

Meghalaya Power Transmission Corporation Limited

Bidding Document

For

Re-Conductoring and Strengthening of the 132 KV
Mawlai to Sohra Single Circuit Transmission Line and
132 KV NEHU to Lad Nongkrem to Mustem to
Khliehriat Sub station by ACSR Panther Conductor
and Related Services (Line length 101.452CKM)



(E Tender)

Volume-II

Technical Specifications

BID IDENTIFICATION No:

MePTCL/CE(T)/ACSR /2026

TECHNICAL SPECIFICATION

CONTENTS

SECTION – 1	SCOPE AND GENERAL TECHNICAL CONDITIONS
SECTION – 2	TECHNICAL SPECIFICATIONS OF ACSR PANTHER CONDUCTOR WITH NON-METALLIC SOLID CORE/MULTI STRANDCORE
SECTION – 3	TECHNICAL SPECIFICATIONS OF HARDWARE FITTINGS & OTHER ACCESSORIES
SECTION – 4	TECHNICAL SPECIFICATIONS OF COMPOSITE LONG ROD INSULATORS
SECTION – 5	TECHNICAL SPECIFICATIONS FOR STRINGING ACTIVITIES OF ACSR PANTHER CONDUCTOR
SECTION – 6	TECHNICAL DATA SHEET

SECTION - 1

SCOPE AND GENERAL TECHNICAL CONDITIONS

Table of Contents

1.1.0	INTENT OF THE SPECIFICATION
1.2.0	SCOPE
1.3.0	DETAILS OF TRANSMISSION LINE ROUTES AND TERRAIN
1.4.0	CONTRACTOR TO INFORM HIMSELF FULLY
1.5.0	ACCESS TO THE LINE
1.6.0	BASIC TECHNICAL DATA
1.7.0	DRAWINGS AND DOCUMENTS
1.8.0	QUALITY ASSURANCE AND INSPECTION
1.9.0	TESTS AND STANDARDS
1.10.0	TEST REPORTS
1.11.0	GUARANTEED TECHNICAL PARTICULARS
1.12.0	COMMISSIONING SPARES
1.13.0	CONFORMITY WITH INDIAN ELECTRICITY RULES & OTHER REGULATIONS
1.14.0	CONTRACTOR'S REQUIREMENT

SCOPE AND GENERAL TECHNICAL CONDITIONS

1.1.0 INTENT OF THE SPECIFICATION

1.1.1 This Volume of the specification deals with the information & criteria for design, manufacture, supply, erection, testing and commissioning and setting to work of 132 KV Transmission lines, conductor, insulators, ground wire and accessories and installation of 132 KV Transmission lines as “Turnkey Contract” as defined in Volume 1.

1.2.0 SCOPE

The scope of work include

- (i) De-stringing of ACSR Panther Conductor of the **existing 132 KV Transmission lines**, removing of Hardware fittings, insulators and accessories, loading & unloading and mounting of Insulator String for ACSR Panther Conductor including Laying, Jointing, Tensioning Stringing, sagging and Clamping of Conductor, Fixing of Vibration Dampers, arching Horns etc. in all respects . Except for ACSR Panther conductor, all other equipment, hardware fittings, accessories etc are to be transported to MePTCL stores.
- (ii) Dismantling of existing clamps and connectors from Gantry to Bus bar **connected with** 132 KV Single circuit line from Mawlai Sub Station to 132 KV Sohra Grid Sub Station and **from Gantry to Bus bar connected with** 132 KV Single Circuit from NEHU Sub station to Mawlyndep to Mustem to Khliehriat Sub station, and reconnection with ACSR Panther Conductor. In all the substations – Mawlai, Sohra, NEHU, Mawlyndep, Mustem and Khliehriat, both supply of materials and installation should be complete in all respects.
- (iii) Supply & Stringing of ACSR Panther Conductors, Hardware fittings & Insulators for Re Conductoring and Strengthening of 132 KV Single circuit line from Mawlai Sub station to 132 KV Sohra Grid Sub Station and 132 KV Single Circuit from NEHU Substation to Mawlyndep to Mustem to Khliehriat Substation.

1.2.1 The work involves design (as applicable), engineering, manufacture, assembly, inspection, testing at manufacturer’s works before dispatch, packing, supply, including insurance during transit, delivery at site, subsequent storage, civil work (if any), erection, testing and commissioning at site.

1.2.2 The scope under this Bid covers briefly the following:

- (i) Supply of Conductor, Hardware fittings etc.
- (ii) Stringing of conductor along with all necessary line accessories.
- (iii) Testing & commissioning of the erected transmission lines.
- (iv) Other items not specified in this specification and / or Bid form, price and other schedules but are required for the successful completion, commissioning, efficient operation & reliability of the transmission lines, unless specifically excluded in the specification.

1.2.3 The various items of work **are** described very briefly in the schedule of Bid Form, Prices & Other Schedules. The various items as defined in these schedules shall be read in conjunction with the corresponding Section in the Technical Specifications including Amendments and, additions if any. The Bidder’s rates shall be based on the description of activities in the schedules as well as necessary operations detailed in Technical Specifications.

1.2.4 It is not the intent to specify completely herein, all details of design and construction of the ACSR conductor and accessories, However, the ACSR conductor and accessories shall conform in all

respects to high standards of engineering, design and workmanship and be capable of performing in continuous operation up to the bidder's guarantees in a manner acceptable to the Purchaser, who will interpret the meaning of drawings and specifications, and shall be entitled to reject any work or material which in his judgment is not in full accordance therewith.

- 1.2.5 Whether called for specifically or not, all accessories and work required for the completion of the work are deemed to be considered as a part of the bidder's scope supply, unless and until mentioned very clearly in exclusions.
- 1.2.6 The rates quoted shall include minor details which obviously **are** fairly intended, and which may not have been included in these documents but are essential for the satisfactory completion of the various works.
- 1.2.7 The rates quoted shall be inclusive of all ACSR conductor, men, material, skilled & unskilled labour etc. essential for satisfactory completion of various works.
- 1.2.8 All measurements for payment shall be in SI Units; lengths shall be measured in meters corrected to two decimal places. Areas shall be computed in square meters and volume in cubic meters, rounded off to two decimal places.
- 1.2.9 This specification includes supply of hardware fittings and all type of accessories for Conductor as detailed in the specification. Contractors shall clearly indicate in their offer, the source from where they propose to procure these materials in **the** appropriate Schedule of Bid Form, Prices & other schedules. The technical description of these items is given in subsequent Sections of this Volume.
- 1.2.10 All raw materials such as, line hardware etc. bolts, nuts, washers, etc. required for stringing shall be included in the contractor's scope of supply. Bidders shall clearly indicate in their offer, the source from where they propose to procure the raw materials and the components.
- 1.2.11 The tentative Schedule of Quantities are furnished in Bill of Quantity (BOQ) at the online portal. Bidders are requested to note the following points: (a) The items mentioned in these Annexure shall only be used while preparing the Price Schedules. If **there are** any items which **are** not specifically mentioned in Bill of Quantity (BOQ) but **are** required to complete the works as per Specification, **the same** shall deemed to be included in any of the items of these Annexure. Additions, deletions or modification of these items while preparing the Price Bid by the Bidder shall render his bid non responsive. (b) The quantities are provisional in nature and for bidding purpose and for bid comparison purpose only. Quantities may vary to the extent of **(+) 15 % to (-) 15%** in terms of total Contract Price.
- 1.2.12 The quantities mentioned in Schedule-I are based on the survey made by the Employer. It is expected that the Contractor will further optimize the requirement **of** towers and tower foundations based on the Detailed and Check Survey made by the Contractor.
- 1.3.0 **DETAILS OF TRANSMISSION LINE ROUTES AND TERRAIN**
- 1.3.1 The route alignment **that** has been carried out by the employer will be provided to the successful Bidder.
- 1.3.2 Bidders may visit the line route to acquaint themselves with the terrain etc., of the proposed transmission lines. For this purpose, they are requested to contact the following address: The Chief Engineer (Transmission), Meghalaya Power Transmission Corporation Limited, Lumjingshai, Shillong-793001.

1.4.0 CONTRACTOR TO INFORM HIMSELF FULLY

1.4.1 The contractor should ensure that he has examined the General Conditions, Specifications and Schedules as brought out in Volume-1 and has satisfied himself as to all the conditions and circumstances affecting the contract price and fixed his price according to his own views on these matters, and acknowledge that no additional allowances, except as otherwise provided therein, will be levied.

1.4.2 The Employer shall not be responsible for any misunderstanding or incorrect information obtained by the contractor other than information given to the contractor in writing by the Employer.

1.5.0 ACCESS TO THE LINE

1.5.1 It is the responsibility of the turnkey contractor to ensure clearing of all obstacles along the right of way of the transmission line routes, like cutting of trees, jungles etc.

1.6.0 BASIC TECHNICAL DATA

1.6.1 Service Conditions:

The lines covered under this contract are to run entirely in the State of Meghalaya, India and shall be suitable for the tropical climatic conditions prevailing in the area as listed below.

a)	Peak ambient day temperature in still air			40°C
b)	Minimum night temperatures			0°C
c)	Reference ambient day temperature			40°C
d)	Relative Humidity	a)	Maximum -	100%
		b)	Minimum	10%
e)	Altitude	1000 M above MSL		
f)	Maximum wind pressure:	As per IS: 802 latest code (Zone-5)		
g)	Other Data:	Refer Meteorological data pertaining to the location		

1.6.2 Basic System Data

Sl No	Description	
1	Nominal system voltage KV rms	132 kV
2	Highest system voltage KV rms	145 kV
3	System of grounding	Solidly Grounded
4	Impulse insulation level KV peak	650
5	Power frequency withstand voltage (wet) KV rms	275
6	Protective shielding angle against direct lightning	NOT EXCEEDING 30°
7	Creepage Distance	31 mm/KV
8	Minimum Corona extinction voltage at 50Hz AC system Dry condition (phase to earth)	Not less than 154 KV
10	Insulator String Hardware	i. Anchor Shackle / D-Shackle ii. Ball Hook / Ball Eye iii. Socket Eye / Socket Clevis

		iv. Ball Clevis / Clevis Eye v. Chain link vi. Yoke plate vii. Arcing horn holding plate viii. Arcing horns ix. Free centre type/ armour grip suspension clamp for suspension strings x. Envelope (Trunnion) Type Suspension Clamp xi. Compression Tension Clamp (Dead-End Assembly) xii. Balancing weight
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Item	Particulars	Data
1 . ACSR CONDUCTOR DATA	(i) Material	Aluminium and Steel
	(ii) Overall diameter of Conductor	21 mm
	(iii) Nominal mass of conductor	≤ 974 kg/Km
	(iv) Minimum Breaking load of strand	As per IS and other applicable international standards
	(v) Co-efficient of linear expansion	
	(vi) Number of conductor per phase	
	(vii) Ultimate tensile strength	
	(viii) Modulus of elasticity	
2. INSULATORS	(i) Type	As per supply schedule
	(ii) Size of disc	As per supply schedule
	(iii) Composite insulator	90 KN 120KN
	(a) Suspension (b) Tension	
	(iv) Electro-mechanical strength	90 kN 120 kN
	(a) Suspension (b) Tension	
	(v) Minimum creepage distance	320 mm

1.7.0 DRAWINGS AND DOCUMENTS

1.7.1 In addition to those stipulated in clause regarding drawings in Volume -1, the following also shall apply in respect of Contractor Drawings.

1.7.2 Each drawing submitted by the Contractor for approval of the Employer shall be clearly marked with the name of the Employer, the specification title, the specification number and the name of the Project. All titles, noting, markings and writings on the drawing shall be in English. All the dimensions should be to the scale and in S.I. units.

- 1.7.3 The approval of the documents and drawings by the Employer shall mean that the Employer is satisfied that:
- a) The Contractor has completed the part of the Works covered by the subject document (i.e. confirmation of progress of work).
 - b) The Works appear to comply with requirements of Specifications. In no case the approval by the Employer of any document **will** imply compliance with neither all technical requirements nor the absence of errors in such documents. If errors are discovered any time during the validity of the contract, then the Contractor shall be responsible of their consequences.
- 1.7.6 All Designs / Drawings / Calculations/ Data submitted by the contractor from time to time shall become the property of the Employer, and the Employer has the right to use or replicate such designs for future contracts / works without the permission of the Contractor. The Employer has all rights to use/ offer above designs/drawings/data sheets to any other authority without prior Permission of the Contractor.
- 1.8.0 **QUALITY ASSURANCE AND INSPECTION**
- 1.8.1 Quality Assurance: To ensure that the supply and services under the scope of this Contract, whether manufactured or performed within the Contractor's works or at site or at any other place of where work, are in accordance with the specifications, the Contractor shall adopt suitable quality assurance program to control such activities at all points necessary. Such program shall be outlined by the Contractor and shall be finally accepted by the Employer after discussions before the award of Contract. A quality assurance program of the Contractor shall generally cover but not limited to the following:
- The Quality plan shall be mutually discussed and approved by the Employer after incorporating necessary corrections by the Contractor as may be required.
- 1.8.2 Quality Assurance: Documents
- The Contractor shall be required to submit all the Quality Assurance Documents as stipulated in the Quality Plan at the time of Employer's inspection of equipment/material. The Employer or his duly authorized representatives reserves the right to carry out Quality Audit and Quality Surveillance of the systems and procedures of the Contractors/his vendors, Quality Management and Control Activities.
- 1.9.0 **TESTS AND STANDARDS**
- 1.9.1 The type, acceptance and routine tests and tests during manufacture shall be carried out on the material and shall mean as follows:
- a) Type Tests shall mean those tests, which are to be carried out to prove the process of manufacture and general conformity of the material to this Specification. These tests shall be carried out on samples prior to Commencement of commercial production against the order. The Bidder shall indicate his schedule for carrying out these tests.
 - b) Acceptance Tests shall mean those tests, which are to be carried out on samples taken from each lot offered for pre-dispatch inspection, for the purposes of acceptance of that lot.
 - c) Routine Tests shall mean those tests, which are to be carried out on the material to check requirements, which are likely to vary during production.

- d) Tests During Manufacture shall mean those tests, which are to be carried out during the process of manufacture and end inspection by the Contractor to ensure the desired quality of the end product to be supplied by him.
- e) The norms and procedure of sampling for these tests will be as per the Quality Assurance Program to be mutually agreed to by the Contractor and the Employer.
- f) For all type and acceptance tests, the acceptance values shall be the values specified in this Specification or guaranteed by the Bidder, as applicable.

1.10.0 **TEST REPORTS**

- 1.10.1 Copies of acceptance test reports shall be furnished in at least four (4) copies along with one original. After approval of Test Certificates by the Purchaser, only the material will be dispatched.
- 1.10.2 Record of routine test reports shall be maintained by the Bidder at his works for periodic inspection by the Purchaser's representative.
- 1.10.3 Test Certificates of tests conducted during manufacture shall be maintained by the Bidder. These shall be produced for verification as and when desired by the Purchaser.
- 1.10.4 Type Test Reports older than 10 (ten) years on the date of Technical Bid opening shall not be accepted.

1.11.0 **GUARANTEED TECHNICAL PARTICULARS**

- 1.11.1 The Guaranteed Technical Particulars as per relevant IS or IEC latest standards as applicable of the various items shall be furnished by the Bidders with Technical Bid in the prescribed schedules of the Specifications. The Bidder shall also furnish any other information as in their opinion is needed to give full description and details to judge the item(s) offered by them.
- 1.11.2 The data furnished in Guaranteed Technical Particulars should be the minimum or maximum value (as per the requirement of the specification) required. A Bidder may guarantee a value more stringent than the specification requirement. However, for testing purpose or from performance point of view, the material shall be considered performed successfully if it achieves the minimum/maximum value required as per the technical specification. No preference what so ever shall be given to the bidder offering better/more stringent values than those required as per specification except **wherever** stated otherwise.

1.12.0 **COMMISSIONING SPARES**

- 1.12.1 It will be the responsibility of the Contractor to provide all commissioning spares required for initial operation till the Employer declares the equipment as ready for commissioning. All commissioning spares shall be deemed to be included in the scope of the Contract at no extra cost to the Employer.

1.13.0 **CONFORMITY WITH INDIAN ELECTRICITY RULES & OTHER REGULATIONS**

- 1.13.1 The contractor shall note that all overhead power lines shall comply with the latest provisions of Indian Electricity Rules and with any other Regulations **and Standards**. Local authorities concerned in the administration of the rules and regulation relating to the power lines shall be consulted, if necessary, in regard to the rules and regulations that may be applicable. Highway department and aerodrome authorities shall also be consulted whenever power lines run near or across the area under their jurisdiction.

1.14.0 **CONTRACTOR'S REQUIREMENT**

- 1.14.1 The Contractor should be in possession of a valid E.H.V. Electrical License and Electrical Supervisory Licence issued by the Senior Electrical Inspector, as per the provision of Law. An attested copy of the aforementioned License must be handed over to the Owner for his record prior to handing/ taking over of sites. The Employer/ his representative will give necessary assistance to the contractor in obtaining license from statutory authorities.
- 1.14.2 All the works shall also be inspected by the Senior Electrical Inspector, Govt. of Meghalaya or his authorized representatives. It is the responsibility of the Contractor to obtain pre-requisite commissioning clearance of any equipment from the said Inspectorate. The Contractor will pay necessary fees to the Inspectorate, which it may levy.
- 1.14.3 It is obligatory on the part of contractor to obtain prior approval from the Employer regarding the guaranteed technical particulars of all the equipment/material ordered from the vendors before effecting purchase.
- 1.14.4 The Contractor shall provide necessary drawings and documents required by statutory authorities and obtain the approval before taking up Re stringing work The Employer/ his representative will give technical assistance to the contractor in obtaining approval from statutory authorities

Section - 2

Technical Specifications of ACSR PANTHER Conductor

Table of Contents

S. No	Description
2.1	Scope
2.2	Service Conditions
2.3	Type Test Reports
2.4	Guaranteed Technical Particulars
2.5	Technical Specification of ACSR PANTHER Conductor
2.6	Supervision in Stringing
2.7	Tests and Standards
2.8	Packing
2.9	Marking
2.10	Verification on Standard Length
2.11	Standards

ANNEXURE –A Tests on Conductors

Section -2

Technical Specifications on ACSR Panther

2.1 SCOPE

2.1.1 The brief description of scope of work covered under this Bidding Document is furnished below:
Design, manufacture, testing at manufacturer's works, supply, and erection of ACSR Panther Conductor.

- a) Design, Manufacture, testing at manufacturer's works, supply and erection of Insulators, Hardware Fittings and other line accessories suitable for ACSR Panther conductor.
- c) The installation & stringing of the offered ACSR Panther conductor for the above transmission line shall be carried out by the experience transmission line contractor under supervision of the Conductor supplier as per Appendix v to ITB 2.

2.1.2 It is also responsibility of the Contractor to obtain any road permits and any other permits or licenses to execute the works.

2.2 SERVICE CONDITIONS

2.2.1 The materials and accessories supplied shall be suitable for operation under the following climatic and other conditions:

- a. Peak ambient day temperature in still air: 40°C
- b. Minimum night temperatures: 0°C
- c. Reference ambient day temperature: 40°C
- d. Relative Humidity a) Maximum b) Minimum: 100 %: 10%
- e. Altitude: 1000 m above MSL f. Isokeraunic level: 100/Year
- g. Maximum wind pressure: As per IS: 802 latest code.
- h. Seismic Intensity: ZONE-V as per IS 1893.
- i. Wind Velocity: 50 m/sec

2.3 TYPE TEST REPORTS

2.3.1 ACSR Panther conductors and related Hardware fittings which have never been tested for critical performance shall not be accepted.

