

Overhead electrical lines exceeding AC 45 kV —

Part 3: Set of National Normative Aspects

ICS 29.240.20

National foreword

This British Standard is the UK implementation of EN 50341-3:2001, incorporating corrigenda April 2006, October 2006, February 2009, June 2010 and October 2010.

The start and finish of text introduced or altered by corrigendum is indicated in the text by tags **[AC]** **<AC>**. Text altered by CENELEC corrigendum April 2006 is indicated in the text by **[AC]** **<AC>**.

The start and finish of text introduced or altered by corrigendum is indicated in the text by tags. Text altered by CENELEC corrigendum February 2009 is indicated in the text by **[AC₂]** **<AC₂>**.

The UK participation in its preparation was entrusted to Technical Committee PEL/11, Overhead lines.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

Compliance with a British Standard cannot confer immunity from legal obligations.

This British Standard, having been prepared under the direction of the Electrotechnical Sector Policy and Strategy Committee, was published under the authority of the Standards Policy and Strategy Committee on 25 April 2002

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	31 May 2010	Implementation of CENELEC corrigendum February 2009
	30 April 2011	Implementation of CENELEC corrigendum June 2010 and October 2010, fully replacing National Normative Aspects for Finland, Germany and Italy



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**Overhead electrical lines exceeding AC 45 kV
Part 3: Set of National Normative Aspects**

Lignes électriques aériennes dépassant
AC 45 kV
Partie 3: Aspects Normatifs Nationaux

Freileitungen über AC 45 kV
Teil 3: Nationale Normative Festlegungen

This European Standard was approved by CENELEC on 2001-01-01. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CENELEC member.

This European Standard exists in one official version (English). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the Central Secretariat has the same status as the official versions.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

CENELEC

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

Central Secretariat: rue de Stassart 35, B - 1050 Brussels

Foreword

The different parts of this European Standard EN 50341-3 were prepared by the respective CENELEC National Committees in cooperation with the Technical Committee CENELEC TC 11, Overhead electrical lines exceeding 1 kV AC (1,5 kV DC).

The text of the drafts were submitted to the Unique Acceptance Procedure and were approved by CENELEC as EN 50341-3 on 2001-01-01.

The following dates were fixed:

- | | | |
|--|-------|------------|
| - latest date by which the EN has to be implemented
at national level by publication of an identical
national standard or by endorsement | (dop) | 2002-05-01 |
| - latest date by which the national standards conflicting
with the EN have to be withdrawn | (dow) | 2004-01-01 |

Text of EN 50341-3

Please see the subparts specific to each National Committee.

NOTE This Part 3 of EN 50341 is published by CENELEC in English only.

AC₂ Index of National Normative Aspects

Reference	Country		Valid version in
	Code	Name	
EN 50341-3-1	AT	Austria	EN 50341-3:2001 modified by Corr. April 2006 + Corr. February 2009
EN 50341-3-2	BE	Belgium	EN 50341-3:2001
EN 50341-3-3	CH	Switzerland	EN 50341-3:2001
EN 50341-3-4	DE	Germany	Replaced by Corr. April 2006
EN 50341-3-5	DK	Denmark	EN 50341-3:2001
EN 50341-3-6	ES	Spain	EN 50341-3:2001
EN 50341-3-7	FI	Finland	Replaced by Corr. April 2006
EN 50341-3-8	FR	France	EN 50341-3:2001
EN 50341-3-9	GB	Great Britain and Northern Ireland	Replaced by Corr. April 2006
EN 50341-3-10	GR	Greece	EN 50341-3:2001
EN 50341-3-11	IE	Ireland	EN 50341-3:2001
EN 50341-3-12	IS	Iceland	EN 50341-3:2001
EN 50341-3-13	IT	Italy	EN 50341-3:2001
--	LU	Luxembourg	No NNA
EN 50341-3-15	NL	Netherlands	EN 50341-3:2001 modified by Corr. April 2006
EN 50341-3-16	NO	Norway	Replaced by Corr. February 2009
EN 50341-3-17	PT	Portugal	EN 50341-3:2001

AC₂

AC2

Reference	Country		Valid version in
	Code	Name	
EN 50341-3-18	SE	Sweden	Replaced by Corr. April 2006, modified by Corr. February 2009
EN 50341-3-19	CZ	Czech Republic	Replaced by Corr. April 2006
EN 50341-3-20	EE	Estonia	Added by Corr. October 2006
--	SI	Slovenia	No NNA
EN 50341-3-22	PL	Poland	Added by Corr. February 2009
--	MT	Malta	No NNA
--	HU	Hungary	No NNA
--	SK	Slovakia	No NNA
--	LT	Lithuania	No NNA

AC2

National Normative Aspects (NNA) for AUSTRIA

based on EN 50341-1:2001

Version circulated with corrigendum February 2009.

In this document, the paragraphs modified/added by the corrigendum April 2006 are identified by tags **AC** **AC**.

In this document, the paragraphs modified/added by the corrigendum February 2009 are identified by **AC₂** **AC₂**.

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	TELECOMMUNICATION LINES CARRIED ON OVERHEAD TRANSMISSION LINES	

Foreword

1. The Austrian National Committee (NC) is identified by the following address:

Austrian Electrotechnical National Committee
Österreichischer Verband für Elektrotechnik (ÖVE)
Eschenbachgasse 9, A-1010 Vienna, Austria
Phone no. +43.1.587.63.73
Fax no. +43.1.586.74.08
name/number of relevant subcommittee: Fach(normen)ausschuss L

2. The Austrian NC has prepared this Part 3-1 of EN 50341 listing the Austrian national normative aspects, under its sole responsibility, and duly passed it through the CENELEC and CLC/TC11 procedures.

NOTE The final draft prEN 50341-3-1:2000 was published as Entwurf ÖVE/ÖNORM EN 50341-3-1:2000-08 on Austrian national level. At the end of deadline, 2000-09-15, the supposed changes have been discussed during the 82nd meeting of „Fach(normen)ausschuss L“. The agreed changes are incorporated in this document.

3. This EN 50341-3-1 is normative in Austria and informative for other countries;
4. This EN 50341-3-1 has to be read in conjunction with EN 50341-1, hereinafter referred to as Part 1. All clause numbers used in this Part 3-1 correspond to those of Part 1. Specific subclauses, which are prefixed „AT“, are to be read as amendments to the relevant text in Part 1. Any necessary clarification regarding the application of Part 3-1 in conjunction with Part 1 shall be referred to the Austrian NC who will, in cooperation with CLC/TC11 clarify the requirements.

When no reference is made in Part 3-1 to a specific subclause, then Part 1 applies.

5. In the case of „boxed values“ defined in Part 1, amended values (if any) which are defined in Part 3-1 shall be taken into account in Austria.

However any boxed value, whether in Part 1 or Part 3-1, shall not be amended in the direction of greater risk in a Project Specification.

6. The Austrian NC declares in accordance with subclause 3.1 of Part 1 that this Part 3-1 follows the „Empirical Approach“ (subclause 4.3), and that consequently subclause 4.2 „General Approach“ is not applicable for Austria.
7. The national Austrian standards/regulations related to overhead electrical lines exceeding 1 kV (A.C.) are identified/listed in 2.3.

NOTE All national standards referred to in this Part 3-1 will be replaced by the relevant European Standards as soon as they become available and are declared by the Austrian NC to be applicable and thus reported to the secretary of CLC/TC 11.

Clause National regulation**1 General scope – Field of application**

(A-dev) **AT.1** Notes 1, 2 and 3 are normative in Austria:

NOTE 1 The extent of the application of this standard is defined in Austrian „Elektrizitätsverordnung – ETV“.

NOTE 2 The construction of lines with covered conductors (KUF) and reduced internal or external clearance is not permitted in Austria. For KUF-lines the prescriptions for clearances as from 5.4.2.1 apply.

NOTE 3 In addition to the text from Part 1 the following applies:
These regulations also cover telecommunication lines which are carried on supports of OH high voltage lines. These regulations are 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. For such constructions the normal additional load as from 4.3.3 and the exceptional additional loads with minimum 12 N/m are to be considered.

For such constructions with metallic materials internal clearances as defined in 5.4.2.1 apply.

2 Definitions, symbols and references**2.1 Definitions**

(A-dev) **AT.1**

endurance tensile stress

of a conductor is the greatest constant tensile stress the conductor can withstand for a year without breaking

(A-dev) **AT.2**

a **conductor crosses an object** when, as a result of being deflected by wind blowing in the direction of that facility, the outline of the conductor intersects the outline of the object

(A-dev) **AT.3**

In addition to the definition in Part 1:

Conductors

are understood to mean bare, insulated, or sheathed wires and cables suspended between the supports of an overhead high-tension power transmission line – regardless of whether they are energized or not. Included here are lines having multiple functions (composite cables for conductors and earthwires). **OPCON** and **OPGW** are to be considered as conductors.

(A-dev) **AT.4**

the **protective zone** of an object is determined from the plan area which results when the ground plan of that object is enlarged equally on all sides by the extent indicated as the relevant lateral clearance for the object in question and for that group of overhead HV-lines, the Protective Zone is specified for.

(A-dev) **AT.5**

conductor in protective zone

a conductor of an overhead HV-line is within the protective zone of an object when, as a result of being deflected by wind blowing in the direction of the object, the outline of that conductor intersects the protective zone of that object

Clause National regulation

(A-dev) **AT.6**

clearance

the shortest permissible distance between a conductor of an overhead HV-line and an object. The clearance can occupy any position in space. The object in question may also be a conductor of another line. (Expression in German: „Schutzabstand“)

(A-dev) **AT.7**

normal additional load

that additional load which acts vertically and evenly distributed along the length of a conductor, and which is to be considered for normal loading assumptions as given in 4.3.3.

(A-dev) **AT.8**

exceptional additional load

that additional load which acts vertically and evenly distributed along the length of a conductor, and which on the basis of experience, can be expected only exceptionally and is to be considered for exceptional loading assumptions as given in 4.3.3.

(A-dev) **AT.9**

normal loading conditions

no ice conditions between temperatures of -20 and +40°C and under -5°C plus regular additional loads as defined in table 4.3.10.3/AT.2.

(A-dev) **AT.10**

exceptional loading conditions

conditions under -5°C plus regular additional loads as defined in table 4.3.10.3/AT.2.

(A-dev) **AT.11**

line groups

are defined as follows in Table 2.1/AT.11

Table 2.1/AT.11 - Line groups

Line Group	Nominal Insulation (series)	Maximum Operating Voltage, Effective Value in kV	Proof Alternating Voltage A (Alternating Voltage Holding Voltage) Effective Value in kV	Normal Surge Level (Surge Holding Voltage) Peak Value in kV
I	till 45kV	see ÖVE-L11 ³⁾ till 45kV	see ÖVE-L11 ³⁾ till 45kV	see ÖVE-L11 ³⁾ till 45kV
II	60 N	72,5	140	325
	110 NE ¹⁾	123	185	450
	110 N	123	230	450 ²⁾
III	150 NE ¹⁾	170	275	650
	150 N	170	325	750
	220 NE ¹⁾	245	395	900
	220 N	245	460	1050
IV	380 NE ¹⁾	420	630	1425
¹⁾ The letter „E“ indicates that it is a system with an effectively earthed neutral point. ²⁾ Applies only to overhead lines. In the case of other plant a value of 550 kV applies. ³⁾ New editions of ÖVE-L11 are published as series ÖVE/ÖNORM E 8111.				

