Eskom	Standard	Technology

Title: **EVALUATION STANDARD FOR EXOTHERMIC WELD CONNECTIONS FOR SUBSTATION EARTHING**

Unique Identifier:	**240-170000763**
Alternative Reference Number:	**n/a**
Area of Applicability:	**Engineering**
Documentation Type:	**Standard**
Revision:	**1**
Total Pages:	**15**
Next Review Date:	**April 2027**
Disclosure Classification:	**Controlled Disclosure**

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Date: 2022/04/04	Date: 12 April 2022	Date: 22/04/2022

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PCM Reference: **Design Substations**

SCOT Study Committee Number/Name: **Substations**

Content

1. Introduction

"Exothermic welding", also referred to as "thermite welding" is a process where metallic components such as earthing conductors are fused together in molten copper metal within a graphite mould crucible in order to form a joint between the components.

This document contains the evaluation criteria to be used to evaluate tender technical submissions including the associated joint samples.

2. Supporting clauses

2.1 Scope

This standard covers the Eskom specific technical evaluation requirements for exothermic weld connections to be used in Eskom Substations for earthing purposes.

2.1.1 Purpose

The purpose of this document is to provide the criteria to be used in the technical evaluation of exothermic weld connections in order to provide an objective and auditable evaluation.

2.1.2 Applicability

This document shall apply throughout Eskom Holdings Limited Divisions.

2.2 Normative/informative references

Parties using this document shall apply the most recent edition of the documents listed in the following paragraphs.

2.2.1 Normative

[1] 32-1034, Eskom Procurement and Supply Management Procedure

[2] 240-48929482, Tender Technical Evaluation Procedure

[3] 240-170000535, Exothermic Weld Connections for Substation Earthing

2.2.2 Informative

None

2.3 Definitions

2.3.1 General

Definition	Description
Anneal	To subject to great heat and then slow cooling, and sometimes reheating and further cooling, for the purpose of rendering the material less brittle, to temper or to toughen.
Conductivity	A material's ability to conduct electric current. It is the inverse of its volume resistivity. Unit of measurement is "Siemens per metre."
Copper-clad steel	Bimetallic conductor that is manufactured by a thermo-mechanical bonding process that produces a metallurgical bond between a solid oxygen-free copper layer and a steel core.

Definition	Description
Corrugated fibreboard	A material consisting of a fluted corrugated sheet and one or two flat linerboards.
Dead Soft Annealed (or "Fully Annealed")	Metal is heated to above the critical range and appropriately cooled to develop the greatest possible commercial softness or ductility.
Exothermic welding	Also known as exothermic bonding, thermite or thermite welding. It is a welding method that employs molten metal to mechanically and electrically fuse two earth rods, or an earth conductor to an earth rod, or conductor to conductor. The process employs an exothermic reaction of a thermite composition to heat the metal and requires no external source of heat or current.
Longitudinal Test	The lengthwise axis of the weld is parallel or inline to the direction of the applied load.
Transverse Test	The lengthwise axis of the weld is at right angles to the direction of the applied load.

2.3.2 Disclosure classification

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

2.4 Abbreviations

Abbreviation	Description
Ω·m	ohm metre
°C	degree Celsius
CCS	Copper Clad Steel
CoE	Centre of Excellence
Cu	Copper
DSA	Dead Soft Annealed
g	gram
IEC	International Electrotechnical Commission
m	metre
mm	millimetre
NRS	National Rationalised Standard
OEM	Original Equipment Manufacturer
RTS	Rated Tensile Strength
SANS	South African National Standard
TCIF	Technical Change Implementation Forum

2.5 Roles and responsibilities

Suppliers are responsible for manufacturing, testing and supplying products in accordance with document [3]. Personnel involved with the design, procurement and construction of Eskom substations shall ensure compliance to these requirements and that substation exothermic weld-metals and weld connection moulds are evaluated in accordance with this document.

