

 Eskom	Specification	Group Technology
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Transmission Engineering

Documentation Type: **Specification**

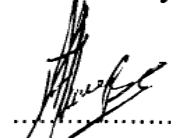
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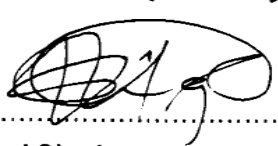
Compiled by


.....
AS Jacobs

Chief Technologist

Date:

Functional Responsibility


.....
Vinod Singh

Power Plant Technologies Manager

Date: **28/9/12**

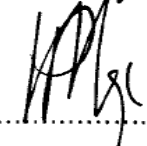
Approved by


.....
Riaz Vajeth

Line Engineering Services Manager

Date:

Authorized by


.....
Prince Moyo

Power Delivery Engineering GM (Acting)

Date: **29/8/2012**

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Foreword

This document outlines additional measures that can be taken to try and prevent the theft of members from Eskom lattice type structures as well as other infrastructure. It describes how to reinforce existing bolts that is used to bolt the different members together as well as alternatives to standard bolts. Furthermore, marking of tower members are also covered

Revision history

This is a new document.

Date	Rev.	Compiled By	Clause	Remarks
Sept 2012	0	B Jacobs	Clause no.	First issue

Acceptance

This document has been seen and accepted by:	
Name	Designation
P Moyo	Power Delivery Engineering GM (Acting)
V Singh	Design Base Design Manager
R Vajeth	Line Engineering Services Manager

This specification shall apply throughout Eskom Holdings Limited, its divisions, subsidiaries and entities wherein Eskom has a controlling interest.

Development team

B. Jacobs	Technology – Line Engineering Services (LES)
M. Kielkowski	Trans Africa Projects (TAP)
J. Calitz	RT & D Department
D. A. Dukhan	Technology – Line Engineering Services (LES)

Keywords

Member theft, welding, swaged bolts, galvanizing, break-away nuts, marking, stamping, Zincfix

Bibliography

Hot Dip Galvanized Information Sheets, HDGSA

1 Scope

This specification details the measures that can be employed on new and existing lines in an attempt to combat tower member theft. The aim is to minimise, reduce or stop the stealing of members generally encountered on steel lattice structures of any voltage line. Three areas will be covered in this specification namely; welding of existing bolts and nuts used on structures, installation of swaged bolts and marking of members using hand crimp tools.

2 Normative references

The following documents contain provisions that, through reference in the text, constitute requirements of this specification. At the time of publication, the editions indicated were valid. All standards and specifications are subject to revision, and parties to agreements based on this specification are encouraged to investigate the possibility of applying the most recent editions of the documents listed below. Information on currently valid national and international standards and specifications can be obtained from the Information Centre and Technology Standardization Department at Megawatt Park, Johannesburg, South Africa.

SANS 10280, Overhead power lines for conditions prevailing in South Africa, Part 1: Safety, 2011

Occupational Health and Safety Act 85 of 1993, incorporating the Construction Regulations, and Electrical Machinery Regulations. Published by South African Government Press, under auspices of the Department of Labour.

3 Definitions and abbreviations

3.1 Definitions

Break-away nut: A special type of nut consisting of two parts namely tapered part and hexagon part. The hexagon part can shear off at a pre-determined torque load whilst the joint is being tightened leaving the tapered part, making it difficult to undo.

Swage bolt: Is a fastener, alternative to a bolt-nut pair, where the joint strength is obtained by applying an axial force to the bolt and which is maintained by deforming a metal collar in contact with the bolt shaft and one of the components of the joint.

Anti-climbing device: Is part of a tower structure preventing unauthorized access to the upper part of the tower. It can consist of barbed or razor wire supported by steel brackets which is strung around the tower with a certain spacing. It can also consist of metal spikes suitably attached and spaced around the tower legs or tower body.

3.2 Abbreviations

None

4 Requirements

4.1 Welding of Bolts and Nuts

4.1.1 General

Existing tower bolts and nuts that is used to keep the members connected to the main members or onto each other can be welded using generally available welding equipment. The details of the welding specification can be seen in Appendix A. The main requirements are that all the bolts and nuts of existing members, up to anti-climb device level be welded together for a minimum of half the bolt circumference. No welding onto tower members is allowed under any circumstances. Only qualified welders, suitably trained to perform this job should be used.

