

CONTEC

Comissão de Normalização
Técnica

SC-08

Fired Heaters

Fired Heater Data Sheet

Revalidation

Revalidated in 03/2022.

Replace ISO 13075 by API STD 560.

Fired Heater Data Sheet

Standardization

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 nonmandatory 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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Fired Heaters

Introduction

PETROBRAS Technical Standards are prepared by Working Groups - WG (consisting specialized of Technical Collaborators from Company and its Subsidiaries), are commented by Company Units and its Subsidiaries, are approved by the Authoring Subcommittees - SCs (consisting of technicians from the same specialty, representing the various Company Units and its Subsidiaries), and ratified by the Executive Nucleus (consisting of representatives of the Company Units and its Subsidiaries). A PETROBRAS Technical Standard is subject to revision at any time by its Authoring Subcommittee and shall be reviewed every 5 years to be revalidated, revised or cancelled. PETROBRAS Technical Standards are prepared in accordance with PETROBRAS Technical Standard N-1. For complete information about PETROBRAS Technical Standards see PETROBRAS Technical Standards Catalog.

Foreword

This Standard is the English version (issued in 05/2011) of PETROBRAS N-1664 REV. E 12/2010. 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 standardizes two Data Sheet forms in the Annexes A and B for fired heater, to be used in the PETROBRAS designs.

1.2 This Standard applies to designs starting from its issue date.

1.3 This Standard only contains Technical Requirements.

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 (including any amendments) applies.

PETROBRAS [N-381](#) - Execution of Drawing and other General Technical Documents;

PETROBRAS [N-1521](#) - Identification of Industrial Equipment;

PETROBRAS [N-1671](#) - Design and Fabrication of Fired Heater;

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

API [STD 560](#) - Petroleum, Petrochemical and Natural Gas Industries - Fired Heaters for General Refinery Service.

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 Terms and Definitions

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

3.1

heater service

general denomination or the main service of the heater. Example: atmospheric heater, vacuum heater, primary reformer, naphtha vaporizer and others

3.2

heater type

denomination of the structural and tube coil configuration. Example: cylindrical, cabin, box, doublecell box and others

3.3 Process Conditions

3.3.1

operation case

defines the operation condition or the processed load case. Example: normal condition, design condition, emergency condition, naphtha case, gas case and others

3.3.2

heater section

it refers to the physical location of the heater coil. Example: radiant, shield and convection section

3.3.3

service

service of the heater coil at the referred section. Example: process 1, process 2, superheater, vaporizer and others

3.3.4

pressure drop

it shall be calculated for each flow, as being, for all the way travelled by the fluid between two terminal points outside the heater

3.3.5

average flux density

heat absorbed by the coil divided by the exposed circumferential outside area of a determinate coil section or service. Shield tubes shall be specified separately from radiant and convection tubes. Average heat flux density for an extended surface tube shall be indicated on a bare tube surface basis, provided the extension ratio is noted

3.3.6

maximum flux density

it shall be interpreted as the maximum punctual heat transfer rate in a determinate coil section or service, referred to the outside area heating exposed

3.3.7

velocity limitation

it refers to a specific velocity limitation of the process fluid, that the client judges necessary to indicate such as: actual velocity, mass velocity, and others. Proper units shall be specified

3.3.8

maximum allowable inside film temperature

it shall be specified only if localized temperatures are critical with respect to the limit conditions of the process fluid

3.3.9

fouling factor

thermal resistance estimated for the coat that it deposits in the tube surface

3.4 Combustion Design Condition

3.4.1

flue gas temperature leaving radiant section

temperature of the combustion gases leaving the radiant section. Depending on the heater configurations it shall be considered the energy absorbed by the tubes of shield section

3.4.2

flue gas mass velocity through convection section

it shall be based on minimum free-flow area. This area is perpendicular to the gases flow. Extended surfaces (fins and studs) and corbels shall be taken into account when calculating

3.5 Coil Design

3.5.1 Design Pressure

3.5.1.1

elastic design pressure

maximum pressure that the heater coil will sustain for short periods of time

3.5.1.2

rupture design pressure

maximum operating pressure that the heater coil will sustain in continuous operation

NOTE The Rupture Design Pressure is usually less than the Elastic Design Pressure.

3.5.2

design fluid temperature

maximum anticipated bulk temperature in the coil. It shall be used as a basis of flange and header design

3.5.3

maximum tube wall temperature

maximum temperature of the tube wall in a coil. It shall be based on the fluid temperature profile through the coil, fouling factor, and local maximum flux density

3.5.4

type and arrangement of fins or studs

it defines the type of extended surface (example: studs and continuous helicoid fins) and fins or studs arrangement on the tubes (on line or staggered)

3.5.5

spacing of fins and studs

quantity of fins and stud planes per linear length of tube

3.5.6

extension ratio

ratio of total outside exposed surface to outside bare-tube surface before the extended surface is applied

3.6 Lining Refractory

3.6.1 Hot-Face Temperature

3.6.1.1

design hot-face temperature

maximum allowable temperature of the material

3.6.1.2

calculated hot-face temperature

maximum estimated temperature in the operation

3.6.2

refractory layers

It is defined that the first refractory layer is the one in contact with the heater casing

4 General Requirements

4.1 This Standard is founded on the API [STD 560](#) Data Sheet.

4.2 The Data Sheet forms in the Annexes A and B are used to record the purchaser's requirements and the design details of the supplier and, after filled out, it shall constitute a permanent document for the equipment.

4.3 The Data Sheet forms in the Annexes A and B are standardized in the A4 size as shown in the:

- a) Annex A: form with units in the Engineering System;
- b) Annex B: form with units in the International System of Units - SI.

4.4 The requirements of PETROBRAS [N-381](#) shall be met for filling out the heading and footnote of the Data Sheet in the Annexes A and B.

4.5 The applicable Annex of PETROBRAS [N-381](#) shall be used if additional space is required for continuing any item which does not fit in the Annex A or B here to.

4.6 The tag number of the fired heater shall be in accordance with PETROBRAS [N-1521](#) and inserted in the heading space reserved for the title Fired Heater, on the right hand corner.