2.6 Process for monitoring

All substation exothermic weld-metals and weld connection moulds supplied to Eskom shall be in accordance with [3] and shall be evaluated against the criteria as stipulated in this document. It will be communicated via the TCIF structures to affected departments for noting and compliance. The Substations COE will ensure that this evaluation standard is updated should it be required, with the support of the Substation Products Care Group.

2.7 Related/supporting documents

This document must be applied together with [3].

3. Technical tender evaluation procedure

The technical evaluation procedure is specific to each item tendered for.

The technical evaluation for the exothermic weld-metals and weld connection moulds shall comprise of two main parts namely documentation or desktop evaluation and connection sample evaluation. The criteria for the technical evaluation is based on the specified requirements in [3].

All documentation for this tender shall be in English.

For the supplier's submission to be compliant all tender technical returnables must be submitted as stipulated in [3], and the qualitative evaluation shall result in a score of at least 90%.

Suppliers who are tendering but are not the OEM of the product must source the required technical returnable from the OEM where relevant. Missing information will not be requested by Eskom after the enquiry closing date.

If any part or sub-component of the production process is outsourced, the Supplier shall retain full and complete accountability for the complete tendered product.

3.1 Documentation evaluation

The documentation evaluation shall be conducted by Eskom assessment representatives. This part of the evaluation starts when submissions are opened and confirmed that all required tender technical returnables have been submitted.

Total compliance with the stipulated criteria in Level 1 of the evaluation (refer to Annex A1 and B1), will result in the tender submission moving on to the qualitative criteria evaluation in Level 2. Tenderers that do not submit all the required tender technical returnables will be disqualified and consequently will not proceed to the qualitative (Level 2) part of the assessment. The following is applicable to Level 1 evaluations:

- Submissions meeting 100% of the Level 1 requirements will proceed to the next level of the technical evaluation.
- Submissions failing to meet 100% of the Level 1 requirements will be deemed non-responsive (non-compliant); the submission will be disqualified and not evaluated further.
- Where clarifications are required, the rules as per [1] shall be applied and no tender is to be made responsive via the clarification process.

During the qualitative (Level 2) assessment, the Eskom evaluating representatives will review the qualifying submissions in detail and assign a score to each item evaluated. Refer to Annex A2 and B2. The tender submission evaluated must attain a score of at least 90% in the Level 2 evaluation to be considered as technically qualified.

3.2 Sample evaluation

As part of the qualitative tendering criteria suppliers are required to submit samples for evaluation. The samples should be:

- Packaging: The exact packaging that will be used for the exothermic weld-metals and weld connection moulds offered, including the protective boxes for the exothermic weld-metals and weld connection moulds.
- Labels: The exact labels that will be fixed to the exothermic weld-metals and weld connection moulds offered, as well as what will be on the protective boxes for the exothermic weld-metals and weld connection moulds.
- Sample connections: The exact product that will be obtained if the exothermic weld-metals and weld connection moulds offered for evaluation are used, should the supplier be successful in this evaluation.

The sample evaluation determines the compliance of the items listed above to the requirements stated in [3].

4. Authorization

This document has been seen and accepted by:

Name and surname	Designation
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5. Revisions

Date	Rev	Compiler	Remarks
April 2022	1	TJ Marais	First issue

6. Development team

- Theunus Marais Chief Engineer – Substation Engineering

7. Acknowledgements

- Gavin Strelec Chief Engineer – RT&D

Annex A – Documentation Evaluation: Exothermic weld-metal

This section only covers the Exothermic Weld-metal document evaluation.

A1 Weld-metal Level 1 Evaluation: Tender Technical Returnables

The tender technical returnables are not point scored but assessed on a Yes/No basis as to whether all required technical documents have been submitted. All submissions must comply with [3].

A separate technical evaluation shall be completed per item offered.

