Equipment Technical Specification

Overhead line fittings

IMPORTANT DISCLAIMER

As the information contained in this publication is subject to change from time to time, Endeavour Energy gives no warranty that the information is correct or complete or is a definitive statement of procedures. Endeavour Energy reserves the right to vary the content of this publication as and when required. You should make independent inquiries to satisfy yourself as to correctness and currency of the content. Endeavour Energy expressly disclaims all and any liability to any persons whatsoever in respect of anything done or not done by any such person in reliance, whether in whole or in part, on this document.
1.0 PURPOSE ........................................................................................................................................5
2.0 SCOPE ..........................................................................................................................................5
3.0 REFERENCES ................................................................................................................................5
4.0 DEFINITIONS AND ABBREVIATIONS .......................................................................................6
5.0 ACTIONS .......................................................................................................................................6
  5.1. General Requirements ...........................................................................................................6
    5.1.1. Service conditions and durability ......................................................................................6
    5.1.2. Compatibility with conductors and other fittings ............................................................7
    5.1.2.1. Conductors used in Endeavour Energy ..................................................................7
    5.1.3. General marking requirements .......................................................................................8
    5.1.4. General material requirements .....................................................................................8
    5.1.5. General testing requirements .........................................................................................8
    5.1.6. General batch test requirements ...................................................................................9
6.0 GAIN BLOCKS ............................................................................................................................9
  6.1. Technical Requirements ..........................................................................................................9
    6.1.1. Materials .....................................................................................................................9
    6.1.2. Dimensions ................................................................................................................9
    6.1.3. Additional marking requirements ..................................................................................9
  6.2. Testing Requirements .............................................................................................................9
    6.2.1. Batch tests ..................................................................................................................9
7.0 HELICAL FITTINGS ..................................................................................................................10
  7.1. Technical requirements ..........................................................................................................10
    7.1.1. Additional material requirements ..................................................................................10
    7.1.2. Protection against corrosion .........................................................................................10
  7.2. Specialised requirements .......................................................................................................10
    7.2.1. Deadends / terminations ..............................................................................................10
    7.2.2. Full-tension splices ......................................................................................................10
    7.2.3. Guy locks .....................................................................................................................10
OVERHEAD LINE FITTINGS

7.2.4. Armour rods ......................................................................................................... 10
7.2.5. Metallic top and side ties .................................................................................... 10
7.2.6. Non-metallic top and side ties ........................................................................... 11
7.2.7. Spiral vibration dampers ................................................................................... 11
7.2.8. Helical suspension and support units ................................................................. 11

7.3. Testing Requirements ........................................................................................... 11
7.3.1. Type tests .......................................................................................................... 11
7.3.2. Batch Tests ........................................................................................................ 13

8.0 INSULATOR FITTINGS .............................................................................................. 14

8.1. Technical requirements ......................................................................................... 14
8.1.1. Castings ............................................................................................................. 14
8.1.2. Forged steel ...................................................................................................... 14
8.1.3. Welding .............................................................................................................. 14
8.1.4. Nuts and bolts ................................................................................................. 14
8.1.5. Dimensions ....................................................................................................... 14
8.1.6. Marking requirements ...................................................................................... 14

8.2. Testing Requirements .......................................................................................... 15
8.2.1. Type tests .......................................................................................................... 15
8.2.2. Routine tests ..................................................................................................... 15
8.2.3. Batch tests ........................................................................................................ 16

9.0 NON-TENSION FITTINGS ......................................................................................... 16

9.1. Technical requirements for parallel groove clamps ............................................. 16
9.1.1. Materials .......................................................................................................... 16
9.1.2. Clamp requirements ......................................................................................... 16
9.1.3. Other requirements .......................................................................................... 17

9.2. Technical requirements for split bolts ................................................................. 18
9.2.1. Materials .......................................................................................................... 18
9.2.2. Tightening torque ............................................................................................ 18
9.2.3. Marking requirements ...................................................................................... 18

9.3. Testing Requirements .......................................................................................... 18
9.3.1. Type tests (PG Clamps) .................................................................................... 18
9.3.2. Batch tests ........................................................................................................ 19

10.0 PROTECTIVE FITTINGS ......................................................................................... 19

10.1. Technical requirements ....................................................................................... 19
10.1.1. Marking ........................................................................................................... 20

10.2. Testing Requirements ......................................................................................... 20
10.2.1. Type tests ........................................................................................................ 20
10.2.2. Batch tests ..................................................................................................... 21

11.0 SUSPENSION CLAMPS ......................................................................................... 22

11.1. Technical requirements ....................................................................................... 22
<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>11.1.1</td>
<td>Marking</td>
<td>22</td>
</tr>
<tr>
<td>11.2</td>
<td>Testing Requirements</td>
<td>23</td>
</tr>
<tr>
<td>11.2.1</td>
<td>Type tests</td>
<td>23</td>
</tr>
<tr>
<td>11.3</td>
<td>Routine and batch tests</td>
<td>23</td>
</tr>
<tr>
<td>12.0</td>
<td>PACKAGING</td>
<td>24</td>
</tr>
<tr>
<td>13.0</td>
<td>RELIABILITY</td>
<td>24</td>
</tr>
<tr>
<td>14.0</td>
<td>SERVICE HISTORY</td>
<td>24</td>
</tr>
<tr>
<td>15.0</td>
<td>QUALITY ASSURANCE</td>
<td>24</td>
</tr>
<tr>
<td>16.0</td>
<td>TRAINING MATERIAL</td>
<td>25</td>
</tr>
<tr>
<td>17.0</td>
<td>ENVIRONMENTAL CONSIDERATIONS</td>
<td>25</td>
</tr>
<tr>
<td>18.0</td>
<td>VARIATIONS OVER TIME</td>
<td>25</td>
</tr>
<tr>
<td>19.0</td>
<td>SAFETY DATA SHEET (SDS)</td>
<td>25</td>
</tr>
<tr>
<td>20.0</td>
<td>AUTHORITIES AND RESPONSIBILITIES</td>
<td>26</td>
</tr>
<tr>
<td>21.0</td>
<td>DOCUMENT CONTROL</td>
<td>26</td>
</tr>
<tr>
<td>ANNEXURE 1 – CATALOGUE ITEMS</td>
<td>27</td>
<td></td>
</tr>
<tr>
<td>ANNEXURE 2 – GAIN BLOCK DIMENSIONS AND DRAWINGS</td>
<td>30</td>
<td></td>
</tr>
</tbody>
</table>
1.0 PURPOSE
To specify the requirements for overhead line fittings for use on Endeavour Energy’s electrical networks.

2.0 SCOPE
This specification covers the design, engineering, manufacture, testing, supply and delivery of overhead line fittings installed as part of Endeavour Energy’s electrical networks.

3.0 REFERENCES

Internal
- Company Policy 9.2.5 – Network Asset Design
- Company Policy 9.7.1 – Network Asset Construction
- Annexure 1 – Catalogue Items
- Annexure 2 – Gain block dimensions and Drawings

External
- AS 1110.1:2000 - ISO metric hexagon bolts and screws - Product grades A and B - Bolts
- AS 1111:2000 - ISO metric hexagon bolts and screws - Product grade C - Bolts
- AS 1112:2000 - ISO metric hexagon nuts
- AS 1154.1:2009 - Insulator and conductor fittings for overhead power lines – Performance, material, general requirements and dimensions
- AS 1154.3:2009 - Insulator and conductor fittings for overhead power lines – Performance and general requirements for helical fittings
- AS 1214:1983 - Hot-dip galvanized coatings on threaded fasteners (ISO metric coarse thread series)
- AS 1222.1:1992 - Steel conductors and stays – Bare overhead – Galvanized (SC/GZ)
- AS 1222.2:1992 - Steel conductors and stays – Bare overhead – Aluminium clad (SC/AC)
- AS 1275:1985 – Metallic screw threads for fasteners
- AS 1442:2007 - Carbon steels and carbon-manganese steels - Hot rolled bars and semi-finished products
- AS 1531:1991 - Conductors – Bare overhead – Aluminium and aluminium alloy
- AS 1554.1:2011 - Structural steel welding - Welding of steel structures
- AS 1565:1996 - Copper and copper alloys - Ingots and castings
- AS/NZS 1567:1997 - Copper and copper alloys - Wrought rods, bars and sections
- AS 1746:2000 - Aluminium and aluminium alloys - Steel reinforced
- AS 1874:2000 - Conductors – Bare overhead – Hard-drawn copper
- AS 2738 - 2000 Copper and copper alloys - Compositions and designations of refinery products, wrought products, ingots and castings -
- AS 2837 - 1986 - Wrought alloy steels - Stainless steel bars and semi-finished products
- AS 2848.1 - 1998 Aluminium and aluminium alloys - Compositions and designations - Wrought products
- AS/NZS 4534:2006 - Zinc and zinc/aluminium-alloy coatings on steel wire
- AS/NZS 4680:2006 - Hot dip galvanized (zinc) coatings on fabricated ferrous articles
- AS 60120:2010 - Dimensions of ball and socket couplings of string insulator units
- AS 60372:2010 - Locking devices for ball and socket couplings of string insulator units - Dimensions and tests
- AS 60471:2010 - Dimensions of clevis and tongue couplings of string insulator units
• AS/NZS ISO 14001:2004 - Environmental management systems - Requirements with guidance for use
• ENA National Electricity Network Safety Code (Doc 01-2008)

