Eskom	Standard	Technology

Title: **SPECIFICATION FOR SUBSTATION CLAMPS FOR TUBE ALUMINIUM CONDUCTORS**

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1. Introduction

Substation clamps are critical components within a substation since they are generally connected in series with the current path. The reliability of the whole power network may be compromised by the failure of clamps if they are not properly designed, manufactured and adequately tested to operate not only under normal operating conditions, but also a range of abnormal conditions as well.

2. Supporting clauses

2.1 Scope

This standard covers Eskom's requirements for the design, manufacture, testing, supply and delivery of substation clamps for tubular aluminium conductors and related applications for use in outdoor high-voltage substations with system voltages of up to and including 800 kV.

2.1.1 Purpose

This document gives the minimum requirements for the design, manufacture, testing, supply and delivery of substation clamps for tube conductors that will ensure adequate performance and operation within the Eskom system.

2.1.2 Applicability

This document shall apply throughout Eskom Holdings Limited Divisions.

2.2 Normative/informative references

Parties using this document shall apply the most recent edition of the documents listed in the following paragraphs.

2.2.1 Normative

[1] ANSI/NEMA CC 1: Electric power connection for substations.

[2] ANSI C119.4: Electric connectors - Connectors to use between aluminum-to-aluminum or aluminium-to-copper conductors.

[3] BS EN 573-3: Aluminium and aluminium alloys – Chemical composition and form of wrought products – Part 2: Chemical symbol based designation system.

[4] BS EN 573-3: Aluminium and aluminium alloys – Chemical composition and form of wrought products – Part 3: Chemical composition and form of products.

[5] BS EN 1706: Aluminium and aluminium alloys – Castings – Chemical composition and mechanical properties

[6] BS EN 10002-1: Metallic materials – Tensile testing – Part 1: Method of test at ambient temperature.

[7] CISPR 16-1: Specification for radio disturbance and immunity measuring apparatus and methods – Part 1: Radio disturbance and immunity measuring apparatus.

[8] CISPR 18-2: Radio interference characteristics of overhead power lines and high-voltage equipment – Methods of measurement and procedure for determining limits.

[9] IEC 60060-1: High-voltage test techniques – Part 1: General definitions and test requirements.

[10] IEC 60273: Characteristics of indoor and outdoor post insulators for systems with nominal voltages greater than 1000 V.

[11] IEC 60943: Guidance concerning the permissible temperature-rise for parts of electrical equipment, in particular for terminals.

[12] IEC 61854: Overhead Lines – Requirements and Tests for Spacers

[13] IEC 62271-1: High-voltage switchgear and control gear – Part 1: Common specifications

[14] IEC 62271-301: High-voltage switchgear and control gear – Part 301: Dimensional Standardization of Terminals.

[15] ISO 9001: Quality Management Systems.

[16] ISO 9591: Corrosion of aluminium alloys – Determination of resistance to stress corrosion cracking.

[17] NEMA 107: Methods of measurement of radio influence voltage (RIV) of high voltage apparatus.

[18] SANS 1700: (series): Fasteners.

2.2.2 Informative

[19] 240-56030435 Outdoor Ceramic Station Post Insulators for Systems with Nominal Voltages up to 765kV Specification

[20] 240-67841451: Pro-forma for Substation Tubular Clamps

[21] 240-84237021 Technical Evaluation Standard for Substation Tubular Clamps

[22] National Treasury / Department of Trade and Industry Instruction (2015): Stipulated minimum threshold for local production and content for Steel Power pylons, Steel Substation Structures, Powerline Hardware, Street Lighting Steel Poles and Steel Lattice Towers and Masts.

2.3 Definitions

2.3.1 General

Definition	Description
Clamp/connector	A device that joins two or more conductors for the purpose of providing a continuous electrical path.
Manifold	A pipe or chamber branching into several openings / a chamber having several outlets through which a liquid or gas is distributed or gathered. – in the case of this document, it is an electrical application, where electrical current is distributed or gathered
Pad	A solid, flat, rectangular block
Pad terminal connector	A connector that joins a conductor to the terminal pad of electrical apparatus.
Routine tests	Tests done to verify the quality and uniformity of the workmanship and materials used in the manufacture of electric power connectors. The tests are done to prove conformance of clamps to specific requirements and are made on every clamp
Saddle	A clamp that fastens onto a bolted clamp/connector to hold the conductor in place
Sample tests	Tests done to verify the quality of materials and workmanship. These tests are performed on samples taken from manufacturing batches.
Stem	A solid cylindrical termination
Stem terminal connector	A connector that joins a conductor to the terminal stem of electrical appliances

Definition	Description
Type tests	Tests done on the completion of the development of a new design to establish representative performance data. They need to be repeated only if the design is changed to modify its performance or there is a change in the manufacturing process or material used.

2.3.2 Disclosure classification

Controlled disclosure: controlled disclosure to external parties (either enforced by law, or discretionary).

2.4 Abbreviations

Abbreviation	Description
AMSL	Above Mean Sea Level
CISPR	International Special Committee on Radio Interference
ID	Inner Diameter
OD	Outer Diameter
PCD	Pitch Circle Diameter
PI	Post Insulator
RIV	Radio Interference Voltage

2.5 Roles and responsibilities

All personnel involved within the substation environment shall ensure compliance to these requirements.

2.6 Process for monitoring

Not applicable.

2.7 Related/supporting documents

This document supersedes all sections applicable to tubular conductor clamps in 240-83534936.

3. Specification for Substation Clamps for Tubular Conductors

3.1 General

3.1.1 Service conditions

The clamps/connectors shall be suitable for use in substations under the following service conditions:

a) Altitude : up to 1 800 m AMSL

b) Ambient air temperatures

1) minimum : -10 ^{o}C

2) maximum : 45 ^{o}C

3) daily average : 30 ^{o}C

4) yearly average : 20 ^{o}C

c) Maximum solar radiation : 1 100 Watts/m^{2}

d) Wind speed : 0.44 m/s

3.1.2 Technical information

Aluminium or aluminium alloy clamps/connectors, and conductors are required for making connections between various arrangements of stranded conductors, tubes, solid terminal stems and pads. The standard dimensions adopted by Eskom for these items are listed in Table 1 below.

Table 1: Dimensions of Aluminium conductors, stems and pads used in Eskom

Type	Diameter (mm)	Length (mm)	Remarks
Stranded All Aluminium Conductors	16,25	-	"Hornet"
	26,46	-	"Centipede"
	38,34	-	"Bull"
Stranded All Aluminium Alloy Conductors	6,24	-	“Acacia”
	8,31	-	“35”
	10,83	-	“Pine”
	13,95	-	“Oak”
	17,4	-	“Ash”
	22,61	-	“Sycamore”
	24,71	-	“UPAS”
Tubular Conductors	OD = 80; ID = 8	-	-
	OD = 120; ID = 4	-	-
	OD = 120; ID = 6	-	-
	OD = 150; ID = 6	-	-
	OD = 160; ID = 6	-	-
	OD = 200; ID = 6	-	-
	OD = 250; ID = 6	-	-
Stems	26,0	125	-
	38,0	125	-
	60,0	125	-
Pads - 14mm diameter holes, - 16mm minimum pad thickness	4-bolt pad to IEC 62271-301	100 x 100 (50mm centre-to-centre)	SANS/IEC 62271-301
	4-bolt pad (125x125)	125 x 125 (80mm centre-to-centre)	SANS/IEC 62271-301
	8-bolt pad to IEC 62271-301	100 x 200 (50mm centre-to-centre)	SANS/IEC 62271-301
	9-bolt pad to IEC 62271-301	125 x 125 (40mm centre-to-centre)	SANS/IEC 62271-301

In addition tubular conductors must be supported on post insulators, Table 2 details the PI top metal fitting PCD and hole detail applicable per voltage level as well as the fault current withstand voltages and typical tube outer diameters. Table 2 is used to determine the individual clamp requirements as stipulated in Annex A.

Table 2: Short time withstand current, support post insulator and clamp PCD details

Max system voltage (Um) (kV rms)	Fault current withstand rating [kA rms]	Typical tube outer diameter used (mm)	PI top metal fitting PCD (mm)	PI top metal fitting hole detail	Tubular support clamps hole detail
≤ 36	31.5	80 & 120	76	4 x M12 (Tapped)	4 x Ø14 x 21 mm slot
72.5	31.5	80 & 120	127	4 x M16 (Tapped)	4 x Ø18 x 27 mm slot
100 & 145	40	Dx: 80, 120 Tx: 150, 160, 200	127	4 x M16 (Tapped)	4 x Ø18 x 27 mm slot
245 & 300	50	200 & 250	127	4 x M16 (Tapped)	4 x Ø18 x 27 mm slot
			225	4 x M18 (Tapped)	4 x Ø20 x 27 mm slot
420	63	250	127	4 x M16 (Tapped)	4 x Ø18 x 27 mm slot
			225	4 x M18 (Tapped)	4 x Ø20 x 27 mm slot
800	50	200	225	4 x M18 (Tapped)	4 x Ø20 x 27 mm slot

3.2 Clamp Types, Dimensions and Ratings

The list of clamps that are covered by this specification is shown in Table 3 below. The table also shows the clamps that need to be tested in order to qualify a family/series of clamps.

Table 3: List of Eskom Clamps

Annexure B location	Clamp Type / Designation	Page number	Clamps to be tested to qualify a Family of clamps (e.g. for ECC-PI-S type test clamps E or F and K)	
Table A.1	Type ECC-PI-F	35	F	
Table A.2	Type ECC-PI-F	36	K	
Table A.3	Type ECC-PI-S	37	F	K
Table A.4	Type ECC-PI-FF	38	*Non Buyers' Guide, items to be tested as required*	
Table A.5	Type ECC-T-PI	39	P	
Table A.6	Type ECC-TT	40	C	
Table A.7	Type ECC-TT	40	G	
Table A.8	Type ECC-T	41	K	
Table A.9	Type ESC-PI-F (80mm – 120mm)	42	F	
Table A.10	Type ESC-PI-F (150mm – 250mm)	43	K	
Table A.11	Type ESC-PI-TF	44	*Non Buyers' Guide, items to be tested as required*	
Table A.12	Type ESC-PI-TS	45	F	
Table A.13	Type ESC-PI-S	46		
Table A.14	Type ESC-V-TT 15	47	A	
Table A.15	Type ESC-H-TT 15	48		
Table A.16	Type EEC-TB-FS	49	*Non Buyers' Guide, items to be tested as required*	
Table A.17	Type EEC-TB-SS	50		
Table A.18	Type EEC-PI-SS	51	F	Q
Table A.19	Type EEC-PI-FS	52		

Annexure B location	Clamp Type / Designation	Page number	Clamps to be tested to qualify a Family of clamps (e.g. for ECC-PI-S type test clamps E or F and K)	
Table A.20	Type EEC-PI-SS 90	53	*Non Buyers' Guide, items to be tested as required*	
Table A.21	Type EEC-PI-FS 90	54		
Table A.22	Type EEC-I-8HV-S	55	B	
Table A.23	Type EEC-8HV-S	56	C	
Table A.24	Type EEC-8HH-S	57	*Non Buyers' Guide, items to be tested as required*	
Table A.25	Type EEC-H/VS-TB	58	H	
Table A.26	Type EEC-H/VS-TB	59	*Non Buyers' Guide, items to be tested as required*	
Table A.27	Type EEC-4HV	60	C	
Table A.28	Type EEC-T-S	61	A	
Table A.29	Type ECB-TT	62	*Non Buyers' Guide, items to be tested as required*	
Table A.30	Type ECC-8HH	63		
Table A.31	Type ECC-9HH	64		
Table A.32	Type ECC-8HV	65		
Table A.33	Type ECC-9HV	65		
Table A.34	Type ECC-9HH-EE	66		
Table A.35	Type ECC-IL-ST	67	B or F	K
Table A.36	Type ECC-T-ST:	68	B or F	
Table A.37	Type ETP-IL 1	69	C or J	M or N
Table A.38	Type ETP-IL 2	70	R or S or T	AD or AE or AF
Table A.39	Type ETP-IL 3	72	L or M	
Table A.40	Type ETP-TW 2	73	AD or AE or AF	
Table A.41	Type ETP-TW 3	75	K or L or M	
Table A.42	Type ETP-TE-IL 1	76	R or S or T	X or Y or Z
Table A.43	Type ETP-TE-IL 2	77		
Table A.44	Type ETP-PL-1H	78	A or C	
Table A.45	Type ETP-PL-4H	79		
Table A.46	Type EWI 0	80	F	
Table A.47	Type EWI 30	81		
Table A.48	Type EWI 45	82		
Table A.49	Type EWI 78	83		
Table A.50	Type EWI 90	84		
Table A.51	Type EWI-2C 45	85	C	
Table A.52	Type ETEC-CF	86	F	
Table A.53	Type ETEC-PL	87		
Table A.54	Type ETEC-DC	88	F or G	
Table A.55	Type EET-TB	89	A or C	

Annexure B location	Clamp Type / Designation	Page number	Clamps to be tested to qualify a Family of clamps (e.g. for ECC-PI-S type test clamps E or F and K)
Table A.56	Type EET-TPZ	90	A or C
Table A.57	Type EHS Spacer	90	A
Table A.58	Type EHCT Terminal clamp	91	
Table A.59	Type ECES Sleeve	91	Not applicable

3.2.1 Type ECC-PI-(F/S) Clamps

The ECC-PI family of clamps are coupling clamps for the purpose of jointing two lengths of tubular conductors on top of a post insulator. It therefore performs both a current-carrying (jointing) and non-current-carrying (support) function. ECC-PI clamps are bolted clamps with a cradle to support the tubular conductors, and bolted clamping saddles for the mechanical and electrical connection. The mounting (support) base of the clamp bolts onto a post insulator with standard PCD. The clamp shall be fitted with a minimum of two independent clamping saddles per side (tube connection). The clamp's through-current capacity shall match that of the tube size it is designed to joint.

ECC-PI clamps have either a fixed base (ECC-PI-F) or a sliding base (ECC-PI-S), which allows for movement in the tubular conductors. The fixed base can be either cast as part of the clamp, or bolted to the bottom of the clamp, in which case a static discharge strap will be provided. The sliding clamps shall always be supplied with a static discharge strap.

Fixed-base clamp variations:

1) A split unit (ECC-PI-FF) with two individual bolted clamps, connected with a stranded conductor bridge for current transfer. This is to provide a coupling clamp with additional width and flexibility.

2) A Tee-variation that provides a tee connection between two tubular conductors on top of a post insulator, with the tee being in-line with the post insulator, e.g. vertical on a standard upright post insulator.

Types, dimensions and ratings for the fixed clamps (ECC-PI-F) are shown in Table A.1 and Table A.2. The clamps are illustrated in Figure A.1 and Figure A.2. (Buyers Guide D-DT-6086)

Types, dimensions and ratings for the sliding clamps (ECC-PI-S) are shown in Table A.3. The clamp is illustrated in Figure A.3. (Buyers Guide D-DT-6086)

Types, dimensions and ratings for the split fixed clamps (ECC-PI-FF) are shown in Table A.4. The clamp is illustrated in Figure 4.

Types, dimensions and current ratings for the tee variation (ECC-T-PI) are shown in Table A.5. The clamp is illustrated in Figure A.5. (Buyers Guide D-DT-6350)

3.2.2 Type ECC-TT Clamps

The ECC-TT family of clamps are coupling clamps providing a straight tube-to-tube connection for same-sized tubes. It performs a purely current-carrying (coupling) function; therefore the clamp's through-current capacity shall match that of the tube size it is designed to joint. ECC-TT clamps are bolted clamps with a cradle to support the tubular conductors, and bolted clamping saddles for the mechanical and electrical connection. The clamp shall be fitted with a minimum of two independent clamping saddles per side (tube connection).

Types, dimensions and ratings of the clamps are shown in Table A.6 and Table A.7. The clamps are illustrated in Figure A.6 and Figure A.7. (Buyers Guide D-DT-6116)

3.2.3 Type ECC-T Clamps

The ECC-T clamps are coupling clamps providing a tee (90°) tube-to-tube connection for different sized tubes. It performs a purely current-carrying (coupling) function; therefore the clamp's through-current capacity shall match that of the smaller tube size it is designed to joint. ECC-T clamps are bolted clamps with a cradle to support the tubular conductors, and bolted clamping saddles for the mechanical and electrical connection. The clamp shall be fitted with a minimum of two independent clamping saddles per side (tube connection).

Types, dimensions and ratings are shown in Table A.8. The clamp is illustrated in Figure A.8. (Buyers Guide D-DT-6351)

3.2.4 Type ESC-PI Clamps

The ESC-PI family of clamps are support clamps for mounting tubular conductors on top of a post insulator. It performs a non-current-carrying (support) function. The mounting (support) base of the clamp bolts onto a post insulator with standard PCD. ESC-PI clamps are mostly bolted clamps with a cradle to support the tubular conductors, and bolted clamping saddles for the mechanical connection.

ESC-PI clamps have four variations: 1) a fixed tube clamp with a fixed base (ESC-PI-F); 2) a fixed tube clamp with the tube clamped to the base (ESC-PI-TF); 3) a sliding tube clamp where the tube slides inside the clamp (ESC-PI-TS) and 4) a fixed tube clamp with a sliding base (ESC-PI-S). The fixed base can be either cast as part of the clamp, or bolted to the bottom of the clamp, in which case a static discharge strap shall be provided. The sliding clamp in variation 4 shall also be supplied with a static discharge strap.

Types, dimensions, ratings and illustrations for the variations of the clamps are shown as follows:

- ESC-PI-F in Table A.9 and Table A.10 and illustrated in Figure A.9 and Figure A.10. (Buyers Guide D-DT-6039)
- ESC-PI-TF in Table A.11 and illustrated in Figure A.11. (Buyers Guide D-DT-6118)
- ESC-PI-TS in Table A.12 and illustrated in Figure A.12. (Buyers Guide D-DT-6118)
- ESC-PI-S in Table A.13 and illustrated in Figure A.13. (Buyers Guide D-DT-6316)

3.2.5 Type ESC-V/H-TT 15 Clamps

Tube-to-tube support clamps are used to support tubular connections from busbar level to feeder level. These clamps are used to connect angled support tubes to the horizontal busbars and vertical connections. These clamps provide a support function, and share in the current transfer, due to the conductive nature of the support. ESC-V/H-TT clamps are bolted clamps with a cradle to support the tubular conductors, and bolted clamping saddles for the mechanical (and electrical) connection.

Types, dimensions and ratings for the vertical clamps (ESC-V-TT 15) are shown in Table A.14. The clamp is illustrated in Figure A.14. (Buyers Guide D-DT-6352)

Types, dimensions and ratings for the horizontal clamps (ESC-H-TT 15) are shown in Table A.15. The clamp is illustrated in Figure A.15. (Buyers Guide D-DT-6353)

Considering these clamps main application is as busbar support they can be tested on its own or as intended to be used. Refer to Annex C for a proposed test setup for as intended to be used.

3.2.6 Type EEC-TB Clamps

The EEC-TB family of clamps are tubular conductor mounted expansion clamps. The purpose of the tubular mounting of the clamp base is to allow for an extended vertical connection to certain equipment terminals. The expansion clamp consists of two bolted clamped connections on either side connected with stranded conductor for current transfer. There are two configurations of the clamping connections on either side relative to the base of the unit: 1) one side fixed with other side sliding (EEC-TB-FS) or 2) both sides sliding (EEC-TB-SS). These clamps are used in instrument transformer (CVT) applications, therefore the tubular base.

The discharge strap therefore provides an electrical connection, albeit at extremely low current (µA-mA range) and the mechanical integrity of the connection is crucial. **The discharge straps on these clamps will be fitted with lugs with a proportionally longer crimping sleeve that will be crimped twice, with an indent type crimper, as opposed to the normal oval type circumference crimper.**

Types, dimensions and ratings for EEC-TB-FS are shown in Table A.16. The clamps are illustrated in Figure A.16.

Types, dimensions and ratings for EEC-TB-SS are shown in Table A.17. The clamps are illustrated in Figure A.17.

3.2.7 Type EEC-PI Clamps

The EEC-PI family of clamps are post-insulator mounted tubular expansion clamps. The expansion clamp consists of two tubular connections on either side connected with stranded conductor for current transfer. EEC-PI clamps are bolted clamps with a cradle to support the tubular conductors, and bolted clamping saddles for the mechanical (and electrical) connection. The stranded conductor for current transfer will be attached to the bolted saddles and have a current rating similar to that of the tubular conductors it connects. There are four configurations of the clamp: 1) one side fixed with the other side sliding (EEC-PI-FS), 2) both sides sliding (EEC-PI-SS) and 3) 90 degree variations for each of the previous (EEC-PI-FS 90 and EEC-PI-SS 90). The sliding portion of the clamp shall be supplied with a static discharge strap.

Types, dimensions and ratings for EEC-PI-SS clamps are shown in Table A.18. The clamps are illustrated in Figure A.18. (Buyers Guide D-DT-6093)

Types, dimensions and ratings for EEC-PI-FS clamps are shown in Table A.19. The clamps are illustrated in Figure A.19. (Buyers Guide D-DT-6093)

Types, dimensions and ratings for EEC-PI-SS 90 clamps are shown in Table A.20. The clamps are illustrated in Figure A.20.

Types, dimensions and ratings for EEC-PI-FS 90 clamps are shown in Table A.21. The clamps are illustrated in Figure A.21.

3.2.8 Type EEC-8H-S Clamps

The EEC-8H-S family of clamps are equipment mounted tubular expansion clamps meant for making tubular connections to equipment 8-hole palm terminals, while allowing for tubular expansion. As with all expansion clamps, the clamp has fixed and sliding sections. The fixed section of the clamp bolts onto the 8-hole palm terminal of the equipment (vertical and horizontal variations available) with the opposite end consisting of a plunger that fits into the interior diameter of the tube, allowing the tube to slide over it. Current transfer is achieved via a rated stranded conductor bridge between the fixed section of the clamp and a bolted clamped section that bolts around the outer diameter of the tube. The clamp's through-current capacity shall match that of the tube size it is designed to connect to the equipment.

There are three variations in this family of clamps – two for connection to vertical palm terminals (in-line (EEC-IL-8HV-S) and offset (EEC-8HV-S)) and one for connection to horizontal palm terminals (EEC-8HH-S).

Types, dimensions and ratings for EEC-IL-8HV-S clamps are shown in Table A.22. The clamps are illustrated in Figure A.22.

Types, dimensions and ratings for EEC-8HV-S clamps are shown in Table A.23. The clamps are illustrated in Figure A.23. (Buyers Guide D-DT-6354)

Types, dimensions and ratings for EEC-8HH-S clamps are shown in Table A.24. The clamps are illustrated in Figure A.24.

3.2.9 Type EEC-H/VS-TB Clamps

The EEC-H/VS-TB clamp is an equipment mounted tubular expansion clamps meant for making tubular connections to equipment stem terminals, while allowing for tubular expansion. As with all expansion clamps, the clamp has fixed and sliding sections.

The fixed section of the clamp bolts onto the stem terminal of the equipment (vertical/horizontal) with the opposite end consisting of a plunger that fits into the interior diameter of the tube, allowing the tube to slide over it. Current transfer is achieved via a rated stranded conductor bridge between the fixed section of the clamp and a bolted clamped section that bolts around the outer diameter of the tube. The clamp's through-current capacity shall match that of the tube size it is designed to connect to the equipment.

Types, dimensions and ratings for these clamps are shown in Table A.25 and Table A.26. The clamps are illustrated in Figure A.25 and Figure A.26. (Buyers Guide D-DT-6317)

3.2.10 Type EEC-4HV-S Clamps

The EEC-4HV clamps are equipment mounted tubular expansion clamps meant for making tubular connections to equipment 4-hole vertical palm terminals, while allowing for tubular expansion. As with all expansion clamps, the clamp has fixed and sliding sections. The fixed section of the clamp bolts onto the vertical palm terminal of the equipment with the opposite end consisting of a plunger that fits into the interior diameter of the tube, allowing the tube to slide over it. Current transfer is achieved via a rated stranded conductor bridge between the fixed section of the clamp and a bolted clamped section that bolts around the outer diameter of the tube. The clamp's through-current capacity shall match that of the tube size it is designed to connect to the equipment.

Types, dimensions and ratings for EEC-4HV-S clamps are shown in Table A.27. The clamps are illustrated in Figure A.27. (Buyers Guide D-DT-6355)

3.2.11 Type EEC-T-S Clamps

The EEC-T-S clamps are tee-off expansion clamps meant for making a tubular tee-off connection from a tubular conductor, allowing for tubular expansion on the tee-off. The clamp consists of a bolted clamped (fixed) connection to the run conductor, with a sliding plunger connection to the tee conductor. Current transfer is achieved via a rated stranded conductor bridge between the fixed section of the clamp and a bolted clamped section that bolts around the outer diameter of the tubular tee-off conductor. The clamp's through-current capacity shall match that of the tube size it is designed to connect.

Types, dimensions and ratings for EEC-T-S clamps are shown in Table A.28. The clamps are illustrated in Figure A.28 **(Buyers Guide D-DT-6363)**.

3.2.12 Type ECB-TT Clamps

The ECB-TT clamp is a tubular-to-tubular conductor current bridge which consists of separate bolted clamped connections on either side, connected only with a stranded conductor bridge for current transfer. The stranded conductor bridge shall have the same current rating as the tubular conductors it is connecting.

Types, dimensions and ratings are shown in Table A.29. The clamp is illustrated in Figure A.29.

3.2.13 Type ECC-Palm Clamps

The ECC palm clamps are a family of clamps used for connecting tubular conductors to equipment pad terminals. It consists of a bolted clamped connection for the tubular conductor and a flat palm connection for connecting to the equipment pad terminal. The terminal pad shall be in accordance with IEC 518.

There are five (5) clamps in this family:

- ECC-8HH – 8-hole horizontal pad
- ECC-9HH – 9-hole horizontal pad
- ECC-8HV – 8-hole vertical pad
- ECC-9HV – 9-hole vertical pad
- ECC-9HH-EE – 9-hole horizontal pad - elevated

For the ECC-8HH clamp, types, dimensions and ratings are shown in Table A.30. The clamp is illustrated in Figure A.30.

For the ECC-9HH clamp, types, dimensions and ratings are shown in Table A.31. The clamp is illustrated in Figure A.31.

For the ECC-8HV clamp, types, dimensions and ratings are shown in Table A.32. The clamp is illustrated in Figure A.32.

For the ECC-9HV clamp, types, dimensions and ratings are shown in Table A.33. The clamp is illustrated in Figure A.33.

For the ECC-9HH-EE clamp, types, dimensions and ratings are shown in Table A.34. The clamp is illustrated in Figure A.34.

3.2.14 Type ECC-ST Clamps

The ECC-ST clamps are a family of clamps used for connecting tubular conductors to equipment stem terminals. It consists of bolted clamped connections for both the tubular conductor and the equipment stem terminal.

There are two (2) clamps in this family:

- ECC-IL-ST – inline tube-to-stem connector
- ECC-T-ST – tee tube-to-stem connector

For the ECC-IL-ST clamp, types, dimensions and ratings are shown in Table A.35. The clamp is illustrated in Figure A.35 (Buyers Guide D-DT-6037)

For the ECC-T-ST clamp, types, dimensions and ratings are shown in Table A.36. The clamp is illustrated in Figure A.36. (Buyers Guide D-DT-6035)

3.2.15 Type ETP Clamps

The ETP family of clamps are tap-off clamps that allow for an electrical tap-off from a tubular busbar conductor. The tap-off provides connection for single or multiple stranded conductors or cables. The clamp consists of a bolted clamped connection to the tubular conductor and 1) crimped connections to the tap-off stranded conductors or 2) a palm connection for cable lugs. There are 4 main categories within the family:

1) ETP-IL – Inline tap-off clamps where the manifold for the multiple conductors are perpendicular to the run of the tubular conductor, allowing droppers in horizontal configuration to be curved INLINE with the tubular conductor. Available in single and multiple conductor variations.

Types, dimensions and ratings for the ETP-IL-1 clamp are shown in Table A.37. The clamp is illustrated in Figure A.37. (Buyers Guide D-DT-6119)

Types, dimensions and ratings for the ETP-IL-2 clamp are shown in Table A.38. The clamp is illustrated in Figure A.38. (Buyers Guide D-DT-6119)

Types, dimensions and ratings for the ETP-IL-3 clamp are shown in Table A.39. The clamp is illustrated in Figure A.39. (Buyers Guide D-DT-6119)

2) ETP-TW – twisted tap-off clamps where the manifold for the multiple conductors are inline with the run of the tubular conductor, allowing droppers in horizontal configuration to be curved perpendicular (sideways) with the tubular conductor. Available in multiple conductor variations.

