GENERAL PARTICULARS AND TECHNICAL PARTICULARS FOR ACSR CONDUCTORS

1. SCOPE: This specification provides for the Manufacture, Testing before despatch supply and delivery of ISI Marked Aluminum Conductors Galvanised Steel Reinforced (ACSR) conductors.

2. STANDARD: The conductor shall strictly comply in all respect with the Indian Standard Specification IS:398 (Part-2)/1996 with the latest amendments unless otherwise stipulated in this specification, or any other International Standards which ensure equal or higher quality material and workmanship.

The ACSR Conductor shall also conform to the following standards:-

Sl.No.	Indian Standards	Title	International
1	IS:209-1979	Specification for Zinc	BS-3436-1961
2	IS:398-1996	Specification for aluminium conductors for overhead transmission prupose.	
	Part-II	Aluminium Conductors	IEC-209-1966
		Galvanized steel reinforced	BS-215 (Part-II)
3	IS:1521-1972	Method of Tensile Testing of Steel wire	ISO/R89-1959
4	IS:1778-1980	Reels and Drums for Bare conductors	BS-1559-1949
5	IS:1841-1978	E.C. Grade Aluminium rod produced by rolling	
6	IS:2629-1966	Recommended practice for Hot Dip Galvanizing of iron and steel	
7	IS:2633-1986	Method of testing uniformity of coating of zinc coated articles.	
8	IS:4826-1968	Galvanized coatings on round steel wires.	ASTM A472-729
9	IS:5484-1978	E.C. Grade Aluminium rod produced by continuous casting and rollings.	
10	IS:6745-1972	Methods of determination of weight of zinc-coating of zinc coated iron and steel articles	BS-443-1969

3. MATERIAL:

3.1 The conductors offered shall be of best quality and workmanship. The steel reinforced aluminium conductors shall be manufactured of hard drawn EC Grade aluminium wires and high tensile galvanised steel wires of the sizes as specified in Table-I and with mechanical and electrical properties as specified in Table-II . The coating on the galvanized steel wires may be applied by hot process or electrolytic process in accordance with IS:4826-1979(specifications for hot dipped galvanized coatings on round steel wires). The core wire used for ACSR Conductor shall also be of ISI Marked.

3.2 The wires shall be smooth and free from all imperfections such as spills and splits and rolling and wire drawing defects etc., resulting in reduction in cross – sectional area over the entire length.

4. TOLERANCE: The following tolerance shall be permitted:-

(i) Tolerance on Nominal diameter of Aluminium wires plus/minus 1%.

(ii) Tolerance on Nominal diameter of High Tensile Galvanised Steel Wires plus /

minus 2%.

5. MODULUS OF ELASTICITY AND CO-EFFICIENT OF LINEAR EXPANSION:

The values of the final modulus of elasticity and co-efficient of linear expansion of ACSR conductor shall be as given hereunder:-

Item	**No. of wires**	**Final modulus of elasticity GN/mm^2 (practical)**	**Coefficient of linear expansion per ^{0} C**	**Density at temp. of 20 ^{0} C**
ACSR	6/1 (Al./Steel)	79	19.1X10^{-6} for ACSR conductor	7.8gm/cm^3 (Steel) 2.703gm/cm^3 (Al.)
ACSR	6/7 (Al./Steel)	75	19.8X10^{-6} for ACSR conductor	7.8gm/cm^3 (Steel) 2.703gm/cm^3 (Al.)
ACSR	30/7 (Al./Steel)	80	17.8X10^{-6} for ACSR conductor	7.8gm/cm^3 (Steel) 2.703gm/cm^3 (Al.)

6. JOINTS IN WIRES:

(a) During stranding in aluminium wire no welds shall be made for the purpose of achieving the required conductor length.

Joint in the stranded Aluminium wires of finished conductors are permitted as per the provisions of IS:398 Part-II & latest amendment thereof.

(b) There shall be no joints in finished steel wires forming the core of the steel reinforced aluminium conductor.

7. **STRANDING**:

7.1 The wires used in the manufacturing of a stranded conductor before stranding satisfy all requirement of IS:398(Part-2)/1996 with its latest amendments. The lay ratio of the layer shall be within the limit given under clause-8 below.

