

Design and Fabrication of Fired Heater

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 System 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 System that uses this Standard. It is characterized by imperative nature.

For adoption of the Standard, the effective deadline for implementation to replace the previous review is up to 180 days from the date of its publication. If the Department of PETROBRAS System that is applying the Standard understands that it is not possible to implement it within this period, it must register an Implementation Plan within 180 days defining the necessary actions and the respective deadlines.

The definition of the effective deadline for implementing the requirements of this Standard, when it is referenced in contracts for the provision of services and acquisition of goods, is the exclusive prerogative of PETROBRAS.

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 specific application. The alternative adopted shall be approved and registered by the Department of PETROBRAS System that uses this Standard. It is characterized by verbs of a nonmandatory nature. It is indicated by the expression: **[Recommended Practice]**.

For the continuous improvement of the Standard, copies of the records of technical-managerial decisions prepared by the Departments of PETROBRAS System that may contribute to the improvement of this Standard are requested to be sent to the Authoring Subcommittee.

"The present Standard is the exclusive property of PETRÓLEO BRASILEIRO S.A. - PETROBRAS, for internal use in the Company, and any reproduction for external use or disclosure, without previous and express authorization from the owner, will imply an unlawful act pursuant to the relevant legislation through which the applicable responsibilities shall be imputed. External circulation shall be regulated by a specific clause of Secrecy and Confidentiality pursuant to the terms of intellectual and industrial property law."

Introduction

PETROBRAS Technical Standards are prepared by Working Groups (GT), formed by experts from the PETROBRAS System, commented and voted on by the Departments of PETROBRAS System and approved by the Authoring Subcommittees (SC). The PETROBRAS Technical Standard is subject to review at any time by the SC and must be re-analyzed every 5 years to be revalidated, revised or canceled. PETROBRAS Technical Standards are prepared in accordance with PETROBRAS Technical Standard N-1. To see the collection, see PETROBRAS Technical Standards Catalog. ([Click here](#)).

CONTEC

 Comissão de Normalização
Técnica

SC - 08

Fired Heaters

Summary

Foreword.....	4
1 Scope.....	4
2 Normative References.....	4
3 Design and Fabrication Standard.....	5
4 Design Requirements.....	5
4.1 Thermal Design.....	5
4.2 Mechanical Design.....	6
5 Tubes.....	6
6 Tube Supports.....	7
7 Stacks, Ceilings, Ducts and Breeching.....	7
8 Pressure Relief Doors.....	8
9 Observation Doors.....	8
10 Instrument and Auxiliary Connections.....	8
11 Auxiliary Equipment.....	9
11.1 Burners.....	9
11.2 Soot Blowers.....	10
11.3 Fans and Drivers.....	10
11.4 Ladders and Platforms.....	11
12 Refractory/Insulating Coating.....	11
13 Fabrication.....	11
14 Performance Test.....	11
Annex A - Figures and Table.....	13

Figures

Figure A.1 - Snuffing Steam Nozzle	13
Figure A.2 - Snuffing Steam Nozzle in Header Box and Plenum Chamber	13
Figure A.3 - Test and/or Sampling Nozzle	14
Figure A.4 - Pressure Instrument Nozzle	14
Figure A.5 - Temperature Instrument Nozzle	15
Figure A.6 - Tube Skin Temperature Nozzle	15
Figure A.7 - Nozzle for O ₂ Analyzer	16
Figure B.1 - Schematic Design (in Section) of Door.....	18

Table

Table A.1 - Description of Connections	17
--	----

Foreword

This Standard is the English version (issued in 11/2023) of PETROBRAS N-1671 REV. G 10/2023. 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 defines the required conditions for design, materials, fabrication, inspection, testing, and preparation for shipment of tubular fired heaters and auxiliary equipment generally used in refinery services.

1.2 The descriptions and terminology of the tubular fired heaters are given by ABNT [NBR 10778](#).

1.3 This Standard revision does not apply to procedures started before this publication.

1.4 This Standard contains Technical Requirements and Recommended Practices.

1.5 Relevant local legislation must be complied.

2 Normative References

The documents listed below are essential to the application of this document. For dated references, only the mentioned editions shall be applied. For non-dated references, the newest mentioned editions are applied.

Norma Regulamentadora nº 12 ([NR-12](#)) - Segurança no Trabalho em Máquinas e Equipamentos;

Norma Regulamentadora nº 14 ([NR-14](#)) - Fornos;

Norma Regulamentadora nº 15 ([NR-15](#)) - Atividades e Operações Insalubres;

Resolução CONAMA nº [382](#), de 26 de dezembro de 2006 - Estabelece os Limites Máximos de Emissão de Poluentes Atmosféricos para Fontes Fixas;

Resolução CONAMA nº [436](#), de 22 de dezembro de 2011 - Estabelece os limites máximos de emissão de poluentes atmosféricos para fontes fixas instaladas ou com pedido de licença de instalação anteriores a 02 de janeiro de 2007;