Clause National regulation

- (ncpt) **AT.12**
minimum mechanical failing load
of a conductor is defined as 0,95 times its rated breaking load
- (ncpt) **AT.13**
cross section of a **conductor** (in German: Sollquerschnitt)
the metallic cross section, calculated from the data sheets

cross section of an **aerial cable**
the mechanical load carrying section of the cable only
- (ncpt) **AT.14**
span
the sector of a line between two consecutive supports of that line
- (ncpt) **AT.15**
span length
the horizontal distance between two consecutive supports of that line
- (ncpt) **AT.16**
section
the sector of a HV-line having one or more spans between two consecutive tension towers
- (ncpt) **AT.17**
conductor pull
the product of the rated cross-section of the conductor and the tensile stress acting in this cross-section in the tangential direction of the sag curve
- (ncpt) **AT.18**
upward or downward pull
the product of horizontal conductor pull and the tangent of the angle of inclination of the straight line connecting the two suspension points against the horizontal
- (ncpt) **AT.19**
sag
of a conductor is the vertically measured distance between a point of the conductor axis and the straight line connecting the conductor's two points of suspension
- (ncpt) **AT.20**
initial state
that one of the two states, -5°C plus normal additional load, or -20°C without additional load, at which the higher tensile stress occurs in the peak of the sag curve
- (ncpt) **AT.21**
initial tensile stress is the horizontal component of the tensile stress in the conductor when in the initial state
- (ncpt) **AT.22**
maximum tensile stress
the tensile stress occurring in the upper point of suspension of a conductor when in the initial state

Clause National regulation

(ncpt) **AT.23**
tensile strength

(ncpt) defined by
$$SZ = \frac{0,95 \times \text{theoretical break load of conductor}}{\text{nominal cross-section}}$$

(ncpt) **AT.24**
fittings

constructional elements which are installed either individually or in combination on or between conductors, insulators as well as between conductors resp. insulators and supports

Until IEC TC11 has finalized its document on tests of overhead lines fittings the failure criteria of fittings are defined by the following definitions of **limit loads for fittings**:

(A-dev) **AT.25**
breaking load

that load at which breaking occurs and thus the coupling is interrupted

(A-dev) **AT.26**
ultimate load

that load at which – despite progressive deformation – no further load can be taken up

(A-dev) **AT.27**
stretching load

that load at which permanent deformation will occur if further loads are applied

(ncpt) **AT.28**
safety

the quotient of limit load divided by the load arising from normal and exceptional loadings

(ncpt) **AT.29**
nominal cross section (in German: Nennquerschnitt)
the cross section used to define the conductor

2.3 References

(ncpt) **AT.1** ÖNORM B 3304, Natural rock aggregates for concrete

(ncpt) **AT.2** ÖNORM B 3307, Ready-mixed concrete

(ncpt) **AT.3** ÖNORM B 4100, Teil2, Timber structures, design and construction

(A-dev) **AT.4** ÖNORM B 4200 Teil 4, Reinforced concrete structures, basic rules for design

(A-dev) **AT.5** ÖNORM B 4200 Teil 7, Reinforced concrete structures, concrete reinforcement

(A-dev) **AT.6** ÖNORM B 4200 Teil 8 und 9, Reinforced concrete structures, design and detailing

(A-dev) **AT.7** ÖNORM B 4200 Teil 10, Concrete- production, applicability and verification of quality

Clause National regulation

- (A-dev) **AT.8** ÖNORM B 4430, Teil 1, Earthwork and foundation engineering; permissible soil pressures; areal foundations
- (A-dev) **AT.9** ÖNORM B 4430 Teil 2, Earthwork and foundation engineering; permissible soil pressures; pile foundations
- (A-dev) **AT.10** ÖNORM B 4605, Steel structures; towers, analysis, erection and workmanship
- (ncpt) **AT.11** ÖNORM E4000, Electrical overhead lines; aluminium and E-AlMgSi wires for stranded conductors
- (ncpt) **AT.12** ÖNORM E4030, Electrical overhead lines, Technical supply Conditions for strands and conductors type AAC, AAAC or steel also A/ACSR and aluminium/alluvium-clad steel conductors and AACSR conductors
- (ncpt) **AT.13** ÖNORM E4006 Galvanized steel strands for stranded conductors
- (ncpt) **AT.14** ÖNORM E 4200, Electrical overhead lines, Wooden poles, acceptance criteria
- (ncpt) **AT.15** ÖNORM E 4201, Electrical overhead lines, Wooden poles, calculation and construction
- (ncpt) **AT.16** ÖNORM E 4202, Electrical overhead lines, Wooden poles, bearing capacity of basic types
- (A-dev) **AT.17** ÖNORM S 1119, Low frequency lactic and magnetic fields, Permissible limits of exposure for the protection of persons in the frequency range 0 Hz to 30 kHz
- (ncpt) **AT.18** DIN 48200, part 1 Strands made of copper for stranded conductors
- (A-dev) **AT.19** ÖVE EN 50110-1, Operation of electrical installations
- (A-dev) **AT.20** ÖVE-L11, Construction of overhead power lines of more than 1kV

3 Basis of design

- (ncpt) **AT.1** : If elements are used which are not standardised, is shall be proven, that they guarantee the requested safety. Proof by calculation is allowed.

4 Actions on lines

4.1 Introduction

- (A-dev) **AT.1** : In Austria chapter 4.3 Actions, Empirical Approach, is to be followed.

AC Clause National regulation**4.3 Actions, empirical approach**

(ncpt) **AT.1** : The supports are to be designed to withstand the following external forces (loads):

- (1) selfweight of support
- (2) permanent loads
- (3) additional loads
- (4) assembly loads
- (5) wind loads
- (6) conductor pulls

4.3.2 Wind loads

(ncpt) **AT.1** : Wind loads on line supports are to be calculated for general under normal loading conditions, components exposed to wind are free of ice.

(ncpt) **AT.2** : In unusual cases, under particularly unfavourable climatic conditions, it may be necessary, in addition to the exceptional loading conditions as from relevant clauses of this regulations to allow for additional loading conditions, i.e. wind pressure on ice-covered components.

(ncpt) **AT.3** :

Table 4.3.2/AT.3 Wind pressure acting upon the directly affected components
Values relate to a wind velocity of 120 km/h and a thrust of 700 N/m²

1.1.1.1.1.1.1 Component	aerodyn. drag coefficient C_x	$C_x \cdot q_{120}$ N/m ²	Reduction factor
full flat surfaces	1,6	1112	1
flat lattice walls	made of angle profiles	1,4	973
	made of rods	1,1	765
Timber poles, steel poles, concrete poles of circular or near-circular shape	0,7	487	1
steel poles and concrete poles of hexagonal or octagonal shape	1,0	695	1
Double poles of Timber, steel resp. concrete	in the pole-plane	0,7	487
	rectangular to pole-plane where $e < d_m$ ¹⁾	0,8	556
wires and conductors of Circular or elliptical shape	$d < 15,8$ mm	1,15	600
	$d > 15,8$ mm	1,0	521
Aircraft warning and radar sphere $d < 1,0$ m	0,4	278	1
¹⁾ e inner distance pole to pole d_m means diameter of pole			

(ncpt) **AT.4** : Wind loads acting upon supports resulting from conductors are to be calculated as from the formula $Q_{wc} = q_c \cdot G_c \cdot C_c \cdot d \cdot L \cdot \cos \phi$

(ncpt) **AT.5** : Plane surfaces and lattice construction in direction of wind may be neglected when calculating the wind load.

(ncpt) **AT.6** : In case of „quartering wind“ the total wind force acting on equilateral-triangular or quadratic steel lattice towers is to be taken as twice the wind force blowing vertically against one individual tower wall. Following that, back walls are considered as already taken into account in that calculation. **AC**

Clause National regulation

(ncpt) **AT.7** : For components in the lee of wind, the wind load may be assumed as per Table 4.3.2/AT.7.

Table 4.3.2/AT.7 - Wind Load acting on components in the lee of the wind

Component		Wind load as per 4.3.2	
Back structure of lattice towers and lattice-type crossarms		80% of wind forces acting on the front lattice surface	
A-poles (wind in direction of A-plane on the rear pole)		50% of wind forces on the front pole.	
Bundle conductors horizontally arranged, for individual conductors in lee		80% of wind forces acting on the front conductor.	
Components located in lee of the wind, Depending on the distance x of these components and upon the breadth B of the front component	$x < B$	no wind load	
	$x = B$ to $x = 20 B$	50 %	of wind load on the front component
	$x > 20 B$	100 %	

(snc) **AT.8:** Span factor $G_c = 1,0$

(snc) **AT.9** : Factor V_h (m/s) given in the formula in 4.3.2 and AT.4 is to be calculated:

- at elevations above 15 m to 40 m above ground: at least 33,33 m/s (120 km/h).
- at elevations up to 15 metres and over 40 metres: Values for $C_x \cdot q_{120}$ according to Table 4.3.2/AT.3 may be reduced by 30% for elevations up to 15 metres above ground. For elevations of more than 40 metres above ground these values are to be increased by 30% for each 50 metres additional height started upon - on those parts of the line located at that greater heights.

4.3.3 Ice loads

(A-dev) **AT.1** : Ice loads on conductors (including earth wires and OPGWs): Ice loads occur as „normal additional loads“ in „normal conditions“ and as „exceptional additional loads“ in „exceptional conditions“.

(A-dev) **AT.2** : Normal and exceptional additional loads on conductors are to be selected with a view to the prevailing climatic conditions; the minimum assumptions are:

Normal additional load: $(4 + 0,2 \times d)$ in N/m (d = conductor diameter in mm)

Exceptional additional load for Group	II	III	IV	
	35	40	50	<N/m>

Clause National regulation

(snc) **AT.3** For **towers and equipment** the following loading conditions apply:

Table 4.3.3/AT.3 - Additional loads, ice loads

	Normal additional loads	Exceptional additional loads
Insulators strings of glass or porcelain ¹⁾	minimum 20% of their self weight	minimum 40% of their self weight
Tower body	No	no
Crossarms made of steel profiles	minimum 40% of their self weight.	minimum 80% of their self weight.
Crossarms made of other materials	minimum 120 N/m ² acting on total surface of all parts of crossarms.	minimum 250 N/m ² acting on total surface of all parts of crossarms.
Warning spheres and radar marker	minimum 120 N/m ² acting on total surface	minimum 250 N/m ² acting on total surface
¹⁾ For strings of composite insulators eventually higher percentages are to be considered.		

4.3.4 Combined wind and ice loads

(ncpt) **AT.1** : For calculation of wind loads all components of the line exposed to wind are free of ice as minimum requirement. Prevailing climatic conditions are to be considered. In unusual cases, under particularly unfavourable climatic conditions, it may be necessary to allow for additional loading conditions, i.e. wind pressure on ice-covered components, in addition to the exceptional loading conditions as per tables 4.3.10/AT.1 AT.3

4.3.6 Construction and maintenance loads

(ncpt) **AT.1** : Construction loads are to be assumed as perpendicularly acting single loads. They act on

- (1) crossarms which jut out more than 1,2 metres: at the crossarm's end
- (2) horizontal bracing of crossarms: in the middle of the bracing (crossarm's upper not horizontal bracings need not to be assumed with construction loads)
- (3) In areas with climbing facilities (e.g. ladder, steps) on supports: diagonals of these parts need not to be calculated for construction loads.
- (4) all horizontal bracings of tower bodies in the middle of the bracings (e.g. plan bracing, secondary bracing)

At (1) and (2) loadings of normal conditions according to 4.3.10.4 are to be assumed additionally, but not in cases (3) and (4).

Poles of wooden towers need not to be assumed with construction loads.

4.3.7 Security loads

(A-dev) **AT.1** : Consideration of security loads is covered under „exceptional load cases“ of 4.3.10 „Load Cases“, no additional consideration is demanded.

4.3.8 Short circuit-loads

(ncpt) **AT.1** : Short-circuit loads need not to be considered.

Clause National regulation**4.3.10.3 Conductor tension load cases**

(ncpt) **AT.1** : The calculation of the mechanical stresses of conductors and the determination of the sag are to be carried out on the basis of loading conditions as given in table 4.3.10.3/AT.2.

(ncpt) **AT.2** :
Table 4.3.10.3/AT.2 - Loading conditions and conductor tension load cases

Loading conditions	Temp. °C ¹⁾	Vertical load	Permissible stress
Normal loading condition	-5	Conductor weight + normal additional load	Initial tensile stress may not exceed the permissible initial tensile stress from table 9.5/AT.2. Maximum tensile stress may exceed this initial tensile stress by 5% at the most.
	-20	Conductor weight	
	+40 ²⁾	Conductor weight	
Exceptional loading condition	-5	Conductor weight + exceptional additional load	Tensile stress in the upper point of suspension under exceptional load conditions may not exceed the endurance tensile strength.
¹⁾ Under uncommon climatic conditions (e.g. in high mountain regions) it may become necessary to adapt the upper and lower temperature limits (+40°C resp. -20°C) to values which have been determined on experience of many years' observations. ²⁾ In case of lines which even in summer are subjected to very heavy specific current loading, a temperature of +60°C must be allowed for. Similarly the increase of conductor's temperature is to be considered when using high temperature conductors.			

(ncpt) **AT.3** : Under regular loading conditions the conductor pulls shall be assumed to be as in the initial state.

(ncpt) **AT.4** : Under exceptional loading conditions that conductor pulls at -5 °C and the, exceptional addition load shall be assumed. Differences in conductor pulls on both sides of tension towers of up to 10% of the greater conductor pull may be ignored.

(ncpt) **AT.5** : In loading cases where conductor pulls are to be deduced or be zero, the assumption is to be done in such a way, that the worst load results for the element in question.

4.3.10.4 Standard load cases

Loading cases as from table 4.3.10.4/AT.1 (suspension and angle suspension towers), table 4.3.10.4/AT.1 (suspension and angle suspension towers) and table 4.3.10.4/AT.3 (tapping towers) are to be considered.