7.2 In all construction, the successive layers shall have opposite directions of lay. The outermost layer shall have right hand lay. The wires in each layer shall be evenly and closely stranded.

8. **LAY RATIO:** The lay ratio (ratio of the axial length of a complete turn of the helix formed by an individual wire in a stranded conductor to the external diameter of the helix) shall be within the limit given below:-

Item	No. of wires			Ratio of Aluminium Wire dia to Steel wire dia	Lay ratio for Aluminium wire		Lay ratio for Steel wire	
	Aluminum	Steel	Total		Max.	Min.	Max.	Min.
ACSR Conductor	6	1	7	1	14	10	-	-
	6	7	13	1	14	10	28	13
	30	7	37	1	14 (First layer)	10	28	13
					16	10		

					(Second layer)			

9. PACKING AND MARKING:

(A) The conductor shall be wound in non-returnable reels or drums conforming to IS: 1778 (Specifications for reels and drums for bare wire) or the latest version thereof. The drums shall be marked with the following details:-

(a) Manufacturer's name
(b) Trade Mark, if any
(c) Drum No. & identification Number
(d) Size of conductor
(e) Number and lengths of pieces of conductor on each drum
(f) Gross mass of the packing
(g) Net mass of conductor
(h) ISI or relevant international standard specification mark, if any
(i) Name and address of the consignees.

10. PACKING CONDITION:

10.1 The conductor shall be supplied in non-returnable strong wooden drums provided with lagging of adequate strength constructed to protect the conductor against any damage and displacement during transit, storage and subsequent handing and stringing operations in the field. The drums shall generally conform to IS-1778-1980 and latest version except as otherwise specified hereinafter. The conductor drums shall be adequate to wind one standard length of SQUIRREL /WEASEL/ RABBIT/ RACCOON/ DOG/ PANTHER ACSR Conductor.

10.2 The drums shall be suitable for wheel mounting and for letting off the conductor under a minimum controlled tension of the order of 5 KN. The Conductor drums shall be provided with necessary clamping arrangements so as to be suitable for tension stringing of power conductor.

10.3 The bidders should submit their drawings of the conductor drums along with the bid. After placement of letter of intent the Manufacturer shall submit four copies of fully dimensioned drawing of the drum for Employer's approval.

10.4 All wooden components shall be manufactured out of seasoned wood of good quality free from defect that may materially weaken the component parts of the drums. Preservative treatment for anti-termite / anti-fungus shall be applied to the entire drum with preservatives of a quality which is not harmful to the conductor.

10.5 All flanges shall be 2-ply construction with 64 mm thickness. Each ply shall be nailed and clenched together at approximately 90 degrees. Nails shall be driven from the inside face of the flange, punched and then clenched on the outer face. Flange boards shall not be less than the nominal thickness by more than 2 mm. There shall not be less than 2 nails per board in each circle.

10.6 The wooden battens used for making the barrel of the conductor shall be of segmental type. These shall be nailed to the barrel supports with at least two nails. The battens shall be closely butted and shall provide a round barrel with smooth external surface. The edges of the battens shall be rounded or chamfered to avoid damage to the conductor.

10.7 Barrel studs shall be used for construction of drums. The flanges shall be holed and the barrel supports slotted to receive them. The barrel studs shall be

threaded over a length on either end, sufficient to accommodate washers, spindle plates and nuts for fixing flanges at the required spacing.

10.8 Normally, the nuts on the studs shall stand protruded of the flanges. All the nails used on the inner surface of the flanges and the drum barrel shall be countersunk. The ends of the barrel shall generally be flushed with the top of the nuts.

10.9 The inner cheek of the flanges and drum barrel surface shall be painted with bitumen based paint.

10.10 Before reeling, card board or double corrugated or thick bituminized waterproof bamboo paper shall be secured to the drum barrel and inside of flanges of the drum by means of a suitable commercial adhesive material. The paper should be dried before use. Medium grade craft paper shall be used in between the layers of the conductor for multi strand conductor i.e. above 100 mm2. After reeling the conductor, the exposed surface of the outer layer of conductor shall be wrapped with thin polythene sheet across the flanges to preserve the conductor from dirt, grit and damage during transportation and handling and also to prevent ingress of rain water during storage / transport.

