

GENERAL SPECIFICATION

SAFETY

GS EP SAF 227

Safety rules for fired heaters

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General Specification		GS EP SAF 227
Safety rules for fired heaters		
Rev.: 05	Effective date: 05/2015	Page: 2 of 39

Contents

1. Scope	4
1.1 Purpose of the specification	4
1.2 Applicability	4
2. Reference documents	4
3. Reference documents	5
4. Terminology and definitions	6
5. Layout	10
5.1 Location and minimum distances	10
5.2 Hazardous areas	12
5.3 Ventilation	13
5.4 Drainage of liquid spills	13
5.5 Floors and clearances	13
6. Design	15
6.1 General	15
6.2 Heaters structural design	16
6.3 Igniters	16
6.4 Air flow	16
6.5 Dampers and flame arresters	17
6.6 Safety shutdown devices	17
6.7 Stack	19
6.8 Specifics to liquid-fuels	20
6.9 Design validation	20
7. Controls and Safety instruments	20
7.1 General	20
7.2 Process fluids	21
7.3 Combustion	22
7.4 Gas detection	23
7.5 Shutdowns	23
7.6 Alarms	26

General Specification		GS EP SAF 227
Safety rules for fired heaters		
Rev.: 05	Effective date: 05/2015	Page: 3 of 39

7.7	Installation of analysers.....	28
8.	Operating requirements.....	28
8.1	Start-up.....	28
8.2	Dual-fuel operation.....	30
8.3	Shutdowns	30
9.	Fire protection	31
9.1	Fire detection	31
9.2	Fire-proofing	31
9.3	Fire-fighting systems.....	31
Appendix 1	Typical schematics & drawings.....	35
Appendix 2	Typical schematics - Liquid fuel.....	36
Appendix 3	Ignition Logic diagram	37
Appendix 4	Typical safety valves arrangement (Heater with five burners minimum).....	38
Appendix 5	Typical safety valves arrangement (Heater with five burners minimum).....	39

General Specification		GS EP SAF 227
Safety rules for fired heaters		
Rev.: 05	Effective date: 05/2015	Page: 4 of 39

1. Scope

1.1 Purpose of the specification

The purpose of this general specification is to define the safety requirements for the design and installation of fired heaters and associated equipment. There are different types of heaters, and the aim of this specification is to define some basic safe practices applicable in every case unless otherwise stated.

1.2 Applicability

This specification applies to **all types of fuel-fired heaters with a total heat release greater than 100 Kw**, including liquid bath indirect heaters, reboilers and waste incinerators. This specification **is not retroactive**. It shall apply to new installations and to major modifications or extensions of existing installations, both onshore and offshore.

This specification is applicable to typical fired heaters used in the E&P industry such as:

- Glycol reboilers,
- Crude Oil or Process Gas heaters,
- Hot oil or pressurised hot water heaters,
- Steam boilers,
- Molecular sieve dryer regeneration gas heater,
- Incinerators.

This specification **does not cover**:

- Electrical heaters,
- Fired heaters used where chemical reactions take place in the tubular coils,
- Manually operated fired heaters (not applicable for new designs, upgrading requirements for existing units as per [NFPA 85](#) if needed),
- Pulverised coal firing, which is at present not used in Company's upstream facilities,
- Specific safety requirement for fired heaters using premix burners,
- Oxy-combustion equipment using enriched air or pure oxygen,
- Domestic use fired heaters.

2. Reference documents

The reference documents listed below form an integral part of this General Specification. Unless otherwise stipulated, the applicable version of these documents, including relevant appendices and supplements, is the latest revision published at the EFFECTIVE DATE of the CONTRACT.

The applicability of the referenced documents is as follows:

- [ISO 13705 / API STD 560](#) covers the minimum requirements for the design, materials, fabrication, inspection, testing, preparation for shipment, and erection of fired heaters for general refinery service. [ISO 13705 / API STD 560](#) is mainly dealing with combustion

General Specification		GS EP SAF 227
Safety rules for fired heaters		
Rev.: 05	Effective date: 05/2015	Page: 5 of 39

process and mechanical technical matters, and with fabrication, inspection, testing, preparation for shipment, and erection on site. It is **not** devoted to safety or operational matters.

- **NFPA 86** This standard applies to Class A, Class B, Class C, and Class D ovens (refer to chapter 3), dryers, and furnaces, thermal oxidizers, and any other heated enclosure used for processing of materials and related equipment.

Class A, Class B, or Class C oven is any heated enclosure operating at approximately atmospheric pressure and used for commercial and industrial processing of materials.

This standard does not cover to the following:

- (1) Coal or other solid fuel-firing systems,
- (2) Listed equipment with a heating system(s) that supplies a total input not exceeding 44 kW (150,000 Btu/h).

This standard provides the requirements for furnaces to minimize the fire and explosion hazards that can endanger the furnace, the building, or personnel.