Types, dimensions and ratings for the ETP-TW-2 clamp are shown in Table A.40. The clamp is illustrated in Figure A.40. (Buyers Guide D-DT-6356)

Types, dimensions and ratings for the ETP-TW-3 clamp are shown in Table A.41. The clamp is illustrated in Figure A.41. (Buyers Guide D-DT-6356)

3) ETP-TE-IL – Inline tube-end clamps allowing for stranded conductor tap-off in line with the end of a tubular conductor.

Types, dimensions and ratings for the ETP-TE-IL 1 clamp are shown in Table A.42. The clamp is illustrated in Figure A.42. (Buyers Guide D-DT-6090)

Types, dimensions and ratings for the ETP-TE-IL 2 clamp are shown in Table A.43. The clamp is illustrated in Figure A.43. (Buyers Guide D-DT-6090)

4) ETP-PL – tap-off clamps with a palm connector for bolting of cable lugs.

Types, dimensions and ratings for the ETP-PL-1H clamp are shown in Table A.44. The clamp is illustrated in Figure A.44. (Buyers Guide D-DT-6092)

Types, dimensions and ratings for the ETP-PL-4H clamp are shown in Table A.45. The clamp is illustrated in Figure A.45. (Buyers Guide D-DT-6358)

3.2.16 Type EWI Inserts

The EWI family are tubular welded inserts that are machined inserts used to weld tubular conductor lengths together. These provide electrical and mechanical joints for tubular conductors, in straight, angular and diameter change applications. They are provided for predetermined design angles.

Types, dimensions and ratings for the EWI 0 degree inserts are shown in Table A.46. The insert is illustrated in Figure A.46.

Types, dimensions and ratings for the EWI 30 degree inserts are shown in Table A.47. The insert is illustrated in Figure A.47.

Types, dimensions and ratings for the EWI 45 degree inserts are shown in Table A.48. The insert is illustrated in Figure A.48. (Buyers Guide D-DT-6359)

Types, dimensions and ratings for the EWI 78 degree inserts are shown in Table A.49. The insert is illustrated in Figure A.49. (Buyers Guide D-DT-6360)

Types, dimensions and ratings for the EWI 90 degree inserts are shown in Table A.50. The insert is illustrated in Figure A.50.

Types, dimensions and ratings for the EWI-2C 45 degree inserts are shown in Table A.51. The insert is illustrated in Figure A.51. (Buyers Guide D-DT-6361)

3.2.17 Type ETEC Caps

These are tubular conductor end caps used to close the open ends of tubular conductors.

1) ETEC-CF – corona free end cap, providing a rounded finish to the end of the tubular conductor.

2) ETEC-PL – plain flat end cap.

3) ETEC-DC – plain flat end cap with a clamp connection on the inside for a damping conductor (stranded) to be attached and fitted inside the tubular conductor.

Types, dimensions and ratings for the ETEC-CF caps are shown in Table A.52. The cap is illustrated in Figure A.52. (Buyers Guide D-DT-6362)

Types, dimensions and ratings for the ETEC-PL caps are shown in Table A.53. The cap is illustrated in Figure A.53. (Buyers Guide D-DT-6040)

Types, dimensions and ratings for the ETEC-DC caps are shown in Table A.54. The cap is illustrated in Figure A.54. (Buyers Guide D-DT-6040)

3.2.18 Type EET Earthing Clamps

The EET clamps are earthing clamps designed to provide attachment points for the application of portable earthing gear to tubular conductors. It shall have a bolted clamped connection to the tubular conductor and a secondary rod of sufficient diameter for portable earthing gear clamps to connect onto. The clamp shall be rated to withstand the fault current rating of the portable earthing gear. Two variations of earthing clamps are stipulated:

1) Earthing peg (EET-TB) with the earthing rod protruding perpendicular to the tubular conductor, equipped with an enlarged tip to prevent the earthing clamp from sliding off.

2) Earthing trapeze (EET-TPZ) with the earthing rod parallel to the tubular conductor and connected on either side to the tube with clamping saddles.

Types, dimensions and ratings for EET-TB clamps are shown in Table A.55. The clamp is illustrated in Figure A.55. (Buyers' Guide D-DT-6080)

Types, dimensions and ratings for EET-TPZ clamps are shown in Table A.56. The clamp is illustrated in Figure A.56.

3.2.19 Type EHS spacer

These six conductor hexagonal spacers are intended to be used on bundled conductors used in conjunction with tubular conductors in UHV applications. Spacers shall be designed to meet all the requirements of IEC 61854.

Types, dimensions and ratings are shown in Table A.57. The clamp is illustrated in Figure A.57.

3.2.20 Type EHCT Clamps

These six conductor compression terminal clamps are intended to be used for terminating stranded conductor bundles, used in conjunction with tubular conductors in UHV applications, onto 8-hole palm connectors.

Types, dimensions and ratings are shown in Table A.58. The clamp is illustrated in Figure A.58.

3.2.21 Type ECES End Sleeves

These end sleeves are used to crimp onto the loose ends of stranded damping conductors utilised inside tubular conductor busbars, in order to prevent the ends from fraying.

Types and dimensions are shown in Table A.59. The clamp is illustrated in Figure A.59. (Buyers' Guide D-DT-6001)

3.3 Technical Requirements

3.3.1 Dimensions

The clamps shall be designed for use with tubular conductors with outer nominal diameters ranging from 80 mm to 250 mm.

Tolerance on the inner nominal diameter of clamps shall be ±1% of specified nominal inner diameter of the clamp.

The inner nominal diameter of the clamp shall be of the same dimension as the outer nominal diameter of the connected tubular conductor. The inner diameter of the clamp shall be specified in Schedule A.

3.3.2 Material

3.3.2.1 All Clamps excluding welded couplers (EWI Inserts)

All clamps shall be made of aluminium or aluminium alloys. The alloys used, their chemical composition, electrical and mechanical properties shall be in accordance with SANS 51706. The alloys and its chemical composition shall be stated in Technical Schedule B. The alloy shall contain no more than 0,1% Cu and shall not be prone to stress corrosion, cracking or layer corrosion in accordance with the requirements of ISO 9591. The manufacturing method (e.g. cast or wrought) and the alloy shall fulfil the requirements relating to tensile strength, hardness and conductivity. The clamp materials shall be resistant to atmospheric corrosion.

3.3.2.2 Welded couplers (EWI Inserts)

The tubular inserts shall be made of aluminium alloy and shall be 6061 (EN equivalent AlMg1SiCu) with temper of T6. The aluminium alloys shall have the chemical composition limits specified in the relevant clauses of EN 573-3 and the inserts shall be free of any material defects.

The electrical resistivity of the material shall not exceed 0.037 x 10^{-6} Ωm at 20°C.

3.3.3 Machining

The contact areas of the clamps shall present a true cylindrical profile within the specified tolerances.

The contact surfaces of the current-carrying ends of the clamp, that bolt onto stranded conductor, shall be grooved, with each end of the groove equipped with a so called ‘serve spot‘ to allow easy embedding of the served stranded conductor. It is left to the manufacturer to provide specially designed grooves or ridges on the contact surface.

Pads are to be serrated-machined to guarantee the best current transfer.

The surfaces that interface with solid cylindrical conductors e.g. aluminium tubes or stems shall be smooth machined with an average roughness (Ra) ranging from 1,6 to 2.

The damage caused to the conductor by the clamps e.g. by grooves that cut into the conductor, shall be such that the conductor strength is not reduced to less than 90 % of the ultimate strength, nor shall the electrical conductance be impaired.

3.3.4 Bolted Connections

Bolted connections shall be equipped with two or more independent saddles in accordance with the specified requirements.

3.3.4.1 Bolts

Bolts shall comply with the requirements of SANS 1700 and have hexagonal heads.

For tube sizes up to and including 120 mm diameter bolts shall be made from hot-dip galvanized high tensile steel (grade 8.8). Bolts made of any other material shall only be used upon approval by Eskom or as requested and specified by Eskom.

For tube sizes above 120mm diameter bolts will be 7075.T73 aluminium alloy.

The surface of the bolts shall be treated to prevent seizure. The supplier shall specify the method of treatment.

Bolts shall be resistant to corrosion.

Steel bolts shall have a minimum tensile strength of 480 MPa and aluminium alloy bolts that of 380 MPa, in accordance with NEMA CC 1

Bolts shall be of a quality that enables the desired torque levels to be achieved without damage and without compromising contact pressure.

No bolt shall have a diameter of less than 10 mm unless otherwise approved by Eskom.

The design torque that is to be applied to the bolts for optimum performance shall be stated in Schedule B, together with the minimum torque at which satisfactory operation is guaranteed. The minimum torque shall be ≈ 10% below the recommended design torque.

After the bolts have been tightened, the gap between the saddle and the clamp body shall not be less than 2 mm.

The maximum tightening torque on any size of bolt shall be in accordance with the following:

a) shall not exceed 75 Nm.

b) shall not exceed 50 % of the value at which fracture or permanent distortion of the bolts, or fracture of the clamp, occurs. Bolt fracture shall occur before the threads strip.

c) the maximum specific surface pressure under flat washers shall not exceed 120 N/mm^2,

d) whichever of the above that results shall be the limiting case.

3.3.4.2 Nuts

Nuts shall comply with the requirements of SANS 1700 and have hexagonal heads.

Nuts shall be made of the same material as the bolts used, hot-dip galvanized high tensile steel (grade 8.8) for tubes up to and including 120mm diameter and 7075.T73 aluminium alloy for tube sizes above 120mm diameter.

Nuts shall be resistant to corrosion.

3.3.4.3 Washers

Only flat plain washers shall be used and comply with the requirements of SANS 1700.

Flat washers shall be made of the same material as the bolts used, hot-dip galvanized high tensile steel (grade 8.8) for tubes up to and including 120mm diameter and 7075.T73 aluminium alloy for tube sizes above 120mm diameter.

Flat washer/bolt size combinations shall be according to ANSI/NEMA CC 1.

Washers shall be resistant to corrosion.

Flat washers shall be provided under the bolt head only if the bolt head is free to move and captive nuts are provided. Alternatively, if captive bolts are provided, and the nuts are free to move, plain washers shall be provided under the nut.

3.3.5 Compression Connections

A compression connection shall be any conductor connection requiring a compression tool capable of exerting a compressive force sufficient to deform the clamp sleeve and all layers of the conductor so that an electrical and mechanical joint is achieved.

The compression sleeves shall be manufactured from extruded tubing having bore sizes to suit conductors shown in Table 4. The type of tubing, alloy and dimensions used shall be stated in Technical Schedule B.

The supplier shall ensure that the sleeve tubing is dimensioned and manufactured properly, taking into consideration the diameter range of the corresponding conductor in Table 4. The sleeve must be designed in such a way that the conductor shall fit into the tubing with ease and still not compromise the integrity of the entire connection.

Table 4: Dimensions of stranded aluminium conductors

Conductor type	Conductor cross-sectional area (mm^2)	Conductor diameter (mm)	
		Minimum	Maximum
Hornet	150	16.25	16.42
Centipede	400	26,46	26,73
Bull	800	38,34	38,73

The recommended compression force and the number of compressions per joint shall be stated in Technical Schedule B.

If line boring, or drilling techniques are used in the manufacture of the sleeves, the tolerance on the wall thickness shall not exceed 5%.

All compression clamp sleeves shall be pre-greased and the conductor opening shall have a dust cap applied. The grease shall be applied to cover the entire inner tubing of the sleeve. The type of grease used shall be specified in Technical Schedule B.

Compression clamp sleeves shall have a drilled hole with a diameter of 4mm that will serve as a passage for the flow of excess grease during compression.

The compression sleeves are required to be marked externally with the position, the number of compressions required and the across flats dimension. The die size shall also be marked on the compression sleeve.

3.3.6 Welded Connections

All welds shall be of a quality and type that will ensure “fusing” between the materials involved. Welding shall be done using either a tungsten inert-gas-shielded arc or metal inert gas-shielded arc process. Welding jigs shall be used to ensure the correct alignment of sleeves. Welds shall be clean, sound, smooth, uniform without overlaps, properly fused and completely sealed. There shall be no cracks, voids, incomplete penetration, incomplete fusion, undercutting or inclusions. Porosity shall be minimised so as not to affect the mechanical properties of the aluminium alloys. Welds shall be performed by accredited welding personnel and the welding procedure might be subject to Eskom’s approval. Welded connections shall have an electrical conductivity equal to or greater than the original material.

3.3.7 Pad Terminals

Pad terminals shall be dimensioned in accordance with IEC 62271-301 and shall have 4, 8 or 9 holes. The number of holes required shall be shown on the sample drawings of the relevant clamps in Annexure A and specified in Technical Schedule A.

All pad terminals shall be serrated-machined to guarantee the best current transfer.

3.3.8 Electrical Joint Compound

In order to minimise contact resistance due to oxidation of the aluminium surfaces, a recommendation shall be submitted regarding the cleaning treatment to be adopted, the type of compound to be used, and its properties, including the following:-

- temperature rating, particularly under short-circuit conditions, degree of adhesion,
- performance in wet or salt-water conditions,
- suitability for use in bolted and / or compression clamps,
- need for replenishment and expected life span, and
- availability and sources of supply.

The compound shall not attack the aluminium material.

The compound shall not cause corona.

The drop point of the compound shall be >90 °C.

The flash point of the compound shall be ≥140 °C.

The oil separation of the compound shall be ≤ 1% at 100 °C for 4 hours.

3.3.9 Busbar Support Clamps

3.3.9.1 Busbar Support Clamp PCDs

The PCD of clamps to be connected to busbar support post insulators shall be dimensioned according to IEC 60273. The required PCD per clamp is stated in the relevant tables in Annex A.

All insulator support clamps with PCD terminals shall have slotted holes. Dimensions as per Table 2 are applicable.

3.3.9.2 Height of Busbar Support Clamps

The distance from the centreline of busbar support clamps to the top of post insulators shall be in accordance with ANSI/NEMA CC 1. For tubes with outer diameters of 200mm and 250mm, the distance shall not exceed 200mm and 220mm respectively. The distance shall be shown in the clamp drawing to be submitted by the supplier at the tender stage.

3.3.10 Welded Couplers (EWI Inserts)

Welded couplers shall be made of aluminium alloy as specified.

The inserts shall have a smooth-finished surface. Tolerance on the outer diameter shall be ±1% of specified outer diameter and the tolerance of the wall thickness of the tubular conductor shall not exceed ±0.4 mm.

Welded inserts shall have a minimum tensile strength of 245 MPa and 0.2% proof strength of 195 MPa.

3.3.11 Current Bridges

Current bridges shall be made of a minimum of two aluminium conductors and shall be capable of carrying the rated nominal current continuously without exceeding the specified temperature-rise limit.

Current bridges shall be securely fastened to avoid localised overheating.

Current bridges shall be capable of withstanding the specified short-circuit currents for the specified duration without any damage or pull-out.

Current bridges shall be able to withstand the same mechanical forces as the clamp and conductor it is connected to.

3.3.12 Rated Normal Current

The rated normal current of each clamp shall be in accordance with the value stated in the relevant table of this specification.

Clamps shall be capable of carrying continuously the rated normal current specified without exceeding the maximum allowable operating temperature of 45°C above an ambient temperature of 45°C.

When a connection is made between two conductors of different sizes (or tubular to stranded), the current rating of the current-carrying clamps used shall not be less than that of the lowest rated conductor(s).

3.3.13 Rated short-circuit withstand current

Clamps with inner diameters of less than 200 mm shall be capable of withstanding short-circuit currents of not less than 40kA_{rms} (thermal) for 3 seconds and 107 kA_{peak} (mechanical).

Clamps with inner diameters of 200 mm and above shall be capable of withstanding short-circuit currents of not less than 63kA_{rms} (thermal) for 1 seconds and 170 kA_{peak} (mechanical).

Refer to tables in Annex A for the requirements applicable to the various clamps.

3.3.14 Maximum Operating Temperature

Under normal operating conditions, clamps shall be capable of carrying continuously the rated normal current specified without exceeding the maximum allowable operating temperature of 45°C above an ambient temperature of 45°C.

The temperature rise of a clamp shall not exceed the temperature rise of the conductor to which it is connected.

Where different sizes of conductors are interconnected by a clamp, the temperature rise of the clamp shall not exceed the temperature rise of the conductor having the highest temperature rise.

Under short-circuit conditions; the clamp temperature rise shall not exceed 200 °C.

3.3.15 Thermal Expansion

Clamps must be designed and manufactured to allow for tubular conductor thermal expansion and contraction due to temperature variations whilst in service.

3.3.16 Corona Performance

All clamp/connector assemblies shall be capable of operating at the stipulated voltages (U_m) without any signs of visible corona, at altitudes of up to and including 1800 m.

All clamps shall be corona free on their own (without the application of corona rings) up to the voltage specified. Clamps with a specified U_m > 420 kV shall be corona free on their own up to and including at 420 kV, and up to the specified voltage with the aid of a corona ring.

3.3.17 Mechanical Strength

Clamps shall be designed in such a way that they are capable of withstanding mechanical forces to which they may be subjected to in service, including those due to short-circuits and wind loading, without failure or damage.

The cantilever strength of busbar support clamps shall not be less than the cantilever strength of the post insulators to which the clamps are connected to. The minimum cantilever strengths of busbar support clamps are listed in Table 6.

Table 5: Minimum Cantilever Strength of Busbar Support Clamps

Clamp Inner Diameter (mm)	Cantilever Strength (kN)
80	10
120	12.5
150	12.5
160	12.5
200	16
250	16

3.4 Tests

A series of tests to evaluate performance of the tubular conductor clamps are specified below. The tests are classified as type tests, sample tests and routine tests.

Manufacturers shall comply with all test requirements stated in this document and any other test that the manufacturer may deem necessary.

Eskom shall have the right to witness any testing. Where type tests are mandatory, the contractor shall inform Eskom eight weeks in advance before the date of commencement of testing. Should Eskom exercise its right to witness testing, its employees and/or appointed representatives shall be given access and permission to the test facility.

If the clamps and connectors offered have been tested for compliance with an internationally accepted standard, such tests may be accepted by Eskom in lieu of the tests covered by this specification. Tenderers are requested to indicate if they comply with such tests at the tendering stage and shall submit these relevant test reports with their tender for Eskom's consideration.

A family of clamps is a group of clamps using similar design criteria. In order to qualify a family of clamps (for a specific type of clamp), all the relevant clamps as specified by Eskom in Table 3 shall be tested.

For all type tests, a minimum of three (3) identical clamps shall be tested and none of these clamps shall fail during a test. Eskom shall provide a list of clamps to be tested. Eskom reserves the right to witness any or all of the tests.

3.4.1 Test Samples

A minimum of three samples of each type of clamp shall be tested.

All the tested samples shall pass the test. Should any one sample fail the test, the type shall be considered to have failed the test.

Unless otherwise specified, only the clamp having the highest rating in a particular type shall be type-tested.

3.4.2 Type Tests

Type tests are intended to establish design characteristics. They are normally only made once and repeated only when the design, manufacturing process or the material of the fitting is changed. The results of type tests are recorded as evidence of compliance with design requirements.

The clamps are specified for service at altitudes of up to 1800 m. If a clamp is tested at an altitude below 1800 m, the limits of operating temperature under normal and short-circuit conditions should be reduced by 2,5 % for each 500 m that the altitude specified exceeds 1000 m.

A series of type tests to evaluate performance of the clamps are specified below. These tests are divided into two categories, viz. electrical and mechanical type tests. Some of these tests can be combined as part of the electrical tests since severe shock forces are exerted on the clamps in the case of short circuit tests.

Clamps intended to connect tubular conductors to other tubes, stranded conductors, support insulators or primary equipment terminals must be able to withstand all forces that develop under field operating conditions without the formation of cracks or failures occurring.

Extrapolation of **mechanical tests** shall be allowed across a family of clamps if it is proven that the construction and type of connection is the same.

Extrapolation of **electrical tests** shall be allowed:

- within a family of clamps;
- across a family of clamps if it is proven that the construction and type of connection is the same.

The following rule shall apply: Extrapolation shall be allowed downwards only, i.e. the highest rated clamps test results may be used to extrapolate downwards to a lower rated clamp where the construction and type of connection is the same.

Extrapolated test results might have an influence on qualifying a family of clamps and will be reviewed on a case by case base, since it deviates from the specified clamps required to be tested in Table 3.

3.4.2.1 Heat (current)-cycle test

Heat (current)-cycle tests shall be conducted using the light-duty cycle (N = 125 cycles) in accordance with the relevant test procedure and requirements of ANSI C119.4.

3.4.2.2 Temperature-rise test

Temperature rise tests shall be conducted in accordance with the relevant test procedure and requirements of ANSI/NEMA CC 1, with the exception that the rated current of the clamps shall be as stated in this specification.

3.4.2.3 Corona and RIV tests

Corona tests shall be performed according to the test procedure and requirements of ANSI/NEMA CC 1.

RIV tests shall be performed according to the test and requirements of CISPR 16-1 and CISPR 18-2 or NEMA CC 1.

The test voltage for radio influence voltage shall be $1.1U_m/\sqrt{3}$, where Um is the maximum system voltage.

Tests should be done for altitudes up to 1800 m, correction factors shall be applied in accordance with IEC 60060-1.

3.4.2.4 Short-circuit current withstand test

Short-circuit withstand tests shall be conducted in accordance with the test procedure and requirements of IEC 62271-1

3.4.2.5 Bolt tightening torque test

The bolt tightening torque test shall be performed according to the relevant test procedure and requirements of ANSI/NEMA CC 1.

The gap between the clamping covers and the body of the clamp shall not be less than 2 mm.

3.4.2.6 Slip/pull-out strength test

The slip/pull-out strength test shall be performed in accordance with the relevant test procedure and requirements of ANSI/NEMA CC 1.

3.4.2.7 Cantilever test (specified for bus supports)

Cantilever test shall be done in accordance with the relevant test procedures and requirements of ANSI/NEMA CC 1.

3.4.3 Type-Test Acceptance Criteria

The clamps are specified for service at altitudes of up to 1800 m. If a clamp is tested at an altitude below 1800 m, the limits of operating temperature under normal and short-circuit conditions should be reduced by 2,5 % for each 500 m that the altitude specified exceeds 1000 m.

3.4.3.1 Heat (current)-cycle test

The resistance of the clamp shall be stable between the twenty-fifth (25^{th}) cycle and the completion of the number of current cycles required (N). The number of cycles (N) is specified in ANSI C119.4. Stability is when any resistance measurement does not vary by more than 5% from the average of all the measurements at specified intervals during the test.

The temperature of the clamp shall, measured at the intervals specified in ANSI C119.4, shall not exceed that of the reference conductor.

The average resistance of the joint over the last 0.5 N cycles shall not exceed the initial resistance of the joint by more than 50 %.

3.4.3.2 Temperature rise test

The maximum temperature of the clamp shall not exceed 45 °C above an ambient temperature of 45 °C.

The temperature rise of an electric power connector at rated current shall not exceed the temperature rise of the conductor with which it is intended to be used. The temperature of the clamp shall be at least 2 ^{o}C lower than that of the control conductor.

The temperature rise of an electric power connector that connects conductors of varying sizes shall not exceed the temperature rise of the conductor having the highest temperature rise.

3.4.3.3 Corona and RIV tests

There shall be no sign of visible corona below the test voltage required for minimum corona extinction.

The clamp shall be considered to have passed the test if the radio interference voltage level at 1,1.Um/√3 does not exceed 200 µV as per ANSI/NEMA CC 1.

3.4.3.4 Short-circuit current withstand test

Clamps shall be capable of withstanding short-circuit currents without any mechanical damage or overheating. The short-circuit current withstand ratings are given in the respective clamp tables in Annex A.

Under short-circuit conditions the clamp temperature shall not exceed 200°C.

3.4.3.5 Thermal withstand

a) Clamps with inner diameters of less than 200 mm shall be capable of withstanding short-circuit currents of at least 40 kA for 3 second with no signs of melting of clamp components.

b) Clamps with inner diameters of 200 mm and above shall be capable of withstanding short-circuit currents of at least 63 kA for 1 second no signs of melting of clamp components.

c) Under short-circuit testing the clamp temperature shall not exceed 200 °C.

d) After the short-circuit withstand test, the clamp shall be capable of carrying its rated normal current continuously without exceeding the maximum operating temperature of 90 °C.

3.4.3.6 Mechanical withstand

a) Clamps with inner diameters of less than 200 mm shall be able to withstand short-circuit currents of 107 kA peak without any mechanical damage.

b) Clamps with inner diameters of 200 mm and above shall be capable of withstanding short-circuit currents of 170 kA peak without any mechanical damage.

c) Clamps shall be capable of withstanding short-circuit currents without any mechanical damage or overheating.

3.4.3.7 Bolt tightening torque test

There shall be no evidence of mechanical damage to all the clamp components and the conductor after the test.

3.4.3.8 Slip/pull-out strength test

The test shall be considered successful if:

a) the clamp does not suffer any mechanical damage,

b) the clamp’s mechanical strength should not be reduced to below 90%,

c) the connected conductor does not pull out of the clamp.

3.4.3.9 Cantilever Test (specified for bus supports)

There shall be no mechanical damage to the clamp assembly during and after the test.

3.4.4 Sample Tests

The following sample tests shall be conducted according to the relevant procedures of IEC 61854.

Eskom reserves the right to inspect and check the clamps at any stage during or after manufacture, and to witness any of the sample tests.

3.4.4.1 Visual examination

Visual examination shall be undertaken to ensure conformity of manufacturing process, shape and surface finish of the clamps with the contract drawings.

The quality of the welds shall be checked for integrity and consistency.

For corona-free clamps, visual inspection shall include comparison of the surface finish of sampled clamps with those clamps that passed corona tests.

3.4.4.2 Verification of dimensions and material

Verification of dimensions shall be undertaken to ensure that clamps are within the specified material properties, dimensions and dimensional tolerances. The mass and dimensions of the clamps shall also be checked against manufacturer's drawings to confirm compliance.

3.4.4.3 Clamp bolt tightening test

The bolt tightening torque test shall be performed according to the relevant test procedure and requirements of ANSI/NEMA CC 1.

The gap between the clamping covers and the body of the clamp shall not be less than 2 mm.

3.4.5 Routine Tests

Routine tests in accordance with the manufacturer's standards shall be carried out at the works and shall include a dimensional check of each type of connector on a 1 % sample basis. Eskom reserves the right to inspect and check the equipment at any stage during or after manufacturing, and to witness any of the routine tests.

3.4.5.1 Drift Test

Every batch of tubes used in the manufacture of sleeves shall be drift tested. The test shall be performed by expanding the sample, using a drift cone of suitable angle, until the increase in outside diameter of the tube exceeds 25 % or until splitting of the sample occurs, whichever occurs first. If any test piece splits before 125% of the outside tube diameter is reached, the relevant length of tube shall be scrapped.

3.4.5.2 Verification of dimensions, material and mass

Verification of dimensions shall be undertaken to ensure that clamps are within the specified material properties, dimensions and dimensional tolerances.

The mass and dimensions of the clamps shall also be checked against approved manufacturer's drawings to confirm compliance.

3.4.5.3 Visual examination

Visual examination shall be undertaken to ensure conformity of manufacturing process, shape and surface finish of the clamps with the contract drawings.

The quality of the welds shall be checked for integrity and consistency.

For corona-free clamps, visual inspection shall include comparison of the surface finish of sampled clamps with those clamps that passed corona tests.

3.4.6 Type Test Certificates and Reports

Copies of all type-test reports and certificates shall be submitted to Eskom in electronic format at the tender stage. Copies of sample and routine test reports shall be submitted to Eskom on request. The contractor shall retain copies of sample and routine test reports for a period of at least 2 years.

Type test reports and certificates will be acceptable as long as the clamp's design, material composition and manufacturing process stay unchanged. Should any of these change the applicable clamp or family of clamps shall be retested.

Type test reports shall contain, as a minimum, the following information:

- Name and address of test facility.
- Contact details of test facility.
- Details and validity of accreditation of test facility.
- Date of test.
- Type of clamp tested.
- Description of the test equipment used, including test equipment serial number and last date of calibration.
- Description of test set-up, including photographs of the set-up.
- Description of test procedure.
- Test results.
- Analysis of test results.
- A statement that the clamp conforms, or does not conform, to the requirements of this specification.
- Description of the condition of the clamp after testing (include picture of the clamp).
- Names and titles of personnel who conducted the test.

3.5 Drawings

Drawings shall comply with the requirements stated in the relevant conditions of contract or order. The following drawings shall be submitted for approval:

- Outline dimensioned drawing for each type of connector/clamp.
- Outline dimensioned drawings for all compression tools, where applicable.

3.6 Identification Marking

Clamps shall be clearly and indelibly marked with the following minimum information:

- Manufacturer's identification.
- Eskom clamp code number.
- Nominal size or range of sizes of conductors with which the clamp is intended to be used.

3.7 Inspection of Samples

A list of samples of clamps to be submitted during tendering shall be included in the tender enquiry documents.

3.8 Packaging

All individual clamps shall be packaged in sealed, heavy duty, UV stabilised plastic bag. The clamps/connectors shall be packed in such a manner that they are adequately protected to avoid damage during transportation and storage.