10.11 A minimum space of 75 mm shall be provided between the inner surface of the external protective lagging and outer layer of the conductor. Outside the protective lagging, there shall be minimum of two binders consisting of hoop iron / galvanised steel wire. Each protective lagging shall have two recesses to accommodate the binders.

10.12 Each batten shall be securely nailed across grains as for as possible to the flange edges with at least 2 nails per end. The length of the nails shall not be less than twice the thickness of the batten. The nail shall not protrude above the general surface and shall not have exposed sharp edges or allow the battens to be released due to corrosion.

10.13 The conductor ends shall be properly sealed and secured with the help of U-nails on one side of the flanges.

10.14 As an alternative to wooden drum Bidder may also supply the conductors in non-returnable painted steel drums. The painting shall conform to IS:9954-1981, reaffirmed in 1992. Wooden / steel drum will be treated at par for evaluation purpose and accordingly the Bidder should quote the rate.

11. <u>STANDARD LENGTH</u>:-

"**The standard wire length for ACSR shall be 2 kms. for squirrel & weasel Conductors where for other sizes it shall be 1.5 kms. Longer lengths shall be acceptable. Short lengths of not less than 50% of the standard lengths, as indicated above, shall be acceptable to the maximum extent of 10% of the quantity ordered for each size".**

12. **<u>TESTS</u>**:

(A) Type Test Certificate:-

The following type test should be performed on ISI Marked ACSR Conductor as IS:398 (PART-II):-

(i) Measurement of Diameter (Aluminium & Steel Wire)
(ii) Breaking Load Test (Aluminium & Steel Wire)
(iii) Resistance Test (Aluminium Wire)
(iv) Ductility Test (Steel Wire)

(v) Galvanizing Test (Steel Wire)
(vi) Measurement of lay ratio
(vii) Wrapping Test

Tests to be performed for size more than 100 mm2 :-

(i) Surface condition test,
(ii) Ultimate breaking load test
(iii) Stress strain test

The type test certificate should invariably be submitted alongwith tender. The test certificate should not be older than ten years from the date of opening of tender and should be performed at the Govt. Approved Laboratory only.

It may be noted carefully that the type test reports submitted by the bidders will be sent to the testing laboratory / institution from where the type test are carried out for verification & genuineness. In case any discrepancy is reported by Testing Laboratory / Institution the offer will be outrightly rejected and the action against the bidder for submission of forged / fake type test report will be taken in accordance with **Clause 34 of Annexure-B (GENERAL TERMS & CONDITIONS OF PURCHASE)**

12.1 Samples of individual aluminium, aluminium alloy and steel wires for tests shall be taken before stranding from not less than 10% of the spools/coils. If samples are taken after stranding, they shall be obtained by cutting 1.2 metres from the outer end of the finished conductor from not more than 10% of the reels.

12.2 The mechanical tests shall be carried out on single wires only and not on complete conductor.

12.3 The Rejection and Re-test procedure shall be followed as stipulated in IS:398(Part-2)/1996 and IS:398(Part-4)/1994.

13. **CHECKING AND VERIFICATION OF LENGTH OF CONDUCTORS**:

The supplier/manufacturer of conductor should arrange for the inspection by the representative of the purchaser specially authorised for this purpose. At least 5% of the total number of drums of conductors taken at random should be checked to ascertain the lengths of conductor adopting either of the following two methods:-

(a) The drum along with the conductor should be weighed and six empty drums along with protective laggings & studs etc. normally used for winding the conductor should also be weighed. Net weight of the conductor should be calculated by subtracting the average weight of the six empty drums from the gross weight of the conductor and drums. Having known the weight of the conductor, the length of the conductor can be computed.

In case of empty conductor drums, a check weighment of every one in ten empty drums shall also be done before the conductors are wound on the drums.

(b) Arrangements should be made available in the works of the manufacturer for transferring the conductor from one reel to another at the same time measuring the length of the conductor so transferred by means of a meter. Percentage shortage, if any, in the length thus obtained and as declared by the supplier in the packing list shall be applied to all the drums.

