

DEP SPECIFICATION

**CLASSIFICATION, SPECIFICATION AND TESTING FOR
ANCILLARY MATERIALS FOR REFRACTORY BRICK
CONSTRUCTION**

DEP 44.24.90.34-Gen.

February 2012

DESIGN AND ENGINEERING PRACTICE



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1. INTRODUCTION

1.1 SCOPE

This new DEP specifies requirements and gives recommendations for classification, specification, and quality requirements of ancillary materials for use with refractory brick and shapes in equipment linings. Ancillary materials include refractory mortar, metal anchors and supports, surface coatings and expansion joint materials.

Construction requirements in this DEP are specified in more detail in an equipment application DEP such as DEP 64.24.32.11-Gen., or other DEPs referenced herein.

Requirements and recommendations for refractory unshaped materials are found in DEP 64.24.32.30-Gen., and should be read in conjunction with this DEP if shaped and unshaped refractory are required.

The contents of this DEP are based on material originally contained in DEP 44.24.90.31-Gen., March 2001 and DEP 64.24.32.30-Gen., December 1997.

1.2 ASSOCIATED DEPS

This DEP may be used in conjunction with one or more of the following DEPS for refractory bricks and shapes.

DEP 44.24.90.31-Gen.	Refractory bricks and shapes
DEP 44.24.90.32-Gen.	Classification of refractory bricks and shapes
DEP 44.24.90.33-Gen.	Specification for sampling and testing of refractory bricks and shapes
DEP 44.24.90.35-Gen.	Specification and quality control for precast or specialty cast refractory baffle wall tile (shapes)
DEP 64.24.32.31-Gen.	Construction details for refractory brick construction

1.3 DISTRIBUTION, INTENDED USE AND REGULATORY CONSIDERATIONS

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This DEP is intended for use in facilities related to oil and gas production, gas handling, oil refining, chemical processing, gasification, distribution and supply/marketing. This DEP may also be applied in other similar facilities.

When DEPs are applied, a Management of Change (MOC) process shall be implemented. This is of particular importance when existing facilities are to be modified.

If national and/or local regulations exist in which some of the requirements could be more stringent than in this DEP, the Contractor shall determine by careful scrutiny which of the requirements are the more stringent and which combination of requirements will be acceptable with regards to the safety, environmental, economic and legal aspects. In all cases, the Contractor shall inform the Principal of any deviation from the requirements of this DEP which is considered to be necessary in order to comply with national and/or local regulations. The Principal may then negotiate with the Authorities concerned, the objective being to obtain agreement to follow this DEP as closely as possible.

1.4 DEFINITIONS

1.4.1 General definitions

The **Contractor** is the party that carries out all or part of the design, engineering, procurement, construction, commissioning or management of a project or operation of a facility. The Principal may undertake all or part of the duties of the Contractor.

The **Refractory Contractor** is the party that carries out all or part of the construction design, engineering, material procurement and installation of refractory materials. The Refractory Contractor has overall responsibility for the quality control of the products and services including those of any sub-contractors or Suppliers related to the installation.

The **Manufacturer/Supplier** is the party that manufactures or supplies materials, equipment and services to perform the duties specified by the Refractory Contractor. The Manufacturer may undertake all or part of the duties of the Refractory Contractor.

NOTE: For the purposes of this DEP, the Manufacturer/Supplier is the party that manufactures the refractory products and/or ancillaries for supply to the Refractory Contractor, Principal or another Supplier and has primary responsibility for material design properties, manufacturing quality control at the manufacturing site and specific procedures such as but not limited to those for product mixing, installation and start-up.

The **Principal** is the party that initiates the project and ultimately pays for it. The Principal may also include an agent or consultant, authorised to act for, and on behalf of, the Principal.

The word **shall** indicates a requirement.

The word **should** indicates a recommendation.

1.4.2 Specific definitions

Term	Definition
Batch	A batch is defined as a collection of individual raw material components for a specific lot of bricks, bags or pails collected in the mixer for blending.
Batch Lot	A batch lot is defined as the number of batches for the specific product manufactured and stored in bulk (outside of mixer) prior to brick pressing. Where batch lots consist of more than one single batch, the number of batches in the batch lot shall be taken into consideration for the sampling plan and shall be clearly indicated on purchase documentation.
Classification Temperature	The classification temperature as it applies to refractory ceramic fibre products as determined by ASTM C356, to determine product linear shrinkage not exceeding a given value typically 2 % for boards and vacuum shaped products and 4 % for blanket and felt.
Manufactured Lot	A manufactured lot is defined as the number of metallic parts manufactured from a single qualified mill run of metal.
Maximum Continuous Use Temperature	The term used by most ceramic fibre manufacturers to "suggest" a limit temperature after which products can no longer be expected to work for extended periods of time without adverse effects on the physical properties.
Mill Run	A mill run is defined as the run of metal manufactured by the steel manufacture subject to certification and traceability by a steel mill industry specification.
Run	A run is defined as the entire product produced from an uninterrupted production schedule from the individual manufacturing process utilizing the same manufacturing procedures including equipment, raw materials, blend etc., with no changes.

Term	Definition
Sample	A sample is a finished brick or piece normally ready for packaging. In the case of blended products such as refractory mortar, a sample refers to an individual unopened container from a series of containers made of designated weight from a product batch.