- **NFPA 85** code shall apply to single burner boilers, multiple burner boilers, stokers, and atmospheric fluidized-bed boilers with a fuel input rating of 3.7 MW (12.5 million Btu/hr) or greater, to pulverized fuel systems, to fired or unfired steam generators used to recover heat from combustion turbines [heat recovery steam generators (HRSGs)], and to other combustion turbine exhaust systems.

The purpose of this code shall be to contribute to operating safety and to prevent uncontrolled fires, explosions, and implosions in equipment described here above. This code establishes minimum requirements for the design, installation, operation, training, and maintenance of pulverized fuel systems, boilers, HRSGs, combustion turbine exhaust systems, and their systems for fuel burning, air supply, and combustion products removal.

3. Reference documents

The reference documents listed below form an integral part of this General Specification.

External Documents

Unless otherwise stipulated, the applicable version of these documents, including relevant appendices and supplements, is the latest revision published at the effective date of this document.

Reference	Title
ISO 13705 / API STD 560	Petroleum, petrochemical and natural gas industries - Fired heaters for general refinery service
NFPA 12	Standard on Carbon Dioxide Extinguishing Systems
NFPA 17	Standard for Dry Chemical Extinguishing Systems
NFPA 85	Boiler and Combustion Systems Hazards Code
NFPA 86	Standard for Ovens and Furnaces

General Specification		GS EP SAF 227
Safety rules for fired heaters		
Rev.: 05	Effective date: 05/2015	Page: 6 of 39

Total General Specifications

Unless otherwise stipulated, the applicable version of these documents, including relevant appendices and supplements, is the latest revision published in the applicable yearly collection.

Reference	Title
GS EP INS 110	Instrumentation for package units
GS EP SAF 021	Layout
GS EP SAF 216	Area classification
GS EP SAF 228	Liquid drainage
GS EP SAF 253	Impacted area, restricted area and fire zones
GS EP SAF 261	Emergency Shutdown and Emergency De-Pressurisation (ESD & EDP)
GS EP SAF 311	Rules for the selection of fire-fighting systems
GS EP SAF 312	Fire and Gas detection systems
GS EP SAF 322	Fixed fire water systems
GS EP SAF 331	Carbon dioxide fixed fire extinguishing systems
GS EP SAF 334	Foam fire extinguishing systems
GS EP SAF 337	Passive fire protection: Basis of design

4. Terminology and definitions

There are five types of **statements** in this specification, the “shall”, “should”, “may”, “can” and “must” statements. They are to be understood as follows:

Shall	Is to be understood as mandatory. Deviating from a “shall” statement requires derogation approved by Company.
Should	Is to be understood as strongly recommended to comply with the requirements of the specification. Alternatives shall provide a similar level of protection and this shall be documented.
May	Is to be understood as permission.
Can	Is to be understood as a physical possibility.
Must	Expresses a regulatory obligation

Note that “will” is not to be understood as a statement. Its use is to be avoided, unless it is necessary to describe a sequence of events.

For the purpose of this specification, the following definitions shall apply:

General Specification		GS EP SAF 227
Safety rules for fired heaters		
Rev.: 05	Effective date: 05/2015	Page: 7 of 39

Alarm	Audible or visible signal indicating an off-standard or abnormal condition.
Burner	Device or group of devices for the introduction of fuel and air into a heater at the velocities, turbulence, and concentration necessary to maintain ignition and combustion of the fuel within the heater.
Burner, atomising	Burner in which oil is divided into a fine spray by an atomising agent, such as steam or air.
Burner, combination fuel-gas and oil	Burner that can burn either fuel-gas or oil, or both simultaneously.
Burner, dual-fuel	Burner designed to burn either fuel-gas or oil, but not both simultaneously.
Burner, pressure atomising	Burner in which oil under high pressure is forced through small orifices to emit liquid fuel in a finely divided state.
Casing	Metal plate used to enclose a fired heater.
Convection section	Portion of the heater in which the heat is transferred by convection.
Damper	A device for introducing a variable resistance for regulating volumetric flow of flue gas or air (ISO 13705 / API STD 560).
Duct	Conduit for air or flue gas flow.
Flame detector	Device that senses the presence or absence of flame and provides a usable signal.
Flue gas	Gaseous product of combustion including the excess air.
Furnace	Portion of a fired heater enclosure within which the combustion process takes place and wherein the heat transfer occurs predominantly by radiation.

General Specification		GS EP SAF 227
Safety rules for fired heaters		
Rev.: 05	Effective date: 05/2015	Page: 8 of 39

Fired heaters

A vessel in which the temperature of a fluid is increased by the addition of heat supplied by a flame within the vessel (Company from API). Fired heaters is a generic terms that covers all type of heaters including steam boilers, reboilers (flame tube or flue gas tube), indirect heaters (hot oil or hot water), incinerators, etc. Fired heaters are sorted into the following classes:

- **Class A:** A heater that has heat utilisation equipment operating at approximately **atmospheric pressure** wherein there is a **potential explosion or fire hazard** that could be created by the presence of flammable volatile or combustible materials processed or heated in the heater.
- **Class B:** A heater that has heat utilisation equipment operating at approximately **atmospheric pressure** wherein there are **no flammable volatile or combustible materials** being heated.
- **Class C:** A heater that has a potential hazard due to a flammable or other special atmosphere being used for treatment of material in process. Not used in oil and gas production business and not developed further in present specification.
- **Class D:** A heater that operates below atmospheric pressure. Not used in oil and gas production business and not developed further in present specification.

