Polski Komitet Normalizacyjny

POPRAWKA do POLSKIEJ NORMY

ICS 29.240.20;

PN-EN 50341-3:2002/AC

Styczeń 2007

Wprowadza
EN 50341-3:2001/AC:2006 , IDT

Zastępuje

Dotyczy
PN-EN 50341-3:2002 (U)

Elektroenergetyczne linie napowietrzne prądu przemiennego powyżej 45 kV -- Część 3: Zbiór normatywnych warunków krajowych

Na wniosek Komitetu Technicznego nr 80
ds. Ogólnych w Sieciach Elektroenergetycznych
poprawka do normy europejskiej EN 50341-3:2001/AC:2006 Overhead electrical lines exceeding AC 45 kV -- Part 3: Set of National Normative Aspects
ma status Poprawki do Polskiej Normy

nr ref. PN-EN 50341-3:2002/AC:2007 (U)

Corrigendum to EN 50341-3:2001

English version

Add the following part to EN 50341-3:

Part 3-20	Estonia	Addition

October 2006

National Normative Aspects (NNA)

for

ESTONIA

based on EN 50341-1:2001

Version circulated with corrigendum October 2006.

Contents

Foreword

1. The Estonian National High Voltage Technical Committee of Estonian Centre for Standardisation (EVS/TC 19) is identified by the following address:

   Address: Aru str. 10, 10317 Tallinn, ESTONIA
   Phone: +372 620 3755 Fax: +372 620 3751
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2. EVS/TC 19 has prepared this Part 3-20 of EN 50341, listing the Estonian National Normative Aspects under its sole responsibility, and duly passed it through the CENELEC and CLC/TC 11 procedures.

   NOTE EVS/TC 19 also takes sole responsibility for the technical correct coordination of this EN 50341-3-20 with EN 50341-1.

3. This EN 50341-3-20 is normative for Estonia and informative for other countries.

4. This EN 50341-3-20 has to be read in conjunction with EN 50341-1, hereafter referred to as Part 1. All clause numbers used in this Part 3-20 correspond to those of Part 1. Specific subclauses, witch are prefixed "**EE**", are to be read as amendments to the relevant articles in Part 1. Any necessary clarification regarding the application of Part 3-20 in conjunction with Part 1 shall be referred to the EVS/TC 19 that will, in cooperation with CLC/TC 11 clarify the requirements.
   When no reference is made in Part 3-20 to a specific subclause, then Part 1 applies.

5. In the case of "box values" defined in Part 1, amended values (if any) which are defined in Part 3-20 shall be taken into account in Estonia.
   However any boxed value, whether in Part 1 or Part 3-20, shall not be amended in the direction of greater risk in the Project Specification.

6. The EVS/TC 19 declares in accordance with subclause 3.1 of Part 1 that this Part 3-20 follows the "General Approach" (subclause 4.2), and that consequently subclause 4.3 "Empirical Approach" is not applicable for Estonia.

7. The national Estonian standards/regulations related to overhead electrical lines exceeding 45 kV (AC) are identified/listed in the text of this Part 3-20.

   NOTE All national standards referred to in this Part 3-20 will be replaced by the relevant European Standards as soon as they become available and are declared by the Estonian Centre for Standardisation to be applicable and thus reported to the secretary of CLC/TC 11.

Clause National Regulation

1 Scope

(ncpt) **EE.1 Application to existing overhead lines**

This Part 3-20 is applicable for new high voltage overhead transmission lines only, not for existing lines in Estonia. In other cases (i.e. major revisions of existing lines) the applicability of this Part 3-20 shall be determined case by case in each project by the line owner or the competent authority.

(nspt) **EE.2 Application of covered conductors**

Requirements for the design and construction of overhead lines with application of covered conductors will be specified in the Project Specification.

(ncpt) **EE.3 Application of cables for telecommunication**

This Part 3-20 is not valid for constructions of conductors or cables with integrated optical fibres independent from their function which do not have simultaneously the function of a conductor or an earth wire.

(ncpt) **EE.4 Application to mounting of telecommunication equipment**

This Part 3-20 is not applicable for fixing of structural elements for telecommunication (e.g. dishes), if these are mounted on power line supports (towers).
Mounting of telecommunication equipment will be specified in the Project Specification and the requirements of EVS/TS 1993-3-1 (Towers and Masts) have to be taken into account, too.

2 Definitions, symbols and references

2.3 References

(A-dev) **EE.1** Part 1 of the standard applies without change. References to Estonian national standards and regulations are given in the text of the Part 3-20.

3 Basis of design

3.1 General

(ncpt) **EE.1** The EVS/TC 19 declares that this Part 3-20 follows the “General Approach” (subclause 4.2), and that consequently subclause 4.3 “Empirical Approach” is not applicable for Estonia.

