Eskom	Standard	Technology

Title: **CURRENT-CARRYING COMPRESSION FITTINGS FOR OVERHEAD RETICULATION SYSTEMS**

Unique Identifier:	**240-75883110**
Alternative Reference Number:	**34-1083**
Area of Applicability:	**Engineering**
Documentation Type:	**Standard**
Revision:	**1**
Total Pages:	**27**
Next Review Date:	**November 2022**
Disclosure Classification:	**Controlled Disclosure**

Compiled by	Approved by	Authorized by
Boitumelo Nteo	Bharat Haridas	Riaz Vajeth
Trainee Engineer	Senior Consultant	Senior Manager
Date: 24/10/2017	Date: 24/10/2017	Date: 24/10/2017

Supported by SCOT/SC

Riaz Vajeth
SCOT/SC Chairperson
Date: 24/10/2017

PCM Reference: **240-51017656**
SCOT Study Committee Number/Name: **Hardware Care Group**

Content

Figures

Tables

1. Introduction

None. ??????? cannot be none

2. Supporting clauses

2.1 Scope

This specification covers Distribution Group's requirements for the manufacture, testing and supply of current-carrying compression fittings. It is applicable to fittings for bare ACSR and AAAC phase conductors (with the aluminium area not exceeding 120 mm^2), and bare galvanized steel wire, for use on a.c. system voltages from 1 kV up to and including 33 kV.

The tests prescribed will be used to evaluate the performance of the fittings on the associated conductors

2.1.1 Purpose

None. ??????? cannot be none

2.1.2 Applicability

This document shall apply throughout Eskom Holdings Limited Divisions.

2.2 Normative/informative references

2.2.1 Normative

[1] IEC 60050-466, International Electrotechnical vocabulary – Chapter 466: Overhead lines.

[2] IEC 60518, Dimensional standardization of terminals for high-voltage switchgear and control gear.

[3] IEC 61089, Round wire concentric lay overhead electrical stranded conductors.

[4] IEC 61284, Overhead lines – Requirements and tests for fittings.

[5] ISO 2859-1, Sampling procedures for inspection by attributes – Part 1: Sampling plans indexed by acceptable quality level (AQL) for lot-by-lot inspection.

[6] ISO 2859-2, Sampling procedures for inspection by attributes – Part 2: Sampling plans indexed by limiting quality level (LQ) for isolated lot inspection.

[7] ISO 3951, Sampling procedures and charts for inspection by variables for percent nonconforming.

[8] SABS ISO 7253, Paints and varnishes – Determination of resistance to neutral salt spray.

[9] ISO 9001,Quality Management systems — Requirements

[10] BS 3288-1, Insulator and conductor fittings for overhead power lines – Part 1: Performance and general requirements.

[11] SABS 136, ISO metric precision hexagon-head bolts and screws, and hexagon nuts (coarse thread, medium fit series).

[12] (Amendment No. 1, 1992)

[13] SABS 1037, Standard transformer bushings.

[14] NWS 1019, Compression accessories for phase and earth conductors for transmission lines.

[15] SCSPVAAT6, Distribution Standard – Part 9: Buyers' Guide.

2.2.2 Informative

None

2.3 Definitions

2.3.1 General

Definition	Description
"T" fitting	A fitting for the permanent connection of the end of one conductor (tap conductor) to a point on the length of the second conductor (main conductor). The connection is not subject to line tension although the main conductor to which the fitting is applied may be at line tension.
All aluminium alloy conductor (AAAC):	A stranded conductor of which all wires are made of aluminium alloy.
Aluminium conductor steel reinforced (ACSR)	A reinforced conductor with one or more layers of aluminium wire stranded around a core of galvanised steel wires.
Bimetallic fitting	A fitting that is suitable for joining conductors of different materials.
Breaking force	A conductor fitting designed to ensure electrical and/or mechanical continuity of the overhead line conductor, in which the force necessary to grip the conductor is provided by permanent plastic deformation of the fitting and all layers of the conductor by an appropriate compression tool.
Dead-end tension joint	A joint inserted at the end of a conductor for attachment to an insulator tension set, designed to carry the full current and to provide mechanical termination of the conductor.
International Annealed Copper Standard (IACS):	Internationally accepted value for the resistivity of annealed copper, ($1{,}7241 \times 10^{-8}$ Ωm at 20 °C), referred to as 100 % conductivity (see 3.1.12).
Jumper flag/lug	The part of a fitting that permits electrical continuity with another conductor.
Jumper terminal	The termination of a conductor that permits electrical continuity with a jumper flag/lug using bolts.
Mid-span tension joint	A fitting inserted between two lengths of a conductor to provide electrical and mechanical continuity of the conductor.
Non-tension fitting	A fitting that is inserted between two lengths of conductor but not held at line tension, to provide electrical continuity between the conductors.
Percent conductivity	The rating of the conductivity of an aluminium alloy in terms of its percentage ratio to the conductivity of IACS.
Repair sleeve	A special fitting composed of two interlocking parts, that connect to each other to form a tubular sleeve. The sleeve can be installed over a damaged conductor to restore its mechanical and electrical properties.
Specified minimum failure load (SMFL)	The minimum load specified by the purchaser or declared by the supplier, at which mechanical failure shall not take place.
Tension fitting	A fitting designed to ensure electrical and mechanical continuity of the conductor under line tension.

Definition	Description
Termination lug	The termination of a conductor, that permits electrical connection to other equipment.

2.3.2 Disclosure classification

Controlled disclosure: controlled disclosure to external parties (either enforced by law, or discretionary).

2.4 Abbreviations

Abbreviation	Description
AAAC	All aluminium alloy conductor
ACSR	Aluminium conductor steel reinforced
AQL	Acceptable quality level
IACS	International annealed copper standard
ISO	International Electrotechnical Commission
M-value	International Organization for Standardization
SMFL	Marking load (in tension test)

2.5 Roles and responsibilities

Not applicable.

