. **SCOPE:** This specification covers the requirements of three- pulley type regulating equipment (3:1 Ratio) to be installed at either end of traction overhead lines for providing a constant tension of 2400 kg in traction overhead line conductors at different ambient temperatures by using balancing weights of 800 kgf. It comprises of a pulley block consisting of two pulleys towards anchoring mast/portal and one movable pulley on the OHE side. The assembly shall have anti-falling device so that in case of breakage of stainless steel wire rope and/or clevis & eye, the overhead conductors are prevented from falling. For semi high speed (160-200kmph) lines, Overhead Equipment tension shall be 2400 kgf i.e. 1200kgf in Catenary wire and 1200kgf in Contact wire. For higher tension in Overhead Equipment, three- pulley Automatic Tensioning Device assembly with 2400 kg tension in overhead line is required.

2. **Reference Specifications:** In perpetration of this specification reference is made to the following specifications:

i	IS: 617-1994	Specification for Cast Aluminum and its alloys-Ingots and Castings for General Engineering Purposes.
ii	IS:3091-1999	Specification for Aluminum Bronze Ingots and Castings for Overhead fittings in Electric Traction.
iii	TI/SPC/OHE/FAST NERS/0120	Specification for Steel Fasteners and Stainless Steel Fasteners.
iv	TI/SPC/OHE/FITTI NGS/0130(10/13)	Specification for 25 kV, AC OHE Fittings.
v	ETI/OHE/13(4/84)	Specification for Hot dip Zinc Galvanizing of Steel Mast, Tubes, Fittings used on 25kV AC OHE.
vi	BS:970 (Part-4)-1970	Specification for Wrought Steels.
vii	IS:1570(Part-5)-1985	Schedule for Wrought Steels (Stainless & heat resisting steel).
viii	IS:549 - 2005	Specification for Spilt Pins
ix	IS:2062 -2011	Specification for Hot Rolled Medium & High Tensile Structural Steel.
x	IS 2004 - 1991	Specification for Carbon Steel Forgings for General Engineering Purposes

3. **ENVIRONMENTAL & WORKING CONDITIONS:** The Automatic Tensioning Device assembly is expected to be used in varying atmospheric and climatic conditions. The environment factors are expected to vary in the range as tabulated below.

i	Ambient air temperature	0°C to (+)55°C
ii	Maximum temperature of metallic object in sun.	70°C
iii	Minimum Temperature	(-) 10°C
iii	Maximum relative humidity	100%
iv	Annual rainfall: Dry Arid regions and also heavy monsoon affected regions with rainfall ranging from 1750 to 6250 mm	
v	Maximum number of Thunder storm days per annum	85
vi	Maximum number of Dust storm days per annum	35
vii	Number of Rainy days per annum.	120
viii	Basic wind pressure	216 kgf/m ²
ix	Altitude:	

	1000m above mean sea level. 2000m above mean sea level in J & K area.
x	Corrosion Resistance: The ATD assembly shall be designed to work in humid salt laden and corrosive atmosphere. The maximum values of the condition shall be as under: Maximum pH value : 8.5 Sulphate : 7 mg/liter Max concentration : 6 mg/liter of chlorine Max. conductivity : 130 micro Siemens /cm

4. General Construction & Material Specification:

- 4.1 The regulating equipment shall be manufactured generally in accordance with the RDSO drawings given below. The manufacturer shall submit his own drawings indicating the tolerances and material specifications of all parts, for approval of RDSO before undertaking manufacture of prototypes.

Drawing for three pulley High tension type regulating equipment

SN	Drawing No.	Description
1.	TI/DRG/OHE/ATD2400/RDSO/ 00001/16/1	Regulating equipment (three pulley type) 3:1 ratio
2.	TI/DRG/OHE/ATD2400/RDSO/ 00002/16/1	Part details of regulating equipment (three pulley type) 3:1 ratio
3.	TI/DRG/OHE/ATD/RDSO/ 00008/05/0	Drawing of M-18 X 75/32 bolt with castle nut
4.	TI/DRG/OHE/ATD/RDSO/ 00005/02/1	Part drawing for clevis & eye forged (RI 5322-1)
5.	ETI/OHE/P/5341 REV 'A'	Part drawing for stainless steel rope end fitting (RI 5341)