2.3.2 Type test acceptance and routine tests and tests during manufacture, shall be carried out on the conductor as per the IS-398 (Part-II) of 2025

2.3.3 Test reports to be acceptable must be related directly to the materials offered.

2.3.4 Type Test Reports older than ten (10) years on the date of Technical bid opening shall not be accepted.

2.4 GUARANTEED TECHNICAL PARTICULARS.

2.4.1 The Guaranteed Technical Particulars of the various items shall be furnished by the Bidders in the prescribed Schedules of the Section-5 with the Technical Bid. The Bidder shall also furnish any other information's as in their opinion is needed to give full description and details to judge the item(s) offered by them.

2.4.2 The data furnished in Guaranteed Technical Particulars should be the minimum or maximum value (as per the requirement of the specification) required. A Bidder may guarantee a value more stringent than the specification requirement. However, for testing purpose or from performance point of view, the material shall be considered performed successfully if it achieves the minimum/maximum value required as per the technical specification. No preference what so ever shall be given to the bidder offering better/more stringent values than those required as per specification except **wherever** stated otherwise.

2.5 TECHNICAL SPECIFICATION OF ACSR Panther Conductor

2.5.1 GENERAL REQUIREMENTS

The offered ACSR Panther Conductor shall be capable of providing the specified maximum ampacity of 578 A at an ambient temperature of 45°C

The physical and operating performance requirements of the transmission line with type ACSR Panther conductor are mentioned below. The bidder shall offer ACSR Panther conductor complying with the specified requirements. The Bidder shall indicate particulars of the proposed conductor in the relevant GTP schedule of BPS along with calculations to establish compliance with the specified requirements.

2.5.2 The ACSR Panther conductor shall be suitable to carry minimum specified 50 Hz alternating current 578 Amperes of 50 Hz alternating current under ambient temperature of 45°C & maximum conductor sag specified below while satisfying other specified technical requirements/ parameters as mentioned in the Service condition above.

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2.5.4 Technical Particulars of ACSR Panther Conductor

The ACSR PANTHER conductor shall meet the following minimum requirements:

Overall diameter of complete conductor	21 mm
Nominal mass of complete conductor (kg/km)	Less than or equal to 974 kg/km +/- 5%
Direction of lay of outer layer	Right Hand

The bidder shall indicate the technical particulars and details of the construction of the conductor in the relevant schedule of GTP. The bidder shall also guarantee the DC resistance of conductor at 20 deg C and AC resistance at the calculated temperature corresponding to 50Hz alternating current flow of 578 amperes at specified ambient conditions (maximum continuous operating temperature).

2.5.5 Workmanship:

All the conductor strands shall be smooth, uniform and free from all imperfections, such as spills and splits, cracks, die marks, scratches, abrasions, rust etc.

The finished conductor shall be smooth, compact, uniform and free from all imperfections including kinks (protrusion of wires), wire cross over, over riding, looseness (wire being dislocated by finger/hand pressure and/or unusual bangle noise on tapping), material inclusions, white rust, powder formation or black spot (on account of reaction with trapped rain water etc.), dirt, grit etc.

2.5.6 Joints in Wires

2.5.6.1 Aluminum OR Aluminum Alloy Wires during stranding no Aluminum/ aluminum Alloy welds shall be made for the purpose of achieving the required conductor length.

2.5.6.2 For ACSR PANTHER Conductor there shall be no joint of any kind.

2.5.6.3 Materials used for construction of the conductor shall be such that the conductor meets the specified technical and performance requirements.

2.5.6.4 Standard Length

The standard length of the conductor shall be indicated by the bidder in the guaranteed technical particulars of offer. A tolerance of +/-5% on the standard length offered by the Bidder shall be

permitted. However, during execution cut lengths shall be acceptable matching with Tower Schedule.

2.6 **Supervision in Stringing**

2.6.1 The installation & stringing of the offered ACSR PANTHER conductor for the above transmission line shall be carried out by the Qualified Bidder himself. Bidder's responsibility is to provide Sag-Tension chart based on existing site conditions. It may be noted that MePTCL will not consider any modifications (tower extensions etc) on existing tower/span.

2.6.2 The circuit on which the existing ACSR Panther is strung shall be kept under charged condition during the execution. The installation & stringing of the offered ACSR PANTHER conductor for the above transmission line shall be carried out by the Qualified Bidder himself shall string the circuit with the ACSR PANTHER conductor section by section and restore the line in original conditions as per program finalized in co-ordination with site. The bidder's engineers are to supervise whether appropriate safety measures along with necessary safety tools and equipment's to carry out stringing operations under the above conditions including mechanical/ structural safety of the towers, are maintained or not.

2.6.3 Necessary calculations shall be carried out by the bidder to ensure that by replacing the existing ACSR PANTHER conductor with the new ACSR PANTHER conductor, the loadings on the towers due to conductor tensions as well as loads on account of the re-conductoring activities shall be within specified limits. These calculations shall be submitted by the bidder along with bid.

2.6.4 The Bidder should deploy stringing/ installation experts during erection of the offered ACSR PANTHER conductor.

2.7 **Tests and Standards**

2.7.1 Type Tests

All the tests mentioned below shall be conducted on ACSR Conductor as per IS: 398 (Part-II) 1996 with latest Amendment.

Type Tests on Stranded Conductor/ Stranded wire: The following tests shall be conducted once on sample/samples of conductor from each manufacturing facility:

Sl no	Particulars of Test	Clause No.
1	Measurement of diameter of individual Aluminium and Steel Wires	13.2 of IS- 398 (Part-II)
2	Measurement of Lay Ratio/ Direction of Lay	13.8
4	Ductility Test (Torsion/ Elongation)	13.4
5	Wrapping Test (Aluminum and Steel)	13.5
6	. Resistance Test	13.6
7	Galvanizing Test (Uniformity of Galvanizing and Mass of coating	13.7
8	Surface Condition Test	13.9
9	Test for Ultimate Breaking Load on	13.10

	Stranded Conductor	
10	Stress Strain Test	13.11

The Type Tests are to be carried out within last 10(ten) years from the due date of submission of tender and the reports of Type Test successfully carried out for the respective item from Govt. approved/ NABL accredited laboratory shall be furnished by the bidder along with their offer. The Type Test Reports shall bear Logo of NABL accreditation.

The test reports of Routine/ Acceptance tests and checking of length etc. as specified in Clause no 13 shall be signed jointly by the supplier's representative and MePTCL representative.

In the event of any discrepancy in the test report (i.e., any test report not applicable due to any design/ material/manufacturing process change including substitution of components or due to non-compliance with the requirement stipulated in the Technical Specification) the tests shall be conducted by the Contractor at no extra cost to the Employer/ Employer/ Employer.

2.7.2 Acceptance Tests:

Acceptance Tests shall mean those tests, which are to be carried out on samples taken from each lot offered for pre-despatch inspection, for the purposes of acceptance of that lot.

a)	Visual and dimensional check on drum	IS:398 (Part II) 2025
b)	Visual check for joints scratches etc. and length measurement of conductor by rewinding	IS:398 (Part II) 2025
c)	Dimensional check on core strands and Aluminium or Aluminium Alloy strands	IS:398 (Part II) 2025
d)	Check for lay-ratios of various layers	IS-398 (Part-II) 2025
e)	Galvanising test on steel strands	
f)	Torsion and elongation test on steel strands	
g)	Breaking load test on steel and Aluminium strands.	
h)	Wrap test on steel and Aluminium strands.	
i)	DC resistance test on Aluminium strands	As per this specification
j)	UTS test on welded joint of Aluminium strand	

2.7.3 Routine Test

a)	Check to ensure that the joints are as per Specification
b)	Check that there are no cuts, fins etc., on the strands.
c)	Check that drums are as per Specification

2.7.4 Tests during Manufacture

a)	Chemical analysis of zinc used for galvanizing	IS:398 (Part II) 2025
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b)	Chemical analysis of Aluminium alloy used for making Aluminium Alloy strands	
c)	Chemical analysis of Steel used making Steel strands	

No type test charges shall be payable to the supplier.

The entire cost of testing for the acceptance and routine tests and Tests during manufacture as well as type tests, if required, specified herein shall be treated as included in the quoted unit price of conductor, including the expenses of the inspector/Employer's representative.

The Supplier shall intimate the Employer about carrying out of the type tests along with detailed testing program at least 2 weeks in advance of the schedule date of testing during which the Employer will arrange to depute his representative to be present at the time of carrying out the tests and expenditure incurred thereof for travel and accommodation is to be borne by the selected Bidder.

In case of failure in any of the type test/s, the supplier is either required to modify the design of the material or repeat the particular type test three times successfully at his own expense. The decision of the MePTCL in this regard shall be final and binding. The MePTCL at its own discretion may also cancel the order at the risk and cost of the supplier if the material fails twice in the Type test.

2.7.5 Test Reports

Record of routine test reports shall be maintained by the Supplier at his works for periodic inspection by the Employer's representative. Test Certificates of tests during manufacture shall be maintained by the Supplier. These shall be produced for verification as and when desired by the Employer.

2.7.5 Inspection

The Employer's representative shall at all times be entitled to have access to the works and all places of manufacture, where conductor shall be manufactured and representative shall have full facilities for unrestricted inspection of the Supplier's works, raw materials and process of manufacture for conducting necessary tests as detailed herein.

The Supplier shall keep the Employer informed in advance of the time of starting and of the progress of manufacture of conductor in its various stages so that arrangements can be made for inspection.

No material shall be dispatched from its point of manufacture before it has been satisfactorily inspected and tested, unless the inspection is waived off by the Employer in writing. In the latter case also the conductor shall be dispatched only after satisfactory testing for all tests specified herein have been completed.

The acceptance of any quantity of material shall in no way relieve the Supplier of any of his responsibilities for meeting all requirements of the Specification, and shall not prevent subsequent rejection if such material is later found to be defective.

2.7.6 Test Facilities

The following additional test facilities shall be available at the Supplier's works:

- a) Calibration of various testing and measuring equipment including tensile testing machine, resistance measurement facilities, burette, thermometer, barometer etc.
- b) Standard resistance for calibration of resistance bridges.
- c) Finished conductor shall be checked for length verification and surface finish on separate rewinding machine at reduced speed (variable from 8 to 16 meters per minute). The rewinding facilities shall have appropriate clutch system and free of vibrations, jerks etc. with traverse laying facilities.

2.8 **Packing**

The conductor shall be supplied in non-returnable, strong, wooden/painted steel/hybrid (painted steel cum wood) drums provided with lagging of adequate strength, constructed to protect the conductor against all damage and displacement during transit, storage and subsequent handling and stringing operations in the field. The Supplier shall select suitable drums for supply of conductor and shall be responsible for any loss or damage to conductor and/or drum during transportation handling and storage due to improper selection of drum or packing.

The Bidder should submit their proposed drum drawings along with the Bid.

- a One conductor length only shall be wound on each drum.
- b The conductor ends shall be properly sealed and secured on the side of one of the flanges to avoid loosening of the conductor layers during transit and handling.

2.9 **Marking**

Each drum shall have the following information stenciled on it in indelible ink along with other essential data:

- a) Contract/Award letter number.
- b) Name and address of consignee.
- c) Manufacturer's name and address.
- d) Drum number
- e) Size of conductor
- f) Length of conductor in meters
- g) Arrow marking for unwinding
- h) Position of the conductor ends
- i) Distance between outer-most Layer of conductor and the inner surface of lagging.
- j) Barrel diameter at three locations & an arrow marking at the location of the measurement.
- k) Number of turns in the outer most layer.
- l) Gross weight of drum after putting lagging.
- m) Tear weight of the drum without lagging.
- n) Net weight of the conductor in the drum.

The above should be indicated in the packing list also.

2.10 **Verification of Standard Length**

The Employer reserves the right to verify the length of conductor after unreeling at least ten (10) percent of the drums in a lot offered for inspection.

2.11 **Standards**

The conductor shall conform to the following Indian/International Standards, which shall mean latest revisions, with amendments/changes adopted and published, unless specifically stated otherwise in the Specification.

In the event of the supply of conductor conforming to standards other than specified, the Bidder shall confirm in his bid that these standards are equivalent to those specified. In case of award, salient features of comparison between the standards proposed by the Supplier and those specified in this document will be provided by the Supplier to establish their equivalence.

Sl No	Indian Standard	Title	International Standard
1	IS: 209-1992	Specification for zinc	BS:3436-1986
2	IS: 398 (part I to V) As relevant	Specification for Aluminium Conductors for Overhead Transmission Purposes	IEC:1089-1991 BS:215-1970
3	IS: 398 (part I to V) As relevant	Aluminum Conductor Galvanised Steel Reinforced	BS:215-1970 IEC:1089-1991
4	IS: 398 (part I to V) As relevant	Aluminum Conductor Galvanised Steel Reinforced For Extra High Voltage (132 KV) and above	IEC:1089-1991 BS:215-1970
5	IS : 1778-1980	Reels and Drums for Bare Conductors	BS:1559-1949
6	IS : 1521-1991	Method of Tensile Testing of Steel Wire	ISO 6892-1984
7	IS : 2629-1990	Recommended Practice for Hot Dip Galvanising of Iron and Steel	
8	IS : 2633-1992	Method of Testing Uniformity of Coating on Zinc Coated Articles	
9	IS : 4826-1992	Galvanised Coating on Round Steel Wires	IEC : 888- 1987 BS:443- 1969
10	IS : 6745-1990	Methods of Determination of Weight of Zinc Coating of Zinc Coated Iron and Steel Articles	BS:433-1969 ISO 1460 – 1973
11	IS : 8263-1990	Method of Radio Interference Tests on High Voltage Insulators	IEC:437-1973 NEMA:107-1964 CISPR
12	IS : 9997-1988	Alloy Redraw Rods	IEC 104 – 1987
13		Zinc Coated steel wires for stranded Conductors	IEC : 888-1987
14		Hard drawn Aluminium wire for overhead line conductors	IEC : 889-1987
15	IS:398 (Part-IV)	Aluminium Alloy stranded conductor	IEC : 208-1966 BS-3242-1970
16		Aluminium clad steel wires	IEC:1232

ANNEXURE –A

Tests on Conductors

Tests on ACSR PANTHER Conductor

1.1 Ultimate Tensile Strength Test on Stranded Conductor

Circles perpendicular to the axis of the conductor shall be marked at two places on a sample of conductor of minimum 5 m length between fixing arrangement suitably fixed by appropriate fittings on a tensile testing machine. The load shall be increased at a steady rate upto 50% of minimum specified UTS and held for one minute. The circles drawn shall not be distorted due to relative movement of strands. Thereafter the load shall be increased at steady rate to minimum UTS and held for one minute. The Conductor sample shall not fail during this period. The applied load shall then be increased until the failing load is reached and the value recorded.

1.2 Surface Condition Test

A sample of the finished conductor for use in 400/220 / 132/ 66 KV system having a minimum recommended length of 5 meters with compression type dead end clamps compressed on both ends in such a manner as to permit the conductor to take its normal straight line shape, shall be subjected to a tension of 50 percent of the UTS of the conductor. The surface shall not depart from its cylindrical shape nor shall the strands move relative to each other so as to get out of place or disturb the longitudinal smoothness of conductor. The measured diameter at any place shall be not be less than the sum of the minimum specified diameters of the individual aluminum and steel strands as given in this specification.

1.3 D.C. Resistance Test on Stranded Conductor

On a conductor sample of minimum 5m length two contact-clamps shall be fixed with a predetermined bolt torque. The resistance shall be measured by a Kelvin double bridge or using micro ohm meter of suitable accuracy by placing the clamps initially zero meter and subsequently one meter apart. The test shall be repeated at least five times and the average value recorded. The value obtained shall be corrected to the value at 20° C as per IS:398- (Part- IV)/(Part-V). The resistance corrected at 20° C shall conform to the requirements of this Specification.

1.4 Stress-strain test

This test is contemplated to collect the creep data of the conductor from the Bidder. A sample of conductor of minimum 10 meters length shall be suitably compressed with dead end clamps.

1.5 Test Set Up

- 1.5.1 The test sample shall be supported in a through over its full length and the through shall be adjusted such that the conductor does not get lifted by more than 10mm under tension. This shall be ascertained by actual measurement.
- 1.5.2 The distance between the clamp and the sleeve mouth shall be monitored with calipers during the test to ensure that after the test, it does change by more than +/- 0.1 mm from the value before the test.
- 1.5.3 The conductor strain shall be evaluated from the measured displacements at the two ends of the gauge length of the sample. The gauge reference targets shall be attached to the clamps which lock the steel and aluminum wires together. Target plates may be used with dial gauges on displacement transducers and care shall be taken to position the plates perpendicular to the conductor. Twisting

the conductor, lifting it and moving it from side-to side by the maximum amounts expected during the test should introduce no more than 0.3 mm error in the reading.

1.6 Test Load for complete Conductor

The loading conditions for repeated stress-strain tests for complete conductor shall be as follows:

- 1.6.1 1 KN load shall be applied initially to straighten the conductor. The load shall be removed after straightening and then strain gauges are to be set at zero at the zero tension.
- 1.6.2 For non-continuous stress-strain data, the strain readings at 1 KN intervals at lower tension and 5 KN intervals above 30% of UTS shall be recorded.
- 1.6.3 The sample shall be reloaded to 50% of UTS and held for 1 hour. Readings are to be noted after 5, 10, 15, 30, 45 and 60 Minutes. The load shall then be released.
- 1.6.4 Reloading up to 70% of UTS shall be done and held for 1 hour. Readings are to be noted after 5,10,15,30,45 and 60 minutes and then load shall be released.
- 1.6.5 Reloading up to 85% of UTS shall be done and held for 1 hour. Readings are to be noted after 5,10,15,30,45 and 60 minutes and then load shall be released.
- 1.6.6 Tension shall be applied again and shall be increased uniformly until the actual breaking strength is reached. Simultaneous readings of tension and elongation shall be recorded up to 90% of UTS at the intervals described.

1.7 Test Load For Steel Core only

The loading conditions for repeated stress-strain tests for Steel core of conductor shall be as follows:

- 1.7.1 The test shall consist of successive application of load applied in a manner similar to that for one complete conductor at 30%, 50%, 70% and 85% of UTS.
- 1.7.2 The steel core shall be loaded until the elongation at the beginning of each hold period corresponds to that obtained on the complete conductor at 30%, 50%, 70% and 85% of UTS respectively.

1.7 Chemical Analysis of Zinc

Samples taken from the zinc ingots shall be chemically / spectrographically analysed. The same shall be in conformity to the requirements stated in this specification.

1.8 Chemical Analysis of Aluminium and Steel

Samples taken from the Aluminium ingots/coils/strands shall be chemically / spectrographically analysed. The same shall be in conformity to the requirements stated in this specification.

1.9 Visual and Dimensional Check on Drums

The drums shall be visually and dimensionally checked to ensure that they conform to the approved drawings.

1.10 Visual Check for Joints, Scratches etc.

Conductor drums shall be rewound in the presence of the Employer. The Employer shall visually check for scratches, joints etc. and that the conductor generally conform to the requirements of this Specification. Ten percent (10%) drums from each lot shall be rewound in the presence of the Employer's representative.

1.20 Dimensional Check on Aluminium and Steel strands

The individual strands shall be dimensionally checked to ensure that they conform to the requirement of this Specification.

1.21 Check for Lay-ratios of Various Layers

The lay-ratios of various layers shall be checked to ensure that they conform to the guaranteed values furnished by the Contractor.

1.22 Galvanizing Test

The test procedure shall be as specified in IS. The material shall conform to the requirements of this Specification. The adherence of zinc shall be checked by wrapping around a mandrel four times the diameter of steel wire.

1.23 Breaking load test on Welded Aluminium Strand

Two Aluminum wire shall be welded as per the approved quality plan and shall be subjected to tensile load. The welded point of the wire shall be able to withstand the minimum breaking load of the individual strand.