2.6 Process for monitoring

Not applicable.

2.7 Related/supporting documents

Not applicable.

3. Requirements

3.1 General

Nothing in this specification shall lessen the obligations of the supplier. The supplier shall be fully responsible for the fitting design and its satisfactory performance in service. Approval by Eskom shall not relieve the supplier of the responsibility for the adequacy of the design.

3.1.1 Workmanship

All fittings shall have a smooth finish, be free of defects and shall be of high quality workmanship.

3.1.2 Drawings

a) Manufacturing drawings of all fittings submitted for tender, shall be submitted to IARC (Distribution Technology) for approval at the time of tendering.

b) All drawings shall clearly indicate all critical dimensions and tolerances.

c) The material grade and the heat treatment required for individual items shall be clearly indicated on all drawings.

d) Any revision to drawings of fittings being manufactured for and supplied to Eskom shall clearly indicate the revision number and date, and shall be submitted to Distribution Technology for approval at the time of tendering.

3.1.3 Tolerances

Tolerances shall be ± 0.7 mm of all dimensions up to and including 35 mm unless the conductor or bolt dimensions the fitting is for do not allow for such a wide tolerance. Tolerances for dimensions above 35 mm shall be ± 2 % of the dimension. Fittings found to be outside of the specified tolerance will be rejected. The supplier shall ensure that all dimensions are suitable for the application for which they are to be used.

3.1.4 Range of system

The compression fittings are required for making connections between various arrangements of stranded conductor and terminal stems. The conductor diameter range shall be identified by the colour code given for each fitting in table 1.

Range taking fittings are required for all non-tension fittings for ACSR and AAAC conductors. The range and maximum internal diameter of the tubes are as follows:

a) Acacia/Magpie/Squirrel/35/Fox conductors and maximum tube size of 9 mm inside diameter;

b) Pine/Mink/Oak/Hare conductors and maximum tube size of 15 mm inside diameter;

The range talking joints include conductors with different colour codes. All colour codes shall be displayed on the surface of the fitting. The names of the standard conductors within the range of the fitting shall be engraved on each fitting.

Full tension joints will be two piece joints. Full tension fittings will have a smaller range taking ability. The standard range to be covered for mid span full tension joints is:

a) Magpie;

b) Acacia /Squirrel;

c) 35/Fox;

d) Pine/Mink; and

e) Oak/Hare.

The standard conductor and terminal stem characteristics for these items are given in table 1:

Table 1: Standard dimensions of range of conductors and terminal stems

1	2	3	4	5	6	7
Type	**Diameter (max) mm**	**Stranding and wire diameter Mm**	**All areas mm^2**	**Breaking force KN**	**Current rating @ 75 °C A**	**Colour code**
Conductors						
Aluminium						
Acacia AAAC	6,24	7/2,08	23,79	6,69	133	Orange
Squirrel ACSR	6,33	6/1/2,11	20,98	8,20	130	Orange
Magpie ACSR	6,35	3/4/2,118	10,58	18,573	92	Green
35 AAAC	8,31	7/2,77	42,18	11,86	189	Blue
Fox ACSR	8,37	6/1/2,79	36,68	13,10	190	Blue

Pine AAAC	10,94	7/3,61	71,65	20,20	262	Red
Mink ACSR	10,98	6/1/3,66	63,13	21,90	260	Red
Oak AAAC	14,09	7/4,65	118,90	33,33	359	Brown
Hare ACSR	14,16	6/1/4,72	104,98	36,00	360	Brown
Copper						
0.025 (SQ. IN.)	5,67	3/2.64	16,44	6,77	120	
0.05 (SQ. IN.)	8,05	3/3.73	32,85	12,94	185	
0.1 (SQ. IN.)	10,4	7/3.45	65,6	26,09	277	
Terminals						
MV bushing terminals of transformers, VT-CT units and auto-reclosers SABS 1037	M12	Brass and copper in old transfor-mers		Up to 350		
Surge arresters	M12					
Note 1: Conductors as per IEC 601089. **Note 2:** The types and quantities of fittings required will be specified in schedule A of an enquiry document.						

3.1.5 General principles of the design

The fittings shall be manufactured for compression using an approved hydraulic compression tools utilizing the die-less, four-point shallow indentation system.

Fittings shall be designed for hydraulic tools with a force ranging between 48kN and 55kN. The tool type, tool model and tool supplier shall be approved by Eskom Distribution Technology.

The compression fittings shall be designed to allow their application using also live line techniques.

Surfaces of compression fittings in contact with the conductor or earth wire shall be protected from contamination before installation by placing plugs in both ends of the fittings.

The compression fittings, when applied to the appropriate conductor, shall comply with the electrical and mechanical requirements of this specification and retain these characteristics during the normal life of the fitting, whilst in an outdoor environment.

3.1.6 Electrical criteria

The compression fittings shall:

a) provide satisfactory distribution of current in the jointed conductors,

b) sustain the passage of service current and short-circuit current without excessive heating,

c) not increase the resistance of the elements of the circuit in which they are incorporated relative to the resistance of the reference conductor,

d) they shall provide the lowest possible emission of radio interference voltage, and

shall not contribute to corona levels.

3.1.7 Mechanical criteria

The mounted compression fittings shall:

a) be unaffected by conductor motion and vibrations, as well as changes of tension, temperature and any other environmental conditions experienced while in service;

b) be resistant to intergranular and stress corrosion;

c) cause no damage to or have any deteriorating effect on the conductor, after being installed in accordance with this specification;

d) include systems that prevent the loosening of contact during the serviceable life of bolted connections;

e) withstand loads related to installation, maintenance, and service; and

f) withstand a tensile force equal to but not less than the values indicated in table 2.