Clause National regulation

(ncpt) **AT.1 :**

Table 4.3.10.4/AT.1 - Load cases for suspension and angle suspension towers

Normal loading conditions														
A	Horizontal forces	Wind Load: Wind perpendicular to the direction of the line, in the case of angle suspension towers in the direction of the bisectors, acting upon: tower, equipment, and ice-free conductors. Horizontal conductor pull: of all conductors												
	Vertical forces	Permanent Loads Upward and downward pulls Weight of the normal additional load on crossarms, equipment and conductors of the adjacent span halves Construction Load Selfweight of support Normal additional loads and construction loads are to be taken into account for the rating of those components for which the additional consideration of these loads along with the other vertical loads produces the less favourable stresses												
B	Horizontal forces	Wind Load: Wind in direction of the line, in the case of angle suspension towers vertical to the bisector of the angles, acting upon: tower, equipment, and ice-free conductors. Horizontal conductor pull: of all conductors.												
	Vertical forces	as per loading condition A.												
C	Horizontal forces	Reduction of the horizontal conductor pulls of all conductors in one adjacent span to the following percentages: <table><tr><td></td><td>II</td><td>IV</td><td>IV</td></tr><tr><td>for conductors</td><td>85</td><td>90</td><td>90 %</td></tr><tr><td>for ground wires</td><td>80</td><td>80</td><td>80 %</td></tr></table> Horizontal conductor pull of all conductors in the other adjacent span.		II	IV	IV	for conductors	85	90	90 %	for ground wires	80	80	80 %
		II	IV	IV										
for conductors	85	90	90 %											
for ground wires	80	80	80 %											
Vertical forces	as per loading condition A													
D	Horizontal forces	Discontinuation of the horizontal pull of one conductor resp. one bundle conductor in one adjacent span and reduction of the horizontal conductor pull of this conductor resp. bundle conductor in the other adjacent span to the following percentages: for single conductors 40 % for bundle conductors 20 % of the entire bundle conductor Horizontal conductor pull in all other conductors												
	Vertical forces	as per loading condition A For the conductor or bundle conductor with discontinued horizontal conductor pull the upward or downward pull is discontinued. For the conductor or bundle conductor with reduced horizontal conductor pull the upward or downward pull is to be reduced to the same percentage as the horizontal pull.												
E	Horizontal forces	Wind Load: Wind blowing diagonally to the assumed diagonal of the tower body cross-section, acting upon: tower, equipment and ice-free conductors. These loading conditions need only be considered in the case of towers with a total height of more than 40 metres above ground level.												
	Vertical forces	as per loading condition A												
Exceptional loading conditions														
K	Horizontal forces	Horizontal conductor pull: of all conductors in both spans.												
	Vertical forces	Permanent Loads Upward and downward pulls Weight of exceptional additional load on crossarms, equipment and conductors of the adjacent span halves. Selfweight of support												
L	Horizontal forces	Reduction of horizontal conductor pulls of all conductors in one adjacent span to the same percentage as under normal loading conditions C. Horizontal conductor pull of all conductors in the other adjacent span.												
	Vertical forces	as per loading condition K												

Clause National regulation(ncpt) **AT.2** :**Table 4.3.10.4/AT.2 - Load cases for tension and angle tension towers
(analogously for terminal tension towers)**

Normal loading conditions		
A	Horizon- tal forces	Wind Load: Wind perpendicular to the direction of the line, in case of angle tension towers in the direction of the bisectors or in that of the main axis of the support which deviates least from the direction of the resultant horizontal conductor pull, acting upon: tower, equipment, and ice-free conductors. Horizontal conductor pull: of all conductors
	Vertical forces	Permanent Loads Upward and downward pulls Weight of the normal additional load on crossarms, equipment, and conductors of the adjacent span halves Construction Load Selfweight of support Normal additional loads and construction loads are to be taken into account for the rating of those components for which the additional consideration of those loads along with the other vertical loads produces the less favourable stressing
B/C	Horizon- tal forces	Wind Load: Wind in direction of the line, in the case of angle tension towers perpendicular to the bisectors of the angle or vertical to that main axis of the support which deviates least from the direction of the resultant horizontal conductor pull, acting upon: tower, equipment, and ice-free conductors. Reduction of horizontal conductor pulls of all conductors in one adjacent span to 50 %. Horizontal conductor pull of all conductors in the other adjacent span.
	vertical forces	as per loading condition A. In the case of conductors with reduced horizontal conductor pulls the upward and downward pulls are to be reduced to 50 %.
D	Horizon- tal forces	Discontinuation of the horizontal pull of one tensioned conductor or bundle conductor whilst the full horizontal conductor pull is being considered by all other conductors tensioned on the tower.
	Vertical forces	as per loading condition A For the conductor or bundle conductor with discontinued horizontal conductor pull the upward or downward pull is discontinued.
Exceptional loading conditions		
K	Horizon- tal forces	Horizontal conductor pull: of all conductors.
	Vertical forces	Permanent Loads Upward and downward pull Weight of exceptional additional load on crossarms, equipment and conductors of the adjacent span halves. Selfweight of support.
L	Horizon- tal forces	Reduction of horizontal conductor pulls of all conductors in one adjacent span to 50 %. Horizontal conductor pull of all conductors in the other adjacent span.
	Vertical forces	as per loading condition K In the case of conductors with reduced horizontal pull the upward and downward pulls are to be reduced to 50 %.
M	Horizon- tal forces	Decrease of the horizontal conductor pull of one conductor or bundle conductor to 50 %, whilst the full horizontal conductor pull acting in all other conductors on the tower.
	Vertical forces	as per loading condition K In the case of conductors or bundle conductors with reduced horizontal conductor pull the upward or downward pull is to be reduced to 50 %

Clause National regulation

(ncpt) **AT.3:**

Table 4.3.10.4/AT.3 - Load cases for tapping towers

Normal loading conditions														
A	Horizon- tal forces	Wind Load: Wind in the direction of that main axis of the tower which deviates least from the resultant horizontal conductor pulls. acting upon: the tower, equipment, and conductors free of ice. Horizontal conductor pull: of all conductors												
	Vertical forces	Permanent Loads Upward and downward pulls Weight of the normal additional load on crossarms, equipment, and conductors of the adjacent span halves Construction Load Selfweight of support Normal additional loads and construction loads are to be taken into account for the rating of those components for which the additional consideration of those loads along with the other vertical loads produces the less favourable stressing												
B	Horizon- tal forces	Wind Load: Wind perpendicular to that main axis of the tower which deviates least from the resultant horizontal line pulls, acting upon: the tower, equipment, and conductors free of ice. Horizontal conductor pulls of all conductors												
	vertical forces	as per loading condition A.												
C	Horizon- tal forces	Wind Load: Wind perpendicular to that main axis of the tower which deviates least from the resultant horizontal line pulls, acting upon: the tower, the equipment, and the ice-free conductors. Terminated Conductors: Reduction of the horizontal conductor pulls of all conductors in an adjacent span or more adjacent spans to 50%. Horizontal conductor pulls of all conductors in all other adjacent spans. Non-terminated Conductors: Reduction of the horizontal conductor pulls of all conductors in an adjacent span or more adjacent spans to the following percentages: <table><tr><td>Group</td><td>II</td><td>III</td><td>IV</td></tr><tr><td>for conductors</td><td>85</td><td>80</td><td>90%</td></tr><tr><td>for ground wires</td><td>80</td><td>80</td><td>80%</td></tr></table> Horizontal conductor pull of all conductors in the other adjacent spans.	Group	II	III	IV	for conductors	85	80	90%	for ground wires	80	80	80%
	Group	II	III	IV										
for conductors	85	80	90%											
for ground wires	80	80	80%											
Vertical forces	as per loading condition A In the case of terminated conductors with reduced horizontal conductor pulls the upward and downward pulls are to be reduced to 50%.													
D	Horizon- tal forces	Horizontal forces Terminated Conductors: Discontinuation of the horizontal conductor pull of a conductor or bundle conductor in a span of the through system whilst in the other span the full horizontal conductor pull is exerted, and possible simultaneous discontinuation of the horizontal conductor pull of a conductor or bundle conductor of the tapping system. Horizontal conductor pull in all other conductors of the adjacent spans. Horizontal forces Non-terminated Conductors: Discontinuation of the horizontal conductor pull of a conductor or a bundle conductor in an adjacent span and reduction of the horizontal conductor pull of this conductor or bundle conductor in the other adjacent span of each conductor system to the following percentages: for single conductors 40%, for bundle conductors 20% of the entire bundle conductor. Horizontal conductor pull in all other conductors.												
	Vertical forces	as per loading conditions A In the case of the terminated conductors with discontinued horizontal conductor pull the upward or downward pull is discontinued. In the case of nonterminated conductors for which the horizontal conductor pull is discontinued, the upward or downward pull is also discontinued. In the case of conductors with reduced horizontal conductor pull the upward or downward pull is reduced to the same percentage as for the horizontal conductor pulls.												

continued at next page

Clause National regulation

Continuation of Table 4.3.10.4/AT.3

Exceptional loading conditions														
K	Horizontal forces	Horizontal conductor pull of the conductors of all adjacent spans.												
	Vertical forces	Permanent Loads Upward and downward pulls Weight of the exceptional load on the crossarms, the equipment, and the conductors of the adjacent spans. Selfweight of the support.												
L	Horizontal forces	Horizontal forces Terminated Conductors: Reduction of the horizontal conductor pulls of all conductors in an adjacent span to 50%. Horizontal conductor pulls of all conductors in all other adjacent spans. Horizontal forces Non-terminated Conductors: Reduction of the horizontal conductor pulls in one of the adjacent spans to the following percentages: <table><tr><td>Group</td><td>II</td><td>III</td><td>IV</td></tr><tr><td>for conductors</td><td>85</td><td>90</td><td>90%</td></tr><tr><td>for ground wires</td><td>80</td><td>80</td><td>80%</td></tr></table> Horizontal conductor pull of all conductors in the other adjacent spans.	Group	II	III	IV	for conductors	85	90	90%	for ground wires	80	80	80%
	Group	II	III	IV										
for conductors	85	90	90%											
for ground wires	80	80	80%											
	Vertical forces	as per loading conditions K In the case of terminated conductors with reduced horizontal conductor pulls the upward and downward pulls are to be reduced to 50%.												
M	Horizontal forces	Horizontal forces Terminated Conductors: Reduction of the horizontal conductor pull of a conductor or bundle conductor in an adjacent span of a through system to 50%, whilst in the other adjacent span the full horizontal conductor pull is acting, and possible simultaneous reduction of the horizontal conductor pull of a conductor or bundle conductor of the tapping system to 50%. Horizontal conductor pull in all conductors of the other adjacent spans. Horizontal forces Non-terminated Conductors: Horizontal conductor pull in all conductors.												
	Vertical forces	as per loading conditions K In the case of all conductors with reduced horizontal conductor pull the upwards and downwards pull is to be reduced to 50%.												

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(ncpt) **AT.4** : For timber poles of lines Group II with nominal insulation 45¹⁾ the following applies:

Table 4.3.10.4/AT.4 - Loading assumptions for timber poles

Timber poles lines group II nominal insulation 45 kV ¹⁾	Loading assumption
Suspension and angle suspension towers	Table 4.3.10.4/AT.1 A, B, C
Tension and angle tension towers	Table 4.3.10.4/AT.2 A, B/C
Tapping poles	Table 4.3.10.4/AT.3 A, B, C
¹⁾ Calculation of wooden towers of other Group II -lines (above 45kV) which remain in service for only a short period is also covered here, provided that they do not violate the Protective Zone of a facility where Enhanced Safety applies. In the event of violation of the said Protective Zone, complete loading conditions apply also for timber poles as from 4.3.10.4/AT.1 ...AT.3 of lines Group II which remain in service for only a short period of time.	

(ncpt) **AT.5** : If suitable measures are adopted at suspension towers and angle suspension towers to ensure that there is no stress as per loading conditions D (discontinuation of the conductor pull of one conductor) or loading conditions C (differential pull), these loading conditions need not be taken into account. However, if the said measures ensure only partial relief, the percentages shown in Table 4.3.10.4/AT.1 must be adjusted to the extent of the effective relief. Reference for loading condition C is on the basis of the assumption that the conductor on one side of the tower is stressed with the normal additional load at -5°C whilst on the other side there is no additional load. Reference for loading condition D is on the basis of the assumption that on one side of the tower a conductor or a conductor of a bundle conductor has ruptured whereby on the opposing side the conductor pull reduced by the said special measures must be taken into account.

In the case of lines equipped with suspension strings it may be additionally assumed for the purposes of loading conditions C and D that between the tower in question and the next conductor termination there are three level spans with normal span lengths and similarly equipped suspension towers.

(ncpt) **AT.6** : If towers of a multiple-circuit line are initially only partially utilised, this is to be taken into account in the rating.

(ncpt) **AT.7** : If multiple strings are used, for the purpose of rating these supports and the components of these supports are also to be rated for the case of an individual string failing in the most unfavourable position.

Clause National regulation**4.3.11 Partial factors for actions**(ncpt) **AT.1 :****Table 4.3.11/AT.1 - Partial factors for actions - Ultimate limit states**
Values given below supersede those given in tables of Part 1.

