Eskom	Standard	Generation Engineering

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1. INTRODUCTION

Ceramic lined pulverised fuel pipework is often the product of choice on milling plants due to the superior abrasive wear resistance offered by the ceramics. Using ceramics in this application extends the life of the pulverised fuel piping network specifically in high wear areas such as bends. The ceramics protect the internal diameter of the base material from wear resulting in improved containment of pulverised fuel particles, better structural integrity of the pulverised fuel piping network and reduced plant life cycle costs.

2. SUPPORTING CLAUSES

2.1 SCOPE

2.1.1 Purpose

This standard details Eskom's requirements for the design, manufacture and supply of ceramic lined pulverised fuel pipework.

2.1.2 Applicability

The standard applies to all Eskom fossil fuel fired power stations and covers any item of pulverised fuel pipework between the mill classifier outlet and the burners.

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] BS 2971:1991, Specification for Class II arc welding of carbon steel pipework for carrying fluids

[2] BS EN 10210-1:2006 (Hot finished structural hollow sections of non-alloy and fine grain steels. Technical delivery requirements)

[3] BS EN 10025-3:2004 (Hot rolled products of structural steels. Technical delivery conditions for normalized/normalized rolled weldable fine grain structural steels)

[4] BS EN 10025-4 2004 (Hot rolled products of structural steels. Technical delivery conditions for thermomechanical rolled weldable fine grain structural steels)

[5] BS EN 10025-1:2004 (Hot rolled products of structural steels. General technical delivery conditions)

[6] BS EN ISO 18286:2010 (Hot-rolled stainless-steel plates. Tolerances on dimensions and shape)

[7] BS7668:2016 (Weldable structural steels. Hot finished structural hollow sections in weather resistant steels. Specification)

[8] BS EN 1092-1:2007+A1:2013 (Flanges and their joints. Circular flanges for pipes, valves, fittings and accessories, PN designated. Steel flanges)

[9] BS EN 1092-3:2003 (Flanges and their joints. Circular flanges for pipes, valves, fittings and accessories, PN designated. Copper alloy flanges)

[10] BS EN 1092-2: 1997 (Flanges and their joints. Circular flanges for pipes, valves, fittings and accessories, PN designated. Cast iron flanges)

[11] SABS 630: 2009, Decorative high gloss enamel paints.

[12] SIS 055900, Practical surface preparation standards for painting steel surfaces.

[13] SABS ISO 9001:2015, Quality Management Systems - Requirements

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[14] 240-105658000: Supplier Quality Requirements Specification

2.2.2 Informative

[15] 240-53114026: Project Engineering Change Management Procedure

[16] 240-48929482: Tendering Engineering Evaluation Process

[17] 240-106027729: Burner Manufacturing Standard

[18] NFPA

2.3 DEFINITIONS

Definition	Description
New supplier	A supplier who has not previously supplied the relevant component to Eskom. The new supplier shall be subjected to a capability assessment by Generation Engineering Department. Upon successful completion of the assessment, Eskom shall determine a test programme to evaluate the suitability of the supplier.
Ceramic	Type of material with increased wear properties for extended life times for components.

2.3.1 Disclosure Classification

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

2.4 ABBREVIATIONS

Abbreviation	Description
PF	Pulverised Fuel
SANAS	South African National Accreditation Standard
mm	Milli meter
MPa	Mega Pascal
°C	Degree Celsius
kg	Kilogram

2.5 ROLES AND RESPONSIBILITIES

2.5.1 Eskom Power Station PF Pipe System Engineer

a. Ensure that Eskom material stock descriptions are up to date and in accordance with this standard.

b. Ensure that the correct revisions of the manufacturing drawings are available and signed off for manufacturing (if the drawings are owned by Eskom).

c. Ensure that all concessions applied for by the supplier are considered and resolved proficiently and timeously whilst ensuring that the technical integrity of the ceramic linings will not be compromised.

d. Ensure that the Eskom Power Station Appointed Approved Inspection Authority is involved with the quality control and acceptance of the manufactured product as specified below.

e. To be involved with the manufacturing and quality control inspections of the ceramic linings as required.

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2.5.2 Third Party Inspector (Eskom Approved Inspection Authority)

a. Ensure that the ceramic linings are manufactured according to this standard and applicable drawing.

b. Notify the Eskom PF Pipe System Engineer of any deviations of the manufacture ceramic linings from this standard, the order placed by Eskom or the approved manufacturing drawing and inspection sheets.