ABNT [NBR 6123](#) - Forças Devidas ao Vento em Edificações;

ABNT [NBR 8800](#) - Projeto de Estruturas de Aço e de Estruturas Mistas de Aço e Concreto de Edifícios;

ABNT [NBR 10778](#) - Forno Tubular Sujeito à Chama;

ABNT [NBR ISO 2768-1](#) - Tolerâncias Gerais - Parte 1: Tolerâncias para Dimensões Lineares e Angulares sem Indicação de Tolerância Individual;

ANSI/AISC [360](#) - Specification for Structural Steel Buildings;

API [STD 530](#) - Calculation of Heater-Tube Thickness in Petroleum Refineries;

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

API [STD 614](#) - Lubrication, Shaft-Sealing and Oil-Control Systems and Auxiliaries;

API [STD 670](#) - Machinery Protection Systems;

API [STD 673](#) - Centrifugal Fans for Petroleum, Chemical and Gas for Industry Services;

ASME [B31.3](#) - Process Piping;

ASME [STS-1](#) - Steel Stacks;

ASME [BPVC Section I](#) - Rules for Construction of Power Boilers;

BSI [BS ISO 15259](#) - Air Quality - Measurement of Stationary Source Emissions - Requirements for Measurement Sections and Sites and for the Measurement Objective, Plan and Report.

NOTE For documents referred in this Standard and for which only the Portuguese version is available, the PETROBRAS department that uses this Standard should be consulted for any information required for the specific application.

3 Design and Fabrication Standard

3.1 The design and fabrication of the fired heater shall follow API [STD 560](#), supplemented and/or modified by this Standard.

3.2 For the linear and angular tolerances with no direct indication in the design documents, ABNT [NBR ISO 2768-1](#) shall be followed.

3.3 Coils shall be designed as follows:

- a) coils containing hydrocarbons and exposed to flue gas: API [STD 530](#);
- b) manifolds and piping containing hydrocarbons and not exposed to flue gas: ASME [B31.3](#);
- c) coils containing fluids other than hydrocarbon: ASME [BPVC Section I](#).

3.4 To comply with the environmental legislation for installations in Brazil, the applicable CONAMA resolutions must be followed and the state and municipal environmental legislations must be verified, as well as other specific restrictions of the enterprise.

3.5 For installations in Brazil, the Regulatory Standards of the Labor Ministry [NR-12](#), [NR-14](#) and [NR-15](#) shall be complied.

4 Design Requirements

4.1 Thermal Design

4.1.1 It is recommended that distributors/collectors (manifolds) from fired heaters with multi-pass, in single phase flow, are dimensioned for a maximum difference between the flow rates less than 10%. **[Recommended Practice]**

4.1.2 It is not recommended to use distributors where the flow is two-phase. **[Recommended Practice]**

4.1.3 Windows shall be provided in the convection section for cleaning with water lance, CO₂ or similar method, meeting the following criteria:

- a) Each window shall allow for the cleaning of 3 rows of tubes with pins or fins above and 3 rows below its elevation;
- b) One window every 4.5 m of straight pipe length.

4.1.4 The arrangement of the convection tubes shall provide a vertical gap of at least 450 mm between fin tips at each vertical space between intermediate supports or at most every eight rows of tubes. A 600 x 600 mm access door shall be included in each span. Specific ladders and platforms need not be provided to serve these access doors.

4.1.5 Serreted fins shall not be used.

4.1.6 Drains and vents internal to the fired heater shall not be used. Drains and vents shall be provided near the inlet and outlet terminals of the coils and/or at the crossovers.

4.2 Mechanical Design

4.2.1 The structures and their components shall be designed for all load conditions expected during transport, assembly, operation, and maintenance. This includes support to equipment, machinery and scaffolding, outside and inside the fired heater.

4.2.2 The fired heaters that will have pig decoking shall have sufficient space and facilities for the installation of the pig launchers in the inlet and outlet nozzles of the coil.

4.2.3 For reformer fired heaters, the elements Al, Zn (including galvanized components), Pb, Sn and Cd shall not be used in components, accessories, coatings or painting located above the arch.

4.2.4 The design and manufacture of the structures shall be carried out in accordance with AISC 360 or NBR 8800.

4.2.5 Screwed panels should preferably be used in the headboxes, and the use of hinged covers is allowed, when necessary.

4.2.6 Horizontal baffles shall be installed in the headboxes to reduce the flue gas by-pass with a maximum vertical span of 1.5m.

4.2.7 Grids and expanded sheets shall be used only on stairs and platforms.

5 Tubes

5.1 To austenitic stainless steel coils, only 18 Cr-8 Ni or 25 Cr - 20 Ni stainless steel pins or fins shall be used.

5.2 The stainless steels type 321 and 347 shall be provided on solubilized and stabilized condition.

5.3 The circumferential joints of tubes shall be positioned in order to not interfere with the supports and guides upon thermal expansion.

6 Tube Supports

6.1 The calculated deflection of the tube, due to the long term creep rate, shall be, at most, equal to a nominal diameter for maximum design condition.