To facilitate inspection and handling, the sealed clamps shall be supplied in strong durable containers. Wooden crates shall be treated.

A suitable metal label bearing the Eskom's order and item number, the quantity and the delivery address shall be securely attached to the container. The markings on the label shall not be destroyed during storage and transport.

Each crate shall be clearly marked in order to identify each crate as belonging to a specific clamp. Each container/crate shall be clearly marked with a durable label using an indelible font indicating the following information:

- Eskom order number;
- Eskom SAP number;
- Eskom clamp designation/code
- Manufacturer’s name
- Contents of the container/crate (i.e. a parts list);
- Overall dimensions of container/crate (in mm); and
- Total mass of each crate (e.g. “TOTAL MASS: 50 KG”);
- Pictograms / symbols showing correct storage and stacking instructions for crates.

3.9 Off-loading and Storage

A copy of storage and handling procedures shall be submitted to Eskom at tendering stage for acceptance. The procedure shall stipulate the maximum recommended period of storage, as well as recommended actions to be taken if a longer storage period is required.

The supplier shall contact the relevant personnel for delivery of clamp consignment at least one (1) week before delivery.

At the time of off-loading at an Eskom facility, the supplier shall ensure that clamps are off-loaded properly and safely.

3.10 Installation

The supplier shall submit relevant installation procedures for clamps and spacers to Eskom at the tender stage.

3.11 Inspections

The supplier shall supply inspection information in the form of manuals to Eskom at the tender stage. The manuals shall cover, amongst others, the following aspects:

a) Frequency of inspections.

b) Scope of inspection.

c) Parameters to be inspected

d) Inspection tools

e) Inspection procedure

f) Remedial actions

3.12 Documentation

The manufacturer shall submit the following documentation, in English, with the tender:

a) A completed technical schedule B for each clamp type. The technical schedule B shall not be left blank. Where numerical values (for example, rated values and dimensions) or specific information is required, the actual value/information shall be stated. In such cases, use of words, such as “COMPLY”, “TBA”, is not acceptable;

b) A full set of drawings

c) A list and copies of all type test certificates and reports specified in the specification

d) Manual for storage, installation and inspections

e) Welding procedure

f) Proof of accreditation of welder

4. Authorization

This document has been seen and accepted by:

Name and surname	Designation
Phineas Tlhatlhetji	Senior Manager – PDE Substation Engineering
AJS Groenewald	Corporate Consultant – PDE Substation Engineering
Athelene Gouws	Senior Engineer – PDE Standards Implementation, Gauteng OU
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Best Khoza	Engineer – Distribution Division, Western Cape OU
Christy Thomas	Senior Engineer – PDE Substation Engineering
Derrick Delly	Chief Engineer – PDE Substation Engineering
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5. Revisions

Date	Rev	Compiler	Remarks
Nov 2018	2	JS Terblanche	Compiler changed from TJ Marais to JS Terblanche Layout aligned with 240-53113927, including document renumbered and reformatted Noteworthy content changes as follows: • Publishing dates removed from references • Section 2.2.2: Informative References added • Definitions added and amended • Section 3.2 General removed Table 2 added • New Section 3.2 added with Table 3, clamp type family descriptions and Buyer's Guide references • Section 3.3.2.2 added: EWI material details • Updated technical requirements to align with reference documents Removed unnecessary test requirements • Section 3.4.6 Type Test Certificates and Reports validity requirements updated • Annex A – Impact Assessment removed • Annex B changes: ○ Renamed to Annex A ○ All drawings updated ○ All tables updated in accordance with Table 2. ○ Buyer's Guide references added where applicable • Changed codes of end caps: ○ A.52: EEC-CF to ETEC-CF ○ A.53: EEC-PL to ETEC-PL ○ A.54: EEC-DC to ETEC-DC • Table A.26 EEC-H/VS-F A to H corrected to EEC-H/VS-TB K to S (previous Table 25) • Table A.10 corrected as per 240-83534936 • Items added: ○ A.30 ECC-8HH: 120mm tube ○ A.42 ETP-TE-IL1: 200mm and 250mm tubes and 0º, 45º, 90º options for all clamps ○ A.43 ETP-TE-IL2: 0º, 45º, 90º options for all clamps ○ A.58: EHCT Hexagonal terminal clamp ○ A.59: ECES Conductor end sleeve • Annex C changes: ○ Renamed to Annex B ○ Tables updated according to document changes. • New Annex C added

Date	Rev	Compiler	Remarks
May 2014	1	TJ Marais	Unique Identifier changed from TSP 474-217 to 240-53113923 Compiler changed from NP Tlhatlhetji to TJ Marais Approver changed from E Lechtman to NP Tlhatlhetji Supported changed from E Lechtman to NP Tlhatlhetji New document format applied with the following content changes: • Figures 1, 2 corrected • Table 5: item ECC-PI-S-L added • Table 8: item ECC-TT-G code corrected • Table 9: item ECC-T-K added • Table 34: item ECC-IL-ST-L code corrected • Table 36: all codes corrected • Table 42: items ETP-TE-IL 2-G and ETP-TE-IL 2-H added • Table 50: item EWI-2C 45-C added • Table 55: item EET-TPZ-C added
July 2012	0	NP Tlhatlhetji	First issue.

6. Development team

The following persons were involved with the development of the original document:

- Braam Groenewald — Corporate Consultant (Substations) – Technology
- Rob Stephen — General Manager - Master Specialist (Technology)
- Abre Le Roux — Chief Engineer – Technology
- Faria Essopp — Senior Engineer – Technology
- Ian Hill — Senior Technologist – Technology
- Mohamed Khan — Senior Engineer – KZN Operating Unit
- Thandiwe Nkambule — Senior Engineer – Technology
- Phineas Tlhatlhetji — Chief Engineer – Technology

7. Acknowledgements

Callie Brits for redoing and correcting all the drawings used in the document.

Jason Blaauw for scrutinizing the document and ensuring it is correct and aligned with 240-53113927.

Annex A – Clamp types, sample drawings, dimensions and ratings

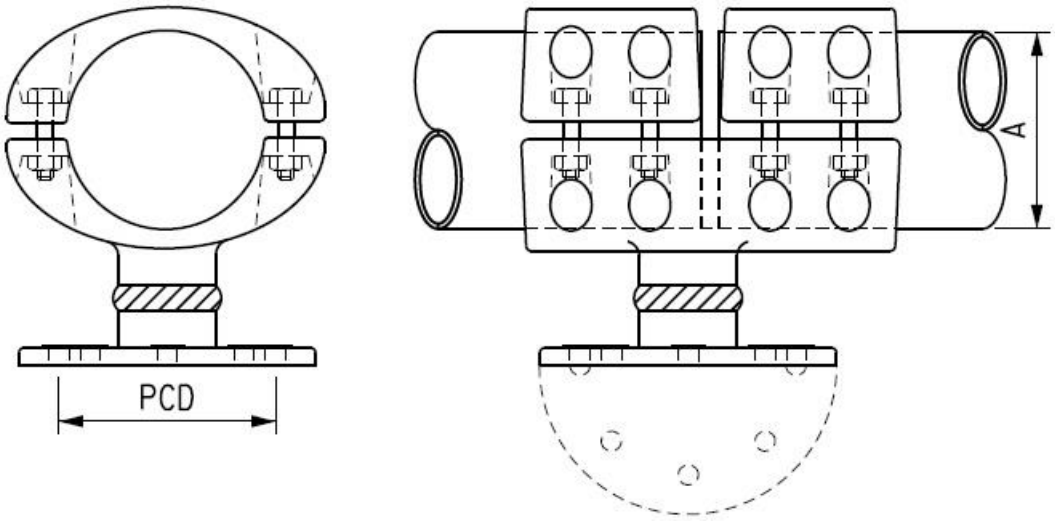

Figure A.1: ECC-PI-F: Coupling Clamp – Post Insulator Mounted – Fixed (D-DT-6086)

Table A.1: Type ECC-PI-F

Type	Tube diameter "A" (mm)	PCD (mm)	Minimum Rated Current @ 90 ^{O}C (A rms)	Maximum Voltage [Um] (kV rms)	1s Fault Current Withstand Rating [kA rms]
ECC-PI-F-A	80	76	2000	36	31.5
ECC-PI-F-B	80	127	2000	145	40
ECC-PI-F-C	100	76	2500	36	31.5
ECC-PI-F-D	100	127	2500	145	40
ECC-PI-F-E	120	76	3150	36	31.5
ECC-PI-F-F	120	127	3150	145	40

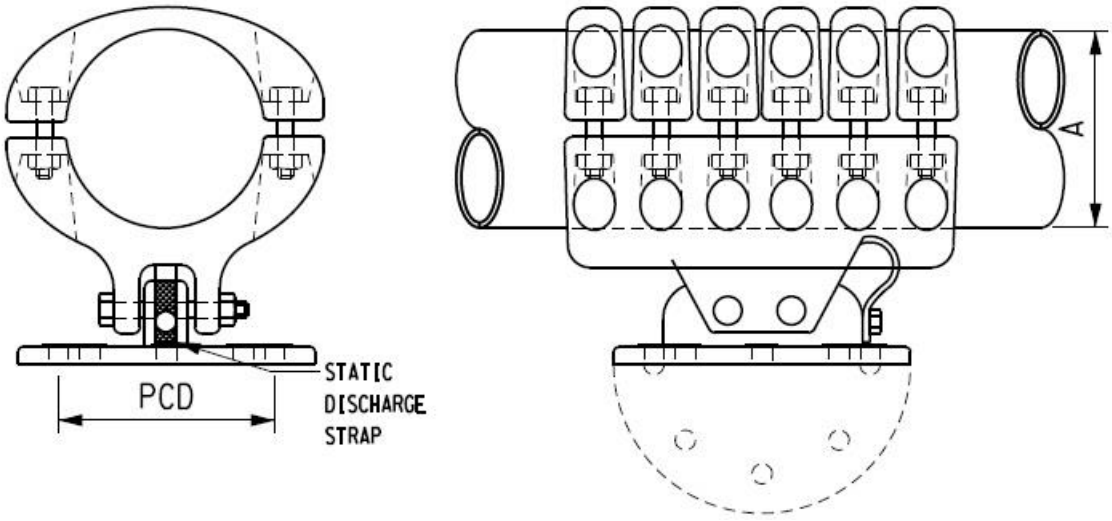

Figure A.2: ECC-PI-F: Coupling Clamp – Post Insulator Mounted – Fixed (D-DT-6086)

Table A.2: Type ECC-PI-F

Type	Tube diameter "A" (mm)	PCD (mm)	Minimum Rated Current @ 90 ^{O}C (A rms)	Maximum Voltage [Um] (kV rms)	1s Fault Current Withstand Rating [kA rms]
ECC-PI-F-G	150	127	3150	145	40
ECC-PI-F-H	160	127	3150	145	40
ECC-PI-F-J	200	225	4000	800	50
ECC-PI-F-K	250	225	4000	420	63
Note: All clamps with a specified Um > 420kV shall be corona free on their own up to and including at 420kV, and up to the specified voltage with the aid of a corona ring.					

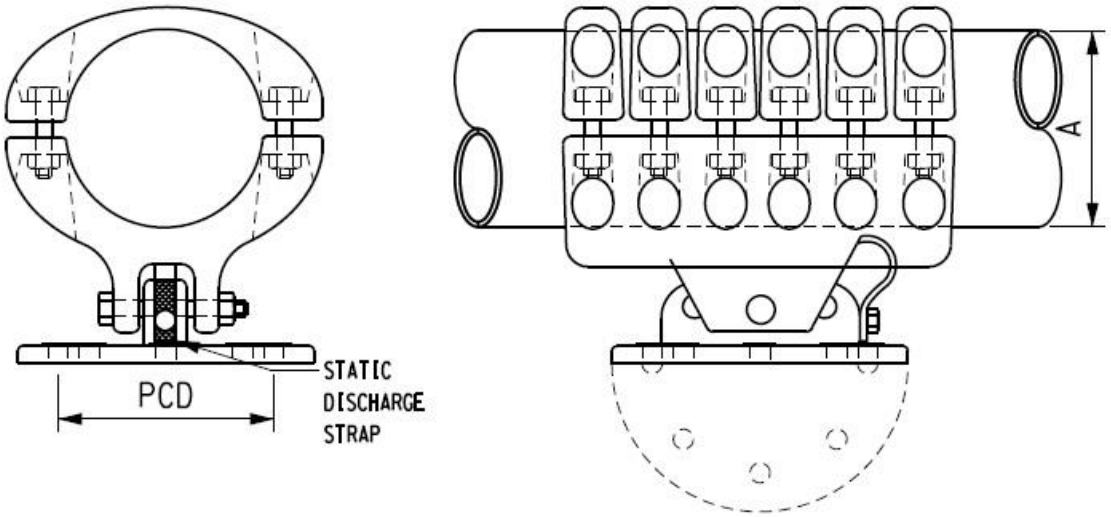

Figure A.3: ECC-PI-S: Coupling Clamp – Post Insulator Mounted – Slide (D-DT-6086)

Table A.3: Type ECC-PI-S

Type	Tube diameter "A" (mm)	PCD (mm)	Minimum Rated Current @ 90 ^{O}C (A rms)	Maximum Voltage [Um] (kV rms)	1s Fault Current Withstand Rating [kA rms]
ECC-PI-S-A	80	76	2000	36	31.5
ECC-PI-S-B	80	127	2000	145	40
ECC-PI-S-C	100	76	2500	145	40
ECC-PI-S-D	100	127	2500	145	40
ECC-PI-S-E	120	76	3150	145	40
ECC-PI-S-F	120	127	3150	145	40
ECC-PI-S-G	150	127	3150	145	40
ECC-PI-S-H	160	127	3150	145	40
ECC-PI-S-J	200	225	4000	800	50
ECC-PI-S-K	250	225	4000	420	63
ECC-PI-S-L	200	127	4000	420	63
Note: All clamps with a specified Um > 420kV shall be corona free on their own up to and including at 420kV, and up to the specified voltage with the aid of a corona ring.					

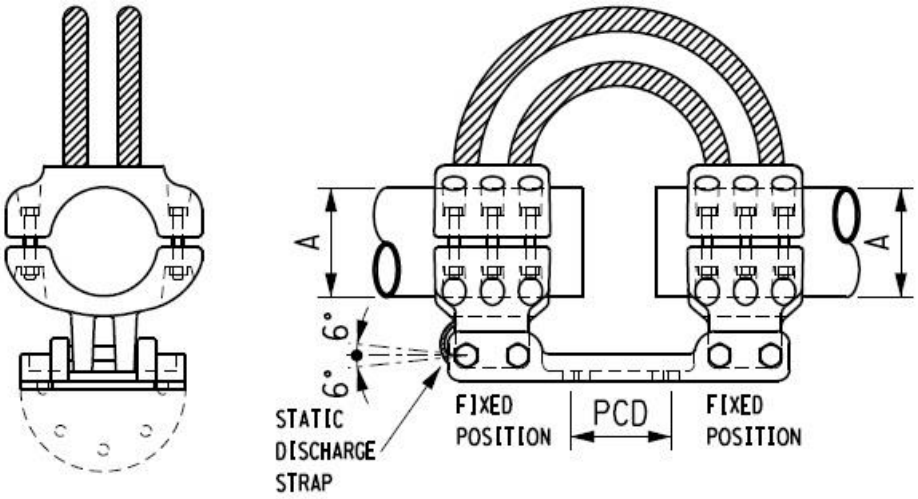

Figure 4: ECC-PI-FF: Coupling Clamp – Post Insulator Mounted – Fixed/Fixed

Table A.4: Type ECC-PI-FF

Type	Tube diameter "A" (mm)	PCD (mm)	Minimum Rated Current @ 90 °C (A rms)	Maximum Voltage [Um] (kV rms)	1s Fault Current Withstand Rating [kA rms]
ECC-PI-FF-A	80	76	2000	36	31.5
ECC-PI-FF-B	80	127	2000	145	40
ECC-PI-FF-C	100	76	2500	36	31.5
ECC-PI-FF-D	100	127	2500	145	40
ECC-PI-FF-E	120	76	3150	36	31.5
ECC-PI-FF-F	120	127	3150	145	40
ECC-PI-FF-G	150	76	3150	36	31.5
ECC-PI-FF-H	150	127	3150	145	40
ECC-PI-FF-J	150	225	3150	145	40
ECC-PI-FF-K	160	76	3150	36	31.5
ECC-PI-FF-L	160	127	3150	145	40
ECC-PI-FF-M	160	225	3150	145	40
ECC-PI-FF-N	200	76	4000	36	31.5
ECC-PI-FF-P	200	127	4000	420	63
ECC-PI-FF-Q	200	225	4000	800	50
ECC-PI-FF-R	250	225	4000	420	63
Note: All clamps with a specified Um > 420kV shall be corona free on their own up to and including at 420kV, and up to the specified voltage with the aid of a corona ring.					

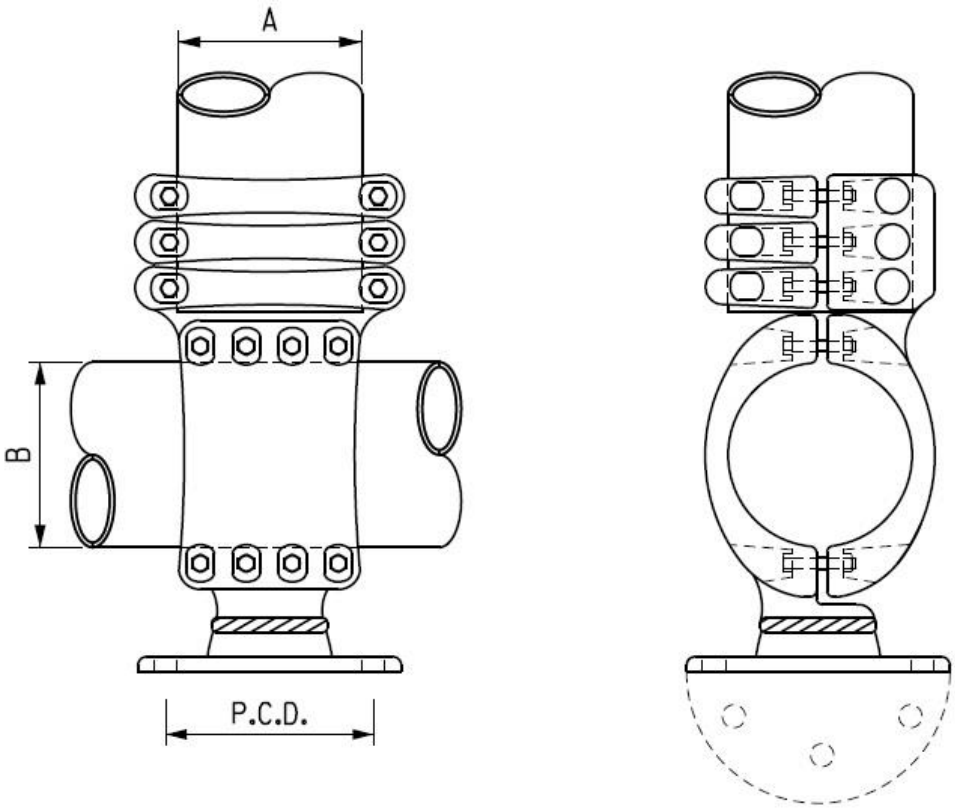

Figure A.5: ECC-T-PI: Coupling Clamp – Tee Connection – Post Insulator Mounted (D-DT-6350)

Table A.5: Type ECC-T-PI

Type	Tube diameter (mm)		PCD (mm)	Minimum Rated Current @ 90 °C (A rms)	Maximum Voltage [Um] (kV rms)	1s Fault Current Withstand Rating [kA rms]
	"A"	"B"				
ECC-T-PI-A	80	80	76	2000	36	31.5
ECC-T-PI-B	80	80	127	2000	145	40
ECC-T-PI-C	100	100	76	2500	36	31.5
ECC-T-PI-D	100	100	127	2500	145	40
ECC-T-PI-E	120	80	127	2000	145	40
ECC-T-PI-F	120	80	225	2000	145	40
ECC-T-PI-G	120	120	127	3150	145	40
ECC-T-PI-H	120	120	225	3150	145	40
ECC-T-PI-J	150	150	127	3150	145	40
ECC-T-PI-K	150	150	225	3150	145	40
ECC-T-PI-L	160	160	127	3150	145	40
ECC-T-PI-M	160	160	225	3150	145	40
ECC-T-PI-N	200	200	127	4000	420	63
ECC-T-PI-P	200	200	225	4000	800	50
ECC-T-PI-Q	250	250	127	4000	420	63
ECC-T-PI-R	250	250	225	4000	420	63
Note: All clamps with a specified Um > 420kV shall be corona free on their own up to and including at 420kV, and up to the specified voltage with the aid of a corona ring.						

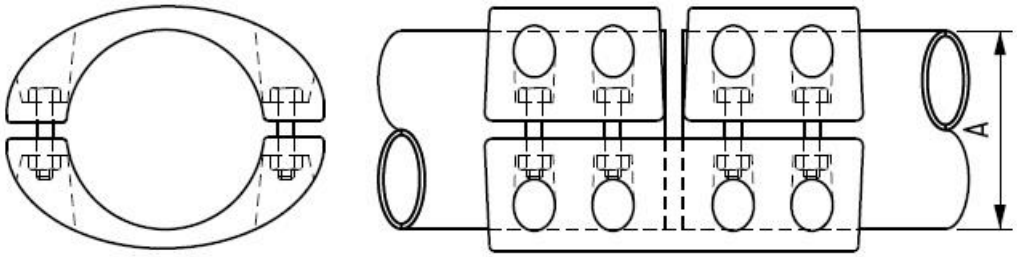

Figure A.6: ECC-TT: Coupling Clamp – Tube-to-Tube (D-DT-6116)

Table A.6: Type ECC-TT

Type	Tube diameter "A" (mm)	Minimum Rated Current @ 90 ^{O}C (A rms)	Maximum Voltage [Um] (kV)	1s Fault Current Withstand Rating [kA rms]
ECC-TT – A	80	2000	145	40
ECC-TT – B	100	2500	145	40
ECC-TT - C	120	3150	145	40

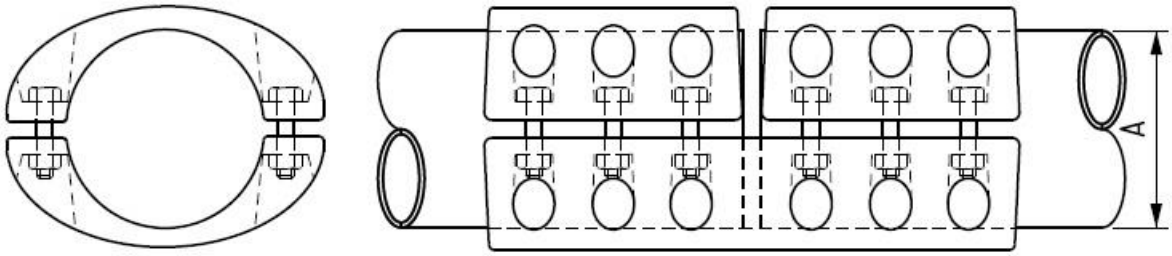

Figure A.7: ECC-TT: Coupling Clamp – Tube-to-Tube (D-DT-6116)

Table A.7: Type ECC-TT

Type	Tube diameter "A" (mm)	Minimum Rated Current @ 90 ^{O}C (A rms)	Maximum Voltage [Um] (kV rms)	1s Fault Current Withstand Rating [kA rms]
ECC-TT-D	150	3150	145	40
ECC-TT-E	160	3150	145	40
ECC-TT-F	200	4000	800	50
ECC-TT-G	250	4000	420	63
Note: All clamps with a specified Um > 420kV shall be corona free on their own up to and including at 420kV, and up to the specified voltage with the aid of a corona ring.				

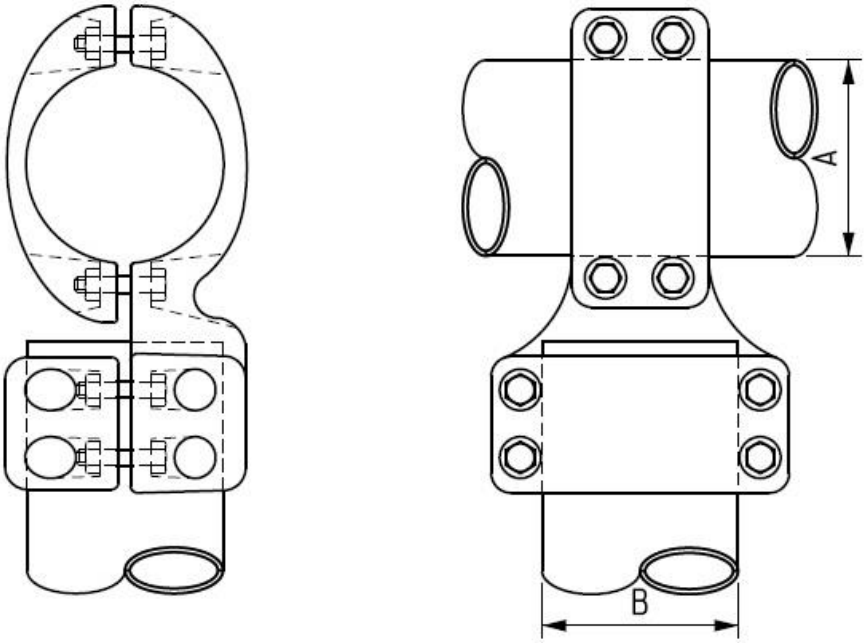

Figure A.8: ECC-T: Coupling Clamp – Tee Connection (D-DT-6351)

Table A.8: Type ECC-T

Type	Tube diameter (mm)		Minimum Rated Current @ 90 ^{O}C (A rms)	Maximum Voltage [Um] (kV rms)	1s Fault Current Withstand Rating [kA rms]
	"A"	"B"			
ECC-T-A	80	80	2000	145	40
ECC-T-B	100	100	2500	145	40
ECC-T-C	120	80	2000	145	40
ECC-T-D	120	120	3150	145	40
ECC-T-E	150	150	3150	145	40
ECC-T-F	160	160	3150	145	40
ECC-T-G	200	120	3150	800	50
ECC-T-H	200	250	4000	800	50
ECC-T-J	250	250	4000	420	63
ECC-T-K	200	200	4000	800	50
Note: All clamps with a specified Um > 420kV shall be corona free on their own up to and including at 420kV, and up to the specified voltage with the aid of a corona ring.					

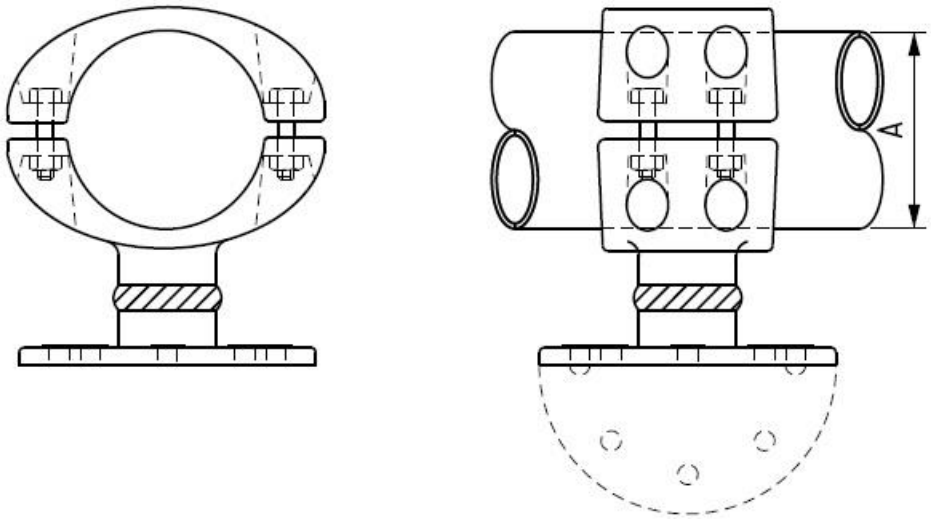

Figure A.9: ESC-PI-F: Post insulator mounted fixed support clamp (80mm – 120mm) (D-DT-6039)

Table A.9: Type ESC-PI-F (80mm – 120mm)

Type	Tube diameter "A" (mm)	PCD (mm)	Minimum Rated Current @ 90 ^{O}C (A rms)	Maximum Voltage [Um] (kV rms)	1s Fault Current Withstand Rating [kA rms]
ESC-PI-F-A	80	76	2,000	36	31.5
ESC-PI-F-B	80	127	2,000	145	40
ESC-PI-F-C	100	76	2,500	36	31.5
ESC-PI-F-D	100	127	2,500	145	40
ESC-PI-F-E	120	76	3,150	36	31.5
ESC-PI-F-F	120	127	3,150	145	40

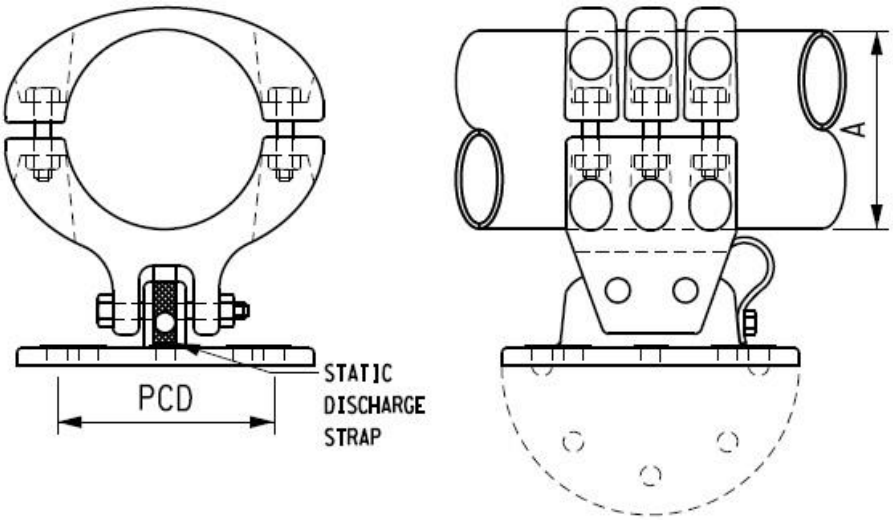

Figure A.10: ESC-PI-F: Post insulator mounted fixed support clamp (150mm – 250mm) (D-DT-6039)

Table A.10: Type ESC-PI-F (150mm – 250mm)

Type	Tube diameter "A" (mm)	PCD (mm)	Minimum Rated Current @ 90 ^{O}C (A rms)	Maximum Voltage [Um] (kV rms)	1s Fault Current Withstand Rating [kA rms]
ESC-PI-F-G	150	127	3,150	145	40
ESC-PI-F-H	160	127	3,150	145	40
ESC-PI-F-J	200	127	4,000	420	63
ESC-PI-F-K	200	225	4,000	800	50
ESC-PI-F-L	250	225	4,000	420	63
Note: All clamps with a specified Um > 420kV shall be corona free on their own up to and including at 420kV, and up to the specified voltage with the aid of a corona ring.					

