

b)	Purity of Zinc used for galvanising	%	99.95 (IS 209) or 98.5 (IS 13229)
c)	Min. No. of dips in standard preece test the ferrous parts can withstand	No.	a) Fasteners: 4 dips of 1 minute b) Spring washers: 3 dips of 1 minute c) all others: 6 dips of 1 minute

K) Accessories for ACSR BERSIMIS conductor for 765 kV transmission line with Quad BERSIMIS conductor

1. Mid span compression Joint for ACSR BERSIMIS Conductor

Sl.	Description	Unit	Particulars/ Value	
			<u>Aluminium Sleeve</u>	<u>Steel Sleeve</u>
1.	Material of Joint		Aluminium of purity 99.5%	Mild Steel (Fe-410, IS:2062)
2.	Range of Hardness of the steel sleeve (Brinell hardness)	BHN	From 100 to 200	
3.	Weight of Zinc coating for steel sleeve	gm/m ²	610	
4.	Dimension of sleeve Before compression		<u>Aluminum sleeve</u>	<u>Steel sleeve</u>
i)	Inside diameter	mm	37.40 ± 0.5	8.10 ± 0.2
ii)	Outside diameter	mm	58.4 ± 1.01.0	20.70 ± 0.5
iii)	Length	mm	865 ± 5	220 ± 5
5.	Dimensions of Sleeve after compression		<u>Aluminum sleeve</u>	<u>Steel sleeve</u>
i)	Outside dimension (Corner to corner)	mm	57.40 ± 0.5	20.20 ± 0.5
ii)	Outside dimension (face to face)	mm	49.70 ± 0.5	17.50 ± 0.5
iii)	Length	mm	938 (approx)	250 (approx)
5.	Slip strength	KN	146.3	
6.	Maximum resistance of the compressed unit expressed, as percentage of the resistance of equivalent length of bare conductor.	%	75	
7.	Minimum corona Extinction voltage kV (rms) under dry condition	kV	510	
8.	Maximum Radio Interference Voltage at 1 MHz for phase to earth voltage of 510 kV (rms) under dry condition	Micro Volts	1000	

2. Repair sleeve for ACSR BERSIMIS Conductor

Sl.	Description	Unit	Particulars/ Value
1.	Material		Aluminium of minimum purity 99.5%
2.	<u>Dimension of Aluminum sleeve Before compression</u>		
i)	Inside diameter	Mm	37.40 ± 0.5
ii)	Outside diameter	Mm	58.4 ± 1.1.
iii)	Length	Mm	530 ± 5
3.	<u>Dimensions of Aluminum Sleeve After compression</u>		
i)	Outside dimension (Corner to corner)	Mm	57.40 ± 0.5
ii)	Outside dimension (face to face)	Mm	949.70 ± 0.5
iii)	Length	Mm	570 (approx)
4.	Minimum corona Extinction voltage kV (rms) under dry condition	kV	510
5.	Maximum Radio Interference Voltage at 1 MHz for phase to earth voltage of 510 kV (rms) under dry condition	Micro Volts (μV)	1000

3. QUAD SPACER DAMPER FOR QUAD ACSR BERSIMIS CONDUCTOR

Sl.	Description	Unit	Particulars / Value
1.	Type of Clamps		Preformed rods.
2.	Type of Damping element		Spring / Elastomer / EPDM
3.	Material of		
	(a) Clamp		Al Alloy IS:4600 or Equivalent for Casting & Al Alloy 6061 or Equivalent (for Forging)
	(b) Body		Al Alloy 4600 or Equivalent for Casting & Al Alloy 6061 or Equivalent (for Forging)
4.	Elastomer (<i>if used</i>)		
	(a) Shore hardness		65-80
	(b) Temp. range for which designed	°C	Upto 95°C
5.	Minimum ultimate tensile strength of spacer		
	(a) Compressive load	kN	15
	(b) Tensile load	kN	7.5
6.	Slipping strength of spacer clamp		

	(a) Before vibration test	kN	Clamp type	Longitudinal Load (kN)	Maxm Slip permitted (mm)
			Preformed rods	2.5	12
	(b) After vibration test	kN	80% of the above values		
7.	Maximum magnetic power loss of at sub conductor current of 500 amperes, 50Hz AC	Watts	Below 1 watt.		
8.	Minimum corona Extinction voltage kV (rms) under dry condition	kV	510		
9.	Radio Interference Voltage at 1 MHz for phase to earth voltage of 510 kV (rms) Microvolts under dry condition	μV	Below 1000		
10.	Galvanising				
a)	Minimum weight of Zinc coating for steel parts	gm/m ²	610		
b)	Purity of Zinc used for galvanising	%	99.95 (IS 209) or 98.5 (IS 13229)		
c)	Min. No. of dips in standard preece test the ferrous parts can withstand	No.	a) Fasteners: 4 dips of 1 minute b) Spring washers: 3 dips of 1 minute c) all others: 6 dips of 1 minute		

4. QUAD RIGID SPACER FOR QUAD ACSR BERSIMIS CONDUCTOR

Sl.	Description	Unit	Particulars / Value
1.	Material of		
	(a) Clamp		Al Alloy IS:4600 or Equivalent
	(b) Body		Galvanised Steel / Al Alloy 4600 or Equivalent
2.	Elastomer (if used)		
	(a) Shore hardness		65 - 80
	(b) Temp. range for which designed	°C	Upto 95°C
3.	Minimum ultimate tensile strength of spacer		
	(a) Compressive load	kN	15
	(b) Tensile load	kN	7.5

4.	Slipping strength of spacer clamp	kN	Clamp type	Longitudinal Load (kN)	Maxm Slip permitted (mm)
			Metal – Metal Bolted	6.5	1
			Rubber loaded	2.5	2.5
5.	Maximum magnetic power loss of at sub conductor current of 500 amperes, 50Hz AC	Watts	Below 1 watt.		
6.	Minimum corona Extinction voltage kV (rms) under dry condition	kV	510		
7.	Radio Interference Voltage at 1 MHz for phase to earth voltage of 510 kV (rms) Microvolts under dry condition	μV	Below 1000		
8.	Galvanising				
a)	Minimum weight of Zinc coating for steel parts	gm/m ²	610		
b)	Purity of Zinc used for galvanising	%	99.95 (IS 209) or 98.5 (IS 13229)		
c)	Min. No. of dips in standard preece test the ferrous parts can withstand	No.	a) Fasteners: 4 dips of 1 minute b) Spring washers: 3 dips of 1 minute c) all others: 6 dips of 1 minute		

L) Accessories for ACSR MOOSE conductor for 400 kV transmission line

1. Mid span compression Joint for ACSR MOOSE Conductor

Sl.	Description	Unit	Particulars/ Value	
			<u>Aluminium Sleeve</u>	<u>Steel Sleeve</u>
1.	Material of Joint		Aluminium of purity 99.5%	Mild Steel (Fe-410, IS:2062)
2.	Range of Hardness of the steel sleeve (Brinell hardness)	BHN	From 100 to 200	
3.	Weight of Zinc coating for steel sleeve	gm/m ²	610	
4.	Dimension of sleeve Before compression		<u>Aluminum sleeve</u>	<u>Steel sleeve</u>
i)	Inside diameter	mm	34.00 ± 0.5	11.10 ± 0.2
ii)	Outside diameter	mm	54.00 ± 1.0	21.00 ± 0.5
iii)	Length	mm	735 ± 5	250 ± 5
5.	Dimensions of Sleeve after compression		<u>Aluminum sleeve</u>	<u>Steel sleeve</u>
i)	Outside dimension (Corner to corner)	mm	53.00 ± 0.5	20.20 ± 0.5
ii)	Outside dimension (face to face)	mm	46.00 ± 0.5	17.50 ± 0.5
iii)	Length	mm	785 (approx)	286 (approx)
6.	Slip strength	KN	153.2	
7.	Maximum resistance of the compressed unit expressed, as percentage of the resistance of equivalent length of bare conductor.	%	75	
8.	Minimum corona Extinction voltage kV (rms) under dry condition	kV	320	
9.	Maximum Radio Interference Voltage at 1 MHz for phase to earth voltage of 305 kV (rms) under dry condition	Micro Volts	1000	

2. Repair sleeve for ACSR MOOSE Conductor

Sl.	Description	Unit	Particulars/ Value	
1.	Material		Aluminium of minimum purity 99.5%	
2.	Dimension of Aluminum sleeve Before compression			
i)	Inside diameter	mm	34.00 ± 0.5	
ii)	Outside diameter	mm	54.00 ± 1.0	
iii)	Length	mm	300.00 ± 5.0	
3.	Dimensions of Aluminum Sleeve after compression			

i)	Outside dimension (Corner to corner)	mm	53.00 ± 0.5
ii)	Outside dimension (face to face)	mm	46.00 ± 0.5
iii)	Length	mm	330.00(Approx.)
4.	Minimum corona Extinction voltage kV (rms) under dry condition	kV	320
5.	Maximum Radio Interference Voltage at 1 MHz for phase to earth voltage of 305 kV (rms) under dry condition	Micro Volts	1000

3. T-connector for ACSR MOOSE Conductor

Sl.	Description	Unit	Particulars/ Value
1.	Material		Aluminium of purity 99.5%
2.	Dimension of Aluminum sleeve Before compression		
	i) Inside diameter	mm	34.00 ± 0.5
	ii) Outside diameter	mm	54.00 ± 1.0
	iii) Length	mm	400.00 ± 5.0
3.	Dimensions of Aluminum Sleeve after compression		
	i) Outside dimension (Corner to corner)	mm	53.00 ± 0.5
	ii) Outside dimension (face to face)	mm	46.00 ± 0.5
4.	Axial tensile strength of welded portion of T-connector	KN	30
5.	Maximum resistance of the compressed unit expressed, as percentage of the resistance of equivalent length of bare conductor.	%	75
6.	Minimum corona Extinction voltage kV (rms) under dry condition	kV	320
7.	Maximum Radio Interference Voltage at 1 MHz for phase to earth voltage of 305 kV (rms) under dry condition	Micro Volts	1000

4. Vibration Damper for ACSR MOOSE conductor (For twin bundle conductor line only)

Sl.	Description	Unit	Particulars/ Value
1.	Type of Damper		4R-Stockbridge type
2.	Materials of components		
	a) Damper masses		Cast iron/mild steel/Zinc alloy duly hot dip galvanised
	b) Clamp		Aluminum alloy 4600
	c) Messenger cable		High tensile strength galvanized steel
3.	Number of strands in stranded messenger cable	Nos.	19

4.	Minimum ultimate tensile strength of stranded messenger cable	Kg/m m ²	135
5.	Slip strength of stranded messenger cable (mass pull off)	KN	5
6.	Slipping strength of damper clamp		
	(a) Before fatigue test	KN	2.5
	(b) After fatigue test	KN	2
7.	Resonance frequencies range	Hz	5 to 40
8.	Maximum magnetic power loss per vibration damper watts for 600 amps, 50 Hz Alternating Current	Watts	1
9.	Minimum corona Extinction voltage kV (rms) under dry condition	kV	320
10.	Maximum Radio Interference Voltage (RIV) at 1 MHz for phase to earth voltage of 305 kV (rms) under dry condition	Micro Volts	1000
11.	Percentage variation in reactance after fatigue test in comparison with that. before fatigue test	%	+/-40 (Maximum)
12.	Percentage variation in power dissipation after fatigue test in comparison with that before fatigue test	%	+/-40 (Maximum)
13.	Galvanising		
a)	Minimum weight of Zinc coating for steel parts	gm/m ²	610
b)	Purity of Zinc used for galvanising	%	99.95 (IS 209) or 98.5 (IS 13229)
c)	Min. No. of dips in standard preece test the ferrous parts can withstand.	Nos.	a) Fasteners: 4 dips of 1 minute b) Spring washers: 3 dips of 1 minute c) all others: 6 dips of 1 minute

5. Bundle Spacer for ACSR MOOSE conductor (For twin bundle conductor line only)

Sl.	Description	Unit	Particulars/ Value		
1.	Type of Bundle Spacer		Armour grip type		
2.			Insert	Main body	Retaining rods (if any)
(i)	Materials of components		Aluminum alloy 6061/65032	Tube Aluminum alloy 6063/63400; 6061/65032	Aluminum alloy 6061/65032

(ii)	Manufacturing process of component parts		Forged	Tube-extrusion	Heat treatment during manufacturing
3.	Retaining rods (if used)				
	(a) Number of retaining rods used for each spacer	no.	8		
	(b) Diameter	mm	7.87-0.1		
	(c) Length	mm	1100+15		
	(d) Minimum UTS of rods	Kg/mm ²	35		
4.	Elastomer				
	(a) Type		Chloroprene/Neoprene		
	(c) Moulded on insert		Yes		
	(d) Shore hardness		65 to 80		
	(e) Thickness on insert	mm	5(Average)		
	(f) Temp. range for which designed	°C	95		
5.	Minimum ultimate tensile strength of spacer				
	(a) Compressive load	kN	14		
	(b) Tensile load	kN	7		
6.	Slipping strength of spacer clamp				
	a) Before vibration test	KN	2.5		
	b) After vibration test	KN	2		
7.	Minimum corona Extinction voltage kV (rms) under dry condition	kV	320		
8.	Maximum Radio Interference Voltage (RIV) at 1 MHz for phase to earth voltage of 305 kV (rms) under dry condition	Micro volts	1000		

