**WESTERN POWER DISTRIBUTION**

*Serving the Midlands, South West and Wales*

# Company Directive

## STANDARD TECHNIQUE: SD8A/3

## Relating to Revision of Overhead Line Ratings


**Policy Summary**

This Standard Technique contains all overhead line ratings used within WPD at all voltages.

These ratings are to be used when designing or operating any overhead line within the WPD electricity distribution network.



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**Implementation Date:** **February 2020**

**Approved by**

**Paul Jewell**
**DSO Development Manager**

**Date:** 5 February 2020

| | |
|---|---|
| **Target Staff Group** | **Control Engineers, Planners, PSD Engineers, Network Strategy Engineers and other staff with Network Design and assessment responsibilities. Staff responsible for maintaining databases containing overhead line ratings.** |
| **Impact of Change** | **AMBER - All databases containing overhead line ratings will need to be updated. Staff undertaking system studies will need to familiarize themselves with the new seasonal boundaries and the guidance relating to choice of exceedance when determining which rating to apply.** |
| **Planned Assurance checks** | **Database owners will be contacted 4 months after the issue of this document to confirm that the necessary changes have been made.** |

**IMPLEMENTATION PLAN**

**Introduction**

This Standard Technique provides guidance on the ratings to be applied to all overhead lines within WPD.

**Main Changes**

This document has been re-written to comply with the new issue of ENA ER P27, which is due to be published shortly. The new document reflects learning from a recent WPD NIA project, revising the probabilistic rating calculation, the assumed seasonal boundaries and their associated weather conditions, and the recommended exceedance levels to use when applying ratings.

**Impact of Changes**

While the new issue of P27 highlights some areas where ratings have improved (e.g. summer season), there are others (notably in the winter) where ratings have been reduced. The impact of these reductions has been largely mitigated through the use of separate “pre-fault” and “post-fault” ratings, allowing higher exceedance levels to be applied compared to those given in ST:SD8A/2. Overall, initial studies have indicated that the impact of the new, standard ratings will be minor, although parts of the network that are already close to becoming overloaded may see reinforcement requirements accelerated. The new seasonal boundaries will provide the opportunity to better match ratings with load data during system studies.

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|---|---|
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| **Impact of Change** | **AMBER - All databases containing overhead line ratings will need to be updated. Staff undertaking system studies will need to familiarize themselves with the new seasonal boundaries and the guidance relating to choice of exceedance when determining which rating to apply.** |

**Implementation Actions**

Teams responsible for databases and design tools shall ensure that any stored overhead line ratings are updated in line with this document – PowerOn (DSO Systems), PSSE Database, PVCR, DINIS (Network Strategy), WinDebut (DSO Development), and any other systems or tools that may apply. Where a specific system is not capable of storing or referencing the full set of ratings associated with a conductor, the person responsible for use of the system shall select the appropriate rating values to use.

There is no requirement to undertake any new system studies solely as a result of the issue of this document, however all system studies undertaken from the implementation date of this Standard Technique shall use the ratings it contains.

**Implementation Timetable**

Affected databases shall be updated within 3 months of issue of this document.

**REVISION HISTORY**

| Document Revision & Review Table | | |
|---|---|---|
| **Date** | **Comments** | **Author** |
| 08/01/2020 | • Document re-written ahead of new issue of ENA ER P27, highlighting:<br>• Harmonisation of WPD ratings with P27<br>• New seasonal boundaries and default weather conditions<br>• Revised probabilistic function linking base deterministic rating to probabilistic ratings<br>• Revised guidance on acceptable exceedance values to be used for ratings<br>• The introduction of “pre-fault” and “post fault” ratings to voltages lower than 132kV<br>• Appendices added summarising the probabilistic rating calculation method and the probabilistic risk model used to derive acceptable exceedance values | Sven Hoffmann |
| 16/04/2013 | • New Section 5 covering dynamic line ratings | Sven Hoffmann |
| 19/03/2013 | • Section 2 Conditions for Adopting Ratings – Clarification of when the ratings in this document should be used.<br>• Section 4.3 Inclusion of ‘conductor’ in sentence. | Mike Chapman |
| | | |

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## 1. INTRODUCTION

1.1. The thermal rating of an overhead line conductor is the maximum amount of current that can safely be carried without the conductor exceeding its design temperature. During operation a conductor is heated by the current flowing through it and by radiation from the sun. Cooling is provided by the wind and by radiation from the conductor surface. Net heat gain is relative to the ambient temperature.

1.2. Prior to the introduction of The Electricity (Overhead Lines) Regulations in 1970, ratings for overhead lines were deterministic – calculated from worst-case, fixed assumptions for weather conditions (high ambient temperature, high solar radiation, and low wind speed). When the 1970 regulations were introduced, however, a probabilistic (statistical) approach was permitted, resulting from the new requirement that overhead line clearances be maintained for a conductor's *likely* maximum temperature. This requirement continues today under the Electricity Safety, Quality, and Continuity Regulations (ESQCRs). Probabilistic ratings for the UK distribution networks were formally introduced in 1986, with the publication of Engineering Recommendation P27.

1.3. WPD, however, adopted a mixed approach with summer ratings matching the probabilistic ones presented in P27 but with the ratings for other seasons being derived from older, deterministic assumptions that gave higher ratings than P27. This was justified by WPD-specific design policies that provided greater clearances than those required by national standards.

1.4. With the research underpinning the approach of P27 being over 30 years old, a review of the method used to determine probabilistic ratings was recently undertaken. WPD's NIA (Network Innovation Allowance) project "Improved Statistical Ratings for DNO Overhead Lines" was closed in July 2018 and has since been used to review ENA ER P27. Although still in draft form, ENA ER P27 Issue 2 is due for publication later this year, and contains some significant changes.

1.5. With a new P27 imminent, it was decided to review WPD's approach to ratings and to update this Standard Technique in line with the new, national document.

## 2. ENA ER P27 Issue 2 - BASIS OF RATING CALCULATIONS

2.1. The probabilistic rating of an overhead line is based on:

- The conductor's rated temperature, also described as design or profile temperature. This is the conductor temperature at which electrical clearances are assessed
- An assumed set of weather conditions (varied seasonally)
- A desired "exceedance", or risk level

2.2. In order to establish a probabilistic rating, the weather conditions assumed do not have to represent the worst case – they are chosen to represent typical conditions that give rise to high conductor temperatures. These conditions, when applied to standard heat-balance equations together with the conductor's rated temperature, define a "base" rating that can then be scaled up or down according to the desired exceedance. An empirically derived function links this scaling factor with desired risk, and is provided in P27. It should be noted that this scaling factor function and the default, assumed weather conditions used in the calculation are intrinsically linked – using different weather conditions will invalidate the scaling function. Appendix A provides further details.

2.3. The exceedance, expressed as a percentage, represents the risk of a conductor exceeding its rated temperature when full, rated current is applied to it. So the 3% exceedance rating for a line built for a rated temperature of 50°C, for example, would result in a 3% probability of the conductor being warmer than 50°C with the full rating applied.

2.4. This general approach to probabilistic ratings remains unchanged, although the exact weather assumptions and the form of the empirically derived risk / rating function have changed in comparison to that used for ENA ER P27 Issue 1. While a range of factors will have contributed to these changes, the dominant issue is that of climate change – weather patterns and temperatures are measurably different today than 30 years ago.

2.5. This effect is most noticeable when it comes to seasonal boundaries. The original, 1986 Issue of P27 used three different seasons – Summer, Winter, and a combined Spring / Autumn. The recent NIA project indicated that a 4-season approach was more appropriate. The changes are described in the table below - the new seasonal splits better represent the variability of temperatures throughout the year, and the increased granularity allows for closer matching of ratings with load data for system studies.

| **Month** | **Original Season (P27, 1986)** | **New Season (P27, 2019)** |
|---|---|---|
| January | Winter | Winter |
| February | Winter | Winter |
| March | Spring / Autumn | Intermediate (Cool) |
| April | Spring / Autumn | Intermediate (Cool) |
| May | Summer | Intermediate (Warm) |
| June | Summer | Summer |
| July | Summer | Summer |
| August | Summer | Summer |
| September | Spring / Autumn | Intermediate (Warm) |
| October | Spring / Autumn | Intermediate (Warm) |
| November | Spring / Autumn | Intermediate (Cool) |
| December | Winter | Winter |

## 3. APPLICATION OF ENA ER P27 Issue 2

3.1. Ratings calculated from the methodology of P27 Issue 2, and tabulated in the Appendices of this Standard Technique, shall be applied to all overhead lines within WPD. The increased clearances for lines designed and constructed by WPD shall no longer be taken into account for rating purposes, primarily because lines are not maintained to these enhanced clearances.