4.7 The four columns shown on sheets 2/8 to 6/8 of the Annexes A and B allow the identification of process and mechanical characteristics of the various sections and services of the Heater, in addition to the combustion characteristics of one or more fuels.


4.8 Additional sheets shall be used when more than four columns need to be filled out for a full description of the equipment as 4.7.

4.9 PETROBRAS [N-1671](#) and ABNT [NBR 10778](#) shall be used for filling out the Data Sheet in the Annexes A and B.




4.10 In the filling of Data Sheet in the Annexes A and the B the following requirements shall be followed:

- a) to only fill the applicable fields, eliminating, with a horizontal trace, the not applicable fields to the specific project;
- b) in the blank lines, to add eventual complementary data of the specific project.

 PETROBRAS		DATA SHEET		No.		REV.		
		AREA:				SHEET		of
		TITLE:						
		FIRED HEATER						
1	SERVICE:		MANUFACTURER:				REV.	
2	TYPE:		REFERENCE:					
3	NUMBER REQUIRED:							
4	TOTAL HEATER ABSORBED DUTY, 10^6 kcal/h:							
5	PROCESS DESIGN CONDITIONS							
6	OPERATING CASE							
7	HEATER SECTION							
8	SERVICE							
9	HEAT ABSORPTION, 10^6 kcal/h							
10	FLUID							
11	FLOW RATE, kg/h							
12	FLOW RATE, m^3/h @ $^{\circ}C$							
13	PRESSURE DROP, ALLOWABLE (CLEAN/FOULED), kgf/cm^2							
14	PRESSURE DROP, CALCULATED (CLEAN/FOULED), kgf/cm^2							
15	AVG. RAD. SECT. FLUX DENSITY, ALLOWABLE, $kcal/(h.m^2)$							
16	AVG. RAD. SECT. FLUX DENSITY, CALCULATED, $kcal/(h.m^2)$							
17	MAX. RAD. SECT. FLUX DENSITY, $kcal/(h.m^2)$							
18	CONV. SECT. FLUX DENSITY, (BARE TUBE), $kcal/(h.m^2)$							
19	VELOCITY LIMITATION, m/s							
20	PROCESS FLUID MASS VELOCITY, $kg/(s.m^2)$							
21	MAXIMUM ALLOW./CALC. INSIDE FILM TEMPERATURE, $^{\circ}C$							
22	FOULING FACTOR, $h.m^2 \cdot ^{\circ}C/kcal$							
23	COKING ALLOWANCE, mm							
24	INLET CONDITIONS							
25	TEMPERATURE, $^{\circ}C$							
26	PRESSURE, kgf/cm^2 <input type="checkbox"/> GAUCHE <input type="checkbox"/> ABSOLUTE							
27	LIQUID FLOW, kg/h							
28	VAPOR FLOW, kg/h							
29	WEIGHT PERCENT VAPOR							
30	LIQUID GRAVITY, (DEG API) (SP. GR @ $15^{\circ}C$)							
31	LIQUID VISCOSITY, cP							
32	LIQUID SPECIFIC HEAT, $kcal/(kg.^{\circ}C)$							
33	LIQUID THERMAL CONDUCTIVITY, $kcal/(h.m.^{\circ}C)$							
34	VAPOR MOLECULAR WEIGHT							
35	VAPOR VISCOSITY, cP							
36	VAPOR SPECIFIC HEAT, $kcal/(kg.^{\circ}C)$							
37	VAPOR THERMAL CONDUCTIVITY, $kcal/(h.m.^{\circ}C)$							
38	OUTLET CONDITIONS							
39	TEMPERATURE, $^{\circ}C$							
40	PRESSURE, kgf/cm^2 <input type="checkbox"/> GAUCHE <input type="checkbox"/> ABSOLUTE							
41	LIQUID FLOW, kg/h							
42	VAPOR FLOW, kg/h							
43	WEIGHT PERCENT VAPOR							
44	LIQUID GRAVITY, (DEG API) (SP. GR @ $15^{\circ}C$)							
45	LIQUID VISCOSITY, cP							
46	LIQUID SPECIFIC HEAT, $kcal/(kg.^{\circ}C)$							
47	LIQUID THERMAL CONDUCTIVITY, $kcal/(h.m.^{\circ}C)$							
48	VAPOR MOLECULAR WEIGHT							
49	VAPOR VISCOSITY, cP							
50	VAPOR SPECIFIC HEAT, $kcal/(kg.^{\circ}C)$							
51	VAPOR THERMAL CONDUCTIVITY, $kcal/(h.m.^{\circ}C)$							
52	NOTE(S):							
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THIS FORM IS PART OF PETROBRAS N-1664 REV. E ANNEX A - SHEET 02/08.

