

## **SECTION – VII**

# **TECHNICAL SPECIFICATIONS FOR ACCESSORIES FOR AAAC & ACSR CONDUCTOR AND GROUND WIRE**

## SECTION-VII

### TECHNICAL SPECIFICATION FOR ACCESSORIES FOR AAAC MOOSE CONDUCTORS

#### 1.0 **SCOPE:**

This specification covers design, manufacture, testing at manufacturer's works, supply and delivery of Mid-span compression joints, Preformed Armour rods, Vibration dampers, repair sleeves, P.G. Clamps suitable for AAA MOOSE conductor. The equipment required shall be complete with all components which are necessary or usual for their efficient performance and satisfactory maintenance.

#### 2.0 **STANDARDS:**

The fittings and accessories shall comply in all respects with the latest edition of relevant IS Specification or any other equivalent authoritative standard. Except as modified by this specification, the conductor accessories to be supplied shall conform to the latest addition with amendments and revisions thereof the following Bureau of Indian Standards (IS) and British Standards (BS) specifications.

IS 2486	Insulator fittings for overhead power lines of 3.3 kV and above.
IS 2486 (Part-I) 1977	General Requirements and tests (First Revision with Amendment No.1)
IS 2486 (Part-II) 1974	Dimensional Requirements (First Revision)
IS 2486 (Part-III) 1974	Locking devices
IS 2486 (Part-IV) 1981	Tests for locking devices
IS 2121	Conductors and Earth wire Accessories for overhead power lines
IS 2121 (Part-I) 1981	Armour rods, binding wires and tapes for conductors
IS 2121 (Part-II) 1981	Mid span joints and repair sleeves for conductors.
IS 1363 (Part-I) 1984	Hexagon head bolts (Second Revision with Amendment No.1)
IS 1363 (Part-II) 1984	Hexagon head screws (Second Revision with Amendment No.1)

IS 1363 (Part-III) 1984	Hexagon nuts (Second Revision with Amendment No.1)
IS 1363	Hexagon head bolts, screws and nuts
IS 1367	Technical supply conditions for threaded steel fasteners
IS 1367 (Part-I) 1980	Introduction and general information (Second Revision)
IS 1367 (Part-II) 1979	Product grades and tolerance (Second Revision)
IS 1367 (Part-III) 1979	Mechanical properties and test methods for bolts, screws and studs with full leadability (Second Revision)
IS 6639 – 1972	Hexagon bolts for steel structures (Amendments –1 & 2
IS 2633 – 1972	Methods of testing uniformity of coating on zinc coated articles (First Revision)
IS 2629 – 1966	Recommended practice for hot dip galvanizing of Iron and Steel
IS 209 – 1979	Zinc (Third revision)
IS 9708 – 1980	Stockbridge vibration dampers for overhead power lines
IS 1327 – 1966	Method of determination of mass of tin coating on tinplate (Second revision)
IS 4826 –1979	Hot dipped galvanized coatings on round steel wires (First Revision with Amendment No.1)
IS 1573 – 1976	Electroplated coatings of zinc on Iron & Steel (First revision)
IS 8263 – 1976	Method of radio interference tests on high voltage insulators
IS 10162 – 1982	Spacers and spacer dampers for twin horizontal bundle conductors
IS 2004 – 1978	Carbon steel forging for general engineering purposes (Second Revision)
BS 970 (Part-I) 1983	General instructions and testing procedures specific requirements for carbon and carbon Manganese alloy and stainless steels

Conductor accessories and hardware's conforming to any other national or international standards are also acceptable. However, in such an event, the salient points of comparison between the standards adopted and deviations

schedule in section BPS with an authentic English version of such standards.

### 3.0 **MATERIAL:**

The materials offered shall be complete in all respects and of best quality and workmanship. The materials in the manufacturer of accessories viz. malleable iron and forged steel depending on the type of application for which the accessories are used shall be corrosion resistant and mechinable. The composition of aluminium alloys used shall be made available to the owner if required for verification.

### 4.0 **GENERAL REQUIREMENTS:**

All parts of fittings shall be suitable for use in atmospheric condition indicated elsewhere in the specification inherently resistant to atmospheric corrosion or be suitably protected against corrosion both during storage and in service.

All ferrous metal parts except those made of stainless steel shall be protected by hot dip galvanizing. Spring washers shall be electro galvanized.

All castings shall be free from blowholes and other casting defects such as cracks etc. The surface shall be as smooth as possible.

The tension joints shall be so designed that strength of complete joints shall not be less than 95% of the minimum breaking load of the conductor under tension.

In case of rods, wire or tape no joints shall be permitted except those in the base rod or wire before final drawings.

### 4.1 **MID- SPAN COMPRESSION JOINTS FOR POWER CONDUCTOR:**

- i) This shall be suitable for jointing the two ends of the power conductor. The joint shall have a conductivity of an equivalent length of the conductor. The joint shall not permit slipping of, damage to or failure of the complete conductor or any part thereof at a load of not less than 95% of the ultimate tensile strength of the conductor. The electrical resistance of the joint after installation

shall not exceed 75% of the measured resistance of the equivalent length of the conductor.

- ii) The components of the joint shall consist of Aluminium sleeves made out of aluminium alloy for joint compression of conductors. Tapered Aluminium filler plugs shall be provided at the line of demarcation between compression and non-compression zone.
- iii) The dimensions and dimensional tolerances of this mid span compression joint shall be as per relevant ISS.

#### 4.2 **REPAIR SLEEVES FOR POWER CONDUCTOR:**

- i) Repair sleeves to be used shall be for repairing the conductor when a few strands of the Aluminium conductor in the outermost layer are damaged with scratches, kinks abrasions, nicks or cuts. They shall be of the compression type. The sleeve shall be manufactured out of Aluminium alloy.. The sleeve shall be in two halves with a seat provision for sliding of the keeper piece. The edges of the seat as well as of the keeper piece shall be so rounded that the conductor strands are not damaged during installation. The outer body of the sleeve shall be smooth even and with rounded off edges.
- ii) The compressed conductor with the repair sleeve shall not permit damage or failure of the conductor at a load of not less than 95% of the ultimate tensile strength of the conductor. The electrical resistance of the repaired portion of the conductor shall not exceed 75% of the measured resistance of an equivalent length of the conductor.
- iii) The dimensions and dimensional tolerances of the repair sleeves shall be as per relevant ISS.

#### 4.3 **VIBRATION DAMPERS FOR POWER CONDUCTOR:**

- i) The vibration dampers shall be of the stock bridge 4R type for being used at all suspension and tension points at each and every span to damp out the vibrations of the conductors to the level specified hereinafter. These shall conform to the relevant ISS.

- ii) The clamp of the vibration damper shall be made of aluminium alloy. It shall be capable of supporting the damper during installation and prevent damage or chafing of the conductor during erection or continued operation. The clamp shall have sufficient grip to maintain the damper in position on the conductor without damaging the strands or causing premature fatigue of the conductor under the clamp. The groove of the clamp body and clamp cap shall be smooth, free of projections grit or other materials which could cause damage to the conductor when the clamp is installed. Clamping bolts shall be provided with self-locking nuts and designed to prevent corrosion of the threads or loosening during service.
- iii) The messenger cable of the damper shall be made of high strength steel with a minimum strength of 136 kg/mm. It shall be performed and post formed in order to prevent subsequent drop of weights and to maintain consistent flexural stiffness cable while in service. The messenger cable shall be suitably and effectively sealed to prevent corrosion.
- iv) The damper mass shall be made of hot dip galvanized mild steel/cast iron or a permanent mould cast zinc alloy. All castings shall be free from defects such as cracks, shrinkage, inclusions and blowholes etc. The inside and outside surfaces of the damper masses shall be smooth.
- v) The damper assembly shall be electrically conductive to reduce radio interference.
- vi) The vibration damper shall be capable of being installed and removed from energized line by means of hot line technique. In addition, the clamp shall be capable of being removed and reinstalled on the conductor at the design torque without shearing or damaging of bolts, nuts or cap screws.
- vii) The vibration analysis of the system with and without damper, dynamic characteristic of the damper shall have to be submitted by the Bidder along with the bid. The technical particulars for vibration analysis and damping design of the 220 kV systems.

- viii) The bidders recommend the number of vibration dampers of the type offered by them and their points of fixation for spans of 200M, 250 M, and up to 400 M in steps of 50 Meters.

4.4 **PREFORMED ARMOUR RODS:**

These shall conform to the relevant Drawings. Suitable aluminium alloy shall be used for the manufacture of preformed armour rods. The armour rods shall be marked in the center with black paint. No joint shall be permitted in the individual rods.

4.5 **P.G. CLAMPS:**

Forced wedge type clamps shall be used for giving jump connections at anchor point. All the bolts, nuts and washers should be hot dip galvanized.

5.0 **TESTS:**

All tests shall be conducted in accordance with latest edition of IS 2121/IS 9708. The following shall constitute the tests. Type test certificates of recent origin (not older than 7 years) for having conducted the tests should be furnished along with the quotation. In case the test certificates are older than 7 years, then the contractor shall conduct the same afresh at his own cost.

NOTE: The Type Test / Special Tests, if repeated at the insistence of owner, the applicable testing charges shall be paid by the successful Bidder upfront to the laboratory and the same shall be reimbursable by KPTCL as per actuals on submission of Bills along with proof of payment and on successful completion of all the Type Tests, specified and on approval of the same by the owner.

In case equipment/material fails in the type tests during testing then the testing charges paid by the Bidder to the laboratory will not be reimbursed by KPTCL.

The above clause is applicable for all the equipments /materials, in case, the Type Test/Special Tests, are repeated at the insistence of owner (KPTCL).

5.1 I. **TYPE TESTS:**

The following shall constitute the Type tests. The bidder shall furnish type test certificates for these entire test as per the relevant ISS of recent origin along with the offer.

- i) For Mid Span compression joints and repair sleeves.
  - a) Visual examination.
  - b) Dimensional verification.
  - c) Failing load test.
  - d) Electrical resistance test.
  - e) Heating cycle test.
  - f) Galvanizing test.
- ii) For Preformed Armour Rods.
  - a) Visual examination.
  - b) Verification of dimensions.
  - c) Tensile strength test.
  - d) Electrical resistance test.
  - e) Slip strength test.
  - f) Bend test.
  - g) Resilient test.
- iii) Vibration dampers:
  - a) Visual examination.
  - b) Verification of dimension.
  - c) Resonance frequency test.
  - d) Fatigue test.
  - e) Mass pull off test.
  - f) Dynamic characteristic test.
  - g) Damping efficiency test.
  - h) Clamp slip test.
  - i) Torque test.
  - j) Galvanizing electroplating test.
  - k) Magnetic power loss test.