Type of tower	Partial factors γ	Loading condition						
Suspension and angle suspension towers		A	B	C	D	E	K	L
	γ_G	1,3	1,3	1,3	1,3	1,3	1,0	1,0
	γ_W	1,3	1,3	n.a.	n.a.	1,3	n.a.	n.a.
	γ_I	1,3	1,3	1,3	1,3	1,3	1,0	1,0
	γ_A	n.a.	n.a.	n.a.	n.a.	n.a.	1,0	1,0
	γ_C	1,3	1,3	1,3	1,3	1,3	1,0	1,0
Tension and angle tension towers		A	B/C	D	K	L	M	-
	γ_G	1,3	1,3	1,3	1,0	1,0	1,0	-
	γ_W	1,3	1,3	1,3	n.a.	n.a.	n.a.	-
	γ_I	1,3	1,3	1,3	1,0	1,0	1,0	-
	γ_A	n.a.	n.a.	n.a.	1,0	1,0	1,0	-
	γ_C	1,3	1,3	1,3	1,0	1,0	1,0	-
Tapping towers		A	B	C	D	K	L	M
	γ_G	1,3	1,3	1,3	1,3	1,0	1,0	1,0
	γ_W	1,3	1,3	n.a.	n.a.	n.a.	n.a.	n.a.
	γ_I	1,3	1,3	1,3	1,3	1,0	1,0	1,0
	γ_A	n.a.	n.a.	n.a.	n.a.	1,0	1,0	1,0
	γ_C	1,3	1,3	1,3	1,3	1,0	1,0	1,0
Remarks: γ_G = Partial Factor for Self Loads γ_W = Partial Factor for Wind Loads γ_I = Partial Factor Additional Loads γ_A = Partial Factor Exceptional loads γ_C = Partial Factor for Conductor Pull n.a. not applicable								

(ncpt) **AT.2 :****Table 4.3.11/AT.2 - Partial coefficients for structural materials**

Eurocode	Material	γ_M
EC 2, Concrete	compressive concrete strength	1,5
	reinforcement, yield strength or $\sigma_{0,2}$	1,15
EC 3, Steel	resistance of sections (yield strength) and buckling	1,1
	resistance of bolted and welded connections (ultimate strength)	1,25
Timber	timber and timber based materials	footnote ¹⁾
	steel parts in connection	1,1
Foundations		footnote ²⁾
¹⁾ to be defined as soon as relevant EUROCODES are available. ²⁾ special provisions for dimensioning of foundations are given in 8.7 of this NNA.		

Clause National regulation(ncpt) **AT.3** :**Table 4.3.11/AT.3 - Partial coefficients for insulators, string accessories and conductors**

	Material (failure limit)	γ_M
Insulators	glass and porcelain - cap and pin insulator	2,00
	porcelain long rod insulator	2,00 ³⁾
	composite insulator	footnote ⁴⁾
String accessories	forged steel and structural steel, cast iron, aluminium casting alloy	footnote ¹⁾
Conductors, Earth wires, OPGWs	all types	footnote ²⁾
¹⁾ strength of string accessories from 11.6. ²⁾ Values for limits of strength and stresses from 4.3.10.3, or from clause 9 or from conductor producer's specification. ³⁾ Factors as used before in ÖVE-L11 were altered. The calculation of loads here is based on minimum breaking loads according to IEC method whilst was based on medium values according to ÖVE-L11 ⁴⁾ This value shall be taken from technical data sheets provided by producers.		

5 Electrical requirements

5.4 Internal and external clearances

The Austrian National Committee has undertaken comprehensive calculations to compare the present situation in Austria (according to ÖVE-L11) with the one given in the 3rd pre-draft. We found mostly similar clearances but in some cases inexplicable alterations up to 3 m differences (for external clearances). As the reasons for such differences are unclear and as aspects of safety and security are concerned, the Austrian NC keeps the unchanged clearances as from ÖVE-L11 into the NNAs for the present document. For the same reasons unchanged internal clearances are kept. Additional comparisons are being carried out.

The mentioned comparison can be found in document CLC/TC11(AT)10- December 1998 „Vergleich der externen Abstände zwischen ÖVE-L11 und CENELEC TC11(SEC)40“.

(A-dev) All clearances are a-deviations, as several other laws and regulations refer to these clearances.

5.4.2.1 General considerations and underlying principles

(A-dev) **AT.1** Overhead HV-lines are to be so constructed that:

- (1) conductors which are live are kept at such a distance from one another and from earthed components of their supports that electrical arc-over will be avoided. This condition can be said to be satisfied if the internal clearances required in 5.4.3 are not fallen short of.
- (2) the chance contacting of parts under voltage without the use of any special means is prevented. This condition is regarded as being satisfied if

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- (2.1) the values stipulated in relevant clauses for the clearances between live conductors and the ground are not fallen short of, and
 - (2.2) the lateral clearance between live conductors and facilities as stipulated in relevant clauses are not fallen short of. If the lateral clearances are fallen short of with the result that the overhead line runs in the vicinity of facilities (as per 5.4.5.2 to 5.4.5.5) the current carrying conductors must be so arranged that the clearance stipulated in the relevant clauses is not fallen short of.
 - (3) their supports and the foundations of their supports are built at an adequate distance from certain facilities. This condition is fulfilled when at least the measurements for these lateral clearances are observed.
 - (4) the additional measures called for in the event of line routing in the vicinity of certain facilities are adopted. In this context distinctions are drawn between different types of facilities.
 - (5) In the case of facilities not specified in 5.4.5.2 to 5.4.5.5 these present regulations for the determination of clearances and safety measures are to be applied analogously. There are separate technical regulations concerning clearances and safety measures to be adopted when working in the vicinity of overhead high-tension power transmission lines (ÖVE EN 50110-1).
- (A-dev) **AT.2** : Ground clearances and clearances between conductors and facilities are to be determined (to be checked) as follows:
- (1) Clearances from the ground, measured at right angle to the ground surface,
 - (1.1) for the less favourable of the normal loading conditions according to Table 4.3.10.3/AT.2 measured from the non-deflected conductor,
 - (1.2) for the normal loading conditions according to Table 4.3.10.3/AT.2, +40°C resp. increased temperature, where the conductor is deflected by the wind in that direction which results in a smaller clearance,
 - (1.3) for the exceptional loading conditions according to Table 4.3.10.3/AT.2, measured from the non-deflected conductor.
 - (2) Lateral clearances between the conductor and objects as measured between the outline of the conductor and the outline of the nearest part of the object for normal loading conditions as per Table 4.3.10.3/AT.2, +40°C resp. increased temperature, in the case of deflection of the conductor by wind in the direction which reduces the clearance. This lateral clearance is also to be taken for determining the Protective Zone.
 - (3) Clearance between the conductor and the object (which may occupy any position in space),
 - (3.1) for the least favourable of the normal loading conditions according to Table 4.3.10.3/AT.2 measured from the non-deflected conductors,
 - (3.2) for the normal loading conditions as per Table 4.3.10.3/AT.2, +40°C resp. increased temperature, where the conductor is deflected by wind in the direction which reduces the clearance,
 - (3.3) for the exceptional loading conditions according to Table 4.3.10.3/AT.2, measured from the non-deflected conductor.
 - (4) Clearances for special cases according to 5.4.5.2 to 5.4.5.5 for the values stipulated for each special case.

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(A-dev) **AT.3** : In addition to the prescriptions found in relevant items of clause 5 the following applies:

When crossing or routing **conductors within the protective zone of certain objects** or facilities, the following measures for „Enhanced Safety“ are to be considered if requested in the relevant clauses.

Measures for enhanced safety:

(1) Insulator Strings as Tension Insulators

At tension towers multi-unit strings are to be used in those spans which are in the direction of the crossing span resp. the crossing section. The mechanical dimension is to be done as given in section 10 „Insulators“.

(2) Insulator Strings on Suspension Towers

Multi-unit insulator strings are to be used in the crossing span. The mechanical dimension is to be done as given in section 10 „Insulators“.

(3) Line routing

Measures for enhanced safety for attaching the conductors need not to be taken when due to conductor pulls away from the object the clearances as specified is not possible. This must be met even in the case of unfavourable position of the conductors, e.g. rupture of insulator strings, rupture of insulators.

(4) Oil switches and transformers

Oil switches and transformers may not be mounted on suspension towers. They may be mounted on tension towers if their connections to the conductors (jumpers) are not connected to conductors which are under tension.

5.4.2.2 Load cases for calculation of clearances

(A-dev) **AT.1** : Load cases for calculation of clearances are those from table 4.3.10.3/AT.

5.4.3 Clearances within the span and at the tower

(A-dev) **AT.1** : Clearances between conductors within a span are to be determined on the basis of a deflection image. This check shall be made to determine the convergence of neighbouring conductors under different loading conditions assuming equidirectional deflection by wind. Similarly the convergence of conductors when the lower conductor bounces back after drop of additional loads shall be checked -both when in the deflected and in the non-deflected state of the conductor. Even in the most unfavourable case the clearance "Z" according to Table 5.4.3/AT.10 is not to be violated.

(ncpt) **AT.2** : If conductors are made of the same material, having the same cross-section and the same sag, it is permissible to determine the minimal distance D between the non-deflected conductors in the middle of a span from the formula :

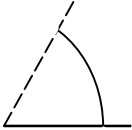
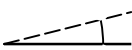
$$D = k \times \text{SQR}(f + L) + Z$$

whereby the value 0,8 metres may not be fallen short of.

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- D is the distance between conductors in metres in the middle of the span;
 f is the sag in the middle of the span in metres for those normal loading conditions according to Table 4.3.10.3AT.2, which produces the greater value;
 L is the length of the insulator string in metres (if the conductors are so fixed at the support that any deflection of insulators in a direction vertical to the axis of the line is prevented, then $L = 0$);
 Z is a supplement in metres which is allocated in Table 5.4.3/AT.10 depending on the nominal insulation of the line;
 k is the factor derived from Table 5.4.3/AT.3 which depends on the angle of deflection of the conductor and on the conductor arrangement on the support.

(ncpt) **AT.3 :****Table 5.4.3/AT.3 - Factor k**

Deflection angle of conductor wind as per 4.3.2 ¹⁾		above 65°	above 55° up to 65°	above 40° up to 55°	up to 40°
Conductors arranged one above the other 	> 60° - 90°	0,95	0,85	0,75	0,7
Conductors arranged diagonally to one another 	> 25° - 60°	0,75	0,70	0,65	0,62
Conductors arranged alongside one another 	0° - 25°	0,70	0,65	0,62	0,60
¹⁾ The angle of deviation relates to the ice-free conductor whereby the tangent of the angle of deviation is calculated as the quotient of wind pressure divided by weight of the conductor.					

(ncpt) **AT.4 :** Conductors arranged one above the other and not deflected, must be:

- (1) either arranged so that the minimum horizontal distance between the conductors is equivalent to the value „Z“ according to Table 5.4.3/AT.10, or
- (2) arranged so far apart from one another that the distance between the conductors is not less than „Z“ according to Table 5.4.3/AT.10 plus 1,7 times the difference between the sag of a conductor without additional load and the sag of a conductor with exceptional ice load at -5°C.

(ncpt) **AT.5 :** Where two neighbouring live conductors are kept apart in a span by means of interphase spacers resulting in subspans, distances between conductors given above in 5.4.3/AT.1 and AT.2 may be reduced. Application of formula (5.4.3/AT.2) to determine the necessary distances between conductors is permissible when the sag which would occur assuming 1,6 times the value of the subspan is taken as basis.

(ncpt) **AT.6 :** If differently routed lines carrying equal or different voltages are brought together to share a common support, the respective clearances of the individual line system in each of the last spans of the converging lines prior to reaching the common support are to be determined according to 5.4.3/AT.1 and are not to be arranged as per 5.4.5.4/AT.1.

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(A-dev) **AT.7** : Clearance on supports: Conductors and other components (e.g. jumpers and connections to instruments, etc.) carrying voltage towards each other are to be arranged that their distance apart is at least equivalent to the air clearance to be observed (see Table 5.4.3/AT.10).

(A-dev) **AT.8** : Clearance on supports: Live conductors and components must be separated from components not carrying voltage by at least a distance equivalent to the distance „E“ according to Table 5.4.3/AT.10.

(A-dev) **AT.9** : Clearance on supports: For the supporting of HV-lines on power stations, transformer stations, outdoor substations, tapping poles, etc., the provisions in 5.4.3/AT.7 and AT.8 apply with regard to the distances between fastening points and conductor arrangement (jumpers, connections, etc.).

(A-dev) **AT.10** :

Table 5.4.3/AT.10 – Distances

(all values not indicated are given in metres)

Group		I ¹⁾						II			III				IV	Application according to
Nominal Insulation		10N	15N	20N	25N 2)	30N 3)	45N	60N	110 NE	110 N	150NE	150 N	220N E	220N	380N E	
Peak Operating Voltage (effective value) kV		12	17,5	24	30	36 (37,5)	52	72,5	123		170		245		420	
Z as a function of the nominal insulation		0,12	0,17	0,20			0,30	0,40	0,73		1,00		1,50		2,50	5.4.3 span
Distance E from components	non deflected parts or cond.	0,12	0,17	0,22	0,26	0,30	0,40	0,50	0,73	0,88	1,00	1,20	1,50	1,76	2,50	5.4.3 tower
	deflected parts corcond.	0,12	0,17	0,20			0,30	0,40	0,73		1,00		1,50		2,50	
normal air clearance ²⁾		0,12	0,17	0,22	0,26	0,32	0,48	0,63	0,92	1,15	1,38	1,62	1,96	2,30	3,05	5.4.3 / AT.7
increased air clearance ³⁾		0,15	,205	0,26	0,32	0,38	0,57	0,74	1,08	1,35	1,62	1,87	2,28	2,65	3,50	
¹⁾ Values for voltages till 45kV are given for completion of the table and are to be understood informative. ²⁾ Minimal clearance (internal) between conductors of the same system. ³⁾ Minimal clearance (internal) between conductors of one system to conductors of another system.																

