



BSI Standards Publication

Overhead electrical lines exceeding AC 1 kV

Part 2-4: National Normative Aspects (NNA) for
GERMANY (based on EN 50341-1:2012)

National foreword

This British Standard is the UK implementation of EN 50341-2-4:2019. It supersedes BS EN 50341-2-4:2016, which is withdrawn.

This standard, together with the following list of National Normative Aspect standards, supersedes BS EN 50423-3:2005 and BS EN 50341-3:2001.

Country Code	Origin	Ref
AT	Austrian National Committee	BS EN 50341-2-1
BE	Belgian National Committee	BS EN 50341-2-2:2019
CH	Swiss National Committee	BS EN 50341-2-3
DE	German National Committee	BS EN 50341-2-4:2019
DK	Danish National Committee	BS EN 50341-2-5:2017
ES	Spanish National Committee	BS EN 50341-2-6:2017
FI	Finnish National Committee	BS EN 50341-2-7:2015
FR	French National Committee	BS EN 50341-2-8:2017
GB	British National Committee	BS EN 50341-2-9:2017+A1:2018
GR	Greek National Committee	BS EN 50341-2-10
IE	Irish National Committee	BS EN 50341-2-11
IS	Iceland National Committee	BS EN 50341-2-12:2018
IT	Italian National Committee	BS EN 50341-2-13:2017+A1:2017
LU	Luxemburg National Committee	No NNA available
NL	Nederland's National Committee	BS EN 50341-2-15:2019
NO	Norwegian National Committee	BS EN 50341-2-16:2016
PT	Portuguese National Committee	BS EN 50341-2-17
SE	Swedish National Committee	BS EN 50341-2-18:2016
CZ	Czech National Committee	BS EN 50341-2-19:2015
EE	Estonian National Committee	BS EN 50341-2-20:2018
PL	Polish National Committee	BS EN 50341-2-22:2016
SK	Slovak National Committee	BS EN 50341-2-23:2016

BS EN 50423-3:2005 and BS EN 50341-3:2001 will be withdrawn upon publication of the rest of the series.

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.

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Published by BSI Standards Limited 2019

ISBN 978 0 539 05214 5

ICS 29.240.20

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

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 30 June 2019.

Amendments/corrigenda issued since publication

Date	Text affected
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English Version

**Overhead electrical lines exceeding AC 1 kV - Part 2-4: National
Normative Aspects (NNA) for GERMANY (based on EN 50341-
1:2012)**

This European Standard was approved by CENELEC on 2019-04-10.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Bulgaria, Croatia, Cyprus, the Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.



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

CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

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European foreword

The following statements 1 to 6 are required from CLC/TC 11 for all NNAs; statement 7 was added by the German National Committee (NC).

- 1 The German National Committee is identified by the following address:

Deutsche Elektrotechnische Kommission im DIN und VDE (DKE)
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Name of the relevant technical body: Komitee 421 (K 421) "Freileitungen" (Overhead power lines)

- 2 The German NC and its technical body K 421 "Overhead power lines" of Deutsche Elektrotechnische Kommission im DIN und VDE (DKE) prepared this Part 2-4 of EN 50341, listing the German National Normative Aspects (NNA) under its sole responsibility, and duly passed it through the CENELEC and CLC/TC 11 procedures.

NOTE The German NC also takes sole responsibility for the technically correct co-ordination of this EN 50341-2-4:2019 with EN 50341-1:2012. It performed the necessary checks in the frame of quality assurance/control. However, it is noted that this quality control was made in the framework of the general responsibility of a standards committee under the national laws/regulations.

- 3 This EN 50431-2-4, hereafter referred to as Part 2-4, is normative in Germany and informative in other countries.

- 4 This Part 2-4 shall be read in conjunction with EN 50341-1, hereafter referred to as Part 1. All clause numbers used in this NNA correspond to those of Part 1. Specific subclauses, which are prefixed "DE", shall be read as amendments to the relevant text in Part 1. Any necessary clarification regarding the application of this NNA in conjunction with Part 1 shall be referred to the German NC who will, in co-operation with CLC/TC 11, clarify the requirements.

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

- 5 In case of "boxed values" defined in Part 1, amended values, (if any) which are defined in Part 2-4 shall be taken into account in Germany.

However, any "boxed value", whether in Part 1 or in this Part 2-4, shall not be amended in the direction of greater risk in a Project Specification.

- 6 The National German standards/regulations related to overhead electrical lines exceeding 1 kV AC are listed in 2.1 of this Part 2-4.

NOTE All national standards referred to in this Part 2-4 will be replaced by the relevant European Standards as soon as they become available and are declared by the German NC to be applicable and thus reported to the secretary of CLC/TC 11.

- 7 5.11.1/DE.1 is an "A-dev"
4.3/DE.1, 4.4.1/DE.1, 4.5.2/DE.1, 5.2.1/DE.1, 5.4.5/DE.1, 5.6.3.2/DE.1, 5.6.3.3/DE.1, 5.6.4/DE.1, 5.6.5/DE.1, and 9.6.4/DE.1 are "snc".
All other subclauses DE.X are "ncpt".

This second edition replaces the first edition published in 2016.

This edition includes the following changes with respect to the previous edition:

- the positions with a technical change have a vertical line in the left margin for identification and
- editorial changes were shaded words.

1 Scope

1.1 General

1.1 DE.1 General

(ncpt) (Supplement to DIN EN 50341-1 (VDE 0210-1):2013-11, clause 1.1)

This EN applies to planning and installation of overhead lines with nominal voltages above AC 1 kV.

This EN needs not to be adopted to existing installations. Installations in the planning and construction stage may be completed adopting the standard edition valid at the beginning of planning.

1.2 Field of application

1.2 DE.1 Application to conductors with components for telecommunication

(ncpt) (Supplement to DIN EN 50341-1 (VDE 0210-1):2013-11, 1.2)

In Germany this EN is applicable to all types of conductors (according to the information in clause 1.2) which contain components for telecommunication.