6.2 For materials not listed on graphs of allowable stresses from API [STD 560](#), the designer shall specify the source (manufacturer) adopted when determining the allowable stress of tube supports.

6.3 ASTM A 217 Gr. C5 material shall not be used.

6.4 In top supported vertical coils on radiant section, welded guides at lower curves shall not be used.

6.5 The convection tube supports shall be checked for the condition of coil hydrostatic test. In this condition, the calculated stresses shall not exceed 90% of material yield stress.

6.6 The use of detachable parts of the tube supports shall be avoided. Otherwise, the connection pins shall be locked with welded washers.

6.7 End tube supports welded to metal structure of the convection module shall not be used.

6.8 If the fuel contains more than 100 ppm of Na+V and the design temperature of tube supports is greater than 650°C, the following materials shall be used:

- a) For design temperatures less than 980°C and required thicknesses less than 51 mm, the supports shall be made of ASTM A560 Gr 50Cr 50Ni Cb.
- b) In all other cases ASTM A351 Gr HK40 supports shall be used, coated with a 50 mm layer of castable refractory with a density greater than 2300 kg/m³.

7 Stacks, Ceilings, Ducts and Breeching

7.1 The mechanical design of the stack shall be in accordance with ASME [STS-1](#), and the minimum wind loads shall be in accordance with ABNT [NBR 6123](#).

7.2 Provision shall be made for platforms, sampling nozzles, and other facilities according to BSI [BS ISO 15259](#).

7.3 Cylindrical fired heaters with helical tubes shall have radiant section arch fully detachable, in order to allow full replacement of the coil.

7.4 In vertical cylindrical fired heaters, the tube-removal door in the arch shall be large enough to allow removing of at least one 'hairpin' - a group formed by two welded tubes and one return bend.

7.5 Bolted intermediate construction shall be used in stacks only if H₂S in fuel gas is below 100 ppm, unless duly authorized by PETROBRAS.

7.6 Only helical strakes shall be used as aerodynamic devices.

8 Pressure Relief Doors

8.1 Pressure relief doors shall be provided with a minimum area calculated by the following expression:

$$A = 5,1 \times 10^{-7} \times M \times \sqrt{T_g + 273}$$

Where:

A is the total area of the door (m²);

M is the maximum flowrate of combustion gases (kg/h);

T_g is the gas temperature at the door location (°C).

NOTE Design basis:

a) opening pressure = 1245 Pa (127 mm of water column);

b) pressure loss through the door = 2.8 x velocity head;

c) maximum door area does not exceed 0.4 m². **[Recommended Practice]**

8.2 Location of pressure relief doors shall ensure safe passage and no material damage when actuated.

9 Observation Doors

9.1 The net area through glass window shall ensure proper view of burners, pilots and coils along their entire length. The minimum size of the glass window and refractory frame are indicated in Figure B.1. In the case of double-fired fired heaters with horizontal tubes, the doors shall also allow the view and thermography of radiant supports..

9.2 The fastening system shall allow complete removal of the entire door for maintenance or replacement.

9.3 Glass shall be tempered, transparent and colorless, with a minimum thickness of 10 mm.

9.4 Glass shall be installed in a pivoted door, allowing its safe full side opening, its cleaning, its replacement and proper access for thermography.

9.5 The glass protection system shall be provided with internal door and ensure maximum glass temperature of 60 °C in normal operation.

9.6 Observation door shall be designed with a device that keeps it locked at fully opened position.

9.7 Thermal insulation around the door must be carried out according to the instructions provided by the door supplier.

10 Instrument and Auxiliary Connections

10.1 Nozzles for fluid temperature measurement in return bends shall be located in header boxes, outside radiant section.

10.2 The connections installed on the casing of the fired heater, stack and internally insulated ducts (as described below) shall be in accordance with Figures A.1 to A.7 and Table A.1 in Annex A.

- a) Figure A.1 - Nozzle for Snuffing Steam;
- b) Figure A.2 - Nozzle for Snuffing Steam in Header Box and Plenum Chamber;
- c) Figure A.3 - Nozzle for Test and/or Sampling;
- d) Figure A.4 - Nozzle for Pressure Instrument;
- e) Figure A.5 - Nozzle for Temperature Instrument;
- f) Figure A.6 - Nozzle for Tube-Skin Thermocouple;
- g) Figure A.7 - Nozzle for O₂ Analyzer;
- h) Table A.1 - Description of Connections.

11 Auxiliary Equipment

11.1 Burners

11.1.1 The interconnection system between the main burner (and pilot) and their rings (gas, oil and steam) shall use flexible hoses. For the case of steam and oil, external thermal insulation shall be provided for hoses.

11.1.2 Performance test shall be conducted in a test plant defined by the Supplier for burners not yet used in the PETROBRAS system, in fired heaters with severe environmental restrictions (NO_x emission less than 75 ppm @ 3% O₂ dry basis), in fired heaters whose arrangement is in disagreement with the API [STD 560](#) criteria.

