

Title: **STEEL GRADES AND WELDING  
REQUIREMENTS FOR  
STEELWORK AND OVERHEAD  
LINE HARDWARE  
COMPONENTS**

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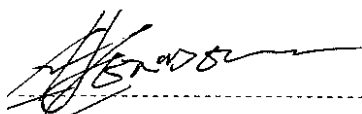
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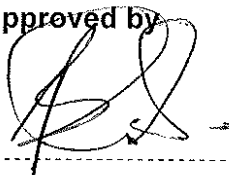


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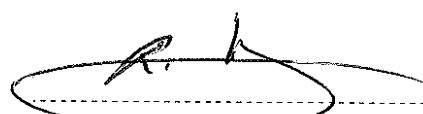


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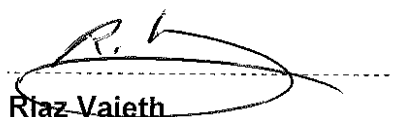


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Date: **29/3/17**

## Content

	Page
Executive Summary.....	4
1. Introduction .....	5
2. Supporting clauses .....	5
2.1 Scope .....	5
2.1.1 Purpose .....	5
2.1.2 Applicability .....	5
2.2 Normative / informative references .....	5
2.2.1 Normative .....	5
2.2.2 Informative .....	5
2.3 Definitions .....	5
2.3.1 General .....	5
2.3.2 Disclosure classification .....	6
2.4 Abbreviations .....	6
2.5 Roles and responsibilities .....	6
2.6 Process for monitoring .....	6
2.7 Related/supporting documents .....	6
3. Requirements .....	6
3.1 Material specification .....	6
3.1.1 Sections and dimensions .....	6
3.2 Material properties .....	7
3.2.1 Chemical composition .....	7
3.2.2 Mechanical properties .....	7
4. Limit state design .....	8
4.1 Welding .....	8
4.1.1 Welding electrodes .....	8
4.1.2 Minimum sizes for fillet welds .....	9
4.2 Compliance with the requirements .....	9
4.2.1 General inspection of steelwork during manufacture .....	9
4.2.2 Welder qualification .....	9
4.2.3 Non-destructive testing of welds .....	9
5. Heat treatments .....	10
6. Galvanizing of the product body .....	10
7. Test facility .....	10
8. Authorization .....	10
9. Revisions .....	10
10. Development team .....	11
11. Acknowledgements .....	11
Annex A – Impact Assessment .....	12

## Tables

Table 1: Sections and dimensions along with material grading .....	6
--	---

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Table 2: Minimum sizes for fillet welds .....9

## **Executive Summary**

This document is currently under review and the compiler / approver of the document should be contacted before use.

## **1. Introduction**

This specification has been recompiled to include a technical bulletin on steel grades. It has been approved by the Technical Steering Committee for use by Eskom distribution as a specification for steel grades and welding requirements for overhead line structures and hardware components.

## **2. Supporting clauses**

### **2.1 Scope**

This specification provides information on steel grade selection for various sizes, to rule out any discrepancies and to ensure compliance. It also covers the welding requirements used on LV, MV and HV distribution electrical networks.

#### **2.1.1 Purpose**

None

#### **2.1.2 Applicability**

None

## **2.2 Normative / informative references**

### **2.2.1 Normative**

Parties using this specification shall apply the most recent edition of the documents listed below:

- [1] EN 10025-2:2004, Hot rolled products of structural steels — Part 2: Technical delivery conditions for non-alloy structural steels.
- [2] SANS 121:2011, Hot dip galvanized coatings on fabricated iron and steel articles - Specifications and test methods.
- [3] SANS 1431:2007, Weldable structural steels.
- [4] SANS 10044-1:2004, Welding Part 1: Glossary of terms.
- [5] SANS 10044-2:2004, Welding Part 2: Symbols.
- [6] SANS 10162-1:2005, The structural use of steel Part 1: Limit-state design of hot-rolled steelwork.
- [7] SANS 15614-1:2004, Specification and qualification of welding procedures for metallic materials- Welding procedure test Part 1: Arc and gas welding of steels and arc welding of nickel and nickel alloys.
- [8] SANS 2001-CS1:2005, Construction works, Part CS1: Structural steelwork
- [9] The Blue Book: Eighth edition 2007, Structural Steel Tables, chapter 4: Welds and welding