 PETROBRAS	DATA SHEET		No.		REV.		
	AREA:				SHEET		
	TITLE:				of		
FIRED HEATER							
1	COMBUSTION DESIGN CONDITIONS						REV.
2	OPERATING CASE						
3	TYPE OF FUEL						
4	EXCESS AIR, %						
5	CALCULATED HEAT RELEASE (LHV), 10 ⁶ kcal/h						
6	FUEL EFFICIENCY, CALCULATED, % (LHV)						
7	FUEL EFFICIENCY, GUARANTEED, % (LHV)						
8	RADIATION LOSS, PERCENT OF HEAT RELEASE (LHV)						
9	FLUE GAS TEMPERATURE LEAVING RADIANT SECTION, °C						
10	CONVECTION SECTION, °C						
11	AIR PREHEATER, °C						
12	FLUE GAS QUANTITY, kg/h						
13	FLUE GAS MASS VELOCITY THRU. CONVECTION SECTION, kg/(s.m ²)						
14	DRAFT: AT ARCH, mm H ₂ O						
15	AT BURNERS, mm H ₂ O						
16	AIR TEMPERATURE, LEAVING AIR PREHEATER, °C						
17	AMBIENT AIR TEMPERATURE, EFFICIENCY CALCULATION, °C						
18	ALTITUDE ABOVE SEA LEVEL, m						
19	VOLUMETRIC HEAT RELEASE (LHV), kcal/(h.m ³)						
20	FUEL CHARACTERISTICS						
21	GAS TYPE:		LIQUID TYPE:		OTHER TYPE:		
22	LHV:	kcal/kg	LHV:	kcal/kg	LHV:	kcal/kg	
23	HHV:	kcal/kg	HHV:	kcal/kg	HHV:	kcal/kg	
24	P. GAUGE @ BURNER:	kgf/cm ²	P. GAUGE @ BURNER:	kgf/cm ²	P. GAUGE @ BURNER:	kgf/cm ²	
25	TEMP. @ BURNER:	°C	TEMP. @ BURNER:	°C	TEMP. @ BURNER:	°C	
26	MOLECULAR WEIGHT:		VISCOSITY @ °C		SSU		
27			ATOMIZING STEAM TEMP.: °C				
28	COMPOSITION	MOLE %	ATOMIZING STEAM P. GAUGE:	kgf/cm ²	COMPOSITION	MOLE %	
29							
30			COMPOSITION	WT %			
31							
32							
33							
34							
35			VANADIUM (ppm)				
36			SODIUM (ppm)				
37			SULFUR				
38			ASH				
39	BURNER DATA						
40	MANUFACTURER:		SIZE/MODEL:		NUMBER:		
41	TYPE:		LOCATION:		ORIENTATION:		
42	HEAT RELEASE PER BURNER, 10 ⁶ kcal/h:		DESIGN:		NORMAL:		
43	PRESSURE DROP ACROSS BURNER @ DESIGN HEAT RELEASE, mm H ₂ O:				MINIMUM:		
44	DISTANCE BURNER CENTER LINE TO TUBE CENTER LINE, mm:		HORIZONTAL:		VERTICAL:		
45	DISTANCE BURNER CENTER LINE TO UNSHIELDED REFRACTORY, mm:		HORIZONTAL:		VERTICAL:		
46	PILOT TYPE:		CAPACITY, kcal/h:				
47	IGNITION METHOD:						
48	FLAME SCANNERS, LOCATION:		NUMBER:				
49	REQUIRED EMISSIONS:		ppmv(d) (CORRECTED TO 3 % O ₂)		NOx: CO: SOx:		
50	kg/(10 ⁶ .kcal) (LHV) (HHV)		UHC:		PARTICULATES:		
51	NOTE(S):						
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 PETROBRAS		DATA SHEET		No.		REV.		
		AREA:				SHEET		of
		TITLE:						
		FIRED HEATER						
1	MECHANICAL DESIGN CONDITIONS						REV.	
2	PLOT LIMITATIONS:			STACK LIMITATIONS:				
3	TUBE LIMITATIONS:			NOISE LIMITATIONS:				
4	STRUCTURAL DESIGN DATA: WIND VELOCITY, m/s:			WIND OCCURANCE:				
5	SNOW LOAD:			SEISMIC ZONE:				
6	MIN. / NORMAL / MAX. AMBIENT AIR TEMPERATURE, °C:			RELATIVE HUMIDITY, %:				
7	HEATER SECTION							
8	SERVICE							
9	COIL DESIGN							
10	DESIGN BASIS TUBE WALL THICKNESS (CODE OR SPEC.)							
11	RUPT. STRENGTH (MINIMUM OR AVERAGE)							
12	DESIGN LIFE, h							
13	DESIGN PRESSURE GAUGE, ELASTIC/RUPTURE, kgf/cm ²							
14	DESIGN FLUID TEMPERATURE, °C							
15	TEMPERATURE ALLOWANCE, °C							
16	CORROSION ALLOWANCE, TUBES/FITTINGS, mm							
17	HYDROSTATIC TEST PRESSURE GAUGE, kgf/cm ²							
18	POST WELD HEAT TREATMENT (YES OR NO)							
19	PERCENT OF WELDS FULLY RADIOGRAPHED							
20	MAXIMUM TUBE METAL TEMPERATURE, (CALCULATED), °C							
21	DESIGN TUBE METAL TEMPERATURE, °C							
22	INSIDE FILM COEFFICIENT, kcal/(h.m ² .°C)							
23	COIL ARRANGEMENT							
24	TUBE ORIENTATION (VERTICAL OR HORIZONTAL)							
25	TUBE MATERIAL (ASTM SPECIFICATION AND GRADE)							
26	TUBE OUTSIDE DIAMETER, mm							
27	TUBE WALL THICKNESS, (MINIMUM) (AVERAGE), mm							
28	NUMBER OF FLOW PASSES							
29	NUMBER OF TUBES							
30	NUMBER OF TUBES PER ROW/NUMBER OF ROWS							
31	OVERALL TUBE LENGTH, m							
32	EFFECTIVE TUBE LENGTH, m							
33	BARE TUBES: NUMBER							
34	TOTAL EXPOSED SURFACE, m ²							
35	EXTENDED SURFACE TUBES: NUMBER							
36	TOTAL EXPOSED SURFACE, m ²							
37	TUBES LAYOUT (IN LINE OR STAGGERED)							
38	TUBE SPACING, CENTER TO CENTER: HORIZONTAL, mm							
39	TUBE SPACING, CENTER TO CENTER: DIAGONAL, mm							
40	TUBE SPACING, CENTER TO CENTER: VERTICAL, mm							
41	SPACING TUBE CENTER TO FURNACE WALL, mm							
42	CORBEL (YES OR NO)							
43	CORBEL WIDTH, mm							
44	DESCRIPTION OF EXTENDED SURFACE							
45	TYPE: (STUDS) (SERRATED FINS) (SOLID FINS)							
46	MATERIAL							
47	DIMENSIONS: HEIGHT, mm							
48	THICKNESS, mm							
49	SPACING, (FINS/m)							
50	MAXIMUM TIP TEMPERATURE, (CALCULATED), °C							
51	EXTENSION RATIO (TOTAL AREA/BARE AREA)							
52	PLUG TYPE HEADERS							
53	TYPE:							
54	MATERIAL (ASTM SPECIFICATION AND GRADE)							
55	NOMINAL RATING							
56	LOCATION (ONE OR BOTH ENDS)							
57	WELDED OR ROLLED JOINT							
58	NOTE(S):							
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 PETROBRAS	DATA SHEET		No.		REV.	
	AREA:				SHEET	
	TITLE:				of	
FIRED HEATER						
1	MECHANICAL DESIGN CONDITIONS (CONT'D)					REV.
2	HEATER SECTION					
3	SERVICE					
4	RETURN BENDS					
5	TYPE					
6	MATERIAL (ASTM SPECIFICATION AND GRADE)					
7	NOMINAL RATING OR SCHEDULE					
8	LOCATION (F.B. = FIREBOX, H.B. = HEADER BOX)					
9	TERMINALS AND/OR MANIFOLDS					
10	TYPE (BEV. = BEVELED, MAN.=MANIFOLD, FLG.=FLANGED)					
11	INLET: MATERIAL (ASTM SPEC. AND GRADE)					
12	SIZE (NPS OR O.D., mm)					
13	SCHEDULE OR THICKNESS, mm					
14	NUMBER OF TERMINALS					
15	FLANGE MATERIAL (ASTM SPEC. AND GRADE)					
16	FLANGE SIZE AND RATING					
17	OUTLET: MATERIAL (ASTM SPEC. AND GRADE)					
18	SIZE (NPS OR O.D., mm)					
19	SCHEDULE OR THICKNESS, mm					
20	NUMBER OF TERMINALS					
21	FLANGE MATERIAL (ASTM SPEC. AND GRADE)					
22	FLANGE SIZE AND RATING					
23	MANIFOLD TO TUBE CONN. (WELDED, EXTRUDED ETC)					
24	MANIFOLD LOCATION (INSIDE OR OUTSIDE HEADER BOX)					
25	CROSSOVERS					
26	WELDED OR FLANGED					
27	PIPE MATERIAL (ASTM SPEC. AND GRADE)					
28	PIPE SIZE (NPS OR O.D., mm)					
29	SCHEDULE OR THICKNESS					
30	FLANGE MATERIAL					
31	FLANGE SIZE/RATING					
32	LOCATION (INTERNAL/EXTERNAL)					
33	FLUID TEMPERATURE, °C					
34	TUBE SUPPORTS					
35	LOCATION (ENDS, TOP, BOTTOM)					
36	MATERIAL (ASTM SPEC. AND GRADE)					
37	DESIGN METAL TEMPERATURE, °C					
38	THICKNESS, mm					
39	INSULATION: THICKNESS, mm					
40	MATERIAL					
41	ANCHOR (MATERIAL AND TYPE)					
42	INTERMEDIATE TUBE SUPPORTS					
43	MATERIAL (ASTM SPEC. AND GRADE)					
44	DESIGN METAL TEMPERATURE, °C					
45	THICKNESS, mm					
46	SPACING, mm					
47	TUBE GUIDES					
48	LOCATION					
49	MATERIAL					
50	TYPE/SPACING					
51	HEADER BOXES					
52	LOCATION: HINGED DOOR/BOLTED PANEL:					
53	CASING MATERIAL: THICKNESS, mm:					
54	LINING MATERIAL: THICKNESS, mm:					
55	ANCHOR (MATERIAL AND TYPE):					
56	NOTE(S):					
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THIS FORM IS PART OF PETROBRAS N-1664 REV. E ANNEX A - SHEET 05/08.