1.4.3 Abbreviations

Term	Definition
AES	Alkaline Earth Silicate
AISI	American Iron and Steel Institute
AQL	Acceptance Quality Limit
ASTM	American Society for Testing and Materials
MSDS	Material Safety Data Sheets
MTR	Material Test Report
PMI	Positive Material Identification
PWHT	Post Weld Heat Treatment
RCF	Refractory Ceramic Fibre

1.5 CROSS-REFERENCES

Where cross-references to other parts of this DEP are made, the referenced section number is shown in brackets (). Other documents referenced by this DEP are listed in (6).

1.6 COMMENTS ON THIS DEP

Comments on this DEP may be sent to the Administrator at standards@shell.com, using the DEP Feedback Form. The DEP Feedback Form can be found on the main page of "DEPs on the Web", available through the Global Technical Standards web portal <http://www.shell.com/standards> and on the main page of the DEPs DVD-ROM.

1.7 DUAL UNITS

This DEP contains both the International System (SI) units, as well as the corresponding US Customary (USC) units, which are given following the SI units in brackets. When agreed by the Principal, the indicated USC values/units may be used.

2. CLASSIFICATION OF MATERIALS

2.1 METAL ANCHORS AND SUPPORTS

Selection of metal anchors and supports depends on the operating temperature and the type of fuels fired. Classification shall be by AISI alloy number.

Table 1 summarises the chemical composition and safe use temperatures for alloys used in metal anchors and supports.

All anchors and supports from austenitic stainless steel materials from cold forming shall be supplied in fully bright solution annealed condition.

Table 1 Chemical composition, safe use temperature, for anchors and supports

Base Materials ⁽¹⁾⁽³⁾	Material Selection						
	Temperature of Anchor Tip		Type of Anchor Material				
			AISI Alloy	Composition			
	°C	°F		Cr	Ni	C	Mn
Austenitic Stainless	871	1600	304	20-18	12-8	<0.08	<2
	871	1600	304L	20-18	12-8	<0.03	<2
	1093	2000	310	26-24	22-19	<0.25	<2
(4)	899	1650	321	20-17	13-9	0.08	<2
	1093	2100	330	20-18	37-34	0.08-0.04	<2
Inconel	1150	2100	601	25-21	63-58	<0.1	<1
Alloy Casting	1149	2100	HH ⁽²⁾	27-23	14-11	0.5-0.35	<2

NOTES: (1) Base Material refers to either pressure retaining or internals, welded with or without PWHT.

(2) ASTM A297.

(3) For welding procedures refer to applicable DEP.

(4) 321 alloy titanium content (>5x carbon content and <0.6 % in total)

2.2 VISUAL RECOGNITION OF METALLIC ANCHORS AND SUPPORTS

For visual recognition of special alloys the tips or edges of parts or anchors with qualities other than SS304 shall be dipped in paint: minimum 10 mm (0.4 in), i.e., SS309 - light blue, SS310 - red, SS330 - yellow, or if not possible, all items shall be suitably marked in some other way.

2.3 REFRACTORY MORTAR

Refractory mortar is classified by its chemistry and setting characteristics.

Classification and physical properties of most frequently used refractory mortars are listed in Table 2. Alternative mortars based on special characteristics of bricks used or of the mortar and specific applications may be used, once classification and physical properties including conformance data have been approved by the Principal.

Table 2 Classification and physical properties of refractory mortar

Properties	Units	High Alumina Heat Setting	High Alumina Phosphorus Bond	60% Alumina Heat Setting	Super Duty Air Setting	Potassium Silicate pH use Range 0.0–7.0 ⁽¹⁾
Continuous use limit temperature	°C	1800	1800	1649	1649	677
	°F	3272	3272	3000	3000	1250
Set Type		Heat	Air	Heat	Air	Air
Base Material		Corundum	Corundum	Sillimanite or Mullite	Kaolin or Mullite	N/A
Grain size	>0.25 mm	<0.5 mm	<0.5 mm	<0.5 mm	<0.5 mm	N/A
Al ₂ O ₃ (%) (minimum)	%	94	90	60	50	N/A
SiO ₂	%	5	2	36	45	N/A
Fe ₂ O ₃ (%) (maximum)	%	<0.5	<0.5	<1	<15	N/A
P ₂ O ₅ (%)	%		5			N/A
Others / Alk	%				2.3	K ₂ SiO ₃

NOTE: (1) Type 5 Acid resistant mortar suitable for use pH 0.0-7.0 with PLC <1.5 %.

2.4 REFRACTORY COATINGS

Typically, refractory coatings are classified by special use, chemical properties and/or setting characteristics.

Classification and physical properties of acceptable bituminous refractory coating is listed in Table 3. Alternative coatings such as cement based or wax based coatings may be used based on special characteristics or any specific application once product classification and physical properties including conformance data have been approved by the Principal.

Table 3 Classification and physical properties of non-refractory coatings

Continuous use limit temperature	°C	204
	°F	400
Set Type		Air
Base Material		Coal tar

2.5 EXPANSION JOINT MATERIAL

Material for refractory lining expansion joints shall be able to maintain long term flexibility for expected duration of operation of equipment between normal outages at normal high operating temperatures. Expansion joint material shall be made from the “spinning” fiberization process”, be double needled, resistant to all expected environmental exposures in operation and not have adverse high temperature reactions with bricks used in the lining design.