4.0 DEFINITIONS AND ABBREVIATIONS

AS | Australian Standard
AAC | All aluminium conductor
AAAC | All aluminium alloy conductor
ACSR | Aluminium conductor, steel reinforced
CBL | Calculated breaking load
LV | Low voltage
MCI | Malleable Cast Iron
MCBL | Minimum Conductor Breaking Load
MFL | Minimum Failing Load
NATA | National Association of Testing Authorities
NZS | New Zealand Standard
RIV | Radio Interference Voltage
SC/GZ | Steel conductor galvanised

5.0 ACTIONS

5.1. General Requirements
Overhead line fittings are required for use on overhead systems ranging from LV to 132 kV.

5.1.1. Service conditions and durability
The items to be supplied under this specification are to be used in a hostile outdoor environment with the following anticipated environmental extremes:

<table>
<thead>
<tr>
<th>Condition</th>
<th>Environmental Extremes</th>
</tr>
</thead>
</table>
| Ambient Temperatures | Max: 50°C Summer daytime  
Min: –15°C Winter night time  |
| Design conductor maximum operating temperatures | 120°C for ACSR conductors  
100°C for all other conductors  |
| Solar Radiation Level | 1100 W/m² with high ultraviolet content.  |
| Precipitation | Maximum annual rainfall range 1800 – 2400mm.  
Minimum annual rainfall range 0 – 100mm.  |
| Humidity | Extreme range of relative humidity from 10% to 100%.  |
| Pollution | Areas of coastal salt spray and/or industrial pollution with equivalent salt deposit densities up to 3.0 g/m².  |
| Isokeraunic level | Maximum of 60 thunder storm days per year.  |

Items may be subject to snow and ice loading, sand storms, rifle-fire vandalism, extended periods of sunshine and high ambient temperature. Any limitations on the service conditions for which the
items offered are not suitable must be provided with the offer. The expected service life of the items must be a minimum of 50 years.

5.1.2. Compatibility with conductors and other fittings

It is a requirement of this specification that the supplier will demonstrate the products offered will be compatible with existing conductors, fittings, overhead constructions or any other products offered.

5.1.2.1. Conductors used in Endeavour Energy

The fittings in this specification are to be made for use on conductors made of aluminium, aluminium alloy, ACSR, copper, and steel. These conductors are manufactured in accordance with Australian Standards AS 1531, AS 1746, AS 3607, AS 1222.1 and AS 1222.2, as well as their historical precedents. The aluminium conductors used may be fully greased, partially greased or ungreased. ACSR and SC/GZ conductors are fully greased. All conductors are right hand lay.

Aluminium and aluminium alloy designations for the conductors used are 1350 and 1120 respectively. Where a fitting is suitable for use on multiple conductor types (such as AAC, AAAC and ACSR), manufacturers should be mindful of the difference in breaking load between these and the implications for type testing.

The following table details the type and overall diameters of the conductors used in Endeavour Energy.

<table>
<thead>
<tr>
<th>Conductor Type</th>
<th>Description</th>
<th>Nominal overall diameter (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>AAC</td>
<td>7/2.25 Jupiter</td>
<td>6.75</td>
</tr>
<tr>
<td></td>
<td>7/3.00 Libra</td>
<td>9.0</td>
</tr>
<tr>
<td></td>
<td>7/3.40 Fly</td>
<td>10.2</td>
</tr>
<tr>
<td></td>
<td>7/3.75 Mars</td>
<td>11.3</td>
</tr>
<tr>
<td></td>
<td>7/4.50 Mercury</td>
<td>13.5</td>
</tr>
<tr>
<td></td>
<td>7/4.75 Moon</td>
<td>14.3</td>
</tr>
<tr>
<td></td>
<td>19/3.25 Neptune</td>
<td>16.3</td>
</tr>
<tr>
<td></td>
<td>19/3.75 Pluto</td>
<td>18.8</td>
</tr>
<tr>
<td>ACSR</td>
<td>6/1/3.00 ACSR/GZ Apple</td>
<td>9.0</td>
</tr>
<tr>
<td></td>
<td>6/1/2.50 ACSR/GZ Almond</td>
<td>7.5</td>
</tr>
<tr>
<td></td>
<td>6/1/3.75 ACSR/GZ Banana</td>
<td>11.3</td>
</tr>
<tr>
<td></td>
<td>6/4.75+7/1.60 ACSR/GZ Cherry</td>
<td>14.3</td>
</tr>
<tr>
<td></td>
<td>3/4/1.75 ACSR/GZ Quince</td>
<td>5.3</td>
</tr>
<tr>
<td></td>
<td>3/4/2.50 ACSR/GZ Raisin</td>
<td>7.5</td>
</tr>
<tr>
<td></td>
<td>4/3/3.00 ACSR/GZ Sultana</td>
<td>9.0</td>
</tr>
<tr>
<td></td>
<td>4/3/3.75 ACSR/GZ Walnut</td>
<td>11.3</td>
</tr>
<tr>
<td>Steel</td>
<td>7/2.75 SC/GZ conductor</td>
<td>8.3</td>
</tr>
<tr>
<td></td>
<td>7/3.25 SC/GZ conductor</td>
<td>9.8</td>
</tr>
<tr>
<td></td>
<td>7/4.00 SC/GZ conductor</td>
<td>11.8</td>
</tr>
<tr>
<td></td>
<td>19/2.75 SC/GZ conductor</td>
<td>13.8</td>
</tr>
<tr>
<td>HDCu</td>
<td>7/1.63 HDCu conductor</td>
<td>4.88</td>
</tr>
<tr>
<td></td>
<td>7/1.75 HDCu conductor</td>
<td>5.25</td>
</tr>
<tr>
<td></td>
<td>7/2.00 HDCu conductor</td>
<td>6.0</td>
</tr>
<tr>
<td></td>
<td>7/2.75 HDCu conductor</td>
<td>8.25</td>
</tr>
<tr>
<td></td>
<td>19/2.00 HDCu conductor</td>
<td>10.0</td>
</tr>
</tbody>
</table>
5.1.3. **General marking requirements**

The following shall be permanently marked on the body of fittings prior to galvanising:

- Manufacturer’s name or trademark
- Manufacturer’s part number
- Batch number (to identify month and year of manufacture at a minimum)

Markings should be applied in such a way as to remain legible after galvanising.

5.1.4. **General material requirements**

All components shall comply with the following (where applicable):

- All ferrous metal parts except those made of stainless steel shall be hot dipped galvanised in accordance with AS/NZS 4680 (or AS 1214 for threaded fasteners).

- Fittings shall be designed, manufactured and finished so as to avoid sharp radii of curvature, ridges and imperfections that may cause conductor damage during conductor vibration, surface tracking, radio interference, harmful corona discharge or employee injury, when installed in accordance with recommended procedure.

- All materials shall have adequate resistance to the effects of ozone, ultraviolet radiation and air-pollution over the whole range of the service conditions.

- Non-metallic materials employed shall have good resistance to ageing and shall be capable of withstanding service temperatures without detrimental change of properties.

- Materials that are susceptible to UV degradation shall be UV stabilised.

- Materials shall not induce corrosion in materials that are in contact with them.

- Components shall be compatible with other components and the conductor with which they will be in contact.

- All parts of the fittings shall be inherently resistant to atmospheric corrosion both during storage and in service.

5.1.5. **General testing requirements**

All type tests must be carried out by a testing authority/laboratory holding accreditation:

- by NATA Australia; or,
- by an accreditation authority recognised by NATA Australia.

Tests from other testing authorities may be accepted at the discretion of Endeavour Energy.

All type test reports must be accompanied by copies of the accreditation certificate(s) issued to the testing laboratory. The accreditation certificate(s) must be valid for the relevant test(s) and for the duration of the test(s).

Type tests must be less than five (5) years old. Type tests beyond this limit may be submitted provided sufficient information to demonstrate that the manufacturing process, raw materials, design and quality control processes have not significantly changed since the original test date is also submitted with the offer.

All documentation submitted (including reports, tests, testing procedures/policies, calibration certificates and the like) written in any language other than English will not be accepted unless the reports are translated into English by a sworn translator.

Type test certificates must specify the overall dimensional details of the fittings, full details of the conductor, armour rods (if required), test assembly, procedure, test requirement and test results.
Test certificates only indicating the items have passed without listing the test conditions above will be deemed non-compliant.

The items may be deemed technically non-compliant if the required accredited type test reports are not submitted with the offer.