(snc) **AT.11** : For calculations of deviations of suspension strings equipped with or without counterweights wind force on conductors may be reduced for spans exceeding 200 m as follows: $G_c = 0,6 + 80/L$ where L is the arithmetic medium value of the adjacent spans.

Clause National regulation**5.4.4 Clearances to ground in areas remote from buildings, roads, railways and navigable waterways**

(A-dev) **AT.1 : Clearances to ground in unobstructed countryside** (expression in German: „Geländeoberfläche“): the following applies:

additional requirements: none .

Clearances between conductors and the ground are to be measured right-angled to the surface of the ground. Minor unevenness in the ground may be ignored here.

Clearance of conductors	Values in metres	II	III	IV
(1) under normal conditions				
(1.1) above normal ground		6	7	8
(1.2) above ground inaccessible to heavy road vehicles carrying high loads		5	6	7
(1.3) above steeply sloping ground, normally not frequented		4	5	6
(1.4) from rock faces, laterally measured rectangular to rock face		3,5	4	5
(2) under exceptional loading conditions in cases (1.1)...(1.4)		3,5	4	5

 Text deleted 

(A-dev) **AT.3 : Clearances to trees under the line and to trees beside the line (Forest aisles and isolated trees and shrubs)**, the following applies:

additional requirements: none .

Lines of Groups II...IV should not become endangered through windbreaks, windfalls, timberwork, snow pressure on tree trunks or branches, etc. The height to which trees will grow until ready for harvesting, the nature of the soil, breakdown of the tree population, and the prevailing wind directions shall be taken into account.

The following minimum clearances may not be fallen short of. They apply to the branch-free space, i.e. these minimum clearances may not be violated by treetops or branches either. Should the safety of operational of the line so require, these clearances are to be increased as necessary (diseased, hanging, or shallow-rooting trees, on steep slopes or where there is a risk of landslide, etc.).

Minimum Clearances	Values in metres	II	III	IV
(1) laterally of the conductor		4	5	6
(2) below the conductor				
(2.1) under normal loading conditions		4	5	6
(2.2) under exceptional loading conditions		0,8	1,5	2,5

The Protective Zone determined by the lateral clearance according to (1) is to be kept free of branches above the conductor to the full height of the tree.

Clause National regulation

5.4.5.2 Clearances to residential and other buildings

- (A-dev) **AT.1** : If the stipulated lateral clearances between overhead HV-lines and any of the facilities specified below being violated with the result that a conductor runs within the Protective Zone (subclause 2.1/AT.4) of a facility, then shortfalls of the clearances indicated in relevant subclauses of 5.4.5.2 may not be tolerated.
- (A-dev) **AT.2** : for **buildings** other than residential and school buildings, industrial or trading complexes, and similar: additional requirements: none .
Clearances as from 5.4.5.2/AT.4 below apply.
- (A-dev) **AT.3** : for **residential and school buildings, industrial or trading complexes, and similar**: Measures for „Enhanced Safety“ apply.
Clearances as from 5.4.5.2/AT.4 below apply.
- (A-dev) **AT.4** : For all buildings mentioned in 5.4.5.2/AT.2 and 5.4.5.2/AT.3 the following applies:

		Values in metres		
		II	III	IV
(1)	lateral distance of conductors from the nearest part of the building	4	5	6
(2)	clearance of conductors from nearest part of building			
(2.1)	under normal loading conditions	4	5	6
(2.2)	under exceptional loading conditions	3,5	4	5
(3)	clearance of conductors from flat roofs having up to 15 degree pitch, and flat constructions such as balconies and terraces, etc.			
(3.1)	under normal loading conditions	5	6	7
(3.2)	under exceptional loading conditions	3,5	4	5
(4)	Mounting overhead lines at residential- or school buildings, industrial or trading complexes etc., external or internal substations: in sectors of the said mounting/tensioning areas of conductors the above mentioned clearances to facilities need not to be considered, Enhanced Safety applies. Danger of electricity shall be payed attention to with measures which are to be considered as best appropriated (e.g. warning boards, barriers on roofs, etc.). Doors and windows may not exist within the mentioned clearances (windows if they are not locked properly or it is not prevented to come into contact with live parts).			
(5)	If the buildings belong to the same power supply station as the line (power station, transforming station, switching station) then smaller clearances are permissible, Enhanced Safety applies.			

⌈AC2⌋ (6) In the case of industrial and trading complexes, the special nature of the operations carried out (e.g. installations entailing a risk of fire or explosion) and also the operating/working space taken up by loading equipment, cranes, etc., must be taken into account, Enhanced Safety applies. ⌋AC2⌋

Clause National regulation** (7) Clearances of overhead lines to biogas installations****(7.1) General****(7.1.1) Definitions**

(7.1.1.1) Biogas installation: An installation used in order to produce, process, store and/or use biogas.

(7.1.1.2) Objects: All containers and gasholders used to produce, process, store and/or use biogas.

(7.1.1.3) Discharges: All pipes such as blow-off pipes, discharges of overpressure protections, air dischargers of a biogas installation, irrespective whether they are integrated or separated.

(7.1.2) Protective zone of an object: the protective zone of an object is determined from the plan area which results when the ground plan of that object is enlarged equally on all sides by the extent indicated as follows:

- overhead lines < 110 kV ... 4,0 m
- overhead lines $\geq$ 110 kV ... 10,0 m

(7.1.3) The outline of the non-deflected conductor shall not intersect the protective zone as defined according to (7.1.2). In addition for deflected conductors EN 50341-3-1:2001, § 5.4.5.2, AT.3, shall apply.

(7.1.4) The protection zone of objects shall be defined irrespective of the following factors:

- single-walled membrane gas tanks – stand-alone type,
- double membrane gas tanks – stand-alone type,
- single-walled membrane gas tanks – stand-alone type with supplementary sheeting for weather protection,
- gasholder for biogas – encapsulated type.

(7.1.5) Discharges are regarded as buildings according to EN 50341-3-1:2001, § 5.4.5.2, AT.2.

(7.1.6) Conductors (stationary or deflected), supports and foundations shall not extend into the explosive areas of the biogas installation (zone 0, 1 and 2). For the conductors the installation rules for normal and exceptional loading conditions apply.

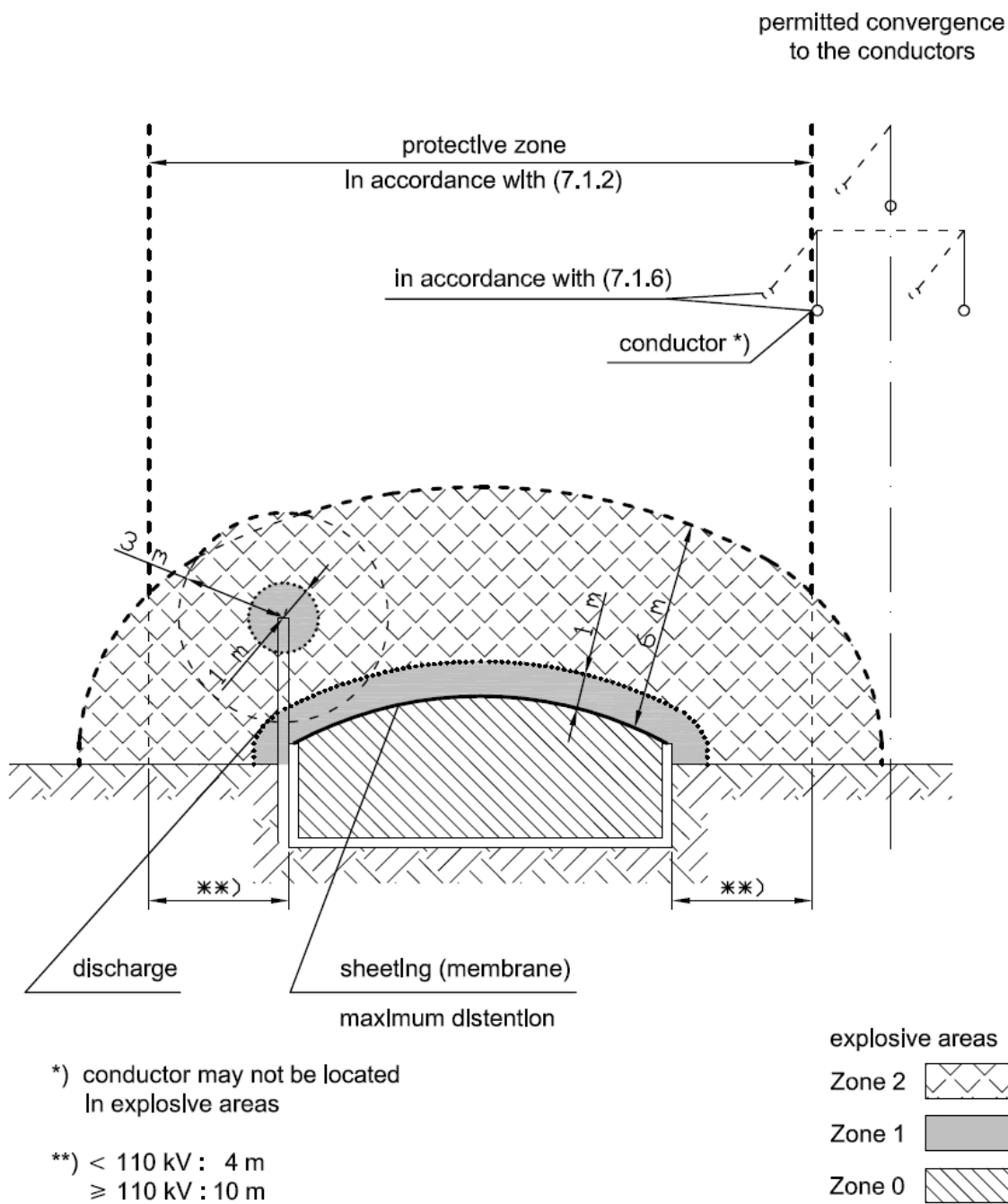
(7.2) Earthing installations

In case earthing installations of pressure vessels converge to the ones of overhead lines separate requirements have to be defined.

Examples for biogas installations: see fig. 5.4.5.2/AT1 and AT2. 

Clause National regulation

AC₂ Figure 5.4.5.2/AT1: single-walled membrane gas tank – stand-alone type

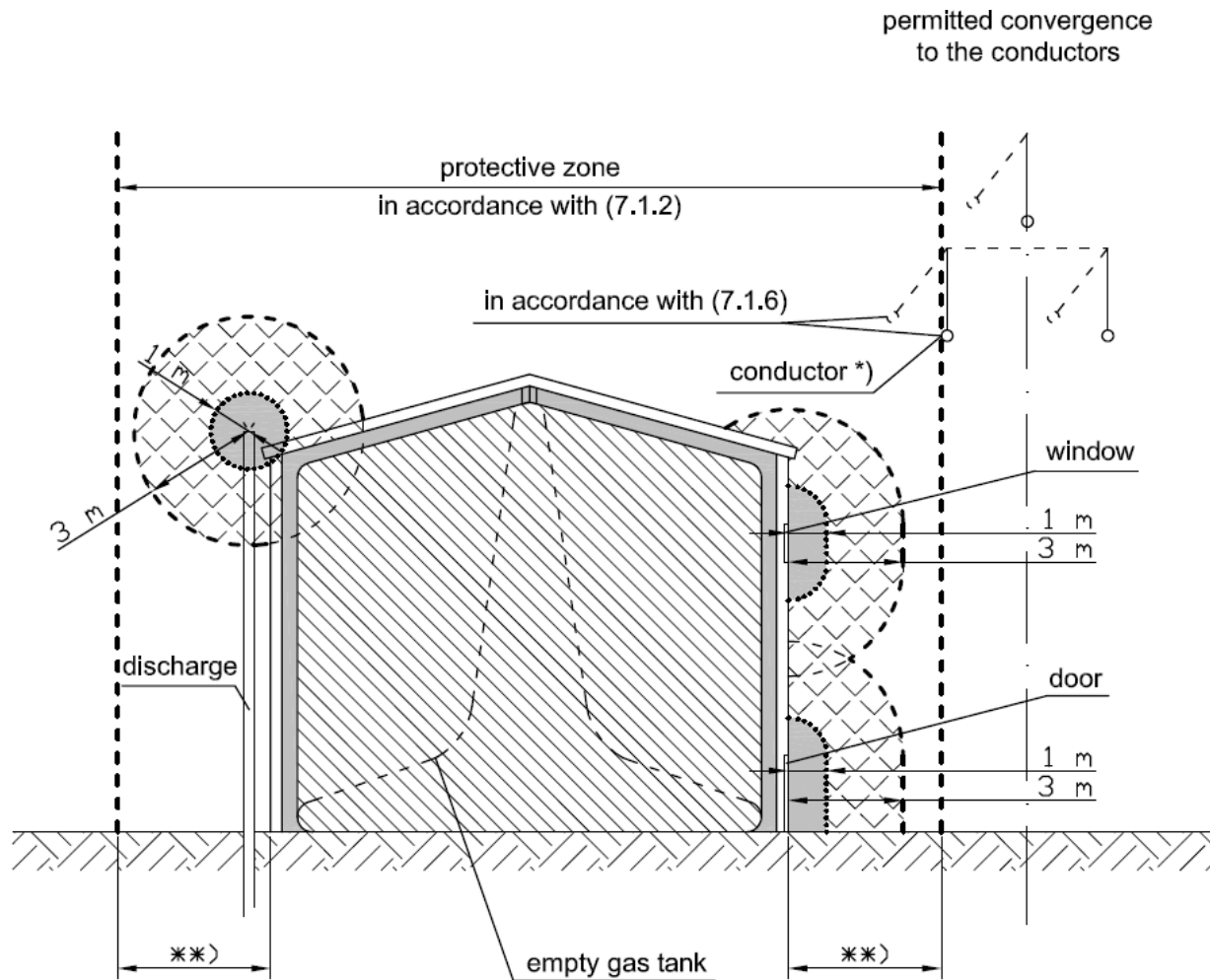


AC₂

Clause National regulation



Figure 5.4.5.2/AT2: gas tank – encapsulated type



*) conductor may not be located
in explosive areas

**) < 110 kV : 4 m
≥ 110 kV : 10 m

explosive areas

Zone 2

Zone 1

Zone 0



Clause National regulation



(8) Clearances of overhead lines pressure vessels (gas, liquid gas)

(8.)1 General

(8.1.1) Definition

(8.1.1.1) Pressure vessels (in terms of this specification): stationary containers used to store gases and gas-overlaid materials, whose product of prescribed highest working pressure in bar and capacity in litres exceeds 3.000 (bar × litres).