1.24 Torsion and Elongation Tests on Steel

The test procedures shall be as per the relevant IS In torsion test, the number of complete twists before fracture shall not be less than 18 on a length equal to 100 times the standard diameter of the strand. In case test sample length is less or more than 100 times the standard diameter of the strand, the minimum number of twist will be proportionate to the length and if number comes in the fraction then it will be rounded off to next higher whole number. In elongation test, the elongation of the strand shall not be less than 4% for a gauge length of 200 mm.

SECTION - 3

TECHNICAL SPECIFICATIONS OF HARDWARE FITTINGS & OTHER ACCESSORIES

Contents

Sr. No.	Description
3.1	General
3.2	Hardware Fittings
3.3	Clamps Fittings
3.4	Dimensions of Insulator String Along with Hardware Fitting
3.5	Interchangeability
3.6	Maintenance
3.7	Designation
3.8	Security Clips and Split Pins
3.9	Arcing Horn
3.10	Yoke Plates
3.11	Suspension Assembly
3.12	Free Centre Type Suspension Clamp
3.13	Standard Preformed Armour Rod Set.
3.14	Armour Grip Suspension Clamp
3.15	Envelope Type Suspension Clamp
3.16	Dead end Assembly
3.17	Fasteners: Bolts, Nuts and Washers
3.18	Materials
3.19	Workmanship
3.20	Bid Drawings
3.21	Accessories for the ACSR PANTHER Conductor
3.22	Mid Span Compression Joint
3.23	Repair Sleeve
3.23	Vibration Damper
3.25	Material and Workmanship
3.26	Compression Markings
3.27	Bid Drawings
3.28	Test & Standards
3.29	Acceptance Test
3.30	Routine Test
3.31	Testing Expenses
3.32	Schedule of Testing and Additional Tests
3.33	Test Reports
3.34	Inspection
3.35	Packing and Marking
3.36	Standard
	Annexure-A Annexure-B

- xiii. Anchor shackle
 - xiv. Chain link
 - xv. Yoke plate
 - xvi. Ball clevis
 - xvii. Arcing horn holding plate
 - xviii. Socket clevis
 - xix. Arcing horns
 - xx. Clevis eye
 - xxi. Free centre type/armour grip suspension clamp for suspension strings
 - xxii. Compression type dead end clamp
- Balancing weight

SECTION – 3

TECHNICAL SPECIFICATIONS OF HARDWARE FITTINGS & OTHER ACCESSORIES

Technical Description of Hardware Fittings

3.1 **General**

This section details technical particulars of hardware fittings and suspension clamps & compression type dead end clamps for the ACSR PANTHER Conductor to be proposed and supplied for replacement of panther conductor by the bidder. Each fitting shall be supplied complete in all respects.

3.2 **Hardware Fittings**

The hardware fittings shall be suitable for use with composite insulators having ball and socket fittings. Each hardware fitting shall be supplied complete in all respects and shall include the following hardware parts:

- 3.2.1 Suitable arcing horn as specified in clause 3.9 hereinafter.
- 3.2.2 Suitable yoke plates complying with the specifications given hereinafter.
- 3.2.3 Corona control rings/grading ring with fittings for attachment to line side yoke plate.
- 3.2.4 Suspension and dead-end assembly to suit conductor size as detailed in clause 3.15 and 3.16 hereinafter.
- 3.2.5 Other necessary fittings viz D-shackles, eye links, extension links, ball clevis, socket clevis, clevis eye, U clevis and chain link etc. to make the hardware fittings complete.

3.3 **Clamps Fittings**

The Clamps fittings shall be suitable for attachment to suspension and tension insulator strings along with hardware fittings for normal stretches as well as river crossing stretches and shall include 2.5 % extra fasteners. The supplier shall be responsible for satisfactory performance of complete conductor system along

3.4 **Dimensions of Insulator String**

Along with Hardware Fitting The various limiting dimensions of the insulator strings shall generally be in conformity with the dimensions of the existing hardware fittings. The Contractor shall be required to verify the dimensions of the existing insulator strings and shall ensure that the new fittings are generally conforming to the dimensions of the existing fittings.

3.5 **Interchangeability**

The hardware for insulator strings with disc composite insulators together with ball and socket fittings shall be of standard design, so that the hardware is interchangeable with each other and suitable for use with insulators of any make conforming to relevant Indian/International Standard

3.6

Maintenance

The hardware fittings offered shall be suitable for employment of hot line maintenance technique so that usual hot line operations can be carried out with ease, speed and safety. The technique adopted for hot line maintenance shall be generally bare hand method & hot stick method

3.7

Designation

3.7.1

Ball and Socket Designation The dimension of the ball and socket shall be 16mm designation for 120KN & 90 KN. The designation should be in accordance with the standard dimensions stated in IS: 2486-(Part-II)/IEC: 60120. The dimensions shall be checked by the appropriate gauge after galvanising only.

3.8

Security Clips and Split Pins

3.8.1

Security clips for use with ball and socket coupling shall be R-shaped, hump type which provides positive locking of the coupling as per IS: 2486-(Part-III)/ IEC: 60372. The legs of the security clips shall be spread after assembly in the works to prevent complete withdrawal from the socket. The locking device should be resilient, corrosion resistant and of suitable mechanical strength. There shall be no risk of the locking device being displaced accidentally or being rotated when in position. Under no circumstances shall the locking devices allow separation of fittings.

3.8.2

The hole for the security clip shall be countersunk and the clip should be of such design that the eye of clip may be engaged by a hot line clip puller to provide for disengagement under **electrically charged** conditions. The force required to pull the security clip into its unlocked position shall not be less than 50 N (5 kg) or more than 500 N (50 kg)

3.8.3

Split pins shall be used with bolts & nuts.

3.9

Arcing Horn

3.9.1

The arcing horn / shall be either ball ended rod type or tubular type.

3.9.2

The arcing horn shall be provided generally as per existing fitting and shall conform to specification requirements

3.9.3

The air gap shall be so adjusted to ensure effective operation under actual field conditions.

3.10

Yoke Plates

The strength of yoke plate ultimate tensile strength as specified. The plates shall be either triangular or rectangular in shape as may be necessary. The design of yoke plate shall take into account the most unfavorable loading conditions likely to be experienced as a result of dimensional tolerances for disc insulators as well as components of hardware fittings within the specified range. The plates shall have suitable holes for fixing corona control rings/grading ring/arcing horn. All the corners and edges should be rounded off with a radius of at least 3 mm. Design calculations i.e. for bearing & tensile strength, for deciding the dimensions of yoke plate shall be furnished by the contractor. The holes provided for bolts in the yoke plate should satisfy shear edge condition.

3.11

Suspension Assembly

3.11.1

The suspension assembly shall be suitable for the ACSR PANTHER Conductor, the bidder intends to supply. The technical details of the conductor shall be as proposed by the bidder

3.11.2

The suspension assembly shall include either free centre type suspension clamp along with standard preformed armour rods or armour grip suspension clamp.

3.11.3

The suspension clamp along with standard preformed armour rods set shall be designed to have maximum mobility in any direction and minimum moment of inertia so as to have minimum stress on the conductor in the case of oscillation of the same.

3.11.4

The suspension clamp shall be designed for continuous operation at the temperature specified by the bidder for conductor.

3.11.5

The suspension assembly shall be designed, manufactured and finished to give it a suitable shape, so as to avoid any possibility of hammering between suspension assembly and conductor due to vibration. The suspension assembly shall be smooth without any cuts, grooves, abrasions,

projections, ridges or excrescence which might damage the conductor.

- 3.11.6 The suspension assembly/clamp shall be designed so that it shall minimise the static & dynamic stress developed in the conductor under various loading conditions as well as during wind induced conductor vibrations. It shall also withstand power arcs & have required level of Corona/RIV performance.

3.12 **Free Centre Type Suspension Clamp**

For the Free Centre Suspension Clamp seat shall be smoothly rounded and curved into a bell mouth at the ends. The lip edges shall have rounded bead. There shall be at least two U-bolts for tightening of clamp body and keeper pieces together.

3.13 **Standard Preformed Armour Rod Set.**

The Preformed Armour Rods Set shall be used to minimise the stress developed in the conductor due to different static and dynamic loads because of vibration due to wind, slipping of conductor from the suspension clamp as a result of unbalanced conductor tension in adjacent spans and broken wire condition. It shall also withstand power arcs, chafing and abrasion from suspension clamp and localized heating effect due to magnetic power losses from suspension clamps as well as resistance losses of the conductor.

- 3.13.1 The preformed armour rods set shall have right hand lay and the inside diameter of the helix shall be less than the outside diameter of the conductor to have gentle but permanent grip on the conductor. The surface of the armour rod when fitted on the conductor shall be smooth and free from projections, cuts and abrasions etc.

- 3.13.2 The pitch length of the rods shall be determined by the Bidder but shall be less than that of the outer layer of conductor and the same shall be accurately controlled to maintain uniformity and consistently reproducible characteristic wholly independent of the skill of linemen.

- 3.13.3 The length and diameter of each rod shall be furnished by the bidder in the GTP. The tolerance in length of the rods between the longest and shortest rod in complete set should be within the limits specified in relevant Indian/International Standards. The ends of armour rod shall be parrot billed.

- 3.13.4 The number of armour rods in each set shall be as per supplier's design to suit ACSR PANTHER Conductor offered Standards. Each rod shall be marked in the middle with paint for easy application on the line.

- 3.13.5 The armour rod shall not lose their resilience even after five applications.

3.14 **Armour Grip Suspension Clamp**

- 3.14.1 The armour grip suspension clamp shall comprise of retaining strap, support housing, elastomer inserts with Aluminium reinforcements and AGS preformed rod set.

- 3.14.2 Elastomer insert shall be resistant to the effects of temperature up to maximum conductor temperature guaranteed by the bidder corresponding to peak current, Ozone, ultraviolet radiations and other atmospheric contaminants likely to be encountered in service. The physical properties of the elastomer shall be of approved standard. It shall be electrically shielded by a cage of AGS performed rod set. The elastomer insert shall be so designed that the curvature of the AGS rod shall follow the contour of the neoprene insert.

- 3.14.3 The supplier shall submit relevant type/performance test certificates as per applicable standard/product specifications for elastomer to confirm suitability of the offered elastomer for the specified application.

- 3.14.4 The AGS preformed rod set shall be as detailed in clause 3.16.4 to 3.16.5 in general except for the following.

- 3.14.5 The length of the AGS preformed rods shall be such that it shall ensure sufficient slipping strength and shall not introduce unfavorable stress on the conductor under all operating conditions. The length of the AGS preformed rods shall be indicated in the GTP.

3.15 **Envelope Type Suspension Clamp**

The seat of the envelope type suspension clamp shall be smoothly rounded & suitably curved at the ends. The lip edges shall have rounded bead. There shall be at least two U-bolts for tightening of clamp body and keeper pieces together. Hexagonal bolts and nuts with split-pins shall be used for attachment of the clamp.

3.16 **Dead end Assembly**

3.16.1 The dead end assembly shall be suitable for the offered ACSR PANTHER Conductor.

3.16.2 The dead end assembly shall be of compression type with provision for compressing jumper terminal at one end. The angle of jumper terminal to be mounted should be 30° with respect to the vertical line. The area of bearing surface on all the connections shall be sufficient to ensure positive electrical and mechanical contact and avoid local heating due to I²R losses. The resistance of the clamp when compressed on Conductor shall not be more than 75% of the resistance of equivalent length of Conductor.

3.16.3 Die compression areas shall be clearly marked on each dead-end assembly designed for continuous die compressions and shall bear the words 'COMPRESS FIRST' suitably inscribed near the point on each assembly where the compression begins. If the dead end assembly is designed for intermittent die compressions it shall bear identification marks 'COMPRESSION ZONE' AND 'NON- COMPRESSION ZONE' distinctly with arrow marks showing the direction of compressions and knurling marks showing the end of the zones. The letters, number and other markings on the finished clamp shall be distinct and legible. The dimensions of dead- end assembly before & after compression along with tolerances shall be guaranteed in the relevant schedules of the bid and shall be decided by the manufacturer so as to suit the conductor size & conform to electrical & mechanical requirement stipulated in the specification. These shall be guaranteed in the relevant schedules of bid.

3.16.4 The assembly shall not permit slipping of, damage to, or failure of the complete conductor or any part thereof at a load less than 95% of the ultimate tensile strength of the conductor.

3.16.5 Jumper bolting arrangement between jumper terminal/cone and terminal pad/plate of dead end assembly of tension hardware fittings shall be designed to suit the specification requirement of 578A/449A, as the case may be, current and shall conform to the relevant Indian/International standards

3.16.6 For ACSR PANTHER conductor, dead end assembly shall *inter alia* include collets, collet housing, inner sleeve etc., suitable for the offered design of ACSR PANTHER conductor.

3.17 **Fasteners: Bolts, Nuts and Washers**

3.17.1 All bolts and nuts shall conform to IS 6639. All bolts and nuts shall be galvanized as per IS 1367 (Part- 13)/IS 2629. All bolts and nuts shall have hexagonal heads, the heads being forged out of solid truly concentric, and square with the shank, which must be perfectly straight.

3.17.2 Bolts up to M16 and having length up to 10 times the diameter of the bolt should be manufactured by cold forging and thread rolling process to obtain good and reliable mechanical properties and effective dimensional control. The shear strength of bolt for 5.6 grade should be 310 MPa minimum as per IS 12427. Bolts should be provided with washer face in accordance with IS 1363 (Part-1) to ensure proper bearing.

3.17.3 Nuts should be double chamfered as per the requirement of IS 1363 Part- III 1984. It should be ensured by the manufacturer that nuts should not be over tapped beyond 0.4 mm oversize on effective diameter for size upto M16.

3.17.4 Fully threaded bolts shall not be used. The length of the bolt shall be such that the threaded portion shall not extend into the place of contact of the component parts.

3.17.5 All bolts shall be threaded to take the full depth of the nuts and threaded enough to permit the firm gripping of the component parts but no further. It shall be ensured that the threaded portion of the bolt protrudes not less than 3 mm and not more than 8 mm when fully tightened. All nuts shall fit

and tight to the point where shank of the bolt connects to the head.

- 3.17.6 Flat washers and spring washers shall be provided wherever necessary and shall be of positive lock type. Spring washers shall be electro- galvanised. The thickness of washers shall conform to IS: 2016.
- 3.17.7 The Contractor shall furnish bolt schedules giving thickness of components connected, the nut and the washer and the length of shank and the threaded portion of bolts and size of holes and any other special details of this nature.
- 3.17.8 To obviate bending stress in bolt, it shall not connect aggregate thickness more than three time its diameter.
- 3.17.9 Bolts at the joints shall be so staggered that nuts may be tightened with spanners without fouling.
- 3.17.10 To ensure effective in-process Quality control it is essential that the manufacturer should have all the testing facilities for tests like weight of zinc coating, shear strength, other testing facilities etc, in- house. The manufacturer should also have proper Quality Assurance system which should be in line with the requirement of this specification and IS-.14000 services Quality System standard.
- 3.17.11 Fasteners of grade higher than 8.8 are not to be used and minimum grade for bolt shall be 5.6.

3.18 Materials

The materials of the various components shall be as specified hereunder. The Bidder shall indicate the material proposed to be used for each and every component of hardware fittings stating clearly the class, grade or alloy designation of the material, manufacturing process & heat treatment details and the reference standards.

- 3.18.1 The details of materials for different component are listed as in TableNo-1

Sl No	Name of item	Material treatment	Process of Standard	Reference	Remarks
1	Security Clips	Stainless Steel/ Phosphor Bronze		AISI 302 or 304- L/ IS- 1385	
2	For Free Centre /Envelope type clamps				
	Clamp Body, Keeper Piece	High Strength Al. Alloy 4600/ LM-6 or 6061/65032	Casted or forged & Heat treated	IS:617or ASTM B429	
	Cotter bolts/ Hangers, Shackles, Brackets	Mild Steel	Hot dip galvanised	As per IS-226 or IS-2062	
	U Bolts	Stainless Steel or High Strength	Forged &&Heat treated	AISI 302 or 304-L ASTM B429	
	P. A. Rod	High Strength Al. Alloy 4600/ LM-6 or 6061/65032	Heat treatment during manufacturing	ASTM-B429	Min. tensile strength of 35 kg/mm2
3	For AGS type clamp				
	Supporting House	High Strength Corrosion resistant Al.Alloy 4600/ LM-6 or 6061/65032	Casted or forged I & Heat treated	Heat treated S:617or ASTM B42	
	Al insert & Retaining strap	High Strength Al. Alloy 4600/ LM-6 or 6061/65032	Casted or forged I & Heat treated	S:617or ASTM B429	High Strength Al. Alloy 4600/ LM-6 or 6061/65032
	Elastomer	Molded on Al. reinforcement			
4	For Dead End Assembly				

(a)	Outer Sleeve	1 of purity not less than 99.50%			
(b)	Steel Sleeve	Mild Steel	Hot Dip Galvanised	IS:226/ IS-2062	
5	Ball & Socket Fittings,	Class-IV Steel	Drop forged & normalized Hot dip galvanised	As per IS: 2004	
6	Yoke Plate	Mild Steel	Hot dip galvanised	As per IS-226 or IS-2062	
7	Corona Control ring/ t Grading ring	High Strength Al. Alloy tube (6061/6063/ 1100 type or 65032/ 63400	Heat treated Hot dip galvanised	ASTM-B429 or as per IS	Mechanical strength of welded joint shall not be less
8	Supporting than 20 Brackets & Mounting Bolts	High strength Al Alloy 7061/ 6063/ 65032/63400 Type) or Mild Steel	Heat treated Hot dip galvanised	ASTM-B429 or as per IS:226 or S:206	

Note: Alternate materials conforming to other national standards of other countries also may be offered provided the properties and compositions of these are close to the properties and compositions of material specified. Bidder should furnish the details of comparison of material offered viz a viz specified in the bid or else the bids are liable to be rejected.

3.19 Workmanship

3.19.1 All the equipment shall be of the latest design and conform to the best modern practices adopted in the Extra High Voltage field. The Bidder shall offer only such equipment as guaranteed by him to be satisfactory and suitable for 132 kV transmission lines and will give continued good performance

3.19.2 High current, heat rise test shall be conducted by the supplier to determine the maximum temperature achieved in different components of fittings / accessories under simulated service condition corresponding to operation of conductor at maximum (emergency) operating temperature. The material of the components should be suitable for continued good performance corresponding to these maximum temperatures. The supplier shall submit relevant type/performance test certificates as per applicable standards/product specifications to confirm suitability of the offered material.

3.19.3 The design, manufacturing process and quality control of all the materials shall be such as to give the specified mechanical rating, highest mobility, elimination of sharp edges and corners to limit corona and radio interference, best resistance to corrosion and a good finish.

All ferrous parts including fasteners shall be hot dip galvanised, after all machining has been completed. Nuts may, however, be tapped (threaded) after galvanising and the threads oiled. Spring washers shall be electro galvanized. The bolt threads shall be undercut to take care of the increase in diameter due to galvanizing. Galvanizing shall be done in accordance with IS 2629 / IS 1367 (Part-13) and shall satisfy the tests mentioned in IS 2633. Fasteners shall withstand four dips while spring washers shall withstand three dips of one minute duration in the standard Preece test. Other galvanized materials shall have a minimum average coating of zinc equivalent to 600 gm/sq.m., shall be guaranteed to withstand at least six successive dips each lasting one (1) minute under the standard preece test for galvanizing.

3.19.4 Before ball fittings are galvanized, all die flashing on the shank and on the bearing surface of the

ball shall be carefully removed without reducing the dimensions below the design requirements.