SAP MATERIAL NO	SAP MATERIAL DESCRIPTION	SELECT ITEM
0703779	WLDG PWDR:EXOTHERMIC;10XCU90	

The applicable tender technical returnables as listed in [3] are:

CRITERIA	CLAUSE in [3]	YES (submitted)	NO (not submitted)
Is all information supplied in English?	3.7		
Completed technical Schedule B	Annex A		
Deviations and Declarations report	Annex C		
Test Report Schedule	Annex D		
Sample packaging for individual weld-metal	3.3.1		
Sample “BOX OF 10”	3.3.1		
Required weld-metal storage instructions	3.3.1		
Sample label for individual weld-metal containers	3.4.1		
Sample label for box of 10 weld-metal powders	3.4.1		

QUALIFYING FOR FURTHER QUALITATIVE EVALUATION?	YES	NO

A2 Weld-metal Level 2 Evaluation: Qualitative Criteria

After it has been confirmed that all the tender technical returnables have been submitted, and that critical requirements have been met, the submission will be assessed against the following criteria (shown below with their relative contribution weightings to the overall score).

CRITERIA	SECTION	% WEIGHT	WEIGHTED SCORE
Weld-metal material	A2.1	50.0	
Packaging	A2.2	27.5	
Labelling	A2.3	22.5	
	Total	**100**	

For each evaluation criteria, the extent to which submissions have complied with the requirements shall be scored based on the following:

SCORE	CRITERIA
5	COMPLIANT Meet technical requirement(s) AND; No foreseen technical risk(s) in meeting technical requirements.
4	COMPLIANT WITH ASSOCIATED QUALIFICATIONS Meet technical requirement(s) with; Acceptable technical risk(s) AND/OR; Acceptable exceptions AND/OR; Acceptable conditions.
2	NON-COMPLIANT Does not meet technical requirement(s) AND/OR; Unacceptable technical risk(s) AND/OR; Unacceptable exceptions AND/OR; Unacceptable conditions.
0	TOTALLY DEFICIENT OR NON-RESPONSIVE

Threshold: The score that each tender submission receives will provide an objective numeric basis for tender comparison. The minimum weighted average score required for an exothermic weld connection mould to be considered “technically acceptable” must be **90% or above**.

ITEM NO	CLAUSE in [3]	DESCRIPTION	UNIT	CRITERIA	SCORE
A2.1		**WELD-METAL MATERIAL**			
A2.1.1	3.1.2 3.5.2	Cu90 weld-metal flash test minimum copper yield (verify on test report)	%	> 95	5
				90 - 95	4
				< 90	0
Photometric Requirements (maximum points: 5)				Score =	
				Weighted score (section weight: 50%) = $(Score) * \left(\frac{50}{5}\right)$ =	

ITEM NO	CLAUSE in [3]	DESCRIPTION	UNIT	CRITERIA	SCORE
A2.2		**PACKAGING**			
A2.2.1	3.3.1	Material used for individual Cu90 weld-metals?		Plastic containers or better	5
				Anything else	0
A2.2.2	3.3.1	Quantity of individual Cu90 weld-metal containers per box?	Units	10	5
				Anything else	0
A2.2.3	3.3.1	Material used for the box?		Sturdy corrugated fibreboard or better	5
				Unsuitable “flimsy” material	0
A2.2.4	3.3.1	Are “boxes of 10” wrapped in a plastic film?		Yes	5
				No	0
A2.2.5	3.3.1	Are storage instructions printed on the box?		Yes	5
				No	0
Photometric Requirements (maximum points: 25)				Score =	
Weighted score (section weight: 27.5%) = $(Score) * \left(\frac{27.5}{25}\right)$ =					

ITEM NO	CLAUSE in [3]	DESCRIPTION	UNIT	CRITERIA	SCORE
A2.3		**LABELLING**			
A2.3.1	3.4.1	Is the manufacturer’s name & part number on each individual weld-metal?		Both	5
				1 only or none	0
A2.3.2	3.4.1	Is the size of the weld-metals on individual weld-metal containers?		Yes	5
				No	0
A2.3.3	3.4.1	Is the manufacturer’s name & part number on each individual starter?		Both	5
				1 only or none	0
A2.3.4	3.4.1	Is the manufacturer’s name, part number, size of the weld-metal and quantity of weld-metals printed on the box?		All 4	5
				Any 3 of the 4	2
				None, 1 or 2 only	0
Photometric Requirements (maximum points: 20)				Score =	
Weighted score (section weight: 22.5%) = $(Score) * \left(\frac{22.5}{20}\right)$ =					

Annex B – Documentation Evaluation: Exothermic weld connection moulds

This section only covers the Exothermic Weld Connection Mould document evaluation.

