IEC 62420

Edition 1.0 2008-04

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Concentric lay stranded overhead electrical conductors containing one or more gap(s)

Conducteurs pour lignes électriques aériennes câblés en couches concentriques comprenant un ou plusieurs intervalles

IEC 62420:2008

IEC Central Office
3, rue de Varembé
CH-1211 Geneva 20
Switzerland
Email: inmail@iec.ch
Web: www.iec.ch

About the IEC

The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

About IEC publications

The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigenda or an amendment might have been published.

- Catalogue of IEC publications: www.iec.ch/searchpub

The IEC on-line Catalogue enables you to search by a variety of criteria (reference number, text, technical committee,…). It also gives information on projects, withdrawn and replaced publications.

- IEC Just Published: www.iec.ch/online_news/justpub

Stay up to date on all new IEC publications. Just Published details twice a month all new publications released. Available on-line and also by email.

- Electropedia: www.electropedia.org

The world's leading online dictionary of electronic and electrical terms containing more than 20 000 terms and definitions in English and French, with equivalent terms in additional languages. Also known as the International Electrotechnical Vocabulary online.

- Customer Service Centre: www.iec.ch/webstore/custserv

If you wish to give us your feedback on this publication or need further assistance, please visit the Customer Service Centre FAQ or contact us:
Email: csc@iec.ch
Tel.: +41 22 919 02 11
Fax: +41 22 919 03 00

A propos de la CEI

La Commission Electrotechnique Internationale (CEI) est la première organisation mondiale qui élabore et publie des normes internationales pour tout ce qui a trait à l'électricité, à l'électronique et aux technologies apparentées.

A propos des publications CEI

Le contenu technique des publications de la CEI est constamment revu. Veuillez vous assurer que vous possédez l'édition la plus récente, un corrigendum ou amendement peut avoir été publié.

- Catalogue des publications de la CEI: www.iec.ch/searchpub/cur_fut-f.htm

Le Catalogue en-ligne de la CEI vous permet d'effectuer des recherches en utilisant différents critères (numéro de référence, texte, comité d'études,…). Il donne aussi des informations sur les projets et les publications retirées ou remplacées.

- Just Published CEI: www.iec.ch/online_news/justpub

Restez informé sur les nouvelles publications de la CEI. Just Published détaille deux fois par mois les nouvelles publications parues. Disponible en-ligne et aussi par email.

- Electropedia: www.electropedia.org

Le premier dictionnaire en ligne au monde de termes électroniques et électriques. Il contient plus de 20 000 termes et définitions en anglais et en français, ainsi que les termes équivalents dans les langues additionnelles. Egalement appelé Vocabulaire Electrotechnique International en ligne.

- Service Clients: www.iec.ch/webstore/custserv/custserv_entry-f.htm

Si vous désirez nous donner des commentaires sur cette publication ou si vous avez des questions, visitez le FAQ du Service clients ou contactez-nous:
Email: csc@iec.ch
Tél.: +41 22 919 02 11
Fax: +41 22 919 03 00

IEC 62420

Edition 1.0 2008-04

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Concentric lay stranded overhead electrical conductors containing one or more gap(s)

Conducteurs pour lignes électriques aériennes câblés en couches concentriques comprenant un ou plusieurs intervalles

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

PRICE CODE
CODE PRIX U

ICS 29.060.10; 29.240.20

ISBN 978-2-88910-699-8

CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

CONCENTRIC LAY STRANDED OVERHEAD ELECTRICAL CONDUCTORS CONTAINING ONE OR MORE GAP(S)

FOREWORD

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
5) IEC provides no marking procedure to indicate its approval and cannot be rendered responsible for any equipment declared to be in conformity with an IEC Publication.
6) All users should ensure that they have the latest edition of this publication.
7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

International Standard IEC 62420 has been prepared by IEC technical committee 7: Overhead electrical conductors.

This bilingual version (2009-04) replaces the English version.