6. Rigid Spacer for Jumper for ACSR MOOSE conductor (For twin bundle conductor line only)

Sl.	Description	Unit	Particulars/ Value
1.	Material of component parts		
	(a) Clamp		Aluminum alloy (4600)
	(b) Main body		Galvanised Steel / Al Alloy 4600 or Equivalent
2.	Elastomer (if used)		
	(a) Shore hardness		65 - 80
	(b) Temp. range for which designed	°C	Upto 95°C
3.	Minimum ultimate tensile strength of spacer		
	(a) Compressive load	kN	14

	(b) Tensile load	kN	7.0
4.	Slipping strength of spacer clamp	kN	2.5
5.	Maximum Magnetic power loss per spacer for 600 Amps, 50 Hz Alternating Current	Watts	1
6.	Minimum corona Extinction voltage kV (rms) under dry condition	kV	320
7.	Maximum Radio Interference Voltage (RIV) at 1 MHz for phase to earth voltage of 305 kV (rms) under dry condition	Micro volts	1000

7. Quad Spacer Damper for ACSR MOOSE conductor

Sl.	Description	Unit	Particulars / Value		
1.	Type of Clamps		Preformed rods.		
2.	Type of Damping element		Spring / Elastomer / EPDM		
3.	Material of				
	(a) Clamp		Al Alloy IS:4600 or Equivalent for Casting & Al Alloy 6061 or Equivalent (for Forging)		
	(b) Body		Al Alloy 4600 or Equivalent for Casting & Al Alloy 6061 or Equivalent (for Forging)		
4.	Elastomer (<i>if used</i>)				
	(a) Shore hardness		65 - 80		
	(b) Temp. range for which designed	°C	Upto 95°C		
5.	Minimum ultimate tensile strength of spacer				
	(a) Compressive load	kN	14		
	(b) Tensile load	kN	7.0		
6.	Slipping strength of spacer clamp				
	(a) Before vibration test	kN	Clamp type	Longitudinal Load (kN)	Max m Slip permitted (mm)
			Preformed rods	2.5	12

	(b) After vibration test	kN	80% of the above values
7.	Maximum magnetic power loss of at sub conductor current of 600 amperes, 50Hz AC	Watt	Below 1 watt.
8.	Minimum corona Extinction voltage kV (rms) under dry condition	kV	320
9.	Radio Interference Voltage at 1 MHz for phase to earth voltage of 305 kV (rms) Microvolts under dry condition	μV	Below 1000
10.	Galvanising		
a)	Minimum weight of Zinc coating for steel parts	gm/m ²	610
b)	Purity of Zinc used for galvanising	%	99.95 (IS 209) or 98.5 (IS 13229)
c)	Min. No. of dips in standard preece test the ferrous parts can withstand	No.	a) Fasteners: 4 dips of 1 minute b) Spring washers: 3 dips of 1 minute c) all others: 6 dips of 1 minute

8. Quad Rigid Spacer for Jumper for ACSR MOOSE conductor

Sl.	Description	Unit	Particulars / Value		
1.	Material of				
	(a) Clamp		Al Alloy IS:4600 or Equivalent		
	(b) Body		Galvanised Steel / Al Alloy 4600 or Equivalent		
2.	Elastomer (<i>if used</i>)				
	(a) Shore hardness		65 - 80		
	(b) Temp. range for which designed	°C	Upto 95°C		
3.	Minimum ultimate tensile strength of spacer				
	(a) Compressive load	kN	14		
	(b) Tensile load	kN	7.0		
4.	Slipping strength of spacer clamp	kN	Clamp type	Longitudinal Load (kN)	Maxm Slip permitted (mm)
			Metal – Metal Bolted	6.5	1
			Rubber loaded	2.5	2.5

5.	Maximum magnetic power loss of at sub conductor current of 600 amperes, 50Hz AC	Watts	Below 1 watt.
6.	Minimum corona Extinction voltage kV (rms) under dry condition	kV	320
7.	Radio Interference Voltage at 1 MHz for phase to earth voltage of 305 kV (rms) Microvolts under dry condition	μV	Below 1000
8.	Galvanising		
a)	Minimum weight of Zinc coating for steel parts	gm/m ²	610
b)	Purity of Zinc used for galvanising	%	99.95 (IS 209) or 98.5 (IS 13229)
c)	Min. No. of dips in standard preece test the ferrous parts can withstand	No.	a) Fasteners: 4 dips of 1 minute b) Spring washers: 3 dips of 1 minute c) all others: 6 dips of 1 minute

M) Accessories for ACSR Snowbird Conductor for 400 kV transmission line

Mid span compression Joint

Sl.	Description	Unit	Particulars/ Value	
			<u>Aluminium Sleeve</u>	<u>Steel Sleeve</u>
1.	Material of Joint		Aluminium of purity 99.5%	Mild Steel (Fe-410, IS:2062)
2.	Range of Hardness of the steel sleeve (Brinnel hardness)	BHN	From 100 to 200	
3.	Weight of Zinc coating for steel sleeve	gm/m ²	610	
4.	Dimension of sleeve Before compression		<u>Aluminum sleeve</u>	<u>Steel sleeve</u>
i)	Inside diameter	mm	33.00 ± 0.5	7.00 ± 0.2
ii)	Outside diameter	mm	54.00 ± 1.0	19.20 ± 0.5
iii)	Length	mm	735 ± 5	250 ± 5
5.	Dimensions of Sleeve after compression		<u>Aluminum sleeve</u>	<u>Steel sleeve</u>
i)	Outside dimension (Corner to corner)	mm	53.00 ± 0.5	20.20 ± 0.5
ii)	Outside dimension (face to face)	mm	46.00 ± 0.5	17.50 ± 0.5
iii)	Length	mm	785 (approx)	286 (approx)
6.	Slip strength	KN	112	

7.	Maximum resistance of the compressed unit expressed, as percentage of the resistance of equivalent length of bare conductor.	%	75
8.	Minimum corona Extinction voltage kV (rms) under dry condition	kV	320
9.	Maximum Radio Interference Voltage at 1 MHz for phase to earth voltage of 305 kV (rms) under dry condition	Micro Volts	1000

Repair sleeve

Sl.	Description	Unit	Particulars/ Value
1.	Material		Aluminium of minimum purity 99.5%
2.	Dimension of Aluminum sleeve Before compression		
i)	Inside diameter	mm	33.00 ± 0.5
ii)	Outside diameter	mm	54.00 ± 1.0
iii)	Length	mm	300.00 ± 5.0
3.	Dimensions of Aluminum Sleeve after compression		
i)	Outside dimension (Corner to corner)	mm	53.00 ± 0.5
ii)	Outside dimension (face to face)	mm	46.00 ± 0.5
iii)	Length	mm	330.00(Approx.)
4.	Minimum corona Extinction voltage kV (rms) under dry condition	kV	320
5.	Maximum Radio Interference Voltage at 1 MHz for phase to earth voltage of 305 kV (rms) under dry condition	Micro Volts	1000

TRIPLE SPACER DAMPER FOR TRIPLE ACSR SNOWBIRD CONDUCTOR

Sl.	Description	Unit	Particulars / Value
1.	Type of Clamps		Preformed rods.
2.	Type of Damping element		Spring / Elastomer / EPDM
3.	Material of		
	(a) Clamp		Al Alloy IS:4600 or Equivalent for Casting & Al Alloy 6061 or Equivalent (for Forging)
	(b) Body		Al Alloy 4600 or Equivalent for Casting & Al Alloy 6061 or Equivalent (for Forging)

4.	Elastomer (<i>if used</i>)				
	(a) Shore hardness		65 – 80		
	(b) Temp. range for which designed	°C	Upto 95°C		
5.	Minimum ultimate tensile strength of spacer				
	(a) Compressive load	kN	14		
	(b) Tensile load	kN	7.0		
6.	Slipping strength of spacer clamp				
	(a) Before vibration test	kN	Clamp type	Longitudinal Load (kN)	Maxm Slip permitted (mm)
			Preformed rods	2.5	12
	(b) After vibration test	kN	80% of the above values		
7.	Maximum magnetic power loss of at sub conductor current of 600 amperes, 50Hz AC	Watt	Below 1 watt.		
8.	Minimum corona Extinction voltage kV (rms) under dry condition	kV	320		
9.	Radio Interference Voltage at 1 MHz for phase to earth voltage of 305 kV (rms) Microvolts under dry condition	µV	Below 1000		
10.	Galvanising				
a)	Minimum weight of Zinc coating for steel parts	gm/m ²	610		
b)	Purity of Zinc used for galvanising	%	99.95 (IS 209) or 98.5 (IS 13229)		
c)	Min. No. of dips in standard preece test the ferrous parts can withstand	No.	a) Fasteners: 4 dips of 1 minute b) Spring washers: 3 dips of 1 minute c) all others: 6 dips of 1 minute		

TRIPLE RIGID SPACER FOR TRIPLE ACSR SNOWBIRD CONDUCTOR

Sl.	Description	Unit	Particulars / Value
1.	Material of		
	(a) Clamp		Al Alloy IS:4600 or Equivalent
	(b) Body		Galvanised Steel / Al Alloy 4600 or Equivalent

2.	Elastomer <i>(if used)</i>				
	(a) Shore hardness			65 – 80	
	(b) Temp. range for which designed	°C		Upto 95°C	
3.	Minimum ultimate tensile strength of spacer				
	(a) Compressive load	kN	14		
	(b) Tensile load	kN	7.0		
4.	Slipping strength of spacer clamp	kN	Clamp type	Longitudinal Load (kN)	Maxm Slip permitted (mm)
			Metal – Metal Bolted	6.5	1
			Rubber loaded	2.5	2.5
5.	Maximum magnetic power loss of at sub conductor current of 600 amperes, 50Hz AC	Watts	Below 1 watt.		
6.	Minimum corona Extinction voltage kV (rms) under dry condition	kV	320		
7.	Radio Interference Voltage at 1 MHz for phase to earth voltage of 305 kV (rms) Microvolts under dry condition	μV	Below 1000		
8.	Galvanising				
a)	Minimum weight of Zinc coating for steel parts	gm/m ²	610		
b)	Purity of Zinc used for galvanising	%	99.95 (IS 209) or 98.5 (IS 13229)		
c)	Min. No. of dips in standard preece test the ferrous parts can withstand	No.	a) Fasteners: 4 dips of 1 minute b) Spring washers: 3 dips of 1 minute c) all others: 6 dips of 1 minute		

T-connector

Sl.	Description	Unit	Particulars/ Value
1.	Material		Aluminium of purity 99.5%
2.	Dimension of Aluminum sleeve Before compression		
	i) Inside diameter	mm	33.00 ± 0.5
	ii) Outside diameter	mm	54.00 ± 1.0
	iii) Length	mm	400.00 ± 5.0
3.	Dimensions of Aluminum Sleeve after compression		
	i) Outside dimension (Corner to corner)	mm	53.00 ± 0.5

	ii) Outside dimension (face to face)	mm	46.00 ± 0.5
4.	Axial tensile strength of welded portion of T-connector	KN	30
5.	Maximum resistance of the compressed unit expressed, as percentage of the resistance of equivalent length of bare conductor.	%	75
6.	Minimum corona Extinction voltage kV (rms) under dry condition	kV	320
7.	Maximum Radio Interference Voltage at 1 MHz for phase to earth voltage of 305 kV (rms) under dry condition	Micro Volts	1000

N) Accessories for ACSR ZEBRA conductor for 220 kV transmission line

1. Mid span compression Joint

Sl.	Description	Unit	Particulars/ Value	
			<u>Aluminium Sleeve</u>	<u>Steel Sleeve</u>
1.	Material of Joint		Aluminium of minimum purity 99.5%	Mild Steel (Fe-410, IS:2062)
2.	Range of Hardness of the steel sleeve (Brinell hardness)	BHN	From 100 to 200	
3.	Dimension of sleeve Before compression		<u>Aluminum sleeve</u>	<u>Steel sleeve</u>
i)	Inside diameter	mm	31.00 ± 0.5	10.00 ± 0.2
ii)	Outside diameter	mm	48.00 ± 1.0	20.00 ± 0.5
iii)	Length	mm	710 ± 5	241 ± 5
4.	Dimensions of Sleeve after compression		<u>Aluminum sleeve</u>	<u>Steel sleeve</u>
i)	Outside dimension (Corner to corner)	mm	47.00 ± 0.5	19.00 ± 0.5
ii)	Outside dimension (face to face)	mm	41.00 ± 0.5	16.00 ± 0.5
5.	Slip strength	KN	123.8	
6.	Maximum resistance of the compressed unit expressed, as percentage of the resistance of equivalent length of bare conductor.	%	75	
7.	Galvanising			

a)	Minimum weight of Zinc coating for steel parts	gm/m ²	610
b)	Purity of Zinc used for galvanising	%	99.95 (IS 209) or 98.5 (IS 13229)
c)	Min. No. of dips in standard preece test the ferrous parts can withstand (wherever applicable)	No.	a) Fasteners: 4 dips of 1 minute b) Spring washers: 3 dips of 1 minute & c) all others: 6 dips of 1 minute