(A-dev) **EE.2** Choice of line route and construction or mounting of high voltage overhead line is regulated by following Estonian laws and Government regulations. (RT – Riigi Teataja, RTL – Riigi Teataja Lisa. The *Riigi Teataja* is the official publication of the Republic of Estonia):

Clause National Regulation

Elektriohutusseadus (RT I 2002, 49,310)
Electrical Safety Act

Elektrituruseadus (RT I 2003, 25, 153)
Electricity Market Act

Ehitusseadus (RT I 2002, 47, 297)
Building Act

Planeerimisseadus (RT I 2002, 99, 579)
Planning Act

Keskkonnamõju hindamise ja keskkonna auditeerimise seadus (RT I 2000, 54, 348)
Environmental Impact Assessment and Environmental Auditing Act

Keskkonnajärelvalve seadus (RT I 2001, 56, 337)
Environmental Supervision Act

Looduskaitseseadus (RT I 2004, 38, 258)
Nature Conservation Act

Veeseadus (RT I 1994, 40, 655)
Water Act

Asjaõigusseadus (RT I 1993, 39, 590)
Law of Property Act

Asjaõigusseaduse rakendamise seadus (RT I 1993, 72/73, 1021)
Law of Property Act Implementation Act

Muinsuskaitseseadus (RT I 2002, 27, 153)
Heritage Conservation Act

Telekommunikatsiooniseadus (RT I 2004, 87, 593)
Telecommunications Act

Lennundusseadus (RT I 1999, 26, 376)
Aviation Act

Teeseadus (RT I 1999, 26, 377)
Roads Act

Raudteeseadus (RT I 2003, 79, 530)
Railways Act

Meresõiduohutuse seadus (RT I 2002, 1, 1)
Maritime Safety Act

Jäätmeseadus (RT I 2004, 9, 52)
Waste Act

Clause National Regulation

Vabariigi Valitsuse määrus „Elektripaigaldise kaitsevööndi ulatus” (RT I 2002, 58, 366)
Government of the Republic regulation “Safety zone of electrical installation”

Võlaõigusseadus (RT I 2001, 81, 487)
Law of Obligations Act

Sotsiaalministri määrus ”Müra normtasemed elu- ja puhkealadel, elamutes ning ühiskasutusega hoonetes ja mürataseme mõõtmise meetodid” (RTL, 14.03.2002, 38, 511)
Regulation of the Minister of Social Affairs “Audible noise limits in residential and recreational areas, residential and social buildings and noise level control methods”

Other relevant normative regulatory documents should be taken in account as soon as they become available.

3.2.2 Reliability of overhead lines

(ncpt) **EE.1 Selection of reliability levels**

Three reliability levels are used as follows:
Level 1 – temporary or unimportant lines
Level 2 – normal lines
Level 3 – very important lines

The importance of lines is specified in the Project Specification.

3.2.6 Additional considerations

(ncpt) **EE.1 Distance between tension supports**

The distance between tension supports will be specified in the Project Specification.

4 Actions on lines

4.1 Introduction

(ncpt) **EE.1** In Estonia Subclause 4.2 is to be followed.

4.2 Actions, General Approach

4.2.1 Permanent loads

(ncpt) **EE.1** Self-weights of conductors are calculated accordingly to the load case and to the actual difference of height levels of adjacent spans.

Clause National Regulation

4.2.2 Wind loads

4.2.2.1 Wind speeds

(snc) **EE.1 Reference wind speed V_R**

For the reference wind speed V_R (II) the following value shall be used:
V_R (II) = 21 m/s

4.2.2.1.1 Field of application

(ncpt) **EE.1** Mean wind speed V_{mean} shall be used as a basis for the extreme wind speed**.**

4.2.2.1.5 Reference wind speed V_R

(snc) **EE.1 Reference wind speeds**

Table 4.2.2.1.5/EE.1 – Reference wind speeds

Terrain category	Reference wind speed (m/s)
I	24,57
II	21,00
III	16,17
IV	11,55

4.2.2.4 Wind forces on overhead line components

4.2.2.4.1 Wind forces on conductors

(snc) **EE.1 Drag factor for the conductor**

The following values of the drag factor for the conductor shall be used:
- C_C = 1,1 for conductors and earthwires without icing and with diameter $d \geq 20$ mm
- C_C = 1,2 for conductors and earthwires without icing and with diameter $d < 20$ mm.

C_C for conductors with icing – see subclause 4.2.4.2.

4.2.2.4.3 Wind forces on lattice towers

(ncpt) **EE.1 Drag factors**

The wind forces on the rectangular towers shall be calculated according to Part 1. However, while the explicit parameters for the drag factors C_{t1} and C_{t2} are not specified in Part 1, they shall be taken from EVS/TS 1993-3-1 (Towers and Masts). For the same reason also the drag factors for other types of lattice towers (towers with triangular body or towers containing sections consisting of mixed profile shapes, i.e. tubular legs and angle bracings) shall be calculated according to EVS/TS 1993-3-1.

Clause National Regulation

4.2.3 Ice loads

4.2.3.1 General

(snc) **EE.1 Ice forces on conductors**

When determining the design values of ice actions, the icing thickness shall be taken equal to 10 mm.

Other values of icing thickness, based on long term statistics and local conditions, can be specified in the Project Specification.

(snc) **EE.2 Ice on structures and insulators**

No ice is considered on structures or insulators, if not otherwise specified in the Project Specification.

4.2.3.2 Characteristic ice load

(snc) **EE.1 Characteristic ice load per unit length**

Characteristic ice load per unit length I_k (N/m) shall be calculated by the following formula:

$$I_k = \pi\, k_l\, k_d\, b\, (d + k_l\, k_d\, b)\, \rho_l\, g\, 10^{-3}$$

where

k_l, k_d are factors, which consider changing of the icing thickness depending on height and diameter of conductor or earthwire (Table 4.2.3.2/EE.1)

b is the icing thickness, mm

d is the diameter of conductor or earthwire, mm

ρ_l is the ice density, which shall be taken equal to 0,90 g/cm^3

g is the gravitational acceleration, g = 9,81 m/s^2

Table 4.2.3.2/EE.1 – Factors, which consider changing of the icing thickness depending on height and diameter of conductors

Height above ground of centre of gravity of conductor or earthwire (m)	k_l	Diameter of conductor or earthwire (mm)	k_d
25	1,0	10	1.0
30	1,4	20	0,9
50	1,6	30	0,8
60	1,7	50	0,7

Clause National Regulation

4.2.4 Combined wind and ice loads

4.2.4.2 Drag factors and ice densities

(snc) **EE.1 Drag factor for the conductor**

For all conductors and earthwires with icing the drag factor CC = 1,2 shall be used.