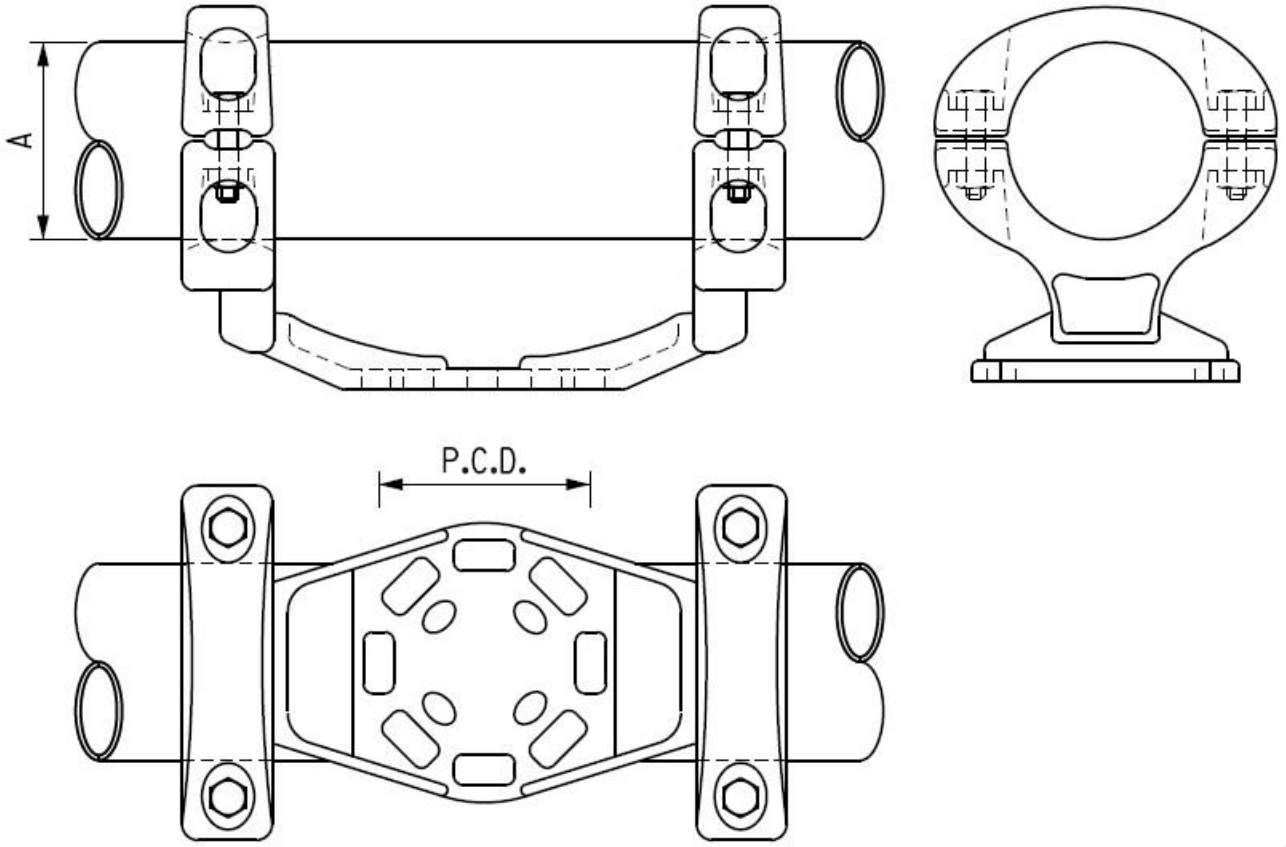

Figure A.11: ESC-PI-TF: Support Clamp – Post Insulator Mounted – Tube Fixed (D-DT-6118)

Table A.11: Type ESC-PI-TF

Type	Tube diameter "A" (mm)	PCD (mm)	Maximum Voltage [Um] (kV rms)
ESC-PI-TF-A	80	76	36
ESC-PI-TF-B	80	127	145
ESC-PI-TF-C	100	76	36
ESC-PI-TF-D	100	127	145
ESC-PI-TF-E	120	76	36
ESC-PI-TF-F	120	127	145
ESC-PI-TF-G	150	76	36
ESC-PI-TF-H	150	127	145
ESC-PI-TF-J	160	76	36
ESC-PI-TF-K	160	127	145
ESC-PI-TF-L	200	76	36
ESC-PI-TF-M	200	127	420
ESC-PI-TF-N	250	76	36
ESC-PI-TF-P	250	127	420

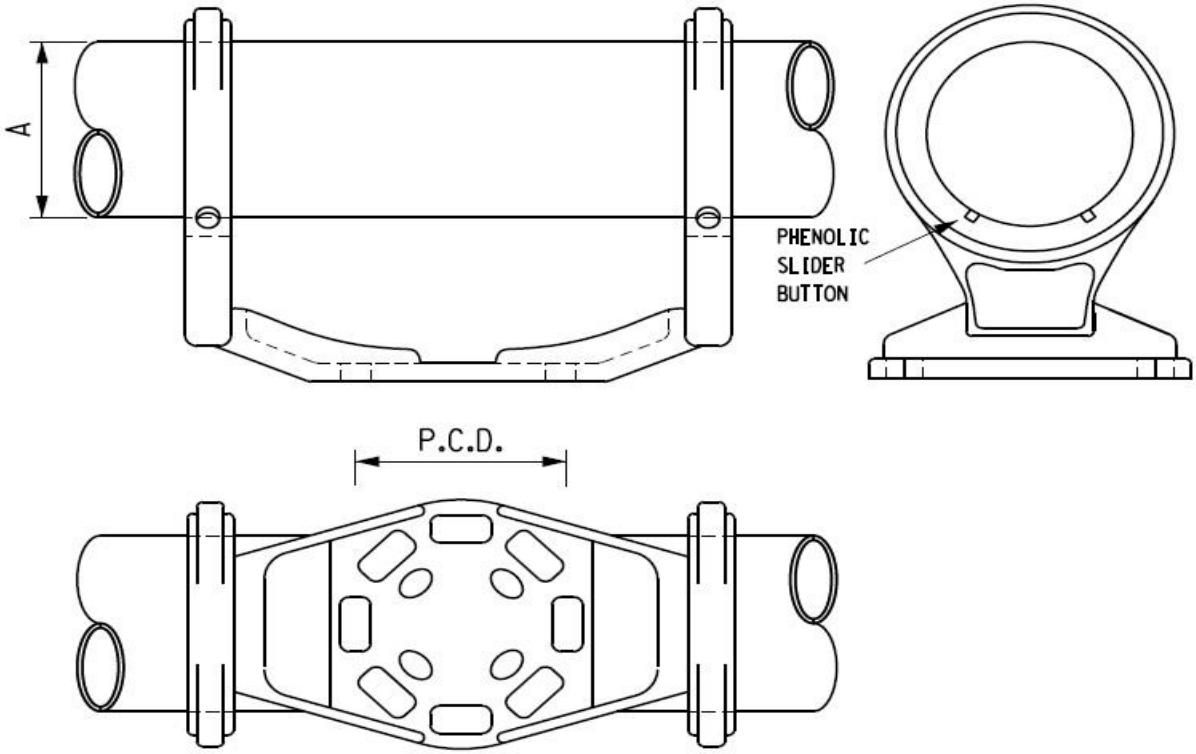

Figure A.12: ESC-PI-TS-1: Support Clamp – Post Insulator Mounted – Tube Slide (D-DT-6118)

Table A.12: Type ESC-PI-TS

Type	Tube diameter "A" (mm)	PCD (mm)	Maximum Voltage [Um] (kV rms)
ESC-PI-TS-A	80	76	36
ESC-PI-TS-B	80	127	145
ESC-PI-TS-C	100	76	36
ESC-PI-TS-D	100	127	145
ESC-PI-TS-E	120	76	36
ESC-PI-TS-F	120	127	145

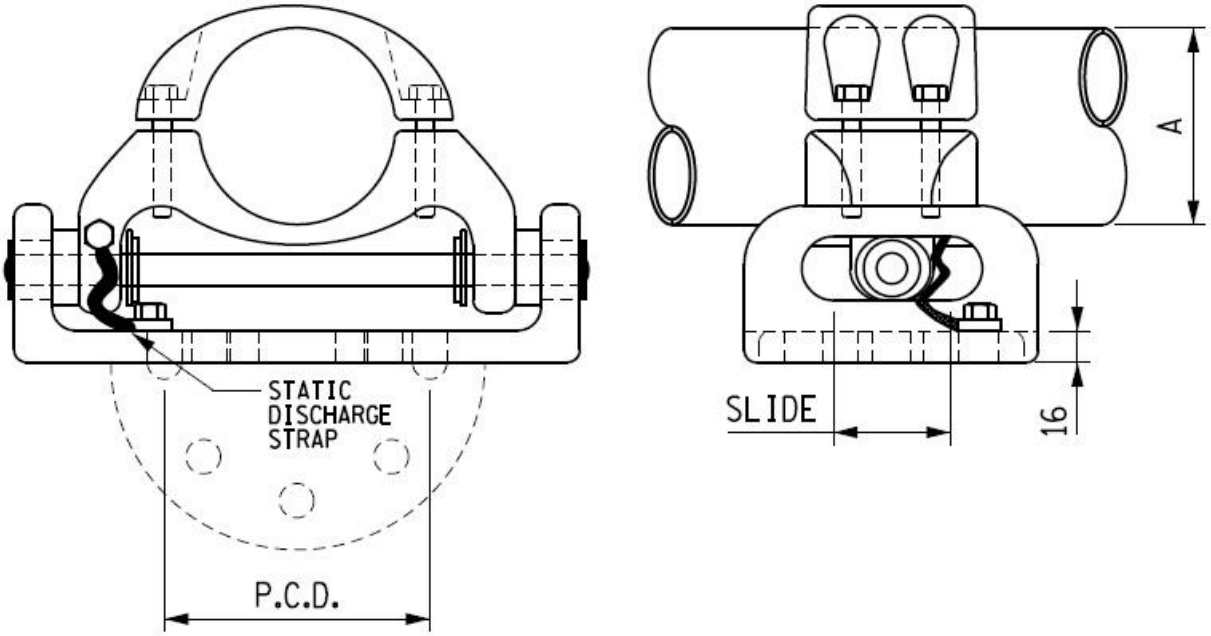

Figure A.13: ESC-PI-S: Support Clamp – Post Insulator Mounted – Slide (D-DT-6316)

Table A.13: Type ESC-PI-S

Type	Tube diameter "A" (mm)	PCD (mm)	Maximum Voltage [Um] (kV rms)
ESC-PI-S-A	80	76	36
ESC-PI-S-B	80	127	145
ESC-PI-S-C	100	76	36
ESC-PI-S-D	100	127	145
ESC-PI-S-E	120	76	36
ESC-PI-S-F	120	127	145

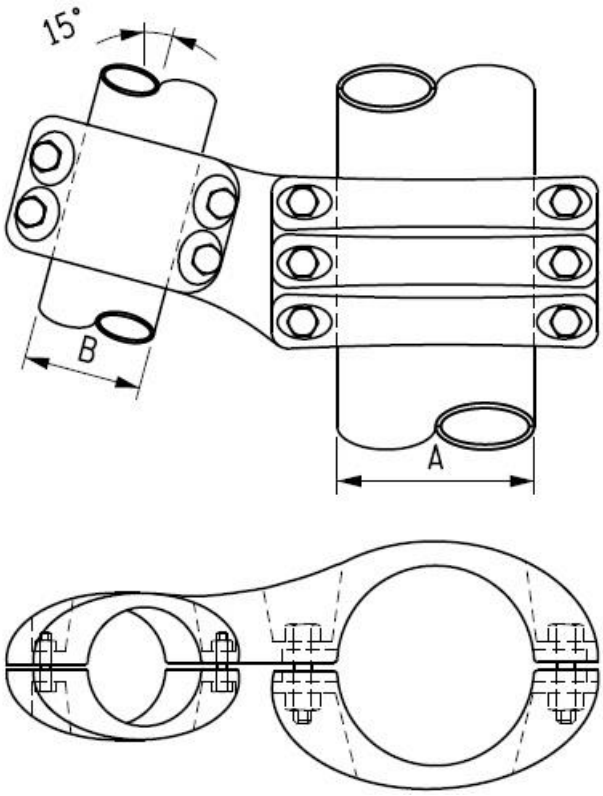

Figure A.14: ESC-V-TT 15: Support Clamp – Vertical – Tube-to-Tube – 15^{O} Tap-off (D-DT-6352)

Table A.14: Type ESC-V-TT 15

Type	Tube diameter (mm)		Minimum Rated Current @ 90 ^{O}C (A rms)	Maximum Voltage [Um] (kV rms)	1s Fault Current Withstand Rating for the [kA rms]	
	"A"	"B"			Complete installation as per Annex C	Clamp on its own
ESC-V-TT 15-A	200	120	3150	800	50	18.5
ESC-V-TT 15-B	250	120	3150	420	63	20

Note 1: All clamps with a specified Um > 420kV shall be corona free on their own up to and including at 420kV, and up to the specified voltage with the aid of a corona ring.

Note 2: Considering this clamp's application as busbar support it can be tested on its own or as intended to be used. Refer to Annex C for a proposed test setup for as intended to be used.

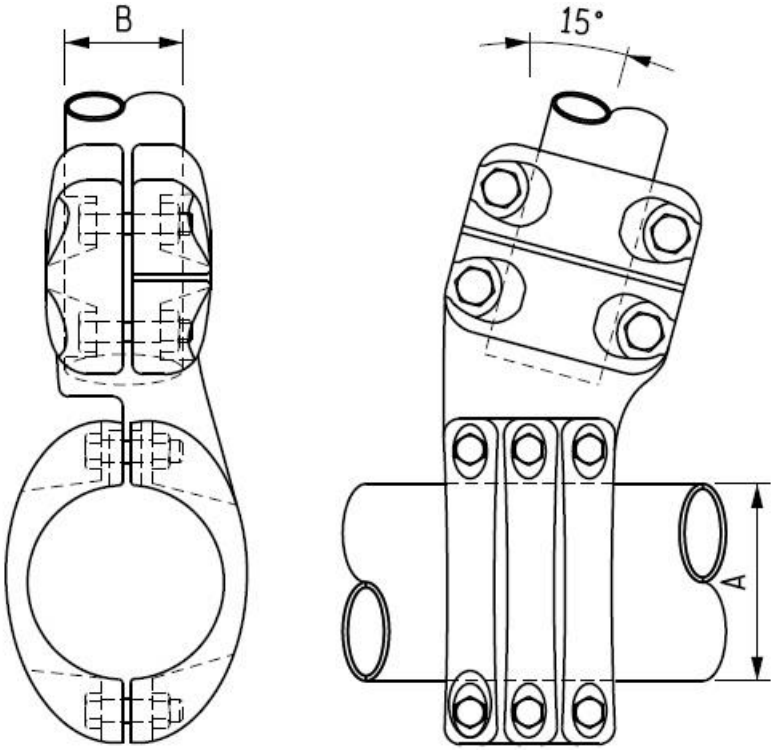

Figure A.15: ESC-H-TT 15: Busbar Support Clamp – Horizontal - Tube-to-Tube – 15^{O} Tap-off (D-DT-6353)

Table A.15: Type ESC-H-TT 15

Type	Tube diameter (mm)		Minimum Rated Current @ 90 ^{O}C (A rms)	Maximum Voltage [Um] (kV rms)	1s Fault Current Withstand Rating for the [kA rms]	
	"A"	"B"			Complete installation as per Annex C	Clamp on its own
ESC-H-TT 15-A	200	120	3150	800	50	18.5
ESC-H-TT 15-B	250	120	3150	420	63	20

Note 1: All clamps with a specified Um > 420kV shall be corona free on their own up to and including at 420kV, and up to the specified voltage with the aid of a corona ring.

Note 2: Considering this clamp's application as busbar support it can be tested on its own or as intended to be used. Refer to Annex C for a proposed test setup for as intended to be used.

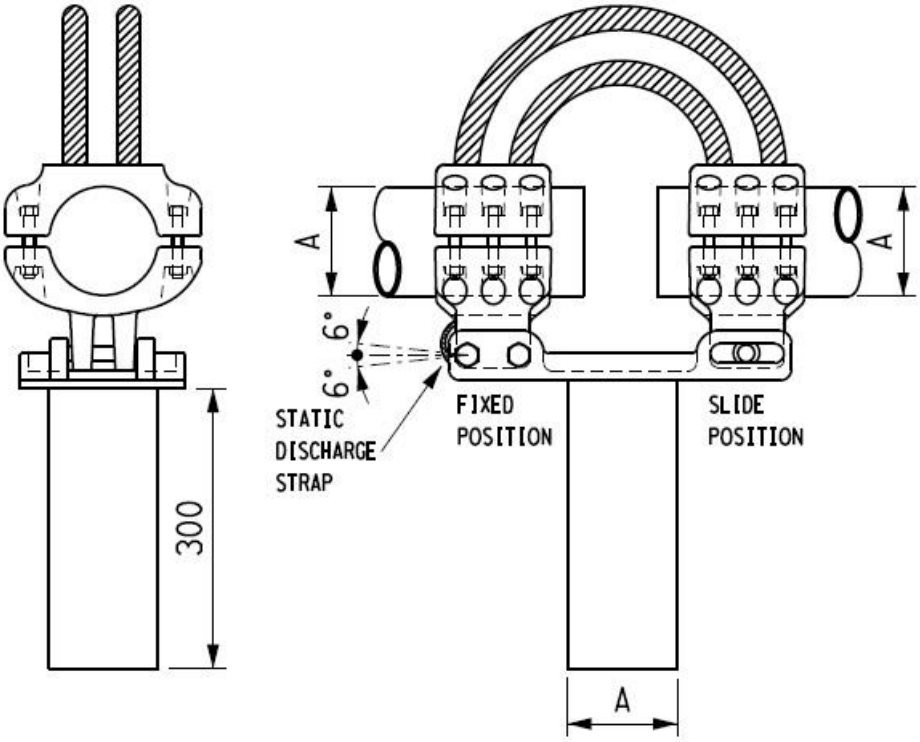

Figure A.16: EEC-TB-FS: Expansion Clamp – Tube Mounted – Fixed/Slide

Table A.16: Type EEC-TB-FS

Type	Tube diameter "A" (mm)	Tubular base length (mm)	Minimum Rated Current @ 90 ^{O}C (A rms)	Maximum Voltage [Um] (kV rms)	1s Fault Current Withstand Rating [kA rms]
EEC-TB-FS-A	80	300	2000	145	40
EEC-TB-FS-B	100	300	2500	145	40
EEC-TB-FS-C	120	300	3150	145	40
EEC-TB-FS-D	150	300	3150	145	40
EEC-TB-FS-E	160	300	3150	145	40
EEC-TB-FS-F	200	300	4000	800	50
EEC-TB-FS-G	250	300	4000	420	63
Note: All clamps with a specified Um > 420kV shall be corona free on their own up to and including at 420kV, and up to the specified voltage with the aid of a corona ring.					

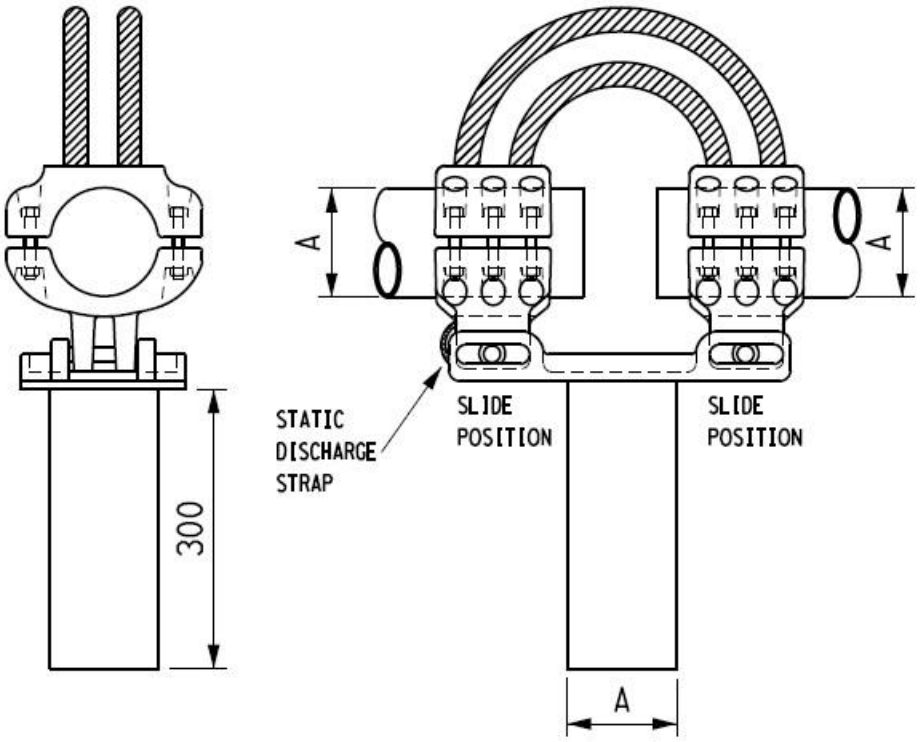

Figure A.17: EEC-TB-SS: Expansion Clamp – Tube Mounted – Slide/Slide

Table A.17: Type EEC-TB-SS

Type	Tube diameter "A" (mm)	Tubular base length (mm)	Minimum Rated Current @ 90 ^{O}C (A rms)	Maximum Voltage [Um] (kV rms)	1s Fault Current Withstand Rating [kA rms]
EEC-TB-SS-A	80	300	2000	145	40
EEC-TB-SS-B	100	300	2500	145	40
EEC-TB-SS-C	120	300	3150	145	40
EEC-TB-SS-D	150	300	3150	145	40
EEC-TB-SS-E	160	300	3150	145	40
EEC-TB-SS-F	200	300	4000	800	50
EEC-TB-SS-G	250	300	4000	420	63
Note: All clamps with a specified Um > 420kV shall be corona free on their own up to and including at 420kV, and up to the specified voltage with the aid of a corona ring.					

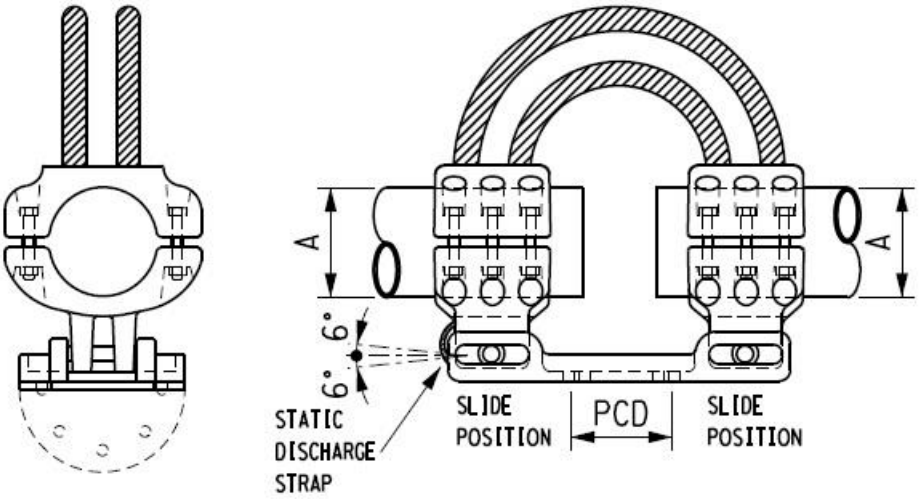

Figure A.18: EEC-PI-SS: Expansion Clamp – Post Insulator Mounted – Slide/Slide (D-DT-6093)

Table A.18: Type EEC-PI-SS

Type	Tube diameter "A" (mm)	PCD (mm)	Minimum Rated Current @ 90 °C (A rms)	Maximum Voltage [Um] (kV rms)	1s Fault Current Withstand Rating [kA rms]
EEC-PI-SS-A	80	76	2000	36	31.5
EEC-PI-SS-B	80	127	2000	145	40
EEC-PI-SS-C	100	76	2500	36	31.5
EEC-PI-SS-D	100	127	2500	145	40
EEC-PI-SS-E	120	76	3150	36	31.5
EEC-PI-SS-F	120	127	3150	145	40
EEC-PI-SS-G	150	76	3150	36	31.5
EEC-PI-SS-H	150	127	3150	145	40
EEC-PI-SS-J	150	225	3150	145	40
EEC-PI-SS-K	160	76	3150	36	31.5
EEC-PI-SS-L	160	127	3150	145	40
EEC-PI-SS-M	160	225	3150	145	40
EEC-PI-SS-N	200	76	4000	36	31.5
EEC-PI-SS-P	200	127	4000	420	63
EEC-PI-SS-Q	200	225	4000	800	50
EEC-PI-SS-R	250	225	4000	420	63
Note: All clamps with a specified Um > 420kV shall be corona free on their own up to and including at 420kV, and up to the specified voltage with the aid of a corona ring.					

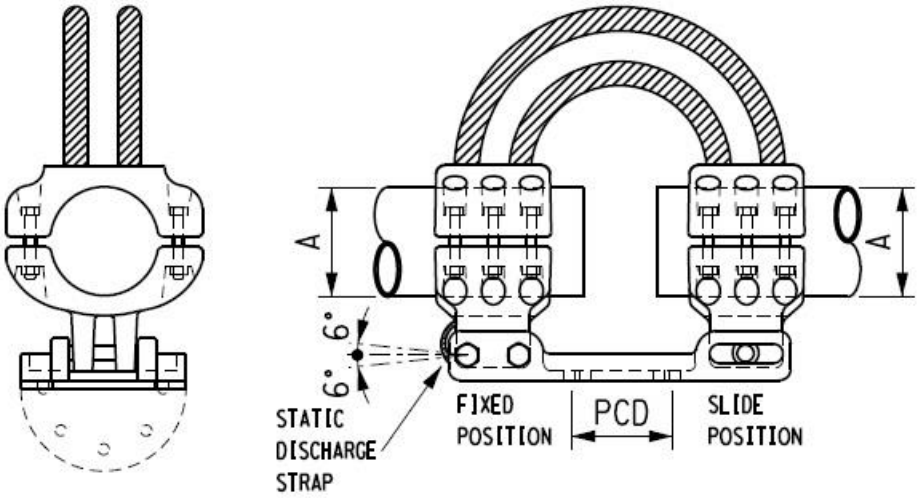

Figure A.19: EEC-PI-FS: Expansion Clamp – Post Insulator Mounted – Fixed/Slide (D-DT-6093)

Table A.19: Type EEC-PI-FS

Type	Tube diameter "A" (mm)	PCD (mm)	Minimum Rated Current @ 90 °C (A rms)	Maximum Voltage [Um] (kV rms)	1s Fault Current Withstand Rating [kA rms]
EEC-PI-FS-A	80	76	2000	36	31.5
EEC-PI-FS-B	80	127	2000	145	40
EEC-PI-FS-C	100	76	2500	36	31.5
EEC-PI-FS-D	100	127	2500	145	40
EEC-PI-FS-E	120	76	3150	36	31.5
EEC-PI-FS-F	120	127	3150	145	40
EEC-PI-FS-G	150	76	3150	36	31.5
EEC-PI-FS-H	150	127	3150	145	40
EEC-PI-FS-J	150	225	3150	145	40
EEC-PI-FS-K	160	76	3150	36	31.5
EEC-PI-FS-L	160	127	3150	145	40
EEC-PI-FS-M	160	225	3150	145	40
EEC-PI-FS-N	200	76	4000	36	31.5
EEC-PI-FS-P	200	127	4000	420	63
EEC-PI-FS-Q	200	225	4000	800	50
EEC-PI-FS-R	250	225	4000	420	63
Note: All clamps with a specified Um > 420kV shall be corona free on their own up to and including at 420kV, and up to the specified voltage with the aid of a corona ring.					