4.1.2 Preparation

If possible the galvanizing and or corrosion products should be removed by brushing with a steel wire brush or other suitable means, prior to welding.

After welding, the bolt and nut should be cleaned of any welding slag and then brushed clean with a steel wire brush. Next any damage to the galvanizing of the bolt and nut should be fixed with Zincfix and then painted with a suitable paint, similar to the punching and painting process. Any galvanizing damage to tower steelwork should be fixed with Zincfix.

4.1.3 Precautions and Safety

Veld fires can easily occur during welding and every effort should be made to avoid this. Measures like fire extinguishers, buckets with sand/water, "brandslaners" etc can all be utilised to kill any fires that may occur during the welding process.

Toxic fumes can be generated when welding the bolts and nuts and the welder should be wearing the necessary respiratory mask to mitigate against inhalation of any toxic fumes during welding.

The correct safety gear and clothing required for doing welding should be worn like welding gloves, safety boots, welding helmet etc.

Where work is going to be conducted at heights, the necessary precautions and measures should be taken to ensure the welding is done in a safe manner. This may include, but is not limited to, hook up at heights by means of a suitable safety belt and/or harness, temporary platforms and/or scaffolding or any other acceptable or suitable way must be employed.

4.2 Swaged Bolts

4.2.1 General

Existing tower bolts and nuts that are used to keep the members connected to the main members or onto each other can be replaced with a bolting system that requires metal deformation during installation. With this system the nut is typically swaged onto the bolt part after the required clamping force has been reached. Due to the high metal deformation that is involved, hydraulic equipment is normally used to perform the installation. Details of the system can be seen in Appendix B. The grade of bolt to be used should be Grade 6.8 or higher and be galvanized. No electroplated coating will be acceptable.

4.2.2 Preparation

Remove existing bolts and nuts using a hydraulic nut splitter or other suitable means. Remove only one bolt at a time and replace the removed bolt with the swaged type before the next bolt is being removed. This should be done not to affect the tower strength by having any members not connected at all at any given time to the tower. Where the tower is fitted with M16 bolts a pin number 16 must be used and where a M20 bolt will be required a pin number 19 should be used.

4.2.3 Precautions

The necessary inspections on hydraulic equipment should be conducted on a daily basis like inspecting the hydraulic hoses and oil tank for leaks or any signs of damage. The equipment is working under pressure and precautions should be taken not to kink or bend the hoses sharply.

Where work is going to be conducted at heights, the necessary precautions and measures should be taken to ensure the installation of swaged bolts is done in a safe manner. This may include, but is not limited to, hook up at heights by means of a suitable safety belt and/or harness, temporary platforms and/or scaffolding or any other acceptable or suitable way must be employed.

4.3 Marking of Members

4.3.1 General

All members up to anti-climbing device level shall be stamped with the words "ESKOM" at 300 mm to 500 mm intervals. The Eskom logo may not be used and no abbreviation of the word ESKOM is allowed.

A battery operated compression tool, with modified jaws to accommodate a single piece stamp with the word ESKOM, can be used to perform the marking. The compression tool must have a crimping capacity of at least 10 ton. Details of the tool (unmodified) and example of the die can be seen in Appendix C.

4.3.2 Preparation

Ensure that the compression tool is in good working order and that the die (with the word ESKOM) is securely fixed into the moveable part of the compression tool. The dies and tower members to be marked should be clean and clear of all foreign material and the dies should be properly locked in place.

The operator should be standing comfortably and press the fixed head of the die against one flange of the member to be marked. Apply power and ensure the moving head makes good contact with the flange and the marking process is done correctly. The indentation with the word ESKOM should be clearly visible on the member. Repeat this operation every 300 to 500 mm along the whole length of the member.

Where damaged has been caused to the galvanizing this should be repaired with Zincfix.

4.3.3 Precautions and Safety

Where work is going to be conducted at heights, the necessary precautions and measures should be taken to ensure the marking of members is done in a safe manner. This may include, but is not limited to, hook up at heights by means of a suitable safety belt and/or harness, temporary platforms and/or scaffolding or any other acceptable or suitable way must be employed.

The compression tool is generally fairly heavy and an additional safety rope that will support the tool and prevent it from falling down is advisable.