#### **2.2.2 Informative**

None

## **2.3 Definitions**

### **2.3.1 General**

None

## 2.3.2 Disclosure classification

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

## 2.4 Abbreviations

Abbreviation	Description
<b>AWS</b>	American Welding Society
<b>HB</b>	Brinell Hardness
<b>HV</b>	Vicker's Hardness
<b>NDT</b>	Non Destructive Testing
<b>SAISC</b>	South African Institute of Steel Construction
<b>SANAS</b>	South African National Accreditation System

## 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 Material specification

Steel used in the fabrication of structural steelwork shall comply with the latest requirements of EN 10025-2 unless otherwise specified.

#### 3.1.1 Sections and dimensions

The table below indicates sections and dimensions with the associated material grading. All designers and specifiers of steel structures and hardware components shall comply with these latest changes.

**Table 1: Sections and dimensions along with material grading**

Sections	Dimensions	Material
1) I & H	All sizes	S355JR
2) Plates	All sizes	S355JR
	Other, 275MPa yield	S275JR
3) Channels	All sizes	S355JR
4) Angles	Equal angles 45x45 and less	S275JR
	Equal angles 50x50 and higher	S355JR
5) Unequal Angles	All sizes	S355JR
6) Flat Bars	90mm wide and less	S275JR
	100mm wide and above	S355JR

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**STEEL GRADES AND WELDING REQUIREMENTS FOR  
STEELWORK AND OVERHEAD LINE HARDWARE  
COMPONENTS**Unique Identifier: **240-75883830**Revision: **1**Page: **7 of 14**

Sections	Dimensions		Material
7) Rounds	General	40mm diameter and less	S275JR
		30mm diameter and above	S355JR can still be specified
	Steel reinforcements	Straight round bars - R6, R8 and R10	S275JR
		Weld mesh fabric ref. no. 245	S275JR
		Y10-Y40 high tensile steel bars	S450JO
8) T	Cut out of I or H sections		S355JR
9) Compound Girders for Cranes Gantries	All sizes		S355JR
10) Plate Girders	All sizes		S355JR
11) Square Solids	Up to 50mm square		S275JR
	50mm and above		S355JR
12) Lipped Angles, Lipped Channels, Lipped Z and Top Hat Sections	2,5mm thick and less		S275JR
	2,5mm thick and higher		S275JR
13) Circular Hollow Sections, Square Hollow Sections and Rectangular Hollow <b>Sections</b>	Hollowed sections made from square or rectangle flat sheet, 2.5mm wall thickness and less		S275JR
	63mm diameter and higher, 2.5mm wall thickness and higher		S355JR

The South African steel grades, Mild steel/commercial steel, 300W and 350WA are not allowed for use in Eskom. The SAISC requires and always emphasizes on use of international steel grades ranging from S185 to E360 for design and construction.

## 3.2 Material properties

All material grades used to manufacture Eskom products shall be supplied with a material grade certificate/mill test certificate and it shall include but not limited to:

### 3.2.1 Chemical composition

Chemical composition of all steel grades shall be stated in a mill test certificate and shall comply with the requirements in BS EN 10025-2.

### 3.2.2 Mechanical properties

#### 3.2.2.1 Tensile properties

If requested at the time of order, tensile strength, yield strength and elongation of steel shall comply with the appropriate requirements given in BS EN 10025-2.

#### 3.2.2.2 Impact resistance tests

The impact resistance of steel is determined using the Charpy V-notch impact test in accordance to EN 10025-2 and shall be specified at the time of order for all steel grades intended for Eskom use.