- 3.19.5 The zinc coating shall be perfectly adherent, of uniform thickness, smooth, reasonably bright, continuous and free from imperfections such as flux, ash rust, stains, bulky white deposits and blisters. The zinc used for galvanising shall be grade Zn 99.95 as per IS:209.
- 3.19.6 Pin balls shall be checked with the applicable "GO" gauges in at least two directions. one of which shall be across the line of die flashing, and the other 90o to this line. "NO GO" gauges shall not pass in any direction.
- 3.19.7 Socket ends, before galvanising, shall be of uniform contour. The bearing surface of socket ends shall be uniform about the entire circumference without depressions or high spots. The internal contours of socket ends shall be concentric with the axis of the fittings as per IS: 2486/IEC: 120.
- 3.19.8 The axis of the bearing surfaces of socket ends shall be coaxial with the axis of the fittings. There shall be no noticeable tilting of the bearing surfaces with the axis of the fittings.
- 3.19.9 In case of casting, the same shall be free from all internal defects like shrinkage, inclusion, blow holes, cracks etc. Pressure die casting shall not be used for casting of components with thickness more than 5 mm.
- 3.19.10 All current carrying parts shall be so designed and manufactured that contact resistance is reduced to minimum.
- 3.19.11 No equipment shall have sharp ends or edges, abrasions or projections and cause any damage to the conductor in any way during erection or during continuous operation which would produce high electrical and mechanical stresses in normal working. The design of adjacent metal parts and mating surfaces shall be such as to prevent corrosion of the contact surface and to maintain good electrical contact under service.
- 3.19.12 All the holes shall be cylindrical, clean cut and perpendicular to the plane of the material. The periphery of the holes shall be free from burrs.
- 3.19.13 All fasteners shall have suitable corona free locking arrangement to guard against vibration loosening.
- 3.19.14 Welding of Aluminium shall be by inert gas shielded tungsten arc or inert gas shielded metal arc process Welds shall be clean, sound, smooth, uniform without overlaps, properly fused and completely sealed. There shall be no cracks, voids incomplete penetration, incomplete fusion, under-cutting or inclusions. Porosity shall be minimised so that mechanical properties of the Aluminium alloys are not affected. All welds shall be properly finished as per good engineering practices.

3.20 **Bid Drawings**

- 3.20.1 The Bidder shall furnish full description and illustrations of materials offered.
- 3.20.2 Fully dimensioned drawings of the hardware and their component parts shall be furnished in three copies along with the bid. Weight, material and fabrication details of all the components should be included in the drawings.
- (i) Attachment of the hanger or strain plate.
 - (ii) Suspension or dead end assembly.
 - (iii) Arcing horn attachment to the string as specified in this technical Specification.
 - (iv) Yoke plates

- (v) Hardware fittings of ball and socket type for inter connecting units to the top and bottom Yoke plates.

3.20.3 All drawings shall be identified by a drawing number and bid number. All drawings shall be neatly arranged. All drafting & lettering shall be legible. The minimum size of lettering shall be 3 mm. All dimensions & dimensional tolerances shall be mentioned in mm.

The drawings shall include:

- (i) Dimensions and dimensional tolerance.
- (ii) Material, fabrication details including any weld details & any specified finishes & coatings. Regarding material designation & reference of standards are to be indicated.
- (iii) Catalogue No.
- (iv) Marking
- (v) Weight of assembly
- (vi) Installation instructions
- (vii) Design installation torque for the bolt or cap screw.
- (viii) Withstand torque that may be applied to the bolt or cap screw without failure of component parts.
- (ix) The compression die number with recommended compression pressure.
- (x) All other relevant terminal details.

3.20.4 After placement of award, the Contractor shall submit fully dimensioned drawing including all the components in four (4) copies to the Owner for approval. After getting approval from the Owner and successful completion of all the type tests, the Contractor shall submit 10 (10) more copies of the same drawings to the Owner for further distribution and field use at Employer's end.

3.21 **Accessories for the ACSR PANTHER Conductor**

General

3.21.1 This portion details the technical particulars of the accessories for Conductor.

3.21.2 2.5% extra fasteners, filler plugs and retaining rods shall be provided.

3.21.3 The supplier shall be responsible for satisfactory performance of complete conductor system along with accessories offered by him for continuous operation at temperature specified for the ACSR PANTHER Conductor.

3.22 **Mid Span Compression Joint**

3.22.1 Mid Span Compression Joint shall be used for joining two lengths of conductor. The joint shall have a resistivity less than 75% of the resistivity of equivalent length of conductor. The joint shall not permit slipping off, damage to or failure of the complete conductor or any part thereof at a load less than 95% of the ultimate tensile strength of the conductor. It must be able to withstand the continuous design temperature of conductor.

3.22.2 The dimensions of mid span compression joint before & after compression along with tolerances shall be guaranteed in the relevant schedules of the bid and shall be decided by the manufacturer so as to suit the conductor size & conform to electrical & mechanical requirement stipulated in the specification. For composite core conductor, suitable sleeve, collets, collet housing shall be used for core jointing.

3.23 **Repair Sleeve**

Repair Sleeve of compression type shall be used to repair conductor with not more than two strands broken in the outer layer. The sleeve shall be manufactured from 99.5% pure Aluminium / Aluminium alloy and shall have a smooth surface. It shall be able to withstand the continuous maximum operating temperature of conductor. The repair sleeve shall comprise of two pieces with a provision of seat for sliding of the keeper piece. The edges of the seat as well as the keeper piece shall be so rounded that the conductor strands are not damaged during installation. The dimensions of Repair sleeve along with tolerances shall be guaranteed in the relevant schedules of the bid and shall be decided by the manufacturer so as to suit the conductor size & conform to electrical & mechanical requirement stipulated in the specification.

3.24 **Vibration Damper**

3.24.1 Vibration dampers of 4R-stockbridge type with four (4) different resonances spread within the specified aeolian frequency band width corresponding to wind speed of 1 m/s to 7 m/s are installed in the existing line at suspension and tension points on each conductor in each span to damp out aeolian vibration as well as sub- span oscillations,. One damper minimum on each side per conductor for suspension points and two dampers minimum on each side per conductor for tension points shall be used for a ruling design span of 320 meters.

3.24.2 The bidder shall offer damping system including Stockbridge type dampers for proposed ACSR PANTHER Conductor for its protection from wind induced vibrations which could cause conductor fatigue /strand breakage near a hardware attachment, such as suspension clamps. Alternate damping systems with proven design offering equivalent or better performance also shall be accepted provided the manufacturer meets the qualifying requirements stipulated in the Specifications. Relevant technical documents including type test reports to establish the technical suitability of alternate systems shall be furnished by the Bidder along with the bid. The damper shall be designed to have resonance frequencies to facilitate dissipation of vibration energy through inter-strand friction of the messenger cable and shall be effective in reducing vibration over a wide frequency range (depending upon conductor dia) or wind velocity range specified above. The vibration damper shall meet the requirement of frequency or wind velocity range and also have mechanical impedance closely matched with the offered ACSR PANTHER conductor. The vibration dampers shall be installed at suitable positions to ensure damping effectiveness across the frequency range. The power dissipation of the vibration dampers shall exceed the wind power so that the vibration level on the conductor is reduced below its endurance limit i.e 150 micro strain. The bidder shall clearly indicate the method for evaluating performance of dampers including analytical and laboratory test methods. The bidder shall indicate the type tests to evaluate the performance of offered damping system.

3.24.3 The clamp of the vibration damper shall be made of high strength Aluminium alloy of type LM-6. It shall be capable of supporting the damper and prevent damage or chafing of the conductor during erection or continued operation. The clamp shall have smooth and permanent grip to keep the damper in position on the conductor without damaging the strands or causing premature fatigue failure of the conductor under the clamp. The clamp groove shall be in uniform contact with the conductor 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 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 threads or loosening in service.

- 3.24.4 The messenger cable shall be made of high strength galvanized steel/stain less 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 weight and to maintain consistent flexural stiffness of the cable in service. The number of strands in the messenger cable shall be 19. The messenger cable other than stainless steel shall be hot dip galvanised in accordance with the recommendations of IS: 4826 for heavily coated wires.
- 3.24.5 The damper mass shall be made of hot dip galvanised mild steel/cast iron or a permanent mold cast zinc alloy. All castings shall be free from defects such as cracks, shrinkage, inclusions and blowholes etc. The surface of the damper masses shall be smooth.
- 3.24.6 The damper clamp shall be casted over the messenger cable and offer sufficient and permanent grip on it. The messenger cable shall not slip out of the grip at a load less than the mass pull-off value of the damper. The damper masses made of material other-than zinc alloy shall be fixed to the messenger cable in a suitable manner in order to avoid excessive stress concentration on the messenger cables which shall cause premature fatigue failure of the same. The messenger cable ends shall be suitably and effectively sealed to prevent corrosion. The damper mass made of zinc alloy shall be casted over the messenger cable and have sufficient and permanent grip on the messenger cable under all service conditions.
- 3.24.7 The damper assembly shall be so designed that it shall not introduce radio interference beyond acceptable limits.
- 3.24.8 The vibration damper shall be capable of being installed and removed from energised line by means of hot line technique. In addition, the clamp shall be capable of being removed and reinstalled on the conductor at the designated torque without shearing or damaging of fasteners.
- 3.24.9 The contractor 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 shall not cause excessive stress concentration on the conductor leading to permanent deformation of the conductor strands and premature fatigue failure in operation.
- 3.24.10 The vibration analysis of the system, with and without damper and dynamic characteristics of the damper as detailed under Annexure-A, shall have to be submitted. The technical particulars for vibration analysis and damping design of the system are as follows:

Sl. No.	Description	Technical particulars
1	Span length in meters i Ruling design span	320 meters
2	Configuration	Double Circuit single conductor per phase in vertical Configuration
3	Tensile load in Conductor at temperature of 0 deg. C and still air	As per Sag – tension calculations
4	Armour rods used	Standard preformed armour rods/AGS
5	Maximum permissible dynamic strain ie endurance limit	+/- 150 micro strains

- 3.24.11 The damper placement chart shall be submitted for spans ranging from 100m to 1100m. Placement charts should be duly supported with relevant technical documents and sample calculations.
- 3.24.12 The damper placement charts shall include the following
- (i) Location of the dampers for various combinations of spans and line tensions clearly indicating the number of dampers to be installed per conductor per span.
 - (ii) Placement distances clearly identifying the extremities between which the distances are to be measured.
 - (iii) Placement recommendation depending upon type of suspension clamps (viz Free centre type/Armour grip type etc.)
 - (iv) The influence of mid span compression joints, repair sleeves and armour rods (standard and AGS) in the placement of dampers.
- 3.25 **Material and Workmanship**
- 3.25.1 All the equipment shall be of the latest proven design and conform to the best modern practice adopted in the high voltage field. The Bidder shall offer only such equipment as guaranteed by him to be satisfactory and suitable for 132 kV transmission line application with single conductors and will give continued good performance at all service conditions. For employer's review of the offered design of accessories, the supplier shall submit document/design details of similar type of accessories used in past for similar type of ACSR PANTHER Conductor application
- 3.25.2 The design, manufacturing process and quality control of all the materials shall be such as to achieve requisite factor of safety for maximum working load, highest mobility, elimination of sharp edges and corners, best resistance to corrosion and a good finish.
- 3.25.3 High current, heat rise test shall be conducted by the supplier to determine the maximum temperature achieved in different components of fittings under simulated service condition corresponding to continuous operation of conductor at rated maximum temperature. The material of the components should be suitable for continued good performance corresponding to these maximum temperatures. The supplier shall submit relevant type/ performance test certificates as per applicable standards/product specifications to confirm suitability of the offered material.
- 3.25.4 All ferrous parts shall be hot dip galvanised, after all machining has been completed. Nuts may, however, be tapped (threaded) after galvanising and the threads oiled. Spring washers shall be electro galvanised as per grade 4 of IS-1573. The bolt threads shall be undercut to take care of increase in diameter due to galvanising. Galvanising shall be done in accordance with IS:2629/ IS-1367 (Part-13) and satisfy the tests mentioned in IS-2633. Fasteners shall withstand four dips while spring washers shall withstand three dips. Other galvanised materials shall have a minimum average coating of Zinc equivalent to 600 gm/sqm and shall be guaranteed to withstand at least six dips each lasting one minute under the standard Preece test for galvanising unless otherwise specified.
- 3.25.5 The zinc coating shall be perfectly adherent, of uniform thickness, smooth, reasonably bright, continuous and free from imperfections such as flux, ash, rust stains, bulky white deposits and blisters. The zinc used for galvanising shall be of grade Zn 99.95 as per IS:209.
- 3.25.6 In case of castings, the same shall be free from all internal defects like shrinkage, inclusion, blow holes, cracks etc.

- 3.23.7 All current carrying parts shall be so designed and manufactured that contact resistance is reduced to minimum and localized heating phenomenon is averted.
- 3.53.8 No equipment shall have sharp ends or edges, abrasions or projections and shall not cause any damage to the conductor in any way during erection or during continuous operation which would produce high electrical and mechanical stresses in normal working. The design of adjacent metal parts and mating surfaces shall be such as to prevent corrosion of the contact surface and to maintain good electrical contact under all service conditions.
- 3.25.9 Particular care shall be taken during manufacture and subsequent handling to ensure smooth surface free from abrasion or cuts.
- 3.25.10 The fasteners shall conform to the requirements of IS: 6639-1972. All fasteners and clamps shall have corona free locking arrangement to guard against vibration loosening.
- 3.26 **Compression Markings**
- Die compression areas shall be clearly marked on each equipment designed for continuous die compressions and shall bear the words 'COMPRESS FIRST' suitably inscribed on each equipment where the compression begins. If the equipment is designed for intermittent die compressions, it shall bear the identification marks 'COMPRESSION ZONE' and 'NON-COMPRESSION ZONE' distinctly with arrow marks showing the direction of compression and knurling marks showing the end of the zones. The letters, number and other markings on finished equipment shall be distinct and legible.
- 3.27 **Bid Drawings**
- 3.27.1 The Bidder shall furnish detailed dimensioned drawings of the equipments and all component parts. Each drawing shall be identified by a drawing number and Contract number. All drawings shall be neatly arranged. All drafting and lettering shall be legible. The minimum size of lettering shall be 3 mm. All dimensions and dimensional tolerances shall be mentioned in mm.
- 3.27.2 The drawings shall include
- (i) Dimensions and dimensional tolerances
 - (ii) Material. fabrication details including any weld details and any specified finishes and coatings. Regarding material, designations and reference of standards are to be indicated.
 - (iii) Catalogue No.
 - (iv) Marking
 - (v) Weight of assembly
 - (vi) Installation instructions
 - (vii) Design installation torque for the bolt or cap screw
 - (viii) Withstand torque that may be applied to the bolt or cap screw without failure of component parts
 - (ix) The compression die number with recommended compression pressure.
 - (x) All other relevant technical details
- 3.27.3 Placement charts for spacer/spacer damper and damper
- 3.27.4 The above drawings shall be submitted with all the details as stated above along with the bid document. After the placement of award. The Contractor shall again submit the drawings in four copies to the Owner for approval. After Owner's approval and successful completion of all type tests, 20 (twenty) more sets of drawings shall be submitted to Owner for further distribution and

field use at Owner's end.

3.28 Test and Standards

3.28.1 Type Test

3.28.1.1 On the complete Insulator Strings with Hardware Fittings

a)	Power frequency voltage withstand test with corona control rings/grading ring and arcing horns under wet condition	As per IEC:60383
2	Impulse voltage withstand test under dry condition	As per IEC:60383
3	Mechanical Strength test	: As per Annex-A

Note: 1) All the type test given in Clause No. 2.30.1.1 shall be conducted on Single 'T' suspension & Single Tension insulator string.

2) All the type tests given under Clause No. 2.30.1.1 (a) to (c) shall also be conducted on Single I Pilot, Double I Suspension & Double Tension insulator strings

3.28.2 On Hardware Fittings

- i) Mechanical Strength Test on Tension Hardware fitting: As per Annex-A ii) Mechanical Strength Test on Suspension Hardware fitting: As per Annex-A 3.30.3 On Suspension Clamp i) Magnetic power loss test: As per Annexure-A
- ii) Clamp slip strength Vs torque test: As per Annexure-A iii) Ozone Test on elastomer: As per Annexure-A iv) Vertical damage load & Failure load test: IEC: 61284

3.28.4 On Dead end Tension Assembly

- i) Electrical resistance test for dead end Assembly: As per IS:2486-(Part-I)
- ii) Heating cycle test for dead end Assembly: As per Annexure-A
- i) Slip strength test for dead end assembly: As per IS:2486-(Part-I)
- ii) Ageing test on filler (if applicable): As per Annexure-A

3.28.5 Mid Span Compression Joint for Conductor

- i) Chemical analysis of materials: As per Annexure-A
- ii) Electrical resistance test: As per IS:2121 (Part-II)
- iii) Heating cycle test: As per Annexure-A
- iv) Slip strength test: As per Annexure-A
- iii) Corona extinction voltage test (dry) : As per Annexure-A
- iv) Radio interference voltage test (dry) : As per Annexure-A 3.30.6 Repair Sleeve for Conductor i) Chemical analysis of materials : As per Annexure-A ii) Corona extinction voltage test (dry) : As per Annexure-A iii) Radio interference voltage test (dry) : As per Annexure-A

3.28.7 Vibration Damper for Conductor

- i) Chemical analysis of materials: As per Annexure-A
- ii) Dynamic characteristics test*: As per Annexure-A
- iii) Vibration analysis: As per Annexure-A
- iv) Clamp slip test: As per Annexure-A
- v) Fatigue tests: As per Annexure-A

- vi) Magnetic power loss test: As per Annexure-A
- v) Corona extinction voltage test (dry) : As per Annexure-A
- vi) Radio interference voltage test (dry) : As per Annexure-A
- vii) Damper efficiency test : As per IS:9708

3.28.8 Type tests specified under Clause 2.30.1 to 2.30.7 shall not be required to be carried out if a valid test certificate is available for a similar design, i.e., tests conducted earlier should have been conducted accredited laboratory (accredited based on ISO/IEC guide 25/17025 or EN 45001 by the National Accreditation body of the country where laboratory is located) or witnessed by the representative (s) Central/State Power Utility.

In the event of any discrepancy in the test report (i.e., any test report not applicable due to any design / material/manufacturing process change including substitution of components or due to non-compliance with the requirement stipulated in the Technical Specification) the tests shall be conducted by the Contractor at no extra cost to the Employer/ Employer/ Employer.

3.29 **Acceptance Tests**

3.29.1 On Both Suspension Clamp and Tension Hardware Fittings

- i) Visual Examination: As per IS:2486-(Part-I)
- ii) Verification of dimensions: As per IS:2486-(Part-I)
- iii) Galvanising/Electroplating test: As per IS:2486-(Part-I)
- iv) Mechanical strength test of each component: As per Annexure-A
- v) Mechanical strength test for corona control ring/ grading ring and arcing horn: As per BS:3288(Part-I)
- vi) Test on locking device for ball and socket coupling: As per IEC:372(2)
- vii) Mechanical Strength test of welded joint: As per Annexure-A
- viii) Chemical analysis, hardness tests, grain size, inclusion rating & magnetic particle inspection for forgings/castings: As per Annexure-A

3.29.2 On Suspension Clamp only

- a) Clamp Slip strength Vs Torque test for suspension clamp: As per Annexure-A
- b) Shore hardness test of elastomer cushion for : As per Annexure-A
AG suspension clamp
- c) Bend test for armour rod set : As per IS:2121(Part-I), Clause 7.5,7,10 & 7.11
- d) Resilience test for armour rod set : As per IS:2121(Part-I), Clause 7.5,7,10 & 7.11
- e) Conductivity test for armour rods set : As per IS:2121(Part-I), Clause 7.5,7,10 & 7.11

3.29.3 On Tension Hardware Fittings only

- a) Slip strength test for dead end assembly : As per IS:2486 (Part-I) Clause 5.4
- b) Ageing test on filler (if applicable) : As per Annexure-B

3.29.4 On Mid Span Compression Joint for Conductor

- a) Visual examination and dimensional verification : As per IS:2121 (Part-II), Clause 6.2, 6.3 & 6.7
- b) Galvanizing test : As per Annexure-B
- c) Hardness test : As per Annexure-B
- d) Ageing test on filler (if applicable) : As per Annexure-B

3.29.5 Repair Sleeve for Conductor

- a) Visual examination and dimensional verification : As per IS: 2121(Part-II) Clause 6.2, 6.3

3.29.6 Vibration Damper for Conductor

- a) Visual examination and dimensional verification : As per IS: 2121(Part-II) Clause 6.2, 6.3 7 6.7
- b) Galvanizing test : As per Annexure-B
- (i) On damper masses : As per Annexure-B
- Ii) On messenger cable : As per Annexure-B
- c) Verification of resonance frequencies : As per Annexure-B
- d) Clamp slip test : As per Annexure-B
- e) Clamp bolt torque test : As per Annexure-B
- f) Strength of the messenger cable : As per Annexure-B
- g) Mass pull off test : As per Annexure-B
- h) Dynamic characteristics test* : As per Annexure-B *

Applicable for 4 R stockbridge dampers. For alternate type of vibration dampers (permitted as per clause 2.26), as an alternative to dynamic characteristic test, damper efficiency test as per IEEE-664 may be proposed/ carried out by the supplier.