 PETROBRAS	DATA SHEET		No.		REV.	
	AREA:				SHEET	
	TITLE:				of	
FIRED HEATER						
1	MECHANICAL DESIGN CONDITIONS (CONT'D)					REV.
2	REFRACTORY DESIGN BASIS:					
3	AMBIENT, °C:		WIND VELOCITY, m/s:		CASING TEMP., °C:	
4	EXPOSED VERTICAL WALLS					
5	LINING THICKNESS, mm:		HOT FACE TEMPERATURE, DESIGN, °C:		CALCULATED, °C:	
6	WALL CONSTRUCTION:					
7						
8	ANCHOR (MATERIAL AND TYPE):					
9	CASING MATERIAL:		THICKNESS, mm:		TEMPERATURE, °C:	
10	SHIELDED VERTICAL WALLS					
11	LINING THICKNESS, mm:		HOT FACE TEMPERATURE, DESIGN, °C:		CALCULATED, °C:	
12	WALL CONSTRUCTION:					
13						
14	ANCHOR (MATERIAL AND TYPE):					
15	CASING MATERIAL:		THICKNESS, mm:		TEMPERATURE, °C:	
16	ARCH					
17	LINING THICKNESS, mm:		HOT FACE TEMPERATURE, DESIGN, °C:		CALCULATED, °C:	
18	WALL CONSTRUCTION:					
19						
20	ANCHOR (MATERIAL AND TYPE):					
21	CASING MATERIAL:		THICKNESS, mm:		TEMPERATURE, °C:	
22	FLOOR					
23	LINING THICKNESS, mm:		HOT FACE TEMPERATURE, DESIGN, °C:		CALCULATED, °C:	
24	FLOOR CONSTRUCTION:					
25						
26	ANCHOR (MATERIAL AND TYPE):					
27	CASING MATERIAL:		THICKNESS, mm:		TEMPERATURE, °C:	
28	CONVECTION SECTION					
29	LINING THICKNESS, mm:		HOT FACE TEMPERATURE, DESIGN, °C:		CALCULATED, °C:	
30	WALL CONSTRUCTION:					
31						
32	ANCHOR (MATERIAL AND TYPE):					
33	CASING MATERIAL:		THICKNESS, mm:		TEMPERATURE, °C:	
34	INTERNAL WALL					
35	TYPE:		MATERIAL:			
36	DIMENSION, HEIGHT/WIDTH, mm:					
37	DUCTS		FLUE GAS		COMBUSTION AIR	
38	LOCATION					
39	SIZE, m OR NET FREE AREA, m ²					
40	CASING MATERIAL					
41	CASING THICKNESS, mm					
42	LINING: INTERNAL/EXTERNAL					
43	THICKNESS, mm					
44	MATERIAL					
45	ANCHOR (MATERIAL AND TYPE):					
46	CASING TEMPERATURE, °C					
47	PLENUM CHAMBER (AIR)					
48	TYPE OF PLENUM (COMMON OR INTEGRAL):					
49	CASING MATERIAL:		THICKNESS, mm:		SIZE, mm:	
50	LINING MATERIAL:		THICKNESS, mm:			
51	ANCHOR (MATERIAL AND TYPE):					
52	NOTE(S):					
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THIS FORM IS PART OF PETROBRAS N-1664 REV. E ANNEX A - SHEET 06/08.