(8.1.2) Overground (stand-alone) pressure vessels

(8.1.2.1) Object: The overground (stand-alone) pressure vessel, including those valves which are connected to the pressure vessel.

(8.1.2.2) Protective zone of the object for overground (stand-alone) pressure vessels: the protective zone of the object is determined from the plan area which results when the ground plan of that object is enlarged equally on all sides by 5 m (see example A). If explosive areas exceed the protective zone the dimensions for explosive areas shall apply (see protective zone for > 30.000 l liquid gas, fig. 5.4.5.2/AT4). The protective zone is determined irrespective whether the stand-alone pressure vessel is designed for

- gases heavier or lighter than air,
- gases about as heavy as air or,
- liquid gas.

(8.1.2.3) The outline of the non-deflected conductor shall not intersect the protective zone as defined according to (8.1.2.2). Additionally EN 50341-3-1:2001, § 5.4.5.2, AT.3, applies for stationary and deflected conductors.

(8.1.2.4) Conductors (stationary or deflected), supports and foundations shall not extend into the explosive areas (zone 0, 1 and 2). For the conductors the installation rules for normal and exceptional loading conditions apply.

(8.1.3) Imbedded (buried) pressure vessels

(8.1.3.1) Imbedded pressure vessels are covered on all sides with earth or sand with a minimum thickness of 0,5 m.

(8.1.3.2) Only the explosive areas apply to imbedded pressure vessels. Conductors (stationary or deflected), supports and foundations shall not extend into the explosive areas (zone 0, 1 and 2). For the conductors the installation rules for normal and exceptional loading conditions apply.

(8.1.4) Pressure vessels in fire-resistive rooms

(8.1.4.1) Only the explosive areas apply to pressure vessels which are located in fire-resistive rooms (ÖNORM B 3800). Conductors (stationary or deflected), supports and foundations shall not extend into the explosive areas (zone 0, 1 and 2). For the conductors the installation rules for normal and exceptional loading conditions apply.

(8.1.4.2) EN 50341-3-1:2001, § 5.4.5.2, AT.3, apply to the building.



Clause National regulation**(8.2) Earthing installations**

In case earthing installations of pressure vessels converge to the ones of overhead lines separate requirements have to be defined.

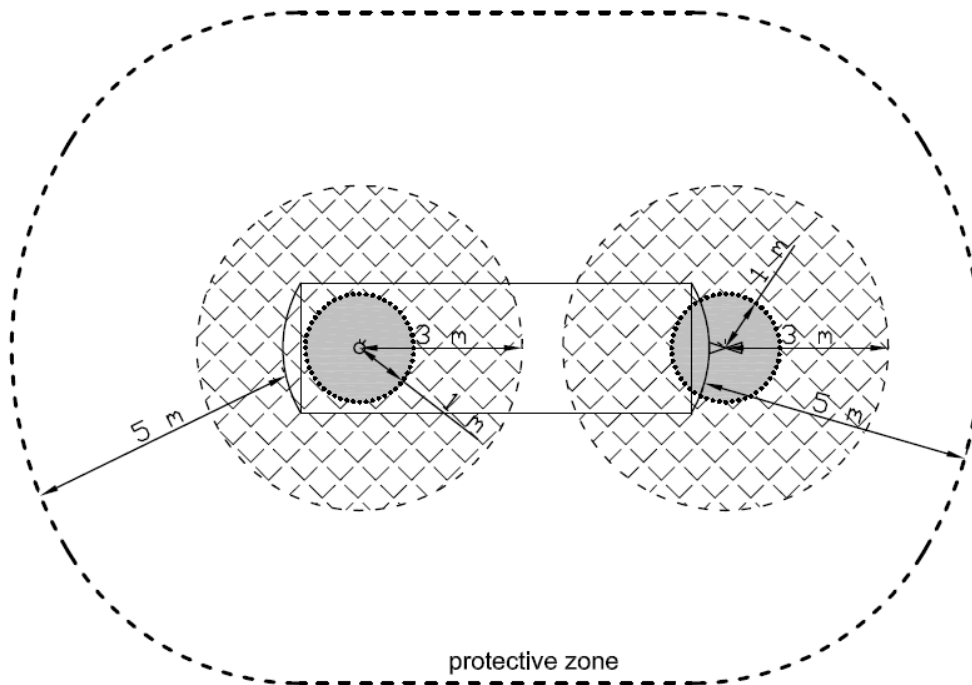
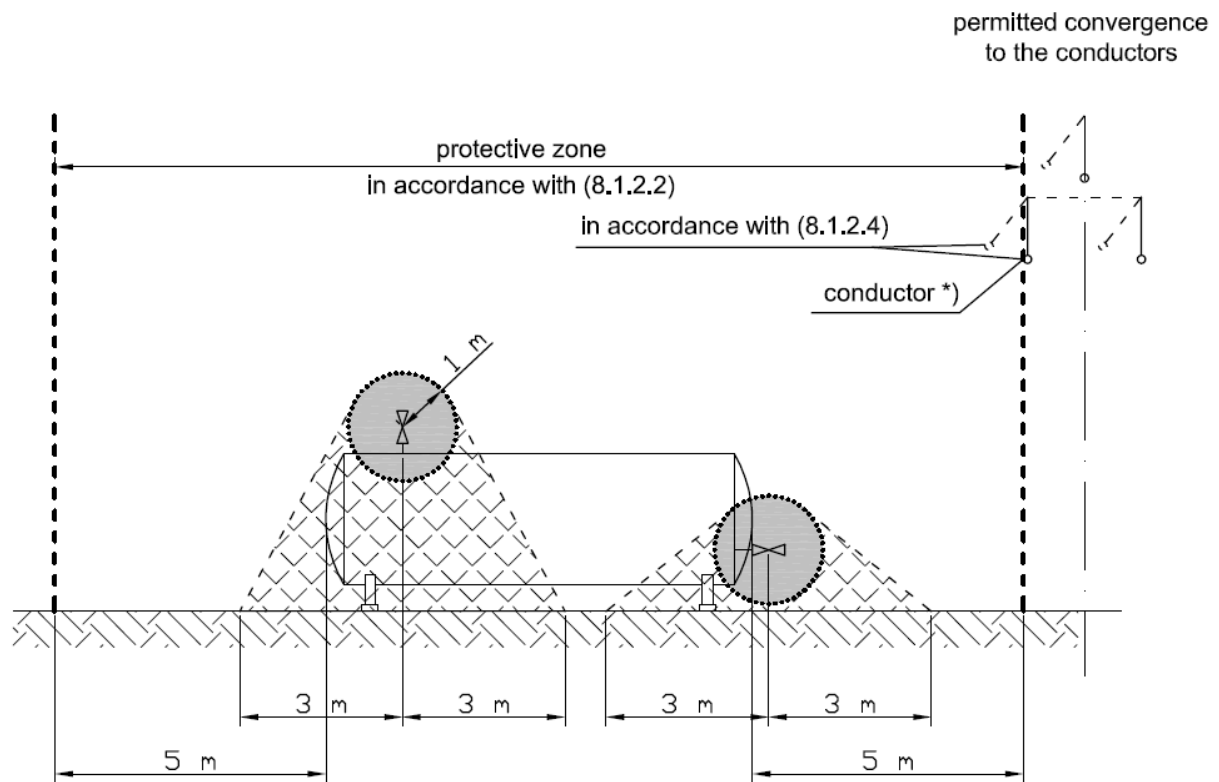
Examples for pressure vessels: see fig. 5.4.5.2/AT3 and AT4.



Clause National regulation



Figure 5.4.5.2/AT3: protective zone of pressure vessels, e.g. for methane



explosive areas

Zone 2

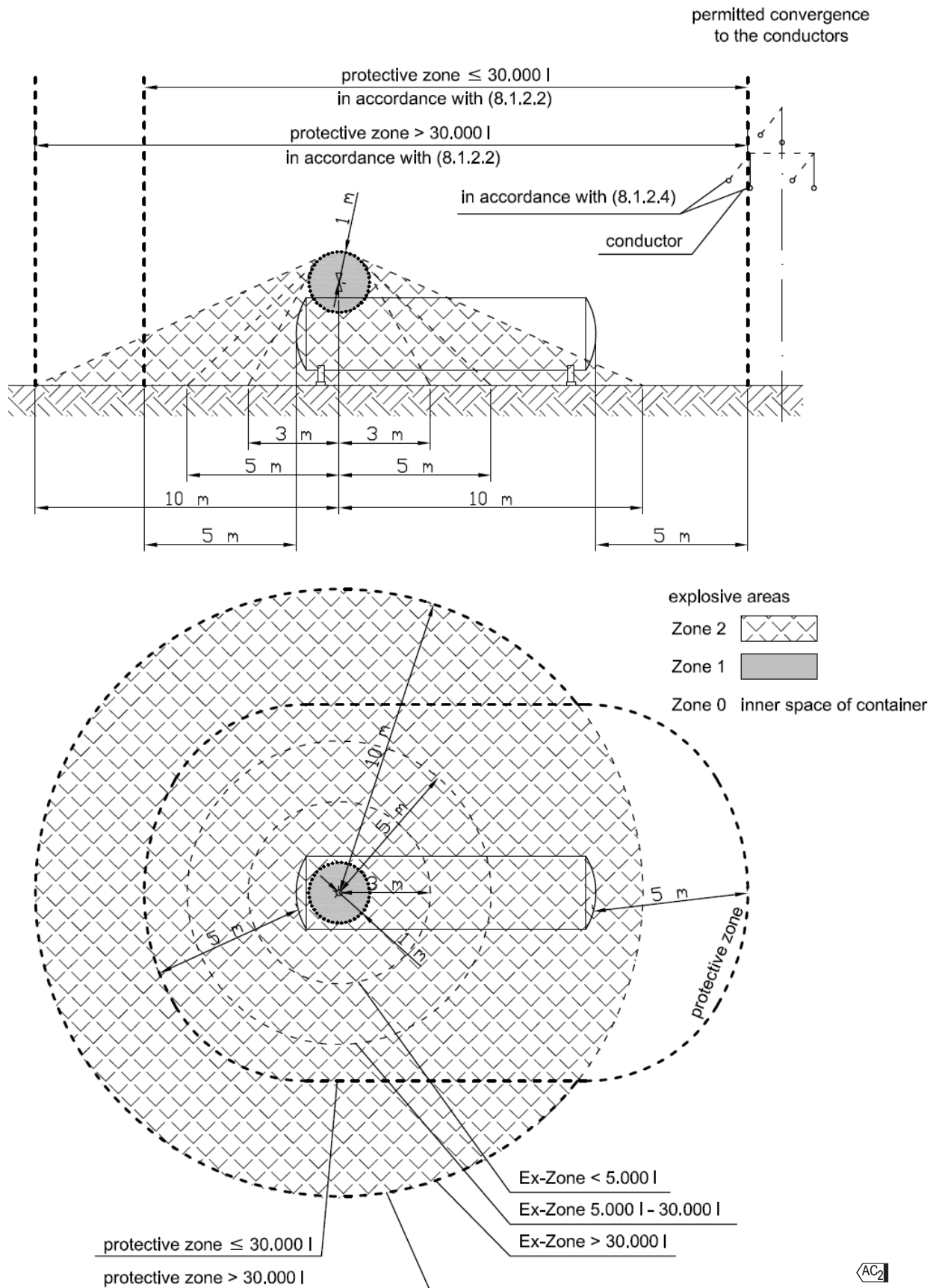
Zone 1

Zone 0 Inner space of container



Clause National regulation

Figure 5.4.5.2/AT4: protective zone of pressure vessels, e.g. for liquid gas



AC2

Clause National regulation



(9) Clearances of overhead lines to petrol stations

(9.1) General

(9.1.1) Definition

Petrol stations are stationary installations used to provide land, water and air crafts with liquid fuel from dispensing devices (e.g. petrol pumps), including storage tanks.