1.2 DE.2 Application to installation of telecommunication equipment on supports

(ncpt) (Supplement to DIN EN 50341-1 (VDE 0210-1):2013-11, 1.2)

In Germany this EN is applicable to the installation of telecommunication equipment on overhead line supports. Reference is made to 4.11.1/DE.1 “Extension of utilization”.

2 Normative references, definitions and symbols

2.1 Normative references

The following documents which are quoted partly or as a whole in this document are necessary for the application of this document. In case of dated reference only the referred edition is applicable. In case of non-dated references the last edition of the referred document (including all modifications) is applicable.

DAST 022¹, *Guideline of DAST for hot-dip-zinc-coating of prefabricated load-bearing steel components*

DAST-Richtlinie – Feuerverzinken von tragenden Stahlbauteilen

DIN 1054:2010-12, *Subsoil – Verification of the safety of earthworks and foundations – Supplementary rules to DIN EN 1997-1:2009-09 + NA:2010-12*

Baugrund – Sicherheitsnachweise im Erd- und Grundbau – Ergänzende Regelungen zu DIN EN 1997-1:2009-09 + NA:2010-12

DIN 4102-7, *Fire behaviour of building materials and building components – Part 7: Roofing – Definitions, requirements and testing*

Brandverhalten von Baustoffen und Bauteilen – Teil 7: Bedachungen – Begriffe, Anforderungen und Prüfungen

DIN 48006-1, *Insulators for overhead lines – Part 1: Long-rod insulators LP with socket caps*
Isolatoren für Starkstrom-Freileitungen – Langstabisolatoren mit Pfannenkappen

¹ SOURCE: Stahlbau Verlags- und Service GmbH, Sohnstraße 65, 40237 Düsseldorf.

DIN 48006-2, *Insulators for overhead lines – Part 2: Long-rod insulators LG with clevis caps*
Isolatoren für Starkstrom-Freileitungen – Langstabisolatoren mit Gabelkappen

DIN 48006-3, *Insulators for overhead lines – Part 3: solid-core insulators*
Isolatoren für Starkstrom-Freileitungen – Vollkernisolatoren VK

DIN EN 338:2016-07, *Structural timber – Strength classes; German version EN 338:2016*
Bauholz für tragende Zwecke – Festigkeitsklassen; Deutsche Fassung EN 338:2016

DIN EN 1090-1, *Execution of steel structures and aluminium structures – Part 1: Requirements for conformity assessment of structural components*
Ausführung von Stahltragwerken und Aluminiumtragwerken – Teil 1: Konformitätsnachweisverfahren für tragende Bauteile

DIN EN 1090-2, *Execution of steel structures and aluminium structures – Part 2: Technical requirements for steel structures*
Ausführung von Stahltragwerken und Aluminiumtragwerken – Teil 2: Technische Regeln für die Ausführung von Stahltragwerken

DIN EN 1991-1-4:2010-12, *Eurocode 1: Actions on structures – Part 1-4: General actions – Wind actions; German version EN 1991-1-4:2005 + A1:2010 + AC:2010*
Eurocode 1: Einwirkungen auf Tragwerke – Teil 1-4: Allgemeine Einwirkungen – Windlasten; Deutsche Fassung EN 1991-1-4:2005 + A1:2010 + AC:2010

DIN EN 1991-1-4/NA:2010-12, *National Annex – Nationally determined parameters – Eurocode 1: Actions on structures – Part 1-4: General actions – Wind actions*
Nationaler Anhang – National festgelegte Parameter – Eurocode 1: Einwirkungen auf Tragwerke – Teil 1-4: Allgemeine Einwirkungen – Windlasten

DIN EN 1992-1-1:2011-01, *Eurocode 2: Design of concrete structures – Part 1-1: General rules and rules for buildings; German version EN 1992-1-1:2004 + AC:2010*
Eurocode 2: Bemessung und Konstruktion von Stahlbeton- und Spannbetontragwerken – Teil 1-1: Allgemeine Bemessungsregeln und Regeln für den Hochbau; Deutsche Fassung EN 1992-1-1:2004 + AC:2010

DIN EN 1992-1-1/NA:2013-04, *National Annex – Nationally determined parameters – Eurocode 2: Design of concrete structures – Part 1-1: General rules and rules for buildings*
Nationaler Anhang – National festgelegte Parameter – Eurocode 2: Bemessung und Konstruktion von Stahlbeton- und Spannbetontragwerken – Teil 1-1: Allgemeine Bemessungsregeln und Regeln für den Hochbau

DIN EN 1993-1-1, *Eurocode 3: Design of steel structures – Part 1-1: General rules and rules for buildings*
Eurocode 3: Bemessung und Konstruktion von Stahlbauten – Teil 1-1: Allgemeine Bemessungsregeln und Regeln für den Hochbau

DIN EN 1993-1-5, *Eurocode 3: Design of steel structures – Part 1-5: Plated structural elements*
Eurocode 3: Bemessung und Konstruktion von Stahlbauten – Teil 1-5: Plattenförmige Bauteile

DIN EN 1993-1-6, *Eurocode 3: Design of steel structures – Part 1-6: Strength and stability of shell structures*
Eurocode 3: Bemessung und Konstruktion von Stahlbauten – Teil 1-6: Festigkeit und Stabilität von Schalen

DIN EN 1995-1-1, *Eurocode 5: Design of timber structures – Part 1-1: General – Common rules and rules for buildings*

Eurocode 5: Bemessung und Konstruktion von Holzbauten – Teil 1-1: Allgemeines – Allgemeine Regeln und Regeln für den Hochbau

DIN EN 1995-1-2, *Eurocode 5: Design of timber structures – Part 1-2: General – Structural fire design*

Eurocode 5: Bemessung und Konstruktion von Holzbauten – Teil 1-2: Allgemeine Regeln – Tragwerksbemessung für den Brandfall

DIN EN 1997-1:2009-09, *Eurocode 7: Geotechnical design – Part 1: General rules; German version EN 1997-1:2004 + AC:2009*

Eurocode 7: Entwurf, Berechnung und Bemessung in der Geotechnik – Teil 1: Allgemeine Regeln; Deutsche Fassung EN 1997-1:2004 + AC:2009