3.2. In order to determine the appropriate exceedance levels against which to calculate ratings, the risk model of P27 has been applied, with the more conservative values recommended in P27 used. A full description of the risk model as applied by WPD is given in Appendix B.

3.3. Ratings for two different exceedances are presented, representing a "**variable load pre-fault**" and a "**post fault**" loading scenario.

3.4. The **variable load pre-fault** rating, corresponding to a 3% exceedance, should be used when lines are subject to the regular, everyday loads that flow through an intact network (including planned outages). Generally, loading levels will vary with overall demand and generation patterns, with the possibility of fairly prolonged peaks (2-3 hours) in the daily load cycle.

3.5. Occasionally, there will be circuits on the network that could be subject to sustained high loads. Examples of such circuits might include connection assets to a conventional generator or to an intensive, industrial load that operates round the clock. In these cases, the rating shall be reduced to 92% of the **"variable load pre-fault"** rating. This rating, referred to as the "**sustained load pre-fault**", corresponds to an exceedance of 0.001%.

3.6. With the increasing use of smart and flexible solutions to HV network constraints, there will be circuits that are subjected to load profiles that will not correspond to the normal daily variation in overall generation and demand patterns. Systems such as ANM (Active Network Management) monitor the network in real time, and either dispatch or curtail load on an automated basis. To avoid an elevated risk of overhead line thermal limits being exceeded, such systems shall, when actively managing load, ensure that real-time loads do not exceed the **sustained load pre-fault** rating.

3.7. In addition to managed HV loads, LV loads are also predicted to deviate significantly from the currently assumed load duration curve, due mainly to the accelerating uptake of electric vehicles. In anticipation of future flexibility needing to be accommodated on LV networks, ABC ratings will now be based on the **sustained load pre-fault** rating, in order to safely accommodate high, sustained levels of demand.

3.8. The **post-fault rating**, corresponding to a 9% exceedance, may be used when lines are subject to increased loadings in the event of faults on adjacent circuits. They are intended to allow for the loading levels that are the immediate consequence of faults, allowing operators time (up to 24 hours) to take appropriate actions to reduce loads to within continuous rating limits.

3.9. Covered conductors (BLL, BLX, PAS, CC) do not have an associated **post-fault rating** due to the risk of permanent damage to insulation in the event of a temperature excursion.

3.10. **Variable load pre-fault** and **post fault** ratings for profile temperatures of 50°C, 65°C, and 75°C are tabulated in Appendix C.

## 4. CONDUCTOR PROFILE TEMPERATURES

4.1. By default, all overhead lines will have a minimum profile temperature of 50°C. Prior to 1970 this was the maximum temperature allowed by regulations. After 1970, the new regulations allowed for higher profile temperatures although 50°C was still typically used as the default.

4.2. Where the profile temperature of a line is known, the ratings associated with that temperature shall apply.

4.3. Where the profile temperature is not known, or where there is doubt as to an assigned temperature, it shall be assumed as 50°C, and rated accordingly. If it is suspected that a higher rated temperature may apply, this shall be confirmed by a survey before ratings are increased to those applicable to the higher temperature.

4.4. The recommended maximum profile temperature for all conductors is 75°C. Higher temperatures may be permissible for AAAC subject to approval by the DSO Development Team. The only exceptions are HDPE covered conductor (BLL) which shall have a maximum profile temperature of 70°C, and the “gap-type” GTACSR which shall have a maximum profile temperature of 120°C.

## 5. ALUMINIUM ALLOY CONDUCTORS

5.1. Where lines are strung with All Aluminium Alloy Conductors (AAAC), there are a number of different grades of alloy that might apply. The two most common are “AL3” and “AL5”, while early AAAC (e.g. “Silmalec”) was “AL2”. The resistivities of AL2 and AL3 are similar enough that any differences in ratings are negligible. AL5 is of significantly lower resistivity resulting in higher ratings for a given size of conductor. Ratings are therefore only provided for AL3 and AL5 alloys.

5.2. Since 2003, WPD (South West and South Wales) has been specifying AL5 (see EE SPEC 85) for $100mm^2$ "Oak" and larger conductors, with smaller conductors specified as AL3. Prior to 2003, AAAC in the South West and South Wales license areas shall be assumed to be AL3 unless it can be confirmed otherwise. The equivalent cut-off date in the Midlands license areas is 2011.

5.3. Where there is any doubt, AAAC shall be assumed to be AL3.

## 6. RESTRICTED RATINGS

6.1. It will occasionally be necessary to employ restricted ratings where specific constraints result in a line being unsuitable for application of the standard ratings tabulated in Appendix C.

6.2. While clearance issues are normally dealt with as any other defect, with specified rectification timescales, there will be occasions where those rectification timescales cannot be met in cases where significant, physical changes are needed to an overhead line which, for tower lines, can be very costly with long lead times. In these cases, a clearance-restricted rating may be applied in order to clear the defect. These ratings are tabulated in Appendix D.

6.3. Clearance-restricted ratings are applicable to TOWER LINES ONLY based on a maximum allowable temperature of 40°C. Prior to applying these ratings it shall be confirmed by survey that the line is clear for this temperature. Lines not clear for at least 40°C shall remain defective.

6.4. Older ACSR Lines with suspect or outdated compression joints ("Tate" indent-compression joints and "Noral" figure-of-eight joints) shall have their ratings restricted to those given in Table D.4.

## 7. DYNAMIC LINE RATINGS

7.1. Probabilistic line ratings are necessarily conservative. As a result, there are numerous occasions when a line's rating may be safely increased when, for example, wind speeds are significantly higher than assumed. The use of real-time data gathered at a specific line's location could therefore be used operationally to continually update that line's rating, allowing advantage to be taken of periods of more favourable cooling conditions. Such ratings are known as dynamic line ratings.

7.2. A system based on real-time weather data was successfully trialled on the Boston-Skegness 132kV line following the connection of a large offshore wind farm. The trial was conducted "off-line", and verified the potential gains as well as the performance of the weather stations and their associated data communications infrastructure. Wind farm connections provide an ideal opportunity for the use of dynamic ratings, as their output is high when winds are high, and therefore when the real-time rating of a nearby line is also likely to be high.

7.3. The Boston-Skegness system is, to date, the only system that has been approved for use on WPD's network. It is important to note that the implementation of dynamic ratings requires careful consideration of both the suitability of the system itself for the line in question and of the condition of the physical assets to be monitored and/or dynamically rated.

7.4. With no "off the shelf" solution within WPD, any intended application of dynamic ratings should be referred to the DSO Development Team.

## 8. CONDUCTORS AND TEMPERATURES NOT REFERENCED

8.1. Where a rating for a conductor / temperature combination is required and where this information is not contained in this document, the DSO Development Team shall be consulted.

**APPENDIX A**

## DERIVATION OF RATINGS

Probabilistic ratings are calculated by a two-stage process.