(9.1.2) EN 50341-3-1:2001, § 5.4.5.2, AT.3, apply to petrol stations in accordance with 1.1. Additional requirements shall be applied in accordance with the following specifications.

(9.1.3) Conductors (stationary or deflected), supports and foundations shall not extend into the explosive areas (zone 0, 1 and 2). For the conductors the installation rules for normal and exceptional loading conditions apply.

Example for the protective zone of petrol stations: see fig. 5.4.5.2/AT5.

(9.1.4) Overground stand-alone containers for flammable liquids, hazard categories I and II¹

(9.1.4.1) Protective zone for overground (stand-alone) containers for flammable liquids: the protective zone is determined from the plan area which results when the ground plan of the container is enlarged equally on all sides by 5 m.

(9.1.4.2) The outline of the non-deflected conductor shall not intersect the protective zone as defined according to (9.1.4.1) Supports and foundations shall not extend into the protective zone.

(9.1.4.3) When the explosive areas are additionally covered by non-combustible materials, EN 50341-3-1:2001, § 5.4.5.2, AT.3, shall apply.

(9.1.5) Imbedded containers for flammable liquids, hazard categories I and II¹

(9.1.5.1) Only the explosive areas apply to imbedded containers (e.g. filler piece, ventilation). Conductors (stationary or deflected), supports and foundations shall not extend into the explosive areas (zone 0, 1 and 2).

(9.1.5.2) The lateral distance of the foundations of the supports from imbedded containers shall be chosen in a way that safeguards the stability of the overhead line. The minimum distance, however, shall never fall short of 1 m.

(9.2) Natural gas stations

For compressor units of natural gas refuelling stations (stand-alone, in housings or in fire-resistive rooms) the requirements for pressure vessels (subclause (8)) shall apply.

(9.3) Earthing installations

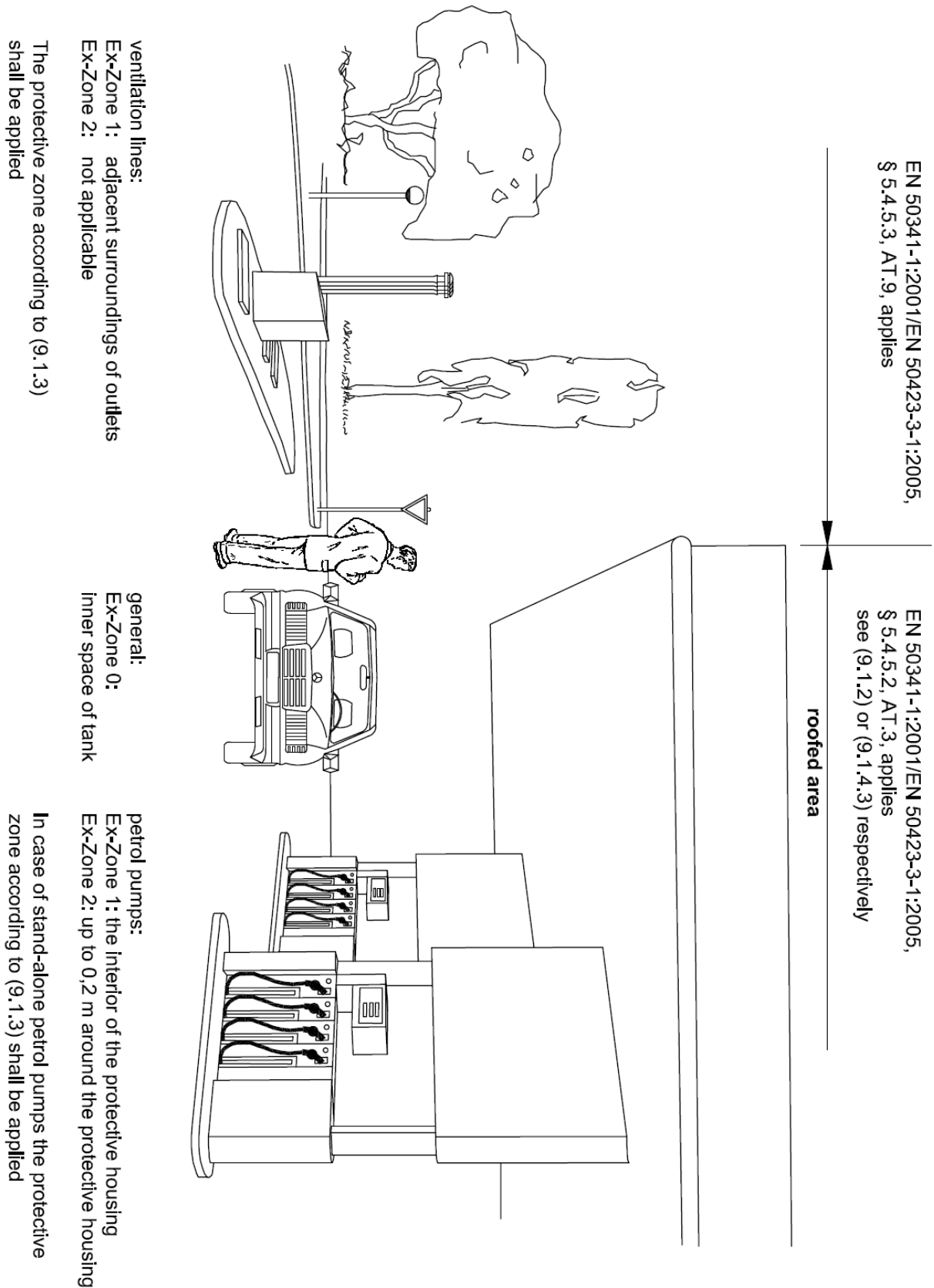
In case earthing installations of containers converge to the ones of overhead lines separate requirements have to be defined.

¹ according to Federal Decree 240/1991 on flammable liquids, „Verordnung über brennbare Flüssigkeiten – VbF“

Clause National regulation



Figure 5.4.5.2/AT5: protective zone of petrol stations, exemplary illustration. The explosive areas have to be defined for each case according to the authorization of the petrol station.



Clause National regulation

(A-dev) **AT.5** : For **street lamps, flag poles, advertising signs and similar structures** the following applies: additional requirements: none.

	Values in metres		
	II	III	IV
(1) lateral distance of conductors from the nearest part of the facility	4	5	6
(2) clearance of conductors from the nearest part of the facility			
(2.1) under normal loading conditions	4	5	6
(2.2) under exceptional loading conditions	3,5	4	5

(A-dev) **AT.6** : **Outdoor antenna installations**

(1) for Outdoor antenna installations (**not mounted on transmission line supports**) the following applies: Measures for „Enhanced Safety“.

These include: outdoor antennae structures, antenna supports, antenna cables, jumpers and lines, supplementary components, and earthing devices of the same. Overhead HV-lines are not permitted to cross under outdoor antenna systems.

	Values in metres		
	II	III	IV
(1.1) lateral distance of the conductors from the outdoor antenna system	2	3	5
(1.2) clearance of conductors from the outdoor antenna system			
(1.2.1) under normal loading conditions	2	3	5
(1.2.2) under exceptional loading conditions	0,8	1,5	2,5
(1.3) clearance of conductors from climbable antenna supports normal loading conditions	3	4	6
(1.4) Where an outdoor antenna system is located laterally to the overhead HV-line but at a higher elevation, then its lateral clearance from the conductors must be so great that, in the event of the antenna support collapsing there will still be a clearance between the outdoor antenna system and the overhead HV-line of at least	1	2	3

This does not necessarily apply if suitable measures are adopted (anchors, etc.) which would reliably prevent a collapsing of the outdoor antenna system in the direction of the overhead HV-line.

(2) for Outdoor antenna installations (**mounted on transmission line supports**) the following applies: additional requirements: none

(2.1) If antenna installations are mounted on transmission OHL structures, these structures remain designated as transmission line structures and their dimensioning underlies the relevant regulations for transmission overhead lines valid at the date of their erection.

Clause National regulation

(2.2) Supporting or mounting parts for antennas as well as climbing facilities, platforms, gratings/grillages etc. are to be considered as part of the support and are to be designed according to the current relevant regulations for transmission overhead lines.

(2.3) The determination of loads on antenna supporting parts and on OHL supports arising from antennas, is to be done according to the current relevant regulations for transmission overhead lines.

(2.4) Clearances are ^{a)} :	Values in metres		
	II	III	IV
(2.4.1) Clearance of live conductors from the antenna under normal loading conditions	2	3	4
(2.4.2) Clearance of not live conductors which are connected with earthed parts of the OHL support from the antenna under normal loading conditions	0,5	0,5	0,5

The low voltage grid feeding the antenna installation may not be influenced exceeding permitted values.

^{a)} For design and installation of climbing facilities, platforms and pedestals, reference is made to regulation ÖVE EN 50110-1.

5.4.5.3.1 Clearances to line crossing roads, railways and navigable waterways and

5.4.5.3.2 Clearances to line near roads, railways and navigable waterways

(A-dev) **AT.7** : for **bridges** the following applies: additional requirements: none .

In addition for facilities in the vicinity of bridges (e.g. traffic areas, lighting systems, etc.) the clearances appropriate to these facilities must also be taken into account. Apart from that the following apply:

		Values in metres		
		II	III	IV
(1)	lateral clearance of conductors from the bridge	4	5	6
(2)	clearance of conductors above the bridge			
(2.1)	under normal loading conditions	4	5	6
(2.2)	under exceptional loading conditions	3,5	4	5
(3)	clearance of conductors under a bridge			
(3.1)	provided the bridge is used as support of the overhead HV-line:	clearances as per 5.4.3		
(3.2)	provided the bridge is not used as support of the overhead HV- line			
(3.2.1)	under normal loading conditions	5	10	10
(3.2.2)	as above, but in the case of bounced up conductors	2	5	6

Clause National regulation

(3.3) If the traffic surface of a bridge is less than 5 metres above the live conductors, a protective plane is to be fitted to both sides of the bridge at the level of the traffic surface or just below. This plane has to cover the total width of the line plus two metres on either side whereby this protective plane must project at least 1 metre the traffic area of the bridge.

(A-dev) **AT.8** : for **municipal roads outside built-up areas** (expression in German: „Gemeindestraßen“) and **other roadways**: additional requirements: none . Clearances as from AT.11 below apply.

(A-dev) **AT.9** : for **federal motorways, type „S“** (expression in German: „Bundesstraßen S - Schnellstraßen“) and **type „B“** („Bundesstraßen“), **country roads** („Landesstraßen“) and for **traffic areas within built-up areas, traffic areas in industrial and trading complexes, and traffic areas in public parks**:
Measures for „Enhanced Safety“ apply. Clearances as from AT.11 below apply.

(A-dev) **AT.10** : for **motorways type „A“** (expression in German: „Autobahnen“) Measures for „Enhanced Safety“ apply. Clearances as from AT.11 below apply.

(A-dev) **AT.11** : for all categories of roads mentioned in AT.8, AT.9 and AT.10 above, the following applies:

When crossing motorways type A (Autobahnen) shortfalls of the required protective clearances are not permitted, even if the following unusual position of the conductors occurs:

- (a) The crossing span of the HV-line is loaded with normal additional load and all other spans of the line are not under additional load (unequal ice-load).
- (b) Breakage of an individual string of a multi-termination in case of normal loading condition. In this case deflection of conductors due to wind need not be taken into account.

		Values in metres		
		II	III	IV
(1)	lateral distance of conductors from the edge of the road (in case of motorways type „A“: from edge of the road or from the outer edge of the outer hard shoulder)	4	5	6
(2)	clearances of conductors from the road surface			
(2.1)	under normal loading conditions	7	8	9
(2.2)	under exceptional loading conditions	5,5	6	7
(2.3)	only for motorways type „A“: in case of conductors being in unusual position as per (a) and (b) above	5,5	6	7
(3)	only for municipal roads outside built-up areas and other roadways: lateral distance of support foundations from edge of the road	1	1	1
(4)	only for motorways type „S“ and „B“ and for countryroads: lateral distance between support's foundations and the edge of the road surface provided that the legally declared building ban is relaxed	2	2	2
(5)	only for motorways type „A“: lateral distance of the support foundations from edge of the road provided that authorities permit violation of the legislative building ban which applies	5	5	5

Clause National regulation

(A-dev) **AT.12** : for **waters** (Expression in German: Gewässer“, Except for Waterways - official shipping waters - which are treated in AT.13 below) the following applies: additional requirements: none .