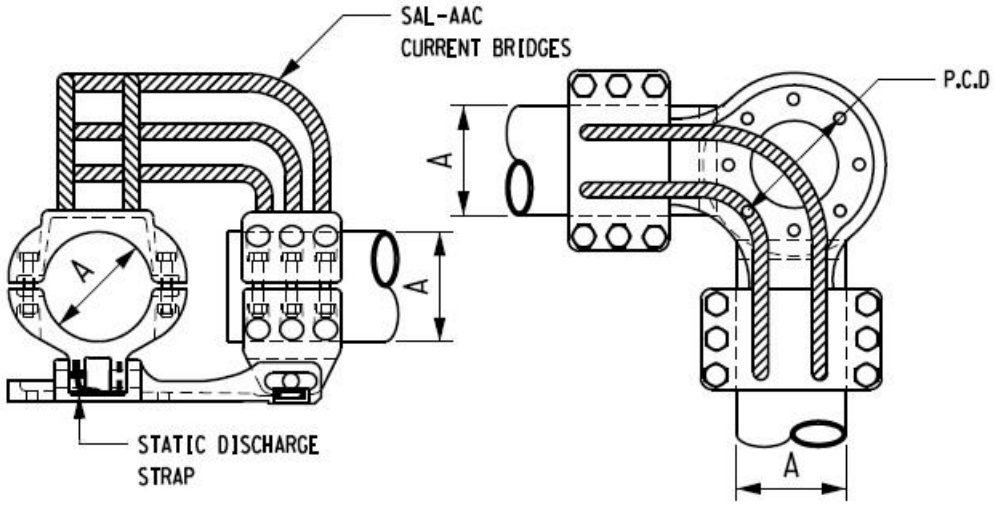

Figure A.20: EEC-PI-SS 90: Expansion Clamp – 90^{O} – Post Insulator Mounted – Slide/Slide

Table A.20: Type EEC-PI-SS 90

Type	Tube diameter "A" (mm)	PCD (mm)	Minimum Rated Current @ 90 ^{O}C (A rms)	Maximum Voltage [Um] (kV rms)	1s Fault Current Withstand Rating [kA rms]
EEC-PI-SS 90-A	80	76	2000	36	31.5
EEC-PI-SS 90-B	80	127	2000	145	40
EEC-PI-SS 90-C	100	76	2500	36	31.5
EEC-PI-SS 90-D	100	127	2500	145	40
EEC-PI-SS 90-E	120	76	3150	36	31.5
EEC-PI-SS 90-F	120	127	3150	145	40
EEC-PI-SS 90-G	150	76	3150	36	31.5
EEC-PI-SS 90-H	150	127	3150	145	40
EEC-PI-SS 90-J	150	225	3150	145	40
EEC-PI-SS 90-K	160	76	3150	36	31.5
EEC-PI-SS 90-L	160	127	3150	145	40
EEC-PI-SS 90-M	160	225	3150	145	40
EEC-PI-SS 90-N	200	76	4000	36	31.5
EEC-PI-SS 90-P	200	127	4000	420	63
EEC-PI-SS 90-Q	200	225	4000	800	50
EEC-PI-SS 90-R	250	225	4000	420	63
Note: All clamps with a specified Um > 420kV shall be corona free on their own up to and including at 420kV, and up to the specified voltage with the aid of a corona ring.					

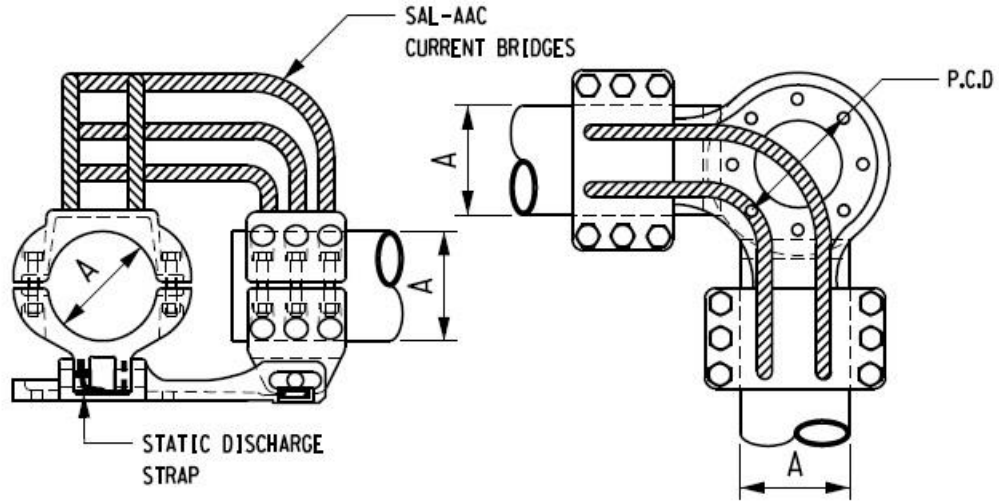

Figure A.21: EEC-PI-FS 90: Expansion Clamp – 90^{O} – Tube Connection – Post Insulator Mounted – Fixed/Slide

Table A.21: Type EEC-PI-FS 90

Type	Tube diameter "A" (mm)	PCD (mm)	Minimum Rated Current @ 90 ^{O}C (A rms)	Maximum Voltage [Um] (kV rms)	1s Fault Current Withstand Rating [kA rms]
EEC-PI-FS 90-A	80	76	2000	36	31.5
EEC-PI-FS 90-B	80	127	2000	145	40
EEC-PI-FS 90-C	100	76	2500	36	31.5
EEC-PI-FS 90-D	100	127	2500	145	40
EEC-PI-FS 90-E	120	76	3150	36	31.5
EEC-PI-FS 90-F	120	127	3150	145	40
EEC-PI-FS 90-G	150	76	3150	36	31.5
EEC-PI-FS 90-H	150	127	3150	145	40
EEC-PI-FS 90-J	150	225	3150	145	40
EEC-PI-FS 90-K	160	76	3150	36	31.5
EEC-PI-FS 90-L	160	127	3150	145	40
EEC-PI-FS 90-M	160	225	3150	145	40
EEC-PI-FS 90-N	200	76	4000	36	31.5
EEC-PI-FS 90-P	200	127	4000	420	63
EEC-PI-FS 90-Q	200	225	4000	800	50
EEC-PI-FS 90-R	250	225	4000	420	63
Note: All clamps with a specified Um > 420kV shall be corona free on their own up to and including at 420kV, and up to the specified voltage with the aid of a corona ring.					

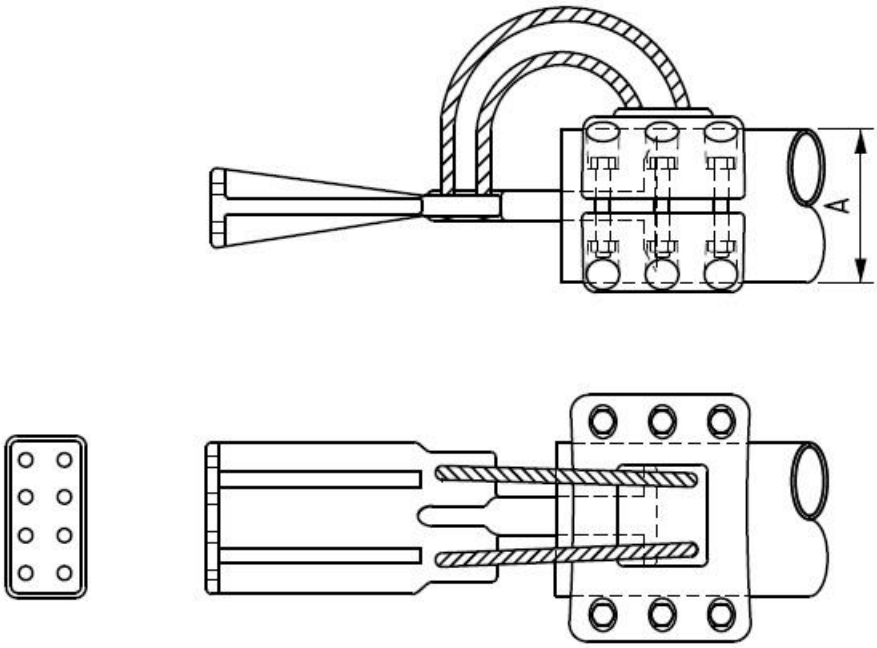

Figure A.22: EEC-I-8HV-S: Expansion Clamp – Inline – 8-Hole Vertical Pad – Equipment Mounted – Slide

Table A.22: Type EEC-I-8HV-S

Type	Tube diameter "A" (mm)	Minimum Rated Current @ 90 ^{O}C (A rms)	Maximum Voltage [Um] (kV rms)	1s Fault Current Withstand Rating [kA rms]
EEC-IL-8HV-S-A	200	4000	800	50
EEC-IL-8HV-S-B	250	4000	420	63
Note: All clamps with a specified Um > 420kV shall be corona free on their own up to and including at 420kV, and up to the specified voltage with the aid of a corona ring.				

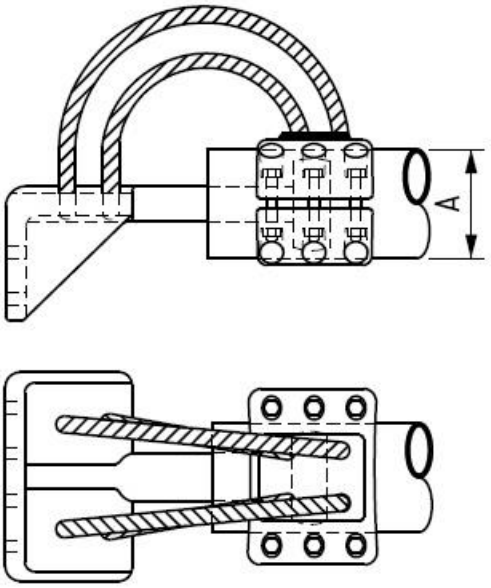

Figure A.23: EEC-8HV-S: Expansion Clamp - 8-Hole Vertical Pad – Equipment Mounted – Slide (D-DT-6354)

Table A.23: Type EEC-8HV-S

Type	Tube diameter "A" (mm)	Minimum Rated Current @ 90 ^{O}C (A rms)	Maximum Voltage [Um] (kV rms)	1s Fault Current Withstand Rating [kA rms]
EEC-8HV-S-A	150	3150	300	40
EEC-8HV-S-B	160	3150	300	50
EEC-8HV-S-C	200	4000	800	50
EEC-8HV-S-D	250	4000	420	63
Note: All clamps with a specified Um > 420kV shall be corona free on their own up to and including at 420kV, and up to the specified voltage with the aid of a corona ring.				

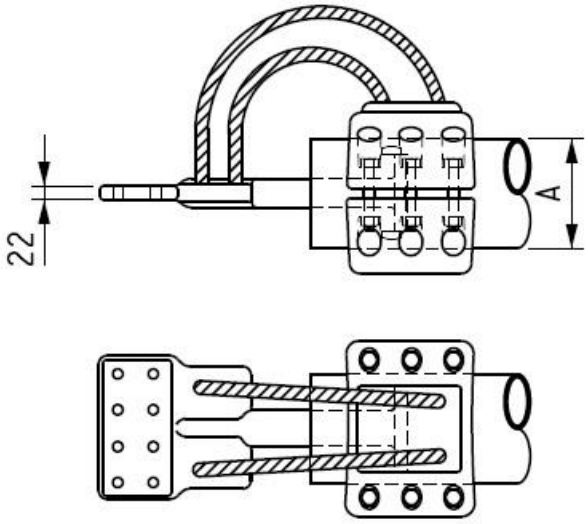

Figure A.24: EEC-8HH-S: Expansion Clamp – 8-Hole Horizontal Pad – Equipment Mounted – Sliding

Table A.24: Type EEC-8HH-S

Type	Tube diameter "A" (mm)	Minimum Rated Current @ 90 ^{O}C (A rms)	Maximum Voltage [Um] (kV rms)	1s Fault Current Withstand Rating [kA rms]
EEC-8HH-S-A	150	3150	300	40
EEC-8HH-S-B	160	3150	300	50
EEC-8HH-S-C	200	4000	800	50
EEC-8HH-S-D	250	4000	420	63
Note: All clamps with a specified Um > 420kV shall be corona free on their own up to and including at 420kV, and up to the specified voltage with the aid of a corona ring.				

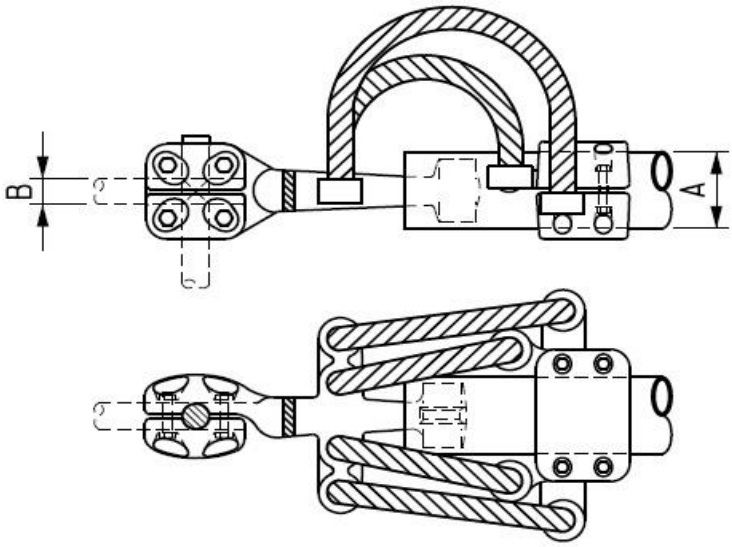

Figure A.25: EEC-H/VS-TB: Expansion Clamp – Horizontal/Vertical Stem – Tube Connection – Equipment Mounted (D-DT-6317)

Table A.25: Type EEC-H/VS-TB

Type	Tube diameter "A" (mm)	Stem diameter "B" (mm)	Minimum Rated Current @ 90 ^{O}C (A rms)	Maximum Voltage [Um] (kV rms)	1s Fault Current Withstand Rating [kA rms]
EEC-H/VS-TB-A	80	26	900	145	40
EEC-H/VS-TB-B	80	38	1350	145	40
EEC-H/VS-TB-C	80	60	2000	145	40
EEC-H/VS-TB-D	100	26	900	145	40
EEC-H/VS-TB-E	100	38	1350	145	40
EEC-H/VS-TB-F	100	60	2500	145	40
EEC-H/VS-TB-G	120	26	900	145	40
EEC-H/VS-TB-H	120	38	1350	145	40
EEC-H/VS-TB-J	120	60	2500	145	40

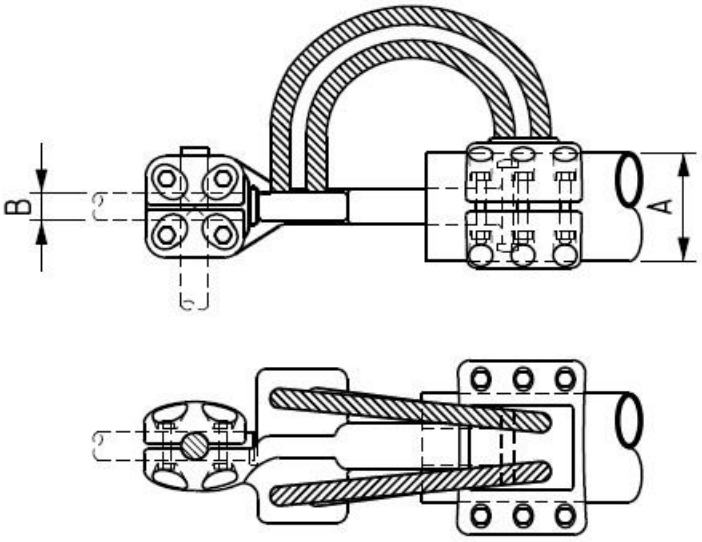

Figure A.26: EEC-H/VS-TB: Expansion Clamp – Horizontal/Vertical Stem – Tube Connection – Equipment Mounted

Table A.26: Type EEC-H/VS-TB

Type	Tube diameter "A" (mm)	Stem diameter "B" (mm)	Minimum Rated Current @ 90 ^{O}C (A rms)	Maximum Voltage [Um] (kV rms)	1s Fault Current Withstand Rating [kA rms]
EEC-H/VS-TB-K	150	38	2500	145	40
EEC-H/VS-TB-L	150	60	3150	145	40
EEC-H/VS-TB-M	160	38	2500	145	40
EEC-H/VS-TB-N	160	60	3150	145	40
EEC-H/VS-TB-P	200	38	2500	420	63
EEC-H/VS-TB-Q	200	60	3150	420	63
EEC-H/VS-TB-R	250	38	2500	420	63
EEC-H/VS-TB-S	250	60	3150	420	63
Note: All clamps with a specified Um > 420kV shall be corona free on their own up to and including at 420kV, and up to the specified voltage with the aid of a corona ring.					

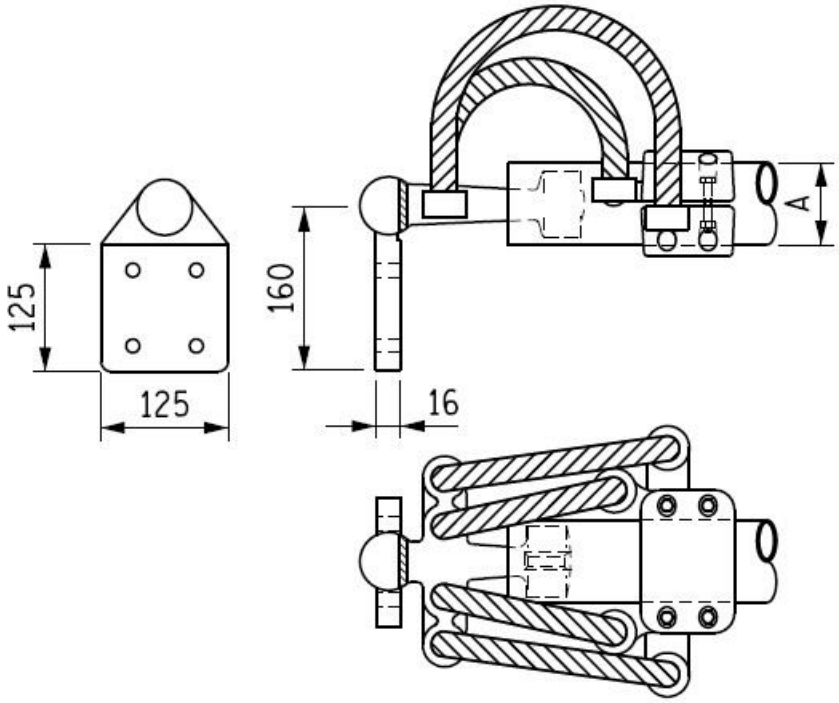

Figure A.27: EEC-4HV: Expansion Clamp – 4-Hole Vertical Pad – Equipment Mounted (D-DT-6355)

Table A.27: Type EEC-4HV

Type	Tube diameter "A" (mm)	Minimum Rated Current @ 90 ^{O}C (A rms)	Maximum Voltage [Um] (kV rms)	1s Fault Current Withstand Rating [kA rms]
EEC-4HV-A	80	2000	145	40
EEC-4HV-B	100	2500	145	40
EEC-4HV-C	120	3150	145	40

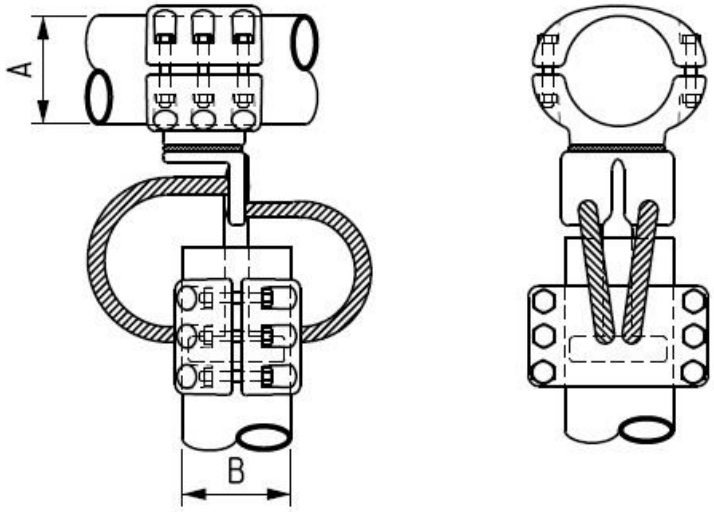

Figure A.28: EEC-T-S: Expansion Clamp – Tee-Off – Slide (D-DT-6363)

Table A.28: Type EEC-T-S

Type	Tube diameter (mm)		Minimum Rated Current @ 90 ^{O}C (A rms)	Maximum Voltage [Um] (kV rms)	1s Fault Current Withstand Rating [kA rms]
	"A"	"B"			
EEC-T-S-A	200	200	4000	800	50
EEC-T-S-B	250	250	4000	420	63
Note: All clamps with a specified Um > 420kV shall be corona free on their own up to and including at 420kV, and up to the specified voltage with the aid of a corona ring.					

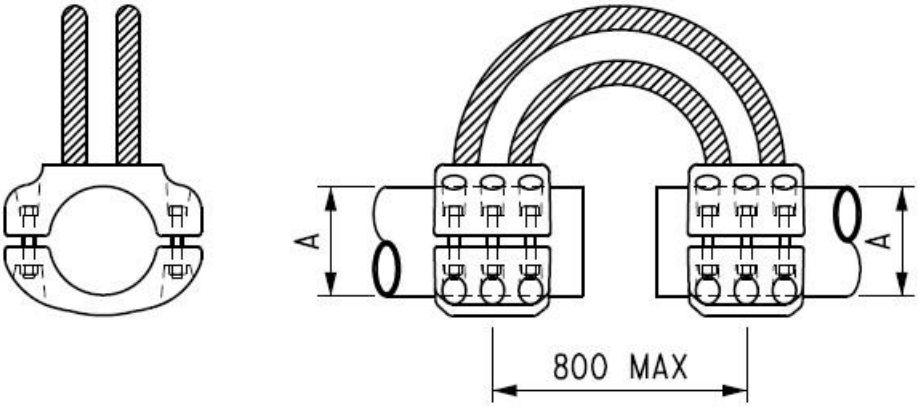

Figure A.29: ECB-TT: Current Bridge – Tube-to-Tube

Table A.29: Type ECB-TT

Type	Tube diameter "A" (mm)	Minimum Rated Current @ 90 ^{O}C (A rms)	Maximum Voltage [Um] (kV rms)	1s Fault Current Withstand Rating [kA rms]
ECB-TT-A	80	2000	145	40
ECB-TT-B	100	2500	145	40
ECB-TT-C	120	3150	145	40
ECB-TT-D	150	3150	145	40
ECB-TT-E	160	3150	145	40
ECB-TT-F	200	4000	800	50
ECB-TT-G	250	4000	420	63
Note: All clamps with a specified Um > 420kV shall be corona free on their own up to and including at 420kV, and up to the specified voltage with the aid of a corona ring.				

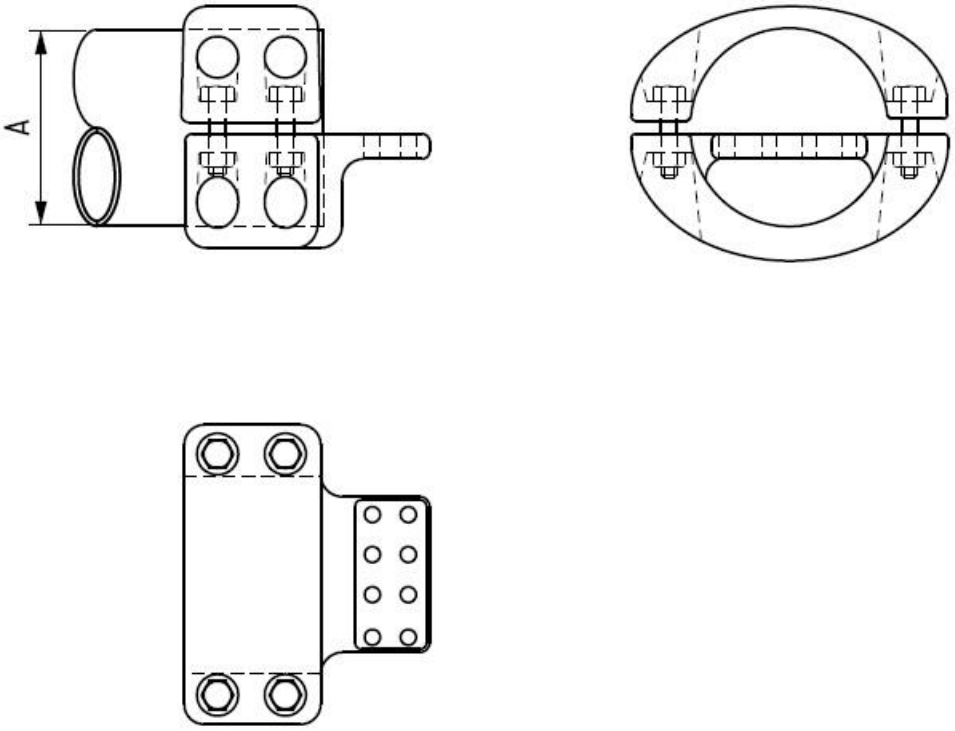

Figure A.30: ECC-8HH: Coupling Clamp – 8-Hole Horizontal Palm – Equipment Mounted

Table A.30: Type ECC-8HH

Type	Tube diameter "A" (mm)	Minimum Rated Current @ 90 ^{O}C (A rms)	Maximum Voltage [Um] (kV rms)	1s Fault Current Withstand Rating [kA rms]
ECC-8HH-A	150	3150	145	40
ECC-8HH-B	160	3150	145	40
ECC-8HH-C	200	4000	800	50
ECC-8HH-D	250	4000	420	63
ECC-8HH-E	120	3150	145	40
Note: All clamps with a specified Um > 420kV shall be corona free on their own up to and including at 420kV, and up to the specified voltage with the aid of a corona ring.				

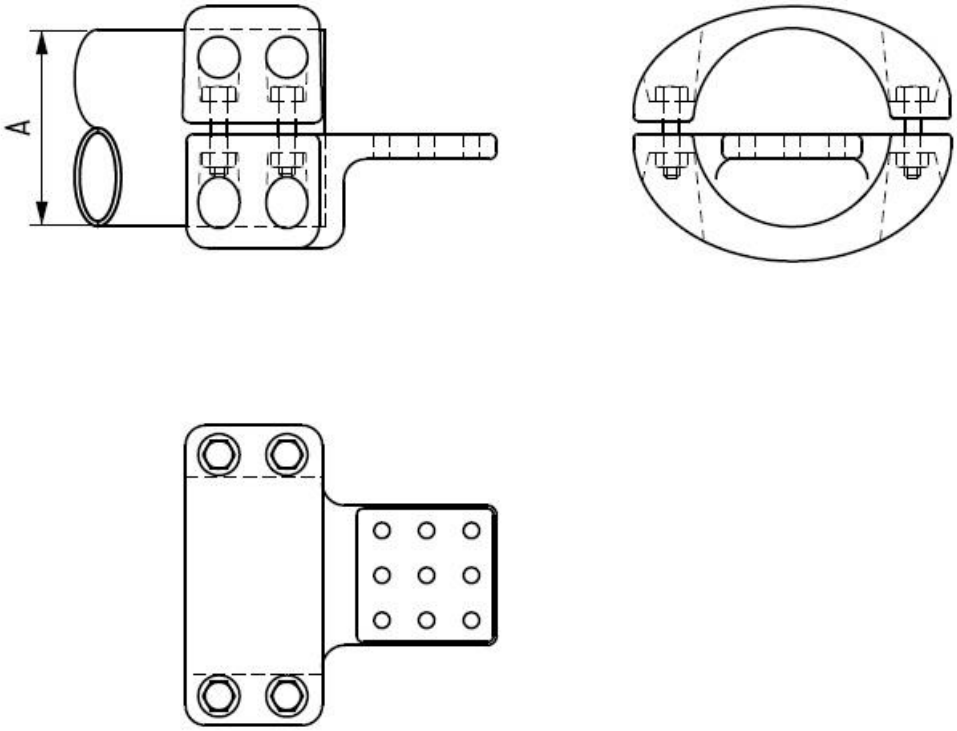

Figure A.31: ECC-9HH: Coupling Clamp –9-Hole Horizontal Palm – Equipment Mounted

Table A.31: Type ECC-9HH

Type	Tube diameter "A" (mm)	Minimum Rated Current @ 90 ^{O}C (A rms)	Maximum Voltage [Um] (kV rms)	1s Fault Current Withstand Rating [kA rms]
ECC-9HH-A	200	4000	800	50
ECC-9HH-B	250	4000	420	63
Note: All clamps with a specified Um > 420kV shall be corona free on their own up to and including at 420kV, and up to the specified voltage with the aid of a corona ring.				