- iv) P.G. Clamps:
  - a) Failing load test.
  - b) Electrical resistance test.

## 5.2 **II. ACCEPTANCE TESTS:**

The following acceptance tests shall be conducted as per the relevant ISS any other relevant standards in the presence of the purchaser's representative

- i. Mid span compression joints and repair sleeves.
  - a) Visual examination.
  - b) Dimensional verification.
  - c) Failing load test.
  - d) Galvanizing test.
- ii. Armour rods.
  - a) Visual examination.
  - b) Verification of dimensions.
  - c) Tensile strength test.
  - d) Electrical resistance.
  - e) Slip strength test.
- iii. Vibration dampers.
  - a) Visual examination.
  - b) Verification of dimensions.
  - c) Resonance frequency test.
  - d) Fatigue test.
  - e) Mass pull off test.
  - f) Galvanizing/electroplating test.
- iv. P.G. Clamps: As per the relevant ISS.

## 5.3 **III. ROUTINE TESTS:**

All the routine tests shall be conducted as per the relevant latest edition of ISS.

## 5.4 **GALVANIZATION TEST:**

Galvanized parts shall be tested in accordance with latest edition of relevant ISS

#### 6.0 **SUBMISSION OF DRAWINGS:**

Drawings equivalent to the number of consignees plus six extra for each item have to be submitted for approval before commencement of supply. Supplies shall not be commenced before approval of drawings. Non submission of drawing/receipt of approval shall not be linked with delivery schedule. Delivery schedule should be adhered to.

The drawing shall be complete in all respects. Detailed dimensions shall be furnished in each of the drawings. Full specification of the equipment such as material weight, tensile strength, tolerance, chemical composition etc shall be incorporated in each drawing.

Any defects noticed in the manufacture of the equipment during inspection or after receipt at destination have to be promptly set right by the contractor free of all cost to the owner.

#### 7.0 **INSPECTION:**

The owner's representative shall have access to the manufacturer's works for purposes of inspection during the manufacture of the equipment.

#### 8.0 **PACKING:**

All accessories shall be supplied in strong wooden case all packages shall be marked on the sides as follows:

- a) Name and designation of the consignee.
- b) Ultimate destination as required by the Owner.

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# **SECTION – VIII**

## **(PART-II)**

# **TECHNICAL SPECIFICATIONS**

## **FOR**

### **ACCESSORIES AND HARDWARE FOR 7/3.15mm**

#### **GROUND WIRE**

## **PART – II**

### **SECTION – VIII**

#### **TECHNICAL SPECIFICATION FOR GROUND WIRE ACCESSORIES**

##### **1.0 SCOPE:**

This specification covers design, manufacture, testing at manufacturer's works, supply and delivery of accessories for the ground conductor. The details of the conductors for which these accessories are required have been given under the specifications for Ground wire elsewhere in the specifications. The equipment required shall be complete with all components which are necessary or usual for their efficient performance and satisfactory maintenance and shall be as per the enclosed drawings.

The accessories/Hardware suitable for 7/3.15 GSS ground wire shall comprise of the following:

- i) Mid span compression joint.
- ii) Flexible copper earth bonds.
- iii) Vibration dampers.
- iv) Suspension clamp.
- v) Tension clamp.
- vi) P.G. Clamps.
- vii) Repair sleeves.

##### **2.0 STANDARDS:**

The fittings and accessories shall comply in all respects with relevant Indian Standard Specification, IS 2121-1962 and IS 2486 with latest amendments. The Indian Standards wherever mentioned in this specification shall mean only the latest edition of the relevant standards including latest amendments.

##### **3.0 MATERIALS:**

The materials offered shall be of best quality and workmanship. The materials employed in the manufacture of accessories viz malleable iron and forged steel etc. on the type of application for which the accessories are used shall be corrosion resistant and mechinable.

#### 4.0 **GENERAL REQUIREMENTS:**

4.01 All parts of fittings shall be suitable for use in atmospheric conditions given in Part-I (General) of Technical Specifications and shall be inherently resistant to atmospheric corrosion or be suitably protected against corrosion both during storage and in service.

All ferrous metal parts except those made of stainless steel shall be protected by hot dip galvanizing. Spring washers shall be electro galvanized.

The threads in nuts and in tapped holes shall be cut after galvanizing and shall be well lubricated or greased. All other threads shall be cut before galvanizing. The bolt threads shall be undercut to take care of the increase in diameter due to galvanizing and if required should be return after galvanizing.

All castings shall be free from blowholes and other casting defects such as cracks.

The tension joints shall be so designed that when installed they withstand at least 95% of the minimum-breaking load of the ground wire.

Fittings intended to connect conductors of two dissimilar metal shall be designed to avoid harmful bimetallic corrosion when erected in accordance with conductor accessories manufacturer's recommendations.

All fittings shall be so designed that the effects of vibration both on the conductor and the fitting itself are minimized.

#### 4.02 **MID SPAN COMPRESSION JOINT FOR GROUND WIRE CONDUCTOR:**

- i) The mid-span compression joint for Ground wire conductor is to be used for jointing of two lengths of galvanized steel stranded (GSS) earth wire of size 7/3.15 mm and of 110 Kgs/ sq.mm tensile strength.
- ii) The joint sleeve shall be made of high strength mild steel tubes with aluminium sleeves and shall be easily compressible with a 100 ton capacity hydraulic compressor. The mild steel shall conform to IS:226 grade, 58A grade or equivalent thereof. The clamp shall not permit slipping or damage to or failure of the complete earth wire or any part thereof at a load of not less than 95% of the ultimate tensile strength of the earth wire. The joint shall have conductivity more than the conductivity of an equivalent length of earth wire. The dimensions of the joint shall be as per drawing enclosed.

#### 4.03 **FLEXIBLE COPPER EARTH BOND:**

The flexible copper earthing bond shall be made of tinned flexible copper cable of size 37/7/0.417 with 9.81 mm dia and copper area equivalent to 34 Sq.mm. The tinning shall be as per relevant Indian Standard. The length of copper cable shall not be less than 500 mm. Two tinned copper connecting lugs shall be press jointed to the either ends of the flexible copper cable. The complete assembly shall also include one 16 mm dia 40 mm. 10 hs HRH M.S. bolt hot dip galvanized with nut and lock washer.

#### 4.04 **VIBRATION DAMPER FOR GROUND WIRE CONDUCTOR:**

- i) Vibration dampers of stock bridge 4R type be used at all suspension and tension points on each overhead ground wire in each span to damp out the vibrations of the ground wire to the specified level as stated hereinafter.

- ii) The clamp of the vibration damper shall be made of aluminium alloy. It shall be capable of supporting the damper during installation and prevent damage or chafing of the earthwire during erection or continued operation. The clamp shall have sufficient grip to maintain the damper in position on the earthwire without damaging the strands or causing premature fatigue of the earthwire under the clamp. The groove of the clamp body and clamp cap shall be smooth, free of projections, grit or other materials, which could cause damage to the earthwire when the clamp is installed.
- iii) The messenger cable of the vibration damper shall be made of high strength steel with a minimum strength of 136 Kg/mm and performed in order to prevent subsequent drop of weights in service. The number of strands in the messenger cable shall be 19. Clamping bolts shall be provided with self-locking nuts designed to prevent corrosion of the threads or loosening during service. The messenger cable shall be suitably and effectively sealed to prevent corrosion.
- iv) The damper mass shall be made of hot dip galvanized mild steel/cast iron or a permanent mould cast zinc alloy. All castings shall be free from defects such as cracks shrinkage, inclusions and blowholes etc. The inside and outside surfaces of the damper masses shall be smooth.
- v) The vibration damper shall be capable of being installed and removed from an energised line by means of hot line techniques. In addition, the clamp shall be capable of being removed and reinstalled on the earthwire at the design torque without shearing or damaging of bolt and nuts or cap screws.

- vi) The vibration analysis of the system with and without damper, dynamic characteristic of the damper shall have to be submitted by Bidder along with the bid. The vibration analysis and damping design shall be suitable to the 220 kV/110 kV/66 kV system now offered for construction.
- vii) The Bidder shall recommend the number of vibration dampers of the type offered by them and their point of fixation for spans of 250 Meters to 600 Meters at an interval of 50 Meters.

4.05 **SUSPENSION HARDWARE FOR GROUND WIRE CONDUCTOR:**

- i) These are to be used for suspending the ground wire conductor at all tangent/suspension towers and shall be suitable for supporting the G.S.S. earth wire of size 7/3.15 mm.
- ii) The suspension clamps shall conform to IS 2486-1971 and shall have adequate area of support for the earth wire. The groove of the clamp shall be smooth, finished in an uniform circular or oval shape and shall slope downwards in a smooth curve to avoid edge support and hence to reduce the intensity of bending moment on the earth wire.
- iii) There shall be no sharp points in the clamps coming in contact with earth wire. There shall not be any displacement in the configuration of the earth wire strands nor shall these be unduly stressed in final assembly.
- iv) The clamping piece and the clamp body shall be clamped by at least two 'U' bolts of size not less than 10 mm with 3-mm thick lock washers on each of its limbs. Suspension clamp shall be provided with



inverted type of 'U' bolts. One limb of the 'U' bolt shall be long enough to accommodate the lug of the flexible copper bond.

- v) The suspension clamp shall be of the 'Trunion' type or envelope type.
- vi) The complete assembly of the suspension clamp shall be guaranteed for slip strength and Mechanical test as per clause 5.4.1 and 5.5.1 of ISS 2486 Part-I 1971.

#### 4.06 **TENSION HARD WARES FOR GROUND WIRE CONDUCTOR:**

- i) These tension hard wares are to be used at all tension towers for anchoring the 7/3.15-mm galvanized steel earthwire (ground wire). The hardware assembly shall comprise of Bolted type/compression type of tension clamp and two 'D' shackles. The tension clamp is to be attached to the horizontal strain plate of the tower body by means of a 'D' shackle.
- ii) These clamps shall give adequate area of support without any slip to the ground wire under normal working tension and vibration conditions.
- iii) The complete tension hardware assembly shall be so designed as to avoid undue bending in any part of the clamp and shall not produce any hindrance to the movements of the clamp in horizontal and vertical direction.
- iv) The slip strength of tension clamp assembly shall not be less than 95% of the ultimate strength of the ground wire. The ultimate strength of the clamp and individual components shall not be less than that of ground wire.

#### 5.0 **MATERIAL, DESIGN AND WORKMANSHIP:**

##### 5.1 **GENERAL:**

- i) All the equipments shall be of the latest design and shall conform to the best modern engineering practice adopted in the field of extra high

voltage engineering. The bidder shall offer only such equipment as are guaranteed for satisfactory and suitable performance of 220 kV transmission lines.