2.5.3 Supplier and Manufacturer

a. Ensure that Eskom is immediately informed of any deviation during the manufacturing process that can influence the technical integrity of the ceramic linings or result in a deviation from these standard and manufacturing drawings.

b. Ensure that Eskom PF Pipe System Engineer and Third-Party Inspector are notified when the ceramic linings and data books are available for inspection, review and final acceptance.

c. Should the supplier not be the manufacture, then Eskom reserve the right to approve or disapprove the use of any alternative manufacturer, should there be a need to change the manufacturer.

d. Shall ensure that all equipment used for verification of tolerances are certified by a SANAS approved laboratory.

2.5.4 Eskom Buyer

a. Ensure that orders are placed according to the station requirements to meet the required delivery dates.

b. Ensure that the order for the Third-Party Inspector is placed timeously.

2.5.5 Eskom Engineering Manager

a. Ensure changes to the plant are conducted in accordance to the Engineering Change Management Procedure **Error! Reference source not found.**.

2.6 PROCESS FOR MONITORING

None.

2.7 RELATED/SUPPORTING DOCUMENTS

None.

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3. CERAMIC LINED PULVERISED FUEL PIPEWORK STANDARD

3.1 REQUIREMENTS

3.1.1 Supplier qualification

Supplier qualification shall be as per Appendix A and B.

3.1.2 Quality management system

Only suppliers who have obtained approval in terms of SABS ISO 9001:2015 will be accepted.

3.1.3 Subcontractors

Upon receipt of an Eskom order for ceramic lined pulverised fuel pipework, the supplier shall submit a list of all proposed subcontractors to Eskom for approval. Further subcontracting, either by the supplier or his subcontractors, shall be subject to prior agreement with Eskom.

3.1.4 New suppliers

New suppliers shall be subjected to a capability assessment by Generation Engineering Department. Upon successful completion of the assessment, Eskom shall determine a test programme to evaluate the suitability of the supplier.

3.2 DESIGN

3.2.1 Design pressure

All ceramic lined pulverized fuel pipework shall be capable of withstanding an internal pressure of 0,35 MPa, with no detrimental effect on either the lining material or the attachment of such.

3.2.2 Compatibility with existing pipework

When replacing cast iron pipework with ceramic lined pipework, all ceramic lined assemblies shall be fully compatible with the existing configuration of pulverised fuel pipework. It shall be made sure that the existing and new pipework is adequately supported by means of permanent hangers and that thermal expansion is taken into account. Any change in mass of the pipe sections resulting from any replacement shall also be taken into account. The inside diameter of the existing pipework shall be maintained in the ceramic lined assembly. There shall be no step changes between ceramic linings and pipe sections.

Full details of proposed flanges, to ensure compatibility with existing flanges, shall be fully explained in the supplier’s quote.

Final responsibility for ensuring compatibility with existing pipework shall remain with the ceramic lined assembly supplier. Any additional modifications required, once the ceramic lined assembly has been delivered to site, shall be carried out by the supplier at no additional cost to Eskom.

3.2.3 Lobster back pulverised fuel bends

Fabricated lobster back bends shall be fabricated from segments having an included angle not greater than 18°.

3.2.4 Modifications to pulverised fuel pipework

Any modifications to the pulverised fuel pipework shall be covered by the Engineering Change Management Procedure (refer 2.2.2) and process and therefore all designs and changes shall be approved before commencement of any work.

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3.3 MATERIALS

3.3.1 Casing

The casing of all assemblies shall be manufactured from steel to BS 4360 Grade 43A, or equivalent approved material, and shall be designed with adequate structural strength to ensure compatibility with the existing support system.

The following shall be the minimum requirements for casing thickness:

Table 1: Casing Thickness

Internal diameter	Casing thickness	Flange thickness
Up to 360 mm	3 mm	20 mm
361 mm to 450 mm	5 mm	25 mm
451 mm to 800 mm	6 mm	25 mm
Greater than 800 mm	8 mm	30 mm

3.3.2 Lining — pulverised fuel pipe bends

Ceramic linings shall conform to either of the following alternatives

a. Sintered type, containing not less than 89 % alumina.

b. Composite type, consisting of a lining conforming to clause 3.3.2 (a) covering not less than 150° on diameter on the extrados of the bend, plus an abrasion resistant lining covering not more than 210° on diameter on the intrados of the bend.