Table 2: Mechanical tension load of compression fittings

1	2
Type of fitting	**SMFL as a percentage of the rated tensile strength of the conductor on which the fitting is applied**
Mid span full tension	95 %
Dead end full tension	95 %
In line non-tension	25 %
Non-tension "T" fitting – tap conductor load	10 %
Non-tension lug	10 %

Note: The main conductor on T-off joints is to be tested in accordance with the IEC 61284 tension requirements.

3.1.8 Classification of fittings

The fittings shall be characterized by their mechanical role, the function they perform and the principle of design. The fittings covered by this specification are classified in table 3.

Table 3: Classification of compression fittings

1	2	3	4	5	6	7
Criteria	**Types**					
Mechanical	Tension	Non-tension			Bimetallic non-tension	
Functional	Joint	Joint	Lug	"T" fitting	Joint	Lug
Principle of shape	Tubular	Tubular	Tubular with palm	Tubular with combinations	Tubular friction welded to tubular	Tubular friction welded to palm
Principle of application	Permanent	Permanent	Permanent	Permanent	Permanent	Permanent

3.1.9 Materials and fabrication

The conductive part of joints shall be made of at least 98,5 % pure aluminium for aluminium based conductors or out of an electrical grade copper for copper conductors. The conductivity of the material shall be greater than 50 % IACS at 20 °C. Joints made for Magpie, galvanized steel and inner cores may use other grades of material for manufacture if the material and design passes the heat cycle test on the conductor the joint is intended for. Two piece joints shall be subject to the corrosion tests with both fittings applied. If the two pieces of the piece joint are manufactured from similar materials, the supplier shall submit evidence to prove that corrosion testing is unnecessary. The corrosion test may be excluded from the list of required type tests if Distribution Technology agrees in writing that detrimental corrosion will not take place in a joint made with the two piece fitting.

All materials used for manufacture of compression fittings shall not age in any way such that type test results do not reflect the true performance of the in-service joint.

If line boring or drilling techniques are used in the manufacture of the sleeves, the tolerance on the wall thickness shall not be exceeded (see 4.1.3).

Every length of tube used in the manufacture of sleeves shall be drift tested (see 5.8).

Welding aluminium alloys shall be done using either a tungsten inert-gas-shielded arc or metal inert-gas-shielded arc process. Welding jigs shall be used to ensure the correct alignment of sleeves. Welds shall be clean, sound, smooth, uniform, without overlaps, properly fused and completely sealed. There shall be no cracks, voids, incomplete penetration, incomplete fusion, undercutting or inclusions. Porosity shall be minimized so as not to affect the mechanical properties of the aluminium alloys. Accredited welding personnel shall perform welds.

All components shall be free of sharp edges; burrs and shall be finished with etching. Voids and brittleness of fittings shall be avoided.

All one piece tubular and core tubes for two piece fittings shall incorporate a staked-in plug, or centre stop, positioned at the centre of the sleeve barrel.

3.1.10 Bimetallic fittings

Bimetallic fittings shall be either:

a) Friction welded with the friction weld coated with an approved epoxy compound sealing the weld interface.

b) Aluminium lugs with forged copper inserts sealed with an epoxy compound sealing the material interface.

c) Other types of fittings or forms of manufacture shall be subject to Eskom's written approval.

If the fitting has a vertical mode and the two metals of the joint are copper and aluminium, the copper shall be placed below the aluminium. The crimp shall ensure that no moisture enters the joint and that dissimilar conductors are completely separated. The metals or alloys used shall not form, in the presence of humidity, an electrolytic coupling that is capable of causing damage to contacts. All bimetallic fittings shall pass the corrosion type test, also see table 4 for testing. The individual Distribution regions shall determine the application and use of, the bimetallic fittings.

3.2 Electrical jointing compound

Jointing compound is required to provide low initial contact resistance and to prevent deterioration of the contact due to oxidation or corrosion, by excluding air and moisture from the contact surface.

The jointing compound shall be:

a) non-toxic and non-inflammable;

b) stable over a wide temperature range (the melting point shall be not less than 100 °C); and

c) neutral, relative to the metals being crimped.

Grease shall comply with that specified in drawing buyers guide D-DT-3178

All one piece compression fittings shall be pre-filled with an adequate amount of the jointing compound to ensure that all voids are filled once the fitting is compressed. The joint shall be closed off at each end with end caps once the grease is in the tube. The grease for two piece joints shall be placed in a separate package. The type of compound and its chemical breakdown shall be stated in schedule B of an enquiry document.

3.3 Tools and the application of fittings

3.3.1 The compression tools

Only compression tools that have passed through the approval process, and have been approved, will be considered for use in Eskom. The approval process is outlined in annex A. The principal guiding requirements for compression tools are as follows:

A hand pump, compressor or motor operated hydraulic system shall drive the compression head. The compression head of the die-less system shall be the four-point shallow indent design. The indentations the jaws create shall resemble that of approved tools. Yoke and side jaws shall operate concentrically with the fixed jaw and shall be self-aligning.

The design of the compression tool shall have the following characteristics:

a) a nominal compression force shall be between 48kN and 55kN.

b) rapid ram advance (a two speed hydraulic pump rapidly advancing the ram with minimum “pump actions” is preferred);

c) some positive indication that full compression force has been achieved

d) the head is rotatable and functional through 180° to facilitate compression at an angle.

Only tools that are approved by Eskom (approval based on identical operation to already approved existing Eskom equipment and technological improvements) shall be used.

3.3.2 Four point indent – general requirements

The indent provided by the four-point shallow indentation system will be accepted as adequate identification.

The length of the indentation bite shall be approximately 14 mm.