Firstly, a deterministic rating ($I_{det}$) is calculated from a generic set of weather conditions (with ambient temperature varied seasonally, as presented in Table A1) and the conductor's rated temperature. Standard heat balance equations contained in CIGRE Technical Brochure TB601 are used.

| Season | Summer | Inter_Warm | Inter_Cool | Winter |
|---|---|---|---|---|
| Associated Months | June<br>July<br>August | May<br>September<br>October | March<br>April<br>November | January<br>February<br>December |
| Ambient (°C) | 14 | 11 | 6 | 4 |
| Wind Speed (m/s) | 0.5 | 0.5 | 0.5 | 0.5 |
| Wind Attack Angle (°) | 12 | 12 | 12 | 12 |
| Solar Flux ($W/m^2$) | 0 | 0 | 0 | 0 |

**Table A1.**
**Overhead Line Rating Seasonal Weather Parameters**

Once a deterministic rating has been calculated, it is factored according to the desired risk level (exceedance) by an experimentally determined function, tabulated in ENA ERP27 and in Table A2 below, to yield a probabilistic rating ($I_{prob}$) as follows:

$$I_{prob} = I_{det} \times \sqrt{Ct}$$

| Exceedance(%) | Ct |
|---|---|
| 0.001 | 0.909700 |
| 0.002 | 0.911480 |
| 0.005 | 0.913820 |
| 0.01 | 0.915590 |
| 0.02 | 0.917360 |
| 0.05 | 0.919705 |
| 0.1 | 0.922710 |
| 0.2 | 0.929800 |
| 0.5 | 0.950000 |

| Exceedance(%) | Ct |
|---|---|
| 1 | 0.980850 |
| 2 | 1.035050 |
| 3 | 1.082400 |
| 5 | 1.164000 |
| 7 | 1.234150 |
| 10 | 1.325700 |
| 20 | 1.566500 |
| 30 | 1.755800 |
| 50 | 2.059600 |

**Table A2.**
**Overhead Line Rating Scaling Factor (Ct)**

**APPENDIX B**

**P27 RISK MODEL FOR OVERHEAD LINE RATINGS**

The acceptable exceedances given by issue 1 of ENA ER P27 were determined according to the methodology described in ENA ACE104. A key condition that this document sought to meet was that the annual probability of a line experiencing a temperature excursion should be limited to $1 \times 10^{-6}$. This is a highly conservative approach that does not fully represent the risk that DNO's are seeking to avoid: the risk of flashover occurring as a result of a thermal event. Issue 2 of P27 recommends that this is the risk that should be kept below $1 \times 10^{-6}$.

Within reason, simply having a conductor exceed its design temperature is typically of negligible consequence. A flashover, however, could have severe consequences. Broadly speaking, a flashover will occur if three conditions are met:

1) There must be an infringement of design clearances sufficient to result in the breakdown of the air. The probability of this occurring is described as P(Clear).

2) This clearance infringement must be to a "limit state" obstacle – for example the clearance requirement over a road caters for vehicles up to 5m in height. Such vehicles are generally only under an overhead line very briefly. The probability of such an obstacle being present is described as P(Obstacle).

3) The voltage on the overhead line conductor must be the highest catered for in the design of the line. "Normal" power frequency voltage is often not the voltage actually used to determine clearances and insulation requirements. At higher nominal operating voltages, for example, insulation is specified so as to cater for switching surges, with clearances designed to match. This probability of maximum voltage being present is described as P(Volts).

Further to (1) above, a clearance infringement requires two conditions to be met:

4) The conductor must exceed its design, profile temperature – the probability being described as P(Temperature).

5) The temperature rise must be sufficient to overcome any excess clearance available – the majority of overhead line spans, once constructed, afford greater clearances than those required simply due to the constraints placed on designers, such as where structures can be placed. This probability is described as P(Design).

Further to (4) above, the temperature exceedance also requires two conditions to be met:

6) The conductor must be carrying a load current greater than the maximum current that would result in a zero exceedance – i.e. the load current must be greater than that determined by the absolute worst set of cooling conditions that a line might experience. This probability is described as P(Load).

7) Finally, the prevailing weather conditions must be insufficient to provide a real time rating greater than the load current. This probability is described as P(Weather)

Graphically, this risk model can be represented as follows:

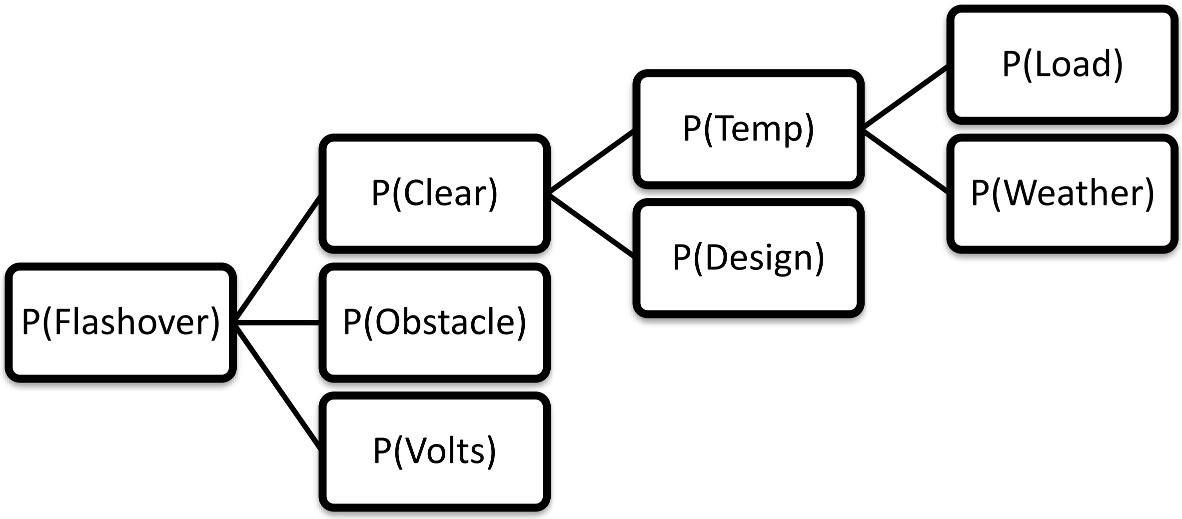


**Figure B1.**
**Overhead Line Rating Risk Model**

In the context of work undertaken in this project, P(Weather) is the exceedance associated with a calculated rating.

While some generic assumptions could sensibly be made for P(Obstacle), P(Volts), and P(Design), and while P(Weather) can reliably be chosen using the methodology of ENA ER P27 Issue 2, the most variable and uncertain parameter above is P(Load).

Depending on the type of network, P(Load) could be dependent on a variety of factors. At one extreme, a single circuit connecting a conventional generator could be subject to full load continuously, with P(Load) = 1. Alternatively, there could be a circuit on the EHV network that might only see maximum load after two circuit outages, where P(Load) could be as low as $10^{-3}$.

WPD Assessment of Appropriate Exceedances

In choosing the acceptable exceedances for WPD's ratings, the following values were used:

| | **Sustained Load Pre-Fault Rating** | **Variable Load Pre-Fault Rating** | **Post-Fault Rating** |
|---|---|---|---|
| | 0.001% Exceedance | 3% Exceedance | 9% Exceedance |
| **P(Load)** | 1.0 (Sustained) | 0.0833 (2hrs/day) | 0.0137 (5days/year) |
| **P(Weather)** | 0.00001 | 0.03 | 0.09 |
| **P(Temp)** | $1.0 \times 10^{-5}$ | $2.5 \times 10^{-3}$ | $8.64 \times 10^{-3}$ |
| **P(Design)** | 0.02 | 0.02 | 0.02 |
| **P(Clear)** | $2 \times 10^{-7}$ | $5 \times 10^{-5}$ | $1.73 \times 10^{-4}$ |
| **P(Obstacle)** | 0.02 | 0.02 | 0.02 |
| **P(Volts)** | 1.0 | 1.0 | 1.0 |
| **P(Flashover)** | $\mathbf{4.0 \times 10^{-9}}$ | $\mathbf{1.0 \times 10^{-6}}$ | $\mathbf{4.92 \times 10^{-7}}$ |

**Table B1.**
**Overhead Line Rating Risk Model – Values Used**

While the values used indicate acceptable likelihoods of flashovers occurring, it is also worth noting the potential consequences in order to put those likelihoods into context. Table B2 indicates, for various exceedances, what the most extreme temperature excursion might be (noting that this is extremely unlikely) as well as the level of load as a percentage of that rating that is required for there to be any risk of an excursion at all.