5.1.6. General batch test requirements

A certificate of compliance in accordance with AS 1874 is to be supplied with each order/delivery. All routine and batch tests may be conducted at the manufacturing facility’s test laboratory on the condition that sufficient evidence is provided with the offer to demonstrate the testing facility’s capability to perform the specified tests. As a minimum, the following information must be provided:

- Qualifications/experience of the testing staff.
- Test procedures for all routine/batch tests.
- Testing facility quality control procedures.
- Test instrument calibration certificates/procedures.

As part of the assessment process, Endeavour Energy will specify in writing if they accept the routine and batch tests being conducted at the manufacturing facility’s test laboratory.

6.0 GAIN BLOCKS

6.1. Technical Requirements

6.1.1. Materials

Gain blocks must be cast from grade BA701 (preferred) or CA401 (or equivalent) aluminium in accordance with AS 1874.

Castings must be clean and free from harmful inclusions, blow holes and all other defects.

6.1.2. Dimensions

Gain blocks are required for use with 100mm, 125mm, and 150mm crossarms. The gain block drawings, dimensions and tolerances are indicated in Annexure 2 of this specification. Supplier’s drawings, dimensions and tolerances for gain blocks must be submitted with the offer.

6.1.3. Additional marking requirements

In addition to the requirements detailed in clause 0 of this specification, the following must be stamped on the body of gain blocks:

- Compatible crossarm size (e.g. 125mm)

6.2. Testing Requirements

6.2.1. Batch tests

The following batch test must be conducted on a minimum of three samples:

<table>
<thead>
<tr>
<th>Test</th>
<th>Pass Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Verification of dimensions</td>
<td>Dimensions are in accordance with relevant drawings and requirements (including any specified tolerances).</td>
</tr>
</tbody>
</table>
7.0 HELICAL FITTINGS

7.1 Technical requirements

7.1.1 Additional material requirements

In addition to the material requirements in clause 5.1.4, helical fittings may be made from any material or combination of materials, if that enables the fitting to reach its design strength capability. It is expected that aluminium alloy, galvanised steel and copper will be used in the manufacture of helical fittings for the respective conductor types.

7.1.2 Protection against corrosion

For helical fittings, all ferrous metal parts that may be exposed to the atmosphere in service, except those made of stainless steel, must be protected by hot-dip galvanizing in accordance AS/NZS 4534 Class W10.

7.2 Specialised requirements

The following clauses detail the additional technical requirements for each type of helical fitting.

7.2.1 Deadends / terminations

Deadends must be a single piece and preference will be given to deadends which are smaller in length.

Deadends must comply with Clause 2 of AS 1154.3. The Mechanical Strength Type Tests of Clause 2.3.1 for anchor fittings will apply. The electrical type tests described in Clause 2.4 are not required.

7.2.2 Full-tension splices

Each splice offered must be designed for the full breaking load of the conductor it is intended to be used with. Single piece splices are preferred for ACSR conductors.

Full-tension splices must comply with Clause 2 of AS 1154.3. The Mechanical Strength Type Tests of Clause 2.3.3 of AS 1154.3 for tension fittings will apply. Electrical type tests in accordance with Clause 2.4 of AS 1154.3 are required.

7.2.3 Guy locks

Guy locks must comply with Clause 2 of AS 1154.3. The Mechanical Strength Type Tests of Clause 2.3.1 of AS 1154.3 for anchor fittings will apply. The electrical type tests described in Clause 2.4 of AS 1154.3 are not required.

7.2.4 Armour rods

Armour rods must comply with Clause 4 of AS 1154.3. The Mechanical Strength Type Tests of Clause 4.2.3 of AS 1154.3 for repair fittings will apply.

7.2.5 Metallic top and side ties

Where armour rods are used in conjunction with tie wires, manufacturers must indicate the compatible armour rod and insulator tie sets. Where armour rods are not used, an elastomeric tube (such as Neoprene or other material with similar performance properties) must be supplied to provide cushioning between the insulator and conductor. Ties will be used on insulators with nominal neck diameters of 76 mm or 113 mm (as per AS 4899), as indicated in Annexure 1.

Top ties must be suitable for line angles of up to 10°, while side ties must be suitable for line angle from 10° to 40°.
Manufacturers must state the nominated holding tension and minimum failing load for all ties offered. It is anticipated that the nominated holding tension will be at least 3.5kN or 15% of the conductor Calculated Breaking Load (CBL), whichever is less, and that the minimum failing load will be at least 20% of the CBL.

7.2.6. **Non-metallic top and side ties**

Non-metallic top and side ties are used to secure covered conductors in the top or side grooves of insulators. The conductor is not stripped, armour rods are not used, and elastomeric tubes are not required.

Top ties must be suitable for line angles of up to 10°, while side ties must be suitable for line angle from 10° to 40°.

Insulators for covered conductors have a nominal neck diameter of 73 mm or 76 mm.

Manufacturers must state the nominated holding tension and minimum failing load for all ties offered. It is anticipated that the nominated holding tension will be at least 3.5kN or 15% of the conductor Calculated Breaking Load (CBL), whichever is less, and that the minimum failing load will be at least 20% of the CBL.

7.2.7. **Spiral vibration dampers**

Spiral vibration dampers must be constructed from a suitable polymer designed to minimise the effects of solar radiation degradation, as required by Clause 4.3.2 of AS 1154.3.

They must be suitable for use on conductors operating at up to 120 °C, and must not cause damage to the conductor through corrosion, abrasion, or any other means.

7.2.8. **Helical suspension and support units**

Support units will be used with clamp top horizontal and vertical line post insulators. Suspension units will attach to the tongue end of a 70 kN socket-tongue or clevis-tongue fitting, and must be supplied with a suitable threaded clevis bolt with locking split pin.

Each unit must consist of a housing, insert and helical rods. The housing must be made of high strength cast aluminium, except for clamps for conductors less than 10 mm diameter, which may be pressed galvanised steel. The insert between the housing and the helical rods must be made of an elastomer such as Neoprene or other material with similar performance properties.

Any nuts and bolts must be made of galvanised steel, split pins must be grade 316 stainless steel, and the outer strap around the suspension unit housing must be high strength aluminium alloy.

Manufacturers must state the nominated holding tension and minimum failing load for all helical suspension and support units offered. It is anticipated that the nominated holding tension will be at least 3.5kN or 15% of the conductor Calculated Breaking Load (CBL), whichever is less, and that the minimum failing load will be at least 50% of the CBL.

7.3. **Testing Requirements**

Type tests must be carried out on all helical fittings in accordance with this clause, which is based on the requirements of AS 1154.3, prior to acceptance.

7.3.1. **Type tests**

Type tests must be performed on no fewer than three fittings, as detailed in Clause 1.5.1 of AS 1154.3. Dimensional details of the fitting must be recorded on the type test certificates, along with full details of the conductor used for the type test.
### Table 3 – Type tests for Helical fittings

<table>
<thead>
<tr>
<th>Helical fitting type</th>
<th>Type test required</th>
<th>Test reference in AS 1154.3</th>
<th>Pass criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dead end / termination</td>
<td><strong>Type test for glue</strong></td>
<td>Clause 2.2</td>
<td>No separation of wires, no peeling or flaking of glue, no other substantial signs of failure.</td>
</tr>
<tr>
<td>Anchor fittings other than fittings for ADSS and OPGW cables</td>
<td><strong>Type test for glue</strong></td>
<td>Clause 2.2</td>
<td>No conductor slip or failure of fitting when held at 90% of conductor breaking load for 1 minute. Force increased, and load and nature of failure to be recorded.</td>
</tr>
<tr>
<td></td>
<td><strong>Tension fittings</strong></td>
<td>Clause 2.3.3</td>
<td>No conductor slip or failure of fitting when held at 90% of conductor breaking load for 1 minute. Force increased, and load and nature of failure to be recorded.</td>
</tr>
<tr>
<td></td>
<td><strong>Resistance test</strong></td>
<td>Clause 2.4.1</td>
<td>Assembly resistance less than 75% of the measured resistance of the equivalent length of conductor, before and after heating cycle and short-time current tests.</td>
</tr>
<tr>
<td></td>
<td><strong>Heating cycle test</strong></td>
<td>Clause 2.4.2</td>
<td>Maximum temperature on surface of fitting must be less than conductor temperature. No sign of heating, burning or fusing of fitting or conductor.</td>
</tr>
<tr>
<td></td>
<td><strong>Short-time current test</strong></td>
<td>Clause 2.4.3</td>
<td>No conductor slip or mechanical failure of fitting. No sign of heating, burning or fusing of fitting or conductor.</td>
</tr>
<tr>
<td>Guy lock</td>
<td><strong>Anchor fittings other than fittings for ADSS and OPGW cables</strong></td>
<td>Clause 2.3.1</td>
<td>No conductor slip or failure of fitting when held at 90% of conductor breaking load for 1 minute. Force increased, and load and nature of failure to be recorded.</td>
</tr>
<tr>
<td>Armour rod</td>
<td><strong>Mechanical strength type test</strong></td>
<td>Clause 4.2.3</td>
<td>No failure of fitting when held at 90% of conductor breaking load for 1 minute.</td>
</tr>
<tr>
<td>Helical fitting type</td>
<td>Type test required</td>
<td>Test reference in AS 1154.3</td>
<td>Pass criteria</td>
</tr>
<tr>
<td>---------------------</td>
<td>------------------------------------------</td>
<td>-----------------------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Top and side ties</td>
<td>Holding tension (withstand slip) test</td>
<td>Clause 3.2.1</td>
<td>No conductor slip and no failure of fitting when held at nominated holding tension for 1 minute. Load increased, and recorded at 3 mm of slip or failure of fitting.</td>
</tr>
<tr>
<td></td>
<td>Failing load test</td>
<td>Clause 3.2.2</td>
<td>Failing load &gt; 20% CBL (or manufacturer’s specified minimum failing load) Failing load recorded for both directions.</td>
</tr>
<tr>
<td>Suspension and support units</td>
<td>Holding tension (withstand slip) test</td>
<td>Clause 3.2.1</td>
<td>No conductor slip and no failure of fitting when held at nominated holding tension for 1 minute. Load increased, and recorded at 3 mm of slip or failure of fitting.</td>
</tr>
<tr>
<td></td>
<td>Failing load test</td>
<td>Clause 3.2.2</td>
<td>Failing load &gt; 20% CBL (or manufacturer’s specified minimum failing load) Failing load recorded, and failure must be ductile.</td>
</tr>
<tr>
<td>Vibration damper</td>
<td>Solar radiation resistance</td>
<td>-</td>
<td>Tests on the material used and its solar radiation resistance.</td>
</tr>
</tbody>
</table>