11.1.3 The burner Supplier shall issue at least the following documents:

- a) general arrangement of the burner, indicating the allowable tolerances, including plenum chamber with noise suppressor, where applicable, space required to remove the pilot, and general details of manufacture and assembly;
- b) details of burner assembling;
- c) nozzles, including location, size, pressure class, and type of face of all connections;
- d) details of the burner tiles, including anchorage;
- e) performance curves for all fuels, as indicated in Burner's Data Sheet.
- f) air pressure drop x heat release curve;
- g) installation, operation and maintenance manuals

11.1.4 When the temperature of the preheated air is equal to or more than 350°C, burner body shall be provided in austenitic stainless steel 300 series.

11.1.5 The burner front-plate shall be provided with a minimum thickness of 9 mm.

11.1.6 Rotating or sliding concentric cylinders air register device types shall not be used.

11.1.7 Individual plenum for each burner or one for each pair of burners is recommended.
[Recommended Practice]

11.1.8 Flame rod shall not be used to monitor flame in oil burners.

11.1.9 Atomizer and the spud shall not be made of brass and shall be provided with materials selected to avoid galling effect.

11.1.10 The elevation of the front-plate shall allow the easy maintenance and operation of the burner without the use of ladders or access platform. The location and length of the pilot shall not result in a change in the elevation of the front-plate of the burner.

11.2 Soot Blowers

11.2.1 Retractable soot blowers shall allow manual return of the lance tube when its activation fails during the blowing operation.

11.2.2 The Supplier shall provide a field panel for operation with output signals to the Distributed Control System (DCS).

11.2.3 The soot blower system shall be sequential and fully automatic.

11.3 Fans and Drivers

11.3.1 The fan shall preferably be designed according to arrangement type 3 of API [STD 673:2002](#) Appendix B, Figures B-1 or B-2. Arrangement type 7 shall be submitted for approval (when it is not possible to specify type 3). Other arrangements shall be avoided.

11.3.2 The bearings shall be rolling or sliding. All bearing cases of the fans and their drivers shall be fitted with provision for oil mist installation. The bearing cases shall be sealed by replaceable isolator seals. Fans in critical services (no reserve) and with bearings with forced lubrication shall have an oil system, according to API [STD 614](#) (or corresponding ISO) in its chapter for special services.

11.3.3 The bearing cases of the fans and their drivers shall be fitted for the installation of accelerometers for measuring vibration, in accordance with API [STD 670](#) (or equivalent ISO).

11.3.4 The capacity control of the fans shall be preferably done by varying the rotation through frequency inverter for electric motors, or speed governors for steam turbines. Alternative designs shall be submitted for approval.

11.3.5 Fan with rated operating speed below 1800 RPM and powered by steam turbine shall have a speed gearbox of the turbine, so that its efficiency is not low.

11.3.6 Forced draft fans shall have blades with airfoil profile for greater efficiency.

11.3.7 Forced draft fans shall have a protective screen installed in the intake duct, in order to prevent entry of foreign matter. Its pressure drop shall be considered in the calculation of the system.

11.3.8 The fan housing material shall be at least in ASTM [A 242](#).

11.3.9 The couplings shall be made of flexible elements of stainless steel. The coupling guard shall be rigid, fixed to the set base and made with non-sparking material.

11.3.10 Fans whose operating temperature exceeds 60°C shall have a removable and reusable thermal protection jacket or blanket, resistant to installation without coverage exposed to weather.

11.3.11 Fans with two shaft ends and two drivers shall have clutch for coupling and decoupling of each driver in order to facilitate the maintenance. The coupling shall be automatic and the decoupling shall be automatic/manual.

11.4 Ladders and Platforms

On the floor of the stairs and platforms, it is recommended the use of galvanized grate, except in the cases specified in 4.2.3. The use of checkered plate floor shall be avoided. **[Recommended Practice]**

12 Refractory/Insulating Coating

12.1 The external temperature of the stack plate shall not exceed 82 °C up to an elevation of 2 m above the sampling platform, considering an ambient temperature of 27 °C with zero wind speed.

12.2 Only paraffin-based membranes can be used for hydraulic curing of insulating/refractory concrete.

13 Fabrication

13.1 Supplying of materials, manufacture, inspection, testing and preparation for transport of the fired heater and auxiliary equipment are considered fabrication steps.

13.2 During transport and storage, components made of austenitic stainless steel shall be protected from contact with saline atmosphere and/or salt water.

13.3 The fired heater shall be pre-manufactured and pre-assembled in the largest possible sizes. The following limits, to be agreed between the manufacturer and PETROBRAS, shall be respected:

- a) maximum allowable width;
- b) maximum allowable height;
- c) maximum allowable length;
- d) maximum allowable weight.

13.4 The number of welded joints in field shall be minimized.

13.5 The convection shall be pre-fabricated in fully assembled modules (structures, header box, tube sheets, coils, lining, nozzles, etc.).

