

# Standard Technical Specification for Heaters and Furnaces

## 1. Purpose

This specification sets forth the minimum requirements for the design, fabrication, inspection, testing, assembly and supply of the heater and furnace of process units.

## 2. Reference Standards

### 2.1. ISO

8501-1 Steel Surface Preparation before Painting

### 2.2. AISC Standards

AISC 360 Specification for Structural Steel Buildings

### 2.3. API Standards

STD 530 Calculation of Heater tube Thickness in Petroleum Refineries

STD 560 Fired Heaters for General Refinery Services

STD 2218 Fireproofing Practices in Petroleum and Petrochemical Processing Plants

### 2.4. AWS Standards

D 1.1 Structural Welding Code-Steel

### 2.5. ABNT

ABNT NBR 10700 / NBR 10701 Amostragem de Gases em Chaminés

ABNT NBR 6123 Carga de Vento sobre Edificações

### 2.6. Petrobras

[http://sites.petrobras.com.br/CanalFornecedor/portugues/requisitocontratacao/requisito\\_normastecnicas.asp](http://sites.petrobras.com.br/CanalFornecedor/portugues/requisitocontratacao/requisito_normastecnicas.asp)

NI-279 Design of Steel Structures

NI-293 Fabrication and Assembly of Steel Structures

NI-133 Welding

N-1671 Projeto e Fabricação de Forno

NI-1756 Fire Protection Design and Application on Onshore Facilities

NI-1890 Ceramic Fiber Linings

NI-1910 Castable Lining Design

### 2.7. Brazilian Legislation

Normas Regulamentadoras do Ministério do Trabalho e Emprego

<http://trabalho.gov.br/seguranca-e-saude-no-trabalho/normatizacao/normas-regulamentadoras>

NR-14 Norma Regulamentadora Fornos

## 3. General Requirements

3.1. Heaters and Furnaces shall be designed and constructed according to standards related herein.

3.2. Manufacturer shall carry out the CFD – Computer Flow Dynamic Analysis for the burners and plenum installation and also for the Radiation Chamber to verify:

- Adequacy of burner flame envelope to Combustion Chamber;
- Air distribution for each burner;
- Vibration limits.

3.3. Smoke test in furnaces and boilers shall be carried out before start-up and all leakages shall be repaired.

3.4. Interlocking system according to Purchase requirements.

#### **4. Specific requirements**

##### **4.1. Casing and structure**

All framework plates of the heater shall be internal continuous welded, the intermittent or tack welds are forbidden.

The bottom of the heater shall be at 2 meters minimum from the ground, to permit free access of people and easy burner remove.

Manholes shall be provided for inspection and maintenance works of the following sections:

- Upside of the radiant coils;
- Upside of the convection coils;
- Beside the suit blowers.

Manholes shall at lateral sides of the heater, don't put them on the floor or on the bottom.

Manholes shall be installed in the convection zone to let cleaning of pinned tubes during the maintenance works.

Convection zone walls shall have removed panels for easy replacement and to let access to the coils.

The convection layout in front of the plug boxes shall provide an enough space easy access during cleaning of the coils and replacement of tubes or plugs.

The cover of the bent boxes shall be easily removed and accessed.

##### **4.2. Platforms**

4.2.1. Platforms on the fired heaters and at ground level, shall have 440V outlets for services.

4.2.2. Platforms for gas sampling at stacks shall follow NBR 10700 and NBR 10701.

Each sample point shall consist of a nozzle NPS 4 pressure class 150.

Four nozzles diametrically opposed in case of stack with diameter  $\geq 1500$  mm and 2 nozzles for smaller.

The upstream length shall be 2 times of stack diameter, as a minimum, and downstream length with a half stack diameter, as a minimum.

The access platform shall be in front of the sample points and all around with 1000 mm width.

##### **4.3. Stacks or chimneys**

Provide the following facilities to maintenance works of stacks:

- Trolley rail a top;
- Davit at top;
- Ladders up to top access;
- Circumferential platform at top.

The instrument and sample nozzles installed on stack shall be sloped to the interior, in order don't accumulate liquids. The thickness of stack wall at these regions shall be increased.

Provide supports internally of the stack for scaffold assemblage.