3.3.3 Lining — other assemblies

Ceramic linings shall be alumina based and shall be of the sintered type, containing not less than 89 % alumina.

3.4 CONSTRUCTION

3.4.1 Welding

All welding shall be carried out in accordance with BS 2971. Where welding is carried out in accordance with other National or International standards, such standards shall be subject to Eskom approval, and the latest edition of such approved standards shall be used.

3.4.2 Flanges

Flanges shall be in accordance with BS EN 1092-1:2007+A1:2013, BS EN 1092-3:2003, and BS EN 1092-2: 1997 for all new systems. Flanges for existing systems shall be compatible with the existing pipework and flanges.

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3.4.3 Lining method

a. Pulverized fuel pipe bends

- Linings shall be in the form of ceramic key pieces built up to form a ring such that a complete ring is self-supporting when fitted inside the steel casing.
- The ceramic tiles shall be chamfered where necessary so that each tile is in intimate contact with adjacent tiles.
- Gaps between tiles, caused by tolerances on the casing or tiles, shall be a maximum of 1 mm, provided that such tiles are in intimate contact at, at least one point.
- Joints in the direction of pulverised fuel flow shall be staggered, as detailed in Figure 1.

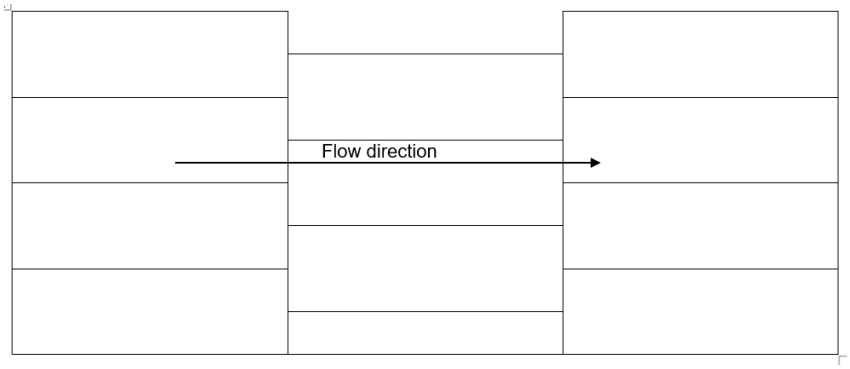

Figure 1: Joints in the direction of flow is staggered perpendicularly

- Tile edges, including weld-on tile plugs, shall not protrude into the pulverised fuel flow, and shall not be more than 1mm below the preceding/upstream adjacent tile.
- The use of “weld-on” ceramic tiles shall not be permitted in pulverised fuel pipe bends of round section, unless the tile is specifically engineered for the bend.

b. Other assemblies

The lining procedure outlined in clause 3.4.3 (a) shall be followed where feasible.

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3.4.4 Fixing method

a. All adhesives and grouts employed in the construction of any ceramic lined assembly shall be non-flammable and capable of withstanding sustained operating temperatures of 120°C. In addition, the fixing method employed in all ceramic lined assemblies shall ensure that the lining remains secure even in the event of a mill fire, or similar occurrence resulting in temperature excursions above 120 °C.

b. Internal preparation of the pipework shall be done to ensure adequate adhesive/grout adhesion, and shall fulfil the specified requirements of the adhesive/grout supplier.

c. The preparation and fixing method shall be provided by a specialist company for ceramic lined pulverised fuel pipes and needs to be declared to Eskom and approved by Eskom, to ensure quality work is done.

d. The section were the ceramic linings need to be applied needs to be free of rust, scale or oil substances.

3.4.5 Size tolerance — pulverised fuel pipe bends

a. The following tolerances shall apply:

Table 2: Size Tolerance

Nominal bore	Tolerance
Up to 400 mm	± 3 mm
401 mm to 600 mm	± 4 mm
Greater than 600 mm	± 5 mm

b. The ceramic lining shall be flush with the flange face or within 3 mm of the face and the lining shall not protrude above the flange face.

3.5 PAINTING

Exposed pipework on all assemblies shall be painted as follows:

3.5.1 Surface preparation

Prior to painting, pipework shall be mechanically wire-brushed to St3 of SIS 055900.

3.5.2 Coating system

Pipework shall be painted with one coat of zinc chromate applied by brush or airless spray. Dry film thickness shall be 35 micrometers minimum.