 PETROBRAS	DATA SHEET		No.		REV.		
	AREA:				SHEET		
	TITLE:				of		
FIRED HEATER							
1	MECHANICAL DESIGN CONDITIONS (CONT'D)						REV.
2	STACK OR STACK STUB						
3	NUMBER:		SELF-SUPPORTED OR GUYED:		LOCATION:		
4	CASING MATERIAL:		THICKNESS, mm:		MINIMUM THICKNESS, mm:		
5	INSIDE METAL DIAMETER, m:		HEIGHT ABOVE GRADE, m:		STACK LENGTH, m:		
6	LINING MATERIAL:				THICKNESS, mm:		
7	ANCHOR (MATERIAL AND TYPE):						
8	EXTENT OF LINING:		INTERNAL OR EXTERNAL:				
9	DESIGN FLUE GAS VELOCITY, m/s:		FLUE GAS TEMPERATURE, °C:				
10	DAMPERS						
11	LOCATION						
12	TYPE (CONTROL, TIGHT SHUT-OFF ETC)						
13	MATERIAL: BLADE:						
14	SHAFT:						
15	MULTIPLE/SINGLE LEAF						
16	PROVISION FOR OPERATION (MANUAL OR AUTOMATIC)						
17	TYPE OF OPERATOR (CABLE OR PNEUMATIC)						
18	PLATFORM						
19	LOCATION	NUMBER	WIDTH	LENGTH / ARC	STAIRS / LADDER	ACCESS FROM	
20							
21							
22							
23							
24							
25	TYPE OF FLOORING:						
26	DOORS						
27	TYPE:	NUMBER	LOCATION	SIZE	BOLTED/HINGED		
28	ACCESS						
29							
30	OBSERVATION						
31							
32	TUBE REMOVAL						
33							
34	MISCELLANEOUS						
35	INSTRUMENT CONNECTIONS:			NUMBER	SIZE	TYPE	
36	COMBUSTION AIR: TEMPERATURE						
37	PRESSURE						
38	FLUE GAS: TEMPERATURE						
39	PRESSURE						
40	FLUE GAS SAMPLE						
41	SNUFFING STEAM/PURGE						
42	O ₂ ANALYZER						
43	VENTS/DRAINS						
44	PROCESS FLUID TEMPERATURE						
45	TUBESKIN THERMOCOUPLES						
46							
47							
48	PAINTING REQUIREMENTS:						
49							
50	INTERNAL COATING:						
51	GALVANIZING REQUIREMENTS:						
52	ARE PAINTER'S TROLLEY AND INCLUDED?:						
53	SPECIAL EQUIPEMENT: SOOTBLOWERS:						
54	AIR PREHEATER:						
55	FAN(S):						
56	OTHER:						
57	NOTE(S):						
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THIS FORM IS PART OF PETROBRAS N-1664 REV. E ANNEX A - SHEET 07/08.


 PETROBRAS	DATA SHEET		No.	REV.
	AREA:		SHEET of	
	TITLE: FIRED HEATER			

1	NOTES	REV.
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THIS FORM IS PART OF PETROBRAS N-1664 REV. E ANNEX A - SHEET 08/08.

<div><div></div><div><div>BR</div></div><div>PETROBRAS</div></div>	DATA SHEET				No.						
	CLIENT:							SHEET			of
	PROGRAM:										
	AREA:										
	TITLE:										
	FIRED HEATER										
INDEX OF REVISIONS											
REV.	DESCRIPTION AND/OR REVISED SHEETS										
	REV. 0	REV. A	REV. B	REV. C	REV. D	REV. E	REV. F	REV. G	REV. H		
DATE											
DESIGN											
EXECUTION											
CHECK											
APPROVAL											
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THIS FORM IS PART OF PETROBRAS N-1664 - REV. F - ANNEX B - SHEET 01/08											

		DATA SHEET		No.		REV.		
		AREA:				SHEET		of
		TITLE:						
		FIRED HEATER						
1	SERVICE:		MANUFACTURER:				REV.	
2	TYPE:		REFERENCE:					
3	NUMBER REQUIRED:							
4	TOTAL HEATER ABSORBED DUTY, MW:							
5	PROCESS DESIGN CONDITIONS							
6	OPERATING CASE							
7	HEATER SECTION							
8	SERVICE							
9	HEAT ABSORPTION, MW							
10	FLUID							
11	FLOW RATE, kg/h							
12	FLOW RATE, m ³ /h @ °C							
13	PRESSURE DROP, ALLOWABLE (CLEAN/FOULED), kPa							
14	PRESSURE DROP, CALCULATED (CLEAN/FOULED), kPa							
15	AVG. RAD. SECT. FLUX DENSITY, ALLOWABLE, W/m ²							
16	AVG. RAD. SECT. FLUX DENSITY, CALCULATED, W/m ²							
17	MAX. RAD. SECT. FLUX DENSITY, W/(h.m ²)							
18	CONV. SECT. FLUX DENSITY, (BARE TUBE), W/(h.m ²)							
19	VELOCITY LIMITATION, m/s							
20	PROCESS FLUID MASS VELOCITY, kg/(s.m ²)							
21	MAXIMUM ALLOW./CALC. INSIDE FILM TEMPERATURE, °C							
22	FOULING FACTOR, m ² .K/W							
23	COKING ALLOWANCE, mm							
24	INLET CONDITIONS							
25	TEMPERATURE, °C							
26	PRESSURE, kPa <input type="checkbox"/> GAUCHE <input type="checkbox"/> ABSOLUTE							
27	LIQUID FLOW, kg/h							
28	VAPOR FLOW, kg/h							
29	WEIGHT PERCENT VAPOR							
30	LIQUID GRAVITY, (DEG API) (SP. GR @ 15 °C)							
31	LIQUID VISCOSITY, mPa.s							
32	LIQUID SPECIFIC HEAT, kJ/(kg.°C)							
33	LIQUID THERMAL CONDUCTIVITY, W/(m.K)							
34	VAPOR MOLECULAR WEIGHT							
35	VAPOR VISCOSITY, cP							
36	VAPOR SPECIFIC HEAT, kJ/(kg.°C)							
37	VAPOR THERMAL CONDUCTIVITY, W/(m.K)							
38	OUTLET CONDITIONS							
39	TEMPERATURE, °C							
40	PRESSURE, kPa <input type="checkbox"/> GAUCHE <input type="checkbox"/> ABSOLUTE							
41	LIQUID FLOW, kg/h							
42	VAPOR FLOW, kg/h							
43	WEIGHT PERCENT VAPOR							
44	LIQUID GRAVITY, (DEG API) (SP. GR @ 15 °C)							
45	LIQUID VISCOSITY, mPa.s							
46	LIQUID SPECIFIC HEAT, kJ/(kg.°C)							
47	LIQUID THERMAL CONDUCTIVITY, W/(m.K)							
48	VAPOR MOLECULAR WEIGHT							
49	VAPOR VISCOSITY, mPa.s							
50	VAPOR SPECIFIC HEAT, kJ/(kg.K)							
51	VAPOR THERMAL CONDUCTIVITY, W/(m.K)							
52	NOTE(S):							
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THIS FORM IS PART OF PETROBRAS N-1664 REV. E ANNEX B - SHEET 02/08.