So, for a 3% exceedance rating, a P(load) of 0.0833 (2hrs/day) corresponds to the amount of time a line is expected to be loaded above 92% of that 3% rating. Additionally, should the absolute worst combination of weather conditions occur while the line is loaded to 100% of its rating, the line could exceed its design temperature by up to 15°C.

| Exceedence | Maximum Excursion Above Profile Temperature | Threshold for P(Load) - % of Full Rating |
|---|---|---|
| 0.001% | Negligible | 100% |
| 1% | 10°C | 96% |
| 3% | 15°C | 92% |
| 6% | 20°C | 87% |
| 9% | 25°C | 84% |

**Table B2.**
**Overhead Line Rating Risk Model – Temperature Rises and Risk Thresholds**

**APPENDIX C**

## RATING TABLES – Standard Ratings

# TABLE C.1

**Variable Load Pre-fault and Post-Fault Ratings (Amps)**
**Hard Drawn Copper Conductors – Metric Sizes to BS 7884**

| Conductor | Type | Temp. (°C) | Variable Load Pre-Fault Rating (A): e = 3% | | | | Post-Fault Rating (A): e = 9% | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Summer | Inter warm | Inter cool | Winter | Summer | Inter warm | Inter cool | Winter |
| 16 mm$^2$ (3/2.65mm) | HDC | 50 | 115 | 120 | 127 | 129 | 126 | 131 | 139 | 142 |
| | | 65 | 135 | 138 | 144 | 147 | 147 | 151 | 158 | 169 |
| | | 75 | 146 | 149 | 155 | 157 | 160 | 163 | 169 | 171 |
| 25 mm$^2$ (7/2.10mm) | HDC | 50 | 147 | 153 | 162 | 165 | 161 | 167 | 177 | 181 |
| | | 65 | 172 | 177 | 184 | 187 | 188 | 194 | 202 | 205 |
| | | 75 | 187 | 191 | 198 | 200 | 204 | 209 | 216 | 219 |
| 32 mm$^2$ (3/3.75mm) | HDC | 50 | 180 | 187 | 198 | 203 | 197 | 205 | 217 | 222 |
| | | 65 | 211 | 217 | 226 | 230 | 231 | 237 | 247 | 251 |
| | | 75 | 229 | 234 | 242 | 246 | 250 | 256 | 265 | 269 |
| *38 mm$^2$ (7/2.64mm) | HDC | 50 | 193 | 201 | 213 | 217 | 211 | 220 | 233 | 238 |
| | | 65 | 227 | 233 | 243 | 246 | 248 | 255 | 265 | 269 |
| | | 75 | 245 | 251 | 260 | 263 | 268 | 275 | 284 | 288 |
| 50 mm$^2$ (7/3.00mm) | HDC | 50 | 228 | 237 | 251 | 256 | 249 | 259 | 274 | 280 |
| | | 65 | 267 | 274 | 286 | 290 | 292 | 300 | 313 | 318 |
| | | 75 | 290 | 296 | 306 | 310 | 317 | 324 | 335 | 340 |
| 70 mm$^2$ (7/3.55mm) | HDC | 50 | 284 | 295 | 312 | 318 | 310 | 322 | 341 | 348 |
| | | 65 | 333 | 342 | 356 | 361 | 364 | 374 | 389 | 395 |
| | | 75 | 361 | 369 | 382 | 387 | 395 | 403 | 418 | 423 |
| 100 mm$^2$ (7/4.30mm) | HDC | 50 | 364 | 378 | 400 | 408 | 398 | 413 | 438 | 447 |
| | | 65 | 427 | 439 | 457 | 464 | 467 | 480 | 500 | 508 |
| | | 75 | 464 | 474 | 490 | 497 | 507 | 518 | 536 | 543 |
| 125 mm$^2$ (19/2.90mm) | HDC | 50 | 418 | 434 | 460 | 469 | 457 | 475 | 503 | 513 |
| | | 65 | 491 | 504 | 525 | 533 | 537 | 552 | 575 | 583 |
| | | 75 | 533 | 545 | 564 | 571 | 583 | 596 | 617 | 624 |
| 150 mm$^2$ (19/3.20mm) | HDC | 50 | 475 | 493 | 522 | 533 | 520 | 540 | 571 | 583 |
| | | 65 | 558 | 573 | 597 | 606 | 611 | 627 | 653 | 663 |
| | | 75 | 606 | 619 | 641 | 649 | 663 | 677 | 701 | 710 |

* 38mm$^2$ is not a metric standard size – this conductor is identical to 0.058in$^2$ to BS 125

# TABLE C.2

**Variable Load Pre-fault and Post-Fault Ratings (Amps)**
**Hard Drawn Copper Conductors – Imperial Sizes to BS 125**

| Conductor | Type | Temp. (°C) | Variable Load Pre-Fault Rating (A): e = 3% | | | | Post-Fault Rating (A): e = 9% | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Summer | Inter warm | Inter cool | Winter | Summer | Inter warm | Inter cool | Winter |
| 0.025 in$^2$ (3/2.64mm) | HDC | 50 | 115 | 119 | 126 | 129 | 125 | 130 | 138 | 141 |
| | | 65 | 134 | 138 | 144 | 146 | 147 | 151 | 157 | 160 |
| | | 75 | 145 | 149 | 154 | 156 | 159 | 163 | 168 | 171 |
| *0.04 in$^2$ (3/3.37mm) | HDC | 50 | 157 | 163 | 173 | 177 | 172 | 178 | 189 | 193 |
| | | 65 | 184 | 189 | 197 | 200 | 201 | 207 | 216 | 219 |
| | | 75 | 199 | 204 | 211 | 214 | 218 | 223 | 231 | 234 |
| 0.05 in$^2$ (3/3.73mm) | HDC | 50 | 180 | 187 | 198 | 202 | 197 | 204 | 216 | 221 |
| | | 65 | 211 | 216 | 226 | 229 | 231 | 237 | 247 | 251 |
| | | 75 | 228 | 234 | 242 | 245 | 250 | 255 | 264 | 268 |
| 0.075 in$^2$ (7/2.95mm) | HDC | 50 | 223 | 231 | 245 | 250 | 244 | 253 | 268 | 274 |
| | | 65 | 261 | 268 | 280 | 284 | 286 | 293 | 306 | 311 |
| | | 75 | 283 | 289 | 300 | 304 | 310 | 317 | 328 | 332 |
| 0.1 in$^2$ (7/3.45mm) | HDC | 50 | 274 | 285 | 302 | 308 | 300 | 312 | 330 | 337 |
| | | 65 | 322 | 331 | 344 | 350 | 352 | 362 | 377 | 383 |
| | | 75 | 349 | 357 | 369 | 374 | 382 | 390 | 404 | 409 |
| 0.15 in$^2$ (7/4.22mm) | HDC | 50 | 355 | 369 | 390 | 398 | 388 | 403 | 427 | 436 |
| | | 65 | 417 | 428 | 446 | 453 | 456 | 468 | 488 | 495 |
| | | 75 | 452 | 462 | 478 | 484 | 495 | 505 | 523 | 530 |
| 0.2 in$^2$ (19/2.95mm) | HDC | 50 | 427 | 443 | 469 | 479 | 467 | 485 | 513 | 524 |
| | | 65 | 502 | 515 | 537 | 545 | 549 | 564 | 587 | 596 |
| | | 75 | 545 | 556 | 576 | 583 | 596 | 609 | 630 | 638 |

* 0.04in$^2$ is not a standard size

# TABLE C.3

**Variable Load Pre-fault and Post-Fault Ratings (Amps)**
**All Aluminium Conductors (AAC) – Metric Sizes to BSEN 50182**