- ii) The design, manufacturing process and quality control of all the materials shall be such as to give maximum factor of safety, maximum possible working load, highest mobility, elimination of sharp edges and corners to limit corona and radio interference best resistance to corrosion and a good finish.

## 5.2 **GALVANIZING:**

- i) All ferrous parts including steel components, bolts, nuts and washers etc shall be hot dip galvanized after all machining has been completed. Nuts may, however be tapped (threaded) after galvanizing. Spring washers shall be electro-galvanized. The bolt threads shall be undercut to take care of increase in diameter due to galvanizing. Galvanizing shall be done in accordance with IS-2629 and shall satisfy the tests mentioned in IS 2633. Bolts and nuts and washers shall withstand four dips while spring washers shall withstand three dips. Other galvanized materials shall be guaranteed to withstand at least six dips each lasting one minute under the standard preece test for galvanizing.
- ii) The zinc coating shall be perfectly adherent, of uniform thickness, smooth, reasonably bright, continuous and free from all imperfections such as flux, ash, rust stains, bulky white deposits and blisters. The zinc used for galvanizing shall be of grade Zn 99.95 as per IS 209.

## 5.3 **CASTINGS:**

- i) All ferrous and aluminium alloy castings, shall be free of all internal defects, shrinkage's, inclusions, blow holes, cracks etc.
- ii) All castings shall be smoothly and evenly finished by machining, buffing etc., so as to eliminate sharp ends, edges, abrasions and projections. No surface area of the accessories and hardware in contact with the conductors in any manner either during erection or during continuous operation. The surface in contact with the conductor shall not cause any abnormal electrical or mechanical stresses during normal working and operating conditions.

#### 5.4 **CURRENT CARRYING PARTS:**

- i) All current carrying parts shall be so designed and manufactured that the contact resistance is reduced to a minimum.
- ii) The design of metal parts and their mating surfaces in contact with power conductors shall be such as to prevent corrosion of the contact surface and to maintain good electrical contact under all operating conditions.

#### 5.5 **METAL PARTS OF GROUND WIRE HARDWARE:**

- i) The suspension clamp shall be of malleable cast iron or forged steel . The tension clamp shall be made of forged steel/malleable cast iron with aluminium sleeves conforming to IS-2486 or of a grade or equivalent thereof.
- ii) 'D' shackles, clevis 'U' bolts, cotter pins and other components shall be manufactured from drop forged steel conforming to IS 2004/1978 or equivalent thereof.

- iii) Bolts, nuts and washers shall be as per IS 1367 and shall be of reputed makes such as GKW, TATA brands etc.
- iv) All split pins shall be of stainless steel.

#### 5.6 **INTERCHANGEABILITY:**

All components like design shall be interchangeable.

#### 5.7 **COMPRESSION MARKINGS:**

- i) Die compression areas shall be clearly marked on components which are to be pressure compressed such as Mid-span compression joints and tension hard wares. The marking shall be an etched inscription with the words “COMPRESS FIRST” on components, which are meant for continuous die compression. Where components are designed for intermittent die compressions, the compression and non-compression zones shall bear etched inscription such as “COMPRESS ZONE” and “NON-COMPRESS ZONE” distinctly with etched arrow signs indicating the direction of compression and knurled marks showing the end of the zones.
- ii) All inscriptions etched on metal shall be distinct, legible and shall not wear out in the course of normal handling.

#### 6.0 **BID DRAWINGS:**

- i) The bidder shall furnish along with the bid the dimensional drawings of all accessories and hardware's.
- ii) These drawings shall include the following information.
  - a) Dimensions.
  - b) Tolerances on dimensions.
  - c) Material designation used for different components with reference to standards.
  - d) Fabrication details such as welds, finishes and coatings.

- e) Catalogue or part numbers for each component and the total assembly with bill of materials.
- f) Identification marking.
- g) Weight of individual components and total assembled weight.
- iii) The assembly drawings shall include the following:
  - a) Brief installation instructions.
  - b) Design installation torque for the bolt or cap screw.
  - c) Withstand torque that can be applied to the bolt or cap screw without failure of components or parts thereof.
  - d) Compression die number with recommended compression pressure.
  - e) Relevant technical details of significance.

## **7.0 TESTS:**

All tests shall be conducted in accordance with IS 2121-1962 and IS-2486. Tests are divided groups viz. type tests, sample tests and routine tests. Details of tests have been given under the respective fittings.

### **7.1 TYPE TESTS:**

Type tests are normally made once and unless otherwise agreed test certificates giving the results of the appropriate type tests made on not less than three fittings identical in all essential details with those to be supplied are regarded as evidence of compliance. All the type test certificates of recent origin not older than 7 years as on Bid opening date conducted in a reputed laboratory shall be furnished along with the Bid. In case the type test reports are older than 7 years the contractor shall conduct the type tests on his own cost before commencement of mass production.

**NOTE: The Type Test / Special Tests, if repeated at the insistence of owner, the applicable testing charges shall be paid by the successful Bidder upfront to the laboratory and the same shall be reimbursable by KPTCL as per actuals on**

submission of Bills along with proof of payment and on successful completion of all the Type Tests, specified and on approval of the same by the owner.

In case equipment/material fails in the type tests during testing then the testing charges paid by the Bidder to the laboratory will not be reimbursed by KPTCL.

The above clause is applicable for all the equipments /materials, in case, the Type Test/Special Tests are repeated at the insistence of owner (KPTCL).

#### 7.2 **SAMPLE TEST:**

Sample tests are not applicable when the order is for less than one hundred identical fittings. The number of samples shall be the nearest whole number to one half of one percent of the batch offered for inspection. If these samples meet the test requirements, the batch is deemed to comply with the standard. In the event of a sample not meeting the requirement, twice the original no. of new samples shall be tested. If all these new samples meet the test requirement, the batch is deemed to comply with the standard but if any fails to do so, the batch is deemed not to comply with the standard.

#### 7.3 **ROUTINE TEST:**

Those shall be applied to every fittings unless mentioned otherwise.

#### 7.4 **ACCEPTANCE TEST:**

These are tests carried out on samples taken from a lot for the purpose of acceptance of the lot.

7.5 The following shall constitute the type tests, routine tests and acceptance tests as contemplated in the relevant ISS.

I. Mid span compression joint for Ground wire, Repair Sleeves and vibration damper for ground wire:

The type tests, acceptance tests and routine tests shall be the same as that for mid span compression joint for ACSR conductor and vibration dampers ACSR conductor respectively. However, following type tests are not applicable for earth wire accessories:

- i) Mid Span compression joint for earth wire.
    - a) Heating Cycle test.
  - ii) Vibration dampers:
    - a) Magnetic power loss test.
- 7.6 The tests to be carried out on other hardware/accessories are as follows:

**II. Flexible copper bond:**

Type test: Slip strength test.

Acceptance test : i) Visual examination ii) Dimensional verification and iii) Slip strength test.

The Routine tests shall be as per the relevant ISS.

**III. Suspension hardware and tension hardware for ground wire:**

**i) Type tests:**

- a) Slip strength test.
- b) Mechanical tests.
- c) Verification of dimensions.
- d) Galvanizing/electroplating test.
- e) Visual examination test.

**ii) Acceptance tests:**

- a) Verification of dimensions.
- b) Galvanizing Test.
- c) Mechanical Test.

**iii) Routine Test:**

- a) Visual examination test.
- b) Routine mechanical test.

All the above tests shall be carried out in accordance with the latest edition of IS 2121, IS 2486, IS 2263, IS 8263.

**iv) P.G. Clamps:**

The type test and routine test shall be

- a) Failing load test and any other test specified in the latest ISS.

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# **SECTION – VII-A**

(VOLUME – II)

## **TECHNICAL SPECIFICATIONS**

**FOR**

ACCESSORIES FOR ACSR CONDUCTORs

PART-IIB

**SECTION-VII**

**TECHNICAL SPECIFICATION FOR ACCESSORIES FOR ACSR CONDUCTORS**

**SCOPE:**

This specification covers, design, manufacture, testing at manufacturer's works, supply and delivery of mid span compression joints, preformed armour rods, vibration dampers, repair sleeves, P.G. Clamps for the power conductor specified. The equipment required shall be complete with all components which are necessary or useful for their efficient performance and satisfactory maintenance.

**STANDARDS:**

The fittings and accessories shall comply in all respects with the latest edition of relevant IS Specification or any other equivalent authoritative standard. Except as modified by this specification, the conductor accessories to be supplied shall conform to the latest addition with amendments and revisions thereof the following Bureau of Indian Standards (IS) and British Standards (BS) specifications.

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IS 1363 (Part-I) 1984	Hexagon head bolts (Second Revision with Amendment No.1)
IS 1363 (Part-II) 1984	Hexagon head screws (Second Revision with Amendment No.1)
IS 1363 (Part-III) 1984	Hexagon nuts (Second Revision with Amendment No.1)
IS 1363	Hexagon head bolts, screws and nuts
IS 1367	Technical supply conditions for threaded steel fasteners
IS 1367 (Part-I) 1980	Introduction and general information (Second Revision)
IS 1367 (Part-II) 1979	Product grades and tolerance (Second Revision)
IS 1367 (Part-III) 1979	Mechanical properties and test methods for bolts, screws and studs with full leadability (Second Revision)
IS 6639 – 1972	Hexagon bolts for steel structures (Amendments –1 & 2
IS 2633 – 1972	Methods of testing uniformity of coating on zinc coated articles (First Revision)
IS 2629 – 1966	Recommended practice for hot dip galvanizing of Iron and Steel
IS 209 – 1979	Zinc (Third revision)
IS 9708 – 1980	Stockbridge vibration dampers for overhead power lines
IS 1327 – 1966	Method of determination of mass of tin coating on tinplate (Second revision)
IS 4826 –1979	Hot dipped galvanized coatings on round steel wires (First Revision with Amendment No.1)
IS 1573 – 1976	Electroplated coatings of zinc on Iron & Steel (First revision)

IS 8263 – 1976	Method of radio interference tests on high voltage insulators
IS 10162 – 1982	Spacers and spacer dampers for twin horizontal bundle conductors
IS 2004 – 1978	Carbon steel forging for general engineering purposes (Second Revision)
BS 970 (Part-I) 1983	General instructions and testing procedures specific requirements for carbon and carbon Manganese alloy and stainless steels

Conductor accessories and hardware's conforming to any other national or international standards are also acceptable. However, in such an event, the salient points of comparison between the standards adopted and deviations schedule in section BPS with an authentic English version of such standards.