3.3.3 Maintenance of tools

All tools are to be checked every 3 months to ensure that the force applied by the indents is between the range 48kN and 55kN. If the range of pressures is **below** or **above** the range stated, the tool is then to be serviced before using it again.

The most feasible way of checking the operating pressure of a crimping tool, is either to crimp a test slug and thereafter compare it to a GO, NO-GO gauge. See Figure 1 below or an approved loadcell jaw pressure testing device.

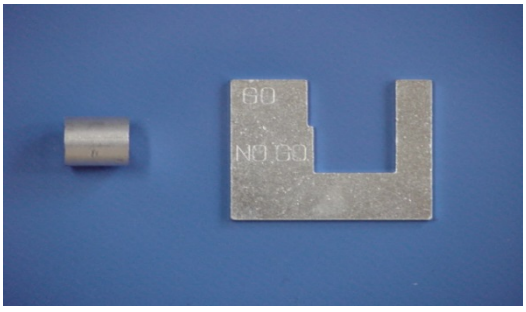

Figure 1: A test slug and a GO, NO-GO gauge

This testing is performed as follows:

a) Insert the test slug into the jaws of the crimper and crimp the slug until the pressure release valve in the crimper operates.

Note: Take care to crimp the test slug in the middle.

b) Compare the length of the test slug to the GO, NO-GO gauge.

1) If the test slug fits in the GO section of the gauge, the crimper is operating correctly. See Figure 2 below.

Figure 2: The test slug fits in the GO section of the gauge indicating that the crimper is operating correctly

2) If the test slug is too large to fit into the gauge, or is short enough to fit in the NO-GO section of the gauge, the crimper must be returned to the supplier for repair. See Figures 3 and 4 below.

Figure 3: The test slug does not fit into the gauge, indicating that the crimper is operating at too high a pressure

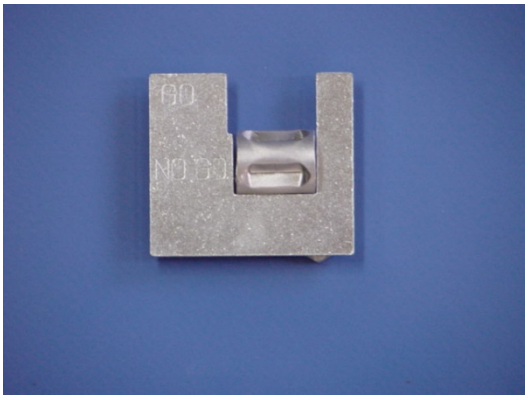

Figure 4: The test slug fits in the NO-GO part of the gauge, indicating that the crimper is operating at too low a pressure

3) Test slugs and GO, NO-GO gauges shall comply with drawing drawing DDT 3040.

4) Each construction tool shall be tested on a weekly basis.

5) Each set of tools shall be supplied with a manual that describes the method of operation and details the maintenance requirements.

3.4 Installation of compression fittings

Fittings shall be installed using a hydraulic compression tool (compressor, hand or motor operated) approved by Eskom. The manufacturer of the fittings shall submit an installation instruction document to Eskom, with the recommendations regarding the cleaning treatment to be used and the type of jointing compound. The methodology of crimping to be used shall be the practice adopted as a standard practice by Eskom, i.e.: crimp between knurls where crimps do not overlap adjacent crimps.

3.5 Documents

The manufacturer shall provide a document describing the detailed installation instructions for the supplied fittings with his tender.

A manual describing the method of operation and detailing maintenance requirements shall be supplied with each tool purchased.

3.6 Quality Assurance

The manufacturer / supplier shall have a formally documented and implemented quality management system in accordance with the international standard ISO9001:2000, Quality management system – Requirements". Formal certification of such quality systems is required from a national quality systems certification body, which holds valid accreditation from a body acceptable to Eskom.

Further specific quality requirements. will be specified separately by the relevant Eskom business unit, either at the time of issuing of a commercial enquiry, and/or with an invitation to supplier technical and quality pre-qualification.

4. Tests

4.1 General

The tests shall be performed to establish the design characteristics of the compression fittings when installed on the relevant conductor and to assure compliance with all requirements specified. The tests shall be conducted on new fittings in the same state as they are normally supplied. Unless otherwise specified, tests shall be conducted at ambient temperatures between 15 °C and 30 °C. Type tests shall be conducted by an independent **organization** or **person** approved by **SANAS** and **Eskom IARC (Distribution Technology)**. Eskom reserves the right to witness any or all of these tests. The supplier or manufacturer shall demonstrate an ability to provide means to enable Eskom to witness any test.

All fittings shall be tested using all the approved crimping tools.

Conductors used for the tests shall be new clean conductors that are in accordance with IEC 61089.The conductor used in the test shall be tested mechanically, to ascertain that the breaking strength is within the limits specified in table 1.

Suppliers are requested to indicate their compliance with the relevant standard at the tendering stage and shall submit all the required type tests (in accordance with table 4), design drawings and samples. If the fittings offered have been tested for compliance with an internationally accepted standard, Eskom may accept those test reports in place of the tests covered by this specification. These type test reports and alternative test standards shall be submitted with their tender, for Eskom's consideration. This is subject to the same crimping technology (and pressures) being used ie 4 point indent crimping.

The qualifying type tests need not be performed if they were successfully completed for a previous Eskom tender, provided that the design and material have not been changed or modified in any way. The type test certificates of completed successful type tests previously submitted, shall be submitted with the current inquiry. Any change in components shall be indicated at the time of tender. Reference to the appropriate inquiry for which the tests were successfully completed, shall be included in the current inquiry.

The fittings shall be mounted on the conductors in accordance with the technical specification of the manufacturer meeting the requirements stipulated in 4.4.

The transfer of test certificates between manufacturers will not be allowed.