7.3.2  Batch Tests

The following batch tests must be conducted:

<table>
<thead>
<tr>
<th>Helical fitting type</th>
<th>Batch test required</th>
<th>Test reference in AS 1154.3</th>
<th>Pass criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>All fittings</td>
<td>Verification of dimensions</td>
<td>Clause 1.6</td>
<td>Dimensions of fittings must be in accordance with manufacturer’s drawing.</td>
</tr>
<tr>
<td>Any fittings</td>
<td>Galvanising tests</td>
<td>Clause 2.5.3</td>
<td>Galvanised fittings must be tested in accordance with AS 1214 or AS/NZS 4534, Class W10.</td>
</tr>
<tr>
<td>containing</td>
<td></td>
<td>Clause 3.5.3</td>
<td></td>
</tr>
<tr>
<td>galvanised steel</td>
<td></td>
<td>Clause 4.4.2</td>
<td></td>
</tr>
<tr>
<td>Top and side ties</td>
<td>Holding tension (withstand slip) test</td>
<td>Clause 3.2.1</td>
<td>Same as type test.</td>
</tr>
<tr>
<td>(additional</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>requirements)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Failing load test</td>
<td>Clause 3.2.2</td>
<td>Same as type test.</td>
</tr>
</tbody>
</table>
8.0 INSULATOR FITTINGS

8.1 Technical requirements

Insulator fittings must be in accordance with AS 1154.1 and the requirements of this document. Where there is a conflict, the requirements of this document must take precedence.

8.1.1 Castings

Castings must be manufactured from materials in accordance with AS 1154.1 Clauses 1.4.6.3, 1.4.6.4 and 1.4.6.5.

Full details of the type of iron to be used must be submitted in the offer.

Castings must be clean, free from harmful inclusions, blow holes, and all other defects.

8.1.2 Forged steel

Forged steel must be in accordance with AS 1154.1 Clause 1.4.6.2, and must be supplied in the heat-treated condition. The steel must be grade X1320, X1340, or equivalent and that the items are suitable for the range of temperatures stipulated in Clause 5.1.1 of this specification. Full details of the type of steel to be used must be submitted in the offer.

8.1.3 Welding

Welding must be in accordance with AS 1554.1. Welds must be sealed unless shown otherwise to prevent ingress of moisture.

8.1.4 Nuts and bolts

All bolts and nuts must be threaded in accordance with AS 1111 and AS 1112 respectively.

Threads must conform to AS 1275.

Internal threads must be cut and greased after galvanising.

8.1.5 Dimensions

Dimensions of fittings must be in accordance with AS 1154.1 Clause 8, unless otherwise noted. Where the dimensions of a fitting differ or if a fitting is not covered in AS 1154.1, drawings showing the dimensions of the item must be submitted in the offer.

Ball and socket couplings must be in accordance with AS 60120.

Locking devices for socket fitting must be in accordance with AS 60372.

Clevis and tongue couplings must be in accordance with AS 60471.

8.1.6 Marking requirements

In addition to the general marking requirements specified in clause 5.1.3 of this specification, the following must be permanently marked on the body of fittings prior to galvanising:
• MFL in kilonewtons
Markings should be applied in such a way as to remain legible after galvanising.

8.2. Testing Requirements

8.2.1. Type tests
Type tests must be carried out on all products in accordance with this clause, which is based on the requirements of AS 1154.1 Clause 2, prior to acceptance. In accordance with AS 1154.1 Clause 1.5.1, type tests must be performed on no fewer than three fittings identical in all essential details with those to be supplied.

The type tests required to be submitted with the offer are:

<table>
<thead>
<tr>
<th>Standard</th>
<th>Test</th>
<th>Pass Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>AS 1154.1 Clause 2.2</td>
<td>Mechanical strength test</td>
<td>No permanent distortion after 50% load for 1 minute (this requirement may be waived if the extended strength test passes). Eventual failure will be of a ductile nature and must occur at a load not less than the MFL. Test must be continued to at least 125% MFL unless failure occurs earlier. Maximum load applied and details of any distortion or failure must be recorded.</td>
</tr>
<tr>
<td>AS 1154.1 Clause 2.2.4</td>
<td>Extended strength test</td>
<td>If distortion occurs after one minute at 50% load in test 2.2 above, no increase in distortion must occur after one minute at 60% load.</td>
</tr>
<tr>
<td>AS 1154.1 Clause 2.3</td>
<td>Hardness test</td>
<td>In accordance with AS 1154.1 Clause 8.1.10.2.</td>
</tr>
</tbody>
</table>

8.2.2. Routine tests
As part of the assessment process, Endeavour Energy will specify in writing if they accept the routine and batch tests being conducted at the manufacturing facility’s test laboratory.

Ferrous insulator fittings that are castings or that have welded joints that are exposed to tensile stress in service must be subjected to the following test:

<table>
<thead>
<tr>
<th>Standard</th>
<th>Test</th>
<th>Pass Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>AS 1154.1 Clause 2.4</td>
<td>Tensile strength test</td>
<td>No breakage, cracking, or permanent distortion.</td>
</tr>
</tbody>
</table>

Fittings that have passed the routine test must be permanently marked.
8.2.3. *Batch tests*

The following batch tests must be conducted:

<table>
<thead>
<tr>
<th>Standard</th>
<th>Test</th>
<th>Pass Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>AS 1154.1</td>
<td>Verification of</td>
<td>Dimensions are in accordance with relevant drawings and requirements (including any specified tolerances).</td>
</tr>
<tr>
<td>Clause 1.6</td>
<td>dimensions</td>
<td></td>
</tr>
<tr>
<td>AS 1154.1</td>
<td>Mechanical test</td>
<td>No permanent distortion after 50% load for 1 minute (this requirement may be waived if the extended strength test passes). Eventual failure</td>
</tr>
<tr>
<td>Clause 2.2</td>
<td></td>
<td>must be of a ductile nature and will occur at a load not less than the MFL. Test must be continued to at least 125% MFL unless failure</td>
</tr>
<tr>
<td></td>
<td></td>
<td>occurs earlier. Maximum load applied and details of any distortion or failure must be recorded.</td>
</tr>
<tr>
<td>AS 1154.1</td>
<td>Hardness test</td>
<td>In accordance with AS 1154.1 Clause 8.1.10.2.</td>
</tr>
<tr>
<td>Clause 2.3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AS 1154.1</td>
<td>Galvanizing test</td>
<td>In accordance with:</td>
</tr>
<tr>
<td>Clause 2.5.3</td>
<td></td>
<td>AS 4680 for fabricated ferrous articles</td>
</tr>
<tr>
<td></td>
<td></td>
<td>AS 1214 for threaded fasteners</td>
</tr>
</tbody>
</table>

9.0  NON-TENSION FITTINGS

9.1. *Technical requirements for parallel groove clamps*

The items offered must be in accordance with AS 1154.1 and the requirements of this document. Where there is a conflict, the requirements of this document must take precedence.

9.1.1. *Materials*

Aluminium components must be one of the following alloys:

- 1050 or 6061 in accordance with AS 2848
- AA603, DA401, CB401 or CC401 in accordance with AS 1874

Copper components must be in accordance with AS 2738 and comprise one of the following alloys:

- C11000, C22000, C51800 in accordance with AS 1567
- C90250, C92610A in accordance with AS 1565

Stainless steel components must be grade 316 in accordance with AS 2837.

Bolts, nuts, flat washers, and Belleville washers must be grade 316 stainless steel.