#### **MATERIAL:**

The materials offered shall be complete in all respects and of best quality and workmanship. The materials in the manufacturer of accessories viz. malleable iron and forged steel depending on the type of application for which the accessories are used shall be corrosion resistant and mechinable. The composition of aluminium alloys used shall be made available to the owner if required for verification.

#### **GENERAL REQUIREMENTS:**

All parts of fittings shall be suitable for use in atmospheric condition indicated elsewhere in the specification inherently resistant to atmospheric corrosion or be suitably protected against corrosion both during storage and in service.

All ferrous metal parts except those made of stainless steel shall be protected by hot dip galvanizing. Spring washers shall be electro galvanized.

All castings shall be free from blowholes and other casting defects such as cracks etc. The surface shall be as smooth as possible.

The tension joints shall be so designed that strength of complete joints shall not be less than 95% of the minimum breaking load of the conductor under tension.

In case of rods, wire or tape no joints shall be permitted except those in the base rod or wire before final drawings.

### **MID Span Compression Joints for Power Conductor:**

This shall be suitable for jointing the two ends of the power conductor. The joint shall have a conductivity of an equivalent length of the conductor. The joint shall not permit slipping of, damage to or failure of the complete conductor or any part thereof at a load of not less than 95% of the ultimate tensile strength of the conductor. The electrical resistance of the joint after installation shall not exceed 75% of the measured resistance of the equivalent length of the conductor.

The components of the joint shall consist of steel and Aluminium sleeves for joint compression of the steel core conductors and aluminium conductors respectively. The steel sleeve shall not crack or fail during compression. The steel sleeve shall be hot dip galvanized. The Aluminium sleeve shall be manufactured and extruded out of EC grade Aluminium with a purity of not less than 99.5%. Tapered Aluminium filler plugs shall be provided at the line of demarcation between compression and non-compression zone.

The dimensions and dimensional tolerances of this mid span compression joint shall be as per relevant ISS.

### **Repair Sleeves for Power Conductor:**

Repair sleeves to be used shall be for repairing the conductor when a few strands of the Aluminium conductor in the outermost layer are damaged with scratches, kinks abrasions, nicks or cuts. They shall be of the compression type. The sleeve shall be manufactured

and extruded out of EC grade Aluminium having a purity of 99.5%. The sleeve shall be in two halves with a seat provision for sliding of the keeper piece. The edges of the seat as well as of the keeper piece shall be so rounded that the conductor strands are not damaged during installation. The outer body of the sleeve shall be smooth even and with rounded off edges.

The compressed conductor with the repair sleeve shall not permit damage or failure of the conductor at a load of not less than 95% of the ultimate tensile strength of the conductor. The electrical resistance of the repaired portion of the conductor shall not exceed 75% of the measured resistance of an equivalent length of the conductor.

The dimensions and dimensional tolerances of the repair sleeves shall be as per relevant ISS.

#### **Vibration Dampers for Power Conductor:**

The vibration dampers shall be of the stock bridge 4R type for being used at all suspension and tension points at each and every span to damp out the vibrations of the conductors to the level specified hereinafter. These shall conform to the relevant ISS.

The clamp of the vibration damper shall be made of aluminium alloy. It shall be capable of supporting the damper during installation and prevent damage or chafing of the conductor during erection or continued operation. The clamp shall have sufficient grip to maintain the damper in position on the conductor without damaging the strands or causing premature fatigue of the conductor under the clamp. The groove of the clamp body and clamp cap shall be smooth, free of projections grit or other materials, which could cause damage to the conductor when the clamp is installed. Clamping bolts shall be provided with self-locking nuts and designed to prevent corrosion of the threads or loosening during service.

The messenger cable of the damper shall be made of high strength steel with a minimum strength of 136 kg/mm. It shall be performed and post formed in order to prevent subsequent drop of weights and to maintain consistent flexural stiffness cable while in service. The messenger cable shall be suitably and effectively sealed to prevent corrosion.

The damper mass shall be made of hot dip galvanized mild steel/cast iron or a permanent mould cast zinc alloy. All castings shall be free from defects such as cracks, shrinkage, inclusions and blowholes etc. The inside and outside surfaces of the damper masses shall be smooth.

The damper assembly shall be electrically conductive to reduce radio interference.

The vibration damper shall be capable of being installed and removed from energized line by means of hot line technique. In addition, the clamp shall be capable of being removed and reinstalled on the conductor at the design torque without shearing or damaging of bolts, nuts or cap screws.

The vibration analysis of the system with and without damper, dynamic characteristic of the damper shall have to be submitted by the Bidder along with the bid. The technical particulars for vibration analysis and damping design of the 220-kV/110 kV/66 kV systems.

The bidders recommend the number of vibration dampers of the type offered by them and their points of fixation for spans of 250 M, 400 M and up to 600 Metres in steps of 50 Meters.

### **Preformed Armour Rods:**

These shall conform to the relevant Drawings. Suitable aluminium alloy shall be used for the manufacture of preformed armour rods. The armour rods shall be marked in the centre with black paint. No joint shall be permitted in the individual rods.

### **P.G. Clamps:**

Forced wedge type clamps shall be used for giving jump connections at anchor point. All the bolts, nuts and washers should be hot dip galvanized.

## **TESTS:**

All tests shall be conducted in accordance with latest edition of IS 2121/IS 9708. The following shall constitute the tests. Type test certificates of recent origin (not older than 7 years) for having conducted the tests should be furnished along with the quotation. In case the test certificates are older than 7 years, then the contractor shall conduct the same afresh at his own cost.

NOTE: The Type Test / Special Tests, if repeated at the insistence of owner, the applicable testing charges shall be paid by the successful Bidder upfront to the laboratory and the same shall be reimbursable by KPTCL as per actuals on submission of Bills along with proof of payment and on successful completion of all the Type Tests, specified and on approval of the same by the owner.

In case equipment/material fails in the type tests during testing then the testing charges paid by the Bidder to the laboratory will not be reimbursed by KPTCL.

The above clause is applicable for all the equipments /materials, in case, the Type Test/Special Tests, are repeated at the insistence of owner (KPTCL).

### I. Type tests:

For Mid Span compression joints and repair sleeves.

- Visual examination.
- Dimensional verification.
- Failing load test.
- Electrical resistance test.
- Heating cycle test.
- Galvanizing test.



For Preformed Armour Rods.

- Visual examination.
- Verification of dimensions.
- Tensile strength test.
- Electrical resistance test.
- Slip strength test.
- Bend test.
- Resilient test.

Vibration dampers:

- Visual examination.
- Verification of dimension.
- Resonance frequency test.
- Fatigue test.
- Mass pull off test.
- Dynamic characteristic test.
- Damping efficiency test.
- Clamp slip test.
- Torque test.
- Galvanising electroplating test.
- Magnetic power loss test.
- Radio interference voltage test.

P.G. Clamps:

- Failing load test.
- Electrical resistance test.

## II. Acceptance Tests:

Following Acceptance tests shall be conducted as per IS 2121 /IS 9708 and any other relevant standards in the presence of the Purchaser's representative.

Mid span compression joints and repair sleeves.

- Visual examination.
- Dimensional verification.
- Failing load test.
- Galvanising test.

Armour rods.

- Visual examination.
- Verification of dimensions.
- Tensile strength test.
- Electrical resistance.
- Slip strength test.

Vibration dampers.

- Visual examination.
- Verification of dimensions.
- Resonance frequency test.
- Fatigue test.
- Mass pull off test.
- Galvanizing/electroplating test.

P.G. Clamps: As per the relevant ISS.

### III. Routine tests:

- i) Mid span compression joints and repair sleeves, armour rods, vibration dampers, spacers and dampers.

- Visual examination.
- Dimensional verification.

### Galvanization test:

Galvanized parts shall be tested in accordance with latest edition of relevant IS.

### **SUBMISSION OF DRAWINGS:**

Drawings equivalent to the number of consignees plus six extra for each item have to be submitted for approval before commencement of supply. Supplies shall not be commenced before approval of drawings. Non-submission of drawing/receipt of approval shall not be linked with delivery schedule. Delivery schedule should be adhered to.

The drawing shall be complete in all respects. Detailed dimensions shall be furnished in each of the drawings. Full specification of the

equipment such as material weight, tensile strength, tolerance, chemical composition etc shall be incorporated in each drawing.

Any defects noticed in the manufacture of the equipment during inspection or after receipt at destination have to be promptly set right by the contractor free of all cost to the owner.

**INSPECTION:**

The owner's representative shall have access to the manufacturer's works for purposes of inspection during the manufacture of the equipment.

**PACKING:**

All accessories shall be supplied in strong wooden case all packages shall be marked on the sides as follows:

- a) Name and designation of the consignee.
- b) Ultimate destination as required by the Owner.

## **ACCESSORIES FOR “MOOSE” ACSR, GROUND WIRE AND HARDWARE FOR GROUND WIRE.**

### **1.00        Scope :**

This specification provides for the manufacture, testing, inspection and testing before dispatch, supply and delivery of

Power conductor Accessories,

Ground wire Accessories and

Ground wire Hardware.

required for 220 KV Multi-circuit and Double circuit transmission line.

### **2.0        Standards :**

The fittings and accessories shall comply in all respects with the latest edition of relevant IS Specification or any other equivalent authoritative standard. Except as modified by this specification, the conductor and ground wire accessories to be supplied shall conform to the latest addition with amendments and revisions thereof the following Bureau of Indian Standards (IS) and British Standards (BS) specifications.