3.30 **Routine Tests**

3.30.1 For Hardware Fittings

- a) Visual examination IS:2486-(Part-I)
- b) Proof Load Test : As per Annexure-A

3.30.2 For conductor accessories

- a) Visual examination and dimensional verification: As per IS: 2121(Part-II) Clause 6.2, 6.3 7 6.7

3.30.3 Tests During Manufacture on all components as applicable

- a) Chemical analysis of Zinc used for galvanizing IS: 2486-(Part-I)
- b) Chemical analysis mechanical metallographic test and : As per Annexure-A magnetic particle inspection for malleable castings
- c) Chemical analysis, hardness tests and magnetic particle : As per Annexure-A inspection for forging

3.31 **Testing Expenses**

3.31.1 As indicated no type test charges shall be payable.

3.31.2 In case type testing is required due to non-availability of type test reports, or type test on the complete insulator string, the Contractor has to arrange similar insulators at his own cost.

3.31.3 Bidder shall indicate the laboratories in which they propose to conduct the type tests. They shall ensure that adequate facilities for conducting the tests are available in the laboratory and the tests can be completed in these laboratories within the time schedule guaranteed by them in the appropriate schedule.

3.31.4 The entire cost of testing for type tests, acceptance and routine tests and tests during manufacture specified herein shall be treated as included in the quoted Ex-works/CIF Price.

3.31.5 In case of failure in any type test, repeat type tests are required to be conducted, then, all the expenses for deputation of Inspector/ Owner's representative shall be deducted from the contract price. Also, if on receipt of the Contractor's notice of testing, the Owner's representative/Inspector

does not find material & facilities to be ready for testing the expenses incurred by the Owner's for re- deputation shall be deducted from contract price.

- 3.31.6 The Contractor shall intimate the Owner about carrying out of the type tests along with detailed testing program at least 3 weeks in advance of the scheduled date of testing during which the Owner will arrange to depute his representative to be present at the time of carrying out the test.

3.32 Schedule of Testing and Additional Tests

- 3.32.1 The Bidder has to indicate the schedule of following activities in their bids

- (a) Submission of drawing for approval.
- (b) Submission of Quality Assurance program for approval.
- (c) Offering of material for sample selection for type tests.
- (d) Type testing.

- 3.32.2 The Employer reserves the right of having at his own expense any other test(s) of reasonable nature carried out at Contractor's premises, at site, or in any other place in addition to the aforesaid type, acceptance and routine tests to satisfy himself that the material comply with the specifications.

- 3.32.3 The Employer also reserves the right to conduct all the tests mentioned in this specification at his own expense on the samples drawn from the site at Contractor's premises or at any other test centre. In case of evidence of noncompliance, it shall be binding on the part of Contractor to prove the compliance of the items to the technical specifications by repeat tests, or correction of deficiencies, or replacement of defective items, all without any extra cost to the Employer.

3.33 Test Reports

- 3.33.1 Copies of acceptance test report shall be furnished in at least, six copies. One copy shall be returned, duly certified by the Employer, only after which the materials will be despatched.

- 3.33.2 Record of routine test report shall be maintained by the Contractor at his works for periodic inspection by the Employer's representative.

- 3.33.3 Test certificates of tests during manufacture shall be maintained by the Contractor. These shall be produced for verification as and when desired by the Employer.

3.34 Inspection

- 3.34.1 The Owner's representative shall at all times be entitled to have access to the works and all places of manufacture, where the material and/or its component parts shall be manufactured and the representatives shall have full facilities for unrestricted inspection of the **Contractor's works / raw materials/ all the materials for conducting necessary tests as detailed herein.**

- 3.34.2 The material for final inspection shall be offered by the Contractor only under packed condition. The engineer shall select samples at random from the packed lot for carrying out acceptance tests.

- 3.34.3 The Contractor shall keep the Employer informed in advance of the time of starting and of the progress of manufacture of material in its various stages so that arrangements could be made for inspection.

- 3.34.4 Material shall not be dispatched from its point of manufacture before it has been satisfactorily inspected and tested unless the inspection is waived off by the Owner in writing. In the latter case also the material shall be dispatched only after all tests specified herein have been satisfactorily completed.

- 3.34.5 The acceptance of any quantity of material shall in no way relieve the Contractor of his

responsibility for meeting all the requirements of the Specification, and shall not prevent subsequent rejection, if such materials are later found to be defective.

3.35 **Packing and Marking**

3.35.1 All material shall be packed in strong and weather resistant wooden cases/crates. The gross weight of the packing shall not normally exceed 200 Kg to avoid handling problems.

3.35.2 The packing shall be of sufficient strength to withstand rough handling during transit, storage at site and subsequent handling in the field.

3.35.3 Suitable cushioning, protective padding, dunnage or spacers shall be provided to prevent damage or deformation during transit and handling.

3.35.4 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 used to prevent their loss.

3.35.5 Each component part shall be legibly and indelibly marked with trade mark of the manufacturer and year of manufacture. However, in such type of component/item, which consists of many parts and are being supplied in assembled condition(suspension clamp, vibration damper, etc.), the complete assembly shall be legibly and indelibly marked on main body/on one of the parts.

3.35.6 All the packing cases shall be marked legibly and correctly so as to ensure safe arrival at their destination and to avoid the possibility of goods being lost or wrongly dispatched on account of faulty packing and faulty or illegible markings. Each wooden case/crate shall have all the markings stencilled on it in indelible ink.

3.36 **Standards**

3.34.1 The Hardware fittings; conductor and earthwire accessories shall conform to the following Indian/International Standards which shall mean latest revisions, with amendments/changes adopted and published, unless specifically stated otherwise in the Specification.

3.34.2 In the event of the supply of hardware fittings; conductor accessories conforming to standards other than specified, the Bidder shall confirm in his bid that these standards are equivalent to those specified. In case of award, salient features of comparison between the Standards proposed by the Contractor and those specified in this document will be provided by the Contractor to establish their equivalence.

Sl. No.	Indian Standard	Title	International Standard
1	IS: 209-1992	Specification for zinc	BS:3436-1986
2	IS:398-1992 Part-V	Aluminum Conductor Galvanised Steel Reinforced For Extra High Voltage (132 KV) and above	IEC:1089-1991 Part-V BS:215-1970
3	IS 1573	Electroplated Coating of Zinc on iron and Steel	
4	IS : 2121 (Part-II)	Specification for Conductor and Earthwire Accessories for Overhead Power lines:	
5	IS:2486 (Part-I)	Mid-span Joints and Repair Sleeves for Conductors Specification for Insulator Fittings for Overhead power Lines with Nominal Voltage greater	
6	IS:2629	han 1000 V: General Requirements and Tests	
7	IS:2633	Method of Testing Uniformity of Coating on Zinc Coated Articles	
8		Ozone test on Elastomer	IEC:383-1993
9		Tests on insulators of Ceramic material or glass for overhead lines with a nominal voltage greater than 1000V	IEC:383-1993

10	IS:4826	Galvanised Coating on Round Steel Wires	ASTM A472-729 BS:443-1969
11	IS:6745	Methods of Determination of Weight of Zinc Coating of Zinc Coated Iron and Steel Articles	BS:433 ISO : 1460 (E)
12	IS:8263	Method of Radio Interference Tests on High Voltage Insulators	IEC:437 NEMA:107 CISPR
13	IS:6639	Hexagonal Bolts for Steel Structures	ISO/R-272
14	IS:9708	Specification for Stock Bridge Vibration Dampers for Overhead Power lines	

ANNEXURE - A

1. Tests on Complete Strings with Hardware Fittings

1.1 Mechanical Strength Test

The complete insulator string along with its hardware fitting excluding arcing horn, corona control ring, grading ring and suspension assembly/dead end assembly shall be subjected to a load equal to 50% of the specified minimum ultimate tensile strength (UTS) which shall be increased at a steady rate to 67% of the minimum UTS specified. The load shall be held for five minutes and then removed. After removal of the load, the string components shall not show any visual deformation and it shall be possible to disassemble them by hand. Hand tools may be used to remove cotter pins and loosen the nuts initially. The string shall then be reassembled and loaded to 50% of UTS and the load shall be further increased at a steady rate till the specified minimum UTS and held for one minute. No fracture should occur during this period. The applied load shall then be increased until the failing load is reached and the value recorded.

1.2 Mechanical Strength Test for Suspension/Tension Hardware Fittings

The complete string without insulators excluding arcing horn, corona control rings/grading ring and suspension assembly/dead end assembly shall be subjected to a load equal to 50% of the specified minimum ultimate tensile strength (UTS) which shall be increased at a steady rate to 67% of the minimum UTS specified. This load shall be held for five minutes and then removed. After removal of the load, the string component shall not show any visual deformation and it shall be possible to disassemble them by hand. Hand tools may be used to remove cotter pins and loosen the nuts initially. The string shall then be reassembled and loaded to 50% of UTS and the load shall be further increased at a steady rate till the specified minimum UTS is reached and held for the one minute. No fracture should occur during this period. The applied load shall then be increased until the failing load is reached and the value recorded.

1.3 Magnetic Power Loss Test for Suspension Assembly

An alternating current over the range of 1000 amps to 1500 shall be passed through each tube. The reading of the wattmeter with and without suspension assemblies along with line side yoke plate, clevis eye shall be recorded. Not less than three suspension assemblies shall be tested. The average power loss for suspension assembly shall be plotted for each value of current. The value of the loss corresponding to 1000 Amperes shall be read off from the graph and the same shall be limited to the value guaranteed by the supplier.

1.4 Galvanising/Electroplating Test

The test shall be carried out as per Clause no. 5.9 of IS: 2486- (Part-1) except that both uniformity of zinc coating and standard preece test shall be carried out and the results obtained shall satisfy the requirements of this specification.

1.5 Mechanical Strength Test of Each Component

Each component shall be subjected to a load equal to the specified minimum ultimate tensile strength (UTS) which shall be increased at a steady rate to 67% of the minimum UTS specified. The load shall be held for five minutes and then removed. The component shall then again be loaded to 50% of UTS and the load shall be further increased at a steady rate till the specified UTS and held for one minute. No fracture should occur. The applied load shall then be increased until the failing load is reached and the value recorded.

1.1 Mechanical Strength Test of Welded Joint

The welded portion of the component shall be subjected to a Load of 2000 kgs for one minute. Thereafter, it shall be subjected to die-penetration/ ultrasonic test. There shall not be any crack at the welded portion.

1.2 Clamp Slip Strength Vs Torque Test for Suspension Clamp

The suspension assembly shall be vertically suspended by means of a flexible attachment. A suitable length of conductor shall be fixed in the clamp. The clamp slip strength at various tightening torques shall be obtained by gradually applying the load at one end of the conductor. The Clamp slip strength vs torque curve shall be drawn. The above procedure is applicable only for free centre type suspension clamp. For AG suspension clamp only clamp slip strength after assembly shall be found out. The clamp slip strength at the recommended tightening torque shall be as indicated in GTP.

1.3 Heating Cycle Test

Heating cycle test shall be performed in accordance with IS 2486 (Part-I) with following modifications:-

- i) Temperature of conductor during each cycle: 40 deg. C above designed maximum operating temperature of the conductor.
- ii) Number of cycle: 100
- iii) Slip strength test shall also be carried out after heating cycle test.

1.4 Ageing Test on Filler (if applicable)

The test shall be done in accordance with Grease drop point test method. The specimen should be drop as a droplet when kept at a temperature 40 deg. C above designed maximum operating temperature of the conductor for 30 minutes. The temperature shall then be increase till one droplet drops and the temperature recorded.

1.10 Shore Hardness Test for Elastomer Cushion for AG Suspension Assembly

The shore hardness at various points on the surface of the elastomer cushion shall be measured by a shore hardness meter and the shore hardness number shall be between 65 to 80.

1.11 Proof Load Test

Each component shall be subjected to a load equal to 50% of the specified minimum ultimate tensile strength which shall be increased at a steady rate to 67% of the UTS specified. The load shall be held for one minute and then removed. After removal of the load the component shall not show any visual deformation.

1.12 Tests for Forging Casting and Fabricated Hardware

The chemical analysis, hardness test, grain size, inclusion rating and magnetic particle inspection for forging, castings and chemical analysis and proof load test for fabricated hardware shall be as per the internationally recognized procedures for these tests. The sampling will be based on heat number and heat treatment batch. The details regarding test will be as in the Quality Assurance program.

1.13 Ozone Test for Elastomer

This test shall be performed in accordance with ASTM D-1171 by the Ozone chamber exposure method (method B). The test duration shall be 500 hours and the ozone concentration 50 PPHM. At the test completion, there shall be no visible crack under a 2 x magnification.

2.0 Tests on Accessories for Conductor

2.1 Mid Span Compression Joint for Conductor

(a) Slip Strength Test

The fitting compressed on conductor shall not be less than one meter in length. The test shall be carried out as per IS:2121 (Part-ii)-1981 clause 6-4 except that the load shall be steadily increased to 95% of minimum ultimate tensile strength of conductor and retained for one minute at this load. There shall be no movement of the conductor relative to the fittings and no failure of the fittings during this one minute period.

(b) Heating Cycle Test

Heating cycle test shall be performed in accordance with IS 2121 (Part-II-1981) with following modifications:-

- i) Temperature of conductor during each cycle: 40 deg. C above designed maximum operating temperature of the conductor.
- ii) Number of cycle: 100
- iii) Slip strength test shall also be carried out after heating cycle test.

2.2 Vibration Damper for Conductor

(a) Dynamic Characteristics, Test

The damper shall be mounted with its clamp tightened with torque recommended by the manufacturer on shaker table capable of simulating sinusoidal vibrations for aeolian vibration frequency band ranging from 5 to 40 Hz for damper for conductor. The damper assembly shall be vibrated vertically with a + 1 mm amplitude from 5 to 15 Hz frequency and beyond 15 Hz at $\pm 0.5\text{mm}$ to determine following characteristics with the help of suitable recording instruments:

- (i) Force Vs Frequency
- (ii) Phase angle Vs frequency
- (iii) Power dissipation Vs. frequency

The Force Vs frequency curve shall not show steep peaks at resonance frequencies and deep troughs between the resonance frequencies. The resonance frequencies shall be suitably spread within the aeolian vibration frequency-band between the lower and upper dangerous frequency, limits determined by the vibration analysis of conductor without dampers. Acceptance criteria for vibration damper.

- (i) The above dynamic characteristics test on five damper shall be conducted. The above dynamic characteristics test on five dampers shall be conducted.
- (ii) The mean reactance and phase angle Vs frequency curves shall be drawn with the criteria of best fit method.
- (iii) The above mean reactance response curve should lie within $0.191 f$ to $0.762f$ Kg/mm limits where f is frequency in Hz.
- (iv) The above mean phase angle response curve shall be between 25° to 130° within the frequency range of interest.
- (v) If the above curve lies within the envelope, the damper design shall be considered to have successfully met the requirement.
- (vi) Visual resonance frequencies of each mass of damper is to be recorded and to be compared with the guaranteed values.

- (b) **Vibration Analysis** The vibration analysis of the conductor shall be done with and without damper installed on the span. The vibration analysis shall be done on a digital computer using energy balance approach. The following parameters shall be taken into account for the purpose of analysis:
- (i) The analysis shall be done for single conductor without armour rods as per the parameters given of this part of the Specification. The tension shall be taken from Sag & Tension calculation (0 deg. C & no wind condition and 320 m ruling span) for a span ranging from 50 m to 1100.
 - (ii) The self damping factor and flexural stiffness (EI) for conductor shall be calculated on the basis of experimental results. The details for experimental analysis with these data should be furnished.
 - (iii) The power dissipation curve obtained from Dynamic Characteristics Test shall be used for analysis with damper.
 - (iv) Examine the aeolian vibration level of the conductor with and without vibration damper installed at the recommended location or wind velocity ranging from 0 to 30 Km per hour, predicting amplitude, frequency and vibration energy input.
 - (iv) From vibration analysis of conductor without damper, anti-node vibration amplitude and dynamic strain levels at clamped span extremities as well as antinodes shall be examined and thus lower and upper dangerous frequency limits between which the Aeolian vibration levels exceed the specified limits shall be determined.
 - (v) From vibration analysis of conductor with damper/dampers installed at the recommended location, the dynamic strain level, at the clamped span extremities, damper attachment point and the antinodes on the conductor shall be determined. In addition to above damper clamp vibration amplitude and anti-node vibration amplitudes shall also be examined.
- The dynamic strain levels at damper attachment points, clamped span extremities and antinodes shall not exceed the specified limits. The damper clamp vibration amplitude shall not be more than that of the specified fatigue limits.

(c) **Clamp Slip and Fatigue Tests**

(i) **Test Set Up**

The clamp slip and fatigue tests shall be conducted on a laboratory set up with a minimum effective span length of 30 m. The conductor shall be tensioned at tension corresponding to 0 deg & no wind condition and ruling span 320 from sag –tension calculation and shall not be equipped with protective armour rods at any point. Constant tension shall be maintained within the span by means of lever arm arrangement. After the conductor has been tensioned, clamps shall be installed to support the conductor at both ends and thus influence of connecting hardware fittings are eliminated from the free span. The clamps shall not be used for holding the tension on the conductor. There shall be no loose parts, such as suspension clamps, U bolts on the test span supported between clamps mentioned above. The span shall be equipped with vibration inducing equipment suitable for producing steady standing vibration. The inducing equipment shall have facilities for stepless speed control as well as stepless amplitude arrangement. Equipment shall be available for measuring the frequency, cumulative number of cycles and amplitude of vibration at any point along the span.

(ii) **Clamp Slip test**

The vibration damper shall be installed on the test span. The damper clamp, after lightning with

the manufacturer's specified tightening torque, when subjected to a longitudinal pull of 2.5 kN parallel to the axis of conductor for a minimum duration of one minute shall not slip i.e. the permanent displacement between conductor and clamp measured after removal of the load shall not exceed 1.0 mm. The load shall be further increased till the clamp starts slipping. The load at which the clamp slips shall not be more than 5 kN.

(iii) Fatigue Test

The vibration damper shall be installed on the test span with the manufacturer's specified tightening torque. It shall be ensured that the damper shall be kept minimum three loops away from the shaker to eliminate stray signals influencing damper movement. The damper shall then be vibrated at the highest resonant frequency of each damper mass. For dampers involving resonant frequencies, tests shall be done at torsional modes also in addition to the highest resonant frequencies at vertical modes. The resonance frequency shall be identified as the frequency at which each damper mass vibrates with the maximum amplitude on itself. The amplitude of vibration of the damper clamp shall be maintained not less than $\pm 25/f$ mm, where f is the frequency in Hz. The test shall be conducted for minimum ten million cycles at each resonant frequency mentioned above. During the, test if resonance shift is observed the test frequency shall be tuned to the new resonant frequency.