4.2.5 Temperature effects

(snc) **EE.1 Applicable temperatures**

The following temperatures in different load conditions shall be applied:

(a) minimum temperature with no other climatic action – -40ºC
(b) temperature for the extreme wind speed condition with no ice – -5 ºC
(c) temperature for the reduced wind speed (0,6 times the extreme wind speed) condition – -15 ºC
(d) temperature used with icing – -5 ºC
(e) temperature used for the combination of wind and ice – -5 ºC.
(f) yearly mean temperature (every day temperature) – +5 ºC
(g) maximum temperature +40 ºC

4.2.6 Construction and maintenance loads

4.2.6.1 General

(ncpt) **EE.1 General**

Supports of overhead lines shall be checked to load conditions corresponding to the installation methods specified in the Project Specification, taking into account tensions caused by pulling ropes, weights of conductors and earthwires as well as weights of insulators, erection facilities and linesmen.

4.2.6.2 Loads related to the weight of linesmen

(ncpt) **EE.1 Bar loads**

A load of 3 kN acting vertically on the centre of the bar shall be taken into account for each bar that are to be used as a support for a ladder.

4.2.7 Security loads

(ncpt) **EE.1 Design calculation conditions for tension supports**

Tension supports shall be dimensioned assuming static loads resulting from the release of the tension of a phase conductor or sub-conductor or of an earthwire in an adjacent span, which cause the maximal loads on corresponding structural elements.

Clause National Regulation

Tension supports shall be dimensioned assuming following conditions:

1. Supports for aluminium, steel or aluminium alloy conductors with any cross-section and for steel reinforced aluminium conductors with the cross-section of aluminium part 150 mm^2 or less:
   - irrespective of the number of circuits on the support abruption of two phase conductors in the same span, earthwires are sound (normal anchor supports)
   - irrespective of the number of circuits on the support abruption of a phase conductors in one span, earthwires are sound (light type anchor supports and dead-end supports)
2. Supports for any type of steel reinforced aluminium conductors with the cross-section of aluminium part more than 150 mm^2 – irrespective of the number of circuits on the support abruption of a phase conductors in one span, earthwires are sound (normal anchor supports and dead-end supports)
3. All tension supports irrespective of the type and cross-section of conductors – abruption of an earthwire in one span (in case of split earthwire abruption of all sub-wires), conductors are sound.

4.2.9 Other special forces

(snc) **EE.1 Avalanches, creeping snow, earthquakes**

Possible additional loads due to avalanches, creeping snow or earthquakes are not considered.

(snc) **EE.2 Floating of ice, accidents of vessels**

Loads caused by floating ice or accidents of vessels shall be taken in account if supports are located in rivers, including river foreland, or lakes. Determination of these loads shall be specified in the Project Specification.

(snc) **EE.3 Mining out areas**

When overhead lines are to be constructed in the mining out areas the special considerations shall be defined in the Project Specification.

4.2.10 Load cases

4.2.10.2 Standard load cases

(snc) **EE.1 Definition of load cases**

Standard load cases, partial factors and combination factors are defined in Table 4.2.11/EE.1.

In case of the minimum temperature wind and ice loads are not considered. The minimum temperature is -40 ºC in accordingly 4.2.5/EE.1.

Clause National Regulation

4.2.11 Partial factors for actions

(snc) **EE.1 Partial factors and combination factors**

Partial factors γ and combination factors Ψ are given in Table 4.2.11/EE.1.

Table 4.2.11/EE.1 – Load cases, temperatures, partial factors and combination factors

No.	Load case	Temperature	Wind load	Ice load	Reliability level						Weight
					1		2		3		
		°C	Ψ_W	Ψ_I	γ_W	γ_I	γ_W	γ_I	γ_W	γ_I	γ_G
1a	Extreme wind speed	-5	1,0		1,0		1,2		1,4		1,0
1b	Minimum temperature	-40									1,0
1c	Moderate wind speed	-15	0,4		1,0		1,2		1,4		1,0
2a	Uniform extreme ice loads	-5		1,0		1,0		1,2		1,4	1,0
2b	Uniform ice loads, transversal bending	-5		α_1		1,0		1,2		1,4	1,0
2c	Unbalanced ice loads, longitudinal bend	-5		α_1		1,0		1,2		1,4	1,0
2d	Unbalanced ice loads, torsional bending	-5		α_1		1,0		1,2		1,4	1,0
3a	Extreme ice loads with reduced wind speed	-5	0,4	1,0	1,0	1,0	1,0	1,2	1,0	1,4	1,0
3b	High wind speed with moderate ice load	-5	0,7	0,35	1,0	1,0	1,2	1,0	1,4	1,0	1,0
4	Construction and maintenance loads	-15			γ_P = 1,5						1,0
5	Security loads	-5			γ_A = 1,0						1,0

5 Electrical requirements

5.1 Voltage classification

(ncpt) **EE.1 Nominal voltages in Estonia**

Table 5.1/EE.1 gives nominal voltages and corresponding highest system voltages preferably used in Estonia.