BS	IS     209-1979	:	Zinc (Third revision)
	970 (Part-I) 1983	:	General instructions and testing procedures specific requirements for carbon and carbon Manganese alloy and stainless steels.
IS	1327-1966	:	Method of determination of mass of tin coating on tinplate (Second revision)
IS	1363	:	Hexagon head bolts, screws and nuts.
IS	1363 (Part-I) 1984	:	Hexagon head bolts (Second Revision with Amendment No.1)
IS	1363 (Part-II) 1984	:	Hexagon head Screws (Second Revision with Amendment No.1)
IS	1363 (Part-III) 1984	:	Hexagon nuts (Second

		Revision with Amendment No.1)
IS	1367	: Technical supply conditions for threaded steel fasteners.
IS	1367 (Part-I) 1980	: Introduction and general information (Second Rvn.)
IS	1367 (Part-II) 1979	: Product grades and tolerance (Second Revn. )
IS	1367 (Part-III) 1979	: Mechanical properties and test methods for bolts screws and studs with full leadability (Second revision)
IS	1573-1976	: Electroplated coatings of zinc on Iron & Steel (First revision)
IS	2004-1978	: Carbon steel forgings for general engineering purposes (Second Revn.)
IS	2121	: Conductors and Earth wire Accessories for overhead power lines.
IS	2121 (Part-I) 1981	: Armour rods, binding wires and tapes for conductors.
IS	2121 (Part-II) 1981:	Mid span joints and repair sleeves for conductors.
IS	2486	: Insulator fittings for overhead power lines of kv and above.
IS	2486 (Part-I) 1977	: General Requirements and tests (First Revision with Amendment No. 1)

IS	2486 (Part-II) 1974	:	Dimensional Requirements (First Revision.)
IS	2486 (Part-III) 1974	:	Locking devices.
IS	2486 (Part-IV) 1981	:	Tests for locking devices
IS	2629-1966	:	Recommended practice for hot dip galvanizing of Iron and Steel.
IS	2633-1972	:	Methods of testing uniformity of coating on Zinc coated articles (First Revision)
IS	3138-1966	:	Specification for Hexagonal Bolts and Nuts.
IS	4218-1967	:	Specification for Metric Screw Threads
IS	4826-1979	:	Hot dipped galvanized coatings on round steel wires (First revision with Amendment No. 1)
IS	5318-1969	:	Specification for Hot dip galvanized coating on fasteners.
IS	6639-1972	:	Hexagon bolts for steel structures (Amendments-1 and 2)
IS	8263-1976	:	Method of radio interference tests on high voltage insulators.
IS	9708-1980	:	Stockbridge vibration dampers for overhead power lines.
IS	10162-1982	:	Spacers and spacer dampers

for twin horizontal bundle  
conductors

Conductor and Ground wire accessories and hard wares conforming to any other national or international standards are also acceptable. However in such an event, the salient points of comparison between the standards adopted and the standards quoted herein shall be detailed in deviations schedule in section BPS with an authentic English version of such standards.

### **3.0            Installations requirements:**

The Conductor and Ground wire Accessories and Hardware shall be suitable for being installed directly in air along with the power and ground wire conductors of 400kV Double Circuit Transmission lines. They shall be therefore suitable for satisfactory operation under the tropical climatic conditions listed else where in the specifications. The applicable design particulars of these lines is furnished in this specifications.

### **4.0            Material :**

The materials offered shall be complete in all respects and of best quality and workmanship. The materials in the manufacture of accessories Viz. Malleable iron and forged steel depending on the type of application for which the accessories are used shall be corrosion resistant and machinable. The composition of aluminium alloys used shall be made available to the owner if required for verification.

### **5.0            General Requirements :**

All parts of fittings shall be suitable for use in atmospheric condition indicated elsewhere in the specification inherently resistant to atmospheric corrosion or be suitably protected against corrosion both during storage and in service.

All ferrous metal parts except those made of stainless steel shall be protected by hot dip galvanizing. Spring washers shall be electro galvanized.

All castings shall be free from blow holes and other castings defects such as cracks etc. The surface shall be as smooth as possible.

The tension joints shall be so designed that strength of complete joints shall not be less than 95% of the minimum breaking load of the conductor under tension.

In case of rods, wire or tape no joints shall be permitted except those in the base rod or wire before final drawings.

## **6.0            TYPES      AND      REQUIREMENT      OF      CONDUCTOR ACCESSORIES AND GROUND WIRE HARDWARES**

### **6.1            REQUIREMENTS**

- i)            The Power conductor accessories that are required shall be suitable for MOOSE ACSR conductor.
- ii)           The ground wire conductor accessories and hardware fittings that are required shall be suitable for 7/3.66mm GSS wire.

### **6.2            TYPES OF POWER CONDUCTOR ACCESSORIES**

- i).          Mid span compression joints.
- ii).          Repair sleeves
- iii).          Vibration Dampers
- iv).          Quad Rigid spacers for line and jumper spacers
- v).          Spacer dampers in lieu of item (iii)
- vi).          Tee clamps

### **6.3            TYPES OF GROUND WIRE ACCESSORIES**

- i)           Mid span compression joints
- ii)           Flexible copper earth bonds.
- iii)           Vibration Dampers

### **6.4            TYPES OF GROUND WIRE HARDWARES**

- i)           Suspension clamps
- ii)           Tension clamps

## **7.0            SPECIFICATION AND DRAWINGS**

- 7.1           A set of specification drawings in respect of all the above types of accessories and hardware listed above are attached herewith. These drawings are for information and guidelines of the Bidder only. The drawing to be furnished by the Bidder shall be as per his own design and



manufacture and shall be distinct and separate from these specification drawings.

## **8.0                    TECHNICAL REQUIREMENTS**

The Technical requirements of the above individual accessories and hardware is set out hereunder.

### **8.1                    MID    SPAN    COMPRESSION    JOINTS    FOR    POWER CONDUCTOR:**

- i)      This shall be suitable for jointing the two ends of the MOOSE ACSR power conductor. The joint shall have a conductivity of an equivalent length of the conductor. The joint shall not permit slipping of, damage to or failure of the complete conductor or any part thereof at a load of not less than 95% of the ultimate tensile strength of the conductor. The electrical resistance of the joint after installation shall not exceed 75% of the measured resistance of the equivalent length of the conductor.
- ii)     The components of the joint shall consist of steel and Aluminium sleeves for joint compression of the steel core and aluminium conductors respectively. The steel sleeve shall not crack or fail during compression. The steel sleeve shall be hot dip galvanized. The Aluminum sleeve shall be manufactured and extruded out of EC grade Aluminium with a purity of not less than 99.5%. Tapered Aluminium filler plugs shall be provided at the line of demarcation between compression and non-compression zones.

### **8.02                    REPAIR SLEEVES FOR POWER CONDUCTORS :**

- i)      Repair sleeves to be used shall be for repairing the conductor when a few strands of the Aluminium conductor in the outermost layer are damaged with scratches, kinks abrasions, nicks or cuts. They shall be of compression type. The sleeve shall be manufactured and extruded out of EC grade Aluminium having a purity of 99.5%. The sleeve shall be in two halves with a seat provision for sliding of a keeper piece. The edges of the seat as well as of the keeper piece shall be so rounded that the conductor strands are not damaged during installation. The outer body of the sleeve shall be smooth even and with rounded off edges.
- ii)     The compressed conductor with the repair sleeve shall not permit damage or failure of the conductor at a load of not less than 95% of the ultimate tensile strength of the conductor. The electrical resistance of the repaired portion of the conductor shall not exceed 75% of the measured resistance of an equivalent length of the conductor.

### 8.03

#### **VIBRATION DAMPERS FOR POWER CONDUCTOR :**

- i) The vibration dampers shall be of the stock bridge 4R type for being used at all suspension & tension points at each and every span to damp out the vibrations of the conductors to the level specified hereinafter. These shall conform to the relevant ISS.
- ii) The clamp of the vibration damper shall be made of aluminium alloy. It shall be capable of supporting the damper during installation and prevent damage or chafing of the conductor during erection or continued operation. The clamp shall have sufficient grip to maintain the damper in position on the conductor without damaging the strands or causing premature fatigue of the conductor under the clamp. The groove of the clamp body and clamp cap shall be smooth, free of projections grit or other materials which could cause damage to the conductor when the clamp is installed. Clamping bolts shall be provided with self-locking nuts and designed to prevent corrosion of the threads or loosening during service.
- iii) The messenger cable of the damper shall be made of high strength steel with a minimum strength of 136 Kg/Sq.mm. it shall be performed and post formed in order to prevent subsequent drop of weights and to maintain consistent flexure stiffness cable while in service. The messenger cable shall be suitable and effectively sealed to prevent corrosion.
- iv) The damper mass shall be made of hot dip galvanized mild steel/cast iron or a permanent mould cast zinc alloy. All castings shall be free from defects such as cracks, shrinkage, inclusions and blowholes etc. the inside and outside surfaces of the damper masses shall be smooth.
- v) The damper assembly shall be electrically conductive to reduce radio interference.
- vi) The vibration damper shall be capable of being installed and removed from energized line by means of hot line technique. In addition, the clamp shall be capable of being removed and reinstalled on the conductor at the design torque without shearing or damaging of bolt, nuts or cap screws.
- vii) The vibration analysis of the system with and without damper, dynamic characteristics of the damper as detailed under the ISS shall have to be submitted by the Bidders along with the bid. The technical particulars for vibration analysis and damping design of the 400 KV system proposed for construction now.

- viii) The bidders recommend the number of vibration dampers of the type offered by them and their points of fixation for spans of 250 M, 400M and up to 1000 Meters in steps of 50 Meters.

#### **8.04 QUAD RIGID SPACER FOR JUMPER:**

- i) Jumpers at tension points shall also be fitted with spacers so as to limit the length or free conductors to 3.65 m and to maintain the sub conductor spacing of 457 mm. It shall meet all the requirements of spacer used in line except for its vibration performance.
- ii) The spacers offered by the Bidder shall satisfy the following requirements.

Spacers shall restore normal spacing of the sub-conductor after displacement due to wind, electromagnetic and electrostatic forces under all operating conditions including the specified short circuit level without permanent deformation/damage either to the conductor or the assemblies themselves. They shall maintain an uniform firm grip on the conductors. They shall also have long life without being subject to fatigue or wear.

They shall preferably be of the one piece construction and shall not have separate small components. All fasteners used, if any, shall be captive and need not be removed in order to fit the spacer to the sub-conductor.

For spacers requiring retaining rods, the retaining rods shall be designed for the specified conductor's size. The rods shall be made of high strength special aluminium alloy of type 6061 having minimum tensile strength of 35 Kg/Sqmm. The ends of retaining rods should be properly terminated. (Parrot billed/ball end). The retaining rods (Armour rods) shall be of preformed type. The rods should be heat treated to give proper resilience. The dimensions shall be generally as follows:

- i) Length of each rod .....About 1086 +/- 15mm  
ii) Diameter of each rod.....7.87 +/- 0.1mm

The conductivity of the rods shall be not less than 40% of IACS (International Annealed Copper Standards). Direction of lay shall preferably be of right hand. Number of rods in the set shall be about 8. The centre line of the rod shall be suitable marked for ease of installation. Where elastomer surfaced clamp grooves are used, the elastomer shall be firmly fixed to the clamp.

Any nut used, shall be locked in an approved manner against loosening caused by vibrations. The ends of bolts and nuts shall be properly rounded off for specified corona performance.

Nut cracker, hinged open and or boltless type clamps are acceptable provided adequate grip can be maintained on the conductor. Designs requiring clamping bolt cap screw on lock pin shall utilize a single captive fastener.

Clamp with cap shall be designed to prevent its cap from slipping out of position when being tightened.

The clamp grooves shall be in contact with the conductor over the entire clamping surface, except for rounded edges. The groove of the clamp body and clamp cap shall be smooth and free of projections, dirt or other materials, which cause damage to the conductor when the clamp is installed.