##### **4.4. Coil cleaning**

4.4.1. Internal cleaning of radiation and convection tubes shall be made by pigging.

4.4.2. Steam air decking shall be provided on heaters where there is product coking tendency.

4.4.3. Delayed Coker Heaters shall be designed to allow both pigging and on line spalling.

##### **4.5. Air pre-heater**

4.5.1. Whenever possible and viable, the design shall maximize thermal efficiency through air pre-heater system and/or steam generation/superheating, evaluating technical and economical. restrictions.

4.5.2. For heaters with air pre-heater system (except reformer heaters), heat duty shall be 100% achieved even in natural draft operation.

4.5.3. For heaters that use only fuel gas the air pre-heaters shall be plate heat exchange type. If burning fuel oil is possible, rotary type pre-heater (Ljungstrom) shall be selected.

#### **4.6. Refractory lining**

4.6.1. When ceramic fiber is specified as thermal insulation material blankets shall be restricted to header boxes insulation; in radiation section, only modules are allowed.

4.6.2. The refractory lining of the heater shall be provided with an internal coating on the plates to protect from acid corrosion.

4.6.3. Whenever possible the refractory lining of the heater shall be with ceramic fiber.

#### **4.7. Inspection facilities**

4.7.1. The top of radiant zone shall be provided with explosion doors with access to check the operability. Avoid the outlet flue gases impingement anyone at the local.

4.7.2. Inspection windows shall be distributed to allow the visage of the burners and also permit the thermography inspection of radiant coils.

4.7.3. The closing of inspection windows shall be internally with a tempered glass and externally with a dark glass, to protect the inspector from flame radiation. Glasses shall be proper for thermal expansion and easy cleaning. All inspection windows shall be covered by a metallic door.

#### **4.8. Suit blowers**

4.8.1. The suit blowers shall be retractable type and fabricated with quenched stainless steel like AISI 446, with electric motor actuators, programmed and operated from Control Room.

4.8.2. Heater wall refractory lining beside the suit blower shall be protected with stainless sheet to avoid direct impingement by the steam.

#### **4.9. Air pre-heating**

4.9.1. The necessity of a heat recovery system from flue gases thru the stack shall be economically analyzed and if convenient to be used shell and tube air pre-heaters.

4.9.2. When used rotary air pre heater it shall be installed with the support axis at vertical position.

4.9.3. Damper on ducts shall be double action type, pneumatically actuated from ground or neighbor platform.

4.9.4. Dampers of air preheated ducts shall open automatically when the by-pass is actuated.

#### **4.10. Combustibles and burner system**

4.10.1. The guaranteed performance for Low-NOx burners shall be applied just for the main combustible.

4.10.2. Coalescer filters shall be provided for gas combustible burning systems.

4.10.3. The burner pilots shall be ignited by electric device and have a flame detectors.

4.10.4. The oil burners shall have an automatic system to block the combustible in case of flooding to avoid fire.

4.10.5. The block valves of the steam piping for fire extinguishing shall have by-passes manually operated to easy testing and close of the main valve for maintenance, in case of failure.

4.10.6.. The air plenum shall be designed to assure individual air flow for each burner and the isolation of any burner during operation.

4.10.7. The combustible and steam atomization piping connections to each burner shall be with flexible piping.

4.10.8. Oil combustible piping for each burner shall have flow control instrument and viscosity and temperature indicators.

4.10.9. The number of burners shall be determined to let a balanced heat flow reduction during the operation.

4.10.10. Whenever air plenum is not provided it shall be installed noise reducers.

4.10.11. The block valves o the combustible piping shall be quick opening and closing type.

4.10.12. All product or combustible piping shall be provided with flanged connections for easy blinding.

#### **4.11. Radiant and convection coils**

4.11.1. Concerning to steam superheating and steam generation coils, design will not consider zero flow rate condition if it results in significant cost increase. Zero flow rate condition may impact not only on steam coil material, but also on systems and components downstream.

4.11.2. Coils shall be manufactured using ASTM material specification for pipes, and dimensions accordingly to ASME B16.10 (carbon and low alloy steel) and ASME B16.19 (stainless steel).

4.11.3. The radiation coils shall be provided externally with drains to remove the washing water during the maintenance. Beside the hater shall be used neutralization boxes to collect the water effluent.

4.11.4. Each radiant and convection coil shall be individually pressure tested and have proper drain and vents.

4.11.5. Radiant zone temperature shall be monitored to high temperature alarm and interlocked to the combustible feed to stop if necessary.

4.11.6. The tubesheet support of pinned pipes shall be independent from smooth pipes.