13.6 The manufacturer shall provide all reinforcements and handling devices required for the transport and assembly. The sizes, weights, center of gravity, and all reinforcements and devices shall be clearly indicated in the assembly documents.

14 Performance Test



After the assembly is completed, the fired heater performance test shall be conducted for the design or REVAMP condition, in which the following aspects, at least, shall be observed:

- a) stability of the burners and pilots throughout the operating range;
- b) verification of the ignition and flame detection system;
- c) interference between flames;
- d) incidence of flames on tubes, refractory walls, supports, etc;
- e) performance of fans, if any;
- f) checking for the existence of hot spots in the coil;
- g) verification of the level of pollutant emissions (NO_x, CO and particulates);
- h) checking for the existence of hot spots on the external casing;
- i) functioning of the draft control;
- j) meeting the nominal capacity of the project.

Annex A - Figures and Table

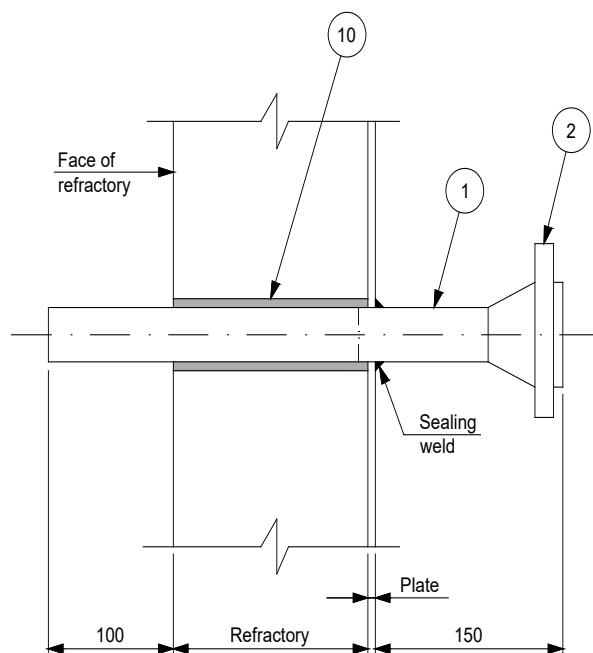