For the spacer involving bolted clamps, the manufacturer must indicate the clamp bolt tightening torque to ensure that the slip strength of the clamp is maintained between 2.5 kN and 5 kN. The clamp when installed on the conductor leading to permanent deformation of the conductor strands and premature fatigue failure in operation.

Universal type bolted clamps, covering a range of conductor sizes will not be permitted.

No rubbing, other than that of the conductor clamp hinges or clamp swing bolts, shall take place between any part of the spacer. Joint incorporating a flexible medium shall be such that there is no relative slip between them. Relative movement of the conductor shall be without friction.

The spacer shall be flexible enough so as to avoid distortion or damage to the conductor or to themselves. Rigid spacers are acceptable only for jumpers.

The spacer shall not damage or chafe the conductor in any way which might affect its mechanical strength or corona performance. The spacer clamp shall not damage the conductor under any conditions.

The spacer assembly shall not have any projections, cuts, abrasions etc., or chattering parts which might cause corona.

The materials used in the spacer shall be corrosion resistant. As far as possible, the spacer shall be made of aluminium alloy of type 6061/65032 or 6063/63400. If iron or steel parts are used, they should be galvanized

conforming to relevant Indian Standards and shall have magnetic power loss of not more than one watt for 600 Amps, 50 Hz. alternating current.

Elastomer, if used, shall be resistant to the effects of the ozone, ultraviolet radiation and other atmospheric contaminants likely to be encountered in service, at temperatures upto 70 deg C. It have fatigue resistant characteristics. The physical properties of the elastomer shall be of approved standard.

The spacer assembly shall have electrical continuity. The electrical resistance between the sub-conductor across the assembly, in case of spacer having elastomer clamp grooves, shall lie between 0.1 and 0.01 mega ohm in order to ensure satisfactory electrical performance under service conditions.

The spacer assembly shall be easy in installation/removal and reinstallation without any damage.

The spacer assembly shall be capable of being installed and removed from the energized line by means of hot line techniques.

#### **8.05      MID SPAN COMPRESSION JOINT FOR GROUND WIRE CONDUCTOR :**

- i) The mid-span compression joint for Ground wire conductor is to be used for jointing of two lengths of galvanized steel stranded (GSS) earth wire of size 7/3.66 mm. and of 110 Kgs./sq.mm tensile strength.
- ii) The joint sleeve shall be made of high strength Mild Steel tubes with Aluminium sleeves and shall be easily compressible with a 100 Ton capacity hydraulic compressor. The Mild Steel shall conform to IS 226 grade or equivalent thereof and other relevant standards. The Brinnel Hardness number of Mild steel shall not exceed 200. The clamp shall not permit slipping or damage to or failure of the complete earth wire or any part thereof at a load of not less than 95% of the ultimate tensile strength of the earth wire. The joint shall have conductivity more than the conductivity of an equivalent length of earth wire.

#### **8.06      FLEXIBLE COPPER EARTH BOND :**

The flexible copper earthing bond shall be made of tinned flexible copper cable of size 37/7/0.417 with 9.81mm dia. and copper area equivalent to 34 Sq.mm. The tinning shall be as per relevant Indian Standard. The length of copper cable shall not be less than 500 mm. Two tinned copper connecting lugs shall be pressed jointed to the either ends of the flexible

copper cable. The complete assembly shall also include one 16 mm. dia 40mm. 10 hs HRH M.S. bolt hot dip galvanized with nut and lock washer.

#### **8.07**

#### **SPACER DAMPER FOR QUAD BUNDLE CONDUCTOR:**

Suitable spacer dampers for four bundle ACSR Moose conductor shall be offered. The spacer damper covered in this specification shall be designed to maintain the bundle spacing of 457 mm under all normal operating conditions and to effectively control Aeolian vibrations as well as sub-span oscillation and to restore conductor spacing after release of any external extraordinary load. The nominal sub conductor spacing shall be maintained within  $\pm 5$  mm.

The spacer damper shall restore the normal sub-conductor spacing due to displacement by wind, electromagnetic and electrostatic forces including the specified short circuit level without permanent deformation or damage either to bundle conductors or to spacer damper itself.

The design offered shall be presented as a system consisting of spacer dampers and their staggering scheme for spans ranging from 100m to 1100m. A Vibration performance test shall be carried out on an experimental test line. The systems tested should be those specified by the Supplier for the 800 kV line conditions. Only systems satisfying the performance criteria shall be submitted by Bidder along with Bid.

The test line selected for the performance evaluation shall have been designed for that purpose, be adequately exposed to wind and properly instrumented.

Sl. No.	Description	Technical particulars.
1	Configuration	Double circuit For ACSR Moose conductor bundle per phase and all three phases per circuit in near vertical configuration on both side of tower
2	Span length in metres	
	i) Ruling span	400 Meters
	ii) Maximum Span	1100 Meters
	iii) Minimum span	100 Meters
3	Tensile load in each sub-conductor	Sag Tension calculation shall be provided to the supplier for various wind temperature loading conditions for two ruling design spans.
4	Maximum permissible dynamic strains	$\pm 150$ micro strains.

Under the operating conditions specified, the spacer damper system shall adequately control Aeolian vibrations throughout the life of the transmission line with wind velocity ranging from 0 to 30 km per hour in order to prevent damage to conductor at suspension clamps, dead end clamps and spacer damper clamps.

The spacer damper system shall also control the sub-span oscillations in order to prevent conductor damage due to chaffing and severe bending stresses at the spacer damper clamps as well as suspension and dead end clamps and to avoid wear to spacer damper components.

The spacer damper shall consist of a rigid central body called the frame linked to the conductor by four articulated arms terminated by suitable clamping system. The articulation shall be designed to provide elastic and damping forces under angular movement of the arms. The dynamic characteristics of the articulations shall be maintained for the whole life of the transmission line.

The clamping system shall be designed to provide firm but gentle and permanent grip while protecting the conductor against local static or dynamic stresses expected during normal operating conditions. The

clamping system shall be designed to compensate for any reduction of conductor diameter due to creep.

Bolted type clamps shall allow installation without removal of the bolts or the clamps from clamp body. Locking mechanism shall be suitable to prevent bolt loosening. Clamp locking devices using small loose components shall not be accepted. Nut cracker, hinged open or boltless type clamps are acceptable provided adequate grip can be maintained on the conductor.

Bolts and nuts shall be of mild steel, stainless steel, or high strength steel in accordance with the design of the spacer damper.

Where elastomer surfaced clamps are used, the elastomer elements shall be firmly fixed to the clamp. The insert should be forged from aluminium alloy of type 6061 or equivalent aluminium alloy having minimum tensile strength of  $25 \text{ kg/mm}^2$ . The insert shall be moulded on the insert surface. The insert shall be duly heat treated and aged to retain its consistent characteristics during service. The grain flow of the forged insert shall be in the direction of the maximum tension and compression loads experienced.

If clamps involving preformed rods are used, these rods shall be designed for specific conductor size. They shall be made of high strength aluminium alloy of type 6061 or equivalent aluminium alloy having a minimum tensile strength of  $35 \text{ kg/mm}^2$ . The rods shall be ball ended. The rods shall be heat treated and aged to achieve specified mechanical properties and to retain the same during service. The length of the rods shall be such that the ends fall inside the imaginary square whose sides are vertical and horizontal outer tangents to the conductor sections.

The spacer damper body shall be cast/forged from suitable high strength corrosion resistant aluminium alloy. The aluminium alloy shall be chosen in relation with the process used. However a combination of aluminium alloy and steel shall also be accepted.

The rubber components involved in the design such as damping elements shall be made with rubber compound selected specifically for that particular application. The Bidder shall submit a complete list of physical and mechanical properties of the elastomer used. This list shall make reference to all applicable ASTM standards.

The rubber components used shall have good resistance to the effects of temperature up to  $95^\circ\text{C}$  and to ultraviolet radiation, ozone and other atmospheric contaminants. The rubber shall have good wear and fatigue resistance and shall be electrically semi conductive.



The spacer damper involving ferrous material shall not have magnetic power loss more than one watt at 600A, 50 Hz alternative current per sub-conductor.

The spacer damper assembly shall have electrical continuity. The electrical resistance between the sub-conductors across the assembly in case of spacer damper involving elastomer surfaced clamps shall be suitably selected by the manufacturer to ensure satisfactory electrical performance and avoid deterioration of elastomer under service conditions.

The spacer damper assembly shall have complete ease of installation and shall be capable of removal/reinstallation without any damage.

The spacer damper assembly shall be capable of being installed and removed from the energized line by means of hot line techniques. The Bidder shall supply with the bid the complete description of the installation, removal and reinstallation procedure.

The Bidder shall recommend the staggering scheme for installation of spacer dampers on the line which shall ensure most satisfactory fatigue performance of the line as specified. The scheme shall indicate the number of spacer dampers per phase per span and the sub-span lengths to be maintained between spacer dampers while installing on the four bundle conductors.

The staggering scheme shall be provided for spans ranging from 100m to 1100m. The number of spacer dampers for a nominal ruling span of 400 m shall not be less than six.

No. of sub-span shall be greater than 70m and no end sub-span shall be longer than 40m.

The staggering scheme shall be such that the spacer dampers be unequally distributed along the span to achieve sufficient detuning of adjacent sub-spans for oscillations of sub-span mode and to ensure bundle stability for wind speed upto 60m/hr..

The Bidder shall furnish all the relevant technical documents in support of the staggering scheme recommended for the spacer damper.

## **8.08 T-CONNECTOR**

T-Connector of compression type shall be used for jumper connection at transposition tower. It shall be manufactured out of 99.50% pure aluminium and shall be strong enough to withstand normal working loads.

The T-Connector shall have a resistivity across jumper less than 75% resistivity of equivalent length of conductor. The T-Connector shall not permit slipping off, damage to or failure of complete conductor. The welded portions shall be designed for 30 kN axial tensile load. Leg sleeve of T-Connector should be kept at an angle of 15 deg.C from vertical and horizontal plane of the conductor in order to minimize jumper pull at the welded portion.