DIN EN 1997-1/NA:2010-12, *National Annex – Nationally determined parameters – Eurocode 7: Geotechnical design – Part 1: General rules*

Nationaler Anhang – National festgelegte Parameter – Eurocode 7: Entwurf, Berechnung und Bemessung in der Geotechnik – Teil 1: Allgemeine Regeln

DIN EN 10025-1:2005-02, *Hot rolled products of structural steels – Part 1: General technical delivery conditions*

Warmgewalzte Erzeugnisse aus Baustählen – Teil 1: Allgemeine technische Lieferbedingungen; Deutsche Fassung EN 10025-1:2004

DIN EN 10025-2:2005-04, *Hot rolled products of structural steels – Part 2: Technical delivery conditions for non-alloy structural steels*

Warmgewalzte Erzeugnisse aus Baustählen – Teil 2: Technische Lieferbedingungen für unlegierte Baustähle; Deutsche Fassung EN 10025-2:2004

DIN EN 12385-4, *Steel wire ropes – Safety – Part 4: Stranded ropes for general lifting applications*

Drahtseile aus Stahldraht – Sicherheit – Teil 4: Litzenseile für allgemeine Hebezwecke

DIN EN 12843, *Precast concrete products – Masts and poles*

Betonfertigteile – Maste

DIN EN 14229, *Structural timber – Wood poles for overhead lines*

Holzbauwerke – Holzmaste für Freileitungen

DIN EN 50182:2001-12, *Conductors for overhead lines – Round wire concentric lay stranded conductors, Deutsche Fassung EN 50182:2001*

Leiter für Freileitungen – Leiter aus konzentrisch verseilten runden Drähten, Deutsche Fassung EN 50182:2001

DIN EN 50183, *Conductors for overhead lines – Aluminium-magnesium-silicon alloy wires for overhead line conductors*

Leiter für Freileitungen – Drähte aus Aluminium-Magnesium-Silizium-Legierung

DIN EN 50189, *Conductors for overhead lines – Zinc-coated steel wires for stranded conductors*

Leiter für Freileitungen – Verzinkte Stahldrähte

DIN EN 50341-1 (VDE 0210-1):2013-11, *Overhead electrical lines exceeding AC 1 kV – Part 1: General requirements – Common specifications; German version EN 50341-1:2012*

Freileitungen über AC 1 kV – Teil 1: Allgemeine Anforderungen – Gemeinsame Festlegungen; Deutsche Fassung EN 50341-1:2012

DIN EN 50413 (VDE 0848-1), *Basic standard on measurement and calculation procedures for human exposure to electric, magnetic and electromagnetic fields (0 Hz – 300 GHz)*
Grundnorm zu Mess- und Berechnungsverfahren der Exposition von Personen in elektrischen, magnetischen und elektromagnetischen Feldern (0 Hz bis 300 GHz)

DIN EN 50443 (VDE 0845-8), *Effects of electromagnetic interference on pipelines caused by high voltage AC electric traction systems and/or high-voltage AC power supply systems*
Auswirkungen elektromagnetischer Beeinflussungen von Hochspannungswechselstrombahnen und/oder Hochspannungsanlagen auf Rohrleitungen

DIN EN 50522 (VDE 0101-2):2011-11, *Earthing of power installations exceeding 1 kV AC, German version EN 50522:2010*
Erdung von Starkstromanlagen mit Nennwechselspannungen über 1 kV; Deutsche Fassung EN 50522:2010

DIN EN 60038 (VDE 0175-1):2012-04, *CENELEC standard voltages (IEC 60038:2009, modified); German version EN 60038:2011*
CENELEC-Normspannungen (IEC 60038:2009, modifiziert); Deutsche Fassung EN 60038:2011

DIN EN 60071-2 (VDE 0111-2):1997-09, *Insulation coordination – Part 2: Application guide (IEC 60071-2:1996); German version EN 60071-2:1997*
Isolationskoordination – Teil 2: Anwendungsrichtlinie (IEC 60071-2:1996); Deutsche Fassung EN 60071-2:1997

DIN EN 60305 (VDE 0446-6), *Insulators for overhead lines with a nominal voltage above 1 kV – Ceramic or glass insulator units for a.c. systems – Characteristics of insulator units of the cap and pin type*
Isolatoren für Freileitungen mit einer Nennspannung über 1 000 V – Keramik- oder Glas-Kettenisolatoren für Wechselstromsysteme – Kenndaten von Kettenisolatoren vom Typ Kappenisolator

DIN EN 60383-1 (VDE 0446-1), *Insulators for overhead lines with a nominal voltage above 1 kV – Part 1: Ceramic or glass insulator units for AC systems – Definitions, test methods and acceptance criteria*
Isolatoren für Freileitungen mit einer Nennspannung über 1 kV – Teil 1: Keramik- oder Glas-Isolatoren für Wechselspannungssysteme – Begriffe, Prüfverfahren und Annahmekriterien

DIN EN 60865-1 (VDE 0103), *Short-circuit currents – Calculation of effects – Part 1: Definitions and calculation methods*
Kurzschlussströme – Berechnung der Wirkung – Teil 1: Begriffe und Berechnungsverfahren

DIN EN 60889, *Hard-drawn aluminium wire for overhead line conductors*
Hartgezogene Aluminiumdrähte für Leiter von Freileitungen

DIN EN 61109 (VDE 0441-100), *Insulators for overhead lines – Composite suspension and tension insulators for AC systems with a nominal voltage greater than 1 000 V – Definitions, test methods and acceptance criteria*
Isolatoren für Freileitungen – Verbund-Hänge- und -Abspannisolatoren für Wechselstromsysteme mit einer Nennspannung über 1 000 V – Begriffe, Prüfverfahren und Annahmekriterien

DIN EN 61232, *Overhead lines – Aluminium-clad steel wires for electrical purposes*
Freileitungen – Aluminium-ummantelte Stahldrähte für die Elektrotechnik

DIN EN 61284 (VDE 0212-1), *Overhead lines – Requirements and tests for fittings*
Freileitungen – Anforderungen und Prüfungen für Armaturen