Table 5.1/EE.1 – Nominal voltages and corresponding highest system voltage

Nominal voltage (kV)	**Highest system voltage** (kV)
110	123
330 *)	362 *)
380	420
480	525
*) These figures according to EVS-EN 60071-1, EN 50341 do not content these voltages.	

Clause National Regulation

5.2 Currents

5.2.1 Nominal current

(snc) **EE.1 Conditions for determination of the maximum design temperature of conductors**

The maximum design temperature of conductors shall be determined at an ambient temperature of +40 ^{0}C and at wind speed of 0 m/s.

5.2.2 Short-circuit currents

(ncpt) **EE.1 Magnitude of short-circuit currents**

The magnitude and duration of short-circuit currents shall be given in the Project Specification.

5.3.5 Electrical clearances to avoid flashover

5.3.5.1 General

(ncpt) **EE.1 Derivation of minimum clearances**

For derivation of D_{el} and D_{pp} or $D_{50Hz\_p\_e}$ and $D_{50Hz\_p\_p}$ it is recommended to use the method described in annex E of Part 1. Details of the Derivation of minimum clearances in more detail can be specified in the Project Specification.

For rough evaluation of or $D_{50Hz\_p\_e}$ and $D_{50Hz\_p\_p}$ empirical values from Table 5.4/EE.1 can be used.

Table 5.4/EE.1 - Minimum electrical clearance distances in air necessary to withstand the power frequency voltage (to be used in extreme wind conditions)

Highest system voltage U_S (kV)	**$D_{50Hz\_p\_e}$ (in metres) Kg = 1,45 conductor-structure**	**$D_{50Hz\_p\_p}$ (in metres) Kg = 1,60 conductor to conductor**
123	0,23	0,37
245	0,43	0,69
362	0,62	1,02
420	0,70	1,17
525	0,86	1,47

Clause National Regulation

For rough evaluation of D_{el} and D_{pp} empirical values from Table 5.5/EE.1 can be used.

Table 5.5/EE.1 – Clearances D_{el} and D_{pp}

Highest system voltage (kV)	D_{el} (m)	D_{pp} (m)
123	1,00	1,15
245	1,70	2,00
362	2,50	2,85
420	2,80	3,20
525	3,50	4,00

5.4 Internal and external clearances

5.4.2.2 Load cases for calculation of clearances

(snc) **EE.1 Maximum design temperature**

The following maximum design conductor temperatures shall be used if otherwise not specified in the Project Specification:

Phase conductor +60 ^{0}C,
Earth wire +40 ^{0}C.

(snc) **EE.2 Design ice load**

For the load case “Ice load” shall be taken uniform extreme ice load with no wind and at temperature -5 ^{0}C. (see Table 4.2.11/EE.1).

(snc) **EE.3 Design wind load**

For the load case “Wind load” in Tables 5.4.3 to 5.4.5 shall be taken the wind load of three-year return period, i.e. the extreme wind load multiplied by the factor 0,58.

For the load case “Extreme wind load” in Tables 5.3.3 to 5.3.5 shall be taken wind load for a 50 year return period for gust conditions.

The assumed temperature is + 15 ^{0}C in both cases.

(ncpt) **EE.4 Combined ice and wind loads**

Combined ice and wind loads need not to be taken into account in the determination of clearances.

(ncpt) **EE.5 Galloping of conductors**

For calculation of clearances the galloping of conductors and earth wires shall be taken into account. The method of calculation shall be specified in the Project Specification.

Clause National Regulation

5.4.3 Clearances within span and at the tower

(ncpt) **EE.1 Reduction factor for clearances**

Clearances D_{el} and D_{pp} by wind load in Table 5.4.3 Part 1, may be reduced by k_1 = 0,75.

5.4.4 Clearances to ground in areas remote from buildings, roads, railways and navigable waterways

(snc) **EE.1 Clearances to ground in areas remote from buildings, roads, railways and navigable waterways**

Minimum clearances to ground in areas remote from buildings, roads, railways and navigable waterways are specified in Table 5.4.4/EE.1.

Table 5.4.4/EE.1 – Minimum clearances to ground in areas remote from buildings, roads, railways and navigable waterways

Load case	Clearance to ground in unobstructed countryside	Clearance to crowns of trees	
		Under the line	Beside the line
Maximum conductor temperature	5 m + D_{el}	2 m + D_{el}	3 m + D_{el}
Ice load	5 m + D_{el}	2 m + D_{el}	3 m + D_{el}
Wind load	5 m + D_{el}	2 m + D_{el}	3 m + D_{el}
Remarks	Basic requirement is that a vehicle or person etc. can pass under the line without danger.	Where trees or ladders are climbed under the line (for example in orchards) then a height above the ladder or tree shall be applied so that work close to the line can be done without danger.	Earth fault due to a falling tree is unacceptable. Distance between a falling tree and the closest phase conductor shall be at least 0,5 m + D_{el}.
NOTE 1 Radius of the tree crowns can be taken for pine 7 m, for fir 5 m, for birch 4,5 m. NOTE 2 These clearances are based on a 5 m high vehicle.			

5.4.5 Clearances to buildings, traffic routes, other lines and recreational areas

5.4.5.1 General

(ncpt) **EE.1 Clearances to residential and other buildings, when the line is above or adjacent to the buildings or near antenna or similar structures**

Clearances to residential and other buildings, when the line is above or adjacent to the buildings or near antenna or similar structures, are specified in Table 5.4.5.2/EE.1.

Crossing over residential and other important buildings is not permitted (see Table 5.4.5.2/EE.1).

Clause National Regulation

Location of antenna towers and their parts in protection zone of the line is not permitted.