All compression fittings shall be stamped with the part number unique to each fitting and manufacturer. Each part number shall have a corresponding test certificate.

4.2 Qualifying tests

Tests to be performed on fittings are divided into three groups. Type tests, sample tests and routine tests. The testing procedures and conformance criteria, for most of the tests required, are set out in IEC 61284. The qualifying tests are given in table 4.

Table 4: Qualifying tests

1	2	3	4	5	6	7
Joints	**Type of fitting**					
	Mid span full Tension joint	In-line non-tension joint	Non-tension lugs	Non-tension "T"-fitting	Non-tension Bimetallic joint	Non-tension Bimetallic lugs
Tests						
5.3 Sampling and visual inspection1)	Xxx	xxx	xxx	xxx	xxx	xxx
5.4 Dimension and material verification1)	Xxx	xxx	xxx	xxx	xxx	xxx
5.5 Mechanical tension tests2)	Xx	x	x	x	x	x
5.6 Heat cycle tests 3)	X	x	x	x	x	x
5.7 Corrosion test4)	X				x	x
5.8 Drift test	Xx	xx	xx	xx	xx	xx

xxx = Type tests, sample tests and routine tests.

xx = Type tests and sample tests only.

x = Type tests only.

Note 1: The sampling, visual inspection, dimensional and material verification is not a test done separately from any of the other tests. These two procedures should form part of all other tests done on fittings such that the fitting can be traced back to all type test certificates. The dimensional verification should be done with reference to a design drawing. This design drawing should be included with all test reports for the fitting and be signed and stamped by the testing engineer for the testing facility. The unique product code (e.g. es122) for each fitting must be displayed on design drawings and engraved on the fitting.

Note 2: One mechanical type test must be done on the smallest diameter conductor of each stranding type, on an in-line range taking joint. For non-tension lugs and T-off fittings smallest and largest must be tested.

Note 3: Heat cycle tests

a) If four in-line non-tension joints pass the Heat cycle type test, a full tension joint and non-tension lug made from a material with the same electrical characteristics, for the same conductor range, need not be heat cycle tested, provided the same number or more crimps are made than the non tension joint.

b) If the four non-tension or T-fitting joints being tested are range taking, the heat cycle type test must be conducted with the largest conductor available. If the joint passes the heat cycle test, then the smaller conductor sizes within the range need to pass criteria 1 of clause 13.5.3.2 in IEC 61284. The ratio of the average criteria 1 resistance from the largest conductor to the criteria 1 resistance for each other conductor in the range should be within 30 % of the conductor resistance ratio quoted by the conductor manufacturer.

c) If all four bimetallic lugs pass the heat cycle test, it is not necessary to heat cycle test bimetallic non-tension joints if the bimetallic fittings have the same manufacturing process and provided the same number or more crimps are made than on the bimetallic lug.

Note 4: If all four bimetallic non-tension lugs pass the corrosion tests and have the same manufacturing process used to manufacture bimetallic in-line non-tension joints, the bimetallic in-line non-tension joints need not be corrosion tested.

4.2.1 Type tests

Type tests are intended to establish design characteristics. They are normally only made once and repeated only when the design or the material of the fitting is changed. The results of type tests are recorded as evidence of compliance with design requirements. Prior to type tests, sample to be tested must be selected and sample tested according to procedures ISO 2859-1 and ISO 2859-2 (inspection and attributes) and to ISO 3951 (inspection by variables).

4.2.2 Sample test

Sample tests are intended to verify the quality of materials and workmanship.

Unless otherwise agreed between the purchaser and the supplier, the sampling plan procedures according to ISO 2859-1 and ISO 2859-2(inspection and attributes) and to ISO 3951 (inspection by variables) shall be applied.

For each sample test, the type of inspection (by attributes or by variables and detailed procedures inspection level, acceptable quality level, single, double or multiple sampling, etc.) shall be agreed between the purchaser and the supplier.

NOTE: Sampling inspection by variables is an acceptance sampling procedure to be used in place of inspection by attributes when it is more appropriate to measure on some continuous scale characteristic(s) under consideration. In the case of failure load test and similar expensive tests, better discrimination between acceptance quality and objective quality is available with acceptance sampling by variables than by attributes for the same sample size.

The purpose of the sampling process may also be important in the choice between a variables or attributes plan. For example, a purchaser may choose to use an attributes acceptance sampling plan to ensure that parts in a shipment lot are within a required dimensional tolerance; the manufacturer may make measurements under a variables sampling plan of the same dimensions because he is concerned with gradual trends or changes which may affect his ability to provide shipment lots which meet the AQL.

4.2.3 Routine tests

Routine tests are intended to prove conformance of fittings to specific requirements and shall be made on every fitting. The tests shall not damage the compression fitting.

4.2.4 Quantity tested

Unless otherwise specified, a minimum of 4 (four) samples of each size and type of compression fitting shall be tested per test. Each test sample shall comply with all the acceptance criteria applicable to the fitting.

4.3 Visual inspection and verification of dimensions

Prior to any test to be done on compression joints, a visual inspection shall be completed to confirm that the fittings to be tested have dimensions that conform to the manufacturer's design drawings. The manufacturer shall supply the relevant drawings indicating all critical dimensions of the fittings.

All test samples shall be submitted to Distribution Technology after testing is completed.

4.4 Material verification test

The analysis of the materials shall be conducted in an official laboratory of the supplier of the raw materials or in a laboratory mutually acceptable to manufacturers of fittings and Eskom.

The composition and properties of the metals and alloys shall correspond to the demands of the approved materials as stipulated in 4.1.9 and 4.1.10.

The amount of impurities in cast and welded fittings shall not exceed the maximum allowable for accepted materials.