DIN EN 61466-1 (VDE 0674-103-1), *Composite string insulator units for overhead lines with a nominal voltage greater than 1 000 V – Part 1: Standard strength classes and end fittings*
Verbund-Kettenisolatoren für Freileitungen mit einer Nennspannung über 1 000 V – Teil 1: Genormte Festigkeitsklassen und Endarmaturen

DIN EN 61466-2 (VDE 0441-5)², *Composite string insulator units for overhead lines with a nominal voltage greater than 1 kV – Part 2: Dimensional and electrical characteristics*
Verbund-Kettenisolatoren für Freileitungen mit einer Nennspannung über 1 000 V – Teil 2: Maße und elektrische Kenngrößen

DIN EN 61952 (VDE 0441-200), *Insulators for overhead lines – Composite line post insulators for A.C. systems with a nominal voltage greater than 1 000 V – Definitions, test methods and acceptance criteria*

Isolatoren für Freileitungen – Verbund-Freileitungsstützer für Wechselstromsysteme mit einer Nennspannung über 1 000 V – Begriffe, Prüfverfahren und Annahmekriterien

DIN EN 62004 (VDE 0212-303), *Thermal-resistant aluminium alloy wires for overhead line conductors*

Wärmebeständige Drähte aus Aluminiumlegierung für Leiter von Freileitungen

DIN EN 62305-2 Beiblatt 1 (VDE 0185-305-2 Beiblatt 1), *Protection against lightning – Part 2: Risk management – Supplement 1: Lightning threat in Germany*
Blitzschutz – Teil 2: Risiko-Management – Beiblatt 1: Blitzgefährdung in Deutschland

DIN EN ISO 898-1, *Mechanical properties of fasteners made of carbon steel and alloy steel – Part 1: Bolts, screws and studs with specified property classes – Coarse thread and fine pitch thread*

Mechanische Eigenschaften von Verbindungselementen aus Kohlenstoffstahl und legiertem Stahl – Teil 1: Schrauben mit festgelegten Festigkeitsklassen – Regelgewinde und Feingewinde

DIN EN ISO 1461, *Hot-dip galvanized coatings on fabricated iron and steel articles – Specifications and test methods*

Durch Feuerverzinken auf Stahl aufgebrachte Zinküberzüge (Stückverzinken) – Anforderungen und Prüfungen

DIN EN ISO 12944 (all parts), *Paints and varnishes – Corrosion protection of steel structures by protective paint systems*

Beschichtungsstoffe – Korrosionsschutz von Stahlbauten durch Beschichtungssysteme

DIN EN ISO 12944-4, *Paints and varnishes – Corrosion protection of steel structures by protective paint systems – Part 4: Types of surface and surface preparation*

Beschichtungsstoffe – Korrosionsschutz von Stahlbauten durch Beschichtungssysteme – Part 4: Arten von Oberflächen und Oberflächenvorbereitung

DIN IEC 60273 (VDE 0674-4), *Characteristics of indoor and outdoor post insulators for systems with nominal voltages greater than 1 000 V*

Kenngrößen von Innenraum- und Freiluft-Stützisolatoren für Systeme mit Nennspannungen über 1 000 V

² A consolidated version of IEC 61466-2, Ed. 1.2, was published 2018-05-09: IEC 61466-2:1998 + A1:2002 + A2:2018. The German standard DIN EN 61466-2 (VDE 0674-103-2) is in preparation.

DIN IEC/TS 60815-1 (VDE V 0674-256-1), *Selection and dimensioning of high-voltage insulators intended for use in polluted conditions – Part 1: Definitions, information and general principles*

Auswahl und Bemessung von Hochspannungsisolatoren für die Anwendung unter Verschmutzungsbedingungen – Teil 1: Begriffe, Informationen und allgemeine Grundlagen

DIN IEC/TS 60815-2 (VDE V 0674-256-2), *Selection and dimensioning of high-voltage insulators intended for use in polluted conditions – Part 2: Ceramic and glass insulators for a.c. systems*

Auswahl und Bemessung von Hochspannungsisolatoren für die Anwendung unter Verschmutzungsbedingungen – Teil 2: Keramik- und Glasisolatoren für Wechselspannungssysteme

DIN IEC/TS 60815-3 (VDE V 0674-256-3), *Selection and dimensioning of high-voltage insulators intended for use in polluted conditions – Part 3: Polymer insulators for a.c. systems*

Auswahl und Bemessung von Hochspannungsisolatoren für die Anwendung unter Verschmutzungsbedingungen – Teil 3: Polymerisolatoren für Wechselspannungssysteme

DIN VDE 0100-442 (VDE 0100-442):2013-06, *Low-voltage electrical installations – Part 4-442: Protection for safety – Protection of low-voltage installations against temporary overvoltages due to earth faults in the high-voltage system and due to faults in the low-voltage system (IEC 60364-4-44:2007 (Clause 442), modified); German implementation HD 60364-4-442:2012*

Errichten von Niederspannungsanlagen – Teil 4-442: Schutzmaßnahmen – Schutz von Niederspannungsanlagen bei vorübergehenden Überspannungen infolge von Erdschlüssen im Hochspannungsnetz und bei Fehlern im Niederspannungsnetz (IEC 60364-4-44:2007 (Abschnitt 442), modifiziert); Deutsche Übernahme HD 60364-4-442:2012

DIN VDE 0105-100 (VDE 0105-100), *Operation of electrical installations – Part 100: General requirements*

Betrieb von elektrischen Anlagen – Teil 100: Allgemeine Festlegungen

DIN VDE 0105-115 (VDE 0105-115), *Operation of electrical installations – Part 115: Particular requirements for agricultural plants*

Betrieb von elektrischen Anlagen – Besondere Festlegungen für landwirtschaftliche Betriebsstätten

DIN VDE 0212-399 (VDE 0212-399), *Conductors for Overhead lines – Conductors of concentric stranded round galvanized steel wires*

Leiter für Freileitungen – Leiter aus konzentrisch verseilten runden verzinkten Stahldrähten

