

Ceramic Fiber for Fired Heater Internal Linings

Procedure

This Standard replaces and cancels its previous revision.

The CONTEC - Authoring Subcommittee provides guidance on the interpretation of this Standard when questions arise regarding its contents. The Department of PETROBRAS that uses this Standard is responsible for adopting and applying the sections, subsections and enumerates thereof.

Technical Requirement: A provision established as the most adequate and which shall be used strictly in accordance with this Standard. If a decision is taken not to follow the requirement ("non-conformity" to this Standard) it shall be based on well-founded economic and management reasons, and be approved and registered by the Department of PETROBRAS that uses this Standard. It is characterized by imperative nature.

Recommended Practice: A provision that may be adopted under the conditions of this Standard, but which admits (and draws attention to) the possibility of there being a more adequate alternative (not written in this Standard) to the particular application. The alternative adopted shall be approved and registered by the Department of PETROBRAS that uses this Standard. It is characterized by verbs of a non mandatory nature. It is indicated by the expression: **[Recommended Practice]**.

Copies of the registered "non-conformities" to this Standard that may contribute to the improvement thereof shall be submitted to the CONTEC - Authoring Subcommittee.

Proposed revisions to this Standard shall be submitted to the CONTEC - Authoring Subcommittee, indicating the alphanumeric identification and revision of the Standard, the section, subsection and enumerate to be revised, the proposed text, and technical/economic justification for revision. The proposals are evaluated during the work for alteration of this Standard.

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Introduction

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CONTEC

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Thermal Insulation and
Refractories

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Foreword

This Standard is the English version (issued in 06/2018) of PETROBRAS [N-1890](#) REV. D 11/2016. In case of doubt, the Portuguese version, which is the valid document for all intents and purposes, shall be used.

1 Scope

1.1 This Standard establishes the conditions required for design, materials and installation of ceramic fiber internal linings in fired heaters.

1.2 This Standard applies to projects starting from its issue date as well as to existing facilities/equipment when maintenance or remodeling work is done.

1.3 This Standard contains Technical Requirements and Recommended Practices.

2 Normative References

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document applies.

PETROBRAS [N-9](#) - Treatment of Steel Surfaces by Abrasive Blasting and Water Jetting;

PETROBRAS [N-133](#) - Soldagem;

PETROBRAS [N-1617](#) - Aplicação de Concreto Refratário;

ABNT [NBR 9688](#) - Isolantes Térmicos com Mantas de Fibra Cerâmica;

ABNT [NBR 9909](#) - Painéis Termoisolantes à Base de Fibra Cerâmica;

ABNT [NBR 15239](#) - Tratamento de Superfícies de Aço com Ferramentas Manuais e Mecânicas;

API [STD 560](#) - Fired Heaters for General Refinery Services;

ASME [BPVC Section IX](#) - Qualification Standard for Welding and Brazing Procedures, Welders, Brazers and Welding and Brazing Operators - Welding and Brazing Qualifications;

ASTM [C 177](#) - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus

ASTM [C 892-18](#) - Standard Specification for High-Temperature Fiber Blanket Thermal Insulation.

3 Terms and Definitions

For the purposes of this document, the following terms and definitions apply.

3.1

adhesive

neutral sodium silicate-based material intended for auxiliary adhesion of the ceramic fiber to the aluminum or stainless steel foil of the vapour barrier and to the equipment casing

3.2**vapour barrier**

lining system used to minimize corrosion attack on equipment casing. It comprises the application of an aluminum or stainless steel foil as a barrier against acid gases

3.3**adhesive cement**

air setting refractory cement used for bonding ceramic fiber modules to refractory linings

3.4**coating**

refractory material used as a coating element for ceramic fiber modules aiming to increase resistance to erosion and abrasion caused by the flow of combustion gases as well as by suspended solid particles from the combustion process, besides reducing attack by sulfur, vanadium and sodium compounds in the ceramic fiber modules

3.5**ceramic fiber rope**

product made from ceramic fibers with or without reinforcements used for sealing or insulation in areas with a complex geometry

3.6**stiffener of ceramic fiber blanket**

inorganic colloidal compound used on wet ceramic fiber blankets or as an agent for surface treatment of dry ceramic fiber blankets to increase their surface resistance

3.7**ceramic fiber**

high purity material obtained by the fusion of alumina and silica for use at temperatures up to 1 260 °C and alumina, silica and zirconia for use at temperatures up to 1 427 °C

3.8**blanket**

product obtained by interweaving ceramic fibers through a needling process, comprising a flexible material with uniform thicknesses and densities and free from binders and/or resins

3.9**blanket with stiffener (wet)**

product made from ceramic fiber blankets with addition of inorganic binders, resulting in a part having a rigid structure when air-dried or when equipment is heated

3.10**anticorrosive mastic**

material used as anticorrosive lining amid acid vapors, minimizing the effects of corrosion by condensation on the casings

3.11**pumpable mastic**

mixture of ceramic fibers and binders for high temperatures intended for repairing slots and cracks by pumping.