The clamp slip test as mentioned hereinabove shall be repeated after fatigue test without re-torquing or adjusting the damper clamp, and the clamp shall withstand a minimum load equal to 80% of the slip strength for a minimum duration of one minute. After the above tests, the damper shall be removed from conductor and subjected to dynamic characteristics test. There shall not be any major deterioration in the characteristic of the damper. The damper then shall be cut open and inspected. There shall not be any broken, loose, or damaged part. There shall not be significant deterioration or wear of the damper. The conductor under clamp shall also be free from any damage.

For the purpose of acceptance, the following criteria shall be applied.

- 1) There shall not be any frequency shift by more than +2 Hz for frequencies lower than 15 Hz and ± 3 Hz for frequencies higher than 15Hz.
- 2) The force response curve shall generally lie within guaranteed % variation in reactance after fatigue test in comparison with that before fatigue test by the Contractor.
- 3) The power dissipation of the damper shall not be less than guaranteed % variation in power dissipation before fatigue test by the Contractor. However, it shall not be less than minimum power dissipation which shall be governed by lower limits of reactance and phase angle indicated in the envelope.

2.3 Corona Extinction Voltage Test (Dry)

The sample when subjected to power frequency voltage shall have a corona extinction voltage of not less than 105 kV rms line to ground under dry condition. There shall be no evidence of corona on any part of the sample. The atmospheric condition during testing shall be recorded and the test results shall be accordingly corrected with suitable correction factor as stipulated in IS:731- 1971.

2.4 Radio Interference Voltage Test (Dry)

Under the conditions as specified under (3.8) above, the sample shall have a radio interference voltage level below 1000 microvolts at one MHz when subjected to 50 Hz AC voltage of 154 kV rms line to ground under dry condition. The test procedure shall be in accordance with IS:8263.

2.5 Tests on All components (As applicable)

2.5.1 Chemical Analysis of Zinc used for Galvanizing Samples taken from the zinc ingot shall be chemically analysed as per IS-209-1979. The purity of zinc shall not be less than 99.95%.

2.5.2 Tests for Forgings

The chemical analysis hardness tests and magnetic particle inspection for forgings, will be as per the internationally recognized procedures for these tests. The, sampling will be based on heat number and heat treatment batch. The details regarding test will be as discussed and mutually agreed to by the Contractor and Employer in Quality Assurance Program.

2.5.3 Tests on Castings

The chemical analysis, mechanical and metallographic tests and magnetic particle inspection for castings will be as per the internationally recognised procedures for these tests. The samplings will be based on heat number and heat treatment batch. The details regarding test will be as discussed and mutually agreed to by the Contractor and Employer in Quality Assurance Program.

ANNEXURE – B

Acceptance Tests

1. Mid Span Compression Joint for Conductor

(a) Hardness Test

The Brinnel hardness at various points on the steel sleeve of conductor core and tension clamp shall be measured.

2. Vibration Damper for Conductor

(a) Verification of Resonance Frequencies

The damper shall be mounted on a shaker table and vibrate at damper clamp displacement of ± 0.5 mm to determine the resonance frequencies. The resonance shall be visually identified as the frequency at which damper mass vibrates with maximum displacement on itself. The resonance frequency thus identified shall be compared with the guaranteed value. A tolerance of ± 1 Hz at a frequency lower than 15 Hz and ± 2 Hz at a frequency higher than 15 Hz only shall be allowed.

(b) Clamp Slip Test Same as Clause 2.2 (c) (ii) of Annexure-A.

(c) Clamp Bolt Torque Test

The clamp shall be attached to a section of the conductor/earthwire. A torque of 150 percent of the manufacturer's specified torque shall be applied to the bolt. There shall be no failure of component parts. The test set up is as described in Clause 2.2 (c) (i) of Annexure-A.

(d) Strength of the Messenger Cable

The messenger cable shall be fixed in a suitable tensile testing machine and the tensile load shall be gradually applied until yield point is reached. Alternatively, each strand of messenger cable may be fixed in a suitable tensile testing machine and the tensile load shall be gradually applied until yield point is reached. In such a case, the 95% of yield strength of each wire shall be added to get the total strength of the cable. The load shall be not less than the value guaranteed by the Contractor

(e) Mass Pull off Test

Each mass shall be pulled off in turn by fixing the mass in one jaw and the clamp in the other of a suitable tensile testing machine. The longitudinal pull shall be applied gradually until the mass begins to pull out of the messenger cable. The pull off loads shall not be less than the value guaranteed by the Contractor.

(f) Dynamic Characteristics Test

The test will be performed as acceptance test with the procedure mentioned for type test with sampling mentioned below:

Vibration Damper of

1 Sample for 1000 Nos. & below Conductor

2 Samples for lot above 1000 & up to 5000 nos. Additional 1 sample for every additional 1500 pieces above 5000.

The acceptance criteria will be as follows

i. The above dynamic characteristics curve for reactance & phase angle will be done for frequency range of 5 Hz to 40 Hz.

ii. If all the individual curve for dampers are within the envelope as already mentioned for type test for reactance & phase angle, the lot passes the test.

- iii. If individual results do not fall within the envelope, averaging of characteristics shall be done.
- a. Force of each damper corresponding to particular frequency shall be taken & average force of three dampers at the frequency calculated.
 - b. Similar averaging shall be done for phase angle.
 - c. Average force Vs frequency and average phase Vs frequency curves shall be plotted on graph paper. Curves of best fit shall be drawn for the entire frequency range.
 - d. The above curves shall be within the envelope specified.

Section – 4

Technical Specification of Composite Long Rod Insulators

Contents

Sr. No.	Description
4.1	Details of Composite Long Rod Insulators
4.2	Dimensional Tolerance of Composite Insulators
4.3	Interchangeability
4.4	Corona and RI Performance
4.5	Maintenance
4.6	Materials
4.7	Workmanship
4.8	Equipment Marking
4.9	Bid Drawings
4.10	Tests and Standards
4.11	Packing and Marking
4.12	Standards

Technical Specifications of Composite Long Rod Insulators

4.1 Details of Composite Long Rod Insulators

- 4.1.1 The insulators of the strings shall consist of composite long rod insulators for transmission system application in a very heavily polluted environment. Couplings shall be ball and socket type.
- 4.1.2 Bidder shall quote such composite insulators which have proven use under foggy/ humid operational conditions in polluted industrial environment combined with smoke and dust particles. The Bidder shall furnish evidence in the form of certification from the power utilities that the similar type of product supplied to them had been performing satisfactory. The Bidder shall also submit certified test report for an accelerated ageing test of 5000 hours such as that described in Appendix-C of IEC-61109.
- 4.1.3 Insulators shall have sheds of the “open aerodynamic profile without any under ribs” with good self- cleaning properties. Insulator shed profile, spacing projection etc. shall be strictly in accordance with the recommendation of IEC-60815.
- 4.1.4 The size of long rod insulator, minimum creepage distance, and the number to be used in different type of strings, their electromechanical strength and mechanical strength of insulator string along with hardware fittings shall be as per the standard technical particulars enclosed at Annexure-B.

4.2 Dimensional Tolerance of Composite Insulators

The tolerances on all dimensions e.g. diameter, length shall be allowed as follows: $\pm (0.04d+1.5)$ mm when $d \leq 300$ mm. $\pm (0.025d+6)$ mm when $d > 300$ mm. Where, d being the dimensions in millimeters for diameter, length as the case may be. The tolerance in creepage distance shall be based on design dimensions and their tolerances. However, no negative tolerance shall be applicable to creepage distance specified in clause 4.1.4.

4.3 Interchangeability

The composite long rod insulators inclusive of the ball & socket connection shall be standard design suitable for use with the hardware fittings of any make conforming to relevant IEC standards.

4.4 Corona and RI Performance

All surfaces shall be clean, smooth, without cuts, abrasions or projections. No part shall be subjected to excessive localized pressure. The insulator and metal parts shall be so designed and manufactured that it shall avoid local corona formation and shall not generate any radio interference beyond specified limit under the operating conditions.

4.5 Maintenance

- 4.5.1 The long rod insulators offered shall be suitable for employment of hot line maintenance technique so that usual hot line operation can be carried out with ease, speed and safety.
- 4.5.2 All insulators shall be designed to facilitate cleaning and insulators shall have the minimum practical number of sheds and grooves. All grooves shall be so proportioned that any dust deposit can be removed without difficulty either by wiping with a cloth or by remote washing under live line condition.

4.6 Materials

- 4.6.1 It shall be a glass-fiber reinforced (FRP rod) epoxy resin rod of high strength. The rod shall be resistant to hydrolysis. Glass fibers and resin shall be optimized. The rod shall be electrical grade corrosion resistant (ECR), boron free glass and shall exhibit both high electrical integrity and high resistance to acid corrosion.

4.7 Workmanship

- 4.7.1 All the materials shall be of latest design and conform to the best modern practices adopted in the extra high voltage field. Bidders shall offer only such insulators as are guaranteed by him to be satisfactory and suitable for transmission lines specified and will give continued good service.
- 4.7.2 The design, manufacturing process and material control at various stages shall be such as to give maximum working load, highest mobility, best resistance to corrosion, good finish and elimination of sharp edges and corners to limit corona and radio interference.
- 4.7.3 The design of the insulators shall be such that stresses due to expansion and contraction in any part of the insulator shall not lead to deterioration.
- 4.7.4 The core shall be sound and free of cracks, impurities and voids that may adversely affect the insulators.
- 4.7.5 Weather sheds/ Housing shall be uniform in quality. It shall be free from voids and impurities. Weather sheds/ Housing shall be clean, sound, smooth and free from gross defects and excessive flashing at parting lines.
- 4.7.6 End fittings shall be free from cracks, seams, shrinks, air holes and rough edges. End fittings should be effectively, sealed to prevent moisture ingress, effectiveness of sealing system must be supported by test documents. All surfaces of the metal parts shall be perfectly smooth with the projecting points or irregularities which may cause corona. All load bearing surfaces shall be smooth and uniform so as to distribute the loading stresses uniformly.
- 4.7.7 All ferrous parts shall be hot dip galvanized to give a minimum average coating of zinc equivalent to 600 gm/sq.m. and shall be in accordance with the requirement of ISO:1461 (E) and shall satisfy the tests mentioned in ISO:1460 (E). The zinc used for galvanizing shall be of purity of 99.95%. The zinc coating shall be uniform, adherent, smooth, reasonably bright continuous and free from imperfections such as flux, ash rust stains, bulky white deposits and blisters. The galvanized metal parts shall be guaranteed to withstand at least six successive dips each lasting for one (1) minute duration under the standard preece test. The galvanizing shall be carried out only after any machining.

4.8 Equipment Marking

- 4.8.1 Each composite long rod unit shall be legibly and indelibly marked with the trade mark of the manufacturer, name of MePTCL and month & year of manufacture. The guaranteed combined mechanical and electrical strength shall be indicated in kilo Newton followed by the word 'kN' to facilitate easy identification and to ensure proper use.
- 4.8.2 One 10 mm thick ring or 20 mm thick spot of suitable quality of paint shall be marked on the cap/end fitting of each composite long rod of particular strength for easy identification of the type of insulator. The paint shall not have any deteriorating effect on the insulator performance. Following codes shall be used as identification mark:

For 70 kN long rod unit : Black
 For 90 kN long rod unit : Red
 For 120 kN long rod unit : Yellow

4.9 **Bid Drawings**

4.9.1 The Bidder shall furnish full description and illustration of the material offered.

4.9.2 The Bidder shall furnish along with the bid the outline drawing of each insulator unit along with grading rings including a cross sectional view of the long rod insulator unit. The drawing shall include but not limited to the following information:

- a) Major Dimensions with manufacturing tolerances
- b) Number of sheds
- c) Minimum Creepage distance with positive tolerance
- d) Protected creepage distance
- e) Unit mechanical and electrical characteristics
- f) Size and weight of ball and socket parts
- g) Weight of composite long rod units
- h) Materials

4.9.3 After placement of award, the Supplier shall submit full dimensioned insulator drawings containing all the details as given in Clause No. 3.2 above, in four (4) copies to Purchaser for approval. After getting approval from Purchaser, the Supplier shall submit 10 more copies of the same drawing along with a soft copy to the Purchaser for further distribution and field use at Purchasers end.

4.9.4 After placement of award the Supplier shall also submit fully dimensioned insulator crate drawing for different type of insulators.

4.10 **Tests and Standards**

4.10.1 Type Tests

The required type tests on composite long rod units, components, materials and complete strings are stipulated hereunder. The specified type tests under the following clause shall not be required to be carried out if a valid test certificate is available for a similar design. The tests certificate shall be considered valid if:

- i. Tests conducted earlier is either conducted in accredited laboratory (accredited based on ISO/IEC vide 25/17025 or EN 45001 by the National accreditation body of the country where laboratory is located) or witnessed by the representative(s) of MePTCL. Tests have been conducted not prior to 10 (ten) years from the date of bid opening. In case the test have been conducted earlier than the above stipulated period or in the event of any discrepancy in the test report (i.e., any test not applicable due to any design/manufacturing change including substitution of components or due to non-compliance with the requirement stipulated in the Technical Specifications), the tests shall be conducted by the Supplier at no extra cost to the Purchaser.
- a) On the complete composite Long Rod Insulator String with Hardware Fittings:

Sl. No.	Tests	Ref	Strings on which test to be conducted*
a)	Power frequency / DC voltage withstand test with corona control rings/grading ring and arcing horns under wet condition	IEC: 383-1993/ IEC:60-1	All strings

b)	Switching surge voltage withstand test under wet condition	IEC:383-1993 A	All strings
c)	Impulse voltage withstand test under dry condition	IEC:383-1993	All strings
d)	Corona (AC / DC) and RIV test under dry condition (applicable for 132kV & above voltage level)	As per Annex-A/ B	All strings
e)	Vibration test	As per Annex-A/ B	All strings except Pilot *
f)	AC Salt-fog pollution withstand test / DC Pollution withstand test A	Annex-A	All strings except Pilot *

*Tests indicated at f) & g) shall not be required to be carried out on DIS & DT strings of 132 & 220kV TL and Single Tension strings of 400kV & 765 kV TL

These type tests on the insulator string assembly shall not be required to be repeated due to use of specified size of grading rings even in case valid type test reports for the offered composite long rod insulator strings are available with different size of grading rings.

b) On Composite Insulator Units

a)	Tests on interfaces and connections of metal fittings	EC: 61109-2008
b)	Assembled core load time test	IEC: 61109-2008
c)	Damage limit proof test and test of tightness of interface between end fittings and insulator housing.	IEC: 61109-2008
d)	High Pressure washing test	Annexure-A
e)	Brittle fracture resistance test	Annexure-A
f)	Dye penetration test	EC: 61109-2008
g)	Water diffusion tes	IEC: 61109-2008
h)	Tracking and erosion test	EC: 61109-2008
i)	Hardness test	IEC: 61109-2008
j)	Accelerated weathering tes	IEC: 61109-2008
k)	Flammability test	IEC: 61109-2008
l)	Silicone content test	Annexure-A
m)	Recovery of Hydrophobicity test	Annexure-A
n)	Torsion test	Annexure-A

Hardness test, Accelerated weathering test & Flammability test specified under Clause No.4.1.2 above shall be conducted on housing/ weather shed of anyone rating of composite long rod Insulator for the same type of material.

4.10.2 Acceptance Tests:

a) For Composite Long Rod Insulators

a)	Verification of dimensions	IEC : 61109-2008
b)	Galvanizing test	IEC : 60383
c)	Verification of end fittings	IEC: 61109 -2008
d)	Recovery of Hydrophobicity	Annexure-A
e)	Verification of tightness of interface between end fittings and insulator housing and of specified mechanical load	IEC : 61109-2008
f)	Tests on interfaces and connections of metal fittings	IEC: 61109-2008
g)	Silicone content test	Annexure-A

h)	Brittle Fracture Resistance Test	Annexure-A
i)	Dye Penetration Test	IEC :61109-2008
j)	Water Diffusion Test	IEC : 61109-2008

The test 3.10.2. (f) to (j) shall be carried out as acceptance test on any one lot. In the event of failure of the sample to satisfy the acceptance test(s) specified in 4.10.2 above, the retest procedure shall be as per IEC 61109.

4.10.3 Routine Tests

a) For Composite Long Rod Insulator Units

a)	Visual Examination	As per IEC:61109-2008
b)	Mechanical routine test	As per IEC:61109 -2008

4.10.4 Tests During Manufacture

On all components as applicable

a)	Chemical analysis of zinc used for galvanizing	As per Annexure-A
b)	Chemical analysis, mechanical, metallographic test and magnetic particle inspection for malleable castings.	As per Annexure-A
c)	Chemical analysis hardness tests and magnetic particle inspection for forgings	As per Annexure-A
d)	Tracking and erosion test on insulating material	IEC 60587

4.10.5 Testing Expenses

- a) No type test charges shall be payable to the supplier.
- b) For Type Tests which involves the tests on the complete insulator string with hardware fitting, standard hardware fittings similar to existing insulator strings shall be arranged and used by the insulator supplier at his own cost.
- c) In case of failure in any type test the supplier is either required to modify the design of the material & successfully carryout all the type tests as has been detailed out in Clause 4.10 of this specifications or to repeat that particular type test at least three times successfully at his own expenses.
- d) Bidder shall indicate the laboratories in which they propose to conduct the type tests. They shall ensure that adequate facilities are available in the laboratory and the tests can be completed in these laboratories within the time schedule guaranteed by them in the appropriate schedule.
- e) The entire cost of testing for acceptance and routine tests and tests during manufacture specified herein shall be treated as included in the quoted Ex-works/CIF Price.
- f) In case of failure in any type test, if repeat type tests are required to be conducted, then all the expenses for deputation of Inspector/ Purchaser's representative shall be deducted from the contract price. Also if on receipt of the Supplier's notice of testing, the Purchaser's representative does not find the material or test setup / equipments to be ready for testing, the expenses incurred by the Purchaser for re-deputation shall be deducted from contract price.
- g) The Supplier shall intimate the Purchaser about carrying out of the type tests along with detailed testing program at least 3 weeks in advance (in case of testing in India) and at least 6 weeks advance (in case of testing abroad) of the scheduled date of testing during which the Purchaser will arrange to depute his representative to be present at the time of carrying out the tests.

4.10.6 Sample Batch for Type Testing

- a) The Supplier shall offer material for sample selection for type testing only after getting Quality Assurance Program approved by the Purchaser. The Supplier shall offer at least three times the quantity of materials required for conducting all the type tests for sample selection. The sample for type testing will be manufactured strictly in accordance with the Quality Assurance Program approved by the Purchaser.
- b) Before sample selection for type testing, the Supplier shall be required to conduct all the acceptance tests successfully in presence of Purchaser's representative.

4.10.7 Schedule of Testing

- a) The Bidder has to indicate the schedule of following activities in their bids:
 - a) Submission of drawing for approval.
 - b) Submission of Quality Assurance Program for approval.
 - c) Offering of material for sample selection for type tests.
 - d) Type testing.

4.10.8 Additional Tests

- a) The Purchaser reserves the right of having at his own expenses any other test(s) of reasonable nature carried out at Supplier's premises, at site, or in any other place in addition to the aforesaid type, acceptance and routine tests to satisfy himself that the material comply with the Specifications.
- b) The Purchaser also reserves the right to conduct all the tests mentioned in this specification at his own expense on the samples drawn from the site at Supplier's premises or at any other test center. In case of evidence of non-compliance, it shall be binding on the part of the Supplier to prove the compliance of the items to the technical specifications by repeat tests or correction of deficiencies or replacement of defective items, all without any extra cost to the Purchaser.

4.10.9 Guarantee

The Supplier of insulators shall guarantee overall satisfactory performance of the insulators.

