

Works Information for lining the Milling Plant components, Burner nests, PF pipework.

1. INTEGRITY, TRACEABILITY AND DUE DILIGENCE

The contractor partners, directors and shareholders must be South African Citizens by birth with the appropriate proof and security clearances.

2. DESCRIPTION OF THE WORKS

In this document, protective lining shall mean engineered refractory tiles made from high resistant wear ceramic material for lining or protecting wear surfaces of the Combustion plant or its sub - system or its components, where raw coal and/or pulverized fuel (PF) coal pass during plant operation in such components.

These include locations such as PF Burners, PF pipe work and the Milling plant. Ceramic tile(s) which have wear and erosion resistant properties and that can withstand high temperature above 1000 degrees are preferred while the word “engineered” shall mean pre-fabricated and profiled or customized to fit properly without the need for cutting or breaking it during installation on the specific plant component referred.

This is to say, such tiles are tailor made to fit the profile of geometries found in the components herein described.

During installation, such tiles shall be bonded to the steel components with adhesive(s) or epoxy of high wear resistance to abrasive coal that has properties that tolerate high temperature operation but also complying with Eskom standard, in relation to health, safety and operation.

The assumption therefore, is that the coal is inherently abrasive in nature or has high abrasive index and that the adhesive to be used will NOT compromise the plant by detaching ceramic tiles prematurely or cause or render the tiles to fall off while the plant is in operation. This alone cannot be acceptable to Eskom at any level of consideration or circumstance and as such that has a potential to negatively impact contractual obligations and thus should be readily born in mind henceforth.

The SOW covers the installation of ceramic tiles on pulverised fuel (PF) pipework between the Mill classifier outlet and including the PF Burners. It also includes among other components but not limited to, the coal chutes and cones, burner boxes, transition pieces and pipe bends.

1.1. Lining method for the PF pipe work

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 one 1 mm, provided that such tiles are in intimate contact at least one point and such adjacent tiles parallel to each other along the contacting faces. Joints in the direction of pulverised fuel flow shall be staggered.

Tile edges, including weld-on tile plugs, shall not protrude into the pulverised fuel flow, and shall be a maximum of 1 mm below adjacent tiles downstream of the pulverised fuel flow.

The use of “weld-on” ceramic tiles shall not be permitted in pulverised fuel pipe bends of round section.

1.2. Fixing method

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 or greater. 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.

Preparation of the component surfaces shall be such that the grout or adhesive is adequate and fulfil the specified requirements of the employer.

3. INSPECTIONS

Inspect the old protective lining on the following components for any possible damage: Mill centre pipe, Cones, PF pipework, Primary air tubes, Transition pieces, Burner boxes, Mill outlet pipes and chutes etc.

Assess the wear damage that may have changed the geometric profile of the plant component i.e. erosion pattern, material thinning, missing tiles or loss of adhesion of the tiles and/or brick detachment.

In some cases there may be additional foreign material buildup such as clinker like bodies or hard formation which may obscure free flow.

4. REPAIRS

4.1. The damaged lining should be carefully removed and replaced whenever the erosion or mechanical damage or irremovable clinkers bonding will potentially compromise the flow.

4.2. The damaged lining to be removed over the full length of the tile and over the breadth of the affected area only. It must be removed in such a manner so as to maintain the stability and shape of the geometry the lining and inherently parallel to the attachment interface. This principle generally applies to all components that are exposed to wear erosion.

4.3. Incorrect removal of the lining can result in the collapse of the lining geometry or the loss of shape resulting in poor combustion problems associated with loose tiles falling off during plant operation resulting blockages which pose serious risk to normal operation.

- 4.4. The lining is to be replaced in such a manner that ensures high compaction without the use of any vibratory techniques. Any vibration techniques compromising or deemed to have a potential to compromise the plant while in service will not be permitted.
- 4.5. During compaction, no impact must occur on the tiles or the anchor system as this will cause unintended damage.