2. Repair sleeve

Sl.	Description	Unit	Particulars/ Value
1.	Material		Aluminium of minimum purity 99.5%
2.	Dimension of Aluminum sleeve Before compression		
i)	Inside diameter	mm	31.00 ± 0.5
ii)	Outside diameter	mm	48.00 ± 1.0
iii)	Length	mm	275.00 ± 5.0
3.	Dimensions of Aluminum Sleeve after compression		
i)	Outside dimension (Corner to corner)	mm	47.00 ± 0.5
ii)	Outside dimension (face to face)	mm	41.00 ± 0.5

3. Vibration Damper

Sl.	Description	Unit	Particulars/ Value
1.	Type of Damper		4R-Stockbridge type
2.	Materials of components		
	a) Damper masses		Cast iron/ mild steel hot dip galvanised / Zinc alloy
	b) Clamp		Aluminum alloy 4600
	c) Messenger cable		High tensile strength galvanized steel
3.	Number of strands in stranded messenger cable	Nos.	19
4.	Minimum ultimate tensile strength of stranded messenger cable	Kg/mm ²	135
5.	Slip strength of stranded messenger cable (mass pull off)	KN	5
6.	Slipping strength of damper clamp		
	(a) Before fatigue test	KN	2.5
	(b) After fatigue test	KN	2
7.	Resonance frequencies range	Hz	5 to 45

8.	Maximum magnetic power loss per vibration damper watts for 500 amps, 50 Hz Alternating Current	Watts	1
9.	Percentage variation in reactance after fatigue test in comparison with that before fatigue test	%	+/-40 (Maximum)
10.	Percentage variation in power dissipation after fatigue test in comparison with that before fatigue test	%	+/-40 (Maximum)
11.	Galvanising		
a)	Minimum weight of Zinc coating for steel parts	gm/m ²	610
b)	Purity of Zinc used for galvanising	%	99.95 (IS 209) or 98.5 (IS 13229)
c)	Min. No. of dips in standard preece test the ferrous parts can withstand (wherever applicable)	No.	a) Fasteners: 4 dips of 1 minute b) Spring washers: 3 dips of 1 minute & c) all others: 6 dips of 1 minute

O) Accessories for ACSR PANTHER conductor for 132 kV transmission line

1. Mid span compression Joint for ACSR PANTHER Conductor

Sl.	Description	Unit	Particulars/ Value	
			<u>Aluminium Sleeve</u>	<u>Steel Sleeve</u>
1.	Material of Joint		Aluminium of minimum purity 99.5%	Mild Steel (Fe-410, IS:2062)
2.	Range of Hardness of the steel sleeve (Brinnel hardness)	BHN	From 100 to 200	
3.	Dimension of sleeve Before compression		<u>Aluminum sleeve</u>	<u>Steel sleeve</u>
i)	Inside diameter	mm	23.00 ± 0.5	9.50 ± 0.2
ii)	Outside diameter	mm	38.00 ± 1.0	18.00 ± 0.5
iii)	Length	mm	610 ± 5	203 ± 5
4.	Dimensions of Sleeve after compression		<u>Aluminum sleeve</u>	<u>Steel sleeve</u>
i)	Outside dimension (Corner to corner)	mm	37.00 ± 0.5	17.40 ± 0.5

ii)	Outside dimension (face to face)	mm	32.00 ± 0.5	15.10 ± 0.5
5.	Slip strength	KN	85.2	
6.	Maximum resistance of the compressed unit expressed, as percentage of the resistance of equivalent length of bare conductor.	%	75	
7.	Galvanising			
a)	Minimum weight of Zinc coating for steel parts	gm/m ²	610	
b)	Purity of Zinc used for galvanising	%	99.95 (IS 209) or 98.5 (IS 13229)	
c)	Min. No. of dips in standard preece test the ferrous parts can withstand (wherever applicable)	No.	a) Fasteners: 4 dips of 1 minute b) Spring washers: 3 dips of 1 minute & c) all others: 6 dips of 1 minute	

2. Repair sleeve for ACSR PANTHER Conductor

Sl.	Description	Unit	Particulars/ Value
1.	Material		Aluminium of minimum purity 99.5%
2.	Dimension of Aluminum sleeve Before compression		
i)	Inside diameter	mm	23.00 ± 0.5
ii)	Outside diameter	mm	38.00 ± 1.0
iii)	Length	mm	241.00 ± 5.0
3.	Dimensions of Aluminum Sleeve after compression		
i)	Outside dimension (Corner to corner)	mm	37.00 ± 0.5
ii)	Outside dimension (face to face)	mm	32.00 ± 0.5

3. Vibration Damper for ACSR PANTHER Conductor

Sl.	Description	Unit	Particulars/ Value
1.	Type of Damper		4R-Stockbridge type
2.	Materials of components		
	a) Damper masses		Cast iron/ mild steel hot dip galvanised / Zinc alloy
	b) Clamp		Aluminum alloy 4600
	c) Messenger cable		High tensile strength galvanized steel
3.	Number of strands in stranded messenger cable	Nos.	19

4.	Minimum ultimate tensile strength of stranded messenger cable	Kg/m m ²	135
5.	Slip strength of stranded messenger cable (mass pull off)	KN	5
6.	Slipping strength of damper clamp		
	(a) Before fatigue test	KN	2.5
	(b) After fatigue test	KN	2
7.	Resonance frequencies range	Hz	5 to 45
8.	Maximum magnetic power loss per vibration damper watts for 350 amps, 50 Hz Alternating Current	Watts	1
9.	Percentage variation in reactance after fatigue test in comparison with that before fatigue test	%	+/-40 (Maximum)
10.	Percentage variation in power dissipation after fatigue test in comparison with that before fatigue test	%	+/-40 (Maximum)
11.	Galvanising		
a)	Minimum weight of Zinc coating for steel parts	gm/m ²	610
b)	Purity of Zinc used for galvanising	%	99.95 (IS 209) or 98.5 (IS 13229)
c)	Min. No. of dips in standard preece test the ferrous parts can withstand (wherever applicable)	No.	a) Fasteners: 4 dips of 1 minute b) Spring washers: 3 dips of 1 minute & c) all others: 6 dips of 1 minute

P) Accessories for ACSR Lapwing conductor for ±800 kV HVDC Transmission Line.

Mid span compression Joint for ACSR Lapwing				
Sl.	Description	Unit	Particulars/ Value	
			<u>Aluminium Sleeve</u>	<u>Steel Sleeve</u>
1.	Material of Joint		Aluminium of purity 99.5%	Mild Steel (Fe-410, IS:2062)
2.	Range of Hardness of the steel sleeve (Brinell hardness)	BHN	From 120 to 200	
3.	Weight of Zinc coating for steel sleeve	gm/m ²	610	

4.	Dimension of sleeve Before compression		<u>Aluminum sleeve</u>	<u>Steel sleeve</u>
i)	Inside diameter: Nominal Tolerance	mm mm	41 ± 0.5	10 ± 0.5
ii)	Outside diameter: Nominal Tolerance	mm mm	64 ± 1.0	21 ± 0.5
iii)	Length	mm	As per design*	As per design*
	*As per design to meet specified strength requirement (Min. Length- Al-Sleeve-860mm, Steel Sleeve-225mm)			
5.	Dimensions of Sleeve after compression		<u>Aluminum sleeve</u>	<u>Steel sleeve</u>
i)	Outside dimension (Corner to corner)	mm	As per design	As per design
ii)	Outside dimension (face to face)	mm	As per design	As per design
iii)	Length	mm	As per design	As per design
5.	Slip strength	KN	178.6	
6.	Maximum resistance of the compressed unit expressed, as percentage of the resistance of equivalent length of bare conductor.	%	75	
7.	Minimum corona Extinction voltage kV (rms) under a voltage gradient of 22 kV/cm on conductor under dry condition	kV	880	
8.	Maximum Radio Interference Voltage at 1 MHz when subjected to conductor surface gradient of 22 kV/cm (positive) under dry condition	Micro Volts	1000	

Repair sleeve for ACSR LAPWING Conductor

Sl.	Description	Unit	Particulars/ Value
1.	Material		Aluminium of minimum purity 99.5%
2.	<u>Dimension of Aluminum sleeve Before compression</u>		
i)	Inside diameter: Nominal Tolerance	mm mm	41 ± 0.5
ii)	Outside diameter: Nominal Tolerance	mm	64 ±1.0
iii)	Length	mm	As per design
	*As per design to meet specified strength requirement (Min. Length- 495mm)		
3.	<u>Dimensions of Aluminum Sleeve After compression</u>		

i)	Outside dimension (Corner to corner)	Mm	As per design
ii)	Outside dimension (face to face)	Mm	As per design
iii)	Length	Mm	As per design
4.	Minimum corona Extinction voltage kV (rms) under a voltage gradient of 22 kV/cm on conductor under dry condition	kV	880
5.	Maximum Radio Interference Voltage at 1 MHz when subjected to conductor surface gradient of 22 kV/cm (positive) under dry condition	Micro Volts (μ V)	1000

Q) Accessories for 7/3.66 mm GS Earthwire for 400 kV and 765 kV transmission line

1. Mid span compression Joint for 7/3.66 mm GS Earthwire

Sl.	Description	Unit	Particulars/ Value		
			<u>Aluminium / Filler Sleeve</u>	<u>Steel Sleeve</u>	
1.	Material of Joint		Aluminium of minimum purity 99.5%	Mild Steel (Fe-410, IS:2062)	
2.	Range of Hardness of the steel sleeve (Brinnel hardness)	BHN	From 100 to 200		
3.	Weight of Zinc coating	gm/m ²	610		
4.	Dimension of sleeve Before compression				
			<u>Aluminium Sleeve</u>	<u>Steel Sleeve</u>	<u>Alu filler sleeve</u>
i)	Inside diameter	mm	22.00 ± 0.5	11.50 ± 0.2	11.50 ± 0.2
ii)	Outside diameter	mm	32.00 ± 0.5	21.00 ± 0.5	21.00 ± 0.5
iii)	Length	mm	400 ± 5	230 ± 5	60 ± 5
5.	Dimensions of Sleeve after compression				
			<u>Aluminium Sleeve</u>	<u>Steel Sleeve</u>	
i)	Outside dimension (Corner to Corner)	mm	29.40 ± 0.5	20.20 ± 0.5	
ii)	Outside dimension (face to face)	mm	25.00 ± 0.5	17.50 ± 0.5	
iii)	Length	mm	430 (approx)	265 (approx)	
6.	Slip strength	KN	65		
7.	Maximum resistance of the compressed unit expressed, as	%	75		

	percentage of the resistance of equivalent length of bare Earthwire		
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2. Flexible AL Bond for 7/3.66 mm GS Earthwire

Sl.	Description	Unit	Particulars/ Value
1.	Stranding		19(12+6+1)/dia2.54
2.	Cross sectional area	Sq.mm	95
3.	Length of aluminium cable	mm	750+5
4.	Material of lugs		Aluminum alloy
5.	Bolt Size		
	i) Diameter	mm	16
	ii) Length	mm	40

3. Vibration Damper for 7/3.66 mm GS Earthwire

Sl.	Description	Unit	Particulars/ Value
1.	Type of Damper		4R-Stockbridge type
2.	Materials of components		
	a) Damper masses		Cast iron/mild steel/Zinc alloy duly hop dip galvanised
	b) Clamp		Aluminum alloy 4600
	c) Messenger cable		High tensile strength galvanized steel
3.	Number of strands in stranded messenger cable	Nos.	19
4.	Minimum ultimate tensile strength of stranded messenger cable	Kg/mm ²	135
5.	Slip strength of stranded messenger cable (mass pull off)	kN	2.5
6.	Slipping strength of damper clamp		
	(a) Before fatigue test	kN	2.5
	(b) After fatigue test	kN	2
7.	Resonance frequencies range	Hz	10 to 60
8.	Percentage variation in reactance after fatigue test in comparison with that before fatigue test	%	+/-40 (Maximum)
9.	Percentage variation in power dissipation after fatigue test in comparison with that before fatigue test	%	+/-40 (Maximum)