Since high forces will be exerted by the compression tool, precautions should be taken that no parts of the body or clothing be trapped in between the jaws of the tool and/or tower member as serious injury may be incurred.

When the depth of the impression becomes inadequate (not easily readable) the operator must check the battery of the compression tool and replace if necessary. If the die becomes worn or blunt it has to be replaced.

4.4 Anticlimbing Devices

4.4.1 General

In compliance with the OHSAct, it is a requirement for all towers to be fitted with effective anti-climbing devices. The anti-climb device for use on existing towers will be as per drawing ER00227-16-04-02 (for inland applications) and ER0027-16-27-00 (for coastal applications) as shown in Appendices D and E.

4.4.2 Preparation

Remove all existing barb-wire type anti-climbs and scrap as per ESKOM commercial asset disposal process. Ensure that the correct PPE is used when working with razor flat wrap. Care must be exercised during the installation process.

4.4.3 Precautions and Safety

Where work is going to be conducted at heights, the necessary precautions and measures should be taken to ensure the anti-climbing devices are installed in a safe manner. This may include, but is not limited to, hook up at heights by means of a suitable safety belt and/or harness, temporary platforms and/or scaffolding or any other acceptable or suitable way must be employed. As the assembly is subjected to tension, precautions should be taken to ensure that no parts of body and clothing be ensnared in the razor flat wrap.

4.5 Installation of Razor Wrap on Tower Members

4.5.1 General

Complementary to installation of anti-vandal bolts and marking of members, protection of the members from vandalism is required. Tower bracings are sawn off either by hand or using portable tools. Mitigation measures to be taken include wrapping of tower members in razor wrap secured in position with anti-vandal clips. Refer to Appendix F for wrapping concept.

4.5.2 Preparation

Ensure that the correct PPE is used when working with razor wrap. Care must be exercised during the installation process.

4.5.3 Precautions and Safety

Where work is going to be conducted at heights, the necessary precautions and measures should be taken to ensure the anti-climbs are installed in a safe manner. This may include, but is not limited to, hook up at heights by means of a suitable safety belt and/or harness, temporary platforms and/or scaffolding or any other acceptable or suitable way must be employed. Precautions should be taken to ensure that no parts of body and clothing be ensnared in the razor wrap.

Annex A - Impact assessment

(Normative)

Impact assessment form to be completed for all documents.

A1. 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.

A2. Critical points

A6.1 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: Implementation required to attempt and combat member theft.

A6.2 If the document to be released impacts on statutory or legal compliance - this need to be very clearly stated and so highlighted.

Comment: N/A – document does not impact on statutory or legal compliance.

A6.3 Impact on stock holding and depletion of existing stock prior to switch over.

Comment: N/A – no stock holding is involved.

A6.4 When will new stock be available?

Comment: N/A – No stock is involved.

A6.5 Has the interchangeability of the product or item been verified - i.e. when it fails is a straight swap possible with a competitor's product?

Comment: N/A.

A6.6 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: Items that will be required include; hydraulic swage bolting equipment, nut splitter, welding machine and various hand tools.

A6.7 Provide details of any comments made by the Regions regarding the implementation of this document.

Comment: (N/A during commenting phase)

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Annex A
(continued)

A3. Implementation timeframe

A3.1 Time period for implementation of requirements.

Comment: Will be decided by different Grids and Regions as and when decided.

A3.2 Deadline for changeover to new item and personnel to be informed of DX wide change-over.

Comment: Will be decided by different Grids and Regions as and when decided by them.

A4. Buyers Guide and Power Office

A4.1 Does the Buyers Guide or Buyers List need updating?

Comment: Yes.

A4.2 What Buyer's Guides or items have been created?

Comment:

A4.3 List all assembly drawing changes that have been revised in conjunction with this document.

Comment: None

A4.4 If the implementation of this document requires assessment by CAP, provide details under 5

A4.5 Which Power Office packages have been created, modified or removed?

Comment: None

A5. CAP / LAP Pre-Qualification Process related impacts

A5.1 Is an ad-hoc re-evaluation of all currently accepted suppliers required as a result of implementation of this document?

Comment:

A5.2 If NO, provide motivation for issuing this specification before Acceptance Cycle Expiry date.

Comment:

A5.3 Are ALL suppliers (currently accepted per LAP), aware of the nature of changes contained in this document?