- 4.2 The aluminium, aluminium-alloy and aluminium-bronze castings, wherever specified, shall be conform to RDSO Specn. No. TI/SPC/OHE/Fittings/0130.
- 4.3 Fasteners shall conform to Specification No. TI/SPC/OHE/FASTNERS/0120. Fasteners shall be procured from RDSO approved vendor directly.
- 4.4 All ferrous parts except for fasteners used in the regulating equipment shall be hot dip galvanized to RDSO Specification No. ETI/OHE/13 (4/84) with A&C slip No. 1, 2 & 3. The weight of zinc coating shall not be less than 610 gm./m².
- 4.5 All ferrous fasteners including washers shall be hot dip galvanized. The mass of zinc coating shall not be less than 400 gm/sq. m.
- 4.6 Split pins shall be of copper and shall conform to IS: 549-2005.
- 4.7 The Bearings used shall be SKF 6307 2RS1, NBC 6307 LLU or FAG 6307 2RSR. Bearings shall be procured from the RDSO approved manufacturers directly.
- 4.8 Only forged clevis and eye shall be used. Forged clevis and eye shall be procured from RDSO approved manufacturers directly.
- 4.9 Parts Identification No., Manufacturer's monogram and month/year of manufacturer shall be engraved on each part of the assembly as shown in relevant drawings.
- 4.10 "Pulley groove radius" shall be marked on the pulley as shown in the relevant drawing.

5. **Interchangeability:** All components of regulating equipment shall be freely interchangeable between one assembly and another.
6. **Deviation from the specification:-** Any deviation from this specification to improve the performance, utility and efficiency of the equipment proposed by the tender will be given due consideration provided full particulars with justification thereof are furnished.
7. **Freedom from Defects:** All parts of regulating equipment's shall be free from casting/manufacturing defects and other irregularities. No repairs shall be done to the castings to hide defects.
8. **Packing & Marking:** The regulating equipment shall be properly packed, duly assembled, in strong wooden boxes so as to avoid damage during transit. One box shall contain not more than two assemblies. Every packing shall carry, in legible and indelible lettering the following information:

i	Type of regulating equipment	ii	Number of Regulating equipment's packed	iii	Production batch No.
iv	Manufacturer's name, brand or trade mark.	v	Any other particulars specified by the purchaser	vi	Contract Purchase Order No. & Consignee
vii	Date of Inspection.	viii	Net & gross weight.		

9. **Tests:**

- 9.1 All the tests on the regulating equipment shall be conducted at the manufacture's works. The manufacturer shall arrange all the necessary machinery, apparatus, labour and assistance required to get the specified tests conducted, in presence of Purchaser representative at his own cost. If certain specified facilities are not available for the tests, the manufactures may arrange those tests at NABL accredited labs /Government Labs at his own cost, for which approval of RDSO shall be obtained in advance.
- 9.2 Before giving call to RDSO/Purchaser for testing of the prototype of the regulating equipment, the manufacturer shall submit a detailed test schedule consisting of the details of each test and nature of the test, venue of the test and the duration of each test and the total number of days required to complete the test at one stretch. Once the test schedule is approved, the test shall invariably be done accordingly. However, during the process of type testing or even later, RDSO's representative reserves the right to conduct any additional test (s) besides those specified herein, on any equipment/sub-system or system, so as to test the system as per requirement or for gaining additional information and knowledge.
- 9.3 In case, any dispute or disagreement arises between the manufacturer and RDSO during the process of testing as regards to the type test and /or the interpretation and acceptability of the type test results, it shall be brought to the notice of Director General (Traction Installation), Research Designs & Standards Organization, Manak Nagar, Lucknow whose decision shall be final and binding.

9.4 **Tests:**

SN.	Tests	Clause	Type	Acceptance	Routine
i	Visual examination	12.1	Y	Y	Y
ii	Verification of dimensions	12.2	Y	Y	Y
iii	Chemical composition	12.3	Y	Y	N

(on test bars and components)					
iv	Mechanical tests on Test Bar	12.4	Y	Y	N
v	Radiographic examination aluminum bronze and aluminum-alloy castings	12.5	Y	N	N
vi	Load test on rope end fitting (RI 5341) and clevis and eye (RI 5322-1)	12.6	Y	Y	N
vii	Galvanizing test	12.7	Y	Y	Y
viii	Tests on fasteners	12.8	As per Specification No. TI/SPC/OHE/FASTNERS/0120		
ix	Mechanical endurance test	12.9.1	Y	N	N
x	Test to check the mechanical advantage	12.9.2	Y	N	N
xi	Proof-load test	12.9.3	Y	N	N

Note: Clause 9.4(viii) for those firms which are manufacturing fasteners in house, if not then submit the manufacturer's certificate.