DIN VDE V 0212-490 (VDE V 0212-490), *Fittings for overhead lines – Part 490: Components for the protection of birds – Requirements and tests*

Armaturen für Freileitungen – Teil 490: Bauteile für den Vogelschutz – Anforderungen und Prüfungen

DIN VDE 0845-6-1 (VDE 0845-6-1) *Influence of high-voltage systems on telecommunication systems – Part 1: General, limits, calculation and measurement methods*

Maßnahmen bei Beeinflussung von Telekommunikationsanlagen durch Starkstromanlagen – Teil 1: Grundlagen, Grenzwerte, Berechnungs- und Messverfahren

DIN VDE 0845-6-2 (VDE 0845-6-2), *Electromagnetic influence of electric power supply on telecommunication systems – Part 2: Influence by three phase ac systems*

Maßnahmen bei Beeinflussung von Telekommunikationsanlagen durch Starkstromanlagen – Teil 2: Beeinflussung durch Drehstromanlagen

VDE-AR-N 4210-11 (VDE-AR-N 4210-11):2011-08³, *Protection of birds on medium voltage overhead lines*
Vogelschutz an Mittelspannungsfreileitungen

Impregnated timber poles – Technical reference (FNN)
*Imprägnierte Holzmaste – Technischer Hinweis (FNN)*⁴

Twentysixth regulation on application of the German Federal Republic Emission Protection Law (Regulation on electro-magnetic fields, version according to the announcement of August 14, 2013 (BGBl p. 3266)
Sechszwanzigste Verordnung zur Durchführung des Bundes-Immissionsschutzgesetzes (Verordnung über elektromagnetische Felder in der Fassung der Bekanntmachung vom 14. August 2013 (BGBl. I S. 3266) – 26. BImSchV)

2.2 Definitions

The terms and definitions listed in DIN EN 50341-1 (VDE 0210-1):2013-11 are supplemented and detailed for the purpose of this Part 2-4 as follows.

2.2 DE.1

Overhead line

(ncpt) the total of a system for overhead transmission of electrical energy consisting of supports and line components

Note 1 to entry: Supports comprise towers, their foundations and earthings. Line components comprise overhead conductors and insulators together with their fittings.

2.2 DE.2

Tower and pole

(ncpt) part of the support consisting of tower body, earthwire peaks and crossarms

Note 1 to entry: Depending on the function within a line the towers and poles can be discerned according to 2.2/DE.2.1 to DE.2.7.

DE.2.1

Suspension tower

tower, which supports the conductors in a straight line

DE.2.2

Angle suspension tower

tower, which serves as suspension support for the conductors, where the line changes direction

DE.2.3

Angle tower

tower, which carries the resulting tensile forces at a point where the line changes direction

DE.2.4

Section tower and angle section tower

tower, which carries the conductor tensile force in line direction or in the resultant direction, respectively, and serves additionally as a rigid point in the line

DE.2.5

Dead end tower

tower, which carries the total conductor tensile forces in line direction on one side

³ SOURCE: VDE-VERLAG GMBH

⁴ SOURCE: VDE-InfoCenter – Verbandsgeschäftsstelle (actual version: version no. 6, 2011-10)

DE.2.6**Special tower**

tower, which serves for one or several of the above mentioned functions

DE.2.7**Guyed tower**

tower, which is provided additionally with stay wires in order to stabilize the tower body

DE.2.8**Uplift or downward force****DE.2.8.1****Uplift force**

component of the conductor tensile force due to different **altitudes** of the suspension points; acting in opposite direction of the conductor deadweight

DE.2.8.2**Downward force**

component of the conductor tensile force due to different **altitudes** of the suspension points; acting in direction of the conductor deadweight

DE.2.9**Span length**

horizontal distance between the attachment points of the conductor on two consecutive supports

Note 1 to entry: When determining the horizontal distance of the attachment points of a conductor the angle of the crossarm to the line needs to be considered accordingly.

[SOURCE: IEC 466-03-02, modified, note added]

DE.2.10**Wind span of a tower or pole**

horizontal distance between the points at mid span on each side of a support

[SOURCE: IEC 466-03-07]

DE.2.11**Weight span of a tower or pole**

horizontal distance between the lowest points of a conductor on either side of a support

[SOURCE: IEC 466-03-08, modified, note deleted]

DE.2.12**Tower equipment**

all components which are not part of the tower structure or the conductors themselves

Note 1 to entry: Insulators and fittings are in this category as well as radar markers and warning spheres when they are fitted directly at the tower or pole.

DE.2.13**Movable crossarm**

crossarm where halves of the crossarm are separately (swinging crossarm) or in total (turning crossarm) movably fixed on or at the body

2.2**DE.3****Foundation**

(ncpt)

part of the support fulfilling the task of transferring the structural loads from the tower or the pole to the subsoil and, at the same time, protecting the tower or pole against critical movements of the subsoil

DE.3.1**Compact foundation**

foundation, which accommodates the tower body **within** one single foundation body

DE.3.2**Separate footing foundation**

foundation, which accommodates the leg members of the tower **within** separate foundation bodies

DE.3.3**Working load of a foundation**

load transferred from tower to the foundation **at** a given load case

DE.3.4**Failing load of a foundation**

load under which the foundation fails

Note 1 to entry: The **failing** is defined **by impermissible** foundation movements and occurs in the transition range between stable and unstable state of equilibrium.

2.2**DE.4****Conductor** (of an overhead line)

(ncpt) a wire or combination of wires not insulated from one another, suitable for carrying an electric current

Note 1 to entry: One or more aluminium, aluminium alloy, copper, zinc-coated or aluminium-clad steel wires, or combinations thereof, wrapped together which collectively have the function of conducting an electric current.

Note 2 to entry: For certain purposes the separation into phase conductors conducting the operation current and earth wires according to DIN EN 50341-1 (VDE 0210-1):2013-11, **2.2.35** is necessary. This applies especially, however, not only **to** 5.8 and 5.9 of this standard.

[SOURCE: IEC 466-01-15, modified, Note 2 to entry added]

DE.4.1**Bundle conductor**

set of individual conductors connected in parallel and disposed in a uniform geometrical configuration, that constitutes one phase or pole of a line.