9.1.2. *Clamp requirements*

No current (or only a negligible amount) must be transmitted through the nuts and bolts used with the connector.
Clamps must be designed to accommodate the differential expansion and contraction of components due to thermal cycling.

Each bolt must include a Belleville washer and two stainless steel flat washers except where noted in Annexure 1.

The flat washers must be of an adequate thickness to evenly distribute the bolt stress on the surfaces and of adequate width to enable Belleville washer to sit completely on one of them.

Stability of the contact pressure must be maintained by stainless steel bolts and nuts. These are to be suitably machined and lubricated with anti-seize grease to stop galling when tightening or untightening the bolt. Keeper bars or thrust plates are not acceptable.

Bolts must be of a sufficient length to allow attachment of the fitting to the largest size conductor without total removal of any part of the connector.

Connectors must be suitable for installation and removal using live line techniques. To allow removal of the connector, the nuts of the bolted connection must be held captive in the body, or the body of the connector must be tapped and the connection designed to withstand the maximum tightening torque.

Connectors of a single-bolt type must be designed so as to prevent the clamp components from rotating out of alignment during installation (for example interlocking claws).

Surfaces of clamps that will be in contact with aluminium conductors must be supplied with an oxide and corrosion inhibiting compound already applied. The compound must be impregnated with zinc grit particles and be suitable for operation up to 100°C.

The supplier must advise the minimum / maximum recommended tightening torque as well as the specified tightening technique / procedure. If a special tool is required to hold the clamp in position while tightening, the supplier must advise the make and model number of the tool.

9.1.3 Other requirements

Hexagonal-head bolts:
- must be in accordance with AS 1110;
- must have uniform cut threads throughout which are free running and of commercial tolerance 8g in accordance with AS 1275.

Hexagonal-head nuts:
- must have free running cut threads of tolerance 6H in accordance with AS 1275.

Connectors:
- must be designed so that the bolt head does not bind on the surface of the connector during tightening.

Surfaces:
- connector surfaces in contact with the conductors must be grooved in a direction transverse to the conductor axis to penetrate the oxide layer on the surface of the conductor for all conductors.

Aluminium to copper (bimetallic) connectors:
- The interface between aluminium and copper must be achieved by friction welding or other methods that tests indicate will have negligible susceptibility to corrosion.
9.2. **Technical requirements for split bolts**

9.2.1. **Materials**
Split bolts must be offered in both natural brass and electro-tinned brass varieties.

9.2.2. **Tightening torque**
The supplier must advise the minimum / maximum recommended tightening torque.

9.2.3. **Marking requirements**
In addition to the general marking requirements detailed in clause 5.1.3 of this specification, the following must be stamped on the body of non-tension fittings:

- Range of conductor cross sectional areas or the conductor diameter for each of the connections; and,
- Installation / tightening torque.

Bimetallic clamps must have visible marking to identify the side with the copper insert. This should be visible from ground level after installation.

9.3. **Testing Requirements**
For split-bolts the only mandatory test is the verification of dimensions; however additional tests will be viewed favourably.

9.3.1. **Type tests (PG Clamps)**
Type tests must be carried out on all products in accordance with this clause, which is based on the requirements of AS 1154.1 Clause 4, prior to acceptance.

In accordance with AS 1154.1 Clause 1.5.1, type tests must be performed on no fewer than three fittings identical in all essential details with those to be supplied.

The type tests required to be submitted with the offer are:

<table>
<thead>
<tr>
<th>Standard</th>
<th>Test</th>
<th>Pass Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>AS 1154.1 Clause 4.3.3 (a) or (b)</td>
<td>Tensile test</td>
<td>No movement of the conductor relative to the fitting due to slip. No failure of the fitting.</td>
</tr>
<tr>
<td>AS 1154.1 Clause 4.4.1</td>
<td>Tee fittings - main conductor integrity test</td>
<td>No failure of main conductor during the 1 minute test period.</td>
</tr>
<tr>
<td>AS 1154.1 Clause 4.4.2.3 (a) or (b)</td>
<td>Tee fittings - tensile and slip test</td>
<td>No slip between fitting and conductor at test load.</td>
</tr>
<tr>
<td>AS 1154.1 Clause 4.5</td>
<td>Heating cycle test</td>
<td>Temperature of fitting not to exceed temperature of conductor. Final resistance not to exceed 130% of initial resistance. No local heating, burning, or fusing of any part of the fitting or conductor.</td>
</tr>
<tr>
<td>AS 1154.1 Clause 4.6</td>
<td>Short-time current test</td>
<td>No local heating, burning, or fusing of any part of the fitting or conductor.</td>
</tr>
</tbody>
</table>
9.3.2. **Batch tests**

The following batch tests must be conducted:

<table>
<thead>
<tr>
<th>Standard</th>
<th>Test</th>
<th>Pass Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>AS 1154.1 Clause 4.7.1</td>
<td>Verification of dimensions</td>
<td>Dimensions are in accordance with relevant drawings and requirements (including any specified tolerances).</td>
</tr>
<tr>
<td>AS 1154.1 Clause 4.3.3 (a) or (b)</td>
<td>Tensile test</td>
<td>No movement of the conductor relative to the fitting due to slip. No failure of the fitting.</td>
</tr>
<tr>
<td>AS 1154.1 Clause 4.4.1</td>
<td>Tee fittings - main conductor integrity test</td>
<td>No failure of main conductor during the 1 minute test period.</td>
</tr>
<tr>
<td>AS 1154.1 Clause 4.4.2.3 (a) or (b)</td>
<td>Tee fittings - tensile and slip test</td>
<td>No slip between fitting and conductor at test load.</td>
</tr>
<tr>
<td>AS 1154.1 Clause 4.7.3</td>
<td>Hardness test</td>
<td>In accordance with AS 1154.1.</td>
</tr>
<tr>
<td>AS 1154.1 Clause 4.7.4</td>
<td>Galvanizing test</td>
<td>In accordance with: AS 4680 for fabricated ferrous articles AS 1214 for threaded fasteners</td>
</tr>
</tbody>
</table>

### 10.0 PROTECTIVE FITTINGS

#### 10.1. Technical requirements

Protective fitting clamp assemblies must be constructed from aluminium alloy. All hardware such as bolts and washers must be grade 316 stainless steel. The messenger cable must be SC/GZ in accordance with AS 1222.1

Table 10 below details the conductor size the protective fittings must be suitable for:

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Item description</th>
<th>Conductor diameter range (mm)</th>
<th>CBL (kN)</th>
<th>Maximum every day tension and stringing temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Damper 19/3.75 Neon and 19/3.75 Pluto</td>
<td>18-21</td>
<td>Neon - 47.8 Pluto – 31.9</td>
<td>21.5% of CBL at 5°C</td>
</tr>
<tr>
<td>2</td>
<td>Damper 30/7/3.50 Lime</td>
<td>24 -29</td>
<td>Lime - 122</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Damper 30/7/2.50 Grape</td>
<td>16-18</td>
<td>63.5</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Damper 19/4.75 Taurus and 19/4.75 Oxygen</td>
<td>23-27</td>
<td>Taurus - 51.3 Oxygen -73.6</td>
<td></td>
</tr>
</tbody>
</table>
10.1.1. Marking
In addition to general marking requirements detailed in clause 5.1.3 of this specification, the following must be permanently marked on the fittings:

- The minimum and maximum conductor diameters.

10.2. Testing Requirements
10.2.1. Type tests
Type tests must be carried out on all protective fittings in accordance with this clause, which is based on the requirements of AS 1154.1, Clause 7 prior to acceptance.

For the damper efficiency type tests, the laboratory span test (AS 1154.1 clause 7.2.2.2) is the preferred test requirement. Where results for this test cannot be provided, field test (AS 1154.1 clause 7.2.2.3) may be considered as acceptable damper efficiency test at the discretion of Endeavour Energy.