Comment:

Annex A

(continued)

A5.4 Is implementation of the provisions of this document required during the current supplier qualification period?

Comment: N/A

A5.5 If Yes to 5.4, what date has been set for all currently accepted suppliers to comply fully?

Comment: N/A

A5.6 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

A5.7 Can the changes made, potentially impact upon the purchase price of the material/equipment?

Comment: N/A

A5.8 Material group(s) affected by specification: (Refer to Pre-Qualification invitation schedule for list of material groups)

Comment: N/A

A6. Training or communication

A6.1 Is training required?

Comment: No

A6.2 State the level of training required to implement this document. (E.g. awareness training, practical / on job, module, etc.)

Comment: N/A

A6.3 State designations of personnel that will require training.

Comment: N/A

A6.4 Is the training material available? Identify person responsible for the development of training material.

Comment: N/A

A6.5 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

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Annex A
(continued)

A6.6 Was Technical Training Section consulted w.r.t module development process?

Comment: N/A

A6.7 State communications channels to be used to inform target audience.

Comment: N/A

A7. Special tools, equipment, software

A7.1 What special tools, equipment, software, etc will need to be purchased by the Region to effectively implement?

Comment: See Annexures

A7.2 Are there stock numbers available for the new equipment?

Comment: N/A

A7.3 What will be the costs of these special tools, equipment, software?

A8. Finances

A8.1 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:

Cost of equipment and tools will depend on volumes purchased.

Impact assessment completed by:

Name: A.S. Jacobs

Designation: Chief Technologist

Annex B – Welding Specification

WELDING PROCEDURE SPECIFICATION (WPS) for manual Metal Arc Welding (MMAW) ('Stick welding')

Company ESKOM Approved by [Signature]
(Signature Required)

WPS No TX 127-07-001 Date 05/06/2012

WPS Revision No. _____ Rev. Date AS REQUIRED

Welding Process(es) Arc welding Type(s) Manual

Joints

Joint Type	<u>Seam weld</u>		
Backing	<u>N/A</u>	Backing Material (Type)	<u>N/A</u>
Groove Angle	<u>N/A</u>		
Back gouging:	<u>No</u>	Back gouging Method	<u>N/A</u>

Base Metals

Specification Type M16 and M20 tower fasteners Grade 6.8

Positions

No welding and/or weld strikes will be allowed on any other tower member except at the nut-thread interface of the fastener as revealing Photograph1.

Weld length to be approximately half of the bolt circumference.



Photograph 1: Reveals the position of the weld

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Electrical Characteristics

Current Type/Polarity	DC
Current (Range)	120 A = 2.5 mm electrode and 140 A 3.15 mm electrode
Cleaning Method	Wire brush and degrease
Voltage (Range)	Determined by power source
Technique	Stringer bead
Electrode Size/Type	2.5 or 3.15 mm Vitemax (type ER 6013)
Pulsing Parameters	N/A
Transfer Mode	N/A (Only applicable to MIG/MAG welding)
Contact Tip to Work Distance	N/A

Addition requirementsHealth and safety

As the welding method requires the welding of galvanised fasteners it is recommend that the requirements as specified by **SANS 10238:2009 Welding and thermal cutting processes — Health and safety** be adhere to.

Fire / burn hazard

The welding of the galvanized fasteners resulted in a significant amount of spatter to occur, hence the need to use non-flammable blankets or alternative products around the base of the tower, as welding will be conducted on site and the spatter could result in the vegetation to ignite. On completion of the welding activity on a structure (tower), proper inspection of the surrounding vegetation need to be conducted in order to ensure that no fires could occur due to hot melt (spatter) falling outside the cover area of the non-flammable blanket.

Corrosion protection

As the welding is conducted on galvanised fasteners, the heat from the welding process vaporizes the protective zinc coating near the weld. Paints which are high in elemental zinc (i.e., "Zinc-rich"), properly applied, will effectively restore full corrosion protection to the weld areas. This paint can be applied to the weld after sand blasting or wire brushing to remove all welding slag followed by wiping the weld clean with a rag.

Eskom will specify the paint to be used for restoring the corrosion protective coating of the welded fasteners.