4. Suspension Clamp for 7/3.66 mm GS Earthwire

Sl.	Description	Unit	Particulars/ Value
1.	Material of components		
	(a) Shackle		Forged Steel

	(b) Clamp Body & Keeper		Malleable cast iron / SGI
	(c) U- Bolt		Mild Steel
2.	Total Drop (Maximum)	mm	150
3.	Breaking Strength (Minimum)	kN	25
4.	Slipping Strength	kN	12 to 17
5.	Galvanising		
a)	Minimum weight of Zinc coating for steel parts	gm/m ²	610
b)	Purity of Zinc used for galvanising	%	99.95 (IS 209) or 98.5 (IS 13229)
c)	Min. No. of dips in standard preece test the ferrous parts can withstand (wherever applicable)	No.	a) Fasteners: 4 dips of 1 minute b) Spring washers: 3 dips of 1 minute & c) all others: 6 dips of 1 minute

5. Tension Clamp for 7/3.66 mm GS Earthwire

Sl.	Description	Unit	Particulars/ Value		
1.	Material of components				
	(i) Anchor Shackle		Forged Steel		
	(ii) Compression Clamp				
	a) Steel Sleeve		Mild Steel		
	b) Aluminium sleeve		Aluminium of purity 99.5%		
	c) Aluminium Filler sleeve		Aluminium of purity 99.5%		
2.	Range of Hardness of the steel sleeve (Brinell hardness)	BHN	120-200		
3.	Dimension of sleeve Before compression				
			Aluminium Sleeve	Steel Sleeve	Aluminium filler sleeve
i)	Inside diameter	mm	22.00 ± 0.5	11.50 ± 0.2	11.50 ± 0.2
ii)	Outside diameter	mm	30.00 ± 0.5	21.00 ± 0.5	21.00 ± 0.5
iii)	Length	mm	245 ± 5	205 ± 5	25 .0
4.	Dimensions of Sleeve after compression				
			Aluminium Sleeve	Steel Sleeve	
i)	Outside dimension (Corner to Corner)	mm	29.40 ± 0.5	20.20 ± 0.5	
ii)	Outside dimension (face to face)	mm	25.00 ± 0.5	17.50 ± 0.5	
5.	Slip strength	KN	65		
6.	Minimum Breaking strength of assembly (excluding clamp)	KN	70		
7.	Compression Pressure	Ton	100		
8.	Galvanising				
a)	Minimum weight of Zinc coating for steel parts	gm/ m ²	610		
b)	Purity of Zinc used for galvanising	%	99.95 (IS 209) or 98.5 (IS 13229)		
c)	Min. No. of dips in standard preece test the ferrous parts can withstand (wherever applicable)	No.	a) Fasteners: 4 dips of 1 minute b) Spring washers: 3 dips of 1 minute & c) all others: 6 dips of 1 minute		

R) Accessories for 7/3.15 mm GS Earthwire for 220 kV and 132 kV transmission line

1. Mid span compression Joint for 7/3.15 mm GS Earthwire

Sl.	Description	Unit	Particulars/ Value		
			<u>Aluminium / Filler Sleeve</u>	<u>Steel Sleeve</u>	
1.	Material of Joint		Aluminium of minimum purity 99.5%	Mild Steel (Fe-410, IS:2062)	
2.	Range of Hardness of the steel sleeve (Brinnel hardness)	BHN	From 100 to 200		
3.	Dimension of sleeve Before compression				
			<u>Alumini um Sleeve</u>	<u>Steel Sleeve</u>	<u>Alu filler sleeve</u>
i)	Inside diameter	mm	22.00 ± 0.5	10.00 ± 0.2	11.50 ± 0.2
ii)	Outside diameter	mm	30.00 ± 0.5	21.00 ± 0.5	21.00 ± 0.5
iii)	Length	mm	315 ± 5	230 ± 5	25 ± 2
4.	Dimensions of Sleeve after compression				
			<u>Aluminium Sleeve</u>	<u>Steel Sleeve</u>	
i)	Outside dimension (Corner to Corner)	mm	29.40 ± 0.5	20.20 ± 0.5	
ii)	Outside dimension (face to face)	mm	25.00 ± 0.5	17.50 ± 0.5	
5.	Slip strength	KN	53.20		
6.	Maximum resistance of the compressed unit expressed, as percentage of the resistance of equivalent length of bare Earthwire	%	75		
7.	Galvanising				
a)	Minimum weight of Zinc coating for steel parts	gm/m ²	610		
b)	Purity of Zinc used for galvanising	%	99.95 (IS 209) or 98.5 (IS 13229)		
c)	Min. No. of dips in standard preece test the ferrous parts can withstand (wherever applicable)	No.	a) Fasteners: 4 dips of 1 minute b) Spring washers: 3 dips of 1 minute & c) all others: 6 dips of 1 minute		

2. Flexible AL Bond for 7/3.15 mm GS Earthwire

Sl.	Description	Unit	Particulars/ Value
1.	Stranding		19(12+6+1)/dia2.54
2.	Cross sectional area	Sq.mm	95
3.	Length of aluminium cable	mm	750+5
4.	Material of lugs		Aluminum alloy
5.	Bolt Size		
	i) Diameter	mm	16
	ii) Length	mm	40

3. Vibration Damper for 7/3.15 mm GS Earthwire

Sl.	Description	Unit	Particulars/ Value
1.	Type of Damper		4R-Stockbridge type
2.	Materials of components		
	a) Damper masses		Cast iron/ mild steel hot dip galvanised / Zinc alloy
	b) Clamp		Aluminum alloy 4600
	c) Messenger cable		High tensile strength galvanized steel
3.	Number of strands in stranded messenger cable	Nos.	19
4.	Minimum ultimate tensile strength of stranded messenger cable	Kg/m m ²	135
5.	Slip strength of stranded messenger cable (mass pull off)	kN	2.5
6.	Slipping strength of damper clamp		
	(a) Before fatigue test	kN	2.5
	(b) After fatigue test	kN	2
7.	Resonance frequencies range	Hz	10 to 60
8.	Percentage variation in reactance after fatigue test in comparison with that before fatigue test	%	+/-40 (Maximum)
9.	Percentage variation in power dissipation after fatigue test in comparison with that before fatigue test	%	+/-40 (Maximum)
10.	Galvanising		

a)	Minimum weight of Zinc coating for steel parts	gm/m ²	610
b)	Purity of Zinc used for galvanising	%	99.95 (IS 209) or 98.5 (IS 13229)
c)	Min. No. of dips in standard preece test the ferrous parts can withstand (wherever applicable)	No.	a) Fasteners: 4 dips of 1 minute b) Spring washers: 3 dips of 1 minute & c) all others: 6 dips of 1 minute

4. Suspension Clamp for 7/3.15 mm GS Earthwire

Sl.	Description	Unit	Particulars/ Value
1.	Material of components		
	(a) Shackle		Forged Steel
	(b) Clamp Body & Keeper		Malleable cast iron / SGI
	(c) U- Bolt		Mild Steel (Fe 410, IS 2062)
2.	Total Drop (Maximum)	mm	150
3.	Breaking Strength (Minimum)	kN	25
4.	Slipping Strength	kN	9 to 14
5.	Galvanising		
a)	Minimum weight of Zinc coating for steel parts	gm/m ²	610
b)	Purity of Zinc used for galvanising	%	99.95 (IS 209) or 98.5 (IS 13229)
c)	Min. No. of dips in standard preece test the ferrous parts can withstand (wherever applicable)	No.	a) Fasteners: 4 dips of 1 minute b) Spring washers: 3 dips of 1 minute & c) all others: 6 dips of 1 minute

5. Tension Clamp for 7/3.15 mm GS Earthwire

Sl.	Description	Unit	Particulars/ Value		
1.	Material of components				
	(i) Anchor Shackle				Forged Steel
	(ii) Compression Clamp				
	a) Steel Sleeve				Mild Steel (Fe 410, IS 2062)
	b) Aluminium sleeve				Aluminium of purity 99.5%
	c) Aluminium Filler sleeve				Aluminium of purity 99.5%
2.	Range of Hardness of the steel sleeve (Brinell hardness)	BHN			100-200
3.	Dimension of sleeve Before compression				
			<u>Aluminium Sleeve</u>	<u>Steel Sleeve</u>	<u>Alu filler sleeve</u>
i)	Inside diameter	mm	22.00 ± 0.5	10.00 ± 0.2	11.50 ± 0.2
ii)	Outside diameter	mm	30.00 ± 0.5	21.00 ± 0.5	21.00 ± 0.5
iii)	Length	mm	220 ± 5	180 ± 5	25.0 ± 2
4.	Dimensions of Sleeve after compression				
			<u>Aluminium Sleeve</u>	<u>Steel Sleeve</u>	

i)	Outside dimension (Corner to Corner)	mm	29.40 ± 0.5	20.20 ± 0.5
ii)	Outside dimension (face to face)	mm	25.00 ± 0.5	17.50 ± 0.5
5.	Slip strength	KN	53.20	
6.	Minimum Breaking strength of assembly (excluding clamp)	KN	70	
7.	Compression Pressure	Ton	100	
8.	Galvanising			
a)	Minimum weight of Zinc coating for steel parts	gm/m ²	610	
b)	Purity of Zinc used for galvanising	%	99.95 (IS 209) or 98.5 (IS 13229)	
c)	Min. No. of dips in standard preece test the ferrous parts can withstand (wherever applicable)	No.	a) Fasteners: 4 dips of 1 minute b) Spring washers: 3 dips of 1 minute & c) all others: 6 dips of 1 minute	

S) Accessories for 7/4.5 mm GS Earthwire for ±800 kV transmission line

Mid span compression Joint for 7/4.5 mm GS Earthwire

Sl.	Description	Unit	Particulars/ Value		
			<u>Aluminium / Filler Sleeve</u>	<u>Steel Sleeve</u>	
1.	Material of Joint		Aluminium of minimum purity 99.5%	Mild Steel (Fe-410, IS:2062)	
2.	Range of Hardness of the steel sleeve (Brinell hardness)	BHN	From 100 to 200		
3.	Weight of Zinc coating	gm/m ²	610		
4.	Dimension of sleeve Before compression				
			<u>Aluminium Sleeve</u>	<u>Steel Sleeve</u>	<u>Alu filler sleeve</u>
i)	Inside diameter: Nominal Tolerance	mm	24-28 ± 0.5	14-15 ± 0.5	14-15 ± 0.5
ii)	Outside diameter: Nominal Tolerance	Mm	32-38 ± 0.5	24-27 ± 0.5	24-27 ± 0.5
iii)	Length	mm	As per design*	As per design*	As per design*
	* As per design to meet specified strength requirement (Minimum length-Al-Sleeve-525mm, Steel sleeve-345mm, Alu filler tube-50mm)				
5.	Dimensions of Sleeve after compression				
			<u>Aluminium Sleeve</u>	<u>Steel Sleeve</u>	
i)	Outside dimension (Corner to Corner)	mm	As per design	As per design	

ii)	Outside dimension (face to face)	mm	As per design	As per design
iii)	Length	mm	As per design	As per design
6.	Slip strength	KN	100.9	
7.	Maximum resistance of the compressed unit expressed, as percentage of the resistance of equivalent length of bare Earthwire	%	75	

2. Flexible AL Bond for 7/4.5 mm GS Earthwire			
Sl.	Description	Unit	Particulars/ Value
1.	Stranding		19(12+6+1)/dia2.54
2.	Cross sectional area	Sq.mm	95
3.	Length of aluminium cable	mm	750+5
4.	Material of lugs		Aluminum alloy
5.	Bolt Size		
	i) Diameter	mm	16
	ii) Length	mm	40
3. Vibration Damper for 7/4.5 mm GS Earthwire			
Sl.	Description	Unit	Particulars/ Value
1.	Type of Damper		4R-Stockbridge type
2.	Materials of components		
	a) Damper masses		Cast iron/mild steel/Zinc alloy duly hop dip galvanised
	b) Clamp		Aluminum alloy 4600
	c) Messenger cable		High tensile strength galvanized steel
3.	Number of strands in stranded messenger cable	Nos.	19
4.	Minimum ultimate tensile strength of stranded messenger cable	Kg/mm ²	135
5.	Slip strength of stranded messenger cable (mass pull off)	kN	5
6.	Slipping strength of damper clamp		
	(a) Before fatigue test	kN	2.5
	(b) After fatigue test	kN	2
7.	Resonance frequencies range	Hz	10 to 60
8.	Percentage variation in reactance after fatigue test in comparison with that before fatigue test	%	+/-25(Maximum)
9.	Percentage variation in power dissipation after fatigue test in comparison with that before fatigue test	%	+/-25 (Maximum)