B1 Connection Moulds Level 1 Evaluation: Tender Technical Returnables

The tender technical returnables are not point scored but assessed on a Yes/No basis as to whether all required technical documents have been submitted. All submissions must comply with [3].

A separate technical evaluation shall be completed per item offered. Select the item to be evaluated in the table below.

MOULD	SAP MATERIAL NO	SAP MATERIAL DESCRIPTION	SELECT ITEM
1	0703781	MOULD THRML WLD:STRAIGHT;8.5-8.5 MM	
2	0703783	MOULD THRML WLD:STRAIGHT;8.5-10 MM	
3	0703785	MOULD THRML WLD:TEE;RUN8.5;TEE8.5 MM	
4	0703784	MOULD THRML WLD:TEE;RUN10;TEE8.5 MM	
5	0703788	MOULD THRML WLD:TEE;RUN 8.5;TEE14.2 MM	
6	0703786	MOULD THRML WLD:CROSS;8.5-8.5 MM;LAPPED	
7	0703790	MOULD THRML WLD:MULTI;2 X 8.5 MM;DOUBLE	
8	0703789	MOULD THRML WLD:STRIP;1 X 8.5 MM;SINGLE	
9	0703787	MOULD THRML WLD:STRUCTURE;8.5 MM;SINGLE	

The tender technical returnables as listed in [3] are:

CRITERIA	CLAUSE in [3]	YES	NO
Is all information supplied in English?	3.7		
Completed technical Schedule B	Annex B		
Deviations and declarations report	Annex C		
Test report schedule	Annex D		
Sample mould packaging	3.3.2		
Sample mould label	3.4.2		
Details of training and certification process	3.6		
Connection sample per mould tendered for	3.5.7		
Contact details of at least three (3) contractors	3.2.1		

QUALIFYING FOR FURTHER QUALITATIVE EVALUATION?	YES	NO

B2 Connection Moulds Level 2 Evaluation: Qualitative Criteria

After it has been confirmed that all the tender technical returnables have been submitted, and that critical requirements have been met, the submission will be assessed against the following criteria (shown below with their relative contribution weightings to the overall score).

CRITERIA	SECTION	% WEIGHT	WEIGHTED SCORE
Mould material	B2.1	27.5	
Weld-metals used	B2.2	10.5	
Mould longevity	B2.3	10.5	
Type test results	B2.4	10.5	
Packaging (from samples received)	B2.5	10.0	
Labelling (from samples received)	B2.6	20.5	
Sample impression	B2.7	10.5	
	Total	**100**	

For each evaluation criteria, the extent to which submissions have complied with the requirements shall be scored based on the following:

SCORE	CRITERIA
5	COMPLIANT Meet technical requirement(s) AND; No foreseen technical risk(s) in meeting technical requirements.
4	COMPLIANT WITH ASSOCIATED QUALIFICATIONS Meet technical requirement(s) with; Acceptable technical risk(s) AND/OR; Acceptable exceptions AND/OR; Acceptable conditions.
2	NON-COMPLIANT Does not meet technical requirement(s) AND/OR; Unacceptable technical risk(s) AND/OR; Unacceptable exceptions AND/OR; Unacceptable conditions.
0	TOTALLY DEFICIENT OR NON-RESPONSIVE

Threshold: The score that each tender submission receives will provide an objective numeric basis for tender comparison. The minimum weighted average score required for an exothermic weld connection mould to be considered “technically acceptable” must be **90% or above**.