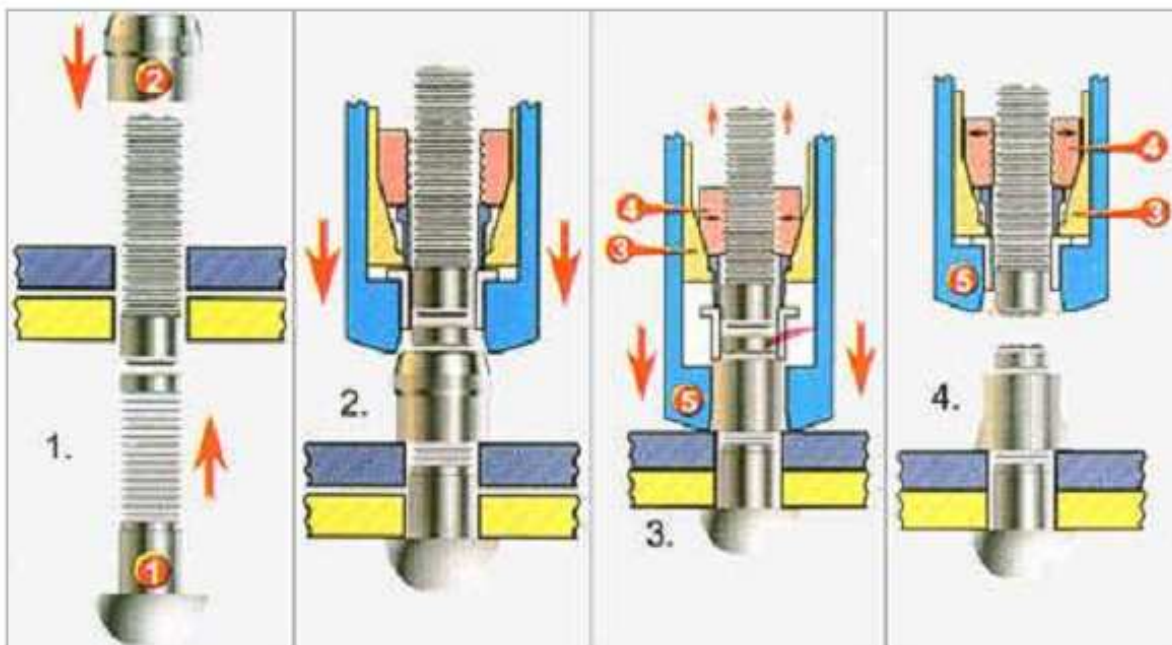
Manufacturer or Contractor _____

Date _____ By _____
(Please Print) (Signature Required)

Annex C – Swaged Bolts

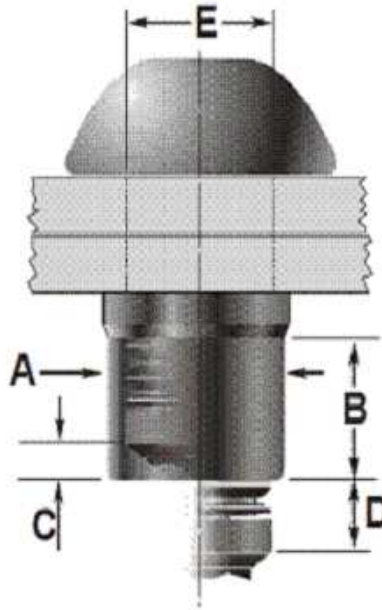
The HydraLoc Installation Guide

1. The Hydraloc pin (1) is pushed through the prepared hole as far as possible. The collar (2) is then placed over the pin and located as close to the joint as possible
2. The installation tool is placed over the assembly holding the pin head close to the joint face and also pushing the collar as close as possible
3. On installation, the collet (3) moves backwards allowing the jaws (4) to grip the pintail. As the collet (3) continues to move backwards, the anvil (5) is forced forward firmly closing any gap condition and then swaging the collar into the grooves, developing the specified clamp and tensile properties
4. On completion of the swaging cycle, the collet (3) continues to move backwards causing the pintail to break off. In the return mode of the tool, the assemble joint is first ejected from the anvil (5) and then the jaws (4) are opened freeing the spent pintail which is then removed from the tool.