- 9.5 **Sampling for type test:** Three samples of each component of regulating equipment shall be subjected to type test given in clause 9.4 except test 9.4(iv) & 9.4(ix),(x)(xi). Test given in clause 9.4(iv) shall be subjected to test bars of aluminium bronze and aluminium alloy of the same melt from which components of the regulating equipment have been drawn. Test given in clause 9.4(ix), (x) & (xi) shall be subjected to whole regulating equipment assembly.
- 9.6 In the event of the tests not being carried through to completion at one stretch, for any reason attributable to the successful manufacturer and it is required for the representative of the Director General (Traction Installation), Research Designs and Standards Organisation, Manak Nagar, Lucknow to go again or more number of times to the works of the successful Manufacturer or other Place(s) for continuing and /or completing the tests on the prototype (s) of the equipment. The guide line of ISO document No. ISO9001:2008 Document No. QO-D-7.1-10 Version No. 3.0 Date Effective: 07/05/2015 for vendor sample type testing and ISO9001:2008 Document QO-D-7.1-14 Version No. 6.0 Date Effective: 14/08/2015 for vendor registration schedule of charges shall be followed.
- 9.7 **BULK MANUFACTURE :** Only after clear written approval of the results of tests on the prototype is communicated by the DG(TI), RDSO to the manufacturer, he shall take up bulk manufacture of regulating equipment, which shall be strictly with the same material and process as adopted for the prototype . In no circumstances, materials other than those approved in the prototype shall be used for bulk manufacture.
- 10 **Inspection and sampling procedure:** The regulating equipment shall be offered for inspection in lots of not more than 100 nos. of regulating equipments, the castings essentially belonging to the same melt and manufactured from the same raw material. Three assemblies of regulating equipment shall be selected at random from every lot, after it has been subjected to the routine tests. The manufacturer shall also offer three test bars each of aluminium bronze and aluminium alloy pertaining to melt of every lot. The components of these assemblies and the test bars shall be subjected to the tests specified in clause 9.4.

11 Criteria for Acceptance

- 11.1** If any sample fails to comply with any test(s) specified in this specification, test(s) shall be repeated on three samples, taken from the same batch but limited to the test(s) in which failure has occurred. If in the retest(s) any sample fails, the batch represented by the sample shall be deemed not to comply with specification and the batch shall be rejected. The rejected batch shall be destroyed in the presence of the inspector, so that they can not be used on the railways.
- 11.2** Inspector shall affix an indelible stamp, punch mark or a label indicating the date of inspection and name of inspector. The label shall be affixed with special glue so that it does not come off.

12. Methods of Tests:

12.1 Visual examination:

- 12.1.1 All the components of the Auto Tensioning Device shall be visually examined for good workmanship and bright and smooth surface finish and freedom from defects stipulated in relevant specification.
- 12.1.2 The components of the Auto Tensioning Device shall be checked for Identification Nos. and Firms Monogram as mentioned in the relevant Drawing.
- 12.1.3 The grooves on the Pulley shall be smooth, clean and uniform all along.
- 12.1.4 The zinc coating on the galvanised components shall be uniform, smooth and free from imperfections such as flux, ash and dross inclusions, bare patches, black spots, pimples, lumpiness and runs, rust stains, bulky white deposits and blisters. The terms have been defined in IS:2629-1985.
- 12.1.5 The Forged heads of Bolts and Tie Rods and holes of Nuts, Washers, Lock Nuts and Locking Plates shall be concentric.
- 12.1.6 The Bearings shall be examined for the free running. The bearing shall be either SKF, NBC or FAG make as specified in clause 4.7.