		DATA SHEET		No.		REV.		
		AREA:				SHEET		of
		TITLE:						
		FIRED HEATER						
1	COMBUSTION DESIGN CONDITIONS						REV.	
2	OPERATING CASE							
3	TYPE OF FUEL							
4	EXCESS AIR, %							
5	CALCULATED HEAT RELEASE (LHV), MW							
6	FUEL EFFICIENCY, CALCULATED, % (LHV)							
7	FUEL EFFICIENCY, GUARANTEED, % (LHV)							
8	RADIATION LOSS, PERCENT OF HEAT RELEASE (LHV)							
9	FLUE GAS TEMPERATURE LEAVING RADIANT SECTION, °C							
10	CONVECTION SECTION, °C							
11	AIR PREHEATER, °C							
12	FLUE GAS QUANTITY, kg/h							
13	FLUE GAS MASS VELOCITY THRU. CONVECTION SECTION, kg/(s.m ²)							
14	DRAFT: AT ARCH, Pa							
15	AT BURNERS, Pa							
16	AIR TEMPERATURE, LEAVING AIR PREHEATER, °C							
17	AMBIENT AIR TEMPERATURE, EFFICIENCY CALCULATION, °C							
18	ALTITUDE ABOVE SEA LEVEL, m							
19	VOLUMETRIC HEAT RELEASE (LHV), kW/m ³							
20	FUEL CHARACTERISTICS							
21	GAS TYPE:		LIQUID TYPE:		OTHER TYPE:			
22	LHV:	kJ/kg	LHV:	kJ/kg	LHV:	kJ/kg		
23	HHV:	kJ/kg	HHV:	kJ/kg	HHV:	kJ/kg		
24	P. GAUGE @ BURNER:	kPa	P. GAUGE @ BURNER:	kPa	P. GAUGE @ BURNER:	kPa		
25	TEMP. @ BURNER:	°C	TEMP. @ BURNER:	°C	TEMP. @ BURNER:	°C		
26	MOLECULAR WEIGHT:		VISCOSITY @ °C		SSU			
27			ATOMIZING STEAM TEMP.: °C					
28	COMPOSITION	MOLE %	ATOMIZING STEAM P. GAUGE:	kPa	COMPOSITION	MOLE %		
29								
30			COMPOSITION	WT %				
31								
32								
33								
34								
35			VANADIUM (ppm)					
36			SODIUM (ppm)					
37			SULFUR					
38			ASH					
39	BURNER DATA							
40	MANUFACTURER:		SIZE MODEL:		NUMBER:			
41	TYPE:		LOCATION:		ORIENTATION:			
42	HEAT RELEASE PER BURNER, MW:		DESIGN:		NORMAL:			
43	PRESSURE DROP ACROSS BURNER @ DESIGN HEAT RELEASE, Pa:							
44	DISTANCE BURNER CENTER LINE TO TUBE CENTER LINE, mm:		HORIZONTAL:		VERTICAL:			
45	DISTANCE BURNER CENTER LINE TO UNSHIELDED REFRACTORY, mm:		HORIZONTAL:		VERTICAL:			
46	PILOT TYPE:		CAPACITY, MW:					
47	IGNITION METHOD:							
48	FLAME SCANNERS, LOCATION:		NUMBER:					
49	REQUIRED EMISSIONS:		ppmv(d) (CORRECTED TO 3 % O ₂)		NOx:			
50	kg/kJ (LHV) (HHV)		UHC:		CO:			
51	NOTE(S):							
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THIS FORM IS PART OF PETROBRAS N-1664 REV. E ANNEX B - SHEET 03/08.