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INSTALLED INSPECTION DATA FOR No 13 TO 28 FASTENERS



	PIN NUMBER					
	13	16	19	22	25	28
A SWAGED DIAMETER MAXIMUM	18.4	23.0	27.8	32.2	36.8	41.35
B SWAGED LENGTH MINIMUM	9.74	15.69	16.95	19.35	21.95	23.60
C PIN INTRUSION MAXIMUM	1.5	1.5	1.5	1.5	1.5	1.5
D PIN PROTRUSION MAXIMUM	9.0	9.0	9.0	9.0	9.0	9.0
E HOLE DIAMETER MAXIMUM	14.2	17.5	20.5	23.7	27.0	30.2

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HYDRA Drive

INSTALLATION TOOLS

**CLOSE QUARTER
INSTALLATION TOOL**
FOR No.16,19,22,25 & 28 FASTENERS

T32, T33, T34, T35, T36



INSTALLATION TOOL TECHNICAL SPECIFICATIONS					
MODEL	T32	T33	T34	T35	T36
Fasteners	No. 16 Hydraloc	No. 19 Hydraloc	No. 22 Hydraloc	No. 25 Hydraloc	No. 28 Hydraloc
Stroke (mm)	33	33	41	41	41
Overall Length (mm)	185	215	214	217	217
Back Mark (mm)	31	34	49	49	49
Mass (kg)	6,3	7,7	17	16	16
Working Pressure					
Pull	55 mPa (8000 PSI)	55 mPa (8000 PSI)	35 mPa (5090 mPa)	55 mPa (8000 mPa)	55 mPa (8000 mPa)
Return	20 mPa (3000 PSI)	20 mPa (3000 PSI)	20 mPa (3000 PSI)	20 mPa (3000 PSI)	20 mPa (3000 PSI)

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Annex D – Marking Compression Tool

REC-5510 12T Battery Crimper



FEATURES:

The REC-5510 is a battery operated 12 ton compression tool to accommodate 12 ton dies for applying compression fittings to copper, aluminum and ACSR conductors widely used in the industry.

Pistol type 12 ton tool makes it easier to work in tight spaces or in control boxes.

The trigger switch and return button are activated by only one hand so that the other hand is always free to hold working material.

New electronic circuit board with LED indicates compression status and battery capacity.

The REC-5000 series tool has a new electronic memory function to record repair history by connecting the optional "ROBO-RW" analyzer.

SPECIFICATIONS:

Ram stroke : 42 mm

Motor : 14.4 VDC

Reservoir capacity : 135cc

Force at die face : 106 kN

DIMENSIONS:

421(L) x 286(H) x 78(W) mm

WEIGHT:

7.1 kg (less battery)

ACCESSORIES:

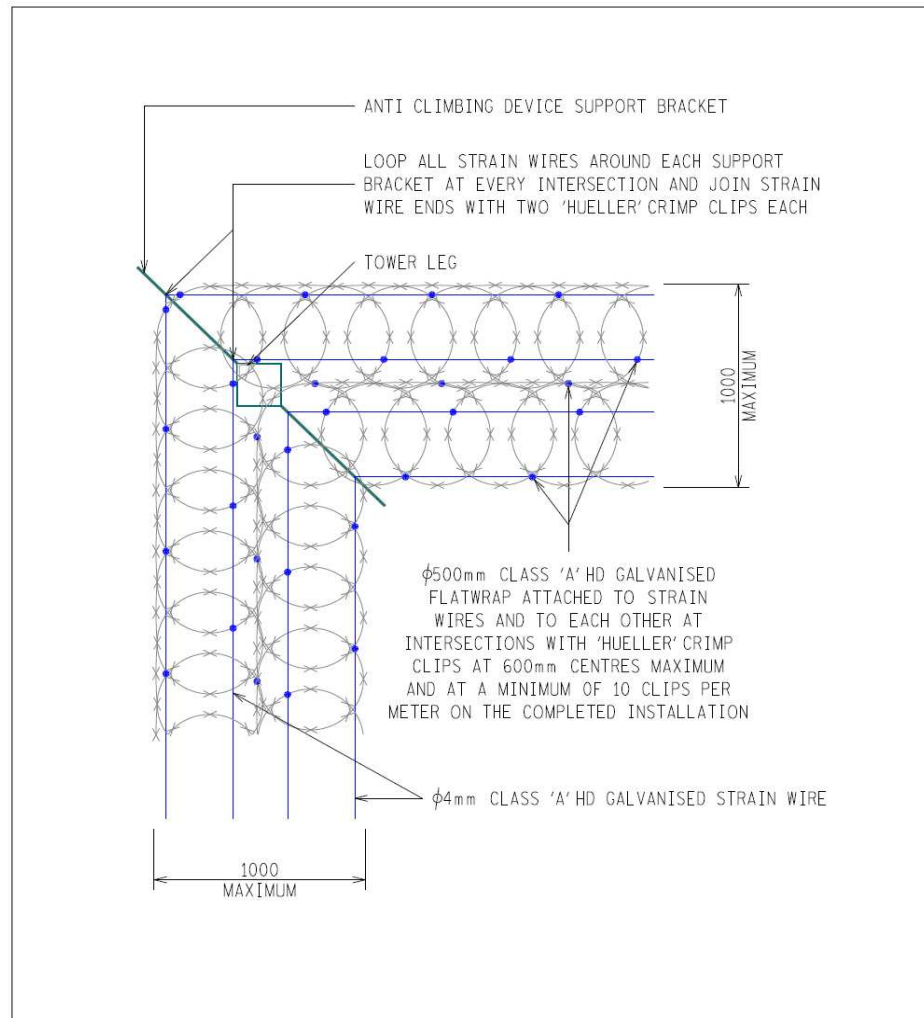
Wrist strap.