All imported steel shall undergo tensile, impact resistance and bending tests. The minimum requirement for impact testing for imported steel is 15J at -10 degree Celsius. However, if the steel complies with BS EN 10025-2, the minimum impact energy value of 27 J at 0 degree Celsius shall be required.

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**3.2.2.3 Bending properties**

If specified at the time of order, plate, sheet, strip, wide flats and flats (width < 150 mm) with a nominal thickness  $\leq 30$  mm shall be suitable for bending without cracking and shall comply to BS EN 10025-2.

**3.2.2.4 Material hardness**

BS EN 10025-2 specifies chemical analyses, impact resistance tests, bending tests energy and no hardness values. Due to a number of hardware failures experienced in Eskom Distribution business, Eskom reserves the right to request hardness values on critical items from suppliers/manufacturers. The table below indicates typical Hardness values for specific materials.

<b>Material</b>	<b>Brinell Hardness</b>
Pure Aluminium	15
Pure Copper	35
Soft brass	60
Mild Steel	120
Annealed chisel steel	235
304 Stainless Steel	250
White cast iron	415
Hardened Tool Steel	650/700
Hard Chromium Plate	1000
Chromium Carbide	1200HV
Tungsten Carbide	1400HV
Titanium Carbide	2400HV
Diamond	8000HV
Sand	1000HV

Please note that hardness varies for specific materials and thus hardness values shall be used as a non-destructive method to determine if the heat treatment process were properly controlled.

**4. Limit state design**

All steelwork shall meet the requirements of SANS 10162-1 with respect to strength of fasteners and welds, strength, stability and resistance to cracking, rupture or unacceptable deformation of the steel in the connection. The quality standard and the fabrication process (including materials, drawings, and erection) shall comply to SANS 2001-CS1.

**4.1 Welding**

The welding procedure shall comply with clause 5 of SANS 15614-1. Zinc coated steels may be welded satisfactorily by most commonly practised welding techniques. However, closer control of welding parameters is necessary in order to reduce the formation of toxic fumes that are not encountered when welding uncoated steel.

**4.1.1 Welding electrodes**

All electrode classifications for steel grades shall comply to BS EN 10025-2. All these electrodes have a tensile strength in excess of 480 MPa whereas the yield strength differs per electrode.



#### **4.1.2 Minimum sizes for fillet welds**

Cracking of a fillet weld due to rapid dissipation of heat into the parent metal can be avoided by placing a lower limit on the weld size (leg length) in relation to the thickness of the thicker part joined. The limits as laid down by AWS D1.1 (America Welding Society) are shown in 2. The weld size does not have to exceed the thickness of the thinner part.

**Table 2: Minimum sizes for fillet welds**

<b>Thickness of thicker part (mm)</b>	<b>Minimum fillet weld size (mm)</b>
Up to 12	5
Over 12 to 20	6
Over 20 to 40	8
Over 40 to 60	10
Over 60 to 150	12

## **4.2 Compliance with the requirements**

### **4.2.1 General inspection of steelwork during manufacture**

Sufficient components shall be checked for dimensional accuracy and conformity to drawings, to prove that the manufacturing process is working satisfactorily.

#### **4.2.2 Welder qualification**

Welders, welding operators and tack welders shall be qualified by a fabricator, steelwork erector or an independent testing agency, in accordance with the provisions of AWS D1.1/D1.1M.

### **4.2.3 Non-destructive testing of welds**

#### **4.2.3.1 Record of testing**

Records of test results shall be kept by the fabricator or steelwork erector.

#### **4.2.3.2 Visual inspection of welds**

All welds on Eskom's structures and hardware components shall be visually inspected in accordance with AWS D1.1/D1.1M, over the full length of the weld before NDT is performed. Any welds which will be rendered inaccessible by subsequent work shall be examined before the loss of access.

A suitably qualified person for visual inspection of welds may be a welding inspector or a welder who can provide evidence of having been trained and assessed for competence in visual inspection of the relevant types of welds.