| Conductor | Type | Temp. (°C) | Variable Load Pre-Fault Rating (A): e = 3% | | | | Post-Fault Rating (A): e = 9% | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Summer | Inter warm | Inter cool | Winter | Summer | Inter warm | Inter cool | Winter |
| 25 mm$^2$ | AAC | 50 | 122 | 126 | 134 | 137 | 133 | 138 | 147 | 150 |
| Gnat | AL1 | 65 | 143 | 147 | 153 | 155 | 156 | 160 | 167 | 170 |
| (7/2.21mm) | | 75 | 155 | 158 | 164 | 166 | 169 | 173 | 179 | 181 |
| 50 mm$^2$ | AAC | 50 | 188 | 196 | 207 | 212 | 206 | 214 | 227 | 232 |
| Ant | AL1 | 65 | 221 | 227 | 237 | 240 | 242 | 249 | 259 | 263 |
| (7/3.10mm) | | 75 | 240 | 245 | 254 | 257 | 262 | 268 | 278 | 281 |
| 100 mm$^2$ | AAC | 50 | 297 | 308 | 326 | 333 | 325 | 337 | 357 | 365 |
| Wasp | AL1 | 65 | 349 | 358 | 373 | 379 | 382 | 392 | 408 | 415 |
| (7/4.39mm) | | 75 | 379 | 387 | 401 | 406 | 414 | 423 | 438 | 444 |
| 150 mm$^2$ | AAC | 50 | 385 | 400 | 424 | 432 | 422 | 438 | 463 | 473 |
| Hornet | AL1 | 65 | 453 | 466 | 485 | 492 | 496 | 509 | 530 | 538 |
| (19/3.25mm) | | 75 | 493 | 503 | 521 | 527 | 539 | 551 | 569 | 577 |
| 250 mm$^2$ | AAC | 50 | 543 | 564 | 596 | 609 | 594 | 617 | 652 | 666 |
| Cockroach | AL1 | 65 | 639 | 656 | 683 | 694 | 699 | 718 | 747 | 759 |
| (19/4.22mm) | | 75 | 695 | 710 | 734 | 744 | 760 | 777 | 803 | 813 |
| 300 mm$^2$ | AAC | 50 | 616 | 640 | 677 | 691 | 674 | 700 | 740 | 756 |
| Butterfly | AL1 | 65 | 726 | 745 | 776 | 787 | 794 | 815 | 848 | 861 |
| (19/4.65mm) | | 75 | 789 | 806 | 834 | 844 | 863 | 882 | 912 | 923 |
| 400 mm$^2$ | AAC | 50 | 726 | 754 | 797 | 814 | 794 | 825 | 872 | 890 |
| Centipede | AL1 | 65 | 856 | 878 | 914 | 928 | 936 | 961 | 1000 | 1015 |
| (37/3.78mm) | | 75 | 931 | 951 | 983 | 995 | 1018 | 1040 | 1075 | 1089 |

# TABLE C.4

## Variable Load Pre-fault and Post-Fault Ratings (Amps)
## All Aluminium Alloy Conductors (AAAC) – AL3 Alloy Metric Sizes to BSEN 50182

| Conductor | Type | Temp. (°C) | Variable Load Pre-Fault Rating (A): e = 3% | | | | Post-Fault Rating (A): e = 9% | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Summer | Inter warm | Inter cool | Winter | Summer | Inter warm | Inter cool | Winter |
| 25 mm$^2$ | AAAC | 50 | 122 | 127 | 134 | 137 | 133 | 139 | 147 | 150 |
| Almond | AL3 | 65 | 143 | 147 | 153 | 156 | 157 | 161 | 168 | 170 |
| (7/2.34mm) | | 75 | 155 | 159 | 164 | 166 | 170 | 173 | 180 | 182 |
| 40 mm$^2$ | AAAC | 50 | 165 | 171 | 181 | 185 | 180 | 187 | 198 | 202 |
| Fir | AL3 | 65 | 193 | 199 | 207 | 210 | 212 | 217 | 226 | 230 |
| (7/2.95mm) | | 75 | 210 | 214 | 222 | 225 | 229 | 234 | 243 | 246 |
| 50 mm$^2$ | AAAC | 50 | 191 | 198 | 210 | 214 | 208 | 217 | 229 | 234 |
| Hazel | AL3 | 65 | 224 | 230 | 239 | 243 | 245 | 251 | 262 | 266 |
| (7/3.30mm) | | 75 | 243 | 248 | 257 | 260 | 266 | 271 | 281 | 285 |
| 60 mm$^2$ | AAAC | 50 | 214 | 222 | 235 | 240 | 234 | 243 | 257 | 263 |
| Pine | AL3 | 65 | 251 | 258 | 269 | 273 | 275 | 282 | 294 | 299 |
| (7/3.61mm) | | 75 | 273 | 279 | 289 | 292 | 298 | 305 | 316 | 320 |
| 100 mm$^2$ | AAAC | 50 | 298 | 310 | 328 | 335 | 326 | 339 | 358 | 366 |
| Oak | AL3 | 65 | 351 | 360 | 375 | 381 | 383 | 394 | 410 | 416 |
| (7/4.65mm) | | 75 | 381 | 389 | 402 | 408 | 416 | 425 | 440 | 446 |
| 150 mm$^2$ | AAAC | 50 | 393 | 408 | 431 | 441 | 430 | 446 | 472 | 482 |
| Ash | AL3 | 65 | 462 | 474 | 494 | 501 | 506 | 519 | 540 | 549 |
| (19/3.48mm) | | 75 | 502 | 513 | 531 | 537 | 549 | 561 | 580 | 588 |
| 175 mm$^2$ | AAAC | 50 | 435 | 451 | 477 | 487 | 475 | 494 | 522 | 533 |
| Elm | AL3 | 65 | 512 | 525 | 547 | 555 | 560 | 575 | 598 | 607 |
| (19/3.76mm) | | 75 | 556 | 568 | 587 | 595 | 608 | 621 | 643 | 651 |
| 200 mm$^2$ | AAAC | 50 | 472 | 490 | 519 | 530 | 517 | 536 | 567 | 579 |
| Poplar | AL3 | 65 | 556 | 571 | 594 | 603 | 608 | 624 | 650 | 660 |
| (37/2.87mm) | | 75 | 604 | 617 | 638 | 647 | 661 | 675 | 698 | 707 |
| 250 mm$^2$ | AAAC | 50 | 551 | 572 | 605 | 618 | 603 | 626 | 662 | 676 |
| Sycamore | AL3 | 65 | 649 | 667 | 694 | 704 | 710 | 729 | 759 | 770 |
| (37/3.23mm) | | 75 | 706 | 721 | 746 | 755 | 772 | 789 | 816 | 826 |
| 300 mm$^2$ | AAAC | 50 | 619 | 643 | 680 | 694 | 678 | 703 | 744 | 759 |
| Upas | AL3 | 65 | 730 | 749 | 780 | 791 | 798 | 819 | 853 | 866 |
| (37/3.53mm) | | 75 | 794 | 811 | 838 | 849 | 868 | 887 | 917 | 928 |
| 500 mm$^2$ | AAAC | 50 | 848 | 880 | 930 | 950 | 928 | 963 | 1018 | 1039 |
| Rubus | AL3 | 65 | 1000 | 1026 | 1068 | 1084 | 1094 | 1123 | 1168 | 1185 |
| (61/3.50mm) | | 75 | 1088 | 1111 | 1149 | 1163 | 1190 | 1216 | 1256 | 1272 |

# TABLE C.5

## Variable Load Pre-fault and Post-Fault Ratings (Amps)
## All Aluminium Alloy Conductors (AAAC) – AL5 Alloy Metric Sizes to BSEN 50182