4.10.10 Test Reports

- a) Copies of type test reports shall be furnished in at least six (6) copies along with one original. One copy shall be returned duly certified by the Purchaser only after which the commercial production of the concerned material shall start.
- b) Copies of acceptance test reports shall be furnished in at least six (6) copies. One copy shall be returned duly certified by the Purchaser, only after which the material shall be dispatched.
- c) Record of routine test reports shall be maintained by the Supplier at his works for periodic inspection by the Purchaser's representative.
- d) Test certificates of test during manufacture shall be maintained by the Supplier. These shall be produced for verification as and when desired by the Purchaser.

4.10.11 Inspection

- a) The Purchaser's representative shall at all times be entitled to have access to the works and all places of manufacture, where insulator, and its component parts shall be manufactured and the representatives shall have full facilities for unrestricted inspection of the Supplier's and sub-Supplier's works, raw materials, manufacture of the material and for conducting necessary test as detailed herein.

- b) The material for final inspection shall be offered by the Supplier only under packed condition as detailed in clause No. 4.10 of the specification. The Purchaser shall select samples at random from the packed lot for carrying out acceptance tests. The lot should be homogeneous and should contain insulators manufactured in 3-4 consecutive weeks.
- c) The Supplier shall keep the Purchaser informed in advance of the time of starting and the progress of manufacture of material in their various stages so that arrangements could be made for inspection.
- d) No material shall be dispatched from its point of manufacture before it has been satisfactorily inspected and tested unless the inspection is waived off by the Purchaser in writing. In the latter case also the material shall be dispatched only after satisfactory testing for all tests specified herein have been completed.
- e) The acceptance of any quantity of material shall be no way relieve the Supplier of his responsibility for meeting all the requirements of the specification and shall not prevent subsequent rejection, if such material are later found to be defective.

4.11 **Packing and Marking**

- a) All insulators shall be packed in suitable PVC/ plastic tubes of at least 3 mm thickness or water resistant packing material and the packaging shall not break during storage & transportation even in overhang condition during transportation. Further, last 20% quantities of insulators shall be packed in PVC/ plastic tubes only to ensure long storage of about 5 years. The packing shall provide protection against rodent. The Supplier shall furnish detailed design of the packing. For marine transportation, crates shall be palletted.
- b) The packing shall be of sufficient strength to withstand rough handling during transit, storage at site and subsequent handling in the field.
- c) Suitable cushioning, protective padding, or dun age or spacers shall be provided to prevent damage or deformation during transit and handling.
- d) All packing cases shall be marked legibly and correctly so as to ensure safe arrival at their destination and to avoid the possibility of goods being lost or wrongly dispatched on account of faulty packing and faulty or illegible markings. Each case/crate shall have all the markings stenciled on it in indelible ink.
- e) The Supplier shall guarantee the adequacy of the packing and shall be responsible for any loss or damage during transportation, handling, storage and installation due to improper packing.

4.12 **Standards**

The insulator strings and its components shall conform to the following Indian / International Standards which shall mean latest revision, with amendments /changes adopted and published, unless specifically stated otherwise in the Specification.

- a) In the event of supply of insulators conforming to standards other than specified, the Bidder shall confirm in his bid that these standards are equivalent or better to those specified. In case of award, salient features of comparison between the standards proposed by the Bidder and those specified in this document will be provided by the Supplier to establish equivalence.

Sl.No	Indian Standard	T i t l e	International Standard
1	IS:209-1992	Specification for zinc	BS:343
2	S:406-1991	Method of Chemical Analysis of Slab Zinc	BS:3436
3	IS:731-1991	Porcelain insulators for overhead Power lines with a nominal voltage greater than 1000 V	BS:137- (I&II) IEC:60383
4	IS:2071 Part(I)-1993 (Part(II)-1991 Part(III)- 1991	Methods of High Voltage Testing	IEC:60060-1
5	IS:2486 Part- I-1993 Part- II-1989 Part-III-1991	Specification for Insulator fittings for Overhead Power Lines with a nominal voltage greater than 1000V General Requirements and Tests Dimensional Requirements Locking Devices	BS:3288 IEC:60120 IEC:60372
6	IS:2629-1990	Recommended Practice for Hot, Dip Galvanization for iron and steel	ISO-1461 (E)
7	IS:2633-1992	Testing of Uniformity of Coating of zinc coated articles	
8	IS:6745-1990	Determination of Weight of Zinc Coating on Zinc coated iron and steel articles	BS:433-1969 ISO:1460-1973
9	IS:8263-1990	Methods of RI Test of HV insulators	IEC:60437 NEMA Publication No.07/ 1964/ CISPR
10	IS:8269-1990	Methods for Switching Impulse test on HV insulators	IEC:60506
11		Thermal Mechanical Performance test and mechanical performance test on string insulator units	IEC: 60575
12		Salt Fog Pollution Voltage Withstand Test	IEC:60507
13		Composite insulators for A.C. Overhead lines with nominal voltage greater than 1000V – Definitions, test methods and acceptance criteria	IEC 61109
14		Selection and dimensioning of high voltage insulators intended for use in polluted conditions: Polymer Insulators for AC systems	IEC:60815-3
15		Tests on insulators of Ceramic material or glass or glass for overhead lines with a nominal voltage greater than 1000V	IEC:60383
16		Composite string insulator units for overhead lines with a nominal voltage above 1000V : Standard strength classes and end fittings	IEC 61466-1
17		Composite string insulator units for overhead lines with a nominal voltage above 1000V : Dimensional and electrical characteristics	IEC 61466-2
18		Electrical Insulating materials used under severe ambient conditions –Test methods for evaluating resistance to tracking and erosion	IEC 60587
19		Polymeric insulators for indoor and outdoor use with nominal voltage greater than 1000V- General definitions, tests, methods and acceptance criteria.	IEC 62217

The standards mentioned above are available from:

Reference Abbreviation	Name and Address
BS	British Standards, British Standards Institution 101, Pentonville Road, N - 19-ND, UK
EC/CISPR	International Electro technical Commission, Bureau Central de la Commission, electro Technique international, 1 Rue de verembe, Geneva, SWITZERLAND
BIS/IS	Bureau Of Indian Standards. Manak Bhavan, 9, Bahadur Shah ZafarMarg, New Delhi - 110001.INDIA
ISO	International Organisation for Standardization. Danish Board of Standardization Danish Standardizing Sraat, Aurehoegvej-12 DK-2900, Heelestrup, DENMARK
NEMA	National Electric Manufacture Association, 155, East 44th Street. New York, NY 10017U.S.A
ASTM	American Society for Testing and Materials, 1916 Race St. Philadelphia, PA19103 USA

ANNEXURE - A

1. Tests on Complete Strings with Hardware Fittings

1.1 Mechanical Strength Test

The complete insulator string along with its hardware fitting excluding arcing horn, corona control ring, grading ring and suspension assembly/ dead end assembly shall be loaded to reproduce design conditions. The testing program varies with string and tower types according to following table:

String Type T	Total Test Load* (kN)	Direction** of Load	Duration of Load (Min.)	Sequence of Testing ***
(Type of Conductor)				
Double Suspension	94	1	5	1
	140	1	1	2
	F****	1	-	3
Single Suspension	47	1	5	1
	70	1	1	2
	F****	1	-	3
Single Tension	60	1	5	1
	90	1	1	2
	F****	1	-	3
Double Tension	120	1	5	1
	180	1	1	2
	F****	1	-	3

* : The total test must be established gradually at a steady rate.

** : Direction of load

1. following string axis
2. following bisector of string angle.
3. Following with respect to vertical, half the string angle, along the axis of one of the arm of the V-string
4. Following with respect to vertical, half the string angle +15 deg, along the axis of one of the arm of the Vstring

*** : The insulator string must be completely unloaded and examined, then the proper direction of loading established before proceeding to the next sequential test.

****: F denotes Failure load The insulator string shall be deemed acceptable if, for all tests loads except failure load, the string components do not show any visual signs of deformation or fracture, and the same components may be disassembled by hand, except for removal of cotter pins and initial loosening of the nuts. The failure load shall be recorded and must be greater than all previous tests loads.

1.2 Vibration Test

The suspension string shall be tested in suspension mode, and tension string in tension mode itself in laboratory span of minimum 30 meter. In the case of suspension string a load equal to 600 kg shall be applied along the axis of the suspension string by means of turn buckle. The insulator string along with hardware fittings and specified no. of sub-conductors each tensioned at 25 % of UTS of the conductor shall be secured with clamps. The system shall be suitable to maintain constant tension on each sub-conductors throughout the duration of the test. Vibration dampers

shall not be used on the test span. Both the sub conductors shall be vertically vibrated simultaneously at one of the resonance frequencies of the insulators string (more than 10 Hz) by means of vibration inducing equipment. The peak to peak displacement in mm of vibration at the antinode point, nearest to the string, shall be measured and the same shall not be less than $1000/f$ 1.8 where f is the frequency of vibration in cycles/sec. The insulator string shall be vibrated for not less than 10 million cycles without any failure. After the test the insulators shall be examined for looseness of pins and cap or any crack in the cement. The hardware shall be examined for looseness, fatigue failure and mechanical strength test. There shall be no deterioration of properties of hardware components and insulators after the vibration test. The insulators shall be subjected to the following test for a tension of 25 KN (132kV line) as per relevant standards:

1.1 AC Salt-fog pollution withstand test

This test shall be carried out in accordance with IEC: 60507. The salinity level for composite long rod insulators shall be 160Kg/m³ NaCl.

1.2 DC pollution withstand test

This test shall be carried out as per IEC-61245 with solid layer method. The D.C. pollution withstand voltage (negative) shall be 500kV for +/-500kV HVDC insulators as applicable at average ESDD of 0.1 mg / sq. cm.

2.0 Composite Long rod Insulator Units

2.1 Brittle Fracture Resistance Test

The test arrangement shall be according to Damage limit proof test with simultaneous application of 1NHNO₃ acid directly in contact with naked FRP rod. The contact length of acid shall not be less than 40mm and thickness around the core not less than 10mm. The rod shall withstand 80% of SML for 96 hours.

2.2 Recovery of Hydrophobicity Test

- (1) The surface of selected samples shall be cleaned with isopropyl alcohol. Allow the surface to dry and spray with water. Record the HC classification. Dry the sample surface.
- (2) Treat the surface with corona discharges to destroy the hydrophobicity. This can be done utilizing a high frequency corona tester, Holding the electrode approximately 3mm from the sample surface, slowly move the electrode over an area approximately 1" x 1". Continue treating this area for 2 – 3 minutes, operating the tester at maximum output.
- (3) Immediately after the corona treatment, spray the surface with water and record the HC classification. The surface should be hydrophilic, with an HC value of 6 or 7. If not, dry the surface and repeat the corona treatment for a longer time until an HC of 6 or 7 is obtained. Dry the sample surface.
- (4) Allow the sample to recover and repeat the hydrophobicity measurement at several time intervals. Silicone rubber should recover to HC 1 – HC 2 within 24 to 48 hours, depending on the material and the intensity of the corona treatment.

2.3 Silicone content test

Minimum content of silicone as guaranteed by supplier shall be verified through FT-IR spectroscopy & TGA analysis or any other suitable method mutually agreed between Purchaser & Supplier in Quality Assurance Program.

- 2.4 High Pressure washing test
- The washing of a complete insulator of each E&M rating is to be carried out at 3800kPa with nozzles of 6mm diameter at a distance of 3m from nozzles to the insulator. The washing shall be carried out for 10minutes. There shall be no damage to the sheath or metal fitting to housing interface. The verification shall be 1 minute wet power frequency withstand test at 275kV r.m.s for 132 KV.
- 2.5 Torsion Test
- Three complete insulators of each E&M rating shall be subjected to a torsional load of 55 Nm. The torsional strength test shall be made with test specimen adequately secured to the testing machine. The torsional load shall be applied to the test specimen through a torque member so constructed that the test specimen is not subjected to any cantilever stress. The insulator after torsion test must pass the Dye Penetration Test as per IEC 61109
2. Tests on All components (As applicable)
- 2.1 Chemical Analysis of Zinc used for Galvanizing
- 2.2 Samples taken from the zinc ingot shall be chemically analyzed as per IS: 209-1979. The purity of zinc shall not be less than 99.95%.
- 2.3 Tests for Forgings
- The chemical analysis hardness tests and magnetic particle inspection for forgings, will be as per the internationally recognized procedures for these tests. The sampling will be based on heat number and heat treatment batch. The details regarding test will be as discussed and mutually agreed to by the Supplier and Owner in Quality Assurance Program.
- 2.4 Tests on Castings The chemical analysis, mechanical and metallographic tests and magnetic, particle inspection for castings will be as per the internationally recognized procedures for these tests. The samplings will be based on heat number and heat treatment batch. The details regarding test will be as discussed and mutually agreed to by the Supplier and Owner in Quality Assurance Program.
- 2.5 Autoclave Test For cement used in the assembly of the insulators six samples from different batches shall be tested in accordance with ASTM C-151. The cement shall have an expansion less than 0.12%.

Section – 5

Technical Specifications for stringing activities of ACSR Panther Conductor

Content

Sr. No.	Description
5.1	Site Inspection Report
5.2	Environmental Conditions
5.3	Span and clearances
5.4	Electrical Clearances
5.5	Stringing of Conductor and Installation of Line Materials
5.6	Final checking, Testing and Commissioning
5.1	Site Inspection
5.1.1	Site Inspection Report
	The contractor shall visit the site to inspect the transmission line and collect observations/information which would be useful for stringing activity & bidding. Complete BOQ of the each transmission line for re-conductoring shall be furnished in the report & is to be got approved.
	a) All observations/ information which the Contractor thinks would be useful to implement the reconductoring of the existing transmission line mentioned under scope of work are to be reported & timely.
	b) The detailed procedure for carrying out the reconductoring shall be submitted to the site Engineer-in-charge before taking up the work
	c) Suggestions regarding location for setting up stores during line construction in consultation with Employer representative shall also be provided by the contractor.
	d) Working months available during various seasons along the transmission line, with period, time of sowing & harvesting of different type of crops and the importance attached to the crops particularly in the context of way leave problems and compensation payable shall be stated by the Contractor.
	e) Some portions of the line may require clearance from various authorities. The Contractor shall indicate the portion of the line so affected, the nature of clearance required and the name of concerned organizations such as local bodies, municipalities, P&T (name of circle), Inland navigation, Irrigation Department, Electricity Boards and Zonal railways, Divisional Forest Authorities etc.
	f) All the requisite data for processing the case of statutory clearances such as PTCC, Forest and Railway shall be provided along with the report.
	g) Six copies of survey reports shall be furnished by the contractor to the Employer.
5.2	Environmental Conditions
5.2.1	The line route passing through forest stretches if any shall be indicated to the successful Bidder.
5.2.2	General Climatic Conditions Climatic conditions shall be of tropical nature having summer period for 8 months and winter period for 4 months in a year. Working season shall be approximately 9

months/year and balance 3 months shall be monsoon period. The maximum temperature during summer shall be of the order of 50°C and the minimum temperature in the winter shall be of the order of 4°C. Normal everyday temperature is 32°C.

5.2.3 Statutory Regulations and Standards

4.2.3.1 Statutory Regulations

The Contractor is required to follow local statutory regulations stipulated in Electricity (Supply) Act 1948, Indian Electricity Rules, 1956 as amended and other local rules and regulations referred in these Specifications.

4.2.3.2 Reference Standards

The Codes and/or standards referred to in the specifications shall govern, in all cases wherever such references are made. In case of a conflict between such codes and/or standards and the specifications, latter shall govern. Such codes and/or standards, referred to shall mean the latest revisions, amendments/changes adopted and published by the relevant agencies. Other internationally accepted standards which ensure equal or better performance than those specified shall also be accepted, subject to prior approval by the Employer.

5.3 Span and clearances

5.3.1 Normal Span

The normal ruling span of the line on panther conductor is 320 m..

5.3.2 Wind Span

The wind span is the sum of the two half spans adjacent to the support under consideration. For normal horizontal spans this equals to normal ruling span.

5.3.3 Weight span

The weight span is the horizontal distance between the lowest point of the conductors on the two spans adjacent to the tower.

5.4 **Electrical Clearances**

5.4.1. Ground Clearance

The minimum ground clearance from the bottom conductor is not to be less than 6100 mm for 132KV line, at the maximum sag conditions corresponding to maximum continuous operating temperature and still air.

5.5 **Stringing of Conductor and Installation of Line Materials**

5.5.1 General

- a) The scope of erection work shall include the cost of all labour, tools and plant and all other incidental expenses in stringing work. The contractor shall have to string with the equivalent ACSR PANTHER Conductor section wise and restore the line in original conditions as per program finalized in co-ordination with site. Stringing of the line shall be carried out under induced voltage condition i.e. one circuit under charged condition. Adequate safety measures and precautions shall be taken by the Contractor during this erection work.
- b) The Contractor shall be responsible for transportation to site of all the materials to be provided by the Contractor as well as proper storage and preservation of the same at his own cost, till such time the erected line is taken over by the Employer. Similarly, the Contractor shall be responsible for proper storage, safe custody, and loss or damage of all Employer's supplied items, if any, as well

as its transportation to site for incorporation in the lines and shall maintain and render proper account of all such materials at all times. The Contractor shall reimburse the cost of any of the materials lost or damaged during storage and erection beyond the limits permitted under this specification.

- c) Contractor shall set up required number of stores along the line and the exact location of such stores shall be discussed and agreed upon with the Employer.
- d) Payment for stringing shall be done on the basis of per kilometer and irrespective of number of tension/suspension towers.
- e) The complete work including installation of line materials (insulator strings, hardware and accessories for conductor) shall be supervised by a team of supplier/Contractor's engineers / supervisory staff/ workmen already experienced in stringing work associated with the type of ACSR PANTHER Conductor being supplied. The contractor shall furnish experience details of the engineers /supervisory staff proposed to be deployed.
- f) The scope of work of the contractor shall inter-alia include the following:-
 - i. Installation of necessary hardware, hoisting of insulator strings, installing & stringing of ACSR PANTHER Conductor including fixing of conductor accessories. Corona control rings/arcing horn shall be fitted in an approved manner. Torque wrench shall be used for fixing various line materials and components.

5.5.2 Handling of Conductor

a. Running Out of the Conductors

The conductors shall be run out of the drums from the top in order to avoid damage. The Contractor shall be entirely responsible for any damage to tower or conductors during stringing.

A suitable braking device shall be provided to avoid damaging, loose running out and kinking of the conductors. Care shall be taken that the conductors do not touch and rub against the ground or objects which could scratch or damage the strands.

The sequence of running out shall be from the top down. Unbalanced loads on towers shall be avoided as far as possible. Inner phase of line conductors shall be strung before the stringing of the outer phases is taken up.

Tower not designed for one sided stringing shall be well guyed and step taken by contractor to avoid damage. Guying proposal along with necessary calculation shall be submitted by the contractor to Employer for approval. All expenditure related to this work is deemed to be included in the bid price and no extra payment shall be made for the same.

The Contractor shall take adequate safety precautions to protect personnel; from the potentially dangerous voltage build up due to electromagnetic and electrostatic coupling in the pulling wire, conductors during stringing operations. These precautions include measures taking in account the other circuit on the line under live conditions.

The Contractor shall also take adequate safety precautions to protect personnel from potentially dangerous voltage build up due to distant electrical storms/energized lines.

b. Running Blocks

The groove of the running blocks shall be of such a design that the seat is semicircular and larger than the diameter of the conductor and it does not slip over or rub against the slides. The grooves

shall be lined with hard rubber or neoprene to avoid damage to conductor and shall be mounted on properly lubricated bearings.

The running blocks shall be suspended in a manner to suit the design of the cross-arm. All running blocks, especially at the tensioning end will be fitted on the cross-arms with jute cloth wrapped over the steel work and under the slings to avoid damage to the slings as well as to the protective surface finish of the steel work.

c. Repairs to Conductors

The conductor shall be continuously observed for loose or broken strands or any other damage during the running out operations.

Repairs to conductor where no more than two strands in the outermost layer are broken shall be carried out with repair sleeve with approval of Engineer-Incharge.