4.5 Mechanical tension tests

Tensile tests shall be done in accordance with IEC 61284.The following criteria shall be used where specified in the IEC 61284:

a) the M value referred to in the IEC 61284 tensile tests, shall be 20 % of the SMFL given in table 2 (section 4.1.7 of this specification);

b) the section of the test where 60 % of SMFL is held shall be for a minimum of 1 min but if possible the tension shall be held for as long as 5 min; and

c) for the remainder of the test Option a) (as in IEC 61284) shall be used.

All the relevant acceptance criteria in IEC 61284 shall be satisfied, to ensure that a specimen complies.

4.6 Heat cycle test

If Class B joints (as defined by IEC 61284) from a specific manufacturer, are heat cycle tested with short-time over-current pulses, then the manufacturer's Class A joints (tension joints) need not be tested with short-time over-current pulses in the heat cycle test. This shall only apply if the tubular material and tube size used for Class A joints is the same as that used for Class B joints. However if Class B joints from the manufacturer are not tested with the short-time over-current pulses or the material of the class B joint differs from the Class A joints, then the class A joint shall be heat cycle tested with short-time over-current pulses. The conditions of the heat cycle test (in accordance with table 3 in IEC 61284) can be chosen by the supplier, based on lowest cost or the availability of current to produce the temperature. However were possible the longest (highest number of cycles) test shall be used.

All other aspects of the heat cycle test shall be performed as described in IEC 61284.

4.7 Corrosion test

Test four fittings and a reference conductor with a length equal to a joint shall be tested.

4.7.1 Test procedure

Place the four fittings and reference conductor in an airtight salt spray cabinet for 1000h in accordance with SABS ISO 7253.

If the testing facility can heat cycle test a joint while in the salt spray cabinet then the following clause shall apply.

Subject the four connectors and reference conductor to 200 heating and cooling cycles while in the salt spray test chamber. For each heating cycle, current shall be circulated such that a temperature of the conductor is, on average, 60 °C for 1 h.

A graph of resistance verses time for the duration of the test shall show that there is no significant change in the electrical characteristics of the clamps from there original product resistance and the resistance of the reference conductor.

4.7.2 Acceptance criteria

After corrosion testing:

a) all four fittings shall be free of any traces of detrimental corrosion and all the markings specified shall be legible under normal viewing; and

b) the initial resistances of each joint shall not differ by more than 30 % from the mean of the final resistance of the four fittings

Note: Heat cycling is not a requirement for this test but a preference.

4.8 Drift test

Each diameter of aluminium tubing used to make compression fittings shall be drift tested to determine the soundness of the extruded seam welds. A sample shall be removed from each length of tube. Suitable markings shall identify the samples with the respective tube. The maximum length of tubing from which test samples are removed shall be 6 m.

The drift test shall consist of expanding each sample, using a drift cone, until the initial outside diameter of the tube is increased by 25 % (–0 %, + 10 % tolerance).

4.8.1 Acceptance criteria

A length of tube shall be considered acceptable if the outside diameter of each test sample is increased by 25 % and no defects or seam splitting occurs. If any test sample splits or appears defective the corresponding tube shall be marked and discarded.

4.9 Test certificates and samples

4.9.1 Qualifying type test

One hard copy and one electronic copy of all type-test reports for compression fittings offered shall be supplied to Eskom for approval at tender stage. Certificates supplied for previous tenders shall be re-submitted.

4.9.2 Production sample test

Eskom does not require copies of sample test certificates but the manufacturer shall retain these certificates for a period of at least 2 years.

4.9.3 Traceability

The test certificates for each fitting shall be traceable by reference to the manufacturer's serial/fitting reference number marked on the fitting. A design drawing shall be included in each test certificate and signed/stamped by the testing facility as checked against sample tested.

4.9.4 Samples

One new sample of each item specified shall be submitted for approval before general manufacture commences. The type-tested samples shall be submitted with first offer made on Eskom national tenders.

5. Marking/packaging/documentation

5.1 Identification and markings

All fittings shall be clearly and durably marked with the following:

a) the manufacturer's name or identification mark;

b) the manufacturers item serial number or the fitting reference number;

c) the batch number;

d) the code names of the conductors or a reasonable abbreviations for conductor codes for which the joint is intended;

e) the conductor colour codes for which they are intended;

f) knurl marks to indicate the number of crimps required and their position, or the beginning and an end in case of overlapping crimps; and

g) the numbers indicating the sequence of crimps if applicable.

Example of marking within the marking area of the fitting:

Manufacturer	ZZZZZZ
Batch No.	036180
Fittings reference No.	MJ54AL
Conductors	PINE/MINK

5.2 Packaging requirements

Two piece tubular joints shall be packed in a sealed plastic bag with a small package of grease sufficient for the joint. Other tubular compression fittings shall be pre-filled with the jointing compound, capped and placed in a sealed plastic bag.

Identical fittings shall be packed together in sealed transparent plastic bags. The thickness of all the plastic material used for plastic bags shall be not less than 100 μm.

The fittings supplied in large quantities shall be bulk packed in suitable containers. The net weight in each container shall not exceed 30 kg.

On the outside of each container the following information shall be provided:

a) product description;

b) product code or part number;

c) name of manufacturer and contact details;

d) number of components of each type in the container;

e) address of the destination;

f) Eskom's purchase order number;

g) Eskom's material SAP number(s).