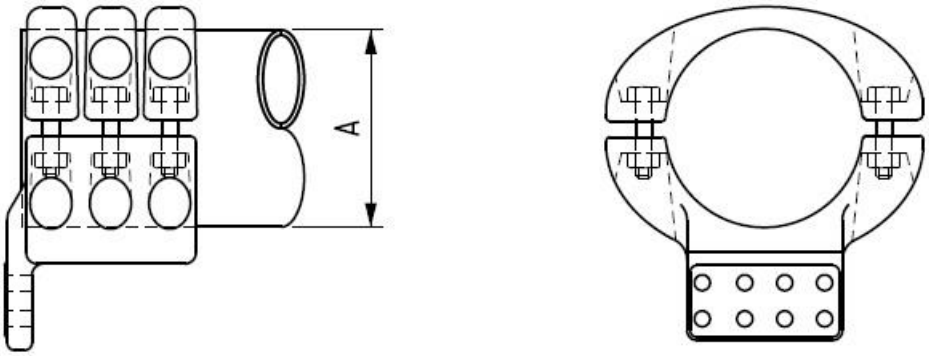

Figure A.32: ECC-8HV: Coupling Clamp – 8-Hole Vertical Palm – Equipment Mounted

Table A.32: Type ECC-8HV

Type	Tube diameter "A" (mm)	Minimum Rated Current @ 90 ^{O}C (A rms)	Maximum Voltage [Um] (kV rms)	1s Fault Current Withstand Rating [kA rms]
ECC-8HV-A	150	3150	145	40
ECC-8HV-B	160	3150	145	40
ECC-8HV-C	200	4000	800	50
ECC-8HV-D	250	4000	420	63
Note: All clamps with a specified Um > 420kV shall be corona free on their own up to and including at 420kV, and up to the specified voltage with the aid of a corona ring.				

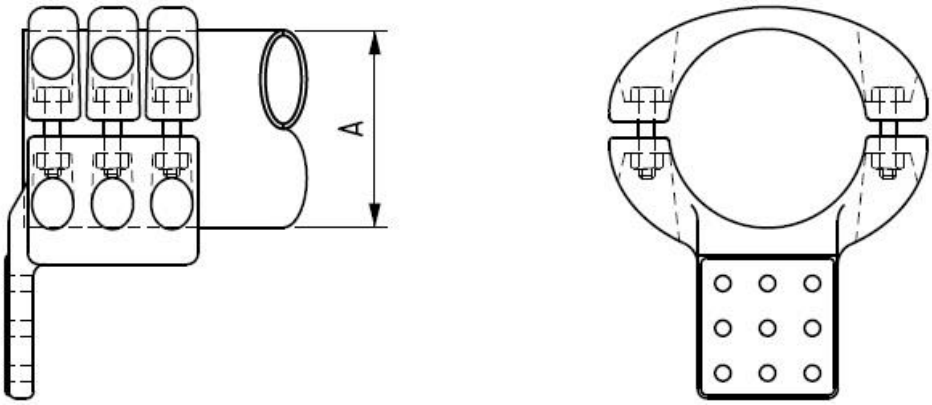

Figure A.33: ECC-9HV: Coupling Clamp –9-Hole Vertical Palm – Equipment Mounted

Table A.33: Type ECC-9HV

Type	Tube diameter "A" (mm)	Minimum Rated Current @ 90 ^{O}C (A rms)	Maximum Voltage [Um] (kV rms)	1s Fault Current Withstand Rating [kA rms]
ECC-9HV-A	150	3150	300	40
ECC-9HV-B	160	3150	300	50
ECC-9HV-C	200	4000	800	50
ECC-9HV-D	250	4000	420	63
Note: All clamps with a specified Um > 420kV shall be corona free on their own up to and including at 420kV, and up to the specified voltage with the aid of a corona ring.				

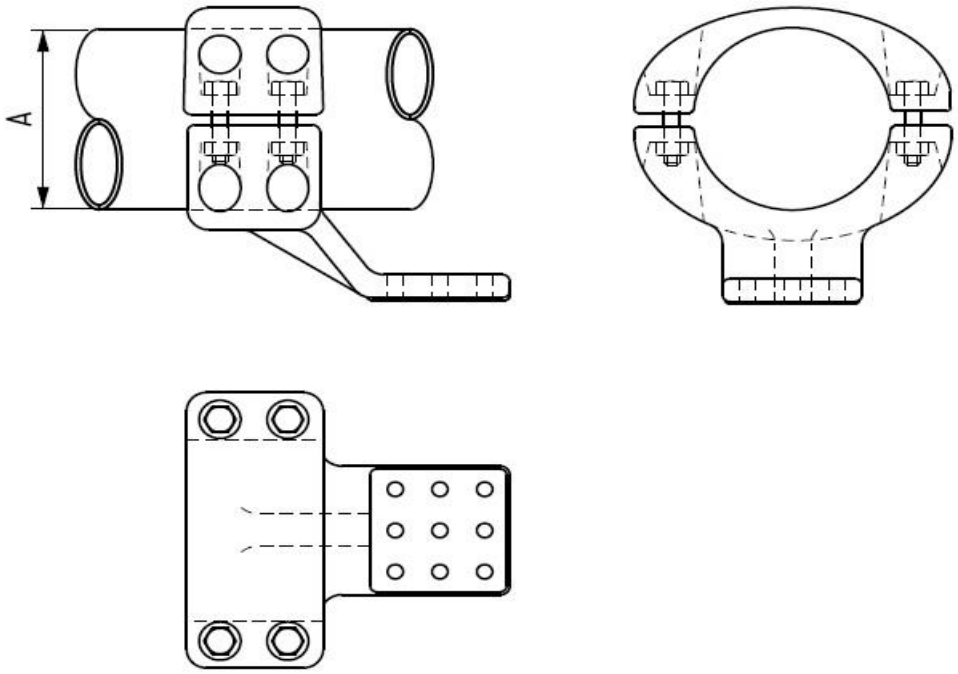

Figure A.34: ECC-9HH-EE: Coupling Clamp – 9-Hole Horizontal Palm – Elevated Equipment Mounted

Table A.34: Type ECC-9HH-EE

Type	Tube diameter "A" (mm)	Minimum Rated Current @ 90 ^{O}C (A rms)	Maximum Voltage [Um] (kV rms)	1s Fault Current Withstand Rating [kA rms]
ECC-9HH-EE-A	200	4000	800	50
ECC-9HH-EE-B	250	4000	420	63
Note: All clamps with a specified Um > 420kV shall be corona free on their own up to and including at 420kV, and up to the specified voltage with the aid of a corona ring.				

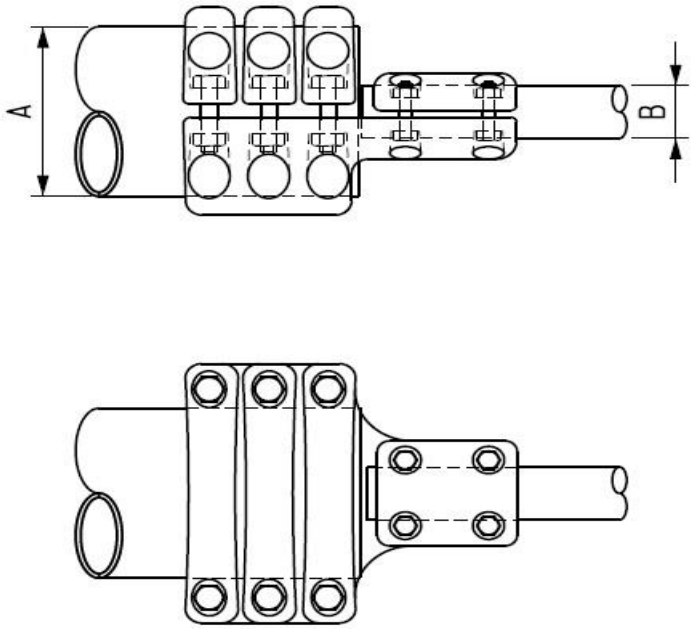

Figure A.35: ECC-IL-ST: Coupling Clamp – Inline – Stem – Equipment Mounted (D-DT-6037)

Table A.35: Type ECC-IL-ST

Type	Tube diameter "A" (mm)	Stem diameter "B" (mm)	Minimum Rated Current @ 90 °C (A rms)	Maximum Voltage [Um] (kV rms)	1s Fault Current Withstand Rating [kA rms]
ECC-IL-ST-A	80	26	900	145	40
ECC-IL-ST-B	80	38	1350	145	40
ECC-IL-ST-C	100	26	900	145	40
ECC-IL-ST-D	100	38	1350	145	40
ECC-IL-ST-E	120	26	900	145	40
ECC-IL-ST-F	120	38	1350	145	40
ECC-IL-ST-G	120	60	3150	145	40
ECC-IL-ST-H	150	60	3150	145	40
ECC-IL-ST-J	160	60	3150	145	40
ECC-IL-ST-K	200	60	3150	420	63
ECC-IL-ST-L	250	60	3150	420	63
Note: All clamps with a specified Um > 420kV shall be corona free on their own up to and including at 420kV, and up to the specified voltage with the aid of a corona ring.					

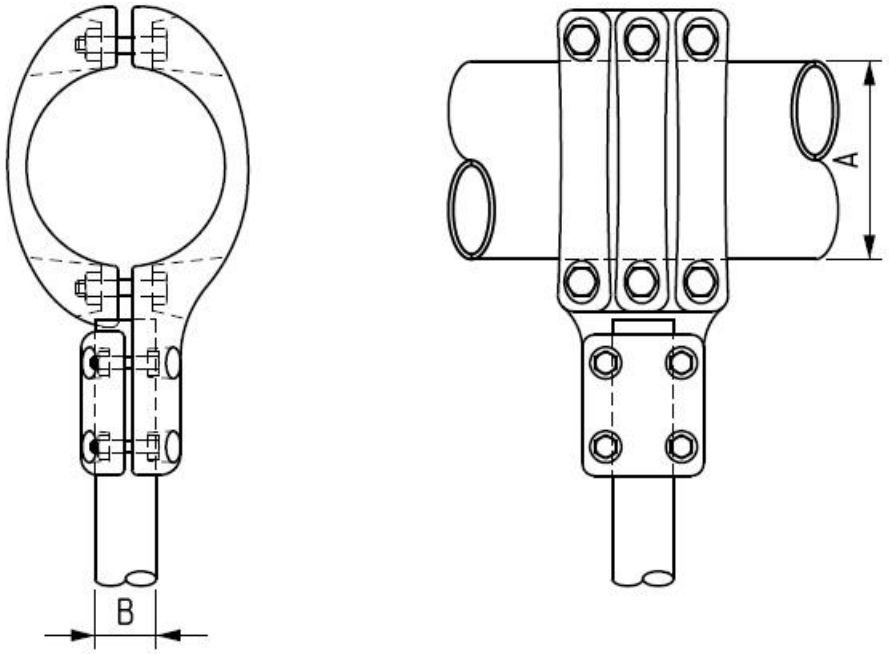

Figure A.36: ECC-T-ST: Coupling Clamp – Tee Connection – Stem – Equipment Mounted (D-DT-6035)

Table A.36: Type ECC-T-ST:

Type	Tube diameter "A" (mm)	Stem diameter "B" (mm)	Minimum Rated Current @ 90 ^{O}C (A rms)	Maximum Voltage [Um] (kV rms)	1s Fault Current Withstand Rating [kA rms]
ECC-T-ST-A	80	26	900	145	40
ECC-T-ST-B	80	38	1350	145	40
ECC-T-ST-C	100	26	900	145	40
ECC-T-ST-D	100	38	1350	145	40
ECC-T-ST-E	120	26	900	145	40
ECC-T-ST-F	120	38	1350	145	40

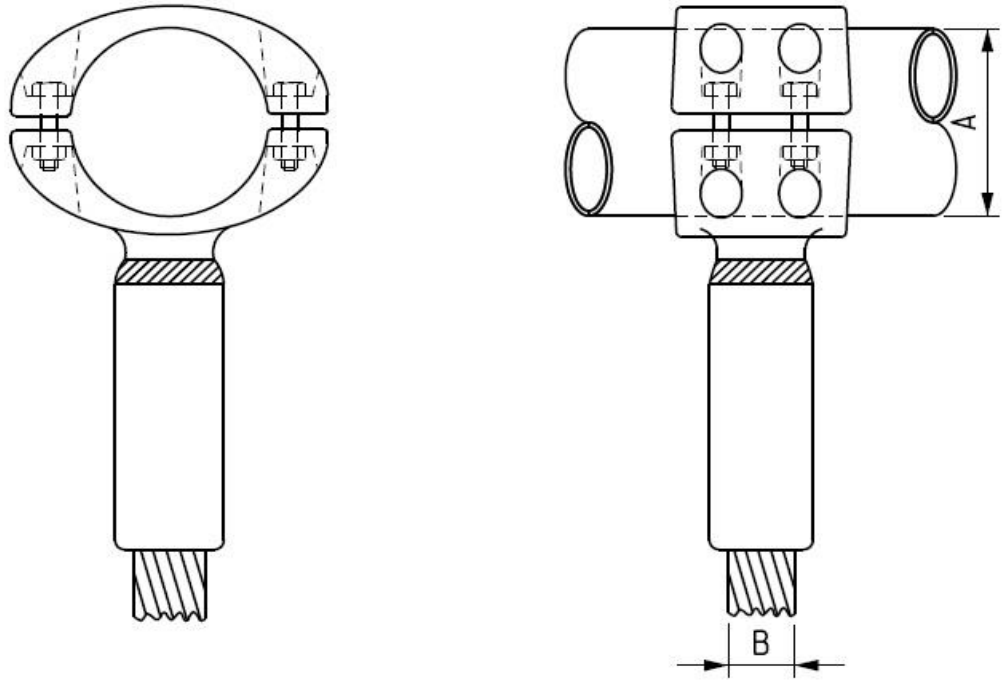

Figure A.37: ETP-IL 1: Clamp – Tap-off – Inline – Single Conductor (D-DT-6119)

Table A.37: Type ETP-IL 1

Type	Tube diameter "A" (mm)	Conductor diameter "B" (mm)	Minimum Rated Current @ 90 ^{O}C (A rms)	Maximum Voltage [Um] (kV rms)	1s Fault Current Withstand Rating [kA rms]
ETP-IL 1-A	80	1x16	450	145	40
ETP-IL 1-B	80	1x26	900	145	40
ETP-IL 1-C	80	1x38.3	1350	145	40
ETP-IL 1-D	100	1x16	450	145	40
ETP-IL 1-E	100	1x26.5	900	145	40
ETP-IL 1-F	100	1x38.3	1350	145	40
ETP-IL 1-G	120	1x16	450	145	40
ETP-IL 1-H	120	1x26.5	900	145	40
ETP-IL 1-J	120	1x38.3	1350	145	40
ETP-IL 1-K	150	1x38.3	1350	145	40
ETP-IL 1-L	160	1x38.3	1350	145	40
ETP-IL 1-M	200	1x38.3	1350	300	50
ETP-IL 1-N	250	1x38.3	1350	300	50

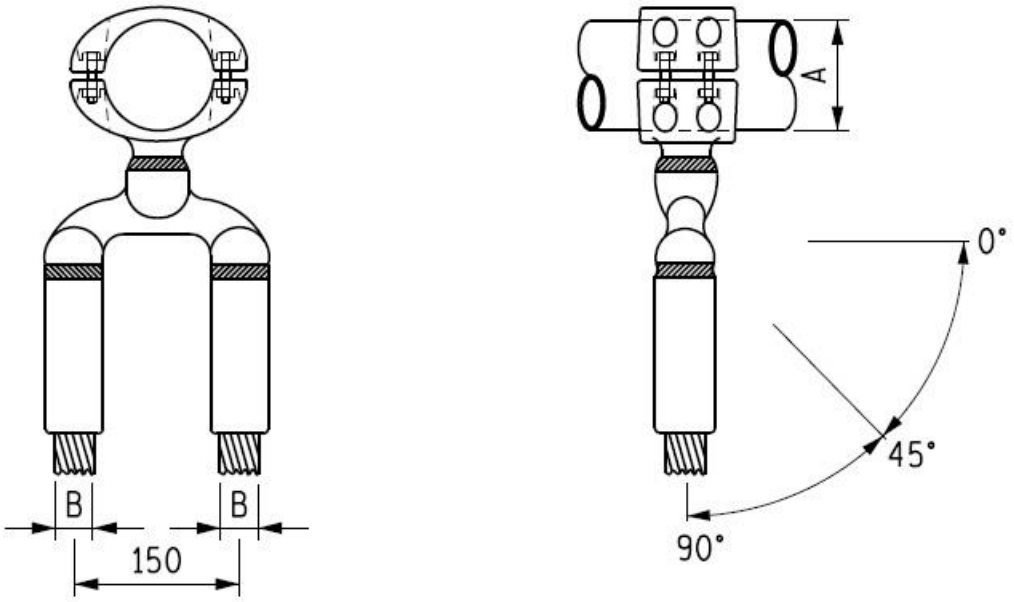

Figure A.38: ETP-IL 2: Clamp – Tap-off – Inline – Two Conductors (D-DT-6119)

Table A.38: Type ETP-IL 2

Type	Tube diameter "A" (mm)	Conductor diameter "B" (mm)	Conductor spacing (mm)	Angle (degrees)	Minimum Rated Current @ 90 °C (A)	Maximum Voltage [Um] (kV rms)	1s Fault Current Withstand Rating [kA rms]
ETP-IL 2-A	80	2x26.5	150	0°	1700	145	40
ETP-IL 2-B	80	2x26.5	150	45°	1700	145	40
ETP-IL 2-C	80	2x26.5	150	90°	1700	145	40
ETP-IL 2-D	80	2x38.3	150	0°	2000	145	40
ETP-IL 2-E	80	2x38.3	150	45°	2000	145	40
ETP-IL 2-F	80	2x38.3	150	90°	2000	145	40
ETP-IL 2-G	100	2x26.5	150	0°	1700	145	40
ETP-IL 2-H	100	2x26.5	150	45°	1700	145	40
ETP-IL 2-J	100	2x26.5	150	90°	1700	145	40
ETP-IL 2-K	100	2x38.3	150	0°	2500	145	40
ETP-IL 2-L	100	2x38.3	150	45°	2500	145	40
ETP-IL 2-M	100	2x38.3	150	90°	2500	145	40
ETP-IL 2-N	120	2x26.5	150	0°	1700	145	40
ETP-IL 2-P	120	2x26.5	150	45°	1700	145	40
ETP-IL 2-Q	120	2x26.5	150	90°	1700	145	40
ETP-IL 2-R	120	2x38.3	150	0°	2700	145	40
ETP-IL 2-S	120	2x38.3	150	45°	2700	145	40
ETP-IL 2-T	120	2x38.3	150	90°	2700	145	40
ETP-IL 2-U	150	2x38.3	150	0°	2700	145	40

Type	Tube diameter "A" (mm)	Conductor diameter "B" (mm)	Conductor spacing (mm)	Angle (degrees)	Minimum Rated Current @ 90 °C (A)	Maximum Voltage [Um] (kV rms)	1s Fault Current Withstand Rating [kA rms]
ETP-IL 2-V	150	2x38.3	150	45°	2700	145	40
ETP-IL 2-W	150	2x38.3	150	90°	2700	145	40
ETP-IL 2-X	160	2x38.3	150	0°	2700	145	40
ETP-IL 2-Y	160	2x38.3	150	45°	2700	145	40
ETP-IL 2-Z	160	2x38.3	150	90°	2700	145	40
ETP-IL 2-AA	200	2x38.3	150	0°	2700	420	63
ETP-IL 2-AB	200	2x38.3	150	45°	2700	420	63
ETP-IL 2-AC	200	2x38.3	150	90°	2700	420	63
ETP-IL 2-AD	250	2x38.3	150	0°	2700	420	63
ETP-IL 2-AE	250	2x38.3	150	45°	2700	420	63
ETP-IL 2-AF	250	2x38.3	150	90°	2700	420	63
Note: All clamps shall be able to withstand 31.5kA (rms) for 1 second without the non-current carrying ES spacer (refer to document 240-53113927) butted up to the crimped tube.							

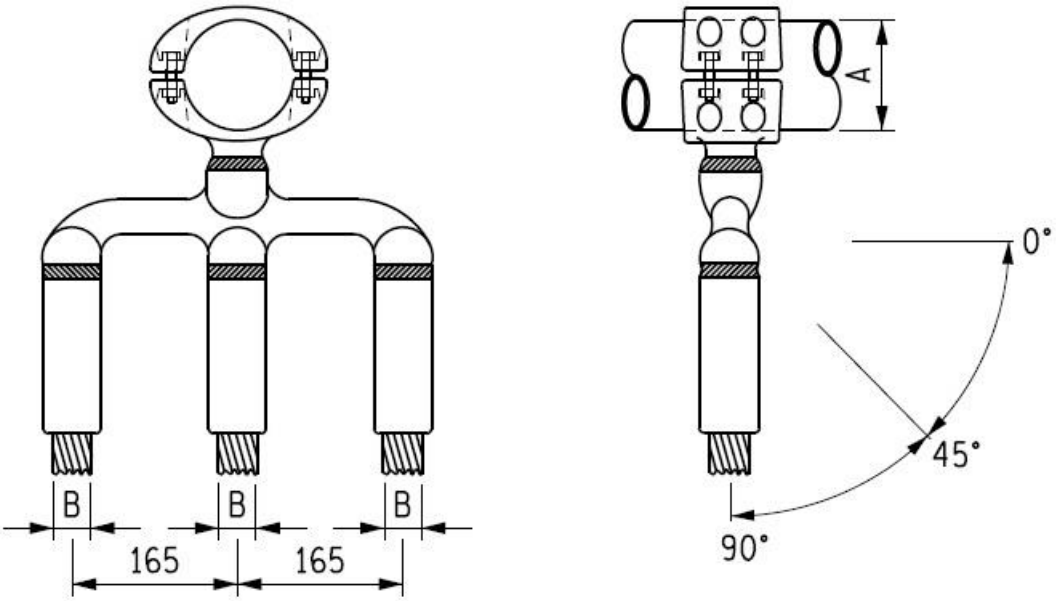

Figure A.39: ETP-IL 3: Clamp – Tap-off – Inline – Three Conductors (D-DT-6119)

Table A.39: Type ETP-IL 3

Type	Tube diameter "A" (mm)	Conductor diameter "B" (mm)	Conductor spacing (mm)	Angle (degrees)	Minimum Rated Current @ 90 °C (A rms)	Maximum Voltage [Um] (kV rms)	1s Fault Current Withstand Rating [kA rms]
ETP-IL 3-A	150	3x38.3	165	0°	3150	145	40
ETP-IL 3-B	150	3x38.3	165	45°	3150	145	40
ETP-IL 3-C	150	3x38.3	165	90°	3150	145	40
ETP-IL 3-D	160	3x38.3	165	0°	3150	145	40
ETP-IL 3-E	160	3x38.3	165	45°	3150	145	40
ETP-IL 3-F	160	3x38.3	165	90°	3150	145	40
ETP-IL 3-G	200	3x38.3	165	0°	4000	420	63
ETP-IL 3-H	200	3x38.3	165	45°	4000	420	63
ETP-IL 3-J	200	3x38.3	165	90°	4000	420	63
ETP-IL 3-K	250	3x38.3	165	0°	4000	420	63
ETP-IL 3-L	250	3x38.3	165	45°	4000	420	63
ETP-IL 3-M	250	3x38.3	165	90°	4000	420	63
Note: All clamps shall be able to withstand 31.5kA (rms) for 1 second without the non-current carrying ES spacer (refer to document 240-53113927) butted up to the crimped tube.							

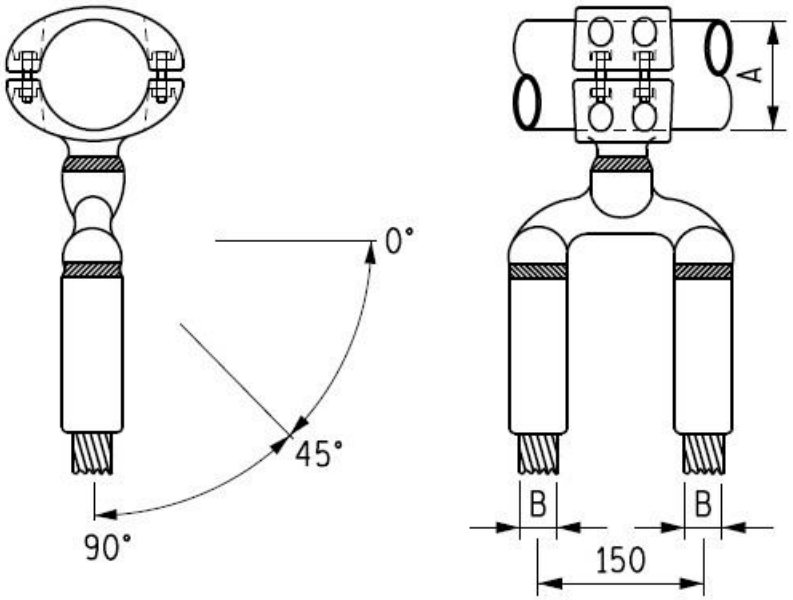

Figure A.40: ETP-TW 2: Clamp – Tap-off – Twisted – Two Conductors (D-DT-6356)

Table A.40: Type ETP-TW 2

Type	Tube diameter "A" (mm)	Conductor diameter "B" (mm)	Conductor spacing (mm)	Angle (degrees)	Minimum Rated Current @ 90 °C (A rms)	Maximum Voltage [Um] (kV rms)	1s Fault Current Withstand Rating [kA rms]
ETP-TW 2-A	80	2x26.5	150	0°	1700	145	40
ETP-TW 2-B	80	2x26.5	150	45°	1700	145	40
ETP-TW 2-C	80	2x26.5	150	90°	1700	145	40
ETP-TW 2-D	80	2x38.3	150	0°	2000	145	40
ETP-TW 2-E	80	2x38.3	150	45°	2000	145	40
ETP-TW 2-F	80	2x38.3	150	90°	2000	145	40
ETP-TW 2-G	100	2x26.5	150	0°	1700	145	40
ETP-TW 2-H	100	2x26.5	150	45°	1700	145	40
ETP-TW 2-J	100	2x26.5	150	90°	1700	145	40
ETP-TW 2-K	100	2x38.3	150	0°	2500	145	40
ETP-TW 2-L	100	2x38.3	150	45	2500	145	40
ETP-TW 2-M	100	2x38.3	150	90°	2500	145	40
ETP-TW 2-N	120	2x26.5	150	0°	1800	145	40
ETP-TW 2-P	120	2x26.5	150	45	1800	145	40
ETP-TW 2-Q	120	2x26.5	150	90°	1800	145	40
ETP-TW 2-R	120	2x38.3	150	0°	2700	145	40
ETP-TW 2-S	120	2x38.3	150	45	2700	145	40
ETP-TW 2-T	120	2x38.3	150	90°	2700	145	40
ETP-TW 2-U	150	2x38.3	150	0°	2700	145	40

Type	Tube diameter "A" (mm)	Conductor diameter "B" (mm)	Conductor spacing (mm)	Angle (degrees)	Minimum Rated Current @ 90 ^{O}C (A rms)	Maximum Voltage [Um] (kV rms)	1s Fault Current Withstand Rating [kA rms]
ETP-TW 2-V	150	2x38.3	150	45^{o}	2700	145	40
ETP-TW 2-W	150	2x38.3	150	90^{o}	2700	145	40
ETP-TW 2-X	160	2x38.3	150	0^{o}	2700	145	40
ETP-TW 2-Y	160	2x38.3	150	45^{o}	2700	145	40
ETP-TW 2-Z	160	2x38.3	150	90^{o}	2700	145	40
ETP-TW 2-AA	200	2x38.3	150	0^{o}	2700	420	63
ETP-TW 2-AB	200	2x38.3	150	45^{o}	2700	420	63
ETP-TW 2-AC	200	2x38.3	150	90^{o}	2700	420	63
ETP-TW 2-AD	250	2x38.3	150	0^{o}	2700	420	63
ETP-TW 2-AE	250	2x38.3	150	45^{o}	2700	420	63
ETP-TW 2-AF	250	2x38.3	150	90^{o}	2700	420	63

Note: All clamps shall be able to withstand 31.5kA (rms) for 1 second without the non-current carrying ES spacer (refer to document 240-53113927) butted up to the crimped tube.