The type tests required to be submitted with the offer are:

<table>
<thead>
<tr>
<th>Standard</th>
<th>Test</th>
<th>Pass Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>AS 1154.1 Clause 7.2.2.2</td>
<td>Damper efficiency type test – Laboratory span test (strongly preferred).</td>
<td>The damper efficiency when calculated by either the power method or the standing wave method as per Annexure B of AS 1154.1 must not be less than the appropriate acceptance curve in Figure B1 of Annexure B in AS 1154.1. The maximum bending amplitude measured 90mm from the rigid support must not exceed 0.25mm peak-to-peak.</td>
</tr>
<tr>
<td>AS 1154.1 Clause 7.2.2.3</td>
<td>Damper efficiency type test – Field test (not preferred but may be considered if laboratory span test cannot be done).</td>
<td>The test duration must be 4 hours. The bending amplitudes or strains on the conductor, wind velocity, wind direction and turbulence must be measured and provided to Endeavour Energy for evaluation. Test results must provide reference of values to CIGRE SC22 WG22.04, or SC22 WGT2.11.02, or to equivalent publications for easy evaluation.</td>
</tr>
<tr>
<td>AS 1154.1 Clause 7.2.3</td>
<td>Mechanical impedance type test</td>
<td>For each amplitude, separate curves for the resistive and reactive components of mechanical impedance must be plotted against frequency as per Annexure C of AS 1154.1. At higher amplitudes of clamp vibration, the damper response must show a downward frequency shift. The value of resistive and reactive component of the impedance must be calculated and provided with the test results along with the CBL and mass per metre of the conductor used for the test.</td>
</tr>
</tbody>
</table>
### Standard Test Pass Criteria

<table>
<thead>
<tr>
<th>Standard</th>
<th>Test</th>
<th>Pass Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>AS 1154.1 Clause 7.2.4</td>
<td>Fatigue type test</td>
<td>After the completion of the test, there must be no damage, deformation or loosening of any part of the damper.</td>
</tr>
<tr>
<td>AS 1154.1 Clause 7.2.5</td>
<td>Weight pull-off type test</td>
<td>Damper weights must not separate from the messenger wire at loads less than the values indicated in Clause 7.2.5.3 of AS 1154.1.</td>
</tr>
<tr>
<td>AS 1154.1 Clause 7.4</td>
<td>Mechanical type test - Clamp slip test</td>
<td>The force at which the clamp slips must be not less than 700 N and must not damage the conductor. Any ancillary device that clamps to the conductor must not damage the conductor by its installation and operation.</td>
</tr>
</tbody>
</table>
| AS 1154.1 Clause 7.5      | Electrical type test – Corona and Radio Interference Voltage (RIV) test | When conducted through methods described in Annexure D of AS 1154.1:  
- The corona extinction of the fitting obtained during the test must exceed the specified minimum corona extinction.  
- The RIV of the fitting recorded at the specified test voltage or conductor voltage gradient must not exceed the specified maximum RIV.  
- The curve indicating the RIV against the test voltage must not present any sudden change between the specified test voltage or conductor voltage gradient and 110% of the specified test voltage or conductor voltage gradient. |

#### 10.2.2. Batch tests

The following batch tests must be conducted:

### Table 12 - Batch tests for protective fittings

<table>
<thead>
<tr>
<th>Standard</th>
<th>Test</th>
<th>Pass Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>AS 1154.1 Clause 7.6.2</td>
<td>Verification of dimensions</td>
<td>The dimensions must be in accordance with relevant drawings within the original design limits (including any specified tolerances).</td>
</tr>
<tr>
<td>AS 1154.1 Clause 7.6.3</td>
<td>Galvanising test</td>
<td>All ferrous metal parts, must be protected by hot-dip galvanizing in accordance with AS/NZS 4680, except that no individual damaged or uncoated area will exceed 10mm², and in accordance with AS 1214 for threaded fasteners.</td>
</tr>
<tr>
<td>AS 1154.1 Clause 7.6.4</td>
<td>Fatigue test</td>
<td>As per type test.</td>
</tr>
<tr>
<td>AS 1154.1</td>
<td>Weight pull-off test</td>
<td>As per type test.</td>
</tr>
</tbody>
</table>
### Table 13 - Clamps for Aluminium alloy, ACSR and SC/GZ conductors

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Item description</th>
<th>MFL (kN)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Clamp 21-27 mm Trunnion Al Suspension</td>
<td>64</td>
</tr>
<tr>
<td>2</td>
<td>Clamp 27-36 mm Trunnion Al Suspension</td>
<td>44</td>
</tr>
<tr>
<td>3</td>
<td>Clamp 6-16 mm Suspension Offset MCI</td>
<td>24</td>
</tr>
</tbody>
</table>

#### 11.0 SUSPENSION CLAMPS

##### 11.1. Technical requirements

Items SC1 and SC2 in Annexure 1 must be constructed from aluminium alloy body suitable for aluminium alloy and ACSR conductors. Item SC3 in Annexure 1 must be constructed from galvanised cast iron body suitable for SC/GZ and copper conductors.

All items must utilise clevis assemblies with unthreaded M16 clevis pins secured by humpback split pins.

All hardware such as clevis pins, clamp U-bolts, nuts and washers must be galvanised in accordance with AS/NZS 4680. Humpback split pins must be grade 316 stainless steel in accordance with AS 1154.1, Figure 8.23.

Clamps must be suitable for installation and removal using live line techniques. Suspension clamps must be constructed such that the nuts of the bolted section must be held captive in the body.

Table 13 below details the Minimum Failing Load (MFL) of the clamps and the conductor size they must be suitable for.

In addition to the general marking requirements detailed in clause 5.1.3 of this specification, the following must be permanently marked on the fittings:

- The minimum and maximum conductor diameters.
11.2. Testing Requirements

11.2.1. Type tests

Type tests must be carried out on all suspension clamps in accordance with this clause, which is based on the requirements of AS 1154.1, Clause 5 prior to acceptance.

The type tests required to be submitted with the offer are:

<table>
<thead>
<tr>
<th>Standard</th>
<th>Test</th>
<th>Pass Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>AS 1154.1 Clause 5.3.1</td>
<td>Holding tension (withstand slip) test</td>
<td>During the 1 min period in which the tensile force is held at the nominated holding tension (15% of the MCBL of the conductor or 3.5kN whichever is lower), there must be no movement of the conductor relative to the fitting due to slip and no failure of the fitting.</td>
</tr>
<tr>
<td>AS 1154.1 Clause 5.3.2</td>
<td>Failing load test</td>
<td>The failing load must not be less than the specified MFL in Table 1 and failure must be of a ductile nature.</td>
</tr>
<tr>
<td>AS 1154.1 Clause 5.4</td>
<td>Clamp bolt tightening test</td>
<td>For torque value of 1.1 times the installation torque of the bolts and nuts of the clamps, there must be no damage to all clamp components and the conductor inside the clamp. For torque value of 2 times the installation torque or maximum torque (recommended by the bolt supplier), there must be no breakage to either the threaded parts or to the components connected to them.</td>
</tr>
</tbody>
</table>

11.3. Routine and batch tests

The following routine and batch tests must be conducted:

<table>
<thead>
<tr>
<th>Standard</th>
<th>Test</th>
<th>Pass Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>AS 1154.1 Clause 5.5</td>
<td>Tensile test – Routine test</td>
<td>There must be no distortion that can be seen by normal or corrected vision without the aid of magnification or measurement.</td>
</tr>
<tr>
<td>AS 1154.1 Clause 5.6.1</td>
<td>Verification of dimensions – Batch test</td>
<td>The dimensions must be in accordance with relevant drawings within the original design limits (including any specified tolerances)</td>
</tr>
<tr>
<td>AS 1154.1 Clause 5.3.2</td>
<td>Failing load test – Batch test</td>
<td>The failing load must not be less than the specified MFL in Table 1 and failure must be of a ductile nature.</td>
</tr>
</tbody>
</table>
### Standard Test Pass Criteria

<table>
<thead>
<tr>
<th>Standard</th>
<th>Test</th>
<th>Pass Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>AS 1154.1</td>
<td>Galvanising tests – Batch test</td>
<td>All ferrous metal parts, must be protected by hot-dip galvanizing in accordance with AS/NZS 4680, except that no individual damaged or uncoated area will exceed 10mm², and in accordance with AS 1214 for threaded fasteners.</td>
</tr>
</tbody>
</table>

#### 12.0 PACKAGING

The items will be packed at the manufacturer’s works and delivered to nominated stores in containers of adequate strength to protect the items during transport and handling. The method adopted must provide corrosion protection of the items in transit and storage. The following information must be legibly and permanently marked on the packing:

- Manufacturer’s name, part number, batch number, corresponding Endeavour Energy catalogue number and Purchase Order number;
- The number of items contained in the package;
- Description of contents and gross mass; and,
- Handling or lifting instructions where applicable.

The number of units in each package must be constant for the life of the contract, unless agreed in writing by both parties.

#### 13.0 RELIABILITY

Suppliers are required to comment on the reliability and performance of the items supplied for a service life of 50 years, under the specified system and environmental conditions.

Such comments must include evidence in support of the reliability and performance claimed, including information on Failure Mode and Effect Analysis. Where items supplied have been found to be defective or fail under normal service conditions within the last 24 months, the supplier may be requested to provide documented evidence that demonstrates changes have been implemented that have rectified the problem(s).

#### 14.0 SERVICE HISTORY

Suppliers must state:

- The period of service of items supplied under this specification within the Australian environmental conditions.
- Australian Electricity Authorities who have a service history of the types of items supplied.
- Contact names and telephone numbers of relevant employees of those supply authorities who can verify the service performance claimed.

#### 15.0 QUALITY ASSURANCE

The supplier and/or manufacturer must provide with the offer a certificate of Quality Management System in accordance with AS/NZS ISO 9001 or similar and an Environmental Management System in accordance with AS/NZS ISO 14001 or similar.
16.0 TRAINING MATERIAL

Training material in the form of drawings, instructions and/or audio visuals may be required to be provided for the items accepted.