4. Suspension Clamp for 7/4.5 mm GS Earthwire			
Sl.	Description	Unit	Particulars/ Value
1.	Material of components		
	(a) Shackle		Forged Steel
	(b) Clamp Body & Keeper		Malleable cast iron / SGI
	(c) U- Bolt		Mild Steel
2.	Total Drop (Maximum)	mm	150
3.	Breaking Strength (Minimum)	kN	45
4.	Slipping Strength	kN	19 to 27
5.	Galvanising		
a)	Minimum weight of Zinc coating for steel parts	gm/m ²	610
b)	Purity of Zinc used for galvanising	%	99.95 (IS 209) or 98.5 (IS 13229)
c)	Min. No. of dips in standard preece test the ferrous parts can withstand (wherever applicable)	No.	a) Fasteners: 4 dips of 1 minute b) Spring washers: 3 dips of 1 minute & c) all others: 6 dips of 1 minute

Tension Clamp for 7/4.5 mm GS Earthwire					
Sl.	Description	Unit	Particulars/ Value		
1.	Material of components				
	(i) Anchor Shackle				Forged Steel
	(ii) Compression Clamp				
	a) Steel Sleeve				Mild Steel
	b) Aluminium sleeve				Aluminium of purity 99.5%
	c) Aluminium Filler sleeve				Aluminium of purity 99.5%
3.	Range of Hardness of the steel sleeve (Brinell hardness)	BHN			120-200
4.	Dimension of sleeve Before compression				
			<u>Aluminium Sleeve</u>	<u>Steel Sleeve</u>	<u>Alu filler sleeve</u>
i)	Inside diameter: Nominal Tolerance	mm mm	24-28 ± 0.5	14-14.5 ± 0.5	14-14.5 ± 0.5
ii)	Outside diameter: Nominal Tolerance	mm mm	32-38 ± 0.5	24-28 ± 0.5	24-28 ± 0.5
iii)	Length	mm	As per design	As per design	As per design
5.	Dimensions of Sleeve after compression				

			<u>Aluminium Sleeve</u>	<u>Steel Sleeve</u>
i)	Outside dimension (Corner to Corner)	mm	As per design	As per design
ii)	Outside dimension (face to face)	mm	As per design	As per design
6.	Slip strength	KN	100.9	
7.	Minimum Breaking strength of assembly (excluding clamp)	KN	120	
8.	Compression Pressure	Ton	100	

Annexure-C

TYPICAL PLACEMENT CHART FOR SPACER DAMPER																			
Span in Meter	No.	Sub Span In meter																	
100	2	34	31	35															
105	2	34	40	31															
110	2	34	45	31															
115	2	34	50	31															
120	2	34	55	31															
125	2	34	60	31															
130	2	34	65	31															
135	2	39	65	31															
140	2	39	65	36															
145	3	34	39	44	28														
150	3	35	40	45	30														
155	3	36	41	47	31														
160	3	37	43	48	32														
165	3	39	44	49	33														
170	3	40	45	50	35														
175	3	40	47	53	35														
180	3	40	50	55	35														
185	3	40	52	58	35														
190	3	40	55	60	35														
195	3	40	57	63	35														
200	3	39	65	58	38														
205	4	37	50	40	46	32													
210	4	38	51	41	47	33													
215	4	36	53	42	50	34													
220	4	39	45	55	44	37													
225	4	39	45	55	49	37													
230	4	39	50	55	49	37													
235	4	39	49	57	52	38													
240	4	39	55	59	50	37													
245	4	39	55	65	49	37													
250	4	39	65	50	58	38													
255	4	40	65	54	61	35													
260	5	40	48	44	52	41	35												
265	5	40	49	45	54	42	35												
270	5	37	52	45	50	47	39												
275	5	36	56	45	55	44	39												
280	5	38	60	46	54	43	39												
285	5	38	60	49	55	44	39												
290	5	38	62	50	56	45	39												

Note: In case of tension towers, one additional Spacer Damper shall be placed within 10m of dead end clamp.

295	5	38	64	51	57	46	39													
300	5	38	62	53	57	51	39													
305	5	38	64	56	60	48	39													
310	5	38	62	55	60	56	39													
315	5	40	62	54	59	65	35													
320	6	40	45	55	49	43	53	35												
325	6	40	46	56	50	44	54	35												
330	6	40	47	57	51	45	55	35												
335	6	38	55	50	45	51	57	39												
340	6	38	57	51	46	52	57	39												
345	6	38	57	52	44	55	60	39												
350	6	38	59	52	44	55	63	39												
355	6	38	58	52	45	60	63	39												
360	6	40	53	62	57	52	61	35												
365	6	40	54	63	58	53	62	35												
370	6	40	55	65	59	54	62	35												
375	7	40	56	47	52	43	48	54	35											
380	7	40	57	47	53	44	49	55	35											
385	7	40	58	48	54	44	50	56	35											
390	7	40	58	49	55	45	51	57	35											
395	7	38	52	57	50	55	45	59	39											
400	7	40	60	51	56	47	53	58	35											
405	7	40	61	52	57	47	54	59	35											
410	7	40	62	52	58	48	55	60	35											
415	7	40	62	54	59	50	55	60	35											
420	7	40	63	54	60	50	57	61	35											
425	7	40	56	62	58	53	57	60	39											
430	7	40	57	64	58	52	57	63	39											
435	7	40	59	63	60	55	58	61	39											
440	7	40	59	64	61	56	59	62	39											
445	8	40	46	56	50	58	54	49	57	35										
450	8	40	48	56	51	59	54	49	58	35										
455	8	40	48	57	52	60	55	50	58	35										
460	8	39	58	55	52	49	53	56	61	37										
465	8	39	59	56	53	50	54	57	60	37										
470	8	39	60	57	54	51	54	57	61	37										
475	8	39	63	60	54	47	55	58	62	37										
480	8	40	52	61	55	64	58	53	62	35										
485	8	40	53	61	56	64	59	54	63	35										
490	9	40	58	48	43	51	56	47	53	59	35									
495	9	40	58	48	44	52	57	48	54	59	35									
500	9	40	59	49	44	52	58	48	55	60	35									

Note: In case of tension towers, one additional Spacer Damper shall be placed within 10m of dead end clamp.

505	9	40	59	50	45	53	59	48	55	61	35										
510	9	40	60	51	45	54	59	49	55	62	35										
515	9	40	61	51	46	54	59	51	56	62	35										
520	9	40	61	51	46	55	60	52	57	63	35										
525	9	40	62	52	47	56	61	51	57	64	35										
530	9	39	62	56	59	53	57	51	55	60	38										
535	9	39	65	56	59	53	57	51	55	62	38										
540	9	40	64	54	49	57	63	54	59	65	35										
545	9	40	65	55	49	59	63	54	60	65	35										
550	10	40	53	58	48	55	45	52	60	48	56	35									
555	10	40	53	58	49	56	46	52	60	49	57	35									
560	10	40	54	59	50	56	47	53	60	49	57	35									
565	10	40	55	60	51	57	47	53	60	50	57	35									
570	10	40	55	61	51	57	48	54	61	51	57	35									
575	10	40	55	61	51	59	49	54	62	51	58	35									
580	10	37	59	52	58	51	56	61	54	60	53	39									
585	10	37	62	52	59	51	56	61	55	60	53	39									
590	10	37	64	52	59	51	56	61	55	63	53	39									
595	10	37	65	53	59	52	56	62	55	64	53	39									
600	10	37	65	54	59	53	57	61	56	64	55	39									
605	10	37	65	55	60	53	57	61	56	64	58	39									
610	10	37	65	56	63	54	57	60	56	64	59	39									
615	10	39	65	59	62	54	57	61	56	64	58	40									
620	11	40	58	51	61	54	49	59	52	45	55	61	35								
625	11	40	58	52	61	55	49	60	52	45	56	62	35								
630	11	40	59	52	62	56	49	60	53	46	56	62	35								
635	11	40	59	53	62	56	50	61	53	46	57	63	35								
640	11	39	54	61	55	60	52	58	53	57	51	60	40								
645	11	39	54	62	56	61	52	59	53	58	51	60	40								
650	11	39	55	62	57	61	53	59	54	58	52	60	40								
655	11	39	55	63	57	62	53	60	54	59	52	61	40								
660	11	39	56	63	58	62	54	60	55	59	53	61	40								
665	11	39	57	65	58	62	54	62	55	59	53	61	40								
670	11	39	57	65	58	64	54	62	55	60	53	63	40								
675	11	39	58	65	59	64	55	62	56	60	54	63	40								
680	11	39	60	64	62	63	55	62	57	60	56	62	40								
685	12	40	60	50	57	62	53	58	49	54	60	50	57	35							
690	12	40	61	51	58	62	53	59	49	55	60	50	57	35							
695	12	40	61	51	58	63	54	59	50	55	61	50	58	35							
700	12	40	61	51	58	63	55	60	50	56	61	51	59	35							
705	12	39	62	55	63	54	61	52	59	53	57	60	50	40							
710	12	39	62	56	63	55	61	53	59	54	57	60	51	40							

Note: In case of tension towers, one additional Spacer Damper shall be placed within 10m of dead end clamp.

715	12	39	63	56	64	55	62	53	60	54	57	61	51	40								
720	12	39	63	57	64	56	62	54	60	55	59	53	58	40								
725	12	39	64	57	65	56	63	54	61	55	60	53	58	40								
730	12	39	64	58	65	57	63	55	61	56	60	54	58	40								
735	13	40	56	61	53	48	56	62	53	47	57	52	60	55	35							
740	13	40	56	61	54	48	57	62	54	47	57	52	61	56	35							
745	13	40	57	63	54	49	57	62	54	47	57	52	62	56	35							
750	13	40	58	63	55	50	57	62	54	48	58	53	61	56	35							
755	13	40	58	63	55	50	58	63	54	48	58	53	63	57	35							
760	13	40	58	65	55	50	59	64	55	48	58	53	63	57	35							
765	13	40	59	65	56	51	59	64	55	49	59	53	63	57	35							
770	13	40	60	65	56	51	59	64	56	49	59	54	64	58	35							
775	13	40	60	65	56	52	59	64	56	50	60	55	65	58	35							
780	13	40	65	58	53	59	54	60	55	61	56	62	55	63	39							
785	14	40	61	55	49	58	53	47	56	61	51	58	48	53	60	35						
790	14	40	61	56	49	59	53	47	56	63	51	59	48	53	60	35						
795	14	40	62	56	50	59	53	47	56	63	52	59	49	54	60	35						
800	14	40	63	56	50	59	54	48	57	63	52	59	49	55	60	35						
805	14	40	63	57	51	60	54	48	57	63	52	59	50	55	61	35						
810	14	40	63	57	51	60	55	48	57	63	54	61	50	55	61	35						
815	14	40	64	57	52	60	55	49	58	63	54	61	51	55	61	35						
820	14	40	64	58	52	61	55	49	58	64	54	61	51	56	62	35						
825	14	40	64	58	52	61	56	49	59	64	55	61	52	57	62	35						
830	14	40	65	58	53	62	56	49	59	64	55	62	52	57	63	35						
835	15	40	53	61	56	50	46	54	61	57	51	60	54	45	51	61	35					
840	15	40	53	62	56	51	46	54	61	57	51	61	55	45	52	61	35					
845	15	40	54	62	57	51	46	54	62	57	52	61	55	46	52	61	35					
850	15	40	54	62	58	51	46	54	63	57	52	61	56	46	53	62	35					
855	15	40	54	62	58	52	46	55	63	58	52	61	56	47	53	63	35					
860	15	40	55	63	58	52	47	55	63	58	53	62	56	47	53	63	35					
865	15	40	55	64	59	52	47	55	64	58	53	62	57	47	54	63	35					
870	15	40	56	64	59	53	47	56	64	59	53	62	57	47	54	64	35					
875	15	40	56	64	59	53	48	56	65	59	54	63	57	48	54	64	35					
880	15	40	56	65	60	53	48	56	65	60	54	63	58	48	54	65	35					
885	15	40	56	65	60	53	48	56	65	60	55	64	58	50	55	65	35					
890	15	40	65	55	64	57	63	59	49	60	50	61	51	62	52	63	39					
895	15	40	65	55	64	58	63	59	50	60	51	61	52	62	53	63	39					
900	16	40	58	51	61	56	51	61	55	49	60	52	63	57	51	45	55	35				
905	16	40	58	52	62	57	52	61	55	49	60	52	63	57	52	45	55	35				
910	16	40	58	52	62	57	52	62	56	50	60	53	63	57	52	46	55	35				
915	16	40	59	52	63	58	53	62	56	50	60	54	63	57	52	46	55	35				
920	16	40	60	52	63	58	53	62	56	51	60	54	63	58	53	46	56	35				

Note: In case of tension towers, one additional Spacer Damper shall be placed within 10m of dead end clamp.