| Conductor | Type | Temp. (°C) | Variable Load Pre-Fault Rating (A): e = 3% | | | | Post-Fault Rating (A): e = 9% | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Summer | Inter warm | Inter cool | Winter | Summer | Inter warm | Inter cool | Winter |
| 100 mm$^2$ | AAAC | 50 | 304 | 316 | 335 | 342 | 333 | 346 | 366 | 374 |
| Oak | AL5 | 65 | 358 | 368 | 383 | 389 | 392 | 402 | 419 | 425 |
| (7/4.65mm) | | 75 | 389 | 397 | 411 | 416 | 425 | 434 | 449 | 455 |
| 150 mm$^2$ | AAAC | 50 | 401 | 416 | 441 | 450 | 439 | 455 | 482 | 492 |
| Ash | AL5 | 65 | 472 | 484 | 504 | 512 | 516 | 530 | 552 | 560 |
| (19/3.48mm) | | 75 | 512 | 524 | 542 | 549 | 561 | 573 | 593 | 600 |
| 175 mm$^2$ | AAAC | 50 | 444 | 461 | 488 | 498 | 485 | 504 | 533 | 544 |
| Elm | AL5 | 65 | 522 | 536 | 558 | 567 | 571 | 587 | 611 | 620 |
| (19/3.76mm) | | 75 | 568 | 580 | 600 | 607 | 621 | 634 | 656 | 664 |
| 200 mm$^2$ | AAAC | 50 | 482 | 501 | 530 | 541 | 527 | 548 | 579 | 591 |
| Poplar | AL5 | 65 | 568 | 583 | 607 | 616 | 621 | 637 | 664 | 674 |
| (37/2.87mm) | | 75 | 617 | 630 | 652 | 660 | 675 | 689 | 713 | 722 |
| 250 mm$^2$ | AAAC | 50 | 563 | 584 | 618 | 631 | 616 | 639 | 676 | 690 |
| Sycamore | AL5 | 65 | 663 | 680 | 708 | 719 | 725 | 744 | 775 | 786 |
| (37/3.23mm) | | 75 | 721 | 736 | 761 | 771 | 788 | 805 | 833 | 843 |
| 300 mm$^2$ | AAAC | 50 | 632 | 656 | 694 | 709 | 692 | 718 | 759 | 775 |
| Upas | AL5 | 65 | 745 | 765 | 796 | 808 | 815 | 837 | 871 | 884 |
| (37/3.53mm) | | 75 | 810 | 828 | 856 | 866 | 886 | 905 | 936 | 948 |
| 500 mm$^2$ | AAAC | 50 | 865 | 898 | 949 | 969 | 946 | 982 | 1039 | 1060 |
| Rubus | AL5 | 65 | 1020 | 1047 | 1089 | 1106 | 1116 | 1145 | 1192 | 1210 |
| (61/3.50mm) | | 75 | 1110 | 1134 | 1172 | 1187 | 1214 | 1240 | 1282 | 1298 |
| 570 mm$^2$ | AAAC | 50 | 933 | 968 | 1023 | 1044 | 1020 | 1059 | 1119 | 1142 |
| Sorbus | AL5 | 65 | 1100 | 1129 | 1174 | 1192 | 1203 | 1235 | 1285 | 1304 |
| (61/3.71mm) | | 75 | 1197 | 1222 | 1263 | 1279 | 1309 | 1337 | 1382 | 1399 |
| 700 mm$^2$ | AAAC | 50 | 1072 | 1113 | 1176 | 1201 | 1173 | 1217 | 1287 | 1313 |
| Araucaria | AL5 | 65 | 1266 | 1299 | 1351 | 1371 | 1385 | 1421 | 1478 | 1500 |
| (61/4.14mm) | | 75 | 1377 | 1407 | 1454 | 1472 | 1507 | 1539 | 1590 | 1610 |

# TABLE C.6

**Variable Load Pre-fault and Post-Fault Ratings (Amps)**
**Aluminium Conductor Steel Reinforced (ACSR) – to BSEN 50182**

| Conductor | Type | Temp. (°C) | Variable Load Pre-Fault Rating (A): e = 3% | | | | Post-Fault Rating (A): e = 9% | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Summer | Inter warm | Inter cool | Winter | Summer | Inter warm | Inter cool | Winter |
| 25 mm$^2$ | ACSR | 50 | 116 | 121 | 128 | 131 | 127 | 132 | 140 | 143 |
| Gopher | | 65 | 136 | 140 | 146 | 148 | 149 | 153 | 159 | 162 |
| (6/2.36mm + 1/2.36mm) | | 75 | 147 | 151 | 156 | 158 | 161 | 165 | 171 | 173 |
| 30 mm$^2$ | ACSR | 50 | 131 | 136 | 144 | 148 | 144 | 149 | 158 | 161 |
| Weasel | | 65 | 154 | 158 | 165 | 167 | 168 | 173 | 180 | 183 |
| (6/2.59mm + 1/2.59mm) | | 75 | 166 | 170 | 176 | 178 | 182 | 186 | 193 | 195 |
| 40 mm$^2$ | ACSR | 50 | 159 | 165 | 175 | 178 | 174 | 180 | 191 | 195 |
| Ferret | | 65 | 186 | 191 | 199 | 202 | 203 | 209 | 218 | 221 |
| (6/3.00mm + 1/3.00mm) | | 75 | 201 | 206 | 213 | 216 | 220 | 225 | 233 | 236 |
| 50 mm$^2$ | ACSR | 50 | 182 | 189 | 202 | 206 | 200 | 207 | 221 | 225 |
| Rabbit | | 65 | 215 | 221 | 230 | 233 | 235 | 241 | 251 | 255 |
| (6/3.35mm + 1/3.35mm) | | 75 | 233 | 238 | 246 | 249 | 255 | 260 | 269 | 273 |
| 60 mm$^2$ | ACSR | 50 | 205 | 213 | 225 | 230 | 225 | 233 | 246 | 252 |
| Mink | | 65 | 241 | 248 | 258 | 262 | 264 | 271 | 282 | 287 |
| (6/3.66mm + 1/3.66mm) | | 75 | 261 | 267 | 277 | 280 | 286 | 292 | 303 | 306 |
| 75 mm$^2$ | ACSR | 50 | 239 | 247 | 261 | 267 | 261 | 271 | 286 | 292 |
| Racoon | | 65 | 278 | 286 | 299 | 304 | 305 | 313 | 327 | 333 |
| (6/4.09mm + 1/4.09mm) | | 75 | 303 | 310 | 321 | 325 | 332 | 339 | 351 | 355 |
| 100 mm$^2$ | ACSR | 50 | 289 | 299 | 316 | 322 | 316 | 327 | 345 | 352 |
| Dog | | 65 | 336 | 345 | 358 | 364 | 367 | 377 | 392 | 398 |
| (6/4.72mm + 7/1.57mm) | | 75 | 363 | 371 | 384 | 391 | 397 | 406 | 420 | 428 |
| 150 mm$^2$ | ACSR | 50 | 388 | 403 | 426 | 435 | 424 | 441 | 466 | 476 |
| Dingo | | 65 | 455 | 467 | 487 | 494 | 498 | 511 | 532 | 540 |
| (18/3.35mm + 1/3.35mm) | | 75 | 494 | 505 | 522 | 529 | 540 | 552 | 571 | 578 |
| 175 mm$^2$ | ACSR | 50 | 439 | 456 | 482 | 492 | 480 | 498 | 527 | 538 |
| Lynx | | 65 | 516 | 529 | 551 | 559 | 564 | 579 | 603 | 612 |
| (30/2.79mm + 7/2.79mm) | | 75 | 559 | 572 | 591 | 599 | 612 | 625 | 647 | 655 |
| 175 mm$^2$ | ACSR | 50 | 428 | 444 | 470 | 480 | 468 | 486 | 514 | 525 |
| Caracal | | 65 | 502 | 516 | 537 | 545 | 550 | 564 | 587 | 596 |
| (18/3.61mm + 1/3.61mm) | | 75 | 545 | 557 | 576 | 583 | 596 | 609 | 630 | 638 |
| 200 mm$^2$ | ACSR | 50 | 467 | 485 | 513 | 524 | 511 | 531 | 562 | 573 |
| Jaguar | | 65 | 549 | 564 | 587 | 596 | 601 | 616 | 642 | 652 |
| (18/3.86mm + 1/3.86mm) | | 75 | 596 | 609 | 629 | 637 | 652 | 666 | 688 | 697 |
| 400 mm$^2$ | ACSR | 50 | 749 | 778 | 822 | 839 | 820 | 851 | 899 | 917 |
| Zebra | | 65 | 880 | 903 | 939 | 953 | 963 | 988 | 1028 | 1043 |
| (54/3.18mm + 7/3.18mm) | | 75 | 956 | 976 | 1008 | 1021 | 1045 | 1067 | 1103 | 1117 |

# TABLE C.7

**Variable Load Pre-fault and Post-Fault Ratings (Amps)**
**Gap-Type Thermal Aluminium Conductor Steel Reinforced (GTACSR)**

| Conductor | Type | Temp (°C) | Variable Load Pre-Fault Rating (A): e = 3% | | | | Post-Fault Rating (A): e = 9% | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Summer | Inter warm | Inter cool | Winter | Summer | Inter warm | Inter cool | Winter |
| 265 $mm^2$ | GTACSR | 75 | 699 | 714 | 738 | 747 | 764 | 781 | 807 | 817 |
| Hen | | 85 | 749 | 762 | 784 | 793 | 819 | 834 | 858 | 867 |
| (Special) | | 95 | 795 | 807 | 827 | 835 | 809 | 883 | 905 | 913 |