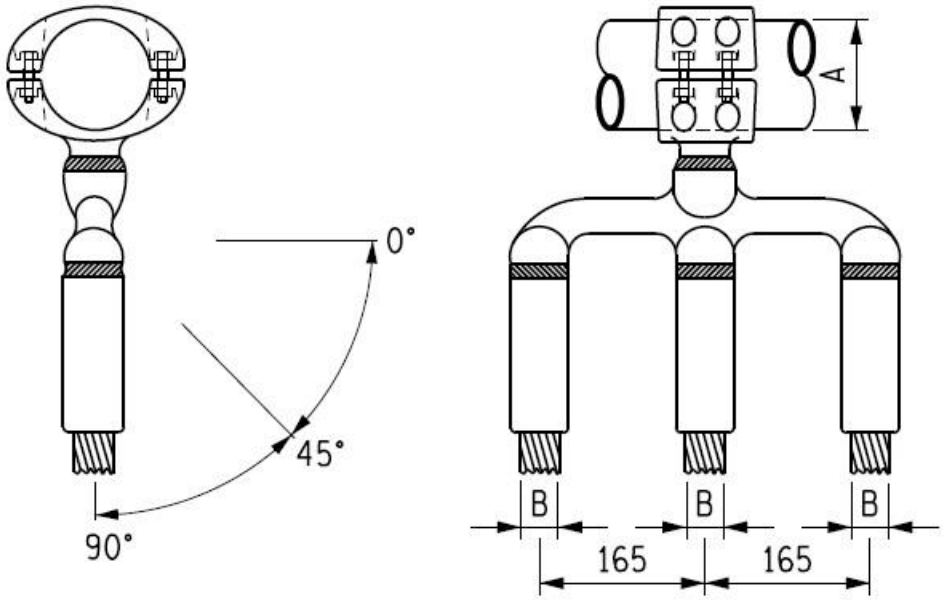

Figure A.41: ETP-TW 3: Clamp – Tap-off – Twisted – Three Conductors (D-DT-6356)

Table A.41: Type ETP-TW 3

Type	Tube diameter "A" (mm)	Conductor diameter "B" (mm)	Conductor spacing (mm)	Angle (degrees)	Minimum Rated Current @ 90 °C (A rms)	Maximum Voltage [Um] (kV rms)	1s Fault Current Withstand Rating [kA rms]
ETP-TW 3-A	150	3x38.3	165	0°	3150	145	40
ETP-TW 3-B	150	3x38.3	165	45°	3150	145	40
ETP-TW 3-C	150	3x38.3	165	90°	3150	145	40
ETP-TW 3-D	160	3x38.3	165	0°	3150	145	40
ETP-TW 3-E	160	3x38.3	165	45°	3150	145	40
ETP-TW 3-F	160	3x38.3	165	90°	3150	145	40
ETP-TW 3-G	200	3x38.3	165	0°	4000	420	63
ETP-TW 3-H	200	3x38.3	165	45°	4000	420	63
ETP-TW 3-J	200	3x38.3	165	90°	4000	420	63
ETP-TW 3-K	250	3x38.3	165	0°	4000	420	63
ETP-TW 3-L	250	3x38.3	165	45°	4000	420	63
ETP-TW 3-M	250	3x38.3	165	90°	4000	420	63

Note: All clamps shall be able to withstand 31.5kA (rms) for 1 second without the non-current carrying ES spacer (refer to document 240-53113927) butted up to the crimped tube.

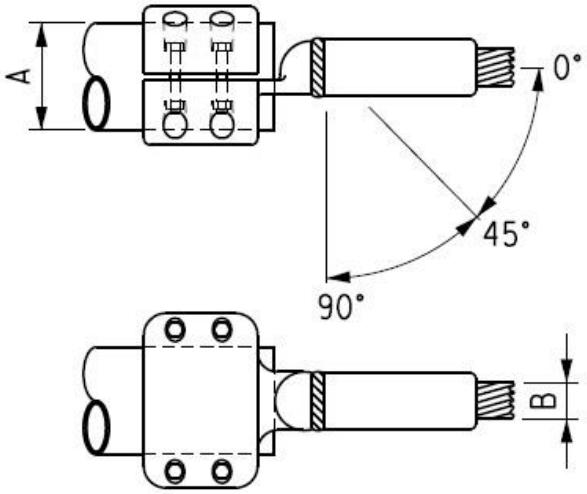

Figure A.42: ETP-TE-IL 1: Clamp – Tap-off – Tube end - Inline – One Conductor (D-DT-6090)

Table A.42: Type ETP-TE-IL 1

Type	Tube diameter "A" (mm)	Conductor diameter "B" (mm)	Angle (degrees)	Minimum Rated Current @ 90 °C (A rms)	Maximum Voltage [Um] (kV rms)	1s Fault Current Withstand Rating [kA rms]
ETP-TE-IL 1-A	80	1x26.5	0°	850	145	40
ETP-TE-IL 1-B	80	1x26.5	45°	850	145	40
ETP-TE-IL 1-C	80	1x26.5	90°	850	145	40
ETP-TE-IL 1-D	80	1x38.3	0°	1350	145	40
ETP-TE-IL 1-E	80	1x38.3	45°	1350	145	40
ETP-TE-IL 1-F	80	1x38.3	90°	1350	145	40
ETP-TE-IL 1-G	100	1x26.5	0°	850	145	40
ETP-TE-IL 1-H	100	1x26.5	45°	850	145	40
ETP-TE-IL 1-J	100	1x26.5	90°	850	145	40
ETP-TE-IL 1-K	100	1x38.3	0°	1350	145	40
ETP-TE-IL 1-L	100	1x38.3	45°	1350	145	40
ETP-TE-IL 1-M	100	1x38.3	90°	1350	145	40
ETP-TE-IL 1-N	120	1x26.5	0°	850	145	40
ETP-TE-IL 1-P	120	1x26.5	45°	850	145	40
ETP-TE-IL 1-Q	120	1x26.5	90°	850	145	40
ETP-TE-IL 1-R	120	1x38.3	0°	1350	145	40
ETP-TE-IL 1-S	120	1x38.3	45°	1350	145	40
ETP-TE-IL 1-T	120	1x38.3	90°	1350	145	40
ETP-TE-IL 1-U	200	1x38.3	0°	1350	300	50
ETP-TE-IL 1-V	200	1x38.3	45°	1350	300	50
ETP-TE-IL 1-W	200	1x38.3	90°	1350	300	50
ETP-TE-IL 1-X	250	1x38.3	0°	1350	300	50
ETP-TE-IL 1-Y	250	1x38.3	45°	1350	300	50
ETP-TE-IL 1-Z	250	1x38.3	90°	1350	300	50

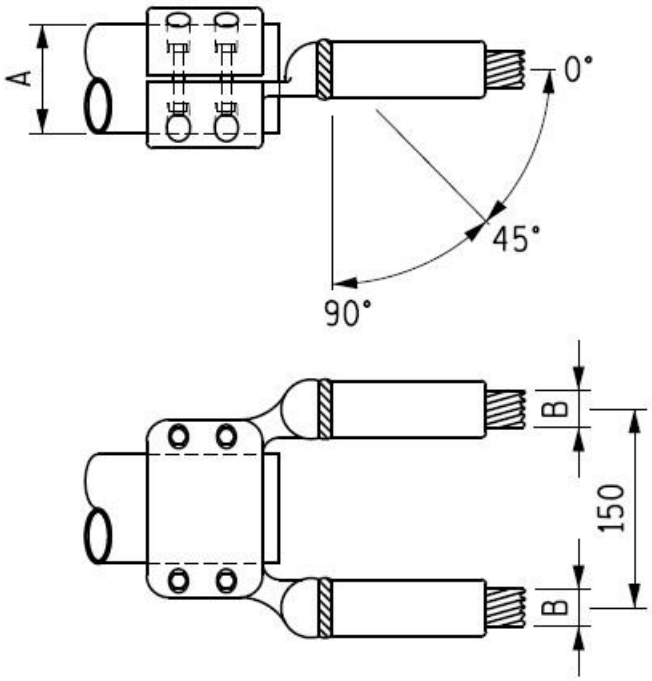

Figure A.43: ETP-TE-IL 2: Clamp - Tube end -Tap-off – Inline – Two Conductors (D-DT-6090)

Table A.43: Type ETP-TE-IL 2

Type	Tube diameter "A" (mm)	Conductor diameter "B" (mm)	Conductor spacing (mm)	Angle (degrees)	Minimum Rated Current @ 90 °C (A rms)	Maximum Voltage [Um] (kV rms)	1s Fault Current Withstand Rating [kA rms]
ETP-TE-IL 2-A	80	2x26.5	150	0°	1700	145	40
ETP-TE-IL 2-B	80	2x26.5	150	45°	1700	145	40
ETP-TE-IL 2-C	80	2x26.5	150	90°	1700	145	40
ETP-TE-IL 2-D	80	2x38.3	150	0°	2000	145	40
ETP-TE-IL 2-E	80	2x38.3	150	45°	2000	145	40
ETP-TE-IL 2-F	80	2x38.3	150	90°	2000	145	40
ETP-TE-IL 2-G	100	2x26.5	150	0°	1700	145	40
ETP-TE-IL 2-H	100	2x26.5	150	45°	1700	145	40
ETP-TE-IL 2-J	100	2x26.5	150	90°	1700	145	40
ETP-TE-IL 2-K	100	2x38.3	150	0°	2500	145	40
ETP-TE-IL 2-L	100	2x38.3	150	45°	2500	145	40
ETP-TE-IL 2-M	100	2x38.3	150	90°	2500	145	40
ETP-TE-IL 2-N	120	2x26.5	150	0°	1700	145	40
ETP-TE-IL 2-P	120	2x26.5	150	45°	1700	145	40
ETP-TE-IL 2-Q	120	2x26.5	150	90°	1700	145	40
ETP-TE-IL 2-R	120	2x38.3	150	0°	2700	145	40
ETP-TE-IL 2-S	120	2x38.3	150	45°	2700	145	40

Type	Tube diameter "A" (mm)	Conductor diameter "B" (mm)	Conductor spacing (mm)	Angle (degrees)	Minimum Rated Current @ 90 °C (A rms)	Maximum Voltage [Um] (kV rms)	1s Fault Current Withstand Rating [kA rms]
ETP-TE-IL 2-T	120	2x38.3	150	90°	2700	145	40
ETP-TE-IL 2-U	200	2x38.3	150	0°	2700	420	63
ETP-TE-IL 2-V	200	2x38.3	150	45°	2700	420	63
ETP-TE-IL 2-W	200	2x38.3	150	90°	2700	420	63
ETP-TE-IL 2-X	250	2x38.3	150	0°	2700	420	63
ETP-TE-IL 2-Y	250	2x38.3	150	45°	2700	420	63
ETP-TE-IL 2-Z	250	2x38.3	150	90°	2700	420	63
Note: All clamps shall be able to withstand 31.5kA (rms) for 1 second without the non-current carrying ES spacer (refer to document 240-53113927) butted up to the crimped tube.							

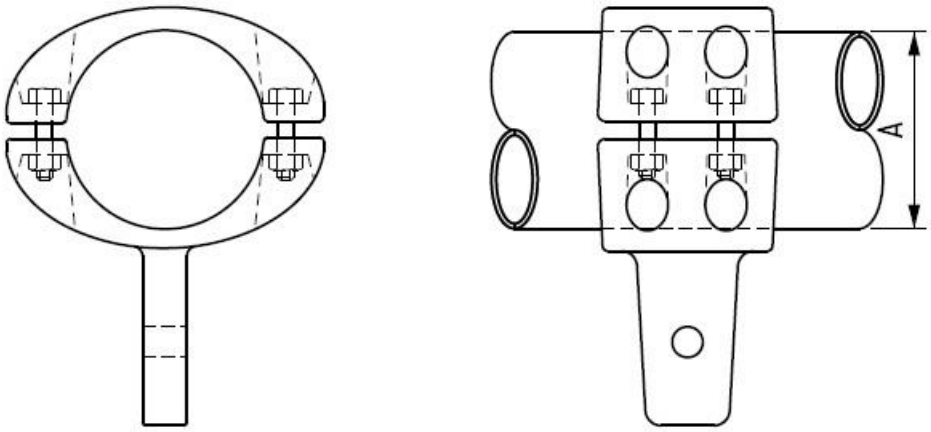

Figure A.44: ETP-PL-1H: Clamp – Tap-off – Palm – Single Hole (D-DT-6092)

Table A.44: Type ETP-PL-1H

Type	Tube diameter "A" (mm)	Minimum Rated Current @ 90 °C (A rms)	Maximum Voltage [Um] (kV rms)	1s Fault Current Withstand Rating [kA rms]
ETP-PL 1H-A	80	650	145	40
ETP-PL 1H-B	100	650	145	40
ETP-PL 1H-C	120	650	145	40

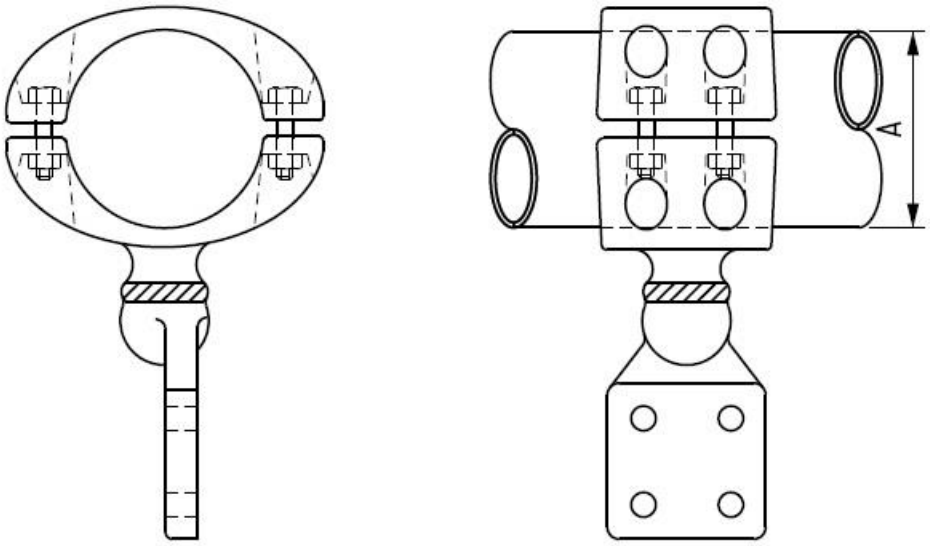

Figure A.45: ETP-PL-4H: Clamp – Tap-off – Palm – 4-Hole (D-DT-6358)

Table A.45: Type ETP-PL-4H

Type	Tube diameter "A" (mm)	Minimum Rated Current @ 90 ^{O}C (A)	Maximum Voltage [Um] (kV rms)	1s Fault Current Withstand Rating [kA rms]
ETP-PL-4H-A	80	1350	145	40
ETP-PL-4H-B	100	1350	145	40
ETP-PL-4H-C	120	1350	145	40

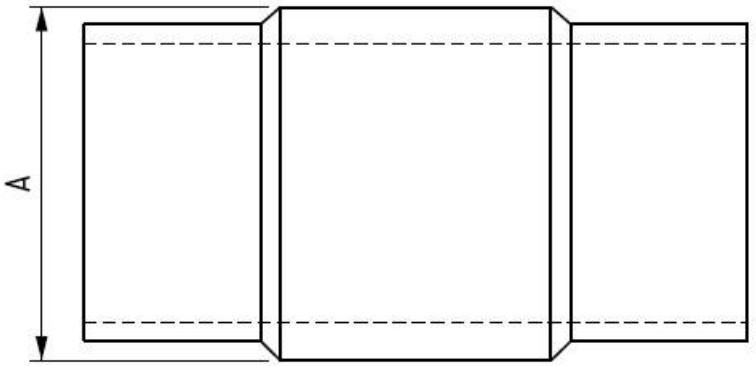

Figure A.46: EWI 0: Welded Insert – 0°

Table A.46: Type EWI 0

Type	Tube diameter "A" (mm)	Minimum Rated Current @ 90 ^{O}C (A rms)	Maximum Voltage [Um] (kV rms)
EWI 0-A	80	2000	145
EWI 0-B	100	2500	145
EWI 0-C	120	3150	145
EWI 0-D	150	3150	300
EWI 0-E	160	3150	300
EWI 0-F	200	4000	800
EWI 0-G	250	4000	420

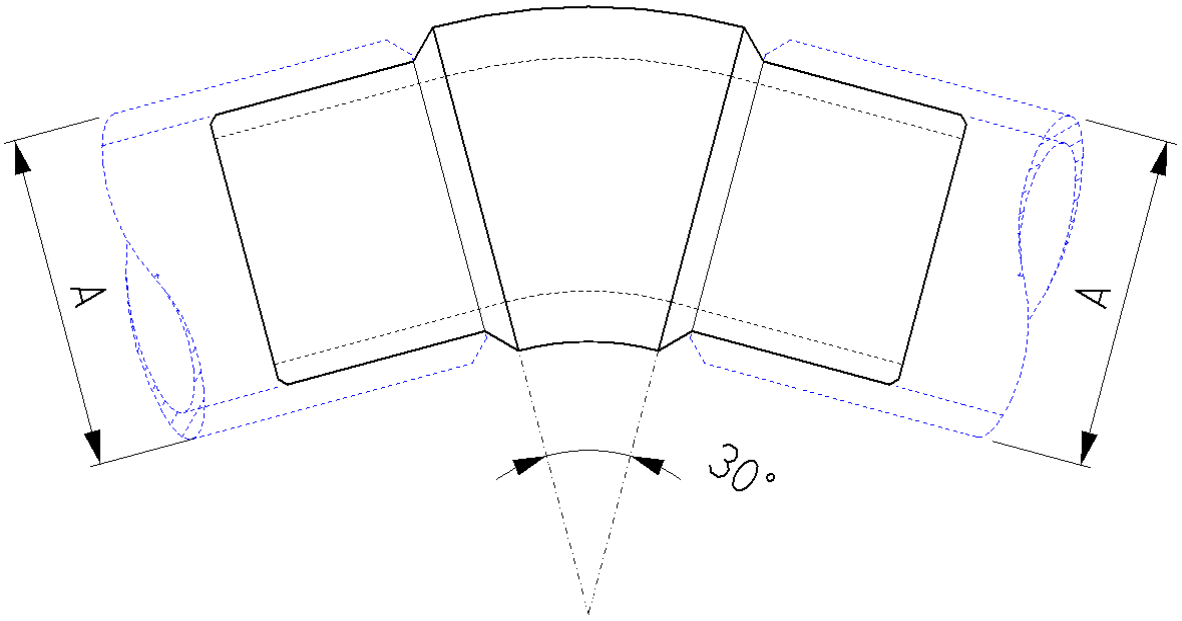

Figure A.47: EWI 30: Welded Insert – 30°

Table A.47: Type EWI 30

Type	Tube diameter "A" (mm)	Minimum Rated Current @ 90 °C (A rms)	Maximum Voltage [Um] (kV rms)
EWI 30-A	80	2000	145
EWI 30-B	100	2500	145
EWI 30-C	120	3150	145
EWI 30-D	150	3150	300
EWI 30-E	160	3150	300
EWI 30-F	200	4000	800
EWI 30-G	250	4000	420

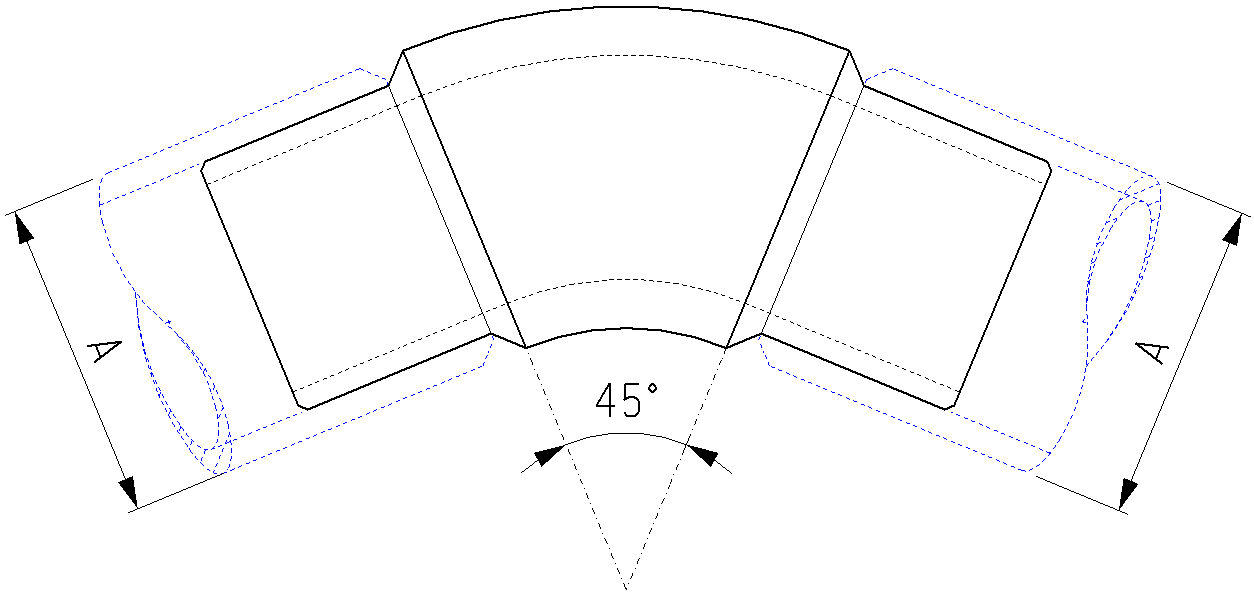

Figure A.48: EWI 45: Welded Insert – 45° (D-DT-6359)

Table A.48: Type EWI 45

Type	Tube diameter "A" (mm)	Minimum Rated Current @ 90 °C (A rms)	Maximum Voltage [Um] (kV rms)
EWI 45-A	80	2000	145
EWI 45-B	100	2500	145
EWI 45-C	120	3150	145
EWI 45-D	150	3150	300
EWI 45-E	160	3150	300
EWI 45-F	200	4000	800
EWI 45-G	250	4000	420

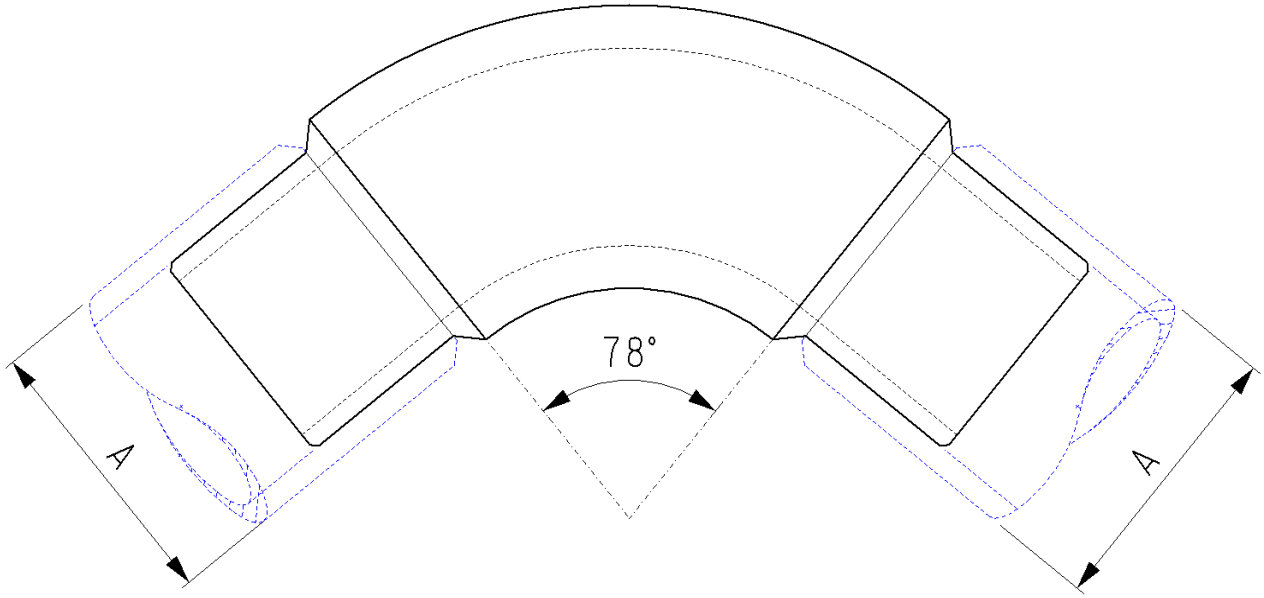

Figure A.49: EWI 78: Welded Insert – 78° (D-DT-6360)

Table A.49: Type EWI 78

Type	Tube diameter "A" (mm)	Minimum Rated Current @ 90 ^{O}C (A rms)	Maximum Voltage [Um] (kV rms)
EWI 78-A	80	2000	145
EWI 78-B	100	2500	145
EWI 78-C	120	3150	145
EWI 78-D	150	3150	300
EWI 78-E	160	3150	300
EWI 78-F	200	4000	800
EWI 78-G	250	4000	420

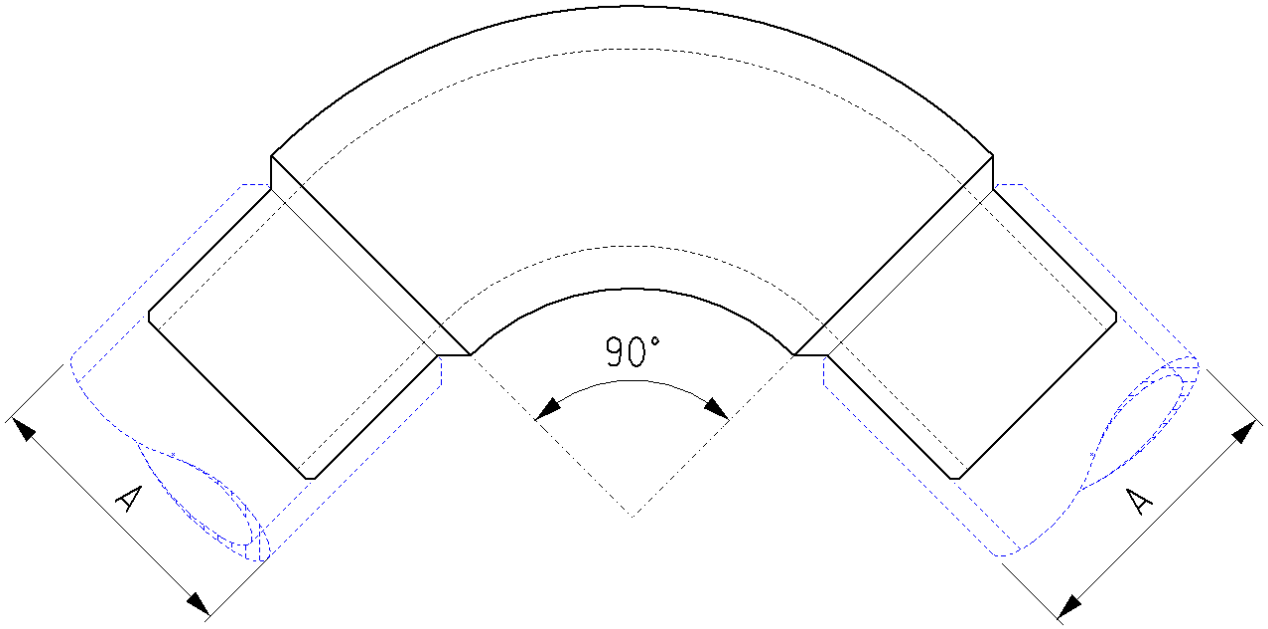

Figure A.50: EWI 90: Welded Insert – 90°

Table A.50: Type EWI 90

Type	Tube diameter "A" (mm)	Minimum Rated Current @ 90 ^{O}C (A rms)	Maximum Voltage [Um] (kV rms)
EWI 90-A	80	2000	145
EWI 90-B	100	2500	145
EWI 90-C	120	3150	145
EWI 90-D	150	3150	300
EWI 90-E	160	3150	300
EWI 90-F	200	4000	800
EWI 90-G	250	4000	420

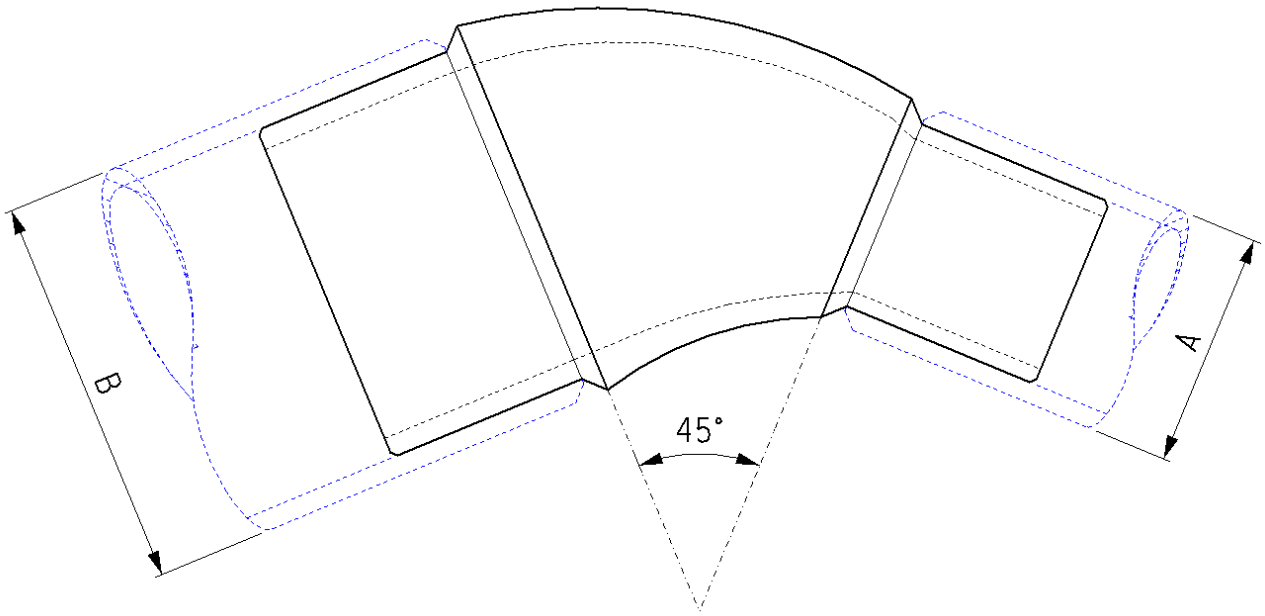

Figure A.51: EWI-2C 45: Welded Insert – 45° – Different Conductor Sizes (D-DT-6361)

Table A.51: Type EWI-2C 45

Type	Tube diameter (mm)		Minimum Rated Current @ 90 °C (A rms)	Maximum Voltage [Um] (kV rms)
	"A"	"B"		
EWI-2C 45-A	80	200	2000	420
EWI-2C 45-B	80	250	2000	420
EWI-2C 45-C	120	200	3150	800

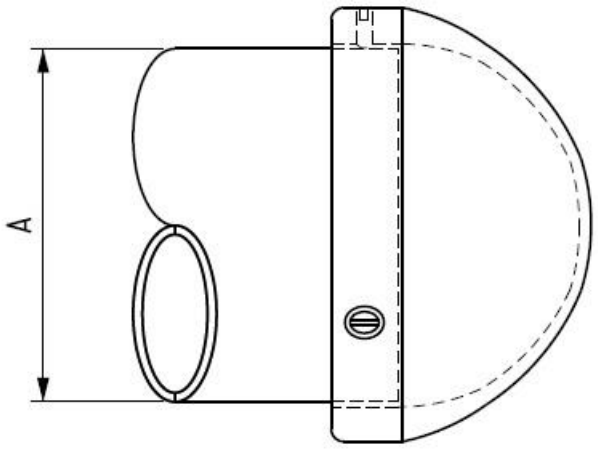

Figure A.52: ETEC-CF: Corona-free End-Cap (D-DT-6362)

Table A.52: Type ETEC-CF

Type	Tube diameter "A" (mm)	Maximum Voltage [Um] (kV rms)
ETEC-CF-A	80	145
ETEC-CF-B	100	145
ETEC-CF-C	120	145
ETEC-CF-D	150	145
ETEC-CF-E	160	145
ETEC-CF-F	200	800
ETEC-CF-G	250	420
Note: All clamps with a specified Um > 420kV shall be corona free on their own up to and including at 420kV, and up to the specified voltage with the aid of a corona ring.		