Suppliers must state the availability of training materials which should include but is not limited to the following topics:

- Application (particularly in areas of heavy coastal pollution)
- Installation
- Maintenance
- Mechanical performance

17.0 ENVIRONMENTAL CONSIDERATIONS

Suppliers are required to comment on the environmental soundness of the design and the materials used in the manufacture of the items offered. In particular, comments should address such issues as recycling and disposal at the end of service life.

18.0 VARIATIONS OVER TIME

Any variation to the design, materials or manufacturing processes associated with the items must be communicated to Endeavour Energy in writing at least three months before any planned change. Endeavour Energy reserves the right to refuse any change without prejudice to any existing right or remedy. Any variation accepted by the purchaser must be conditional upon the Supplier providing suitable test results and documentation that is deemed acceptable.

19.0 SAFETY DATA SHEET (SDS)

A Safety Data Sheet (SDS) for each material used in the manufacture of items must be provided with the offer.
20.0 AUTHORITIES AND RESPONSIBILITIES

General Manager, Asset Management has the authority and responsibility for approving this instruction;
• approving technical specifications including any subsequent variations to the specifications;
• approving the technical compliance of any tender in respect to this Specification;
• approving of type tests performed by a laboratory not recognised by NATA under a Mutual Recognition Agreement (MRA) with an international testing authority; and,
• delegation of any of these authorities and responsibilities to the Manager, Asset Standards and Design.

Manager, Asset Standards and Design has the authority and responsibility for:
• making recommendations to the General Manager, Asset Management in respect to this instruction;
• making recommendations concerning compliance in respect to this Specification; and,
• acceptance and approval of all test reports to be submitted as specified within this document.

Mains Assets Manager has the authority and responsibility for:
• reviewing/accepting type test reports submitted on all proposed fitting constructions; and,
• keeping this instruction up to date.

Manager Procurement & Logistics is responsible for checking that all overhead line fittings purchased by Endeavour Energy complies with the requirements of this instruction.

Contractor Operations Manager and Network Connections Branch are responsible for ensuring that all equipment installed by Level 1 Accredited Service Providers complies with the requirements of this instruction.

21.0 DOCUMENT CONTROL

| Documentation Content Coordinator | : Mains Assets Manager |
| Documentation Distribution Coordinator | : Branch Process Coordinator |
### Annexure 1 – Catalogue Items

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Stockcode</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>GAIN BLOCKS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GB1</td>
<td>Gain block-Aluminium-100mm</td>
<td>1018644</td>
</tr>
<tr>
<td>GB2</td>
<td>Gain block-Aluminium-125mm</td>
<td>1140649</td>
</tr>
<tr>
<td>GB3</td>
<td>Gain block-Aluminium-150mm</td>
<td>1145408</td>
</tr>
<tr>
<td>GB4</td>
<td>Gain block-Aluminium-100mm (for concrete poles)</td>
<td>SB16205</td>
</tr>
<tr>
<td><strong>HELICAL FITTINGS – Dead Ends</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DE2</td>
<td>Deadend for 7/2.25 AAC AAAC</td>
<td>SD10036</td>
</tr>
<tr>
<td>DE4</td>
<td>Deadend for 7/3.00 AAC AAAC</td>
<td>1032033</td>
</tr>
<tr>
<td>DE5</td>
<td>Deadend for 7/3.40 AAC AAAC</td>
<td>SD10257</td>
</tr>
<tr>
<td>DE6</td>
<td>Deadend for 7/3.75 AAC AAAC</td>
<td>1032136</td>
</tr>
<tr>
<td>DE7</td>
<td>Deadend for 7/4.50 AAC AAAC</td>
<td>SD10249</td>
</tr>
<tr>
<td>DE8</td>
<td>Deadend for 7/4.75 AAC AAAC</td>
<td>100060</td>
</tr>
<tr>
<td>DE9</td>
<td>Deadend for 19/3.25 AAC AAAC</td>
<td>SD10230</td>
</tr>
<tr>
<td>DE10</td>
<td>Deadend for 7/5.00 AAC compacted 7% to 14mm diameter for 50mm² HVABC catenary</td>
<td>SD10109</td>
</tr>
<tr>
<td>DE11</td>
<td>Deadend for 19/3.75 AAC compacted 7% to 17.5mm diameter for 150mm² HVABC catenary</td>
<td>SD10044</td>
</tr>
<tr>
<td>DE12</td>
<td>Deadend for 6/1/3.00 ACSR/GZ Apple and 4/3/3.00 Sultana</td>
<td>SD11172</td>
</tr>
<tr>
<td>DE13</td>
<td>Deadend for 6/1/3.75 ACSR/GZ Banana</td>
<td>1032136</td>
</tr>
<tr>
<td>DE14</td>
<td>Deadend for 6/4.75+7/1.60 ACSR/GZ Cherry</td>
<td>1032100</td>
</tr>
<tr>
<td>DE15</td>
<td>Deadend for 3/4/1.75 ACSR/GZ Quince</td>
<td>1032124</td>
</tr>
<tr>
<td>DE16</td>
<td>Deadend for 3/4/2.50 ACSR/GZ Raisin</td>
<td>1032148</td>
</tr>
<tr>
<td>DE17</td>
<td>Deadend for 4/3/3.00 ACSR/GZ Sultana</td>
<td>SD11172</td>
</tr>
<tr>
<td>DE18</td>
<td>Deadend for 4/3/3.75 ACSR/GZ Walnut</td>
<td>1032136</td>
</tr>
<tr>
<td>DE19</td>
<td>Deadend for 7/2.75 SC/GZ Steel conductor</td>
<td>1019600</td>
</tr>
<tr>
<td>DE20</td>
<td>Deadend for 7/3.25 SC/GZ Steel conductor</td>
<td>1019624</td>
</tr>
<tr>
<td>DE21</td>
<td>Deadend for 7/4.00 SC/GZ Steel conductor</td>
<td>SD10184</td>
</tr>
<tr>
<td>DE22</td>
<td>Deadend for 19/2.75 SC/GZ Steel conductor</td>
<td>1019636</td>
</tr>
<tr>
<td>DE23</td>
<td>Deadend for 7/1.63 HDCu Copper conductor</td>
<td>1011145</td>
</tr>
<tr>
<td>DE24</td>
<td>Deadend for 7/1.75 HDCu Copper conductor</td>
<td>1011145</td>
</tr>
<tr>
<td>DE25</td>
<td>Deadend for 7/2.00 HDCu Copper conductor</td>
<td>1011157</td>
</tr>
<tr>
<td>DE26</td>
<td>Deadend for 7/2.75 HDCu Copper conductor</td>
<td>1011169</td>
</tr>
<tr>
<td>DE27</td>
<td>Deadend for 19/2.00 HDCu Copper conductor</td>
<td>1011170</td>
</tr>
<tr>
<td><strong>HELICAL FITTINGS – Armour Rods</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AR1</td>
<td>Armour rod for 7/2.50 AAC AAAC</td>
<td>1032227</td>
</tr>
<tr>
<td>AR2</td>
<td>Armour rod for 7/3.00 AAC AAAC</td>
<td>1032239</td>
</tr>
<tr>
<td>AR3</td>
<td>Armour rod for 7/3.75 AAC AAAC</td>
<td>1032252</td>
</tr>
<tr>
<td>AR4</td>
<td>Armour rod for 7/4.50 AAC AAAC</td>
<td>1032197</td>
</tr>
<tr>
<td>AR5</td>
<td>Armour rod for 19/3.25 AAC AAAC</td>
<td>SR10284</td>
</tr>
<tr>
<td>AR6</td>
<td>Armour rod for 19/3.75 AAC AAAC</td>
<td>1032185</td>
</tr>
<tr>
<td>AR7</td>
<td>Armour rod for 19/4.75 AAC AAAC</td>
<td>SR14387</td>
</tr>
<tr>
<td>AR8</td>
<td>Armour rod for 6/1/2.50 ACSR/GZ Almond</td>
<td>1032227</td>
</tr>
<tr>
<td>AR9</td>
<td>Armour rod for 6/1/3.00 ACSR/GZ Apple</td>
<td>1032239</td>
</tr>
<tr>
<td>AR10</td>
<td>Armour rod for 6/1/3.75 ACSR/GZ Banana</td>
<td>1032252</td>
</tr>
<tr>
<td>AR11</td>
<td>Armour rod for 6/4.75+7/1.60 ACSR/GZ Cherry</td>
<td>1032240</td>
</tr>
<tr>
<td>Item</td>
<td>Description</td>
<td>Stockcode</td>
</tr>
<tr>
<td>-------</td>
<td>-----------------------------------------------------------------------------</td>
<td>------------</td>
</tr>
<tr>
<td>SL1</td>
<td>Stay locks for 19/2.00 w/o lashing rod SC/GZ Steel conductor</td>
<td>1019673</td>
</tr>
<tr>
<td>FS1</td>
<td>Full tension splice for 7/4.00 SC/GZ Steel conductor</td>
<td>SS10452</td>
</tr>
<tr>
<td>FS2</td>
<td>Full tension splice for 19/3.25 (16mm diameter) SC/GZ Steel conductor</td>
<td>SS12803</td>
</tr>
<tr>
<td>IT1</td>
<td>Top ties for 76mm insulator neck for 7/3.00 AAC AAAC</td>
<td>ST16781</td>
</tr>
<tr>
<td>IT2</td>
<td>Top ties for 76mm insulator neck for 7/4.75 AAC AAAC</td>
<td>ST15459</td>
</tr>
<tr>
<td>IT3</td>
<td>Top ties for 76mm insulator neck for 19/4.75 AAC AAAC</td>
<td>1032471</td>
</tr>
<tr>
<td>IT4</td>
<td>Top ties for 76mm insulator neck for 6/1.300 ACSR/GZ Apple</td>
<td>ST16781</td>
</tr>
<tr>
<td>IT5</td>
<td>Top ties for 76mm insulator neck for 6/4.75+7/1.60 ACSR/GZ Cherry</td>
<td>ST15459</td>
</tr>
<tr>
<td>IT6</td>
<td>Top ties for 76mm insulator neck for 30/7/3.50 ACSR/GZ Lime</td>
<td>1032471</td>
</tr>
<tr>
<td>IT7</td>
<td>Top ties for 76mm insulator neck for 4/3/0.00 ACSR/GZ Sultana</td>
<td>ST16781</td>
</tr>
<tr>
<td>IT8</td>
<td>Side ties for 73mm neck for 80 CCT</td>
<td>1134154</td>
</tr>
<tr>
<td>IT9</td>
<td>Side ties for 73mm neck for 120 CCT</td>
<td>1134162</td>
</tr>
<tr>
<td>IT10</td>
<td>Side ties for 73mm neck for 180 CCT</td>
<td>1134170</td>
</tr>
<tr>
<td>IT11</td>
<td>Side ties for 112mm neck for 6/1/2.50 ACSR/GZ Almond</td>
<td>1079232</td>
</tr>
<tr>
<td>VD1</td>
<td>Vibration damper for 7/2.50 Spiral AAAC</td>
<td>SD11647</td>
</tr>
<tr>
<td>VD2</td>
<td>Vibration damper for 7/3.00, 7/3.75 Spiral AAAC</td>
<td>SD11687</td>
</tr>
<tr>
<td>VD3</td>
<td>Vibration damper for 7/4.50 Spiral AAAC</td>
<td>1032598</td>
</tr>
<tr>
<td>ABR1</td>
<td>Anti-birdcaging bundle restraint (pair) for 50mm² NMSHVABC</td>
<td>SD11326</td>
</tr>
<tr>
<td>ABR2</td>
<td>Anti-birdcaging bundle restraint (pair) for 150mm² NMSHVABC</td>
<td>SD11288</td>
</tr>
<tr>
<td>IF1</td>
<td>Ball clevis, 160kN, Forged Steel</td>
<td>SB18259</td>
</tr>
<tr>
<td>IF2</td>
<td>Ball clevis, 70kN, Forged Steel</td>
<td>SB17988</td>
</tr>
<tr>
<td>IF3</td>
<td>Ball tongue, 70kN, Forged Steel</td>
<td>1560044</td>
</tr>
<tr>
<td>IF4</td>
<td>Clevis thimble, 70kN, Alum, Hex</td>
<td>1032823</td>
</tr>
<tr>
<td>IF5</td>
<td>Clevis thimble, 70kN, Alum, Hex 19/4.75</td>
<td>1032835</td>
</tr>
<tr>
<td>IF6</td>
<td>Clevis thimble, 70kN, Forged Steel, Hex</td>
<td>1014961</td>
</tr>
<tr>
<td>IF7</td>
<td>Clevis tongue, 120kN, MCI</td>
<td>ST15696</td>
</tr>
<tr>
<td>IF8</td>
<td>Socket clevis, 160kN, Forged Steel, R clip</td>
<td>1108752</td>
</tr>
<tr>
<td>IF9</td>
<td>Socket clevis, 70kN, Forged Steel, W clip</td>
<td>1502855</td>
</tr>
<tr>
<td>IF10</td>
<td>Socket tongue, 70kN, Forged Steel, 16mm hole, W clip</td>
<td>1108836</td>
</tr>
<tr>
<td>PG1</td>
<td>PG clamp, 11.0-14.5mm Al, 11.0-14.5mm Al, 2xM12 SS</td>
<td>1032884</td>
</tr>
<tr>
<td>PG2</td>
<td>PG clamp, 12.5-20.0mm Al, 10.0-18.0mm Cu</td>
<td>1084379</td>
</tr>
<tr>
<td>PG3</td>
<td>PG clamp, 16.3-33.8mm Al, 16.3-33.8mmAl, 3xM12 SS</td>
<td>SC16757</td>
</tr>
<tr>
<td>PG4</td>
<td>PG clamp, 18.5-29.5mm Al, 18.5-29.5mm Al</td>
<td>SC15890</td>
</tr>
<tr>
<td>PG5</td>
<td>PG clamp, 5.0-10.5mm Al,3.0-9.0mm Cu</td>
<td>1552108</td>
</tr>
<tr>
<td>PG6</td>
<td>PG clamp, 6.0-16.5mm Al, 3.75-12.5mm Cu</td>
<td>1552116</td>
</tr>
<tr>
<td>Item</td>
<td>Description</td>
<td>Stockcode</td>
</tr>
<tr>
<td>------</td>
<td>-------------</td>
<td>-----------</td>
</tr>
<tr>
<td>PG7</td>
<td>PG clamp, 7.5-19.0mm Al, 7.5-19.0mm Al</td>
<td>1134220</td>
</tr>
</tbody>
</table>