Double molded carrying case.



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4.5.3.1.1 Appendix D – Anti-climbing devices for use on existing towers-inland applications

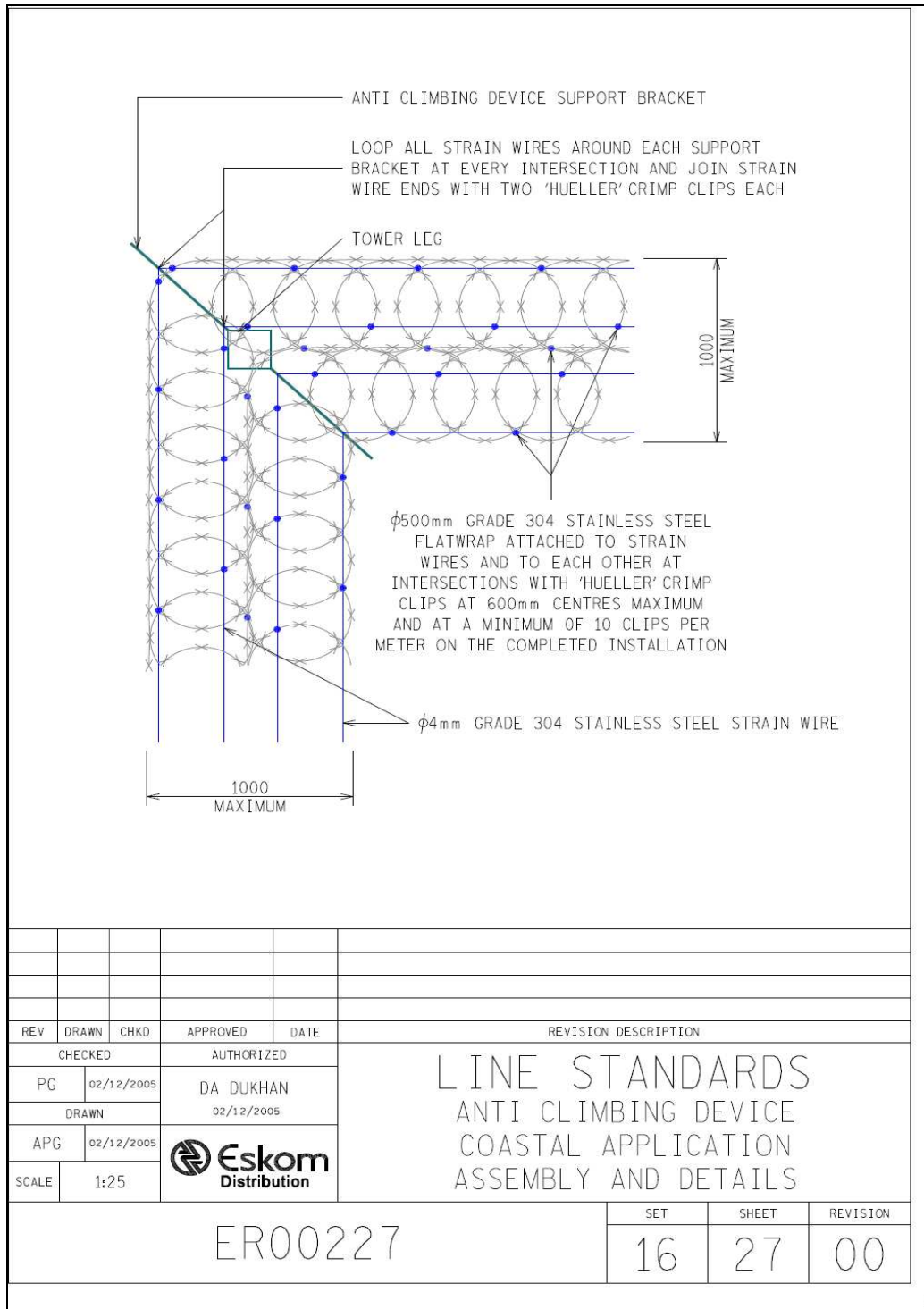


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REV	DRAWN	CHKD	APPROVED	DATE	REVISION DESCRIPTION		
CHECKED			AUTHORIZED				
NJB		7/6/2005		LINE STANDARDS ANTI CLIMBING DEVICE INLAND APPLICATION ASSEMBLY AND DETAILS			
DRAWN		7/6/2005					
APG		7/6/2005					
SCALE		1:25					
ER00227					SET	SHEET	REVISION