[SOURCE: IEC 466-10-20]

DE.4.2**Rated tensile strength of a conductor**

value which is calculated from the specified tensile strengths of the individual strands and can be taken from the conductor standards

Note 1 to entry: This term may **be** introduced in other standards also as nominal strength or design strength of conductors.

DE.4.3**Actual cross section of a conductor**

cross section of metal resulting from the conductor design

DE.4.4**Tensile stress of a conductor**

value which results from the division of the rated conductor tensile force by the actual cross section

DE.4.5**Rated tensile stress of a conductor**

rated tensile strength of a conductor divided by the **actual** cross section of the conductor

DE.4.6**Everyday stress**

horizontal component of the conductor's tensile stress which occurs at the annual mean temperature (normally at +10 °C) without wind load

DE.4.7**Conductor temperature**

temperature of a conductor due to the ambient temperature, wind, solar radiation and electric current

DE.4.8**Conductor sag**

vertical distance between the conductor and the alignment of the conductor suspension points (suspension sets) or at attachments points (tension sets) at the supports

DE.4.9**Maximum conductor sag**

the greater of the values resulting from the conductor temperature of –5 °C with ice load according to 4.5.2/DE.1 or from the maximum design temperature of the conductor without ice load

2.2

DE.5**Insulator**

(ncpt)

device intended for electrical insulation and mechanical fixing of equipment or conductors which are subject to electric potential differences

Note 1 to entry: The definitions for insulators are specified in DIN EN 60383-1 (VDE 0446-1) and DIN EN 61109 (VDE 0441-100).

[SOURCE: IEC 471-01-10, modified, Note 1 to entry added]

DE.5.1**String insulator**

cap and pin insulator or long rod insulator of which the end fittings are suited for flexible attachment to other similar string insulator units or to fittings for insulator sets.

[SOURCE: IEC 471-03-08, modified, “connecting accessories” replaced by “fittings for insulator sets”]

DE.5.1.1**Cap and pin insulator**

insulator comprising an insulating part usually having the form of a disk or bell, with or without ribs on its surface, and end fittings consisting of an outside cap and a ball attached axially

[SOURCE: IEC 471-03-07, modified, “inside pin” replaced by “ball”]

DE.5.1.2**Long rod insulator**

rigid insulator intended to be subjected to tensile loads, comprising an insulating part having an approximately circular cylindrical shank, with or without sheds, and external or internal fixing devices attached to each end

[SOURCE: IEC 471-03-05]

DE.5.2**Post insulator**

insulator intended to give rigid support to a live part which is to be insulated from earth or from another live part

Note 1 to entry: A post insulator may be an assembly of a number of post insulator units.

Note 2 to entry: Post insulators for substations are also known as station post insulators.

[SOURCE: IEC 471-04-01]

DE.5.2.1**Pin insulator**

rigid insulator consisting of an insulating component intended to be mounted rigidly on a supporting structure by means of a pin passing up inside the insulating component which consists of one or more pieces of insulating material permanently connected together

[SOURCE: IEC 471-03-06]

DE.5.2.2**Line post insulator**

rigid insulator intended to be subjected to cantilever, tensile and compressive loads, constructed with one or more insulating materials and assembled on a metal base that is intended to be mounted rigidly on a supporting structure

Note 1 to entry: Depending on the voltage level the design can be supplemented by top and intermediate fittings.

[SOURCE: IEC 471-03-04, modified, Note 1 to entry added]

DE.5.3**Insulator set**

assembly of one or more insulator strings suitably connected together, complete with the necessary fittings for that purpose as required in service

[SOURCE: IEC 471-03-02, modified, “with end fittings and protective devices” replaced by “with the necessary fittings for that purpose”]

DE.5.3.1**Insulator string**

one or more string insulator units coupled together and intended, with the required fittings included, to give flexible support to conductors and stressed mainly in tension

[SOURCE: IEC 471-03-03, modified by adding “with the required fittings included”]

DE.5.3.2**Multiple insulator set**

insulator set consisting of at least two insulator strings, which are designed equivalently

2.2**DE.6****Fitting**

(ncpt)

component, which can serve for the mechanical attachment, the electrical connection and the protection of conductors and insulators against mechanical vibrations and electric arcs as well as for potential control.

DE.6.1**Fitting for conductors**

Dead end equipment, suspension equipment, conductor connections, vibration protection fittings, bundle spacers, fittings for marking the conductors, fittings for repair of conductors

Note 1 to entry Clause 2.2/DE.6.3 applies to straps of wedge-type dead end clamps and suspension clamps as well as to the clevis of compression-type dead end clamps.

DE.6.2**Other fitting for conductor attachment**

side tie rod for line post insulators, top tie rod for line post insulators

DE.6.3**Fitting for insulator set**

component for connecting the dead end or suspension elements to the support, component for connecting the insulators, arc and potential control fittings, component for compensation of lengths and for sagging

Note 1 to entry The fittings for insulator sets are arranged between the dead end or suspension components and the first detachable part at the support, for example the jointing pin or the U-bolt. In case of line post insulators the pin is also included. The fittings for insulator sets, with exception of arc and potential control fittings, are loaded by the conductor tensile forces and the forces of the conductor due to dead-weight, ice loads and wind forces. The insulators themselves are not included.

2.2 **DE.7 Overhead line design**

DE.7.1**Line section**

(ncpt)

part of an overhead line situated between two adjacent section supports

DE.7.2**Span**

(ncpt)

part of a line between two consecutive points of support

[SOURCE: IEC 466-03-01, modified, wording "of a conductor" deleted]

DE.7.3**Crossing span**

(ncpt)

part of an overhead line over or under a crossed installation situated between two adjacent supports

DE.7.4**Clearance**

(ncpt)

distance between conductors and objects, in between conductors or between conductors and ground surface to be kept under consideration of the sag

DE.7.5**Crossing object**

(ncpt)

fixed or movable part of a crossed installation for which the clearances to the overhead lines shall be demonstrated

Note 1 to entry: Movable components may be considered by clearance gauges.