Figure A.1 - Snuffing Steam Nozzle

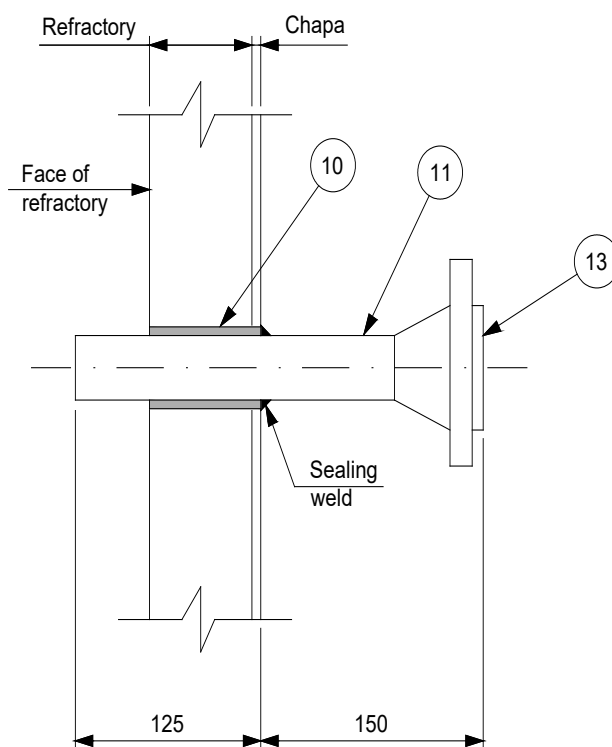


Figure A.2 - Snuffing Steam Nozzle in Header Box and Plenum Chamber

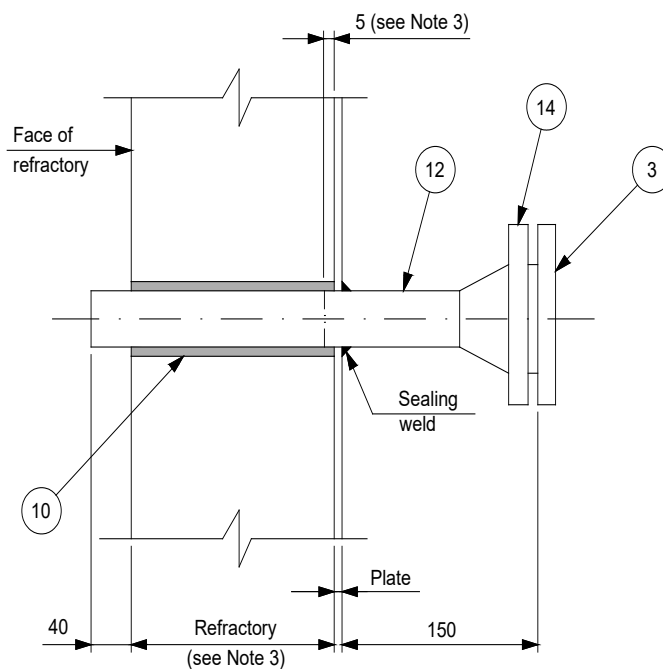


Figure A.3 - Test and/or Sampling Nozzle

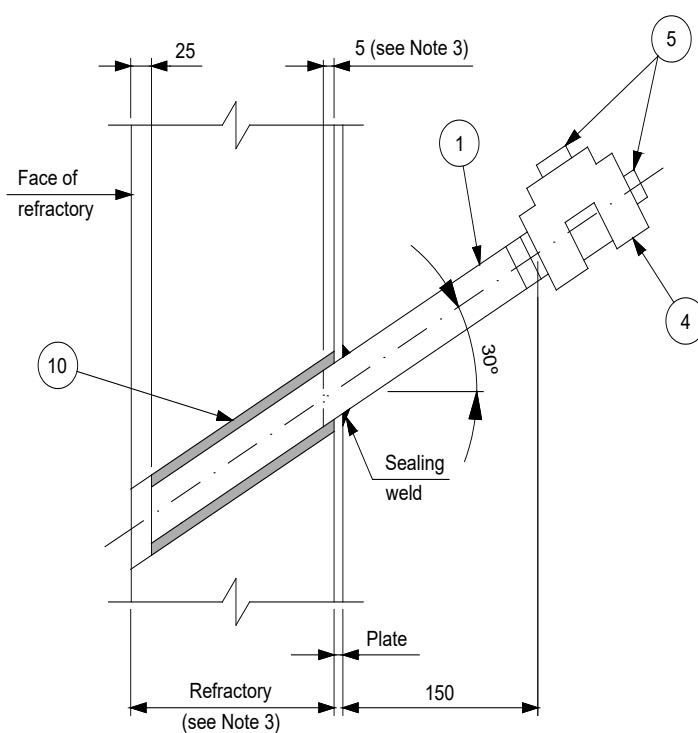


Figure A.4 - Pressure Instrument Nozzle

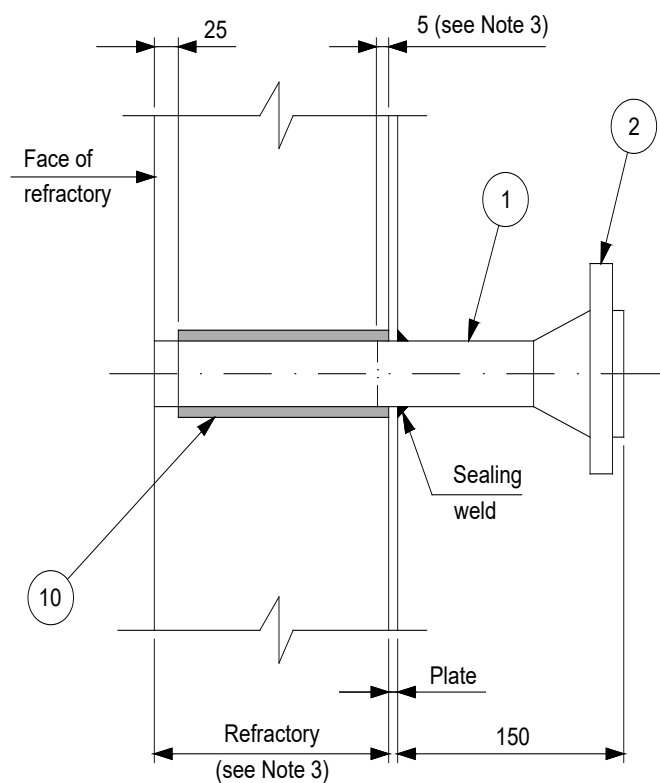


Figure A.5 - Temperature Instrument Nozzle

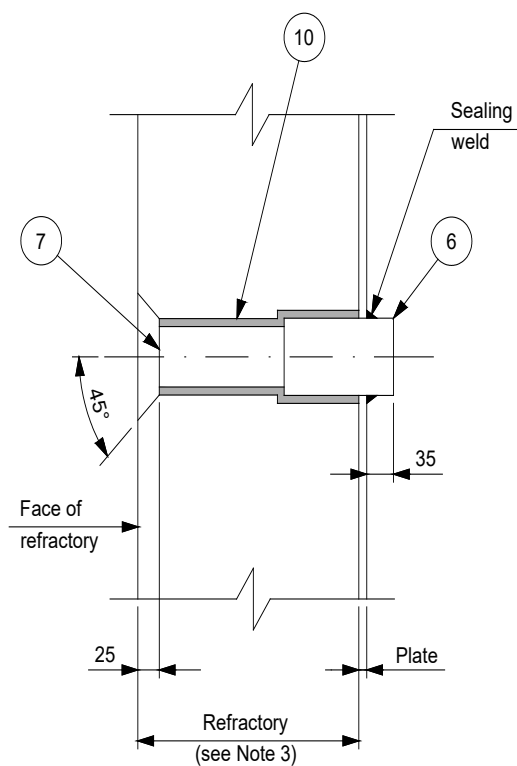


Figure A.6 - Tube Skin Temperature Nozzle

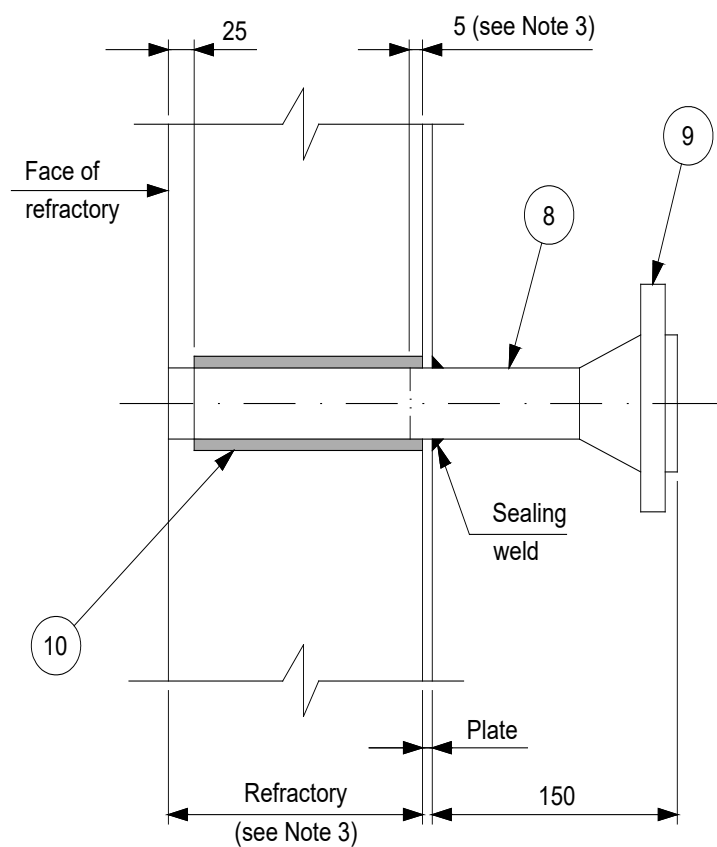
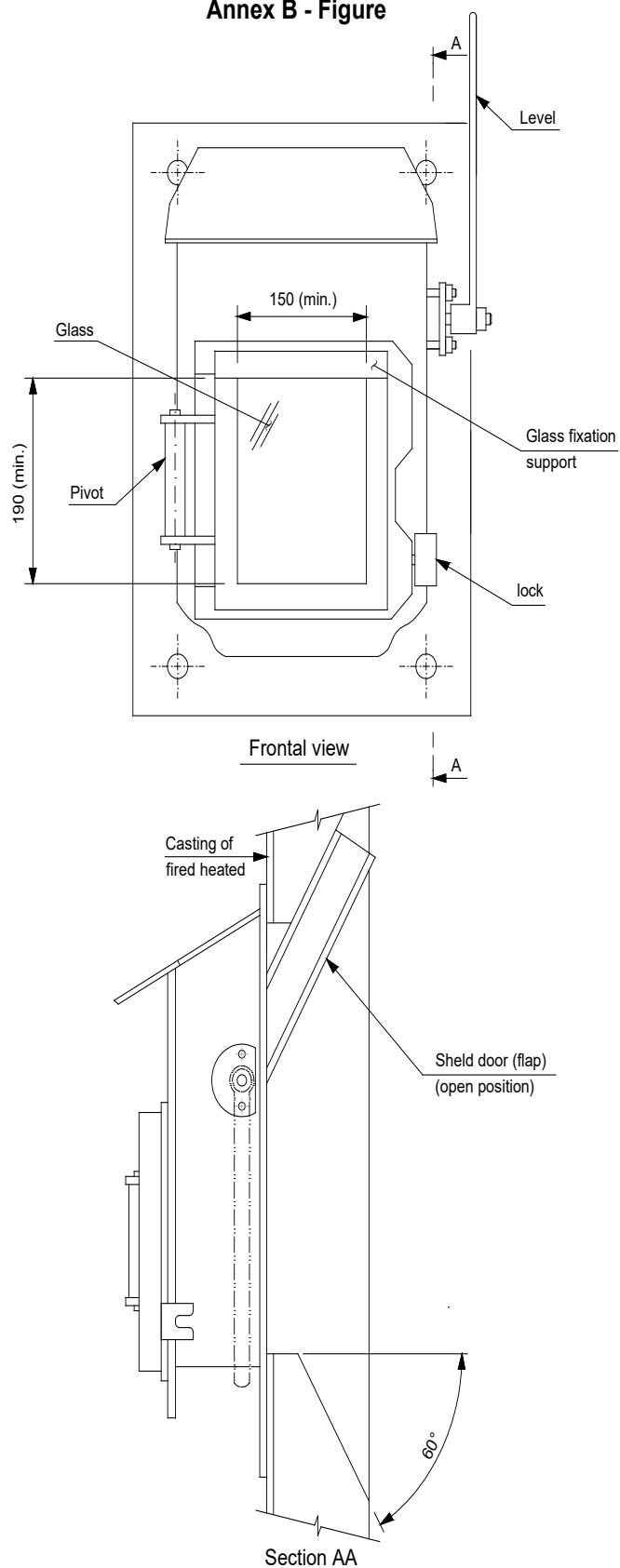