					16	04	02

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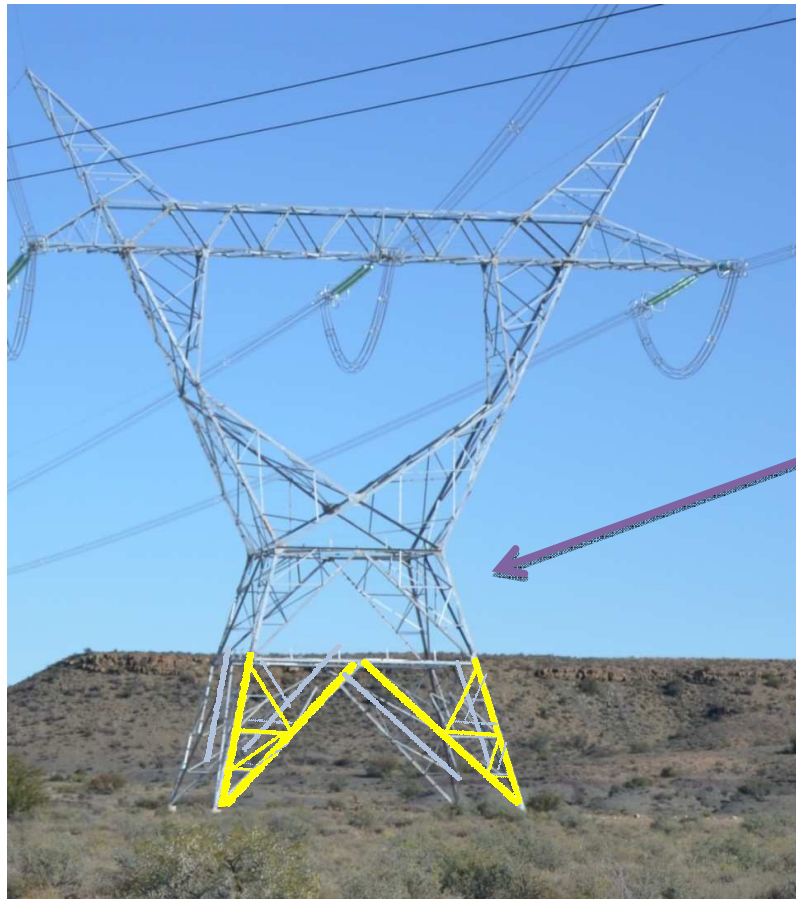
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Annex E – Anti-climb devices for use on existing towers- coastal applications



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Annex F – Razor wrap installation on members up to anti-climbs



Razor wrap and and
crimp all members
up to anti-climbs



Members with anti-
vandal bolts sawn
off and stolen

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