925	16	40	60	53	63	58	53	63	57	51	61	54	64	58	53	46	56	35			
930	16	40	60	53	64	59	53	63	57	51	61	55	64	58	53	48	56	35			
935	16	40	61	53	64	59	54	64	57	51	61	55	65	58	53	48	57	35			
940	16	40	61	54	64	59	54	64	57	52	62	55	65	59	54	48	57	35			
945	17	40	53	47	56	51	61	56	50	60	53	48	57	62	51	46	57	62	35		
950	17	40	53	47	56	51	61	56	51	60	54	48	57	63	52	47	57	62	35		
955	17	40	54	47	57	51	62	57	51	61	54	48	57	63	52	47	57	62	35		
960	17	40	54	48	57	52	62	57	51	61	54	49	57	63	53	48	57	62	35		
965	17	40	54	48	57	52	62	57	52	61	55	49	58	63	53	48	58	63	35		
970	17	40	55	48	58	53	63	58	52	61	55	49	58	63	53	48	58	63	35		
975	17	40	55	49	58	53	63	58	52	61	55	49	59	64	53	48	59	64	35		
980	17	40	55	49	58	53	63	58	52	62	56	50	59	64	54	49	59	64	35		
985	17	40	55	49	59	54	64	58	53	62	56	50	59	64	54	49	59	65	35		
990	17	40	55	49	59	54	64	58	53	63	56	51	59	65	55	49	60	65	35		
995	17	40	56	50	59	54	64	59	53	63	56	51	60	65	55	50	60	65	35		
1000	18	40	45	50	59	52	62	57	52	62	57	48	53	61	56	51	44	54	62	35	
1005	18	40	45	50	60	53	63	57	52	63	58	48	53	61	56	51	44	54	62	35	
1010	18	40	45	50	60	53	63	57	52	63	58	49	53	62	57	51	45	54	63	35	
1015	18	40	46	51	60	54	63	57	52	63	58	49	54	62	57	51	45	55	63	35	
1020	18	40	46	51	61	54	64	58	53	63	58	49	54	62	57	52	45	55	63	35	
1025	18	40	47	51	61	54	64	59	53	63	58	49	55	62	58	52	45	56	63	35	
1030	18	40	47	51	61	54	64	59	54	64	59	50	55	62	58	53	45	56	63	35	
1035	18	40	47	52	61	55	64	59	54	64	59	50	55	63	58	53	46	56	64	35	
1040	18	40	47	52	61	55	64	59	54	64	59	50	55	64	59	54	47	57	64	35	
1045	18	40	47	53	61	56	64	59	54	65	60	50	55	65	59	54	47	57	64	35	
1050	18	40	48	53	61	56	64	59	55	65	60	51	56	65	59	54	47	57	65	35	
1055	19	40	53	61	56	49	44	53	62	56	52	61	56	50	60	54	45	50	56	62	35
1060	19	40	53	61	56	49	44	54	62	57	52	62	56	51	60	54	45	50	57	62	35
1065	19	40	53	62	57	50	44	54	63	57	52	62	56	51	61	54	45	50	57	62	35
1070	19	40	54	62	57	50	45	54	63	57	52	62	57	51	61	55	45	50	57	63	35
1075	19	40	54	62	57	50	45	55	64	58	53	62	57	51	61	55	45	50	58	63	35
1080	19	40	54	63	57	50	45	55	64	58	53	62	57	52	62	55	46	51	58	63	35
1085	19	40	55	63	58	51	46	55	64	58	53	63	57	52	62	55	46	51	58	63	35
1090	19	40	55	64	59	51	46	55	65	59	53	63	57	52	62	55	46	51	58	64	35
1095	19	40	56	64	59	52	46	55	65	59	53	64	57	52	62	55	47	51	59	64	35
1100	19	40	56	64	59	52	47	56	65	59	53	64	58	52	63	55	47	52	59	64	35

Note: In case of tension towers, one additional Spacer Damper shall be placed within 10m of dead end clamp.

SECTION-VI B

CLAMP FITTINGS AND ACCESSORIES FOR HTLS CONDUCTOR

TECHNICAL SPECIFICATIONS

SECTION-VI B

CLAMP FITTINGS AND ACCESSORIES FOR HTLS CONDUCTOR

Revision History

Revision No.	Date	Clause Ref	Description
Rev-0	June'2021		First Release
Rev-1	Sept'2021		First Revision
Rev-2	Jan'2022		Second Revision

TECHNICAL SPECIFICATIONS

SECTION-VI B

CLAMP FITTINGS AND ACCESSORIES FOR HTLS CONDUCTOR

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TECHNICAL SPECIFICATIONS

SECTION- VI B

CLAMP FITTINGS AND ACCESSORIES FOR HTLS CONDUCTOR

1.0 Technical Description of Clamp Fittings for HTLS Conductor

1.1 General

This section details technical particulars of fittings viz. suspension clamps and compression type dead end clamps for the HTLS Conductor to be supplied by the bidder. Each fitting shall be supplied complete in all respects.

- 1.2 The fittings shall be suitable for attachment to suspension and tension insulator strings along with hardware fittings. For owner supplied fittings, 2.5 % extra fasteners (excluding factory fitted fasteners) & retaining rods shall be provided to the Contractor to take care of losses during erection. No payment shall be admissible for these extra supplies. For fittings included in the scope of the Contractor, the contractor is permitted to get inspected and supply upto 2.5% extra fasteners & retaining rods to take care of losses during erection. No payment shall be admissible for these extra supplies. Indicative drawings of complete insulator strings along with hardware fittings as well as indicative drawings for suspension clamps and dead-end clamps are enclosed with this specification. The supplier shall be responsible for satisfactory performance of complete conductor system along with fittings offered by them for continuous operation at the designed maximum temperature specified for the HTLS conductor. The material of the components should be suitable for continued performance corresponding to these maximum temperatures without any deterioration. Maximum allowable temperature for aluminium/ aluminium alloy components, corresponding to the designed maximum temperature of conductor shall be limited to 93 Deg C.

In case, some special arrangement viz. semi-strain assembly is required to maintain low sag behavior of offered HTLS conductor in longer spans, supply & installation of such arrangements shall be in the scope of the Contractor. Documentary evidence regarding contractor/ supplier's previous experience of using such arrangements along with exact number of such arrangements required to be used in longer sections shall be submitted during post award engineering activities. Cost of supply and installation of required number of such arrangements shall be deemed to be included in the total quoted price.

1.3 Corona and RI Performance

Sharp edges and scratches on all the hardware fittings shall be avoided. All surfaces must be clean, smooth, without cuts and abrasions or projections. The

Supplier shall be responsible for satisfactory corona and radio interference performance of the materials offered by him.

1.4 Maintenance

1.4.1 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.

1.5 Split Pins

1.5.1 Split pins shall be used with bolts & nuts (wherever applicable).

1.6 Suspension Assembly

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

1.6.2 The suspension assembly shall include either free centre type suspension clamp along with standard preformed armour rods or armour grip suspension clamp, except for Pilot insulator string for which only suitable Envelope type suspension clamp shall be used.

1.6.3 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.

1.6.4 The suspension clamp shall be designed for continuous operation at the designed maximum temperature for conductor.

1.6.5 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.

1.6.6 The suspension assembly/ clamp shall be designed so that it shall minimize 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.

1.6.7 Slip strength of the offered suspension clamp shall be within 12% to 18% of UTS of the offered HTLS Conductor.

1.7 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.

1.7.1 Standard Preformed Armour Rod Set

1.7.1.1 The Preformed Armour Rods Set shall be used to minimise the stress developed in the sub-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 localised heating effect due to magnetic power losses from suspension clamps as well as resistance losses of the conductor.

1.7.1.2 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.

1.7.1.3 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.

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

1.7.1.5 The number of armour rods in each set shall be as per supplier's design to suit HTLS conductor offered. Each rod shall be marked in the middle with paint for easy application on the line.

1.7.1.6 The armour rod shall not loose their resilience even after five applications.

1.7.1.7 The conductivity of each rod of the set shall not be less than 40% of the conductivity of the International Annealed Copper Standard (IACS) & Minimum tensile strength shall not be less than 35kg/mm².

1.8 Armour Grip Suspension Clamp

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

- 1.8.2 Elastomer insert shall be resistant to the effects of temperature up to designed 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.
- 1.8.3 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.
- 1.8.4 The AGS preformed rod set shall be as detailed in clause 1.7.1.4 to 1.7.1.7 in general except for the following.
- 1.8.5 The length of the AGS preformed rods shall be such that it shall ensure sufficient slipping strength as detailed under clause 1.6.7 and shall not introduce unfavourable stress on the conductor under all operating conditions. The length of the AGS preformed rods shall be indicated in the GTP.
- 1.9 **Envelope Type Suspension Clamp**
- 1.9.1 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.
- 1.10 **Dead end Assembly**
- 1.10.1 The dead-end assembly shall be suitable for the offered HTLS Conductor.
- 1.10.2 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 (including angle of pad) 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 I^2R losses. The resistance of the clamp when compressed on HTLS conductor shall not be more than 75% of the resistance of equivalent length of HTLS conductor.
- 1.10.3 Die compression areas shall be clearly marked on each dead-end assembly designed for continuous die compressions and shall bear the words 'COM PRESS 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.

- 1.10.4 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.
- 1.10.5 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 ampacity at continuous operating conductor temperature as specified in Section-I of this specification and shall conform to the relevant Indian/International standards
- 1.10.6 For composite core HTLS conductor, dead end assembly may inter-alia include collets, collet housing, inner sleeve etc., suitable for the offered design of HTLS conductor
- 1.11 **Fasteners: Bolts, Nuts and Washers**
- 1.11.1 All bolts and nuts shall conform to IS 6639. All bolts and nuts shall be galvanised 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.
- 1.11.2 Bolts upto M16 and having length upto 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.
- 1.11.3 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.
- 1.11.4 Fully threaded bolts shall not be used for parts/components requiring shear/tensile strength. The length of the bolt shall be such that the threaded portion shall not extend into the place of contact of the component parts. Bolts & Nuts for these parts/components shall be of minimum 5.6 grade conforming to IS 1367 or equivalent International standards.
- 1.11.4.1 For parts/ components requiring grip strength viz. arcing horn, corona rings & dead-end jumper assembly, fully threaded bolts can be used as an alternative.

Bolts & nuts for these parts/ components shall be of minimum 4.6 grade conforming to IS 6639 or equivalent International standards

- 1.11.4.2 In case of fasteners of other materials viz. stainless steel, aluminium alloy, etc. are proposed to be used by the supplier, these shall conform to relevant Indian/International standards and complete details shall be submitted by the supplier for review & approval by the Employer.
- 1.11.5 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.
- 1.11.6 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.
- 1.11.7 The Supplier shall indicate required size & length of various bolts in the drawings based on 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.
- 1.11.8 To obviate bending stress in bolt, it shall not connect aggregate thickness more than three time its diameter.
- 1.11.9 Bolts at the joints shall be so staggered that nuts may be tightened with spanners without fouling.
- 1.11.10 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 9001 services Quality System standards.
- 1.11.11 Fasteners of grade higher than 8.8 are not to be used and minimum grade for bolt shall be 5.6.

1.12 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 fitting stating clearly the class, grade or alloy designation of the material, manufacturing process & heat treatment details and the reference standards.

- 1.12.1 The details of materials for different component are listed as in Table No-1.

1.13 Workmanship

- 1.13.1 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 the applicable voltage level of transmission lines and will give continued good performance. For Employer's review of the offered design of clamps/ fittings, the supplier shall submit document/ design details of similar type of clamps/ fittings used in past for similar type of HTLS conductor application.
- 1.13.3 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.
- 1.13.4 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 galvanised. The bolt threads shall be undercut to take care of the increase in diameter due to galvanising. Galvanising 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 galvanised materials shall have a minimum average coating of zinc equivalent to 600 gm/sqm, shall be guaranteed to withstand at least six successive dips each lasting one (1) minute under the standard preece test for galvanising.
- 1.13.5 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.
- 1.13.6 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.
- 1.13.7 All current carrying parts shall be so designed and manufactured that contact resistance is reduced to minimum and localized heating phenomenon is averted.
- 1.13.8 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 conditions.

- 1.13.9 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.
- 1.13.10 The fasteners shall conform to the requirements of IS:6639. All fasteners shall have suitable corona free locking arrangement to guard against vibration loosening.
- 1.13.11 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.

1.14 Bid Drawings

- 1.14.1 The Bidder shall furnish full description and illustrations of materials offered.
- 1.14.2 Fully dimensioned drawings of the hardware and their component parts shall be furnished along with the bid. Weight, material and fabrication details of all the components should be included in the drawings.

All drawings shall be identified by a drawing number and contract 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.

- 1.14.3 After placement of award, the Contractor shall submit fully dimensioned drawing including all the components in four (4) copies to the Employer for approval. After getting approval from the Employer and successful completion of all the type tests, the Contractor shall submit six (6) more copies of the same drawings to the Employer for further distribution and field use at Employer's end.