# TABLE C.8

**Variable Load Pre-fault and Post-Fault Ratings (Amps)**
**Cadmium Copper Conductors – Imperial Sizes to BS 672**

| Conductor | Type | Temp. (°C) | Variable Load Pre-Fault Rating (A): e = 3% | | | | Post-Fault Rating (A): e = 9% | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Summer | Inter warm | Inter cool | Winter | Summer | Inter warm | Inter cool | Winter |
| 0.017 $in^2$ | Cad | 50 | 91 | 94 | 100 | 102 | 99 | 103 | 109 | 111 |
| (3/2.36mm) | Cu | 65 | 106 | 109 | 114 | 116 | 116 | 120 | 125 | 127 |
| | | 75 | 115 | 118 | 122 | 124 | 126 | 129 | 134 | 136 |
| 0.022 $in^2$ / | Cad | 50 | 106 | 110 | 117 | 119 | 116 | 120 | 128 | 130 |
| 16 $mm^2$ | Cu | 65 | 124 | 128 | 133 | 135 | 136 | 140 | 146 | 148 |
| (3/2.67mm) | | 75 | 135 | 138 | 143 | 145 | 148 | 151 | 157 | 159 |
| 0.025 $in^2$ / | Cad | 50 | 115 | 120 | 127 | 129 | 126 | 131 | 139 | 142 |
| 19 $mm^2$ | Cu | 65 | 135 | 139 | 145 | 147 | 148 | 152 | 158 | 161 |
| (3/2.84mm) | | 75 | 147 | 150 | 155 | 158 | 161 | 164 | 170 | 172 |
| 0.035 $in^2$ | Cad | 50 | 141 | 146 | 155 | 158 | 154 | 160 | 170 | 173 |
| (3/3.33mm) | Cu | 65 | 166 | 170 | 177 | 180 | 181 | 186 | 194 | 197 |
| | | 75 | 180 | 184 | 191 | 193 | 197 | 201 | 208 | 211 |
| 0.04 $in^2$ | Cad | 50 | 152 | 158 | 168 | 171 | 167 | 173 | 183 | 187 |
| (3/3.58mm) | Cu | 65 | 179 | 184 | 192 | 195 | 196 | 201 | 210 | 213 |
| | | 75 | 195 | 199 | 206 | 209 | 213 | 218 | 225 | 228 |
| 0.05 $in^2$ | Cad | 50 | 174 | 181 | 191 | 195 | 190 | 198 | 209 | 214 |
| (7/2.62mm) | Cu | 65 | 205 | 210 | 219 | 223 | 224 | 230 | 240 | 243 |
| | | 75 | 222 | 227 | 235 | 238 | 243 | 249 | 257 | 261 |
| 0.075 $in^2$ | Cad | 50 | 228 | 237 | 251 | 256 | 250 | 259 | 275 | 280 |
| (7/3.23mm) | Cu | 65 | 269 | 276 | 288 | 292 | 294 | 302 | 315 | 320 |
| | | 75 | 292 | 299 | 309 | 313 | 319 | 327 | 338 | 342 |
| 0.1 $in^2$ | Cad | 50 | 273 | 284 | 301 | 307 | 299 | 311 | 329 | 336 |
| (7/3.71mm) | Cu | 65 | 322 | 331 | 345 | 350 | 352 | 362 | 377 | 383 |
| | | 75 | 350 | 358 | 370 | 375 | 383 | 392 | 405 | 411 |
| 0.15 $in^2$ | Cad | 50 | 359 | 372 | 394 | 403 | 392 | 407 | 431 | 440 |
| (19/2.77mm) | Cu | 65 | 423 | 434 | 452 | 459 | 463 | 475 | 495 | 502 |
| | | 75 | 460 | 470 | 486 | 493 | 503 | 514 | 532 | 539 |

# TABLE C.9

**Variable Load Pre-fault Ratings (Amps)**
**HDPE Covered Conductor, BLL – AL3 Alloy Conductor**

| Conductor | Type | Temp. (°C) | Variable Load Pre-Fault Rating (A): e = 3% | | | |
|---|---|---|---|---|---|---|
| | | | Summer | Inter warm | Inter cool | Winter |
| 50 $mm^2$ | BLL – AL3 | 60 | 195 | 201 | 210 | 214 |
| | | 70 | 213 | 219 | 227 | 230 |
| 99 $mm^2$ | BLL – AL3 | 60 | 297 | 306 | 320 | 325 |
| | | 70 | 325 | 333 | 346 | 350 |
| 120 $mm^2$ | BLL – AL3 | 60 | 336 | 346 | 362 | 368 |
| | | 70 | 368 | 377 | 391 | 396 |
| 159 $mm^2$ | BLL – AL3 | 60 | 404 | 416 | 435 | 442 |
| | | 70 | 443 | 453 | 470 | 477 |
| 185 $mm^2$ | BLL – AL3 | 60 | 447 | 461 | 482 | 490 |
| | | 70 | 490 | 502 | 521 | 528 |
| 241 $mm^2$ | BLL – AL3 | 60 | 533 | 549 | 574 | 583 |
| | | 70 | 584 | 598 | 620 | 629 |

# TABLE C.10

## Variable Load Pre-fault Ratings (Amps)
## HDPE Covered Conductor, BLL – AL7 Alloy Conductor

| Conductor | Type | Temp. (°C) | Variable Load Pre-Fault Rating (A): e = 3% | | | |
|---|---|---|---|---|---|---|
| | | | Summer | Inter warm | Inter cool | Winter |
| 50 $mm^2$ | BLL – AL7 | 60 | 203 | 209 | 219 | 223 |
| | | 70 | 222 | 228 | 236 | 240 |
| 99 $mm^2$ | BLL – AL7 | 60 | 309 | 319 | 333 | 339 |
| | | 70 | 339 | 347 | 360 | 365 |
| 120 $mm^2$ | BLL – AL7 | 60 | 350 | 361 | 377 | 384 |
| | | 70 | 384 | 393 | 408 | 413 |
| 159 $mm^2$ | BLL – AL7 | 60 | 420 | 433 | 453 | 460 |
| | | 70 | 460 | 472 | 489 | 496 |
| 185 $mm^2$ | BLL – AL7 | 60 | 466 | 480 | 501 | 510 |
| | | 70 | 510 | 523 | 542 | 550 |
| 241 $mm^2$ | BLL – AL7 | 60 | 554 | 570 | 596 | 606 |
| | | 70 | 607 | 621 | 644 | 653 |

# TABLE C.11

**Variable Load Pre-fault Ratings (Amps)**
**XLPE Compacted Covered Conductor, BLX / PAS / CC**

| Conductor | Type | Temp. (°C) | Variable Load Pre-Fault Rating (A): e = 3% | | | |
|---|---|---|---|---|---|---|
| | | | Summer | Inter warm | Inter cool | Winter |
| 50 $mm^2$ | CC – AL2 | 60 | 196 | 201 | 210 | 214 |
| | | 75 | 222 | 227 | 235 | 238 |
| 95 $mm^2$ | CC – AL2 | 60 | 302 | 310 | 325 | 330 |
| | | 75 | 343 | 351 | 363 | 367 |
| 120 $mm^2$ | CC – AL2 | 60 | 349 | 359 | 376 | 382 |
| | | 75 | 397 | 406 | 419 | 426 |
| 185 $mm^2$ | CC – AL2 | 60 | 458 | 471 | 493 | 501 |
| | | 75 | 522 | 534 | 551 | 559 |
| “Hazel” | CC – AL3 | 60 | 234 | 240 | 252 | 256 |
| | | 75 | 266 | 272 | 282 | 285 |

## TABLE C.12

**Sustained Load Pre-fault Ratings (Amps)**
**LV Aerial Bundled Conductor (ABC)**

| Conductor | Type | Temp. (°C) | Sustained Load Pre-Fault Rating (A): e = 0.001% | | | |
|---|---|---|---|---|---|---|
| | | | Summer | Inter warm | Inter cool | Winter |
| 4 x 25 $mm^2$ | LV ABC | 75 | 103 | 106 | 111 | 113 |
| 4 x 35 $mm^2$ | LV ABC | 75 | 124 | 129 | 135 | 138 |
| 4 x 50 $mm^2$ | LV ABC | 75 | 149 | 154 | 162 | 165 |
| 4 x 70 $mm^2$ | LV ABC | 75 | 186 | 192 | 202 | 206 |
| 4 x 95 $mm^2$ | LV ABC | 75 | 226 | 233 | 246 | 251 |
| 4 x 120 $mm^2$ | LV ABC | 75 | 260 | 269 | 284 | 290 |
| | | | | | | |
| 2 x 25 $mm^2$ | LV ABC | 75 | 124 | 128 | 134 | 136 |
| 2 x 35 $mm^2$ | LV ABC | 75 | 150 | 155 | 162 | 165 |
| 2 x 50 $mm^2$ | LV ABC | 75 | 180 | 186 | 195 | 198 |
| 2 x 70 $mm^2$ | LV ABC | 75 | 225 | 232 | 243 | 248 |
| 2 x 95 $mm^2$ | LV ABC | 75 | 274 | 283 | 297 | 302 |

**Notes:**

ABC ratings are calculated in accordance with the methodology presented in ERA Report 90-0386, with ambient temperatures adjusted to the new, standard seasonal temperatures of P27 with the appropriate Ct scaling factor applied to give the 0.001% exceedance rating. Conductor parameters are taken from ENATS 43-13.