Horizontal clearance between the rotor blade tip of the wind power station in most unfavourable position and the closest conductor of the overhead line with no wind shell be at least equal to the rotor diameter.

(ncpt) **EE.2 Clearances to line crossing roads, railways and navigable waterways**

For minor roads the vertical clearance shall not be reduced.

The clearances from the support to roads (incl. hard shoulder), squares, parking places, etc. edges should be not less than 5 m. When crossing a road belonging to the net of extra high transportation the clearance shall fulfil the requirements given by road owner.

Information concerning the highest masts of vessels can be obtained from the Estonian Maritime Administration.

(ncpt) **EE.3 Clearances to line adjacent to roads, railways and navigable waterways**

Clearances to line adjacent to roads, railways and navigable waterways are specified in Table 5.4.5.3.2/EE.3.

(ncpt) **EE.4 Clearances to line crossing or parallel to other power lines or overhead telecommunication lines**

Clearances to line crossing or parallel to other power lines or overhead telecommunication lines are specified in Table 5.4.5.4/EE.4.

(ncpt) **EE.5 Clearances to recreational areas**

Crossing of important sports- and recreational areas etc. is prohibited. (The requirement applies to the sports ground itself, start and winning post installations and the spectator areas for these, but not to other areas as greens with trees etc.) Horizontal clearance to borders of such areas shall be at least 10 m + D_{el} (with no wind).

Crossings are accepted over tennis courts, golf courses, motocross tracks and tracks for horse riding without spectator accommodation.

For the crossing of areas as national parks and other preserved areas a special permission is required from the authorities concerned.

(ncpt) **EE.6 Clearances to explosive storages**

Clearance to storages with explosive materials shall be at least 100 m.

5.4.5.2 Residential and other buildings and constructions

Table 5.4.5.2/EE.1 – Minimum clearances to residential and other buildings and constructions

Load case	**Clearance cases: Minimum clearances to residential and other buildings and constructions**			
	Line above buildings	**Line adjacent to buildings**	**Antennas, street lamps, flag poles, advertising signs and similar structures** (see note)**.**	
	Direct clearance to less important buildings (Crossing over important buildings is prohibited)	Buildings and areas of petrol stations, storage areas for flammable goods and other storage areas	Antennas and lightning protection facilities, flag poles, advertising signs and similar structures which can not be stood on	Street lamps
Maximum conductor temperature	4,5 m + D_{el}	5 m + D_{el}, (Horizontal clearance)	3 m + D_{el}	2m + D_{el}
Ice load	4,5 m + D_{el}	5 m + D_{el}, (Horizontal clearance)	3 m + D_{el}	2m + D_{el}
Wind load	4,5 m + D_{el}	5 m + D_{el}, (Horizontal clearance)	3 m + D_{el}	2m + D_{el}
Remarks	1. Less important buildings are defined as buildings less than 50 m^2 which are not using for living and which only occasionally are used by human beings. (The above applies to small sheds, small barns etc, but also applies to garages constructed from non-combustible materials situated at least 4 m from other buildings). 2. The danger of ice falling from overhead lines on buildings shall be considered.		The clearance D_{el} shall be maintained even when the structure falls towards the line conductors	
	NOTE 1 Crossing over residential buildings are prohibited. The responsible national authorities may accept crossing over other buildings. Special safety measures will be required. NOTE 2 For lines adjacent to or crossing over power stations or substations special regulations apply.		NOTE These clearances are not valid for antenna towers and wind power stations (see 5.4.5.1 EE.1)	

5.4.5.3 Traffic routes

Table 5.4.5.3.2/EE.3 – Minimum clearances to line adjacent to roads, railways and navigable waterways

Load case	**Clearance cases: Line adjacent to roads, railways and navigable waterways**			
	To loading gauge or the components of an electric traction system wire installation of a railway or trolley bus line	To components of a ropeway installation	To outer edge of a carriageway (incl. hard shoulder) of a motorway, highway, country road or of a waterway	Horizontal clearance between nearest part of the overhead line and the outer edge of the nearest track of a railway
Maximum conductor temperature	8 m	4 m + D_{el}	2 m + D_{el}	8 m
Ice load	8 m	4 m + D_{el}	2 m + D_{el}	8 m
Wind load	5 m	4 m + D_{el}	2 m + D_{el}	5 m
Special load case-4	-	4 m + D_{el}	-	-
Remarks	If this horizontal clearance cannot be met, clearances for crossing of railway installations as given in Table 5.4.5.3.1, Part 1 shall be met			If conversion to electric traction system is planned, the clearance by wind load shall be at least 15 m.
Special load case 4: Additionally it shall be assumed that the supporting and pulling ropes of a rope way installation swing through an angle of 45 o towards the overhead line.				
NOTE 1 The bigger clearances may be required in the Project Specification NOTE 2 Problems in connection with induction and with safety clearances at work are not considered.				