The text of this standard is based on the following documents:

FDIS	Report on voting
7/587/FDIS	7/588/RVD

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

The French version of this standard has not been voted upon.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

The committee has decided that the contents of this publication will remain unchanged until the maintenance result date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

CONCENTRIC LAY STRANDED OVERHEAD ELECTRICAL CONDUCTORS CONTAINING ONE OR MORE GAP(S)

1 Scope

This International Standard specifies the electrical and mechanical characteristics of concentric lay stranded overhead electrical conductors, containing one or more self-supporting aluminium or aluminium alloy layer(s) as depicted in Figure 1, made of combinations of any of the following metal wires:

a) hard-drawn aluminium as per IEC 60889, designated A1;

b) aluminium alloy type A or B as per IEC 60104, designated A2 or A3;

c) thermal resistant aluminium alloy type as per IEC 62004, designated AT1, AT2, AT3 or AT4;

d) regular strength steel as per IEC 60888, designated S1A or S1B;

e) high strength steel as per IEC 60888, designated S2A or S2B;

f) extra-high strength steel as per IEC 60888, designated S3A;

g) aluminium-clad steel as per IEC 61232, designated 20SA, 27SA, 30SA or 40SA.

NOTE This standard covers the construction of self-damping conductors, as well as gap-type conductors. Although both types of conductors share a common design feature and the presence of one or more gaps between layers, they are intended for different purposes. Self-damping conductors (SDC) may have more than one gap to provide increased self-damping, whereas gap-type conductors are so designed as to allow the aluminium layers to slide freely over the core during installation, and therefore usually do not require more than one gap.

The various metal combinations permitted by this standard shall be in accordance with Table 1.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60104:1987, *Aluminium-magnesium-silicon alloy wire for overhead line conductors*

IEC 60888:1987, *Zinc-coated steel wires for stranded conductors*

IEC 60889:1987, *Hard-drawn aluminium wire for overhead line conductors*

IEC 61232:1993, *Aluminium-clad steel wires for electrical purposes*

IEC 61395:1998, *Creep test procedures for stranded conductors*

IEC 62004:2007, *Thermal resistant aluminium alloy wire for overhead line conductors*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
aluminium
all types of aluminium and aluminium alloys listed in Clause 1

3.2
annular gap
constant space, void of any material except for air or grease, between two layers of a conductor

3.3
canting
phenomena by which a formed wire is twisted relative to its own axis, thus producing a protuberance outside the layer

3.4
conductor
material intended to be used for carrying electric current consisting of a plurality of uninsulated wires twisted together

3.5
concentric lay stranded conductor
conductor composed of a central core surrounded by one or more adjacent layers of wires being laid helically in opposite directions

3.6
direction of lay
direction of twist of a layer of wires as it moves away from the viewer , with a right-hand lay being a clockwise direction and a left-hand lay being an anti-clockwise direction

3.7
equivalent wire diameter
the diameter of a round wire which would have the same cross-sectional area as a given formed wire

3.8
formed wire
filament of drawn or rolled metal having a constant, non-circular cross-section

3.9
layer
group of wires located at a constant radial distance from the centre of the conductor

3.10
lay length
axial length of one complete turn of the helix formed by an individual wire in a stranded conductor

3.11
lay ratio
ratio of the lay length to the external diameter of the corresponding layer of wires in the stranded conductor

3.12
lot
group of conductors manufactured by the same manufacturer under similar conditions of production

NOTE A lot may consist of part or all of the purchased quantity.

3.13
nominal
name or identifying value of a measurable property by which a conductor or component of a conductor is identified and to which tolerances are applied

NOTE Nominal values should be target values.

3.14
rated tensile strength
calculated maximum tensile load value at which a conductor may be subjected before one or more of its constituent wires break

3.15
round wire
filament of drawn metal having a constant circular cross-section

3.16
self-supporting layer
layer made of formed wires which are designed in such a way as to not rely on the underlying layer for support

4 Designation system

A designation system is used to identify stranded conductors containing one or more gap(s).Conductors are designated AxGy/Syz or AxGy/SA where Ax identifies external wires (or the envelope), Gy denotes the presence and the number of annular gap(s) between two or more layers, and Syz and SA identify the steel core. In the designation of zinc coated wires, y represents the type of steel (regular, high or extra high strength) and z represents the class of zinc coating (A or B).