		DATA SHEET		No.		REV.		
		AREA:				SHEET		of
		TITLE:						
		FIRED HEATER						
1	MECHANICAL DESIGN CONDITIONS						REV.	
2	PLOT LIMITATIONS:			STACK LIMITATIONS:				
3	TUBE LIMITATIONS:			NOISE LIMITATIONS:				
4	STRUCTURAL DESIGN DATA: WIND VELOCITY, m/s:			WIND OCCURANCE:				
5	SNOW LOAD:			SEISMIC ZONE:				
6	(MIN. / NORMAL / MAX) AMBIENT AIR TEMPERATURE, °C:			RELATIVE HUMIDITY, %:				
7	HEATER SECTION							
8	SERVICE							
9	COIL DESIGN							
10	DESIGN BASIS TUBE WALL THICKNESS (CODE OR SPEC.)							
11	RUPT. STRENGTH (MINIMUM OR AVERAGE)							
12	DESIGN LIFE, h							
13	DESIGN PRESSURE GAUCHE, ELASTIC/RUPTURE, kPa							
14	DESIGN FLUID TEMPERATURE, °C							
15	TEMPERATURE ALLOWANCE, °C							
16	CORROSION ALLOWANCE, TUBES/FITTINGS, mm							
17	HYDROSTATIC TEST PRESSURE GAUCHE, kPa							
18	POST WELD HEAT TREATMENT (YES OR NO)							
19	PERCENT OF WELDS FULLY RADIOGRAPHED							
20	MAXIMUM TUBE METAL TEMPERATURE, (CALCULATED), °C							
21	DESIGN TUBE METAL TEMPERATURE, °C							
22	INSIDE FILM COEFFICIENT, W/(m².K)							
23	COIL ARRANGEMENT							
24	TUBE ORIENTATION (VERTICAL OR HORIZONTAL)							
25	TUBE MATERIAL (ASTM SPECIFICATION AND GRADE)							
26	TUBE OUTSIDE DIAMETER, mm							
27	TUBE WALL THICKNESS, (MINIMUM) (AVERAGE), mm							
28	NUMBER OF FLOW PASSES							
29	NUMBER OF TUBES							
30	NUMBER OF TUBES PER ROW/NUMBER OF ROWS							
31	OVERALL TUBE LENGTH, m							
32	EFFECTIVE TUBE LENGTH, m							
33	BARE TUBES: NUMBER							
34	TOTAL EXPOSED SURFACE, m²							
35	EXTENDED SURFACE TUBES: NUMBER							
36	TOTAL EXPOSED SURFACE, m²							
37	TUBES LAYOUT (IN LINE OR STAGGERED)							
38	TUBE SPACING, CENTER TO CENTER: HORIZONTAL, mm							
39	TUBE SPACING, CENTER TO CENTER: DIAGONAL, mm							
40	TUBE SPACING, CENTER TO CENTER: VERTICAL, mm							
41	SPACING TUBE CENTER TO FURNACE WALL, mm							
42	CORBEL (YES OR NO)							
43	CORBEL WIDTH, mm							
44	DESCRIPTION OF EXTENDED SURFACE							
45	TYPE: (STUDS) (SERRATED FINS) (SOLID FINS)							
46	MATERIAL							
47	DIMENSIONS: HEIGHT, mm							
48	THICKNESS, mm							
49	SPACING, (FINS/m)							
50	MAXIMUM TIP TEMPERATURE, (CALCULATED), °C							
51	EXTENSION RATIO (TOTAL AREA/BARE AREA)							
52	PLUG TYPE HEADERS							
53	TYPE:							
54	MATERIAL (ASTM SPECIFICATION AND GRADE)							
55	NOMINAL RATING							
56	LOCATION (ONE OR BOTH ENDS)							
57	WELDED OR ROLLED JOINT							
58	NOTE(S):							
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THIS FORM IS PART OF PETROBRAS N-1664 REV. E ANNEX B - SHEET 04/08.

		DATA SHEET		No.		REV.		
		AREA:				SHEET		of
		TITLE:						
		FIRED HEATER						
1	MECHANICAL DESIGN CONDITIONS (CONT'D)						REV.	
2	HEATER SECTION							
3	SERVICE							
4	RETURN BENDS							
5	TYPE							
6	MATERIAL (ASTM SPECIFICATION AND GRADE)							
7	NOMINAL RATING OR SCHEDULE							
8	LOCATION (F.B. = FIREBOX, H.B. = HEADER BOX)							
9	TERMINALS AND/OR MANIFOLDS							
10	TYPE (BEV. = BEVELED, MAN.=MANIFOLD, FLG.=FLANGED)							
11	INLET: MATERIAL (ASTM SPEC. AND GRADE)							
12	SIZE (NPS OR O.D., mm)							
13	SCHEDULE OR THICKNESS, mm							
14	NUMBER OF TERMINALS							
15	FLANGE MATERIAL (ASTM SPEC. AND GRADE)							
16	FLANGE SIZE AND RATING							
17	OUTLET: MATERIAL (ASTM SPEC. AND GRADE)							
18	SIZE (NPS OR O.D., mm)							
19	SCHEDULE OR THICKNESS, mm							
20	NUMBER OF TERMINALS							
21	FLANGE MATERIAL (ASTM SPEC. AND GRADE)							
22	FLANGE SIZE AND RATING							
23	MANIFOLD TO TUBE CONN. (WELDED, EXTRUDED ETC)							
24	MANIFOLD LOCATION (INSIDE OR OUTSIDE HEADER BOX)							
25	CROSSOVERS							
26	WELDED OR FLANGED							
27	PIPE MATERIAL (ASTM SPEC. AND GRADE)							
28	PIPE SIZE (NPS OR O.D., mm)							
29	SCHEDULE OR THICKNESS							
30	FLANGE MATERIAL							
31	FLANGE SIZE/RATING							
32	LOCATION (INTERNAL/EXTERNAL)							
33	FLUID TEMPERATURE, °C							
34	TUBE SUPPORTS							
35	LOCATION (ENDS, TOP, BOTTOM)							
36	MATERIAL (ASTM SPEC. AND GRADE)							
37	DESIGN METAL TEMPERATURE, °C							
38	THICKNESS, mm							
39	INSTALLATION: THICKNESS, mm							
40	MATERIAL							
41	ANCHOR (MATERIAL AND TYPE)							
42	INTERMEDIATE TUBE SUPPORTS							
43	MATERIAL (ASTM SPEC. AND GRADE)							
44	DESIGN METAL TEMPERATURE, °C							
45	THICKNESS, mm							
46	SPACING, mm							
47	TUBE GUIDES							
48	LOCATION							
49	MATERIAL							
50	TYPE/SPACING							
51	HEADER BOXES							
52	LOCATION: HINGED DOOR/BOLTED PANEL:							
53	CASING MATERIAL: THICKNESS, mm:							
54	LINING MATERIAL: THICKNESS, mm:							
55	ANCHOR (MATERIAL AND TYPE):							
56	NOTE(S):							
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THIS FORM IS PART OF PETROBRAS N-1664 REV. E ANNEX B - SHEET 05/08.