ABC Ratings presented here apply to overhead line pole-top application only and shall not be used for under-eaves installations.

**APPENDIX D**

## RATING TABLES – Restricted Ratings

# TABLE D.1

**Clearance Restricted Ratings (Amps)**
**All Aluminium Alloy Conductors (AAAC) – AL3 Alloy Metric Sizes to BSEN 50182**

| Conductor | Type | Temp. (°C) | Continuous Rating (A): e = 3% | | | | Post-Fault Rating (A): e = 9% | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Summer | Inter warm | Inter cool | Winter | Summer | Inter warm | Inter cool | Winter |
| 100 $mm^2$ Oak (7/4.65mm) | AAAC AL3 | 40 | 256 | 269 | 291 | 299 | 280 | 295 | 318 | 327 |
| 150 $mm^2$ Ash (19/3.48mm) | AAAC AL3 | 40 | 337 | 355 | 383 | 393 | 368 | 388 | 418 | 430 |
| 175 $mm^2$ Elm (19/3.76mm) | AAAC AL3 | 40 | 372 | 392 | 423 | 435 | 407 | 429 | 463 | 476 |
| 200 $mm^2$ Poplar (37/2.87mm) | AAAC AL3 | 40 | 405 | 426 | 460 | 472 | 443 | 466 | 503 | 517 |
| 250 $mm^2$ Sycamore (37/3.23mm) | AAAC AL3 | 40 | 472 | 497 | 536 | 551 | 516 | 544 | 587 | 603 |
| 300 $mm^2$ Upas (37/3.53mm) | AAAC AL3 | 40 | 530 | 559 | 602 | 619 | 580 | 611 | 659 | 677 |
| 500 $mm^2$ Rubus (61/3.50mm) | AAAC AL3 | 40 | 726 | 764 | 824 | 846 | 794 | 836 | 901 | 925 |

# TABLE D.2

**Clearance Restricted Ratings (Amps)**
**All Aluminium Alloy Conductors (AAAC) – AL5 Alloy Metric Sizes to BSEN 50182**

| Conductor | Type | Temp. (°C) | Continuous Rating (A): e = 3% | | | | Post-Fault Rating (A): e = 9% | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Summer | Inter warm | Inter cool | Winter | Summer | Inter warm | Inter cool | Winter |
| 100 $mm^2$ Oak (7/4.65mm) | AAAC AL5 | 40 | 261 | 275 | 297 | 305 | 286 | 301 | 325 | 334 |
| 150 $mm^2$ Ash (19/3.48mm) | AAAC AL5 | 40 | 344 | 362 | 391 | 401 | 376 | 396 | 427 | 439 |
| 175 $mm^2$ Elm (19/3.76mm) | AAAC AL5 | 40 | 380 | 401 | 432 | 444 | 416 | 438 | 473 | 486 |
| 200 $mm^2$ Poplar (37/2.87mm) | AAAC AL5 | 40 | 413 | 435 | 469 | 482 | 452 | 476 | 513 | 527 |
| 250 $mm^2$ Sycamore (37/3.23mm) | AAAC AL5 | 40 | 482 | 508 | 547 | 562 | 527 | 555 | 599 | 615 |
| 300 $mm^2$ Upas (37/3.53mm) | AAAC AL5 | 40 | 541 | 570 | 615 | 632 | 592 | 624 | 673 | 691 |
| 500 $mm^2$ Rubus (61/3.50mm) | AAAC AL5 | 40 | 740 | 780 | 840 | 863 | 810 | 853 | 919 | 944 |
| 570 $mm^2$ Sorbus (61/3.71mm) | AAAC AL5 | 40 | 798 | 840 | 905 | 930 | 873 | 919 | 990 | 1017 |
| 700 $mm^2$ Araucaria (61/4.14mm) | AAAC AL5 | 40 | 917 | 966 | 1041 | 1069 | 1003 | 1057 | 1139 | 1169 |

# TABLE D.3

**Clearance Restricted Ratings (Amps)**
**Aluminium Conductor Steel Reinforced (ACSR) – to BSEN 50182**

| Conductor Type | Temp. (°C) | Continuous Rating (A): e = 3% | | | | Post-Fault Rating (A): e = 9% | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Summ er | Inter warm | Inter cool | Winter | Summ er | Inter warm | Inter cool | Winter |
| 175 $mm^2$ ACSR Lynx (30/2.79mm + 7/2.79mm) | 40 | 377 | 397 | 428 | 440 | 412 | 434 | 468 | 481 |
| 175 $mm^2$ ACSR Caracal (18/3.61mm + 1/3.61mm) | 40 | 367 | 387 | 417 | 429 | 402 | 423 | 457 | 469 |
| 200 $mm^2$ ACSR Jaguar (18/3.86mm + 1/3.86mm) | 40 | 401 | 423 | 456 | 468 | 439 | 462 | 499 | 512 |
| 400 $mm^2$ ACSR Zebra (54/3.18mm + 7/3.18mm) | 40 | 643 | 677 | 730 | 749 | 704 | 741 | 798 | 819 |

# TABLE D.4

**Jointing Restricted Ratings (Amps)**

| Conductor Type | Temp. (°C) | Continuous Rating (A): e = 3% | | | | Post-Fault Rating (A): e = 9% | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Summer | Interwarm | Intercool | Winter | Summer | Interwarm | Intercool | Winter |
| 175 $mm^2$ ACSR Lynx (30/2.79mm + 7/2.79mm) | 50 | 390 | 452 | 452 | 486 | 440 | 490* | 510 | 530* |
| 400 $mm^2$ ACSR Zebra (54/3.18mm + 7/3.18mm) | 50 | 650 | 700 | 700 | 800 | 650 | 700 | 700 | 800 |

**Note:** These ratings are unchanged from ST:SD8A/2, and assign the previous spring/autumn season rating to both the new Interwarm and Intercool season ratings. Ratings marked * are further reduced from ST:SD8A/2 values as otherwise they would be higher than the unrestricted rating. These values have been determined by rounding the unrestricted rating down to the nearest 10A.

**APPENDIX E**

## SUPERSEDED DOCUMENTATION

This document supersedes ST: SD8A/2 dated May 2013 which has now been withdrawn.

**APPENDIX F**

## RECORD OF COMMENT DURING CONSULTATION

ST: SD8A/3 - Comments

**APPENDIX G**

## ASSOCIATED DOCUMENTATION

The Electricity Safety Quality and Continuity Regulations (ESQCRs)
CEGB Standard 99312, Issue 9
*ENA EREC P27 Issue 2 Current Rating Guide for High Voltage Overhead Lines Operating in the UK Distribution System
ENA TS 43-13 Aerial Bundled Conductors (ABC) Insulated with Cross Linked Polyethylene for Low Voltage Overhead Distribution
WPD Closedown Report – Improved Statistical Ratings for DNO Overhead Lines

*In Final Draft but not published at time of issue of this ST

**APPENDIX H**

## KEY WORDS

Overhead Line, Sustained, Continuous, Pre-Fault, Post-Fault, Rating, Conductor, Temperature, Summer, Winter, Inter_Warm, Inter_Cool, Season, Exceedence, Deterministic, Probabilistic, Dynamic.