Conductors are identified as follows:

a) a code number giving the equivalent conductive section of A1 expressed in mm^2;

b) a code number giving the section of the core material in mm^2;

c) a designation identifying the type of wires constituting the conductor in accordance with the second paragraph of this clause. The first designation (Ax) applies to the envelope, the second designation (Gy) applies to the presence and number of annular gap(s), and the third designation (Syz or SA) applies to the core;

d) a code number designating the outside diameter of the conductor.

Example: 400/66-A1G2/S1A-274: A conductor made of 400 mm^2 A1 and 66 mm^2 S1A (regular strength steel), containing two annular gaps, with a nominal outside diameter of 27,4 mm (274 × 0,1).

5 Requirements for stranded conductors

5.1 Material

Stranded conductors shall be made up of round and/or formed aluminium wires and of zinc-coated steel or aluminium-clad wires. Before stranding all wires shall have the properties as specified in the International Standards given in Clause 2.

5.2 Conductor sizes

A list of conductor sizes is given as guidance in Annex E. Conductors for existing or established designs of overhead lines as well as sizes and strandings not included in this

standard may be designed and supplied as agreed upon by the manufacturer and purchaser and the relevant requirements of this standard shall apply.

5.3 Surface

The surface of the conductor shall be free from all imperfections visible to the unaided eye (normal corrective lenses accepted), such as nicks, indentations, etc., not consistent with good commercial practice.

5.4 Stranding

5.4.1 General

All wires of the conductor shall be concentrically stranded. Before stranding, aluminium and core wires shall have approximately uniform temperature.

Adjacent wire layers shall be stranded with reverse lay directions. The direction of lay of the external layer shall be right-hand except when specifically indicated in the purchase order.

5.4.2 Lay ratio for core wires

The lay ratios for the zinc-coated (galvanised) steel or aluminium-clad wire layers shall be as follows:

a) the lay ratio for the six-wire layer of the core shall be not less than 16 nor more than 26;

b) the lay ratio for subsequent core layers shall be not less than 14 nor more than 22. The lay ratio of subsequent layer(s) shall be not greater than the lay ratio of the core layer immediately beneath it.

All core wires shall lie naturally in their position in the stranded core, and where the core is cut, the wire ends shall remain in position or be readily replaced by hand and then remain approximately in position.

5.4.3 Lay ratio for aluminium layer(s)

The lay ratios for the aluminium layer(s) shall be as follows:

a) the lay ratio for the outside layer of aluminium wires shall be not less than 10 nor more than 14;

b) the lay ratios for the inner layers of aluminium wires shall be not less than 10 nor more than 16;

c) the lay ratio of any aluminium layer shall be not greater than the lay ratio of the aluminium layer immediately beneath it.

Aluminium wires composing the outside layer of the conductor shall lie naturally in their position, and where the conductor is cut, they shall remain in position or be readily replaced by hand and then remain approximately in position.

5.4.4 Joints

There shall be no joints of any kind made in the core wire or wires during stranding.

There shall be no joints in the finished aluminium wire prior to stranding.

During stranding, no aluminium wire welds shall be made for the purpose of achieving the required conductor length.

Joints are permitted in aluminium wires unavoidably broken during stranding, provided such breaks are not associated with either inherently defective wire or with the use of short lengths

of aluminium wires. Joints shall conform to the geometry of original wire, i.e. joints shall be dressed smoothly with a shape equal to that of the parent wires and shall not be kinked.

Joints in aluminium wires shall not exceed those specified in Table 2. These joints shall not be closer than 15 m from a joint in the same wire or in any other aluminium wire of the completed conductor.

Joints shall be made by electric butt welding, electric butt cold upset welding or cold pressure welding (see Note 1) and other approved methods. These joints shall be made in accordance with good commercial practice. The first type of joints shall be electrically annealed for approximately 250 mm on both sides of the weld.

While the joints specified in this clause are not required to meet the requirements of unjointed wires (see Note 2), they shall withstand a stress of not less than 75 MPa for annealed electric butt welded joints and not less than 130 MPa for cold pressure and electric butt cold upset welded joints. The manufacturer shall demonstrate that the proposed welding method is capable of meeting the specified strength requirements.