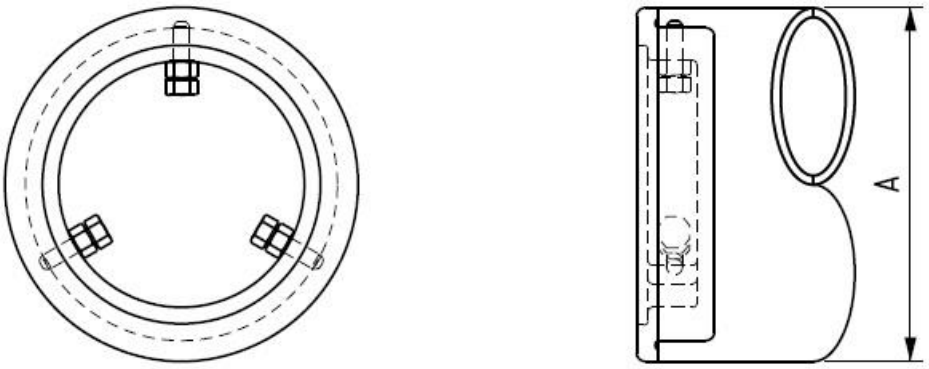

Figure A.53: ETEC-PL: End-Cap – Plain (D-DT-6040)

Table A.53: Type ETEC-PL

Type	Tube diameter "A" (mm)	Tube Wall Thickness (mm)	Maximum Voltage [Um] (kV rms)
ETEC-PL-A	80	8	145
ETEC-PL-B	100	*As required*	145
ETEC-PL-C1	120	4	145
ETEC-PL-C2	120	6	145
ETEC-PL-D	150	*As required*	145
ETEC-PL-E	160	*As required*	145
ETEC-PL-F	200	6	800
ETEC-PL-G	250	6	420
Note: All clamps with a specified Um > 420kV shall be corona free on their own up to and including at 420kV, and up to the specified voltage with the aid of a corona ring.			

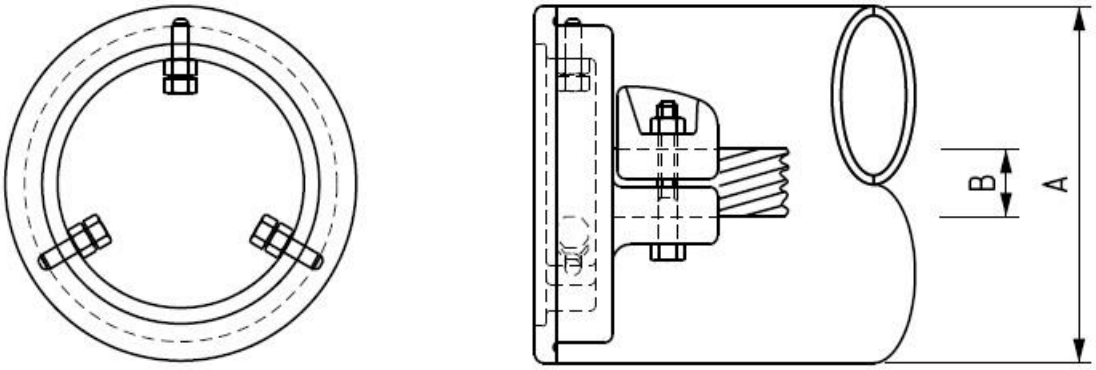

Figure A.54: ETEC-DC: End-Cap – Damping Conductor Fixing (D-DT-6040)

Table A.54: Type ETEC-DC

Type	Tube diameter "A" (mm)	Conductor diameter "B" (mm)	Tube Wall Thickness (mm)	Maximum Voltage [Um] (kV rms)
ETEC-DC-A	80	26.5	8	145
ETEC-DC-B	100	26.5	*As required*	145
ETEC-DC-C1	120	26.5	4	145
ETEC-DC-C2	120	26.5	6	145
ETEC-DC-D	150	26.5	*As required*	145
ETEC-DC-E	160	26.5	*As required*	145
ETEC-DC-F	200	26.5	6	800
ETEC-DC-G	200	38.3	6	800
ETEC-DC-H	250	26.5	6	420
ETEC-DC-J	250	38.3	6	420
Note: All clamps with a specified Um > 420kV shall be corona free on their own up to and including at 420kV, and up to the specified voltage with the aid of a corona ring.				

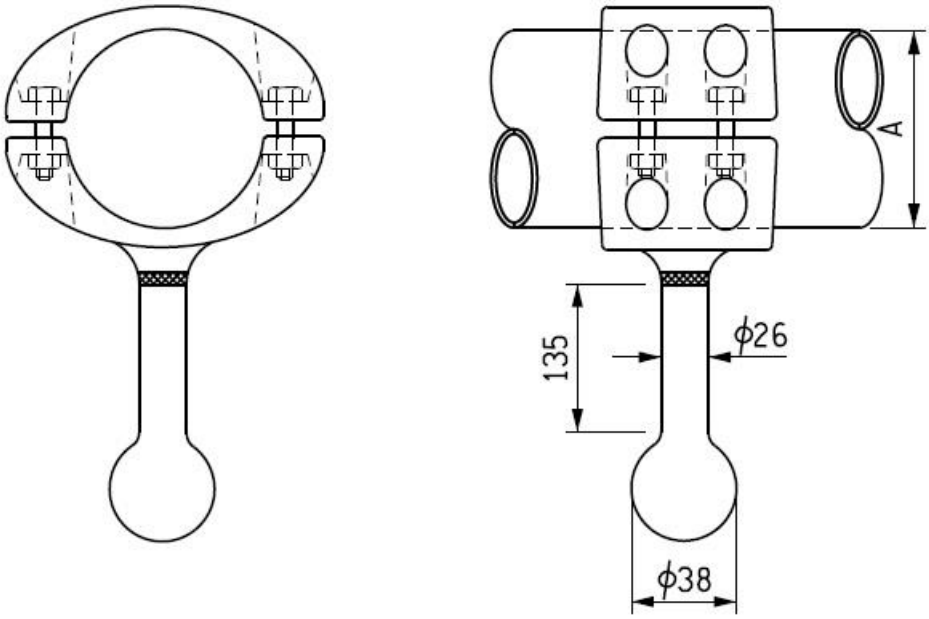

Figure A.55: EET-TB: Clamp - Earthing – Tubular Peg (D-DT-6080)

Table A.55: Type EET-TB

Type	Tube diameter "A" (mm)	Maximum Voltage [Um] (kV rms)	1s Fault Current Withstand Rating [kA rms]
EET-TB-A	80	145	20
EET-TB-B	100	145	20
EET-TB-C	120	145	20

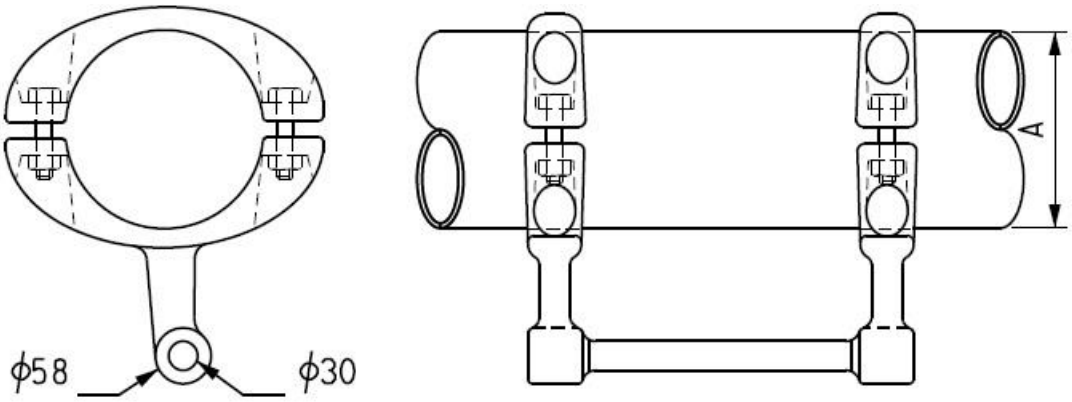

Figure A.56: EET-TPZ: Clamp – Earthing – Trapeze

Table A.56: Type EET-TPZ

Type	Tube diameter "A" (mm)	Contact diameter (mm)	Maximum Voltage [Um] (kV rms)	1s Fault Current Withstand Rating [kA rms]
EET-TPZ-A	200	30	800	50
EET-TPZ-B	250	30	420	63
EET-TPZ-C	120	30	145	40
Note: All clamps with a specified Um > 420kV shall be corona free on their own up to and including at 420kV, and up to the specified voltage with the aid of a corona ring.				

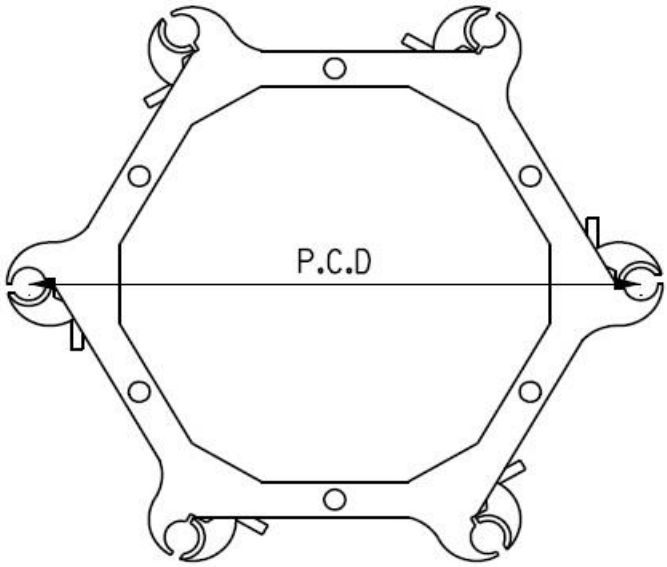

Figure A.57: Type EHS HexagonalSpacer

Table A.57: Type EHS Spacer

Type	Conductor Diameter (mm)	PCD (mm)	Number of Conductors	Minimum Compression Forces (kN)	Maximum Voltage [Um] (kV rms)
EHS-A	38,3	640	6	10	800

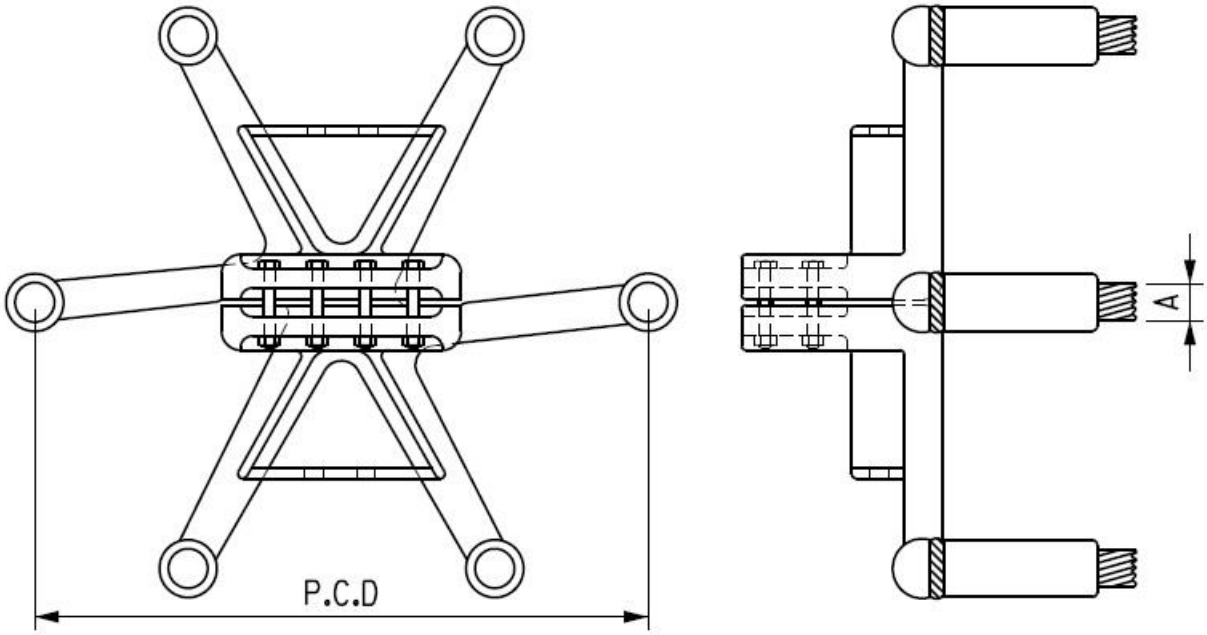

Figure A.58: Type EHCT Six Conductor Compression Terminal clamp

Table A.58: Type EHCT Terminal clamp

Type	Conductor Diameter (mm)	PCD (mm)	Number of Conductors	Minimum Compression Forces (kN)	Normal Rated Current @ 90°C (A)	Maximum Voltage [Um] (kV rms)	1s Fault Current Withstand Rating [kA rms]
EHCT-A	38.3	640	6	10	4000	800	50

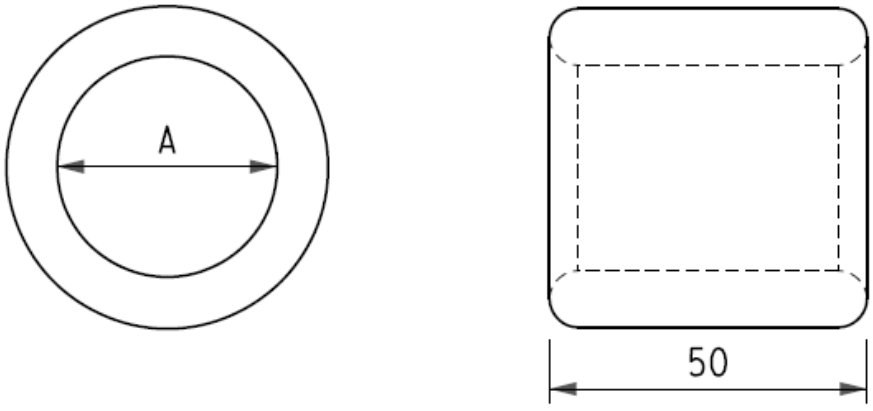

Figure A.59: Type ECES Conductor End Sleeve (D-DT-6001)

Table A.59: Type ECES Sleeve

Type	Conductor Diameter "A" (mm)
ECES-A	26.5
ECES-B	38.3

Annex B – Technical Schedules A and B

SCHEDULE A: ESKOM'S PARTICULARS REQUIREMENTS

SCHEDULE B: GUARANTEES AND TECHNICAL PARTICULARS OF CLAMPS OFFERED

ITEM NO	CLAUSE	DESCRIPTION	UNIT	SCHEDULE A	SCHEDULE B
GENERAL REQUIREMENTS					
1	**3.1.1**	**SERVICE CONDITIONS**			
1.1		Altitude	m	1800	
1.2		Ambient air temperature			
		a) Minimum	^{o}C	-10	
		b) Maximum	^{o}C	+45	
		c) Daily average	^{o}C	30	
		d) Yearly average	^{o}C	20	
1.3		Maximum solar radiation	W/m^2	1 100	
1.4		Wind speed	m/s	0.44	
2	**3.3.2**	**ALLOY**			
2.1		Type of alloy	-	As specified	
2.2		Alloy designation	-	As specified	
2.3		Chemical composition of alloy	-	As specified	
3	**3.3.4**	**BOLTED CONNECTION**			
3.1		Material			
		a) Bolt	-	As specified	
		b) Nut	-	As specified	
		c) Washer	-	As specified	
3.2		Material / Grade of fasteners			
		a) Bolt	-	As specified	
		b) Nut	-	As specified	
		c) Washer	-	As specified	
3.3		Type of washer	-	Plain flat	
3.4		Corrosion resistance of bolts, nuts and washers	-	Yes	
3.5	3.3.4.1	Tensile strength of bolts	MPa	Material dependent	

ITEM NO	CLAUSE	DESCRIPTION	UNIT	SCHEDULE A	SCHEDULE B
3.6		Bolt torque levels			
		a) Recommended	Nm	-	
		b) Minimum	Nm	-	
		c) Ultimate	Nm	-	
3.7		Bolt torque stamped on clamp	-	Yes	
4	**3.3.5**	**COMPRESSION CONNECTIONS**			
4.1		Alloy of compression sleeve	-	-	
4.2		Recommended compression force	kN	-	
4.3		Number of compressions per joint	-	-	
4.4		Diameter of drilled hole	mm	4	
4.5		Die size marking on compression sleeve	-	Yes	
4.6		Type of grease	-	-	
4.7		Compression sleeves pre-greased and sealed before despatch	-	Yes	
5	**3.3.6**	**WELDED CONNECTIONS**			
5.1		Method of welding	-	Tungsten or metal inert-gas	
5.2		Proof of accreditation of welder	-	Yes	
5.3		Welding procedure	-	Yes	
6	**3.3.8**	**ELECTRICAL JOINT COMPOUND**			
6.1		Trade name	-	-	
6.2		Type of compound	-	-	
6.3		Properties of compound			
		a) Drop point	°C	>90	
		b) Flash point	°C	≥140	
		c) Oil separation	-	≤ 1% at 100 °C for 4 hours	
6.4		Temperature rating			
		a) Maximum rated normal current	A	-	
		b) Maximum rated short-circuit current	kA	-	
6.5		Source of supply	-	-	
6.6		Expected lifespan	-	-	

ITEM NO	CLAUSE	DESCRIPTION	UNIT	SCHEDULE A	SCHEDULE B
SPECIFIC CLAMP REQUIREMENTS					
7	**Annex A**	**TYPE**			
7.1		Type designation	-	As specified	
7.2		Drawing number	-	Yes	
8	**Annex A**	**ELECTRICAL RATINGS**			
8.1		Rated system voltage	kV	As specified	
8.2		Rated normal current at 90^{o}C	A	As specified	
8.3		Rated short-circuit withstand current	kA	As specified	
8.4		Duration of short-circuit withstand current	s	As specified	
9		**OVERALL DIMENSIONS**			
9.1		Dimensions	mm	-	
9.2		Mass	kg	-	
10	**3.3.4**	**BOLTED CLAMPS**			
10.1		Bolt size	mm	-	
10.2		Number of saddles per clamp	-	-	
11	**3.3.5**	**COMPRESSION SLEEVES**			
11.1		Inner diameter	mm	-	
11.2		Tolerance of inner diameter		-	
11.3		Wall thickness	mm	-	
11.4		Tolerance of wall thickness		-	
13	**3.3.2.2**	**WELDED COUPLERS**			
13.1		Type of Alloy	-	As specified	
13.2		Temper	-	As specified	
13.3		Designation (in accordance with EN 573-2)	-	-	
13.4		Chemical composition limits of alloy (%) in accordance with EN 573-3	-	As specified	
13.5		Tensile strength	MPa	245	

ITEM NO	CLAUSE	DESCRIPTION	UNIT	SCHEDULE A	SCHEDULE B
13.6		0.2% Proof stress	MPa	195	
13.7		Electrical resistivity @ 20°C	Ωm	0.037×10^{-6}	
13.8	3.3.10	Dimensions and tolerances			
		a) Outer diameter	mm	As specified	
		b) Wall thickness	mm	As specified	
		c) Tolerance of outer diameter	-	As specified	
		d) Tolerance of wall thickness	mm	As specified	
14	**Annex A Table 2**	**SUPPORT CLAMP PCD and HOLE DETAILS**			
14.1		PCD	mm	As specified	
14.2		Hole/slot dimensions	mm	As specified	
15	**3.12**	**DOCUMENTS TO BE SUBMITTED WITH TENDER**			
15.1		Completed technical schedule B for each clamp type	-	Yes	
15.2		Drawing for each type of clamp	-	Yes	
15.3		Manual(s) for handling, storage, installation and inspections	-	Yes	
15.4		Welding procedure	-	Yes	
15.5		Proof of accreditation of welder	-	Yes	
15.6		List of all applicable type test certificates and reports for each clamp type		Yes	
15.7	3.4.2	Copies of all applicable type test certificates and reports for each clamp type	-		Report no:
		a) Heat (current)-cycle test	-	Yes	
		b) Temperature rise test	-	Yes	
		c) Corona test	-	Yes	
		d) RIV test	-	Yes	
		e) Short-circuit withstand test	-	Yes	
		f) Bolt-tightening torque tests	-	Yes	
		g) Slip/Pull-out strength test	-	Yes	
		h) Cantilever test	-	Yes	

Note: Items 3 and 7 – 15.7 to be completed in respect of each type of clamp offered.

Annex C – ESC-V-TT 15 and ESC-H-TT 15 proposed test setup

Considering these clamps are used to create a busbar support they can be tested on their own or as intended to be used. Figure C.1 gives a proposed test setup for these clamps as intended to be used. The current and voltage test requirements are listed in Table A.14 and Table A.15.

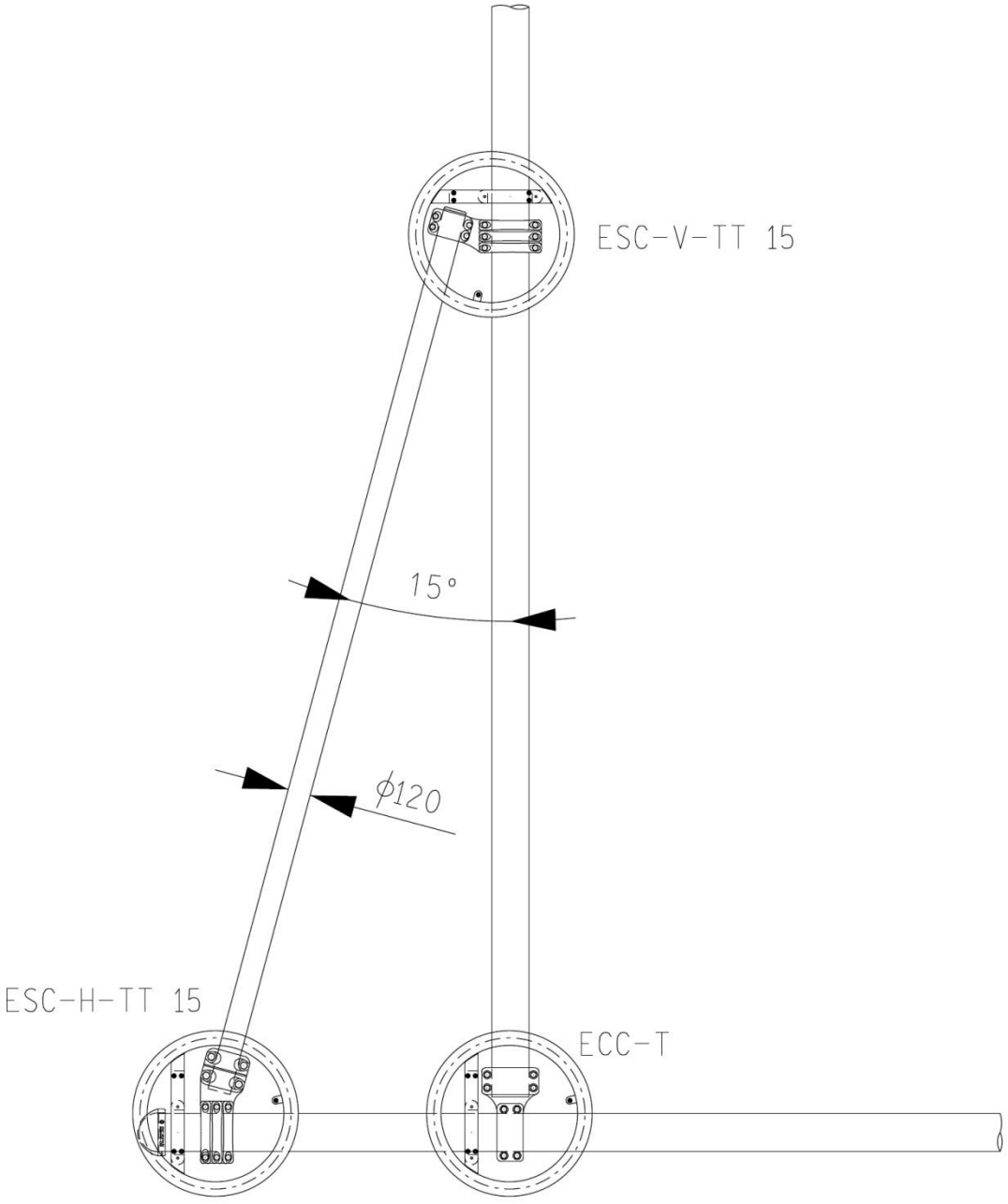

Figure C.1: Proposed test setup for clamps ESC-V-TT 15 and ESC-H-TT 15