DE.7.6**Crossing**

(ncpt)

line section also with several consecutive crossing spans with a crossing object to which horizontal, vertical and shortest clearances shall be demonstrated

Note 1 to entry: In this case, the horizontal minimum clearance from swung conductors forms the uttermost lateral border of the crossing section.

2.3 Symbols

Symbol	Signification	Unit	Reference to subclause/clause
<i>a</i>	Distance between individual poles of a double- and A-type pole at half of the pole height	m	Table 4/DE.1 in 4.4.1/DE.1

a_{LTG}	Horizontal minimum clearance at a wind energy converter site depending on the system voltage according to Table 5/DE.2	m	5.9.3/DE.2.1
a_{Raum}	Working space for erection cranes for construction- and operation-related works at wind energy converters	m	5.9.3/DE.2.1
d_{accept}	Distance between high- and low-voltage earthing electrodes	m	6.1.2/DE.2.2
A	Gross cross section	mm ²	J.3/DE.1
A_{ins}	Insulator area exposed to wind	m ²	4.4.2/DE.1
A_{m}	Area of a crossarm member exposed to wind	m ²	4.4.3.2/DE.1.3
A_{net}	Net cross section	mm ²	J.3/DE.1
A_{pol}	Projected area of a pole	m ²	4.4.4/DE.1
A_{t1} or A_{t2}	Area of tower face 1 or face 2 filled with sections	m ²	4.4.3.2/DE.1.1
A_{tQ}	Area of crossarm face filled with sections	m ²	4.4.3.2/DE.1.2
a_{som}	Shortest distance between live and earthed parts at three supports before the crossing and three supports behind the crossing	m	5.5.3/DE.1; 5.9.1/DE.1
a_{WEA}	Horizontal distance between the uttermost conductor in still air of an overhead line and the axis of a tower of a wind energy converter	m	5.9.3/DE.2.1
C_{ins}	Drag factor for insulator sets	–	4.4.2/DE.1
C_{m}	Drag factor for crossarm members	–	4.4.3.2/DE.1.3
C_{C}	Drag factor for conductors	–	4.4.1/DE.1
C_{pol}	Drag factor for single poles	–	4.4.4/DE.1
C_{Q}	Drag factor for crossarm faces	–	4.4.3.2/DE.1.2
C_{t1} or C_{t2}	Drag factor for tower face 1 or tower face 2	–	4.4.3.2/DE.1.1
d	Conductor diameter without ice load	m	4.4.1/DE.1, 4.5.2/DE.1
d_{m}	Mean value of mean diameters of two single poles	m	Table 4/DE.1 in 4.4.1/DE.1
D_{el}	Minimum electrical clearance between a phase conductor and earthed components	m	5.8/DE.1; 5.9.1/DE.1
D_{l}	Conductor diameter with ice load	m	4.6.4/DE.1

D_{pp}	Minimum electrical clearance phase-to-phase	m	5.8/DE.1; 5.9.1/DE.1
D_{WEA}	Diameter of the rotor of a wind energy converter	m	5.9.3/DE.2.1; 5.9.3/DE.2.2
E_d	Design value of an action	kN	4.13/DE.1
F_k	Characteristic value of an action		10.7/DE.2
$f_{\beta m}$	Angle factor of a crossarm member	–	4.4.3.2/DE.1.3
G_K	Dead weight of conductors, insulators and supports	N	4.13/DE.1
G_m	Factor for type of support	–	4.4.3.2/DE.1.3
g_l	Ice load	N/m	4.5.2/DE.1
G_C	Conductor response factor	–	4.4.1/DE.1
G_x	Reduction factor	–	5.8/DE.1.3
H	Altitude of terrain above sea level	m	4.3/DE.1
h	Height of lower edge of wake	m	5.9.3/DE.2.2
h	Height above surface	m	4.3/DE.1
h_m	Height of a crossarm single member above terrain	m	4.4.3.2/DE.1.3
h_{WEA}	Height of the rotor hub above local terrain surface	m	5.9.3/DE.2.2
I''_{k1}	Initial short-circuit alternating current in case of a single-pole short circuit with earth	A	Table 6/DE.2 in 6.3.2/DE.1
I''_{KEE}	Short-circuit current in case of a double earth short-circuit	A	Table 6/DE.2 in 6.3.2/DE.1
I_C	Capacitive earth short-circuit current	A	Table 6/DE.2 in 6.3.2/DE.1
I_{RES}	Residual short-circuit current	A	Table 6/DE.2 in 6.3.2/DE.1
I_{St}	Peak value of lightning current	A	6.1.3/DE.1
i_{vv}, i_{yy}	Radius of inertia	m	J.6.2/DE.1
k_{125}	Factor for an observation period of 25 years for the reference ice loads of an overhead line grid with a nominal voltage above AC 1 kV up to and including AC 45 kV.	–	4.5.2/DE.1

k_{W25}	Factor for an observation period of 25 years for wind forces of an overhead line grid with a nominal voltage above AC 1 kV up to and including AC 45 kV.	–	4.3/DE.1
k_1	Reduction factor for electric distances	–	5.8/DE.1; 5.8/DE.2
L	Buckling length	m	J.4.3.2/DE.1
L	Span length	m	4.4.1/DE.1
N_{Ed}	Design value of a load	N	J.4.1/DE.2
N_{Rd}	Design value of a strength	N	J.4.1/DE.2
N_{Sd}	Design tensile force	kN	J.3/DE.2
$N_{u,Rd}$	Tensile strength	kN	J.3/DE.2
q	Wind pressure	N/m ²	4.3/DE.1
$q_p(h)$	Wind pressure at height h	N/m ²	4.3/DE.1
$q_p(h_m)$	Maximum value of wind pressure of a crossarm member at height h_m	N/m ²	4.4.3.2/DE.1.3
Q_{CK}	Horizontal conductor tensile force	N	4.13/DE.1
Q_{IK}	Ice load on conductor	N	4.13/DE.1
q_0	Reference wind pressure at 10 m above terrain height	N/m ²	4.3/DE.1
Q_{PK}	Construction load	N	4.13/DE.1
Q_{WC}	Wind force on conductor	N	4.4.1/DE.1
Q_{WCx}	Wind force on tower or pole in direction of crossarm axis	N	4.4.1/DE.1
Q_{WCy}	Wind force on tower or pole rectangular to crossarm axis	N	4.4.1/DE.1
Q_{Wins}	Wind force on insulator sets	N	4.4.2/DE.1
Q_{WK}	Wind force	N	4.13/DE.1
Q_{Wm}	Wind force on a crossarm single member	N	4.4.3.2 DE.1.3
Q_{Wpol}	Wind force on a single pole	N	4.4.4/DE.1
Q_{WtQx}	Component of the wind force on crossarm in parallel to crossarm axis	kN	4.4.3.2/DE.1.2
Q_{WtQy}	Component of the wind force on crossarm rectangular to crossarm	kN	4.4.3.2 DE.1.2