NOTE 1 It is a practice in some countries to require the annealing of cold pressure joints made in A2 or A3 material.

NOTE 2 The behaviour of properly spaced wire joints in stranded conductors is related to both tensile strength and elongation. Because of higher elongation properties, the lower strength annealed electric butt welded joint gives a similar overall performance to that of a cold pressure or an electric butt cold upset welded joint.

5.4.5 Linear mass

The masses given in the Table E.1 of Annex E have been calculated for each size and stranding of conductor using densities for the aluminium, aluminium-clad and zinc-coated steel wires as given in the standards listed in Clause 2, the stranding increments given in Table 3, and the cross-sectional areas for aluminium and core wires based on their theoretical unrounded values.

The increments in per cent, for mass due to stranding, based on the mean lay ratios given in 5.4.2 and 5.4.3, shall be taken as given in Table 3. If greater accuracy is desired, actual lay factors shall be used.

Whenever a conductor is to be greased, the nominal mass of grease shall be calculated according to the method given in Annex C.

5.4.6 Conductor strength

The rated tensile strength at room temperature of composite conductors shall be the sum of the tensile strength of the aluminium portion plus the strength of the core corresponding to an elongation compatible with that of aluminium at rupture load. For the purpose of specification and practicability, the strength of steel and aluminium-clad steel is conservatively established as the stress corresponding to 1 % elongation in a 250 mm gauge length.

The tensile strength of any single wire is the product of its nominal area and the appropriate minimum stress given in the standards listed in Clause 2.

6 Tests

6.1 Classification of tests

Type tests are intended to verify the main characteristics of a conductor which depend mainly on its design. They are carried out once for a new design or manufacturing process of conductor and then subsequently repeated only when the design or manufacturing process is changed.

Sample tests are intended to guarantee the quality of conductors and compliance with the requirements of this standard.

6.2 Type tests

Type tests shall be carried out only on a conductor which meets the requirements of all the relevant sample tests.

Type tests consist of the following:

a) joints in aluminium wires;

b) annular gap(s);

c) stress-strain curves;

d) breaking strength of conductor;

e) creep curves.

6.2.1 Length of sample required

The sample length required for tensile and stress-strain tests shall be at least 400 times the diameter of the conductor but not less than 10 m.

The length of samples in this subclause is the minimum required for a good accuracy of stress-strain curves. In cases where the manufacturer can demonstrate to the satisfaction of the purchaser with significant comparative test results that a shorter length can provide equally accurate results then a short length of samples may be used.

6.2.2 Joints in aluminium wires

The manufacturer shall demonstrate to the purchaser that the method used for jointing aluminium wires meets the strength requirements of 5.4.4 by supplying recent test results or by performing the necessary tests.

6.2.3 Annular gap(s)

The method of measurement of the annular gap(s) shall be agreed upon between the purchaser and the manufacturer. Measurements can be done directly on the outside and inside diameters of the concerned layer or alternatively the method described in Annex D shall be used.

When measured in accordance with this subclause, the value of the annular gap shall not vary by more than +0,15 mm and less than -0,25 mm from the value specified by the supplier.

6.2.4 Stress-strain curves

Stress-strain curves shall be supplied as a type test when requested by the purchaser and shall represent the best knowledge of the behaviour of the purchased conductor under load.

If agreed between purchaser and supplier when placing an order, stress-strain tests shall be performed on the conductor and on the core, in accordance with the method given in Annex B.

6.2.5 Breaking strength of conductor

The breaking strength of conductors shall be determined by pulling a conductor in a suitable tensile testing machine having an accuracy of at least ±1 %. It is recommended that the rate of increase of load should be as in B.6. For the purposes of this test, appropriate fittings shall be installed on the ends of the conductor samples. During this test, the breaking strength of the conductor shall be determined by the load attained at which one or more wires of the conductor are fractured.A retest, up to a total of three tests, may be made if wire fracture

occurs within 10 mm of the end fittings and the tensile strength falls below the specified breaking strength requirements.