TABLE-1
(Details of Materials)

Sl. No.	Name of item	Material treatment	Process of Standard	Reference	Remarks
1.	Security Clips	Stainless Steel/ Phosphor Bronze	-	AISI 304 IS7811	
2.	For Free Centre /Envelope type clamps				
(a)	Clamp Body, Keeper Piece	Al. Alloy 4600	Casted & Heat treated	IS 617	
		Al. Alloy 65032	Forged & Heat treated	IS 733	
		Al Alloy ENAW6082	Forged & Heat treated	EN 573-3	
(b)	Cotter bolts	Mild Steel	Hot dip galvanised	IS-2062	
(c)	Shackles	Forged Steel (Class-IV)	Hot dip galvanised	IS-2004	
(d)	U Bolts	Stainless Steel		AISI 304 IS7811	
		Al alloy 65032	Forged & Heat treated	IS 733	
(e)	P. A. Rod	Al. Alloy 65032	Extruded & Heat treated	IS 733	
3.	For AGS type clamp				
(a)	Supporting House	Al. Alloy 4600	Casted & Heat treated	IS:617	
		Al alloy 65032	Forged & Heat treated	IS 733	
(b)	Al insert & Retaining strap	Al. Alloy 4600	Casted & Heat treated	IS:617	
		Al alloy 65032	Forged & Heat treated	IS 733	
(c)	Elastomer	Moulded on Al. reinforcement			
4.	For Dead End Assembly & Mid Span Compression Joint				
(a)	Outer Sleeve (for	Al Alloy 19500	Extruded	IS 733	

	Annealed Aluminium Conductor)				
(b)	Outer Sleeve (for Aluminium alloy Conductor)	Al Alloy 19500	Extruded	IS 733	
		Al Alloy 63400	Extruded & heat treated	IS 733	
		Al Alloy 6060		EN 573-3	
(c)	Steel Sleeve	Mild Steel	Hot Dip Galvanised	IS-2062	
		Forged Steel (Class-II)		IS-2004	
5	For Repair Sleeve				
(a)		Al Alloy 19500	Extruded	IS 733	
6	For T-Connector				
		Al Alloy 19500	Extruded	IS 733	
		Al Alloy 63400	Extruded & heat treated	IS 733	
		Al Alloy 6060		EN 573-3	
7	For Rigid Spacer				
	Clamp Body, Keeper Piece, Frame	Al. Alloy 4600	Casted & Heat treated	IS 617	
		Al. Alloy 65032	Forged & Heat treated	IS 733	
		Al Alloy ENAW6082	Forged & Heat treated	EN 573-3	
	Al Tube	Al Alloy 63400	Extruded & heat treated	IS 733	
		Al. Alloy 65032		IS 733	
8	For Spacer Damper				
(a)	Clamp Body, Keeper Piece, Frame & Al Insert	Al. Alloy 4600	Casted & Heat treated	IS 617	
		Al. Alloy 65032	Extruded/Forged & Heat treated	IS 733	
		Al Alloy ENAW6082	Forged & Heat treated	EN 573-3	
		Al Alloy 63400	Extruded & Heat treated	IS 733	
9	For Vibration Damper				
(a)	Clamp Body, Keeper Piece	Al. Alloy 4600	Casted & Heat treated	IS 617	
(b)	Damper Mass	Cast Iron/Steel			
(c)	Messenger Cable	High strength galvanised			

		steel/stain less steel			
10.	Yoke Plate	Mild Steel	Hot dip galvanized	IS-2062	
11 (a)	Corona Control ring/ Grading ring	Al. Alloy 65032	Extruded & Heat treated	IS 733	Mechanical strength of welded joint shall not be less than 20 KN
		Al. Alloy 63400	Extruded & Heat treated	IS 733	
		Al. Alloy 63401	Extruded & Heat treated	IS 5082	
11 (b)	Supporting Brackets & Mounting Bolts	Al Alloy 65032/63400	Heat treated	IS 733	
		Mild Steel	Hot dip galvanized	IS 2062	

Note: Alternate materials conforming to International/ 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 during detailed engineering

2.0 Accessories for the HTLS Conductor

2.1 General

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

2.1.2 For owner supplied accessories, 2.5 % extra fasteners (excluding factory fitted fasteners) & retaining rods shall be provided to the Contractor to take care of losses during erection. No payment shall be admissible for these extra supplies. For fittings included in the scope of the Contractor, the contractor is permitted to get inspected and supply upto 2.5% extra fasteners & retaining rods to take care of losses during erection. No payment shall be admissible for these extra supplies.

2.1.3 The supplier shall be responsible for satisfactory performance of complete conductor system along with accessories offered by him for continuous operation at the designed maximum temperature specified for the HTLS Conductor.

2.1.4 The material of the components should be suitable for continued performance corresponding to these maximum temperatures without any deterioration. Maximum allowable temperature for aluminium/ aluminium alloy components, corresponding to the designed maximum temperature of conductor shall be limited to 93 Deg C.

2.2 Mid Span Compression Joint

2.2.1 Mid Span Compression Joint shall be used for joining two lengths of conductor. The resistance of the joint when compressed on the conductor shall not be more than 75% of the resistance 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.

2.2.2 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 may be used for core jointing.

2.3 T-Connector

T-Connector of compression type shall be used for jumper connection at transposition tower. It shall be manufactured out of 99.5% pure aluminium/ aluminium alloy and shall be strong enough to withstand normal working loads as well as able to withstand the continuous maximum operating temperature of conductor. The T-connector 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 resistance of T-connector when compressed on the conductor shall not be more than 75% of the resistance of equivalent length of conductor. The T-connector shall not permit slipping off, damage to or failure of complete conductor. The welded portions shall be designed for 30 kN axial tensile load. Leg sleeve of T-connector should be kept at an angle of 15 deg. from vertical and horizontal plane of the conductor in order to minimise jumper pull at the welded portion. The dimensions of T-connector 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.

2.4 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 designed 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 alongwith 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.

2.5 Vibration Damper

2.5.1 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. One damper on each side per sub-conductor for suspension points and two dampers on each side per sub-conductor for tension points has been used for a ruling design span specified in Section-I. In case, more no. of dampers are recommended by the supplier, the payment shall be restricted to the number of dampers indicated above.

2.5.2 The damper shall be designed to have minimum 4 nos. of resonance frequencies to facilitate dissipation of vibration energy through inter-strand friction of the messenger cable and shall be effective in reducing vibration over aeolian frequency band ranging from $0.18/d$ Hz to $1.4/d$ Hz (where d is conductor diameter in meter). The vibration damper shall meet the requirement of frequency or wind velocity range and also have mechanical impedance closely matched with the offered HTLS 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.

- 2.5.3 The clamp of the vibration damper shall be made of high strength aluminium alloy grade 4600. 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.
- 2.5.4 The messenger cable shall be made of high strength galvanised steel/stain less steel with a minimum strength of 135 kg/mm². 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.
- 2.5.5 The damper mass shall be made of hot dip galvanised mild steel/cast iron or a permanent mould cast zinc alloy. All castings shall be free from defects such as cracks, shrinkage, inclusions and blowholes etc. The surface of the damper masses shall be smooth.
- 2.5.6 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.
- 2.5.7 The damper assembly shall be so designed that it shall not introduce radio interference beyond acceptable limits.
- 2.5.8 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.

2.5.9 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.

2.5.10 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	As per Section-I
	ii) Maximum span	1100 meters
	iii) Minimum span	100 meters
2	Configuration	As per section – I.
3	Tensile load in Conductor	25% of UTS of offered HTLS Conductor
4	Armour rods used	Standard preformed armour rods/AGS
5	Maximum permissible dynamic strain i.e. endurance limit.	+/- 150 micro strains

2.5.14 The damper placement chart shall be submitted for spans ranging from 100 m to 1100 m. Placement charts should be duly supported with relevant technical documents and sample calculations.

2.5.15 The damper placement charts shall include the following

- (1) 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.
- (2) Placement distances clearly identifying the extremities between which the distances are to be measured.
- (3) Placement recommendation depending upon type of suspension clamps (viz Free centre type/ Armour grip type etc.)
- (4) The influence of mid span compression joints, repair sleeves and armour rods (standard and AGS) in the placement of dampers.

2.6 **Rigid Spacer for Jumper (For 400 KV line with twin HTLS Conductor only)**

2.6.1 Jumpers at tension points shall be fitted with spacers so as to limit the length of free conductor to 3.65 m and to maintain the sub conductor spacing of 450 mm for twin bundle conductors. It shall meet all the requirements of spacer

used in line except for its vibration performance. Spacers requiring retaining rods shall not be quoted for jumpers.

- 2.6.2 The spacer offered by the Bidder shall satisfy the following requirements.
- 2.6.2.1 Spacer shall restore normal spacing of the sub-conductors after displacement by wind, electromagnetic and the electrostatic forces under all operating conditions including the specified short circuit level without permanent deformation damage either to conductor or to the assembly itself. They shall have uniform grip on the conductor
- 2.6.2.2 Where elastomer lined clamp grooves are used, the elastomer shall be firmly fixed to the clamp.
- 2.6.2.3 Any nut used shall be locked in such a manner so as to prevent vibration loosening. The ends of bolts and nuts shall be properly rounded for specified corona performance or suitably shielded.
- 2.6.2.4 Clamp with cap shall be designed to prevent its cap from slipping out of position when being tightened.
- 2.6.2.5 The clamp grooves shall be in uniform contact with the conductor over the entire surface, except for rounded edges. The groove of the clamp body and clamp cap shall be smooth and free of projections, grit or other material which cause damage to the conductor when the clamp is installed.
- 2.6.2.6 For the spacer involving bolted clamps, the manufacturer must indicate the clamp bolt tightening torque to ensure that the slip strength of the clamp is maintained between 2.5 kN and 5 kN. The clamp when installed on the conductor shall not cause excessive stress concentration on the conductor leading to permanent deformation of the conductor strands and premature fatigue failure in operation.
- 2.6.2.7 Universal type bolted clamps, covering a range of conductor sizes, will not be permitted.
- 2.6.2.8 No rubbing, other than that of the conductor clamp hinges or clamp swing bolts, shall take place between any parts of the spacer. Joint incorporating a flexible medium shall be such that there is no relative slip between them.
- 2.6.2.9 The spacer shall be suitably designed to avoid distortion or damage to the conductor or to themselves during service.
- 2.6.2.10 The spacer shall not damage or chafe the conductor in any way which might affect its mechanical and fatigue strength or corona performance.
- 2.6.2.11 The clamping system shall be designed to compensate for any reduction in diameter of conductor due to creep.

- 2.6.2.12 The spacer assembly shall not have any projections, cuts, abrasions etc. or chattering parts which might cause corona or RIV.
- 2.6.2.13 The spacer tube shall be made of aluminium alloy 65032/63400. If fasteners of ferrous material are used, they shall conform to and be galvanised conforming to relevant Indian Standards.
- 2.6.2.14 Elastomer, if used, shall be resistant to the effects of temperature upto the designed maximum temperature specified for the conductor, ultraviolet radiation and other atmospheric contaminants likely to be encountered in service. It shall have good fatigue characteristics. The physical properties of the elastomer shall be as per relevant Indian/International standard. The supplier shall submit relevant type/ performance test certificate as per applicable standard/ product specification for elastomer to confirm suitability of the offered elastomer for the specified application.
- 2.6.2.15 The spacer assembly shall have electrical continuity. The electrical resistance between the sub-conductor across the assembly in case of spacer having elastomer clamp grooves shall be suitably selected by the manufacturers to ensure satisfactory electrical performance and to avoid deterioration of elastomer under all service conditions.
- 2.5.2.16 The spacer assembly shall have complete ease of installation and shall be capable of removal/ reinstallation without any damage.
- 2.6.2.17 The spacer assembly shall be capable of being installed and removed from the energized line by means of hot line technique.
- 2.7 Spacer Damper (For 400 KV line with twin HTLS Conductor only)**
- 2.7.1 The spacer damper covered by this specification shall be designed to maintain the bundle spacing of 450 mm under all normal operating conditions and to effectively control Aeolian vibrations as well as sub span oscillation and to restore conductor spacing after release of any external extraordinary load. The nominal sub conductor spacing shall be maintained within ± 5 mm.
- 2.7.2 The spacer damper shall restore the normal sub-conductor spacing due to displacement by wind, electromagnetic and electrostatic forces including the specified short circuit level without permanent deformation or damage either to bundle conductors or to spacer damper itself.
- 2.7.3 The design offered shall be presented as a system consisting of spacer dampers and their staggering scheme for spans ranging from 100 m to 1100 m.
- 2.7.4 Under the operating conditions specified, the spacer damper system shall adequately control Aeolian vibrations throughout the life of the transmission line with wind velocity ranging from 0 to 30 km per hour in order to prevent

damage to conductor at suspension clamps, dead end clamps and spacer damper clamps.