3.12 **moldable mastic**

mixture of ceramic fibers and binders for high temperatures used for filling ceramic cones and slots as well as for covering anchoring washers

3.13 **anchored module**

ceramic fiber block with an integrated attachment system

3.14 **bonded module**

ceramic fiber block bonded with adhesive cement, normally applied on refractory linings

3.15 **frame for observation door**

light vacuum-molded ceramic fiber part which is inert to thermal shock already provided in the specified format for easy and quick application

3.16 **board**

product with characteristics which are similar to the blanket's and provided in parts (board)

3.17 **ceramic fiber paper**

easily cuttable and adaptable fine and flexible material for regions with complex geometry

3.18 **special parts**

parts having an irregular geometric shape which is not a market standard, made out of ceramic fiber products

3.19 **ceramic fiber boards**

rigid product made from vacuum-formed ceramic fibers with the addition of organic and/or inorganic binders

4 Materials**4.1 Anchoring Devices**

Materials of anchoring devices shall comply with the criteria of Table 12 of API [STD 560](#).

4.1.1 Auxiliary Anchoring Washer

Devices used to assist the installation of the blanket's intermediate layers (see Figure A.1.1 of Annex A).

4.1.2 Ceramic Cone

Refractory parts used for attaching the layers of ceramic fiber blankets (see Figure A.2 of Annex A).

4.1.3 Stud and Anchoring Washer

Devices used for attaching the ceramic blanket in accordance with Figures A.1.2 and A.3 of Annex A.

4.1.4 Anchoring of Ceramic Fiber Modules

The type of metal devices used for attaching ceramic fiber modules shall be determined as specified by the designer or manufacturer. The use of a stud with minimum diameter of 3/8" for ceiling and 5/16" for walls is recommended. **[Recommended Practice]**

4.2 Ceramic Fiber Materials

4.2.1 Board

The required characteristics are those contained in ABNT [NBR 9909](#) with the following restrictions and modifications:

- a) for internal use in fired heaters, class A or B of ABNT [NBR 9688](#) must be specified, depending on the operating temperature;
- b) fibers may be composed of metal oxides of, but not limited to, aluminum (Al_2O_3), silicon (SiO_2), calcium (CaO), magnesium (MgO) and zirconium (ZrO_2).
- c) addition of reinforcement with synthetic fibers is allowed;
- d) for class A, use only the densities of 64 kg/m³, 96 kg/m³, 128 kg/m³, 160 kg/m³ and 192 kg/m³;
- e) for class B, use only the densities of 96 kg/m³, 128 kg/m³, 160 kg/m³ and 192 kg/m³;
- f) for design and qualification purposes, the thermal conductivity shall comply with the values in Table 2 of ASTM [C 892](#) as measured by ASTM [C 177](#). Consider grade 4 for 64 kg/m³, grade 6 for 96 kg/m³, grade 8 for 128 kg/m³, grade 10 for 160 kg/m³ and grade 12 for 192 kg/m³.

4.2.2 Blanket

The required characteristics are those contained in ABNT [NBR 9688](#) with the following restrictions and modifications:

- a) for internal use in fired heaters, class A or B of ABNT [NBR 9688](#) must be specified, depending on the operating temperature;
- b) fibers may be composed of metal oxides of, but not limited to, aluminum (Al_2O_3), silicon (SiO_2), calcium (CaO), magnesium (MgO) and zirconium (ZrO_2).
- c) addition of reinforcement with synthetic fibers is allowed;
- d) for class A, use only the densities of 64 kg/m³, 96 kg/m³, 128 kg/m³, 160 kg/m³ and 192 kg/m³;
- e) for class B, use only the densities of 96 kg/m³, 128 kg/m³, 160 kg/m³ and 192 kg/m³;
- f) for design and qualification purposes, the thermal conductivity shall comply with the values in Table 2 of ASTM [C 892](#) as measured by ASTM [C 177](#). Consider grade 4 for 64 kg/m³, grade 6 for 96 kg/m³, grade 8 for 128 kg/m³, grade 10 for 160 kg/m³ and grade 12 for 192 kg/m³.

4.2.3 Moist Blanket

Required characteristics:

- a) minimum density: 300 kg/m³ (after binder addition);
- b) other characteristics as in 4.2.2 (before binder addition).