#### **8.09 VIBRATION DAMPER FOR GROUND WIRE CONDUCTOR :**

- 8.09.1 Vibration dampers of 4R-Stockbridge type with four (4) different frequencies spread within the specified aeolian frequency band-width corresponding to wind speed of 5m/s to 7 m/s shall be used for suspension and tension points on each earth wire in each span to damp out aeolian vibrations as mentioned herein after.
- 8.09.2 Alternate damping systems or “Dogbone” dampers offering equivalent or better performance also shall be acceptable provided the manufacturer meets the qualifying requirements stipulated in the Specifications. Relevant technical documents to establish the technical suitability of alternate systems shall be furnished by the Bidder along with the bid.
- 8.09.3 One damper minimum on each side per earth wire at suspension points and two dampers on each side per earth wire at tension points shall be used for ruling design span of 400 meters.
- 8.09.4 The Bidder may offer damping system involving more number of dampers per ruling design span than the specified. However suitable price compensation **might** be considered for evaluation. For the purpose of price compensation 80% of towers as suspension locations and 20% of the towers as tension locations and all the spans assumed to be ruling design spans.
- 8.09.5 The clamp of the vibration damper shall be made of aluminium alloy. It shall be capable of supporting the damper during installation and prevent damage or chaffing of the earth wire during erection or continued operation. The clamp shall have smooth and permanent grip to keep the damper in position on the earth wire without damaging the strands or causing premature fatigue failure of the earth wire under the clamp. The clamp groove shall be in uniform contact with the earth wire over the entire clamping surface except for the rounded edges. The groove of the clamp body and clamp cap shall be smooth, free from projections, grit or materials which could cause damage to the earth wire when the clamp is installed. Clamping bolts shall be provided with self-locking nuts designed to prevent corrosion of the threads or loosening during service.
- 8.09.6 The messenger cable shall be made of high strength galvanised steel/stainless steel with a minimum strength of 135 Kg/sq.mm. It shall be of preformed and post formed quality in order to prevent subsequent drop of weights and to

maintain consistent flexural stiffness of the cable in service. The number of standards in the messenger cable shall be 19. The messenger cable ends shall be suitably and effectively sealed to prevent corrosion.

8.09.7 The damper mass shall be made of hot dip galvanized mild steel/cast iron or a permanent mould cast zinc alloy. All castings shall be free from defects such as cracks, shrinkages, inclusions and blow holes etc. The inside and outside surfaces of the damper masses shall be smooth.

8.09.8 The vibration analysis of the system, with and without damper, dynamic characteristic of the damper as detailed under Annexure-A, shall have to be submitted by the Bidder along with his bid. The technical particulars for vibration analysis and damping design of the system are as follows:-

Sl.	Description	Technical particulars
1.	Configuration	Two continuously steel earthwire 10.98 mm diameter mm Dia in horizontal configuration. Refer to Section-I for mechanical properties of the earthwire.
2.	Span length in meters	
i)	Ruling design span	400 meters
ii)	Maximum span	1100 meters
iii)	Minimum span	100 meters
3.	Tensile load in Conductor at temperature of 0 deg. C and still air	As per sag tension calculations.
4.	Maximum permissible dynamic strain	+/- 150 micro strains

8.09.9 The damper placement chart for spans ranging from 100 m to 1100 m shall be submitted by the Bidder. All the placement charts should be duly supported by relevant technical documents.

8.09.10 The damper placement charts shall include the following:

- (1) Location of the dampers for various combinations of spans and line tensions clearly indicating number of dampers to be installed per earth wire per span.
- (2) Placement distances clearly identifying the extremities between which the distances are to be measured.
- (3) Placement recommendation depending upon type of suspension clamps (viz, free center type/trunion type etc.)

- (4) The influence of mid span compression joints in the placement of dampers.

#### **8.10 SUSPENSION HARDWARE FOR GROUND WIRE CONDUCTOR:**

- 8.10.1 Standard anchor shackle/twisted shackle for earth wire suspension clamp shall be supplied for attaching to the hanger plate of tower.
- 8.10.2 At all suspension towers, suitable suspension clamps shall be used to support the required earth wire. The clamps shall be of either free center type or trunion type and shall provide adequate area of support to the earth wire. The groove of the clamp shall be smooth, finished in an uniform circular or oval shape and shall slope downwards in a smooth curve to avoid edge support and hence to reduce the intensity of bending moment on earth wire.
- 8.10.3 There shall be no sharp point in the clamps coming in contact with earth wire. There shall not be any displacement in the configuration of the earth wire strands nor shall the strands be unduly stressed in final assembly during working conditions.
- 8.10.4 The clamping piece and the clamp body shall be clamped by at least two U-bolts of size not less than 10 mm diameter having one nut and one 3 mm thick lock nut with washer on each of its limbs. Suspension clamps shall be provided with inverted type U-bolts. One limb of the U-bolt shall be long enough to accommodate the lug of the flexible copper bond.
- 8.10.5 The Contractor shall supply all the components of the suspension assembly including shackles, bolts, nuts, washers, split pin etc. The total drop of the suspension assembly from the center point of the attachment to the center point of the earth wire shall not exceed 150 mm. The design of the assembly shall be such that the direction of run of the earth wire shall be same as that of the conductor.
- 8.10.6 The complete assembly shall adhere to the values stipulated in the Standard Technical Particulars.

#### **8.11 TENSION HARDWARES FOR GROUND WIRE CONDUCTOR :**

- 8.11.1 At all tension towers suitable compression type tension clamps shall be used to hold the required galvanised steel earth wire. Anchor shackle shall be supplied which shall be suitable for attaching the tension clamp to strain plates.
- 8.11.2 The clamps shall have adequate area of bearing surface to ensure positive electrical and mechanical contact and shall not permit any slip to the earth wire under working tension and vibration conditions. The angle of jumper terminal to be mounted should be 30 deg. with respect to the vertical line.

- 8.11.3 The clamps shall be made of mild steel with aluminium encasing. The steel should not crack or fail during compression. The Brinnel hardness of steel sleeve shall not exceed 200. The steel sleeve shall be hot dip galvanised. The aluminium encasing shall have aluminium of purity not less than 99.5%. Filler aluminium sleeve shall also be provided at the end.
- 8.11.4 The complete assembly shall be so designed as to avoid undue bending in any part of the clamp and shall not produce any hindrance to the movements of the clamps in horizontal or vertical directions.
- 8.11.5 The slip strength of the assembly shall not be less than 95% of the ultimate strength of the earth wire.
- 8.11.6 The clamps shall be complete with all the components including anchor shackle, bolts, nuts, washers, split pin, jumper arrangement etc.

**9.00 MATERIAL, DESIGN AND WORKMANSHIP :**

**9.01 GENERAL :**

- i) All the equipment shall be of the latest design and shall conform to the best modern engineering practice adopted in the field extra high voltage engineering. The bidder shall offer only such equipment as are guaranteed for satisfactory and suitable performance of 400 kv transmission lines with bundled conductors.
- ii) The design, manufacturing process and quality control of all the materials shall be such as to give maximum factor of safety, maximum possible working load, highest mobility elimination of sharp edges and corners to limit corona and radio interference best resistance to corrosion and a good finish.

**9.02 GALVANISING :**

- i) All ferrous parts including steel components, bolts, nuts and washers etc. shall be hot dip galvanized after all machining has been completed. Nuts may, however be tapped (threaded) after galvanizing. Spring washers shall be electro galvanized. The bolt threads shall be undercut to take care of increase in diameter due to galvanizing. Galvanizing shall be done in accordance with IS-2629 and shall satisfy the tests mentioned in IS 2633. Bolts and nuts and washers shall withstand four dips, while soaring washers shall with stand three dips. Other galvanized materials shall be guaranteed to with stand at least six dips each lasting one minute under the standard preece test for galvanizing.
- ii) The zinc coating shall be perfectly adherent, of uniform thickness, smooth, reasonably bright, continuous and free from all imperfections

such as flux, ash, rust stains, bulky white deposits and blisters. The zinc used for galvanizing shall be of grade Zn 99.95 as per IS 209.

9.03 CASTINGS

- i) All ferrous and aluminium alloy castings, shall be free of all internal defects, shrinkages, blow holes, cracks etc.
- ii) All castings shall be smoothly and evenly finished by machining, buffing etc., so as to eliminate sharp ends, edges, abrasions and projections. No surface area of the accessories and hard wares in contact with the conductors in any manner either during erection or during continuous operation. The surface in contact with the conductor shall not cause any abnormal electrical or mechanical stresses during normal working and operating conditions.

9.04 CURRENT CARRYING PARTS:

- i) All current carrying parts shall be so designed and manufactured that the contact resistance is reduced to a minimum.
- ii) The design of metal parts and their mating surfaces in contact with power conductors shall be such as to prevent corrosion of the contact surface and to maintain good electrical contact under all operating conditions.

9.05 METAL PARTS OF GROUND WIRE HARDWARE:

- i) The suspension clamp shall be of malleable cast iron or forged steel or of aluminium alloy. The tension clamp shall be made of Forged steel/Mild steel conforming to IS 2486 or of a grade or equivalent thereof with Aluminium Sleeves.
- ii) 'D' shackles, clevis 'U' bolts, cotter pins and other components shall be manufactured from drop forged steel conforming to IS 2004 1978 or equivalent thereof.

iii) Bolts, nuts and washers shall be as per IS 1367 and shall be of reputed makes such as GKW, TATA brands etc.

iv) All split pins shall be of stainless steel.

9.06 **INTERCHANGEABILITY:**

All components like design shall be interchangeable.

9.07 **COMPRESSION MARKINGS:**

- i) Die compression areas shall be clearly marked on components which are to be pressure compressed such as Mid-span compression joints and tension hard wares. The marking shall be an etched inscription with the words “COMPRESS FIRST” on components which are meant for continuous die compression. Where components are designed for intermittent die compressions, the compression and non-compression zones shall bear etched inscription such as “COMPRESSION ZONE” and “NON-COMPRESSION ZONE” distinctly with etched arrow signs indicating the direction of compression and knurled marks showing the end of the zones.
- ii) All inscriptions etched on metal shall be distinct, legible and shall not wear out in the course of normal handling.

10.00 **BID DRAWINGS:**

- i) The bidder shall furnish along with the bid the dimensional drawings of all accessories and hardware.
- ii) These drawings shall include the following information.
  - a. Dimensions.
  - b. Tolerances on dimensions.
  - c. Materials designation used for different components with reference to standards.
  - d. Fabrication details such as welds finishes and coatings.

- e. Catalogue or part numbers for each component and the total assembly with bill of materials.
- f. Identification marking.
- g. Weight of individual components and total assembled weight.

iii) The assembly drawings shall include the following:-

- a. Brief installation instructions.
- b. Design installation torque for the bolt or cap screw.
- c. Withstand torque that can be applied to the bolt or cap screw without failure of components or parts thereof.
- d. Compression die number with recommended compression pressure.
- e. Relevant technical details of significance.

## **11.00      TESTS:**

All tests shall be conducted in accordance with I.S.2121-1962 and IS 2486. Tests are divided into groups viz. type tests, sample tests, acceptance tests and routine tests. Details of tests are as follows.