If the product is supplied by a third party supplier (e.g. importers, agents, etc.) the container shall also bear the following information on the outside of the container:

a) name of the supplier / agent

b) contact details of the supplier / agent

6. Authorization

This document has been seen and accepted by:

Name and surname	Designation
P Moyo	Power Delivery Engineering GM
R Vajeth	Line Engineering Services Manager

7. Revisions

Date	Rev	Compiler	Remarks
Nov 2017	1	B.Nteo	Content copied from old template to current template Document number changed
Sept 2012	0	B Hill	Specification expiry date has expired: re format the document with no changes

Date	Rev	Compiler	Remarks
Nov 2005	3	B Hill	Revised logo Added information as per technical Bulletin 04 TB 030, crimping force to be between 48 and 55kN Maintenance of tools, added Technical Bulletin 02 TB 022 All bimetallic fittings shall be friction welded with the friction weld coated with an approved waterproofing epoxy around the joint. Table 2 added full tension dead ends f g removed as it is supplier specific. **added** All fittings shall be tested using all the approved crimping tools. Added This is subject to the same crimping technology (and pressures) being used ie 4 point indent crimping. Schedules A & B for bi metallic lugs, added items 1.16 & 1.17 Document changed into a new format and a new reference number issued
June 2000	2		Update fittings required, conductors, tool approval process and range taking features for non-tension joints. Colour coding included
March 1999	1		Text changes and tests updated to be in line with IEC 61284
May 2005	0		Original doc issue as SCSSCAAG5

8. Development team

The following people were involved in the development of this document:

- L Bracher CCL Bimetal Connectors
- R S E Martin Eberhardt Martin
- J Hawkins Hardware Assemblies (Now Phistererer)

9. Acknowledgements

Not applicable.

Annex A – Impact assessment

(Normative)

Impact assessment form to be completed for all documents.

1) Guidelines

- All comments must be completed.
- Motivate why items are N/A (not applicable)
- Indicate actions to be taken, persons or organisations responsible for actions and deadline for action.
- Change control committees to discuss the impact assessment, and if necessary give feedback to the compiler of any omissions or errors.

2) Critical points

2.1 Importance of this document. E.g. is implementation required due to safety deficiencies, statutory requirements, technology changes, document revisions, improved service quality, improved service performance, optimised costs.

Comment: It is an existing document that is needed in the business.

2.2 If the document to be released impacts on statutory or legal compliance - this need to be very clearly stated and so highlighted.

Comment: The current document is in place

2.3 Impact on stock holding and depletion of existing stock prior to switch over.

Comment: none as the current document is in place

2.4 When will new stock be available?

Comment: N/A

2.5 Has the interchangeability of the product or item been verified - i.e. when it fails is a straight swop possible with a competitor's product?

Comment: N/A

2.6 Identify and provide details of other critical (items required for the successful implementation of this document) points to be considered in the implementation of this document.

Comment:Same as existing document

2.7 Provide details of any comments made by the Regions regarding the implementation of this document.

Comment: (N/A during commenting phase)

3) Implementation timeframe

3.1 Time period for implementation of requirements.

Comment: N/A

3.2 Deadline for changeover to new item and personnel to be informed of DX wide change-over.

Comment: N/A

4) Buyers Guide and Power Office

4.1 Does the Buyers Guide or Buyers List need updating?

Comment: N/A

4.2 What Buyer's Guides or items have been created?

Comment: none

4.3 List all assembly drawing changes that have been revised in conjunction with this document.

Comment: none

4.4 If the implementation of this document requires assessment by CAP, provide details under 5

4.5 Which Power Office packages have been created, modified or removed?

Comment: none

5) CAP / LAP Pre-Qualification Process related impacts

5.1 Is an ad-hoc re-evaluation of all currently accepted suppliers required as a result of implementation of this document?

Comment: no

5.2 If NO, provide motivation for issuing this specification before Acceptance Cycle Expiry date.

Comment: N/A

5.3 Are ALL suppliers (currently accepted per LAP), aware of the nature of changes contained in this document?

Comment: no changes

5.4 Is implementation of the provisions of this document required during the current supplier qualification period?

Comment: no

5.5 If Yes to 5.4, what date has been set for all currently accepted suppliers to comply fully?

Comment: N/A

5.6 If Yes to 5.4, have all currently accepted suppliers been sent a prior formal notification informing them of Eskom's expectations, including the implementation date deadline?

Comment: N/A

5.7 Can the changes made, potentially impact upon the purchase price of the material/equipment?

Comment: N/A

5.8 Material group(s) affected by specification: (Refer to Pre-Qualification invitation schedule for list of material groups)

Comment: none

6) Training or communication

6.1 Is training required?

Comment: (If NO then 6.2 – 6.6 will be N/A)

6.2 State the level of training required to implement this document. (E.g. awareness training, practical / on job, module, etc.)

Comment: N/A

6.3 State designations of personnel that will require training.

Comment: N/A

6.4 Is the training material available? Identify person responsible for the development of training material.

Comment: N/A

6.5 If applicable, provide details of training that will take place. (E.G. sponsor, costs, trainer, schedule of training, course material availability, training in erection / use of new equipment, maintenance training, etc).

Comment: N/A

6.6 Was Technical Training Section consulted w.r.t module development process?

Comment: N/A

6.7 State communications channels to be used to inform target audience.

Comment: SCOT

7) Special tools, equipment, software

7.1 What special tools, equipment, software, etc will need to be purchased by the Region to effectively implement?

Comment: N/A

7.2 Are there stock numbers available for the new equipment?

Comment: N/A

7.3 What will be the costs of these special tools, equipment, software?

N/A

8) Finances

8.1 What total costs would the Regions be required to incur in implementing this document? Identify all cost activities associated with implementation, e.g. labour, training, tooling, stock, obsolescence

Comment: N/A

……

……

……

Impact assessment completed by:

Name: Barry Hill _____

Designation: Chief Engineer _____

Annex B – Compression tool evaluation process

1) Introduction

Clause 2.3 of SCSSCAAG5 states the following.

“Only compression tools that have passed through the approval process, and have been approved, will be considered on any tender”.

The objective of this document is to describe the process that will enable a manufacturer to supply compression tools for use on Eskom distribution lines.