When tests for breaking strength of conductors are required, these shall withstand, without the fracture of any wire not less than 95 % of their rated tensile strength calculated according to 5.4.6.

When required, the breaking strength of the core shall be determined in accordance with this subclause.

6.2.6 Creep curves

Creep curves shall be supplied as a type test when requested by the purchaser and shall represent the best knowledge of the behaviour of the purchased conductor under load.

If agreed between purchaser and supplier when placing an order, creep tests shall be performed on the conductor, in accordance with IEC 61395.

6.3 Sample tests

Sample tests consist of the following:

a) on wire before stranding as per applicable wire standards;

b) on the completed conductor:
   - cross-sectional area
   - overall diameter
   - linear mass
   - surface condition
   - lay ratio and direction of lay
   - breaking strength of wires after stranding (if requested)
   - wire canting on the outside layer (if requested).

Samples for tests specified in a) shall be taken before stranding and tested in accordance with the standards listed in Clause 2.

Samples for the tests specified in b) shall be taken at random from the outer end of 10 % of the drums of conductor. However, the inspection of the surface condition of the conductor shall be carried out on every drum prior to lagging.

Samples for tests of individual wires after stranding, when requested, shall consist of a 1,5 m length cut from the outer end of the drums of conductors.

6.3.1 Cross-sectional area

The cross-sectional area of the conductor shall be taken as the sum of the areas of the wires composing the conductor. The area of round wires shall be based on the measurements made in accordance with 6.3.1.1. The area of formed wires shall be based on the method in accordance with 6.3.1.2.

6.3.1.1 Round wires

The diameter of a round wire shall include the metallic coating, where applicable and shall be measured using a micrometer calliper having flat surfaces on both the anvil and the end of the spindle and graduated to be read in micrometers.The diameter shall be the average of three diameter measurements, each of which is the average of the maximum and minimum readings at a point taken near each end and in the centre of the sample.

When measured in accordance with this subclause, the area shall not vary from the nominal value by more than ±2 % in any sample and by more than ±1,5 % for the average of any four measured values at locations selected at random with a minimum spacing of 200 mm.

6.3.1.2 Formed wires

The equivalent diameter of a formed wire shall be obtained from the weight measurements made on a sample not less than 1 m in length, and its density as defined in the appropriate standard listed in Clause 2.

When determined in accordance with this subclause, the area shall not vary from the nominal value by more than ±2 % in any sample and by more than ±1,5 % for the average of any four samples selected at random on the bobbins after drawing.

6.3.2 Overall diameter

The conductor diameter shall be measured half-way between the closing die and the capstan while still under tension on the stranding machine. Measurements shall be made with a calliper graduated to be read in 0,01 mm. The diameter shall be the average of two readings, rounded to two decimals of a millimetre, taken at right angles to each other at the same location.

When measured in accordance with this subclause, the diameter of the conductor shall not vary by more than ±1 % for diameters larger than or equal to 10 mm and ±0,1 mm for diameters smaller than 10 mm.

NOTE The purpose of measuring under tension is to ensure that all layers are resting on the layer underneath. Thus, other means of measurement, such as on a cut sample, are possible.

6.3.3 Linear mass

The linear mass of the conductor shall be determined by using apparatus capable of achieving an accuracy of ± 0,1 %.

The mass of grease in a conductor shall be determined from the difference between the mass of the conductor with grease and its mass after removing all the grease. The mass of grease shall correspond at least to the minimum values specified in Annex C. In case of non-compliance with the values of Annex C, the manufacturer shall demonstrate that the weight of grease is adequate to achieve its intended purpose.

When measured in accordance with this subclause, the mass of the conductor per unit length without grease shall not vary from its nominal value by more than ±2 %. In case of non compliance with nominal values, the actual lay factors shall be used.

6.3.4 Surface condition

The surface of the conductor shall comply with the requirements of 5.3.

6.3.5 Lay ratio and direction of lay

The lay ratio of each layer of the conductor shall be obtained through the ratio of the measured lay length to the external diameter of the applicable layer.

When measured in accordance with this subclause, the obtained values shall comply with the requirements of 5.4. In addition, the direction of each layer shall be noted and shall also comply with the requirements of 5.4.