Repairing of the conductor surface shall be carried out only in case of minor damage, scuff marks, etc. The final conductor surface shall be clean, smooth and free from projections, sharp points, cuts, abrasions, etc. The Contractor shall be entirely responsible for any damage to the towers during stringing.

d. Crossings

Derricks or other equivalent methods ensuring that normal services need not be interrupted nor damage caused to property shall be used during stringing operations where roads, channels, telecommunication lines, power lines and railway lines have to be crossed. In case of railway crossings, shutdown might not be available and therefore, contractor shall be required to carry out Reconductoring under such condition i.e. without any shutdown of railways. However, shut down shall be obtained when working at crossings of overhead power lines. The Contractor shall be entirely responsible for the proper handling of the conductor and accessories in the field.

5.5.3 Stringing of Conductor

a. The stringing of the ACSR PANTHER conductor shall be done by the standard stringing method suitable for the type of ACSR PANTHER Conductor offered.

The Contractor shall deploy appropriate tools/ equipments/ machinery to ensure that the stringing operation is carried out without causing damage too conductor and the conductor is installed at the prescribed sag tension as per the approved stringing chart. Prior to taking up stringing work the contractor shall submit for approval of Site-In charge the complete details of stringing methods he proposes to follow. For stringing of ACSR PANTHER Conductor by the contractor, a set of those tools & tackles shall be supplied by the contractor to the Employer, on completion of the project, at no extra cost. The quantity of such tools & tackles shall be sufficient to carry out stringing operations of the longest section (from angle tower to angle tower) of the existing transmission line.

b. The contractor shall submit, for approval of site in-charge, the complete details of the stringing methods he proposes to follow. Prior to stringing the Contractor shall submit the stringing charts for the conductor showing the initial and final sags and tension for various temperatures and spans along with equivalent spans in the lines for the approval of the Employer.

5.5.4 Jointing

- a. Conductor shall not crack or otherwise be susceptible to damage in the stringing operation. The Contractor shall use only such equipment/methods during conductor stringing which ensures complete compliance in this regard.
- b. No joints shall be made in spans crossing over main roads, railways and small river tension spans. Not more than one joint per sub conductor per span shall be allowed. The compression type fittings shall be of the self-centering type or care shall be taken to mark the conductors to indicate when the fitting is centered properly. During compression or splicing operation; the conductor shall be handled in such a manner as to prevent lateral or vertical bearing against the dies. After compressing the joint the aluminum sleeve shall have all corners rounded, burrs and sharp edges removed and smoothened.
- c.. During stringing of conductor to avoid any damage to the joint, the Contractor shall use a suitable protector for mid span compression joints, in case they are to be passed over pulley blocks/aerial rollers. The pulley groove size shall be such that the joint along with protection can be passed over it smoothly.

5.5.5 Tensioning and Sagging Operations

- a. The tensioning the sagging shall be done in accordance with the approved stringing charts or sag tables. The “initial” stringing chart shall be used for the conductor. The conductors shall be pulled up to the desired sag and left in running blocks for at least one hour after which the sag shall be rechecked and adjusted, if necessary, before transferring the conductors from the running blocks to the suspension clamps.
- b. The sag will be checked in the first and the last section span for sections up to eight spans, and in one additional intermediate span for sections with more than eight spans. The sag shall also be checked when the conductors have been drawn up and transferred from running blocks to the insulator clamps.
- c. The running blocks, when suspended from the transmission structure for sagging, shall be so adjusted that the conductors on running blocks will be at the same height as the suspension clamp to which it is to be secured.
- d. At sharp vertical angles, conductor and earth wire sags and tensions shall be checked for equality on both sides of the angle and running block. The suspension insulator assemblies will normally assume verticality when the conductor is clamped.
- e. Tensioning and sagging operations shall be carried out in calm whether when rapid changes in temperature are not likely to occur.

5.5.6 Clipping In

- a. Clipping of the conductors into position shall be done in accordance With the manufacturer’s recommendations.
- b. Jumpers at section and angle towers shall be formed to parabolic shape as per existing tower line diagrams to ensure minimum clearance requirements.
- c. Fasteners in all fittings and accessories shall be secured in position. The security clip shall be properly opened and sprung into position.

5.5.7 Fixing of Conductors Accessories

Conductor accessories and vibration dampers shall be installed by the Contractor as per the design requirements and manufacturer's instruction within 24 hours of the conductor clamping. While installing the conductor accessories, proper care shall be taken to ensure that the surfaces are clean and smooth and that no damage occurs to any part of the accessories or of the conductors. Torque wrench shall be used for fixing the Dampers/Spacer Dampers, Suspension Clamps etc. and torque recommended by the manufacturer of the same shall be applied

5.6 **Final checking, Testing and Commissioning**

After completion of the works, final checking of the line shall be carried out by the Contractor to ensure that all foundation works, tower erection and stringing have been done strictly according to the specifications and as approved by the Employer. All the works shall be thoroughly inspected in order to ensure that:

- a) The stringing of the conductors has been done as per the approved sag and tension charts and desired clearances are clearly available;
- b) All conductor accessories are properly installed;
- c) The original tracings of profile are submitted to the Employer for reference and record.
- d) The insulation of the line as a whole is tested by the Supplier through provision of his own equipment, labour etc., to the satisfaction of the Employer.
- e) The line is tested satisfactorily for commissioning purpose.

Section – 6
Technical Data Sheet

Contents

Schedule – 1	ACSR PANTHER conductor
Schedule – 2	Suspension Hardware Fitting for ACSR PANTHER Conductor Schedule
Schedule – 3	Tension Hardware Fitting for ACSR PANTHER Conductor
Schedule – 4	Mid Span Compression Joint for ACSR PANTHER Conductor
Schedule – 5	Repairing sleeve for ACSR PANTHER Conductor
Schedule – 6	Vibration Dampers for ACSR PANTHER Conductor
Schedule – 7	Insulator String

SCHEDULE -1

GUARANTEED TECHNICAL PARTICULARS OF ACSR PANTHER (30 + 7/3.00 mm)

Sl. No	Description	Value guaranteed by the Bidder
1	Name & address of Manufacturer	
2	Construction of conductor/ Designation of conductor as per IS:398 (Part II) 2025	
3	a). Aluminium wire b). Steel Wire. c). Complete conductor Outer Layers	
4	Stranding and Wire Diameter Standard/ Maximum / Minimum)mm a). Aluminium b). Steel	
5	Calculated Equivalent Aluminium area in Sq.mm	
6	Actual Aluminium area in Sq.mm	
7	Standard area of Cross-section in Sq.mm a. Aluminium Strand b. Steel strand. c. Conductor.	
8	Diameter of complete Conductor in mm	
9	Minimum Ultimate Tensile Stress of strand in kg/ Sq.mm a) Aluminium Strand b) Steel Strand	
10	Guaranteed Ultimate Tensile Strength of Conductor in Kg	
11	Minimum Breaking Load in KN for a) Aluminium Strand. b) Steel Strand	
12	Purity of Aluminium Rods in %	
13	Zinc Coating of Steel Strand a) Thickness of coating number and duration of dips (precede test) b) Minimum weight of coating in gms/ Sq. mm.	
14	Maximum Working Tension	
15	Weight in Kg per KM (Max/ Min) a) Aluminium b) Steel c) Conductor	
16	Maximum Resistance in Ohms per Km at 20° C a) Aluminium Stand b) Conductor	
17	a) Continuous Maximum Current Rating of conductor in Still Air 45° C ambient temperature (Amps) b) Temperature rise for the above current (deg. C)	
18	LAV Ratio Steel Core : 6 Wire Aluminium : 12 Wire Layer 18 Wire Layer	

19	Whether the Drum on which the conductor is wound conforms to the specification and whether the detailed dimensioned drawing submitted with the tender.	
20	Moulds of Elasticity of a) Aluminium Strand : Kgs/ Sq.mm b) Steel Strand : Kgs/ Sq.mm c) Conductor Strand : Kgs/ Sq.mm	
21	Co-efficient of Liner Expansion per Degree Centigrade for a) Aluminium Stand. b) Steel Strand. c) Conductor	
22	Percentage of Carbon in Steel Wire	
23	Standard length of each piece in KM	
24	Maximum Single Length of Conductor which can be manufactured (km)	
25	Tolerance, if any on Standard Lengths.	
26	No. of Standard Lengths in One Reel	
27	Dimension of the Reel in Cm	
28	Weight of the Conductor in One Reel in Kg	
29	Weight of the Reel in Kg	
30	Gross Weight of the Reel including weight of the Conductor (kg)	
31	Standard According to Which the Conductor Will be Manufactured and Tested	
32	Other particulars if any.	

Date:

(Signature).....

Place:

(Printed Name).....

(Designation).....

(Common Seal).....

SCHEDULE -2

GUARANTEED TECHNICAL PARTICULARS OF SUSPENSION HARDWARE FITTINGS

Sl. No	Description	Value guaranteed by the Bidder
1	Name	
2	Address of Manufacturer	
3	Drawing enclosed	
4	Maximum magnetic power loss of suspension clamp at conductor current of 875 amperes	
5	Slipping strength of suspension assembly (clamp torque Vs slip curve shall be enclosed) in KN	
6	Particulars of standard/AGS Standard / AGS preformed armour rod set for suspension Assembly	
	a) No. of rods per set in No	
	b) Direction of lay	
	c) Overall length after fitting on conductor in mm	
	d) Actual length of each rod along its helix in mm	
	e) Diameter of each rod in mm	
	f) Tolerance in	
	i) Diameter of each rod in mm	
	ii) Length of each rod in mm	
	iii) Difference of length between the longest and shortest rod in mm	
	g) Type of Aluminium alloy used for manufacture of PA rod set	
	h) UTS of each rod in Kg/mm ² .	
7	Particulars of Elastome	
	(For AGS Clamp only)	
	a) Supplier of elastomer b) Type of elastomer	
	b) Type of elastomer	
	c) Shore hardness of elastomer	
	d) Temperature range for which elastomer is designed	
	e) Moulded on insert	
8	UTS of suspension clamp	
9	Purity of Zinc used for galvanising %	
10	Maximum permissible continuous operating temperature of	
	i) Clamp body	
	ii) Standard/AGS preformed rods	

Date:

(Signature).....

Place:

(Printed Name).....

(Designation).....

(Common Seal).....

SCHEDULE -3

GUARANTEED TECHNICAL PARTICULARS OF TENSION HARDWARE FITTINGS

Sl. No	Description	Value guaranteed by the Bidder	
1	Name		
2	Address of Manufacturer		
3	Drawing enclosed Yes / No	Yes/ No	
4	Purity of Aluminium used for Aluminium Sleeve %		
5	Material for steel sleeve		
	(i) Type of material with chemical composition		
	(ii) Range of Hardness of material (Brinell Hardness)	Fromto	
	(iii) Weight of zinc coating gm/m ²		
		Aluminium/ Alloy	Steel
6	Outside diameter of sleeve before compression in mm		
7	Inside diameter of sleeve before compression in mm		
8	Length of sleeve before compression		
9	Dimensions of sleeve after compression		
	(a) Corner to Corner		
	(b) Surface to Surface		
10	Length of sleeve after compression		
11	Weight of sleeve		
	(a) Aluminium/ Aluminium Alloy Kg		
	(b) Steel in Kg		
	(c) Total in Kg		
12	Electrical resistance of dead end assembly as a percentage of equivalent length of Conductor %		
13	Slip strength of dead end assembly KN		
14	UTS of dead end assembly in KN		
15	Purity of Zinc used for galvanizing in %		

Date:

(Signature).....

Place:

(Printed Name).....

(Designation).....

(Common Seal).....

SCHEDULE -4

GUARANTEED TECHNICAL PARTICULARS OF MID SPAN COMPRESSION JOINT FOR ACSR PANTHER CONDUCTOR (Non Metallic Core)

Sl. No	Description	Value guaranteed by the Bidder	
1	Name		
2	Address of Manufacturer		
3	Drawing enclosed	Yes/ No	
4	Suitable for conductor size in mm		
5	Purity of Aluminium used for Aluminium Sleeve %		
6	Material for steel sleeve		
	(i) Type of material with chemical composition		
	(ii) Range of Hardness of material (Brinnel Hardness)	Fromto	
	(iii) Weight of zinc coating gm/m ²		
		Aluminium/ Alloy	Steel
7	Outside diameter of sleeve before compression in mm		
8	Inside diameter of sleeve before compression in mm		
9	Length of sleeve before compression		
10	Dimensions of sleeve after compression		
	(a) Corner to Corner		
	(b) Surface to Surface		
11	Length of sleeve after compression		
12	Weight of sleeve in Kg		
	(a) Aluminium/		
	(b) Steel		
	(c) Total		
13	Slip strength in KN		
14	Resistance of the compressed unit expressed, as percentage of the resistivity of equivalent length of bare conductor %		
15	Maximum permissible continuous operating temperature of mid span join in Deg		

Date:

(Signature).....

Place:

(Printed Name).....

(Designation).....

(Common Seal).....

SCHEDULE - 5

GUARANTEED TECHNICAL PARTICULARS OF REPAIRING SLEEVE FOR ACSR
PANTHER CONDUCTOR

Sl. No	Description	Unit	Value guaranteed by the Bidder
1	Name		
2	Address of Manufacturer		
3	Drawing enclosed		Yes/ No
4	Suitable for conductor size	Mm	
5	Weight of the Sleeve	Kg	
6	Before compression dia. of Sleeve	mm	
	a) Inner diameter		
	b) Outer diameter		
7	Dimensions of sleeve after compression	Mm	
	(a) Corner to Corner		
	(b) Surface to Surface		
8	Length of the Sleeve	mm	
	(a) Before compression		
	(b) After compression		
9	Compression pressure	Tonne	
10	Minimum corona extinction voltage under dry conditions	KV	
11	Radio interference voltage under conditions	Micro volts	

Date:

(Signature).....

Place:

(Printed Name).....

(Designation).....

SCHEDULE -6

GUARANTEED TECHNICAL PARTICULARS OF VIBRATION DAMPER FOR ACSR

PANTHER CONDUCTOR (IF APPLICABLE)

Sl. No	Description	Value guaranteed by the Bidder	
1	Name		
2	Address of Manufacturer		
3	Drawing enclosed		
	(a) Design Drawing	Yes/ No	
	(b) Placement Chart	Yes/ No	
4	Suitable for conductor size in mm		
5	Total weight of one damper		
		Aluminium/ Alloy	Steel
6	Diameter of each damper mass in mm		
7	Length of each damper mass in mm		
8	Weight of each damper mas in Kg		
9	Material of damper masses		
10	Material of clamp		
11	Material of the stranded messenger cable		
12	Number of strands in stranded messenger cable		
13	Lay ratio of stranded messenger cable		
14	Minimum ultimate tensile strength of stranded messenger cable Kg/mm ²		
15	Slip strength of stranded messenger cable (mass pull off) KN		
		Right	Left
16	Resonance frequencies		
	(a) First frequency Hz		
	(b) Second frequency Hz		
17	Designed clamping torque Kg-m		
18	Slipping strength of damper clamp in KN		
	(a) Before fatigue test		
	(b) After fatigue test		
19	Magnetic power loss per vibration damper watts for 800 amps, 50 Hz Alternating Current in Watts		
20	Maximum permissible continuous operating temperature of Vibration Damper in Deg		
21	Percentage variation in reactance after fatigue test in comparison with ... that before fatigue test		
22	Percentage variation in power dissipation after fatigue test in comparison with that before fatigue test		

Date:

(Signature).....

Place:

(Printed Name).....

(Designation).....

Schedule 7**Insulator Strings (Suspension Sets For 132 kV Lines) (To be filled up by the Bidder)**

Particulars	Unit	Unit Single Suspension Strings	Double Suspension Strings	
Power frequency withstand voltage of the string with arcing horns and corona control rings / grading rings under wet condition	KV (ms)			
Impulse flashover voltage (peak) under dry conditions				
1) Positive	KV			
2) Negative				
Minimum corona extinction voltage under dry conditions	KV (ms)			
Radio interference voltage under dry conditions at 1MHz, at 105kV	Micro Volts			
Mechanical strength of the complete insulator string along with all hardware fittings	KN			
Maximum voltage (in percentage) across any disc in the complete insulator string under phase to earth voltage (not applicable for string with composite insulator units)	%			
Number of insulator units in each string				
Overall length of the set including clamp and all fittings (specify the tolerance also)	mm			
Weight of the set, complete with all fittings and arcing horns	kg			
Weight of the counter-weights	kg			

Insulator Strings (Suspension Sets For 132 kV Lines(continued)
(To be filled up by the Bidder)

Particulars	Unit	Unit Single Suspension Strings	Double Suspension Strings	
Minimum arcing gap distance	Mm			
Maximum magnetic power loss of the suspension assembly	Watts			
Slipping strength of the suspension assembly (clamp torque Vs. slip curve shall be enclosed)	KN			
Particulars of Standard/AGS preformed armour rod set for suspension				
1) No. of rods per set	No			
2) Direction of the lay				
3) Overall length after fitting on the conductor				
4) Actual length of each rod along its helix	mm			
5) Diameter of each rod	mm			
6) Tolerance in				
a) Diameter of each rod	mm			
b) Length of each rod	+/- mm			
c) Difference of length between the longest and shortest rod in a set	+/- mm			
7) Type of Aluminium alloy used for manufacture of PA rods	+/- mm			
8) UTS of each rod	kg/mm			

Insulator Strings (Suspension Sets For 132 kV Lines (continued))
(To be filled up by the Bidder)

Particulars	Unit	Single Suspension Strings	Double Suspension Strings	
Particular of Elastomer (for AGS clamps only)				
1) Supplier of elastomer				
2) Type of elastomer 150/172				
3) Shore hardness of elastomer				
4) Temperature range for which elastomer is designed	°C			
5) Moulded on insert	yes/no			
Purity of Zinc used for galvanising	%			
Minimum No. of one minute dips the ferrous parts can withstand in Standard Preece	No.			
Minimum weight of Zinc coating per Sq.m. of the uncoated surface	gm/sq.m			

Date:

(Signature).....

Place:

(Printed Name).....

(Designation).....

(Common Seal).....

Insulator Strings (Tension Sets For 132 kV Lines) (To be filled up by the Bidder)

Particulars	Unit	Single Tension Strings	Double Tension Strings	
Power frequency withstand voltage of the string with arcing horns and corona control rings / grading rings under wet conditions	kV(rms)			
Impulse flashover voltage (peak) under dry conditions				
1) Positive	kV			
2) Negative	kv			
Impulse withstand voltage (peak) under dry conditions				
1) Positive kV	kv			
2) Negative kV	kv			
Salt-fog pollution withstand voltage (only for strings with anti-fog units)	kV (rms)			
Minimum corona extinction voltage under dry conditions	kV(rms)			
Radio interference voltage under dry conditions at 1MHz, at 105kV	Micro Volts			
Mechanical strength of the complete insulator string along with all hardware fittings	Kn			
Maximum voltage (in percentage) across any disc in the complete insulator string under phase to earth voltage (not applicable for string with composite insulator units) Number of insulator units in each string	%			

Insulator Strings (Tension Sets For 132 kV Lines(continued)
(To be filled up by the Bidder)

Particulars	Unit	Single Suspension Strings	Double Suspension Strings	
Overall length of the set including clamp and all fittings (specify the tolerance also)	mm			
Weight of the set, complete with all fittings and arcing horns	kg			
Minimum arcing gap distance	mm			
Electrical resistance of the complete tension assembly along with jumper connection	ohms			
Slipping strength of the tension assembly	kN			
Purity of Zinc used for galvanising	%			
Minimum No. of one minute dips the ferrous parts can withstand in Standard Preece Test	No			
Minimum weight of Zinc coating per Sq.m. of the uncoated surface	gm/sq.m			

Date:

(Signature).....

Place:

(Printed Name).....

(Designation).....

(Common Seal).....