5. REPLACEMENT OF DAMAGED QUARL TILES:

- 5.1. The Quarl tiles to be removed must be removed from the 12-0-clock position working either clockwise or counter clockwise so as to remove or damage as few tiles as possible. All old refractory tiles are to be replaced with the new refractory tile.
- 5.2. The tile “back fix anchor rod” system must be removed. The tiles are to be removed from the anchor stud and refractory between the tile and the tile “back fix plate” must be removed. The anchor stud is to be cut from the saddle without damaging or cutting any pressure parts. A new anchor stud is to be fixed to the saddle.
- 5.3. Removal of old wear lining shall not constitute damaging or deformation of the metal surfaces or body geometry of components to be lined or weld attachments thereof and that applies as well during installation of new lining.
- 5.4. The damaged lining should be removed and replaced whenever erosion or mechanical damage is evident or irremovable clinker build-up is evident and potentially compromising the desired flow.
- 5.5. The damaged lining is to be removed over the full length of the lining and the breadth of the affected area. It must be removed in such a manner as to maintain the stability and shape the lining and inherently parallel to the attachment interface. This principle generally applies to all components that are exposed to wear erosion.

6. DRAWINGS N/A

Table.1 Size estimate of lining

Geometric Size Estimate	Thickness (mm)
PF Burner Mouth	25
Cone and chutes	25
Pipework	12
Square to round section	6

7. SPECIFICATIONS

- 7.1. Burner Ceramic lining or refractory should meet the following specification or exceed the mechanical properties as tabled in the tables below.

7.2. Only moldable and castable refractory material manufactured from any baked monolithic refractory or ceramic tiles which will fit the Eskom plant and meet the abrasion quality requirements as **per ASTM C-704 standard** and with mechanical properties as tabled below will be accepted. The refractory must not only be wear resistant but also resist thermal shock over operational period herein envisaged.

7.3. Contractors shall also provide material safety data sheets for tiling and epoxy they will be using that is acceptable to Eskom Plants as alluded, over and above the material itself to guarantee safety and health of personnel and plant as well as environment given that, some materials may release gas or particulate emissions especially when complacency sets in along quality lines.

7.4. Whatever binding refractory epoxy used, should resist high velocity PF erosion and minimum temperature of 1000 degrees for a minimum of 18 months continuous plant operation without compromising the lining itself along the lines of disintegration and separation or cracking and thermal creep if monolithic lining is used. Evidence of such grout or epoxy to be used shall be presented to Eskom before use on Eskom equipment.



Table.2 Acceptable Mechanical properties required for the lining

COMPOSITION	Al ₂ O ₃	92.0%
	SiO ₂	4.20%
	CAO	0.50%
	MGO	0.30%
	Na ₂ O	0.50%
	K ₂ O	0.05%
SPECIFICATION / PHYSICAL PROPERTIES	DENSITY	3.58 G/CM ³
	WATER ABSORPTION	0.0%
	COMPRESSION STRENGTH	N/MM ² ≈1900
	BENDING STRENGTH	N/MM ² ≈280
	MODULUS OF ELASTICITY	N/MM ² ≈280000
	THERMAL CONDUCTIVITY	W/M ^{°K} ≈16

Table.3 Acceptable Mechanical properties required for the lining

GRADE NUMBER		QR-1
BONDING		CLAY
MAX. HOT FACE TEMPERATURE	°C	1550
MODULUS OF RUPTURE ASTM C 133	MPA @ 20°C MPA @ 1350°C	20 15
BULK DENSITY ASTM C 134	GM/CM ³	2,55

APPARENT POROSITY BS 1902	%	16
HOT-LOAD CONTRACTIONS 50 HRS AT 35 KG/CM ASTM C 546	% OF LENGTH	0.0
THERMAL EXPANSION CO-EFFICIENT (MEAN)	CM/CM/°C x 10°	4.7
TERMAL CONDUCTIVITY	W/M°K @ 1477° K	15.4
SPECIFIC HEAT 0 – 1400°C	MEAN CAL/GM/°C	0.28
COMPRESSIVE STRENGTH	MPA	>140
PERMEABILITY AT 25°C	CC OF AIR/MIN/IN ² /IN H ₂ O PRESS	3.4
TYPICAL CHEMICAL ANALYSIS	%SIC SiO ₂ Si ₃ N ₄ Al ₂ O ₃ Fe ₂ O ₃ OTHER OXIDES	87.9 9.6 - 1.6 0.8 0.1
TOTAL EMISSIVITY		0.90

DESIGNATION	COMPILER	SYSTEM ENGINEER	OUTAGES
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SIGNATURE			
DATE	16/05/2022	16/05/2022	