12.2 Verification of dimensions

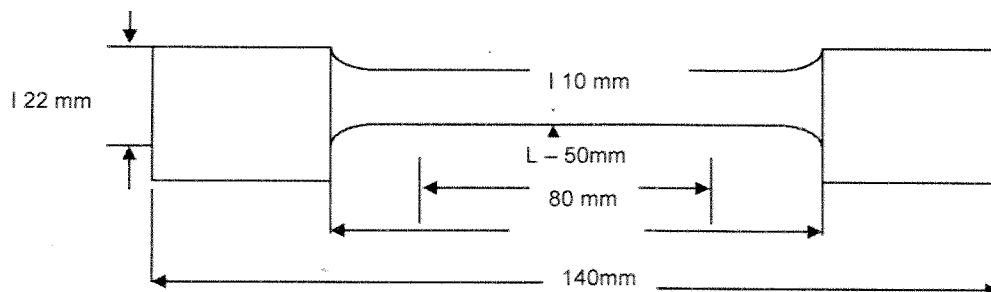
- 12.2.1 Verification of groove profile:** The diameter of the pulleys, groove radius of the pulleys at various points on the groove shall be measured during type test, acceptance test and routine inspection. Pulley groove radius shall be within 4.55mm to 4.75mm. if pulley groove radius is found less than the specified, pulley groove should be remachined to specified groove radius. Pulley shall be rejected, if groove radius is found more than 4.75mm. Pulley groove profile shall be checked with Go, No gauge, which shall be produced by the manufacturer at the time of inspection. Three sets of such Go, No Go gauge should be submitted to RDSO along with QAP. The pulleys shall be marked at two locations for checking the groove radius before and after the endurance test and proof load test.
- 12.2.2 Verification of other critical dimensions:** The dimensions of the castings and other components of the regulating equipment shall conform to the drawings approved by RDSO.
- 12.3 Chemical composition:** The manufacturer shall submit the test bars of aluminium bronze and aluminium alloy from the same melt which represents the lot for chemical analysis. The test bars shall be chemically analysed after the mechanical tests. The purchaser shall be at liberty to analyse any other fittings/

components in addition to test bars. The test bars of aluminium bronze and stainless steel wire rope end fitting (RI 5341) shall meet the requirement of IS 3091-1999. The test bars of aluminium alloy, pulley(RI 5512-1), grease seal(RI 5315-1), wedge(RI 5321) shall meet the requirement of grade 4600M of IS:617-1994.

The material of axles (RI 5332-1, RI 5508-1) shall conform to grade 316S16 of BS: 970(part-4)-1970 or grade AISI 316. Mild steel components pulley bearing bush(RI 5333-1), bush bearing for grease seal (RI 5315-1), Pulley arms (RI 5510-1, RI 5511-1), angle spacers (RI 5505-1, RI 5352-1), locking plates(RI 5336, RI 5323) , pulley arm spacers(RI 5503), tie rod(RI 5509-1) , snap head pin and washers shall meet the requirement of IS 2062:2011 Gr'A'. Forged clevis and eye (RI 5322-1) shall meet the requirement of class II of IS2004 -1991. Split pin shall be of copper as per IS:191-2007.

12.4 **Mechanical Tests on Test Bars:**

12.4.1 Aluminium bronze test bars: The test bars for tensile and elongation tests shall be cast-to-shape type. The shape and dimensions of the test bars shall be as shown in figure-1.



Three cast test bars shall be made for each lot. The test bars shall bear identification mark of the lot and date of the melt. Tensile strength of the test bars shall not be less than 60kgf/sq.mm and elongation shall not be less than 20% minimum.

12.4.2 Aluminium alloy test bars: Three standard round test pieces prepared as specified in clause 6.1.4 of IS: 617-1994 from the same melt for which components have been cast shall be tested for mechanical properties. The test piece shall satisfy the requirement specified in Table-2 of IS 617-1994(Tensile strength of the test bars shall not be less than 190MPa and elongation shall not be less than 7% minimum.)

12.4.3 One test piece shall be tested. If the mechanical properties are met by this test, the lot shall be deemed to have passed the tensile test. If the first test piece fails to conform to the specified requirement, the two remaining test pieces shall be tested and if either of them fails to meet the specified requirements the lot shall be rejected.

12.5 Radiographic Examination Test on pulley, wedge, rope end fitting and grease seal with bush bearing : The aluminium bronze and aluminium alloy castings shall meet the requirement of Specification No. TI/SPC/OHE/FITTINGS/0130, when subjected to radiographic examination.