5.4.5.4 Other power lines or overhead telecommunication lines

Table 5.4.5.4/EE.4 – Minimum clearances to other power lines or overhead telecommunication lines

Load Case	**Crossing of lines**		**Parallel lines on common structures**	**Parallel or converging lines on separate structures**
	Vertical clearance between lowest conductor of the upper circuit and live parts or earthed components of the lower line	Horizontal clearance between the vertical axis of the swung conductor and components of telecommunication lines	Clearance between conductors of lines of separate utilities	
Maximum conductor temperature	1 m + D_{pp} [a), b)]	-	D_{pp} [a)]	D_{pp} [a)]
Ice load	1 m + D_{pp} [a)]	-	D_{pp} [a)]	D_{pp} [a)]
Wind load	1 m + D_{pp} [a)]	Horizontal clearance 1 m + D_{pp} [a)], but greater than 2 m	D_{pp} [a)]	D_{pp} [a)]
Remarks	Special care shall be taken with respect to crossing of lines and parallel lines. The clearance shall be greater than 1,1 times the arcing distance a_{som} (defined as the straight line distance between live and earthed parts) of the insulator string			
	Accounting procedure may be specified in the Project Specification	If this horizontal clearance can not be met, the vertical clearances between lowest conductor of the upper circuit and live parts or earthed components of the lower line shall be met	If circuits of separate utilities are placed on common structures, the possibility of influencing each other shall be minimized; i.e. consideration should be given to the use of rotating crossarms, consequences of broken insulators, induction and maintenance.	If this horizontal clearance can not be met, the vertical clearances between lowest conductor of the upper circuit and live parts or earthed components of the lower line shall be met

[a)] D_{pp} is the greater of the values of D_{pp} for the two lines
[b)] Temperature of the conductor of the lower line shall be taken +15 ^{0}C

Clause National Regulation

(ncpt) **EE.7 Clearances to line crossing or adjacent to overground pipelines, incl. gas and oil pipelines.**

The angle of crossing an overhead line and pipelines with flammable gas or liquid should be as close as possible to 90^0. The angle of crossing an overhead line and pipelines with non-combustible gas or liquid is not specified.

Crossing overhead lines with uncovered main or industrial pipelines with combustible materials is prohibited. In case of such crossings the pipeline shall be covered with ground or equipped with a construction, which prevent falling of the line conductor to the pipes.

If the pipeline is not covered with ground, the pipeline shall be earthed whereby the total earthing resistance should not exceed 10 Ω.

Minimum clearances to line crossing or adjacent to overground pipelines are specified in Table 5.4.5.6/EE.7.

Table 5.4.5.6/EE.7 – Minimum clearances to line crossing or adjacent to over ground pipelines

Line crossing or adjacent to pipeline	**Minimum clearances** m
Vertical clearance between lowest conductor and crossing pipeline or protective construction The same clearance in case of breaking the conductor in neighboring span.	3 m + D_{el} 1 m + D_{el}
Horizontal clearance between closest conductor of overhead line (with no wind) and adjacent to oil or gas main pipelines with pressure over 1,2 Mpa	50 m
Horizontal clearance between closest conductor of overhead line (with no wind) and adjacent to oil or gas pipelines	Height of the support
Horizontal clearance between closest conductor of overhead line (with no wind) and adjacent to water, sewer or district heating pipelines	10 m
Horizontal clearance between closest conductor of overhead line (with no wind) and adjacent to gas pressure control and distribution stations - gas pressure over 1,2 MPa, - gas pressure 1,2 MPa or less	 100 m Height of the support + 3 m
Horizontal clearance between the foundation of support of overhead line and crossing pipeline or protective construction of the pipeline	3 m + D_{el}

Vertical clearances shall be checked in the cases of maximum conductor temperature and extreme ice load with no wind.

The method of calculation and the minimum clearances may be concretised in the Project Specification.

Clause National Regulation

(ncpt) **EE.8 Clearances to line crossing or adjacent to underground pipelines**

The angle of crossing an overhead line and pipelines with flammable gas or liquid should be at least 60^0. The angle of crossing an overhead line and pipelines with non-combustible gas or liquid is not specified.

Minimum clearances to line crossing or adjacent to underground pipelines are specified in Table 5.4.5.7/EE.8.

Table 5.4.5.7/EE.8 – Minimum clearances to line crossing or adjacent to underground pipelines

Line crossing or adjacent to pipeline	Minimum clearances (m)
Horizontal clearance between the closest conductor of an overhead line (at no wind) and adjacent oil or gas main pipelines with pressure over 1,2 MPa	25
Horizontal clearance between foundation of support of an overhead line and crossing or adjacent oil or gas main pipelines with pressure over 1,2 MPa	10
Horizontal clearance between support foundation of an overhead line and crossing or adjacent water, sewer or district heating pipelines	5

In special cases, for example in territories of power stations and industrial enterprises or town streets, the values in Table 5.4.5.7/EE may be reduced. In this situation it is appropriate to consider the methods to protect foundations of supports of the overhead line in case of exploding of pipeline, and methods to avoid transfer of high potentials via metal pipelines.

Horizontal clearance between the closest conductor of an overhead line (at no wind) and adjacent gas pressure control and distribution stations shall be taken, like in case of overground pipelines, according to Table 5.4.5.6/EE.7.

The calculation method and the minimum clearances may be concretized in the Project Specification.

(ncpt) **EE.9 Overhead lines adjacent to aerodromes**

Clearances shall be taken according to the Aviation Act (Lennundusseadus, RT I 1999, 26, 376). Required special conditions shall be coordinated with Estonian Civil Aviation Administration and specified in the Project Specification.

Clause National Regulation

5.5 Corona effect

5.5.1 Radio noise

5.5.1.3 Noise limits

(ncpt) **EE.1 Radio noise limits**

The radio noise at nominal voltage in fair weather at distance of 20 m to the nearest conductor of the line and at frequency of 0,5 MHz shall be no more than 57 dB (in relation to 1 µV/m).

5.5.2 Audible noise

5.5.2.3 Noise limits

(ncpt) **EE.1 Audible noise limits**

The audible noise of the line at nominal voltage in foul weather on the ground under outside conductor of the line shall be no more than 55 dB.