Values in metres
II III IV

Clearance under normal loading conditions

(1) from non-navigable or non-floatable waters

(1.1) above normal waterlevel

5 6 7

(1.2) above highest waterlevel

3,5 4 5

(2) from navigable or floatable waters

(2.1) above highest navigable water level „HSW“

6 7 8

(2.2) above the highest structural part of the watercraft

2 3 5

(3) above the crest of passable flood banks

7 8 9

(4) Lateral clearance of support's foundations from bank edge or from land- or water-side foot of flood banks or berms

3 3 3

Any shortfall of the above clearances are subject to approval of the responsible water board authorities. The orderly use of tow paths (expression in German: „Treidelwege“) may not be obstructed by supports or their foundations.

(A-dev) **AT.13** : for **waterways** (official shipping waters – „Wasserwege“) the following applies: Measures for „Enhanced Safety“ apply.

Values in metres
II III IV

(1) lateral distance of conductors from the edge of river bank or from crest of flood banks

4 5 6

(2) clearance of conductors from highest navigable water level according to § 21(2) and § 21(3) of Austrian „Schiffahrtsanlagenverordnung“ under normal loading conditions

19 20,5 22

(3) clearance of conductors above crest of flood banks under normal loading conditions

7 8 9

(4) lateral distance of support's foundations

(4.1) from foot of the flood dam

5 5 5

(4.2) from flood dam against catastrophic flooding:

tower height + 5 metres;

(4.3) from riverbanks: clearances in accordance with instructions issued by waterway authorities.

(A-dev) **AT.14** : for **railways for public passenger services** (expression in German: „Schienenbahnen für öffentlichen Verkehr“) the following applies: Measures for „Enhanced Safety“ apply.

Clause National regulation

The unobstructed view of signals and level-crossings may not be violated by overhead lines. In the vicinity of railway stations, i.e. in spaces between the home signals and in the vicinity of platforms at railway halts, crossings are to be avoided as far as possible. When crossing trolley wires/facilities the use of wooden towers in the section is not permitted.

For railway power supply lines on own supports regulations according to 5.4.5.4 apply.

When crossing such railways shortfalls of the required protective clearances are not permitted, even if the following unusual position of the conductors occurs:

- (a) The crossing span of the HV-line is loaded with normal additional load and all other spans of the line are not under additional load (unequal ice-load).
- (b) Breakage of an individual string of a multi-termination in case of normal loading condition. In this case deflection of conductors due to wind need not be taken into account.

	Values in metres		
	II	III	IV
(1) Lateral distance between line conductors deflected by wind and the obstruction gauge limit and from trolley wire supports and signalling facilities	4	5	6
(2) Electrified railways, Trolley Wires and Power Supply Lines on Trolley Wire Supports			
(2.1) Clearance between line conductors and trolley wires			
(2.1.1) under normal loading conditions	3	4	6
(2.1.2) under exceptional loading conditions	2	3	5
(2.1.3) in the case of the line conductors being in unusual position as per (a) and (b) above	2	3	5
(2.2) clearance of line conductors from the power supply line			
(2.2.1) under normal loading conditions	2	3	5
(2.2.2) under exceptional loading conditions	0,8	1,5	2,5
(2.3) clearance of line conductors from supports			
(2.3.1) under normal loading conditions	3	4	6
(2.3.2) under exceptional loading conditions	2	3	5
(3) Where electrification is expected, the following is recommended for the free route: clearance of overhead line conductors from the top edge of rails under normal loading conditions	12,5	13,5	13,5
(4) Where no expectation of electrification			
(4.1) clearance of line conductors from top edge of rails			
(4.1.1) under normal loading conditions	7	8	10
(4.1.2) under exceptional loading conditions	6	7	9
(4.1.3) in the case of line conductors being in unusual position as per (a) and (b) above	6	7	9
(5) lateral distance of overhead line supports from obstruction gauge limit and from trolley wires and signalling units provided that the shortfall of the 12 metre building-ban zone (regulations for railways „Eisenbahngesetz“ is permitted by the Railway Authorities („Eisenbahnaufsichtsbehörde“)	5	5	5

Clause National regulation

(A-dev) **AT.15** : for **tramcar** (expression in German: „Straßenbahnen“) and **trolleybus wires, freight railways** („Materialbahnen“), **electrical towing systems** („elektrische Treidelanlagen“) the following applies:

Measures for „Enhanced Safety“ apply.

For supplying power lines on separate own supports the regulations according to

Values in metres II III IV

- | | | | |
|--|-----|-----|-----|
| (1) Lateral distance of the conductors to obstruction gauge limit, in the case of trolleybus wires from the edge of the road and from the trolley wire supports. | 4 | 5 | 6 |
| (2) Clearance of the conductors of the line from trolley wires and from power feed lines on trolley wire supports | | | |
| (2.1) under normal loading conditions, | 4 | 5 | 7 |
| (2.2) under exceptional loading conditions. | 0,8 | 1,5 | 2,5 |
| (3) Clearance of conductors from the top edge of the rails (where there are no overhead wires or power lines on trolley wire poles), | | | |
| (3.1) under normal loading conditions, | 7 | 8 | 10 |
| (3.2) under exceptional loading conditions. | 5,5 | 6 | 7 |
| (4) Lateral clearance of the line supports | | | |
| (4.1) from the obstruction gauge limit and from poles for trolley wire in those cases where the authorities relax the building ban | 5 | 5 | 5 |
| (4.2) from trolley wires and from the edge of the road | 2 | 2 | 2 |

(A-dev) **AT.16** : for **Moveable Counterpoises (Tackle Lines)** (expression in German: „Ortsveränderliche Bodenseilzüge“) the following applies:

additional requirements: none .

When determining distances from these systems the risk of the counterpoise being lifted and whipping up should be borne in mind, particularly in synclinal terrain.

Values in metres
II III IV

- | | | | |
|---|---|---|---|
| (1) clearance of the conductors from the counterpoise under normal loading conditions | 3 | 4 | 5 |
| (2) If it is intended to use guiding pulleys, guard cradles, and guard wires, etc., the clearances must be determined on a case-to-case basis in order to ensure the necessary electrotechnical security. | | | |

Clause National regulation

(A-dev) **AT.17** : for **freight-carrying cable railways** (expression in German: „Material-seilbahnen“), **agricultural and forestry ropeways** („land- und forstwirtschaftliche Seilwege“) the following applies: Measures for „Enhanced Safety“ apply.

Distances of the crossing-over overhead line are to be determined assuming the least favourable position of the cable railway (bouncing up, etc.).

	Values in metres		
	II	III	IV
(1) lateral distance			
(1.1) between the conductors and the cable railway cables, both of which deflected against one another by wind	4	5	6
(1.2) between the deflected conductors of the overhead HV-line and constructional parts of the cable railway	4	5	6
(2) clearance of the conductors from the cable railway			
(2.1) under normal loading conditions	2	3	4
(2.2) under exceptional loading conditions	0,8	1,5	2,5
(3) lateral distance of the line supports from constructional parts of the cable railway and from its deflected cable	2	2	2

In cases where the clearances indicated above cannot be guaranteed with certainty, barrier guards or other cushioning devices must be erected. Distances of the overhead HV-line from these latter fixtures are to be determined on a case-to-case basis in such a way that electrotechnical safety is assured.

Enhanced Safety measures are not necessary in the case of crossing-over cable railways which are not permitted to carry passengers, similarly in the case of agricultural and forestry ropeways, provided that in each case:

1. by virtue of official ruling, authorisation or order, it can be safely assumed that these services will not be operated during catastrophically weather (heavy snowfall, icing, gales, thunderstorms), or
2. barrier guards or other cushioning devices will be fitted which will reliably prevent contact between the conductors of the transmission line and parts of the cable railway.

The above regulations apply also in the case of telecommunication lines associated with agricultural and forestry supply cableways and routed along the same. Crossing under these facilities or their telecommunication lines by an overhead HV-line is permitted only in exceptional cases where there is no alternative. In such cases the most unfavourable position of the conductors of the line (bouncing up after dropping off of exceptional additional load) and the lowest position of the cable or traction system of the cable railway and the transported goods must be taken into account. Enhanced Safety measures for the overhead HV-line are not necessary.

(A-dev) **AT.18** : for **Funicular Railways for goods transport** (expression in German: „Standseilbahnen für Güterbeförderung“) the following applies:

Measures for „Enhanced Safety“ apply.
These include inclined hoists, brake inclines, winding engines, and aerial ropeways, etc., (also for industrial/works services). In case of synclinal longitudinal profile of the funicular railway, springing up of the traction cable must be taken into consideration.

Clause National regulation

	Values in metres		
	II	III	IV
(1) lateral distance of conductors from the obstruction gauge limit	4	5	6
(2) clearance of the line conductors from the obstruction gauge limit and from the traction cable when the latter springs up			
(2.1) under normal loading conditions	2	3	4
(2.2) under exceptional loading conditions	0,8	1,5	2,5
(3) lateral distance of the HV-line's supports from the obstruction gauge limit	2	2	2

(A-dev) **AT.19** : for **cable lifts** (expression in German: „Seilliftanlagen“) **providing public passenger transport service**, the following applies:

Measures for „Enhanced Safety“ apply.

It is not permissible for lines to cross under cable lifts. The clearances are to be calculated assuming the least favourable position of the cable railway cable (bouncing up of cable, etc.). Regulations as from 5.4.5.3.2/AT.21 below apply.

(A-dev) **AT.20** : for **cable railways** („Seilschwebbahnen“) **providing public passenger transport service** the following applies:

Measures for „Enhanced Safety“ apply.

Overhead lines may only **cross under** cable railways providing public passenger transport service in exceptional cases where there is no alternative. In such cases the overhead line is to be shielded by a building structure (protective boarding, tunnel etc.). However, this building structure must not obstruct the operating of the cable railway, even under the most unfavourable cable position. Furthermore, it must permit the accessing of the cable railway cable and also the overhead telecommunication cable associated with the cable railway for the purpose of inspection and maintenance and at the same time prevent the cable railway cable and the associated telecommunication line from coming nearer to the overhead line than permitted.

Where overhead lines **cross over** a cable railway, the most unfavourable position of the cable railway cable (after bouncing up, etc.) must be taken into account. Regulations as from 5.4.5.3.2/AT.21 below apply.

(A-dev) **AT.21** : for **cable lifts** and **cable railways** mentioned in 5.4.5.3.2/AT.19 and 5.4.5.3.2/AT.20 above, the following applies:

	Values in metres		
	II	III	IV
(1) Lateral distance			
(1.1) between line conductors and cable of the cable lift/railway including the rolling stock, when both are deflected towards one another by wind	4	5	6
(1.2) between the deflected conductors of the line and constructional parts of the cable lift/railway	4	5	6

Clause National regulation

- | | | | |
|--|---|---|---|
| (2) Clearance between line conductors and cable lift/railway | | | |
| (2.1) under normal loading conditions | 4 | 5 | 6 |
| (2.2) under exceptional loading conditions | 3 | 4 | 5 |
| (3) Lateral distance of line supports from structural parts of the cable lift/railway in cases where the railway authorities have agreed to relax the 12 metres no-building ban (regulations for railways) | 5 | 5 | 5 |

(A-dev) **AT.22** : for **funicular railways** (expression in German: „Standseilbahnen“) **providing public passenger transport services** the following applies:

Measures for „Enhanced Safety“ apply.

In the case of synclinal longitudinal profile of the funicular railway a bouncing up of the traction cable is to be taken into consideration.

Values in metres
II III IV

- | | | | |
|--|-----|---|---|
| (1) Lateral clearance between line conductors deflected by wind and obstruction gauge limit | 4 | 5 | 6 |
| (2) Protective clearance of line conductors from the obstruction gauge limit and from the traction cable after the latter has bounced up | | | |
| (2.1) under normal loading conditions | 2 | 3 | 4 |
| (2.2) under exceptional loading conditions | 1,5 | 2 | 3 |
| (3) Lateral clearance of line supports from structural parts of the funicular railway in cases where the railway authorities have agreed to relax the 12 metres no-building ban (regulations for railways) | 5 | 5 | 5 |

5.4.5.4 Clearances to other power lines or overhead telecommunication lines:

(A-dev) **AT.1**: for **Overhead Power Lines** the following applies:

Measures for „Enhanced Safety“ apply.

Lines up to 1000 V may not be crossed underneath by HV-lines. Measures for Enhanced Safety are only to be adopted for the line crossing over.

There are special regulations for the routing of overhead lines up to 1000 V at supports of HV-lines.

Values in metres
II III IV

- | | | | |
|---|-----|-----|-----|
| (1) lateral distance between conductors of two HV-lines routed on separate supports whereby it is assumed that the conductor of one line is not deflected and the conductor of the second line is deflected by the wind in the direction of the first | 2 | 3 | 5 |
| (2) clearance of supports | | | |
| (2.1) of the line to deflected conductors of the other line under normal loading conditions. Of criterion is the group of line to which the deflected conductors belong. | 3 | 4 | 6 |
| (2.2) of the deflected conductors of an overhead power line up to 1000 V | 1,5 | 1,5 | 1,5 |