- 2.7.5 The spacer damper system shall also control the sub-span oscillations in order to prevent conductor damage due to chaffing and severe bending stresses at the spacer damper clamps as well as suspension and dead end clamps and to avoid wear to spacer damper components.
- 2.7.6 The spacer damper shall consist of a rigid central body called the frame linked to the conductor by two articulated arms terminated by suitable clamping system. The articulation shall be designed to provide elastic and damping forces under angular movement of the arms. The dynamic characteristics of the articulations shall be maintained for the whole life of the transmission line.
- 2.7.7 The clamping system shall be designed to provide firm but gentle and permanent grip while protecting the conductor against local static or dynamic stresses expected during normal operating conditions. The clamping system shall be designed to compensate for any reduction of conductor diameter due to creep.
- 2.7.8 Bolted type clamps shall allow installation without removal of the bolts or the clamps from clamp body. Locking mechanism shall be suitable to prevent bolt loosening. Clamp locking devices with small loose components shall not be accepted. Nut cracker, hinged open or boltless type clamps are acceptable provided adequate grip can be maintained on the conductor.
- 2.7.9 Bolts and nuts shall be of mild steel, stainless steel, or high strength steel in accordance with the design of the spacer damper.
- 2.7.10 Where elastomer lined clamps are used, the elastomer elements shall be firmly fixed to the clamp. In case of elastomer covered clamps, the insert should be forged from aluminium alloy 65032 or equivalent aluminium alloy having minimum tensile strength of 25 kg/mm². The insert shall be moulded on the insert surface. The insert shall be duly heat treated and aged to retain its consistent characteristics during service. The grain flow of the forged insert shall be in the direction of the maximum tension and compression loads experienced.
- 2.7.11 In case of Spacer dampers with pre-formed rods, the articulated arms shall be terminated by elastomer lined or elastomer covered clamps and securely held by pre-formed retaining helical, factory formed rods. Minimum four (4) no. of rods shall be applied on each clamp to hold the clamp in position., These rods shall be designed for specific conductor size & shall be made of high strength aluminium alloy 65032 or equivalent having a minimum tensile strength of 35 kg/mm². The rods shall be parrot bill ended. The rods shall be heat treated

and aged to achieve specified mechanical properties and to retain the same during service. The length of the rods shall be such that the ends fall inside the imaginary square whose sides are vertical and horizontal outer tangents to the conductor sections.

- 2.7.12 The spacer damper body shall be cast/ forged from suitable high strength corrosion resistant aluminum alloy. The aluminium alloy shall be chosen in relation with the process used.
- 2.7.13 The rubber components involved in the design such as damping elements shall be made with rubber compound selected specifically for that particular application. The Contractor shall submit a complete list of physical and mechanical properties of the elastomer used. This list shall make reference to all applicable Indian/International standards.
- 2.7.14 The rubber components used shall have good resistance to the effects of temperature up to the designed maximum temperature of the conductor and to ultraviolet radiation, ozone and other atmospheric contaminants. The rubber shall have good wear and fatigue resistance and shall be electrically semi-conductive.
- 2.7.15 The spacer damper assembly shall have electrical continuity. The electrical resistance between the sub-conductors across the assembly in case of spacer damper involving elastomer surfaced clamps shall be suitably selected by the manufacturer to ensure satisfactory electrical performance and avoid deterioration of elastomer under service conditions.
- 2.7.16 The spacer damper assembly shall have complete ease of installation and shall be capable of removal/reinstallation without any damage.
- 2.7.17 The spacer damper assembly shall be capable of being installed and removed from the energized line by means of hot line techniques. The Supplier shall furnish the complete description of the installation, removal and reinstallation procedure.
- 2.7.18 A typical placement chart of spacer dampers for spans ranging from 100m to 1100m is indicated in table at Annexure-D. Sub span spacing indicated in Annexure-D may be varied by the manufacturer as per requirement, provided total no. of Spacer Damper in sub-span shall not be less than indicated in table at Annexure-D. In case of tension towers, one additional Spacer Damper shall be placed within 10m of dead end clamp.

Incase more Spacer dampers are recommended by the supplier, the payment shall be restricted to the number of Spacer dampers indicated in table at Annexure-D for different spans and one additional incase of tension towers.

- 2.7.19 The staggering scheme shall be such that no sub span shall be greater than 65 m and no end sub span shall be longer than 40 m & the spacer dampers be unequally distributed along the span to achieve sufficient detuning of adjacent sub spans for oscillations of sub span mode and to ensure bundle stability for wind speeds up to 60 km/hr.
- 2.7.20 In case of Spacer Damper with bolted clamps, the manufacturer/ supplier shall supply free of cost 25 number fixed setting torque wrench (of torque as per spacer damper design) along with 1st batch of supply of spacer dampers for installation of spacer damper on the line by the tower contractors.
- 2.7.21 The Bidder shall furnish all the relevant technical documents in supports of the staggering scheme recommended for the spacer damper.
- 2.8 **Material and Workmanship**
- 2.8.1 All the equipment shall be of the latest proven design and conform to the best modern practice adopted in the extra high voltage field. The Bidder shall offer only such equipment as guaranteed by him to be satisfactory and suitable for intended voltage level of transmission line application 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 HTLS conductor application.
- 2.8.2 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.
- 2.8.3 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.
- 2.8.4 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.

- 2.8.5 In case of castings, the same shall be free from all internal defects like shrinkage, inclusion, blow holes, cracks etc.
- 2.8.6 All current carrying parts shall be so designed and manufactured that contact resistance is reduced to minimum and localised heating phenomenon is averted.
- 2.8.7 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.
- 2.8.8 Particular care shall be taken during manufacture and subsequent handling to ensure smooth surface free from abrasion or cuts.
- 2.8.9 The fasteners shall conform to the requirements of IS 6639. All fasteners and clamps shall have corona free locking arrangement to guard against vibration loosening.
- 2.9 **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.
- 2.10 **Bid Drawings**
- 2.10.1 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.
- 2.10.2 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

2.10.3 Placement charts for spacer/spacer damper and damper

2.10.4 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 Employer for approval. After Employer's approval and successful completion of all type tests, 20 (twenty) more sets of drawings shall be submitted to Employer for further distribution and field use at Employer's end.

3.0 Tests and Standards

3.1 Type Tests

3.1.1 On Suspension Clamp for HTLS Conductor

a)	Visual Examination	IS 2486 (Part-1)
b)	Verification of Dimensions	IS 2486 (Part-1)
c)	Chemical analysis of materials	Annexure-A
d)	Magnetic power loss test	Annexure-A
e)	Slip strength test	Annexure-A
f)	Ozone Test on elastomer	Clause 7.6.3, IEC 61854
g)	Vertical damage load & Failure load test	IEC 61284
h)	Galvanising/Electroplating test	Annexure-A
i)	Thermal Profile test	Annexure-A

3.1.2 On Dead end Tension Assembly for HTLS Conductor

a)	Visual Examination	IS 2486 (Part-1)
b)	Verification of Dimensions	IS 2486 (Part-1)
c)	Chemical analysis of materials	Annexure-A

d)	Electrical resistance test for dead end Assembly	IS 2486-(Part-I)
e)	Heating cycle test for dead end Assembly	Annexure-A
f)	Slip strength test for dead end assembly	Annexure-A
g)	Ageing test on filler (if applicable)	Annexure-A
h)	Thermal Profile test	Annexure-A
i)	Galvanising/Electroplating test	Annexure-A

3.1.3 On Mid Span Compression Joint for HTLS Conductor

a)	Visual Examination	IS 2121 (Part-II)
b)	Dimensional Verification	IS 2121 (Part-II)
c)	Chemical analysis of materials	Annexure-A
d)	Electrical resistance test	IS 2121 (Part-II)
e)	Heating cycle test	Annexure-A
f)	Slip strength test	Annexure-A
g)	Thermal Profile test	Annexure-A
h)	Corona extinction voltage test (dry) (for 400 kV and above voltage level only)	Annexure-A
i)	Radio interference voltage test (dry) (for 400 kV and above voltage level only)	Annexure-A
j)	Ageing test on filler (if applicable)	Annexure-A
k)	Galvanizing test	Annexure-A

3.1.4 T-Connector for HTLS Conductor

a)	Visual Examination	IS 2121 (Part-IV)
b)	Verification of Dimensions	IS 2121 (Part-IV)
c)	Chemical analysis of materials	Annexure-A
d)	Electrical resistance test	IS 2121 (Part-II)
e)	Heating cycle test	Annexure-A

f)	Axial tensile load test on welded portion	Annexure-A
g)	Tensile Test	IEC61284, Clause 11.6.2
h)	Thermal Profile test	Annexure-A
i)	Corona extinction voltage test (dry) (for 400 kV and above voltage level only)	Annexure-A
j)	Radio interference voltage test (dry) (for 400 kV and above voltage level only)	Annexure-A
k)	Galvanizing test	Annexure-A

3.1.5 Repair Sleeve for HTLS Conductor

a)	Visual Examination	IS 2121 (Part-II)
b)	Dimensional Verification	IS 2121 (Part-II)
c)	Chemical analysis of materials	Annexure-A
d)	Tensile Test	IEC61284, Clause 11.7
e)	Thermal Profile test	Annexure-A
f)	Corona extinction voltage test (dry) <i>(for 400 kV and above voltage level only)</i>	Annexure-A
g)	Radio interference voltage test (dry) <i>(for 400 kV and above voltage level only)</i>	Annexure-A

3.1.6 Vibration Damper for HTLS Conductor

a)	Visual Examination	IS 9708
b)	Dimensional Verification	IS 9708
c)	Verification of Resonance Frequencies	Annexure-B
d)	Mass pull off test	IS 9708
e)	Chemical analysis of materials	Annexure-A
f)	Dynamic characteristics test*	Annexure-A
g)	Vibration analysis	Annexure-A
h)	Clamp slip test	Annexure-A
i)	Clamp bolt torque test	IS 9708

j)	Fatigue tests	Annexure-A
k)	Magnetic power loss test	Annexure-A
l)	Thermal Profile test	Annexure-A
m)	Corona extinction voltage test (dry) <i>(for 400 kV and above voltage level only)</i>	Annexure-A
n)	Radio interference voltage test (dry) <i>(for 400 kV and above voltage level only)</i>	Annexure-A
o)	Damper efficiency test	IS 9708
p)	Galvanising/Electroplating test	Annexure-A
* Applicable for 4 R stockbridge dampers. For alternate type of vibration dampers (permitted as per clause 2.5.2), as an alternative to dynamic characteristic test, damper efficiency test as per IEEE-664 Power Manual may be proposed/ carried out by the supplier.		

3.1.7

Rigid Spacer for jumper for twin HTLS Conductor

a)	Visual Examination	IS 10162
b)	Dimensional Verification	IS 10162
c)	Chemical analysis of materials	Annexure-A
d)	Clamp slip test	Annexure-A
e)	Clamp bolt torque test	IS 10162
f)	Assembly Torque test	IS 10162
g)	Magnetic power loss test	Annexure-A
h)	Tension-compression Test	Annexure-A
i)	Thermal Profile test	Annexure-A
j)	Corona extinction voltage test (dry) <i>(for 400 kV and above voltage level only)</i>	Annexure-A
k)	Radio interference voltage test (dry) <i>(for 400 kV and above voltage level only)</i>	Annexure-A
l)	Galvanising Test	Annexure-A

3.1.8 Spacer Damper for twin HTLS Conductor

a)	Visual Examination	IS 10162
b)	Dimensional Verification	IS 10162
c)	Movement Test	IS 10162
d)	Resilience Test (if applicable)	IS 10162
e)	Clamp bolt torque test	IS 10162
f)	Assembly Torque test	IS 10162
g)	Chemical analysis of materials	Annexure-A
h)	Clamp slip test	Annexure-A
i)	Vibration Test	Annexure-A
	(i) Vertical Vibration	IS 10162
	(ii) Longitudinal Vibration	IS 10162
	(iii) Sub-span oscillation	IS 10162
j)	Dynamic characteristics test	Annexure-A
k)	Fatigue tests	Annexure-A
l)	Magnetic power loss test (if applicable)	Annexure-A
m)	Compressive and tension Test	Annexure-A
n)	Thermal Profile test	Annexure-A
o)	Corona extinction voltage test (dry) <i>(for 400 kV and above voltage level only)</i>	Annexure-A
p)	Radio interference voltage test (dry) <i>(for 400 kV and above voltage level only)</i>	Annexure-A
q)	Ozone test on elastomer	Clause 7.6.3, IEC 61854
r)	Log decrement test	Annexure-A
s)	Galvanising Test	Annexure-A

3.1.9 Type tests specified under Clause 3.1.1 to 3.1.8 shall not be required to be carried out if a valid test certificate is available for the offered design. The test certificate shall be considered valid if,