Figure A.7 - Nozzle for O₂ Analyzer

Table A.1 - Description of Connections

Item	Description	Material	Size	Notes
1	Tube	SS - 18% Cr 8% Ni	Ø 1 1/2" - Sch 80	See Note 5
2	Flange	SS - 18% Cr 8% Ni	Ø 1 1/2" WN - 150# RF	
3	Blind flange	SS - 18% Cr 8% Ni	Ø 4" - 150# RF	
4	Forged T	Carbon Steel	Ø 1 1/2" - 3 000#	Screw-NPT
5	Plug	Carbon Steel	Ø 1 1/2" - 3 000#	Screw-NPT
6	Coupling	Carbon Steel	Ø 3/4" - 3 000#	Screw-NPT
7	Tube	SS - 18% Cr 8% Ni	Ø 3/4" - Sch 40	See Note 5
8	Tube	SS - 18% Cr 8% Ni	By manufacturer	See Note 5
9	Flange	SS - 18% Cr 8% Ni	By manufacturer - WN	
10	-	Cardboard craft or ceramic fiber	Thickness of 3/16"	See Note 4
11	Tube	SS - 18% Cr 8% Ni	Ø 1" - Sch 80	See Note 5
12	Tube	SS - 18% Cr 8% Ni	Ø 4" - Sch 80	See Note 5
13	Flange	SS - 18% Cr 8% Ni	Ø 1" - WN - 150# RF	
14	Flange	SS - 18% Cr 8% Ni	Ø 4" - WN - 150# RF	
<p>NOTE 1 All sizes are given in mm, unless noted otherwise.</p> <p>NOTE 2 The thickness of the refractory shall be obtained in the fired heater drawings.</p> <p>NOTE 3 For refractory thicknesses less than 30 mm, or even absence of refractory, the tubes shall extend beyond the lines shown in figures.</p> <p>NOTE 4 Used only when the insulation is Castable.</p> <p>NOTE 5 For chamber temperatures above 1 000° C, use AISI 310 steel.</p>				

Annex B - Figure



NOTE 1 The refractory around door shall be made according to the supplier's of door orientation.
NOTE 2 The dimensions given are internal to the glass holder for fixing the glass.

Figure B.1 - Schematic Design (in Section) of Door

IMPACT REGISTER FORM (IRF)			
REV. 0 to F			
There is no Impact Register Form.			
REV. G			
Standard's Item	Change	Reason for the Change	Potential Impacts
Title Page and Section 1	Inclusion of requirements inherent to the standard's implementation period.	Enable users of this standard to have time to implement requirements and manage changes.	The impacts are positive, allowing the user to adequately plan the implementation of this standard.
Sections 2 and 3	Including Regulatory Standards NR-12, NR-14 and NR-15. Including Resoluções CONAMA nº 382/2006 and nº 436/2011.	Fired heaters shall comply with the occupational health and safety requirements of NR-12, NR-14 and NR-15, in addition to CONAMA's atmospheric emissions requirements.	Adaptation to current legislation.
Section 2 and Subsection 4.2.4	Including ABNT NBR 8800 and ANSI/AISC 360 standards.	ABNT NBR 8800 and ANSI/AISC 360 standards establish design requirements for steel or mixed concrete and steel building structures.	Clearer structural design requirements. Improved reliability and increased time life of the equipment.
Sections 2 and 3	Including API STD 530.	API STD 530 establishes sizing requirements for coils for service with hydrocarbons.	Clearer mechanical and thermal design requirements. Improved reliability and increased time life of the equipment.
Sections 2 and 3	Including ASME B31.3 and ASME BPVC Section I.	ASME B31.3 and ASME BPVC Section I establish criteria for sizing external piping (ASME B31.3) and coils for service with fluids other than hydrocarbons (ASME BPVC Section I).	Clearer mechanical and thermal design requirements. Improved reliability and increased time life of the equipment.
Subsections from 4.1.3 to 4.1.6	New subsections.	Including new thermal design criteria.	Improved equipment operability and maintainability.
Subsections from 4.2.4 to 4.2.7	New subsections.	Including new mechanical design criteria.	Improved equipment operability and maintainability.
Subsection 6.8	New subsection.	New criteria included for fired heater coil tube support materials, when the fuel contains more than 100 ppm Na+V and the design temperature of the supports is greater than 650 °C.	Increased reliability and time life of the equipment.

IMPACT REGISTER FORM (IRF)

[illegible]