The requirements of the directive of Estonian Minister of Social Affairs nr. 42, “Audible noise limits in residential and recreational areas, residential and social buildings and noise level control methods” (RTL, 14.03.2002, 38, 511), should be taken into consideration.

The audible noise limits may be concretized in the Project Specification

5.5.3 Corona loss

(ncpt) **EE.1 Corona loss limits**

Maximum permissible values of corona loss may be defined in the Project Specification.

5.6 Electric and magnetic fields

5.6.1 Electric and magnetic fields under a line

(ncpt) **EE.1 Electric and magnetic fields limits**

The limits of power frequency electric and magnetic fields, recommended by ICNIRP */International Commission on Non Ionizing Radiation Protection/* should be taken into consideration.

The positioning of the electrical network installations in frequently occupied areas shall be such that resulting electric field in these areas does not exceed 5 kV/m and the associated magnetic field does not exceed 100 µT in permanent service operating conditions.

Clause National Regulation

6 Earthing systems

6.2 Dimensioning of earthing systems at power frequency

6.2.2 Dimensioning with respect to corrosion and mechanical strength

6.2.2.1 Earth electrodes

(snc) **EE.1 Material of earth electrodes**

Hot galvanized steel earth electrodes are recommended.

6.2.2.2 Earthing and bonding conductors

(snc) **EE.1 Material of earthing and bonding conductors**

Galvanized steel earthing and bonding conductors are recommended. Aluminium earthing and bonding conductors are not acceptable.

6.2.4 Dimensioning with regard to human safety

6.2.4.2 Measures for the observance of permissible touch voltages

(ncpt) **EE.1 Potential grading**

When determining the touch voltage, the potential grading electrodes shall be taken into account. The determination can be done either by calculations or measurements.

The potential grading may consist of an earth electrode or electrodes connected galvanically to the metallic, touchable parts of the tower and buried ca 0,5 m underground at a distance of 1,00 to 1,25 m.

If permissible touch voltage levels cannot be achieved in the vicinity of the tower, the ground around the tower can be covered with insulating material, for example with gravel.

If permissible touch voltage is not achieved after covering of the ground around the tower with insulating material, the metallic touchable parts of the tower should be insulated.

(ncpt) **EE.2 Earthing of guy supports**

Special requirements for earthing of guyed supports shall be defined in the Project Specification.

Clause National Regulation

6.3 Construction of earthing systems

6.3.1 Installation of earth electrodes

(ncpt) **EE.1 Joining the earthing conductor and earth electrode**

Connection of earthing conductor and earth electrode shall be made so that the earth electrode can be disconnected from the earth conductor. The connector shall not be able to be opened without special tools.

6.4 Earting measures against lightning effects

(ncpt) **EE.1 Avoiding of back-flashovers**

A lightning stroke into earthed components of an overhead line may cause a discharge (back-flashover) to operationally live parts. Such flashovers are in general unlikely if the impulse earth resistance R_{imp} suffices the following relation:

$$R_{imp} \leq \frac{U_{imp}}{I_{tow}}$$

where:

R_{imp} - Impulse earth resistance of the tower earthing. In case of a limited spatial extent (earth rods < 10 m, radial counter poise < 20 m) the earth resistance R_E (see Annex H.2.2 (Part 1)) may be used as an approximation.

U_{imp} - Lightning impulse withstand voltage of the insulation ($U_{90\%\_ff\_is}$)

I_{tow} - Peak value of the lightning current on the tower.

Table 6.4/EE.1 – Cumulative frequency of lightning currents in towers of lines with shield wires (according to the German experience)

Lightning current I_{tow} on the tower up to	20 kA	30 kA	40 kA	50 kA	60 kA
Cumulative frequency of all lightning strokes	80 %	90 %	95 %	98 %	99 %

NOTE It means, for example, that the lightning current does not exceed 50 kA in 98 % of all lightning strokes.

(ncpt) **EE.2 Earthing of a dead-end support**

In purpose to reduce a probability of back flashover, the earthing system of the line dead-end support shall be connected to the earthing system of the substation.

Clause National Regulation

7 Supports

7.2 Materials

7.2.8 Other materials

(ncpt) **EE.1 Structural steel**

Structural steels with other quality may be permitted by the Project Specification.

7.3 Lattice steel towers

7.3.6 Connections

7.3.6.2 Connection with bolts

7.3.6.2.3 Design resistance of bolts

(ncpt) **EE.1 Securing of connection with bolts**

Connections with bolts shall be secured against loosening in service.

7.3.8 Design assisted by testing

(ncpt) **EE.1 Need of testing**

Need of testing and its extent shall be specified in the Project Specification.

7.4 Steel poles

7.4.8 Design assisted by testing

(ncpt) **EE.1 Need of testing**

Need of testing and its extent shall be specified in the Project Specification

7.6 Concrete poles

7.6.6 Design assisted by testing

(ncpt) **EE.1 Need of testing**

Need of testing and its extent shall be specified in the Project Specification

7.9 Corrosion protection and finishes

7.9.3 Metal spraying

(ncpt) **EE.1 Zinc deposit thickness**

Zinc deposit thickness shall be not less than in hot-dip galvanizing.

Clause National Regulation

8 Foundations

8.8 Construction and installation

(snc) **EE.1 Frost-resistance of foundations**

The foundation shall be placed deep enough to be prevented from frost heave.
Concrete structures used in the foundations shall be frost resistant.
Calculation method of foundations can be specified in the Project Specification.