12.6 Load test on clevis & eye & rope end fitting: The Clevis and eye (5322-1) & rope-end fitting (RI 5341) shall be subjected to tensile load test. The fitting shall be assembled with the wire rope or rigid plateaus/bar in a manner {as approximately as possible} in which it is intended to be used in service. The assembly shall be held in a tensile testing machine. In case of fittings assembled with ropes, a tensile load equal to 90% of the breaking load of the rope shall be

applied and the rope marked so as to detect any movement relative to the fittings. The load shall be maintained for one minute. There shall be no relative movement of the fitting during this period of one minute. Then the load shall be gradually increased. The fittings shall not deform, break or slip at loads less than the minimum specified breaking load of the rope. The clevis and eye (RI 5322-1) shall be tested for 5000 kgf load applied for one minute as well as breaking load. The breaking load shall not be less than 13500kgf.

12.7 Galvanizing test on forged clevis & eye, short locking plates, long locking plates, pulley arm, tie rod, angle spacer for pulley arm & tie rod, nuts, bolts & washers: The galvanized components shall be subjected to visual examination, adhesion test, test for uniformity of zinc coating and determination of mass of zinc coating as per spec. ETI/OHE/13(4/84) with A&C slip No. 1,2,3 & shall meet the requirements of clause 4.4 & 4.5.

12.8 Tests on fasteners: The fasteners used in regulating equipment shall be tested for visual examination, dimensional measurement, gauging of threads, tensile & elongation test, head soundness test, proof load test and hardness test for their conformity to specification No. TI/SPC/OHE/FASTENERS/0120.

12.9 Mechanical endurance , mechanical advantage and proof load test: These tests shall be conducted to judge the ability of the equipment to withstand shocks/jerks encountered when the wire ropes breaks.

12.9.1 Mechanical endurance test:

(i) The manufacturer, at his own cost, shall erect the test rig at his premises for endurance, Mechanical Advantage and proof load tests simulating actual working condition. The setup shall be approved by RDSO.

(ii) Two regulating equipment assemblies shall be required for mechanical endurance test. The test shall be conducted for 30000 operations. The stroke of regulating equipment during this test shall be selected in such a way that rope is fully wound and unwound on the pulley. One forward and backward motion of counter weights constitute one operation. After completion of 30000 operations, the components of the regulating equipment shall not show any appreciable wear of groove, deformation of bearings and bearing breakage, cracks or other irregularities. For this purpose, the grooves of pulley shall be measured and recorded at two marked locations, at right angle to each other, before and after the endurance test for analysing the data and performance, in future.

12.9.2 Test for Mechanical Advantage: Before and after endurance test mechanical advantage of the regulating equipment shall be checked at least 10 positions of counterweight ranging from maximum temperature position to minimum temperature position. For this purpose an accurate digital dynamometer shall be installed and tension at different positions of the counterweight shall be recorded. Mechanical advantage shall then be calculated as given below:

$MA = \text{Dynamometer reading}/800 \text{ (counter weight)}$

The mechanical advantage shall not vary from the nominal value of 3 after taking into consideration calibration of the dynamometer, by more than 1%.

12.9.3 Proof load test: At the end of endurance test, the counterweight shall be increased to 1600kgf and this load shall be maintained for 5 minutes. The regulating equipment shall be able to withstand this test successfully without any breakage or deformation of the components.

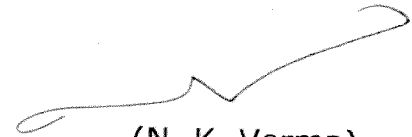
After the endurance and proof load tests have been conducted the equipment shall be brought down for careful examination of various components including bearing. The radii of pulleys and grooves and depth of grooves marked at two places before endurance test shall be measured and recorded.

RDSO's Specification No- TI/SPC/OHE/3PHTATD/0150 of Specification for Three Pulley type regulating equipment with 2400 kgf tension in overhead conductor.

Addendum & Corrigendum Slip No-01 Date of Issue- 28.09.2016

Clause No. 13.0 is added to above mentioned RDSO specification as under

13.0 *"All the provisions contained in RDSO's ISO procedures laid down in document No.- QO-D-7.1-11 dated 19.07.2016 (Titled " Vendor- change in approved status") and subsequent versions/amendments thereof, shall be binding and applicable on the successful vendor//vendors in the contracts floated by Railways to maintain quality of products supplied to Railways"*



(N. K. Verma)
Director (OHE-D)/TI