14. **CHECK MEASUREMENT:-** Where length of conductor is verified by weighment basis, the determining factor will be length/weight ratio of the sample drums verified at

the firm's premises of the lot of which the drum under measurement at the consignee's end forms a part.

(i) Wherever at the end of the consignee, length measurement machines are available, conductors shall be accepted by verification of lengths only and where the length measurement machines are not available, conductor shall be accepted on weighment basis.

(ii) In case, where the recorded weight on the drum tallies with the measured weight at consignee's end, then the conductor length shall be accepted as recorded on the drum. In other cases, the determining factor will be weight / length ratio of the sample(s) inspected at the firm's premises of the lot of which the drum under measurement at the consignee's end, forms a part. The factors of weight/length ratio shall however be made available to the consignees in the despatch instructions itself. If such factors are not available due to some reasons, actual measurement of diameter shall be made and weight/length ratio shall be obtained for the purpose of computing length.

TABLE-I

SIZE AND PROPERTIES OF ACSR/ CONDUCTORS (As per IS:398 (Part-2)/1996)

Code Word	Nominal aluminium area	Stranding and wire diameter		Sectional area of Aluminium	Total Sectional area	Approximate overall Diameter	Approximate mass	Calculated resistance 20 ^{0}C	Approximate calculated breaking load
		Al.	Steel						
	mm^2	mm	mm	mm^2	mm^2	mm^2	Kg/ Km	Ohm/ Km	KN
1.Squirrel	20	6/2.11	1/2.11	20.98	24.48	6.33	85	1.3940	7.61
2.Weasel	30	6/2.59	1/2.59	31.61	36.88	7.77	128	0.9289	11.12
3.Rabbit	50	6/3.35	1/3.35	52.88	61.70	10.05	214	0.5524	18.25
4.Raccoon	80	6/4.09	1.4.09	78.83	91.97	12.27	319	0.3712	26.91
5. Dog	100	6/4.72	7/1.57	105.00	118.30	14.15	394	0.2792	32.41
6. Panther	200	30/3	7/3	212.10	261.50	21.00	974	0.1390	89.67

TABLE-II

(A) PROPERTIES OF ALUMINIUM/STEEL WIRES USED IN THE CONSTRUCTION OF ACSR CONDUCTOR

(i) For ALUMINIUM WIRES:-

Size	DIAMETER			Cross Sectional area of nominal dia. wire	Mass	Resistance 20 ^{0} C	Breaking load Min.	
	Nominal	Min	Max				Before stranding	After stranding
1	2	3	4	5	6	7	8	9
	mm	mm	mm	mm^2	Kg/ Km	Ohm/Km	KN	KN
Squirrel	2.11	2.09	2.13	3.497	9.45	8.237	0.63	0.60
Weasel	2.59	2.56	2.62	5.269	14.24	5.490	0.89	0.85
Rabbit	3.35	3.32	3.38	8.8140	23.82	3.265	1.43	1.36
Raccoon	4.09	4.05	4.13	13.140	35.51	2.194	2.08	1.98
Dog	4.72	4.67	4.77	17.50	47.30	1.650	2.78	2.64
Panther	3.00	3.03	2.97	7.069	19.11	4.079	1.17	1.11

(ii) For Steel Wires:-

SIZE	DIAMETER			Gross sectional Area of nominal dia wire	Mass	Breaking load Min.	
	Nominal	Min.	Max.			Before stranding	After stranding
	1	2	3	4	5	6	7
	mm	mm	mm	mm^2	Kg/Km	KN	KN
Squirrel	2.11	2.07	2.15	3.497	27.27	4.60	4.37
Weasel	2.59	2.54	2.64	5.269	41.09	6.92	6.57
Rabbit	3.35	3.28	3.42	8.814	68.75	11.58	11.00
Raccoon	4.09	4.01	4.17	13.140	102.48	17.27	16.41
Dog	1.57	1.54	1.60	1.936	15.10	2.70	2.57
Panther	3.00	3.06	2.94	7.069	55.13	9.29	8.83

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