9 Conductors and overhead earthwires (ground wires) with or without telecommunication circuits

9.1 Introduction

(ncpt) **EE.1 Consideration the effect of permanent elongation (creep) of conductors**

Conductors are permanently elongating during their lifetime due to creep effect, resulting in increase of conductors sag. This must not cause decrease of air clearances below limit values. So the design and construction of lines shall take into consideration the effect of permanent elongation (creep) on the conductor sag.

(ncpt) **EE.2 Telecommunication circuits**

Installation requirements of telecommunication cables attached to the earth wire system or All Dielectric Self Supporting (ADSS) cables shall be given in the Project Specification.

(ncpt) **EE.3 Transposition of conductors**

To limit unbalance of voltages and currents a full transposition cycle shall be foreseen for lines longer than 100 km.

Partial transposition, transposition with different length of sections or no transposition can be foreseen if estimated voltage unbalance does not exceed 0,5% and estimated current unbalance does not exceed 2%.

In case of vertical arrangement of phase conductors, simplified transposition, where only two outside phases are transposed, can be used.

9.6.2 Partial factors for conductors

(ncpt) **EE.1 Partial factor**

The partial factor applied to the rated tensile strength for all types of conductors shall have a minimum value of:

$$\gamma_M = 1,5$$

Clause National Regulation

10 Insulators

10.7 Mechanical requirements

(ncpt) **EE.1 Minimal partial factors**

Minimal partial factors γ_M are:

for porcelain or glass string insulator unit	$\gamma_M = 2,0$
for composite insulator and stay insulator	$\gamma_M = 2,0$
for line post insulator	$\gamma_M = 2,3$

(ncpt) **EE.2 Multiple insulator sets**

Multiple insulator sets comprise two or more insulator strings. The permissible loading of an insulator set comprising *n* strings may be taken at maximum as *n*-times the permissible loading of an individual insulator string. It is assumed that the total load of multiple insulator set is as far as possible equally distributed over the individual insulator strings.

In case of failure of an insulator string
- a distribution of the total load as equally as possible over the remaining insulator strings shall be guaranteed,
- the partial factor for materials according to 10.7/EE.1 for the remaining tension loaded insulators may be reduced to 1,15,
- any expected dynamic forces and bending moments shall be duly counteracted, to avoid failure of the remaining strings.

(ncpt) **EE.3 Multiple insulator strings in crossings**

Usage of multiple insulator strings in crossings shall be provided in the Project Specification.

11 Line equipment - Overhead line fittings

11.2 Electrical requirements

11.2.2 Requirements applicable to current carrying fittings

(ncpt) **EE.1 Current carrying capabilities of fittings**

Conductor accessories shall be selected in such a manner that they do not reach higher temperatures than the conductors themselves when the maximum permissible electrical load current flows and that the temperature rise do not lead to an inadmissible reduction of mechanical strength when subjected to maximum expected short-circuit loads.

Clause National Regulation

11.6 Mechanical requirements

(ncpt) **EE.1 Partial factor for an action**

The partial factor applied to the specified minimum failure load for all types of line fittings shall have a minimum value of:

$$\gamma_M = 2,0$$

(ncpt) **EE.2 Insulator set fittings**

Fittings of multistring insulator sets should warrant, as much as possible, equal distribution of forces between particular strings.

(ncpt) **EE.3 Conductor clamps**

The conductor shall be fixed to the clamp in such a way that it cannot slip in the clamp in the case the conductor breaks in the adjacent span.

In case the conductor joint or clamp is subject to substantial tension the breaking strength of the joint shall normally not be less than 90 % of the rated braking strength of the conductor. If in a special case the breaking strength of the joint does not fulfil the above mentioned requirement the allowable stress of the conductor shall be calculated according to the breaking strength of the joint.

The installation of a mid-span tension joints in crossing spans over motorways and railways shall be avoided.

11.8 Material selection and specification

(snc) **EE.1 Minimum temperatures**

When selecting materials for the line fittings the minimum operational temperature –40 ºC shall be taken into account.

11.14 Selection, delivery and installation of fittings

(ncpt) **EE.1 Warning signs**

All the line supports shall be equipped with warning signs according to requirements of EVS-EN 61310-1 and the Project Specification.

In case the power line crosses a waterway, installation of warning signs shall to be harmonized with Estonian Maritime Administration.

(ncpt) **EE.2 Climbing facilities**

Steps or other climbing devices are not allowed at a height less than 3 m above the ground. The diagonals of a lattice tower are not considered as the steps mentioned afore.

(ncpt) **EE.3 Marking of guys**

The guys shall be marked on fields and pastures, by roadsides and snow mobile routes with yellow/black signs.

Clause National Regulation

(ncpt) **EE 4 Aerial warning devices**

The use of aerial warning devices including lights, signs, painting of towers etc. shall to be specified in the Project Specification and harmonized with Estonian Civil Aviation Administration.

12 Quality assurance, checks and taking-over

Applies without changes.

Annex G (normative)
Earthing systems

G.2 Minimum dimensions of earth electrode materials ensuring mechanical strength and corrosion resistance

(snc) **EE.1 Material and minimum dimensions of earth electrodes**

Material and minimum dimensions of earth electrodes should meet also the requirements of 6.2.2.1/EE.1 and 6.2.2.2/EE.1.

Annex H (informative)
Earthing systems

H.2 Basis of verification

H.2.1 Soil resistivity

(ncpt) **EE.1 Measuring of soil resistivity**

During the measurements of soil resistivity ρ_E moisture content of soil and temperature should be considered. Relevant coefficients will be given in Project Specification.