### **11.01      TYPE TESTS:**

Type tests are normally made once and unless otherwise agreed test certificates giving the results of the appropriate type tests made on not less than three fittings identical in all essential details with those to be supplied are regarded as evidence of compliance. All the type test certificates are of within 7 years old as on the date of bid opening conducted in a NABL accredited laboratory shall be furnished along with the Bid.

In addition to the above all the type tests as per the relevant ISS shall be repeated after the award of the contract on the same type and make of hardware/accessory offered for construction. The extra cost for these type tests shall be included in the price schedules.

**NOTE:** The Type Test / Special Tests, if repeated at the insistence of owner, the applicable testing charges shall be paid by the successful Bidder upfront to the laboratory and the same shall be reimbursable by KPTCL as per actuals on submission of Bills along with proof of payment and on successful completion of all the Type Tests, specified and on approval of the same by the owner.



In case equipment/material fails in the type tests during testing then the testing charges paid by the Bidder to the laboratory will not be reimbursed by KPTCL.

The above clause is applicable for all the equipments /materials, in case, the Type Test/Special Tests, are repeated at the insistence of owner (KPTCL).

11.02      SAMPLE TEST:

Sample tests are not applicable when the order is for less than one hundred identical fittings. The number of samples shall be the nearest whole number to one half of one percent of the batch offered for inspection. If these samples meet the test requirements, the batch is deemed to comply with the standard. In the event of a sample not meeting the requirement, twice the original No. of new samples shall be tested. If all these new samples meet the test requirement, the batch is deemed to comply with the standard. But if any fails to do so, the batch is deemed not to comply with the standard.

11.03      ROUTINE TEST :

Those shall be applied to every fittings unless mentioned otherwise to check with the requirements that are likely to vary during production.

11.04      STAGE TESTS

Stage tests during manufacture shall mean those tests required to be carried out during the process of manufacture to ensure quality control such that the end product is of the designed quality conforming to the intent of this specification.

11.05      ACCEPTANCE TESTS

Acceptance tests shall mean those tests which are required to be carried out on samples taken from each lot offered for pre dispatch inspection for purpose of acceptance of that lot.

11.06      NORMS, PROCEDURES FOR SAMPLING AND TEST VALUES

All the norms and procedures for sampling and values for all the tests shall be the values guaranteed by the Bidder in the guaranteed

technical particulars or the acceptance value specified in the relevant standard whichever is more stringent for that particular test.

#### 11.07 TYPE TESTS

The following shall constitute the type tests. The Bidder shall furnish type test certificates for all these tests as per the relevant ISS of recent origin along with the offer. These are in addition to the visual inspection and verification of dimensions which are in common.

##### **a) Mid span compression joint for Conductor and Ground wire**

- i) Slip strength test
- ii) Electrical resistance test
- iii) Heating cycle test
- iv) Corona extinction voltage test
- v). Radio Interference Voltage
- vi) Failing load test
- vii) Galvanizing test

Note: Tests at (iii), (iv) and (v) are not applicable for mid span compression joint for ground wire conductor.

##### **b) Flexible copper Bond**

- i) Slip strength test

##### **c) Vibration damper for conductor and ground wire**

- i) Dynamic characteristics
- ii) Vibration analysis
- iii) Clamp slip test
- iv) Fatigue test
- v) Magnetic power loss test
- vi) Corona extinction voltage test
- vii) Radio interference voltage test
- viii) Galvanizing test
- ix) Determination of weight of zinc coating
- x) Torque test
- xi) Resonance frequency test
- xii) Mass pull off test
- xiii) Damping efficiency test

Note: Tests at (v), (vi) and (vii) above are not applicable to vibration dampers for earth wire conductor.

**d) Spacers / Spacer dampers for power conductor**

- i) Vibration test
- ii) Clamp slip test
- iii) Movement test
- iv) Magnetic power loss test
- v) Short circuit test
- vi) Corona extinction voltage test
- vii) Radio interference test
- viii) Decrement test (for spacer –damper only)
- ix) Galvanizing test
- x) Resilience test
- xi) Clamp bolt torque test
- xii) Assembly torque test
- xiii) Tensile load test
- xiv) Compression and pull off test

**e) Rigid Spacer for Jumper**

- i) Visual Examination & Verification of dimension, Material and mass
- ii) Clamp slip test
- iii) Clamp Bolt tightening test (if applicable)
- iv) Magnetic Power loss test (if applicable)
  - i) Tension-compression Test
  - ii) Corona extinction voltage test (dry)
  - iii) Radio interference voltage test (dry)

**f) Suspension clamp for earth wire**

- i) Slip strength test
- ii) Mechanical test
- iii) Galvanizing test

**g) Tension clamp for earth wire**

- i) Slip strength test
- ii) Minimum failing load test
- iii) Galvanizing test

**h) Tee clamps:**

- i) Failing load test
- ii) Electrical resistance test

11.08 Acceptance Tests :

Following Acceptance tests shall be conducted as per the relevant ISS and any other relevant standards in the presence of the purchaser's representative.

**a) Mid span compression joints and repair sleeves.**

- i) Visual examination.
- ii) Dimensional verification.
- iii) Failing load test.
- iv) Galvanizing test.
- v) Hardness test

**b) Vibration dampers.**

- i) Visual examination.
- ii) Verification of dimensions.
- iii) Resonance frequency test.
- iv) Fatigue test
- v) Mass pull off test
- vi) Galvanizing/ electroplating test.
- vii) Strength of the Messenger cable

**c) Tee clamps: As per the relevant ISS**

**d) Spacer/Spacer damper for power conductor.**

- i) Visual examination.
- ii) Dimensional verification.
- iii) Galvanizing test.
- iv) Movement test  
(Except for spacers of jumpers)
- v) Compressive and tensile test
- vi) Clamp bolt torque test
- vii) Assembly torque test
- viii) Hardness test for neoprene ( if applicable)
- ix) UTS of retaining rod (if applicable)
- x) Clamp Slip test

**e) Flexible copper earth bond**

- i) Visual examination.
- ii) Dimensional verification.

iii) Slip strength test

f) **Suspension Hard-wares for Ground wire**

- i) Visual examination.
- ii) Dimensional verification.
- iii) Mechanical tests
- iv) Galvanizing test

g) **Tension Hardware for Ground wire**

- i) Visual examination.
- ii) Dimensional verification.
- iii) Mechanical tests
- iv) Galvanizing test

**11.09 Routine tests**

All the routine tests shall be conducted as per the relevant latest edition of ISS.

11.10 **Test Reports** Copies of test reports shall be furnished in 4 copies to the purchaser within one month of award of the contract. One copy will be returned duly certified by the Purchaser to the Contractor within three weeks there afterwards and on receipt of the same shall commence with the commercial production of the concerned material.

Four copies of the acceptance test reports shall be furnished to the Purchaser. One copy will be returned, duly certified by the Purchaser and only thereafter shall the materials be dispatched.

All records of routine test reports shall be maintained by the Contractor at his works for periodic inspection by the Purchaser.

All test reports of test conducted during manufacture shall be maintained by the Contractor these shall be produced for verification as and when requested by the Purchaser.

**12.00 SUBMISSION OF DRAWINGS** :Drawings equivalent to the number of consignees plus six extra for each item have to be submitted for approval before commencement of supply. Supplies shall not be commenced before approval of drawing. Non

submission of drawing/receipt of approval shall not be linked with delivery schedule. Delivery schedule should be adhered to.

The drawing shall be complete in all respects. Detailed dimensions shall be furnished in each of the drawings. Full specification of the equipment such as material weight, tensile strength, tolerance, chemical composition etc. shall be incorporated in each drawing.

Any defects noticed in the manufacture of the equipment during inspection or after receipt at destination have to be promptly set right by the contractor free of all cost to the owner.

### **13.00      INSPECTION:**

The owner's representative shall have access to the manufacturer's works for purposes of inspection during the manufacture of the equipment and the manufacturer shall provide all facilities for unrestricted inspection of the contractor's works, raw materials, manufacture of all the accessories and for conducting necessary tests as detailed herein.

The successful Bidder/Contractor shall keep the purchaser informed in advance of the time of starting and of the progress of manufacture of accessories in its various stages so that arrangements could be made for inspection.

No material shall be dispatched from their point of manufacture unless the material has been satisfactorily inspected and tested.

The acceptance of any quantity of accessories shall in no way relieve the successful Bidder/Contractor of his responsibility for meeting all the requirements of this specification, and shall not prevent subsequent rejection, if such accessories or hardware are later found to be defective.

### **14.00      PACKING :**

All accessories and Hardware shall be supplied in strong wooden case all packages shall be marked on the sides as follows:-

- a. Name and Designation of the consignee.
- b. Ultimate destination as required by the owner.

- c. Trade Name if any
  - d. Name of the manufacturer
  - e. Any other information required
- 
- i) The gross weight of the packing shall not normally exceed 200 Kg to avoid handling problems.
  - ii) Suitable cushioning, protective padding, or spacer shall be provided to prevent damage to or deformation of the hardware during transit and handling.
  - iii) All identical items shall be dispatched to destination duly assembled and packed. Bolts, Nuts, Washers, Cotter pins, Security clips and Split pins etc., shall be packed duly installed and assembled with the respective parts and suitable measures shall be taken to prevent their transit loss.
  - iv) Each component part shall be eligibly and indelibly marked with the trade mark of the manufacturer and year of manufacture.
  - v) All packing cases shall be marked legibly and correctly so as to ensure their safe arrival at their destination and to avoid the possibility of goods being lost or wrongly dispatched on account of faulty or illegible markings. Each wooden case/crate shall have all the markings stenciled on it in indelible ink.

## ANNEXURE

### **DIMENSIONS AND DIMENSIONAL TOLERANCE FOR MID SPAN COMPRESSION JOINT AND REPAIR SLEEVES**

Sl. No.	Particulars	Dimensions before compression			Dimensions before compression		
		Inner dia. mm	Outer dia. mm	Length mm	Corner to Corner width mm	Face to Face width mm	Length mm
1.	Mid span compression joint i) Aluminium Sleeve	34 +/-0.5	54 +/-1	735 +/-5	53 +/-0.5	46 +/-0.5	785+/-5
	ii) Steel Sleeve	11.5 +/-0.5	21 +/-0.5	250 +/-5	20.2 +/-0.5	17.5 +/-0.5	285+/-5
2.	Repair Sleeve	34 +/-0.5	54 +/-1	300 +/-5	53 +/-0.5	46 +/-0.5	330+/-5

#### **Shape of Cross Section**

- i) Before compression
- ii) After Compression

#### **Mid Span Joint**

- Round
- Hexagonal

#### **Repair Sleeve**

- Round
- Hexagonal.

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