Q_{Wtx}	Component of the wind force on tower body in parallel to crossarm axis	kN	4.4.3.2/DE.1.1
Q_{Wty}	Component of the wind force on tower body rectangular to crossarm axis	kN	4.4.3.2/DE.1.1
r	Earth wire reduction factor	–	Table 6/DE.2 in 6.3.2/DE.1
R_{St}	Impulse earthing resistance of a tower	Ω	6.1.3/DE.1
U_E	Earth potential	V	6.4.3/DE.1
U_m	highest operating voltage of equipment	kV	Table 5/DE.1 in 5.4.2/DE.1
U_n	nominal voltage of system	kV	Table 5/DE.1 in 5.4.2/DE.1 Table 5/DE.2 in 5.9.3/DE.2.1
U_s	maximum operating voltage	kV	Table 5/DE.1 in 5.4.2/DE.1
U_{St}	Lightning impulse withstand voltage	V	6.1.3/DE.1
U_T	Touch voltage	V	6.4.3/DE.1
U_{Tp}	Permissible touch voltage along the human body	V	6.4.3/DE.1
x	Horizontal distance to tower axis of a wind energy converter	m	5.9.3/DE.2.2
ΔA	Sum of the area of holes	mm ²	J.3/DE.1
ϕ	Angle between the wind direction and the crossarm axis	degree	4.4.1/DE.1, 4.4.3.2/DE.1.1
η_i	Reduction factor	–	J.3/DE.2
γ_C	Partial factor for conductor tensile forces	–	4.13/DE.1
γ_G	Partial factor for dead weight	–	4.13/DE.1
γ_I	Partial factor for ice forces	–	4.13/DE.1
γ_M	Partial factor for material	–	Table 3/DE.1 in 3.6.3/DE.1
γ_P	Partial factor for construction loads	–	4.9.1/DE.1, 4.13/DE.1
γ_R	Partial factor for strength		8.2.2/DE.1
γ_W	Partial factor for wind forces	–	4.13/DE.1
λ	Slenderness	–	J.4/DE.3

θ_1, θ_2	Complement to angle of line direction	degree	4.4.1/DE.1
ρ_1	Ice load specific weight	N/m ³	4.6.4/DE.1
ϑ	Angle of wind action	degree	4.4.1/DE.1
ψ	Combination factor	–	4.13/DE.1

3 Basis of design

3.2 Requirements of overhead lines

3.2.1 Basic requirements

3.2.1 DE.1 Basic requirements

(ncpt) All components of an overhead line shall be selected, designed and installed such that they perform reliably and securely under climatic conditions regularly to be expected, under the operational voltage, under action of the operational current and under the short-circuit conditions to be expected. The effect of atmospheric over-voltages and switching over-voltages shall be considered.

These requirements are met if the overhead line is designed and installed according to this standard.

3.2.2 Reliability requirements

3.2.2 DE.1 Reliability of overhead lines

(ncpt) In Germany overhead lines shall be designed such that they meet the requirements of the reliability class 3 according to DIN EN 50341-1:2013-11, Table 3.1. This will be adequately achieved by selecting of characteristic loads with a 50 years return period of climatic effects and multiplication with the stipulated partial factors. Concerning electrical clearances the requirements on reliability are complied with if a power line is designed in accordance with the stipulations of this standard.

3.2.5 Strength coordination

3.2.5 DE.1 Coordination of line strength

(ncpt) The coordination of line strength is substantially achieved by considering these National Normative Aspects in connection with the selected load cases.

3.2.6 Additional considerations

3.2.6 DE.1 Protection of birds

(ncpt) Crossarms, line post insulators and other components of overhead line poles with nominal voltages up to 45 kV shall be designed such that the birds cannot find possibilities for nesting in a dangerous proximity to live conductors.

The measures described in the VDE application rule VDE-AR-N 4210-11:2011-08, Clause 8, shall be applied.

3.4 Actions

3.4.3 Classification of actions by their nature and/or the structural response

3.4.3 DE.1 Dynamic loads

(ncpt) The dynamic loads caused by dropping of ice which adheres at the conductors are covered by the load cases H, J, K and L.

The consideration of loads caused by aeolian vibrations is not generally stipulated for overhead lines in Germany.

3.6 Design values

3.6.3 Design value of a material property

3.6.3 DE.1 Design values for a material property

(ncpt) Table 3/DE.1 contains the partial factors for material used for supports. Concerning concrete poles reference is made to DIN EN 12843.

Table 3/DE.1 – Material partial factors for towers and poles

Eurocode	Material, Type of loading	Material partial factor γ_M
EC2 Concrete and reinforced concrete	Compressive concrete strength	1,5
	Compressive concrete strength for pre-fabricated parts	1,4
	Reinforcement, yield strength or $\sigma_{0,2}$	1,15
EC3 Steel	Resistance of sections and stability (yield strength)	1,1
	Resistance of bolted and welded connections (ultimate tensile strength)	1,25
	Members with bore holes under tension (ultimate tensile strength)	
	Steel stranded ropes	1,65

3.6.4 Combination value of a variable action

3.6.4 DE.1 Combination value of a variable action

(ncpt) Concerning combination value reference is made to 4.13/DE.1.