A list of compression tools that comply with SCSSCAAG5 and that are suitable for Eskom use is to be produced by Distribution Technology as the output of this evaluation process.

Approval is not transferable between manufacturers or suppliers.

2) Compression tool evaluation

The approval of tools will take place in three stages:

Stage1 – Submission of tool and tool documentation.

Stage 2 – The slug test.

Stage 3 – Full tension tests to be completed on approved joints.

Only after all three stages are completed will the tool be considered for approval. Initial approval in most cases will be provisional for a year pending historical field performance data.

2.1 Submission of application for approval and tool sample

Each supplier or manufacturer of the tool seeking approval of the tool, shall provide Eskom with:

1	2	3
No	**Requirement**	**Technical particulars**
a)	One sample tool and accessories supplied with the tool for duration of approval;	
b)	An exploded view drawing and part list of the compression head and hydraulic press;	
c)	A service and operation manual of the submitted tool. The tool service manual should include the tasks that should be performed on the compression head and hydraulic pump in a major service and in periodic maintenance;	
d)	A completed set of tool purchase schedules;	

1	2	3
No	**Requirement**	**Technical particulars**
e)	The tools Service history including: 1) purchasers; 2) quantity supplied on Eskom ENCs and supplied directly to Eskom and other electricity distributors; 3) known failures (if any) and any investigation details; 4) modifications completed in last ten years – date and description of changes and improvements and 5) offered commitment to after sales service.	
f)	Guarantee conditions.	

2.1.1 The slug test

A set of identical standard slugs of equal length (Li) and diameter (Di) shall be used for this test.

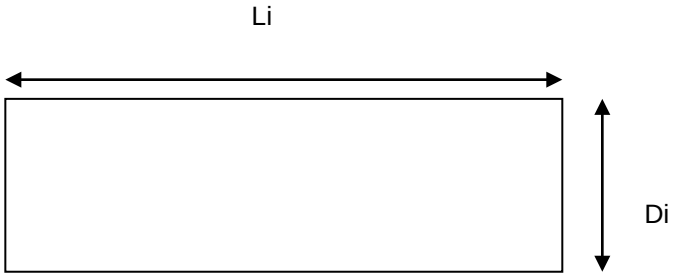

Figure 1: Slug before crimping

Three test slugs shall be compressed with the submitted tool.

2.1.1.1 Acceptance criteria

An average compressed length (Lf) shall be fit in the Go section of the GO- NO Go gauge for which the slug was designed.

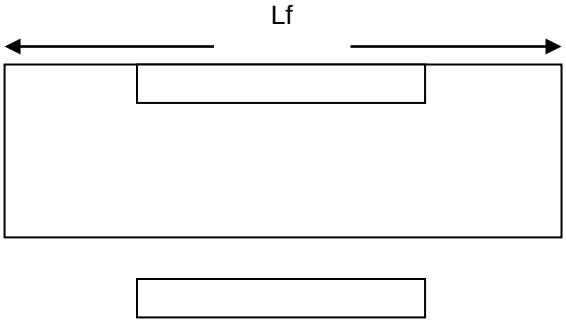

Figure 2: Length of slug after crimping

2.1.2 Mechanical tests

A mechanical test is to be completed in accordance with 5.5 on an approved full tension joint with hare conductor and a T Connector installed mid-span on fox conductor with the submitted tool using the standard installation method as outlined in 4.4. The acceptance criteria for 5.5 shall apply.

2.1.3 Eskom test sites

Eskom may call for samples of compression tool to be submitted for monitoring at one or more of its test sites.

2.1.4 Compression tool acceptability

There are several factors that contribute to the overall acceptability of a compression tool for purchase and use on Eskom's lines.

These include but are not necessarily limited to the following:

a) full compliance with the specification;

b) availability of valid full tension test certificates;

c) previous service history (including after sales service);

d) a reasonable maintenance interval and cost; and

e) quality control procedures.

f) Availability of compression tool spares.

2.1.5 Samples

A sample of the compression tool for which approval is required shall be submitted to Distribution Technology Design Section for attention of the Design Manager at Simmerpan, Corner Lake and Power Streets, Germiston 1400.

The sample shall be clearly marked as follows, using a tie-on tag.

a) For approval.

b) Application reference number i.e. Company Name/Product Code/Date.

2.1.6 Approval process

Upon receipt of the tool information and sample Eskom will begin a standard approval process.

2.1.6.1 Listing

Typical process steps:

		Responsible person
a)	Receive compression tool sample and application for approval.	DT
b)	Register application into compression tool approval register.	DT
c)	Define technical evaluation activities and durations.	DT/CTWG
d)	Advise supplier of evaluation process and targeted completion date.	DT
e)	Negotiate with supplier and finalize evaluation details.	DT/CTWG and supplier

		Responsible person
f)	Testing period.	
g)	Quality control check of company and manufacturing process.	Eskom QA
h)	Commercial check of company.	Eskom/S
i)	Evaluation report including statement of approval or otherwise.	DT/CTWG
j)	Record evaluation output into tool approval register.	DT
k)	Update and disseminate through Distribution Technology the appro-ved compression tool and supplier list.	DT

Note: The process is to be transparent to the supplier of a particular tool at all times.

Key: DT = Distribution Technology.

CTWG = Compression Tool Work Group.

QA = Corporate Quality Assurance.

2.1.6.2 De-listing

Due to the dynamic nature of this technology and market, it may be necessary to remove a product from the approved product list. Prior to a product being removed from the approved product list the manufacturer will be advised in writing and have 14 days in which to lodge any objections. The de-listing process will involve a communiqué to all parties and the re-issue of the modified list.

2.2 Deviations from DSP0035

All variations/deviations to/from the specification shall be fully detailed on this page. Further pages may be added if required. Where there are not deviations/variations this page shall be marked accordingly.