#### **4.2.3.3 Surface flaw detection**

Where a closer examination of a weld surface is required, magnetic particle inspection shall be used in accordance with the recommendations given in AWS D1.1/D1.1M. If magnetic particle inspection is impractical, dye penetrant inspection may be used in accordance with the recommendations given in AWS D1.1/D1.1M.

A suitably qualified person for surface flaw detection of welds may be a welding inspector or a welder who holds a current certificate of competence in surface flaw detection of the relevant types of work, from a nationally recognized authority.

#### **4.2.3.4 Ultrasonic and radiographic examination**

Where ultrasonic or radiographic examination is required in terms of the specification data/Technical A and B schedule, it shall be made in accordance with AWS D1.1/D1.1M.

Operators carrying out final ultrasonic or radiographic examination of the weld shall hold a current certificate of competence from a nationally recognized authority.

### **5. Heat treatments**

Unless otherwise requested by Eskom on critical items, the supplier/manufacturer shall heat treat certain materials found not to comply with the test requirements and / or underwent an extensive welding process. The total number of heat treatment cycles permitted on heat treatable materials shall be limited to two. All reasonable precautions shall be taken to avoid undue decarburization of any material by heat treatment.

### **6. Galvanizing of the product body**

Coatings applied by hot dip galvanizing are designed to protect the iron and steel products against corrosion. All galvanising procedures and tests shall be conducted by a SANAS approved laboratory in accordance to SANS 121. Certificates shall indicate at least five coating thicknesses and the average value. To avoid surface embrittlement of the galvanizing coat, all coating thicknesses shall not be more than 30% of the required coating thickness given in SANS 121.

In a high corrosive environment, it is suggested that a high quality, flexible and corrosion inhibiting epoxy primer be used to top up the galvanising coat.

### **7. Test facility**

The supplier/manufacturer shall ensure that tests conducted outside Eskom, are SANAS approved. Eskom shall not at any stage accept test certificates from an unapproved testing facility.

### **8. Authorization**

This document has been accepted by:

<b>Name and surname</b>	<b>Designation</b>
P Moyo	Power Delivery Engineering GM (Acting)
V Singh	Power Plant Technology Manager
R Vajeth	Chief Engineer

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

### **9. Revisions**

This revision cancels and replaces revision no 0 of document no. **DSP\_34-2051**.

<b>Date</b>	<b>Rev</b>	<b>Compiler</b>	<b>Remarks</b>
March 2017	1	N.Henderson	Document reformatted on to new template, with new document number. No content change. This document supersedes document DSP_34-2051

Date	Rev	Compiler	Remarks
March 2012	1	S Mashaba	This revision combines this specification DSP 34-2051 and the technical bulletin 10TB-033, "Review of material steel grade". They both phase out all South African steel grades. SANS 2001-CS1 added Corrosion spec added
June 2010	0	S Mashaba	Original Document

## 10. Development team

This specification was prepared by a working group comprising the following members:

- Sylvester Mashaba Eskom Distribution Technology

## 11. Acknowledgements

Not applicable.

## **Annex A – Impact Assessment**

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: The document was compiled as part of an initiative by the Line hardware committee to develop a specific Eskom welding specification that could outline the design, manufacturing and testing of welded components.

**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: Existing standards acts as guidance in this document and thus there is no impact on legal requirements

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

Comment: No impact

**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 swap 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: N/A

**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: This document will be communicated via TESCOOD Steering Committee, comments and voting and eventually be published on the DT website.

#### **4) Buyers Guide and Power Office**

##### **4.1 Does the Buyers Guide or Buyers List need updating?**

Comment: Most of the buyers guides need to be changed to the new spec.

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

Comment: N/A

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

Comment: N/A

##### **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: N/A

#### **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: Yes

##### **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: Yes

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

Comment: Yes

##### **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: Yes

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

Comment: No

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

Comment: Removed 300 WA, 350WA and 450 MPa

#### **6) Training or communication**

##### **6.1 Is training required?**

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

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**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: Line Hardware Committee

## **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?**

Comment: 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: None

.....  
.....

Impact assessment completed by:

Name: Sylvester Mashaba

Designation: Engineer