**NON-TENSION FITTINGS – Split bolts**

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Stockcode</th>
</tr>
</thead>
<tbody>
<tr>
<td>SB1</td>
<td>Split bolt, Natural, 16mm²</td>
<td>1009734</td>
</tr>
<tr>
<td>SB2</td>
<td>Split bolt, Natural, 35mm²</td>
<td>1009746</td>
</tr>
<tr>
<td>SB3</td>
<td>Split bolt, Natural, 70mm²</td>
<td>1009758</td>
</tr>
<tr>
<td>SB4</td>
<td>Split bolt, Natural, 95mm²</td>
<td>1009760</td>
</tr>
<tr>
<td>SB5</td>
<td>Split bolt, Natural, 185mm²</td>
<td>1009771</td>
</tr>
</tbody>
</table>

**PROTECTIVE FITTINGS**

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Stockcode</th>
</tr>
</thead>
<tbody>
<tr>
<td>PF1</td>
<td>Damper 19/3.75 Neon and 19/3.75 Pluto</td>
<td>1135128</td>
</tr>
<tr>
<td>PF2</td>
<td>Damper 37/3.75 Phosphorus and 30/7/3.50 Lime</td>
<td>1109396</td>
</tr>
<tr>
<td>PF3</td>
<td>Damper 30/7/2.50 Grape</td>
<td>1109495</td>
</tr>
<tr>
<td>PF4</td>
<td>Damper 19/4.75 Taurus and 19/4.75 Oxygen</td>
<td>1116953</td>
</tr>
</tbody>
</table>

**SUSPENSION CLAMPS**

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Stockcode</th>
</tr>
</thead>
<tbody>
<tr>
<td>SC1</td>
<td>Clamp 21-27 mm Trunnion Al Suspension</td>
<td>SC10333</td>
</tr>
<tr>
<td>SC2</td>
<td>Clamp 27-36 mm Trunnion Al Suspension</td>
<td>SC18946</td>
</tr>
<tr>
<td>SC3</td>
<td>Clamp 6-16 mm Suspension Offset MCI</td>
<td>1014985</td>
</tr>
</tbody>
</table>
Annexure 2 – Gain Block Dimensions and Drawings

<table>
<thead>
<tr>
<th>Dimension</th>
<th>100mm</th>
<th>125mm</th>
<th>150mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>X₁</td>
<td>75</td>
<td>75</td>
<td>75</td>
</tr>
<tr>
<td>Y₁</td>
<td>103</td>
<td>128</td>
<td>156</td>
</tr>
<tr>
<td>X₂</td>
<td>122</td>
<td>146</td>
<td>178</td>
</tr>
<tr>
<td>X₃</td>
<td>105</td>
<td>128</td>
<td>156</td>
</tr>
<tr>
<td>X₄</td>
<td>150</td>
<td>150</td>
<td>150</td>
</tr>
<tr>
<td>R₁</td>
<td>80</td>
<td>80</td>
<td>70</td>
</tr>
</tbody>
</table>

Note:
1. All dimensions in mm.
2. Tolerance for dimensions up to 30mm is +/-1.5mm.
3. Tolerance for dimensions over 30mm is +/-5% with a maximum of 5mm.
100 MM GAIN BLOCK FOR CONCRETE POLES

Note:
1. All dimensions in mm.
2. Tolerance for dimensions up to 30mm is +/-1.5mm.
3. Tolerance for dimensions over 30mm is +/-5% with a maximum of 5mm.