3.5.3 Identification

For identification purposes high gloss enamel paint to SABS 630 Grade 1 shall be used (refer clause 3.6). Dry film thickness shall be 30 micrometers minimum.

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3.6 MARKING OF ASSEMBLIES

3.6.1 Identification for erection purposes

Ceramic lined assemblies shall be marked in the supplier's works (refer clause 3.5.3). The following information shall be clearly marked on each assembly:

a. Manufacturer's name

b. Power Station concerned

c. Assembly reference number

d. Direction of pulverized fuel flow

The assembly reference numbers shall, whenever possible, correspond with reference numbers shown on original Eskom drawings.

3.6.2 Permanent identification

An assembly reference number shall be permanently marked on each assembly. Details of the proposed method of permanent identification shall be submitted to Eskom for approval.

3.7 INSPECTION

Eskom reserves the right to carry out inspection and random surveillance on any of the tests or requirements detailed in this standard.

3.8 DOCUMENT AVAILABILITY

This document can be accessed electronically via the Eskom Intranet and Hyperwave.

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This document has been seen and accepted by:

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5. REVISIONS

Date	Rev.	Compiler	Remarks
February 2013	0	M.A. Muller	Draft document for review created from GGSS0667 R5
February 2013	1	M.A. Muller	Final Document for Authorisation and Publication
February 2023	1.1	L. Botha	First Draft Document for Comments Review Process
March 2023	1.2	L. Botha	Final Draft after Comments Review Process
July 2023	1.3	L. Botha	Additional updates Completed
August 2023	1.4	L. Botha	Final Draft after Additional Updates Completed
August 2023	2	L. Botha	Final Rev 2 Document for Authorisation and Publication

6. DEVELOPMENT TEAM

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

- Hennie Pretorius
- Lettie Botha
- Thobile Tyeke

7. ACKNOWLEDGEMENTS

- Abrie Preller
- Norman Crowe
- Matthew Muller

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APPENDIX A:

(Informative)

Schedule A — Guarantees and technical particulars of equipment offered

1	2		3
Item	**Description**		
1	**Casing**		
1.1	Grade of steel		
1.2	Thickness of steel casing	mm	
1.3	Thickness of steel flanges	mm	
1.4	Type of construction for bends		
1.5	Segment size (for lobster back bends)		
1.6	Method of welding		
1.7	Place of manufacture		
2	**Lining**		
2.1	Material trade name		
2.2	Manufacturer		
2.3	Place of manufacture		
2.4	Chemical composition		
2.5	Thickness of lining	mm	
2.6	Segment size (for lobster back bends)		
2.7	Individual ceramic tile size (min and max)	mm	
2.8	Density		
2.9	Hardness		
2.10	Compressive strength		
2.11	Thermal expansion		
2.12	Thermal conductivity		
2.13	Temperature resistance (max)	°C	
3	**Grouting/adhesive**		

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3.1	Material type		
3.2	Manufacturer		
3.3	Place of manufacture		
3.4	Temperature resistance (max) and duration	°C	
3.5	Long term temperature capability	°C	
4	**Assembly**		
4.1	Place of lining of pipework		
4.2	Assembly mass	kg	

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APPENDIX B
Notes to tenderers

(informative)

B.1 Schedule A — Guarantees and technical particulars of equipment offered

A fully completed schedule A shall accompany each tender.

B.2 Alternatives offered

B.2.1 Alternative ceramic lining systems may be offered for consideration by Eskom. Such requests shall be accompanied by full technical details of the lining system by completing a new schedule A for each alternative offered.

B.2.2 In the case of certain fabrications, e.g. splitters, it may be necessary to deviate from the standard (clause 3.4.3a)). In such cases full technical details shall be provided by completing a new schedule A for each deviation.

B.3 Deviation schedule — at tender stage

In addition to completing schedule A, a fully completed deviation schedule shall accompany each tender.

B.4 Proposed protection prior to installation

Details shall be supplied of how the ceramic lined assemblies will be protected against mechanical damage during transportation and storage prior to installation.

B.5 Drawings

B.5.1 Fully detailed technical drawings for each ceramic lined assembly shall accompany each tender.

B.5.2 The drawings shall detail configuration and dimensions of assembly, steel grade, ceramic grade, and shall provide full details of flanges and any transition pieces.

B.6 Application for concession

Where necessary during manufacture, an application for a concession shall be made.

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