		DATA SHEET		No.	REV.	
		AREA:			SHEET	of
		TITLE:				
		FIRED HEATER				
1	MECHANICAL DESIGN CONDITIONS (CONT'D)				REV.	
2	REFRACTORY DESIGN BASIS:					
3	AMBIENT, °C:		WIND VELOCITY, m/s:	CASING TEMP., °C:		
4	EXPOSED VERTICAL WALLS					
5	LINING THICKNESS, mm:		HOT FACE TEMPERATURE, DESIGN, °C:	CALCULATED, °C:		
6	WALL CONSTRUCTION:					
7						
8	ANCHOR (MATERIAL AND TYPE):					
9	CASING MATERIAL:		THICKNESS, mm:	TEMPERATURE, °C:		
10	SHIELDED VERTICAL WALLS					
11	LINING THICKNESS, mm:		HOT FACE TEMPERATURE, DESIGN, °C:	CALCULATED, °C:		
12	WALL CONSTRUCTION:					
13						
14	ANCHOR (MATERIAL AND TYPE):					
15	CASING MATERIAL:		THICKNESS, mm:	TEMPERATURE, °C:		
16	ARCH					
17	LINING THICKNESS, mm:		HOT FACE TEMPERATURE, DESIGN, °C:	CALCULATED, °C:		
18	WALL CONSTRUCTION:					
19						
20	ANCHOR (MATERIAL AND TYPE):					
21	CASING MATERIAL:		THICKNESS, mm:	TEMPERATURE, °C:		
22	FLOOR					
23	LINING THICKNESS, mm:		HOT FACE TEMPERATURE, DESIGN, °C:	CALCULATED, °C:		
24	FLOOR CONSTRUCTION:					
25						
26	ANCHOR (MATERIAL AND TYPE):					
27	CASING MATERIAL:		THICKNESS, mm:	TEMPERATURE, °C:		
28	CONVECTION SECTION					
29	LINING THICKNESS, mm:		HOT FACE TEMPERATURE, DESIGN, °C:	CALCULATED, °C:		
30	WALL CONSTRUCTION:					
31						
32	ANCHOR (MATERIAL AND TYPE):					
33	CASING MATERIAL:		THICKNESS, mm:	TEMPERATURE, °C:		
34	INTERNAL WALL					
35	TYPE:		MATERIAL:			
36	DIMENSION, HEIGHT/WIDTH, mm:					
37	DUCTS	FLUE GAS		COMBUSTION AIR		
38	LOCATION					
39	SIZE, m OR NET FREE AREA, m ²					
40	CASING MATERIAL					
41	CASING THICKNESS, mm					
42	LINING: INTERNAL/EXTERNAL					
43	THICKNESS, mm					
44	MATERIAL					
45	ANCHOR (MATERIAL AND TYPE):					
46	CASING TEMPERATURE, °C					
47	PLENUM CHAMBER (AIR)					
48	TYPE OF PLENUM (COMMON OR INTEGRAL):					
49	CASING MATERIAL:		THICKNESS, mm:	SIZE, mm:		
50	LINING MATERIAL:		THICKNESS, mm:			
51	ANCHOR (MATERIAL AND TYPE):					
52	NOTE(S):					
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THIS FORM IS PART OF PETROBRAS N-1664 REV. E ANNEX B - SHEET 06/08.

 PETROBRAS		DATA SHEET		No.		REV.		
		AREA:				SHEET		of
		TITLE:						
		FIRED HEATER						
1	MECHANICAL DESIGN CONDITIONS (CONT'D)						REV.	
2	STACK OR STACK STUB							
3	NUMBER:		SELF-SUPPORTED OR GUYED:		LOCATION:			
4	CASING MATERIAL:		THICKNESS, mm:		MINIMUM THICKNESS, mm:			
5	INSIDE METAL DIAMETER, m:		HEIGHT ABOVE GRADE, m:		STACK LENGTH, m:			
6	LINING MATERIAL:				THICKNESS, mm:			
7	ANCHOR (MATERIAL AND TYPE):							
8	EXTENT OF LINING:		INTERNAL OR EXTERNAL:					
9	DESIGN FLUE GAS VELOCITY, m/s:		FLUE GAS TEMPERATURE, °C:					
10	DAMPERS							
11	LOCATION							
12	TYPE (CONTROL, TIGHT SHUT-OFF ETC)							
13	MATERIAL: BLADE:							
14	SHAFT:							
15	MULTIPLE/SINGLE LEAF							
16	PROVISION FOR OPERATION (MANUAL OR AUTOMATIC)							
17	TYPE OF OPERATOR (CABLE OR PNEUMATIC)							
18	PLATFORM							
19	LOCATION	NUMBER	WIDTH	LENGTH / ARC	STAIRS / LADDER	ACCESS FROM		
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22								
23								
24								
25	TYPE OF FLOORING:							
26	DOORS							
27	TYPE:	NUMBER	LOCATION	SIZE	BOLTED/HINGED			
28	ACCESS							
29								
30	OBSERVATION							
31								
32	TUBE REMOVAL							
33								
34	MISCELLANEOUS							
35	INSTRUMENT CONNECTIONS:			NUMBER	SIZE	TYPE		
36	COMBUSTION AIR: TEMPERATURE							
37	PRESSURE							
38	FLUE GAS: TEMPERATURE							
39	PRESSURE							
40	FLUE GAS SAMPLE							
41	SNUFFING STEAM/PURGE							
42	O ₂ ANALYZER							
43	VENTS/DRAINS							
44	PROCESS FLUID TEMPERATURE							
45	TUBESKIN THERMOCOUPLES							
46								
47								
48	PAINTING REQUIREMENTS:							
49								
50	INTERNAL COATING:							
51	GALVANIZING REQUIREMENTS:							
52	ARE PAINTER'S TROLLEY AND INCLUDED?:							
53	SPECIAL EQUIPEMENT: SOOTBLOWERS:							
54	AIR PREHEATER:							
55	FAN(S):							
56	OTHER:							
57	NOTE(S):							
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THIS FORM IS PART OF PETROBRAS N-1664 REV. E ANNEX B - SHEET 07/08.

 PETROBRAS	DATA SHEET		No.	REV.
	AREA:		SHEET of	
	TITLE: FIRED HEATER			

1	NOTES	REV.
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THIS FORM IS PART OF PETROBRAS N-1664 REV. E ANNEX A - SHEET 08/08.

REV. A, B and C

There is no index of revisions.

REV. D

Affected Parts	Description of Alteration
	Revalidation

REV. E

[illegible]