ITEM NO	CLAUSE in [3]	DESCRIPTION	UNIT	CRITERIA	SCORE
B2.1		**MOULD MATERIAL**			
B2.1.1	3.2.1	Material		Graphite	5
				Alternative material	0
B2.1.2	3.2.1	Maximum Grain Size	mm	≤ 2	5
				> 2	0
B2.1.3	3.2.1	Bulk density	g/cm^3	1.63 – 1.76	5
				Outside of range	0
B2.1.4	3.2.1	Compressive strength	MPa	> 30	5
				25 - 30	4
				< 25	0
B2.1.5	3.2.1	Ash content	%	≤ 0.3	5
				> 0.3	0
Mould material (maximum points: 25)				Score =	
				Weighted score (section weight: 27.**5**%) = $(Score) * \left(\frac{27.5}{25}\right)$ =	

ITEM NO	CLAUSE in [3]	DESCRIPTION	UNIT	CRITERIA	SCORE
B2.2		**WELD-METAL USED**			
B2.2.1	3.2.2	Weld-metal used in mould: Quantity and Size	ea.	Mould 6 = 2 x Cu90 All Others = 1 x Cu90	5
				Anything else	0
Weld-metal used (maximum points: 5)				Score =	
				Weighted score (section weight: 10.5%) = $(Score) * \left(\frac{10.5}{5}\right)$ =	

ITEM NO	CLAUSE in [3]	DESCRIPTION	UNIT	CRITERIA	SCORE
B2.3		**MOULD LONGEVITY**			
B2.3.1	3.2.1	Number of connections made per mould (under correct use as specified by the supplier)	ea.	> 100	5
				85 - 100	4
				75 - 85	2
				< 75	0
Mould longevity (maximum points: 5)				Score =	
				Weighted score (section weight: 10.5%) = $(Score) * \left(\frac{10.5}{5}\right)$ =	

ITEM NO	CLAUSE in [3]	DESCRIPTION	UNIT	CRITERIA	SCORE
B2.4		**TYPE TEST RESULTS**			
B2.4.1	3.2.1	Current-temperature cycling; Fault-current; Mechanical	ea.	All tests passed	5
				Any test failed	0
Type test results		**(maximum points: 5)**		Score =	
				Weighted score (section weight: 10.5%) = $(Score) * \left(\frac{10.5}{5}\right)$ =	

ITEM NO	CLAUSE in [3]	DESCRIPTION	UNIT	CRITERIA	SCORE
B2.5		**PACKAGING (from sample)**			
B2.5.1	3.3.2	Material used for protective boxes		Sturdy corrugated fibreboard or better	5
				Unsuitable “flimsy” material	0
Packaging		**(maximum points: 5)**		Score =	
				Weighted score (section weight: 10%) = $(Score) * \left(\frac{10}{5}\right)$ =	

ITEM NO	CLAUSE in [3]	DESCRIPTION	UNIT	CRITERIA	SCORE
B2.6		**LABELLING (from samples)**			
B2.6.1	3.4.2	Mould label material		Metal	5
				Unsuitable alternative	0
B2.6.2	3.4.2	Is the manufacturer’s name, part number, weld-metal size & quantity and conductor sizes printed on the label?		All 5	5
				None, 1, 2, 3 or 4 only	0
B2.6.3	3.4.2	Is the mould connection type indicated on the box?		Yes	5
				No	0
B2.6.4	3.4.2	Is manufacturer’s name, part number and conductor sizes printed on the box?		All 3	5
				None, 1 or 2 only	0
Labelling		**(maximum points: 20)**		Score =	
				Weighted score (section weight: 20.5%) = $(Score) * \left(\frac{20.5}{20}\right)$ =	

ITEM NO	CLAUSE in [3]	DESCRIPTION	UNIT	CRITERIA	SCORE
B2.7		**SAMPLE IMPRESSION**			
B2.7.1	3.5.6	Joint surface finish quality assessed by visual inspection (surface inclusions < 0.5mm across or in depth, are acceptable)		Acceptable	5
				Not acceptable	0
Sample impression		**(maximum points: 5)**		Score =	
				Weighted score (section weight: 10.5%) = $(Score) * \left(\frac{10.5}{5}\right)$ =	