Igniter

Permanent device that provides proven ignition energy to light the main burner immediately. Igniters are further sorted into the following classes:

- **Class 1:** Device applied to ignite fuel input through the burner and to support ignition under any lighting or operating conditions; its energy generally exceeds 10% of the main burner. Igniters, Class 1 can be considered as permanent **pilots**.
- **Class 2:** Device applied to ignite fuel input through the burner and under prescribed lighting conditions; its energy is generally in the 4% - 10% range of the main burner.
- **Class 3:** Device applied to ignite gas and oil burners under prescribed lighting conditions; its energy generally does not exceed 4% of the main burner.
- **Special:** A Class 3 high energy electrical igniter capable of directly igniting the main burner.

Ignition time

Period of time **between** the fuel first entering the combustion chamber **and** the first indication of the flame by the flame detection.

Inerting

Dilution of the oxygen content of an air/fuel mixture through the addition of an inert gas or vapour to a point where it is no longer explosive.

Pass

Flow circuit consisting of one or more tubes in series connected by return fittings or manifolds.

Safety rules for fired heaters

Rev.: 05

Effective date: 05/2015

Page: 9 of 39

Pilot	A flame that is used to light the main burner (NFPA 86). According American vocabulary pilot is equivalent to Igniters, Class 1 (see above) . The wording pilot is often used in an erroneous import to cover any type of igniter. Therefore the use of the word pilot (when referring to fired heaters) shall be avoided and the term igniter shall be used instead.
Purge	Flow of air or inert gas through the furnace , gas passages, and associated flues and ducts that effectively removes any gaseous or suspended combustibles and replaces them with air or inert gas.
Register	Control device in the air duct to set the air flow rate to a burner. Registers, having a control function, are different from dampers used as safety devices an operating on/off.
Restricted area	Area within the boundaries of the installation and hence under the control of Company, which is affected permanently by normal operation of the installation or exceptionally by the consequences of an emergency situation caused by a major failure (Company).
Safety time	Tolerance time during which the effectiveness of a safety device may be impaired without a hazardous condition occurring. For a system comprising burners, this means the following: Safety time, ignition: when starting-up the burner, the period of time between the fuel first entering the combustion chamber and the de-energising of the quick-acting fuel shut-off valve if the flame monitor does not detect a flame. Safety time, main burner: when there is an ignition safety time applicable to an igniter burner only, the period of time between the fuel of the main burner entering the combustion chamber and the de-energising of the quick-acting shut-off valve of the main burner if the flame monitor does not indicate a flame. Safety time, extinction: during operation of the burner, the period of time between the extinction of the flame and the de-energising of the quick-acting shut-off valve.
Soot-blower	Mechanical device for discharging steam or air to clean up heat absorbing surfaces from soot.
Stack	Vertical conduit used to discharge flue gas to the atmosphere.
Unit purge	Air purge rate that is flowed through the unit from the Forced Draught fan through the stack for a period of 2 minutes or 4 changes in volume of the heater enclosure, whichever is longer.
Valve, Safety main fuel trip	Automatically actuated remote valve that shall be accessible even in case of fire and explosion and that closes the main fuel source. Company's practice is to assimilate this valve to an ESDV on P&IDs.

General Specification		GS EP SAF 227
Safety rules for fired heaters		
Rev.: 05	Effective date: 05/2015	Page: 10 of 39

Valve, Safety shut-off Fast-closing valve that automatically and completely shuts-off the fuel supply to main burners or igniters in response to a trip. NFPA uses also the wording "fuel trip valve". Company's practice is to assimilate this valve to a **SDV** on P&IDs.

Valve, Safety shut-off, quick acting Safety shut-off valve closing in less than 1 second.

5. Layout

5.1 Location and minimum distances

5.1.1 Onshore

A heater or a group of heaters shall be located immediately adjacent to an access road and adequate access for fire-fighting from all sides shall be provided. Wherever several heaters are contiguous, they shall be separated from each other by roads of restricted access.

The area under a heater shall be paved and free from hazards so as to allow personnel to move freely. Clearance between ground and heater bottom shall be sufficient to allow access for inspection and maintenance and shall not be less than 0.76 m in all cases. An area extending 2 metres around the heater external wall in all directions shall be free from obstruction by pipe-work, supporting structure, etc.

Fired heaters shall be located outside hazardous areas, at the limit of the process plant. Where possible, heaters shall be up the prevailing winds from process equipment to minimise likelihood of a vapour cloud ignition.

Company's practice is to segregate their installation into fire zones. Process and utilities, liquid hydrocarbon storage, liquefied hydrocarbon storage, wellheads and buildings (LQ, workshops, offices, etc. but not including technical room or control room) shall always be in separate fire zones (refer to [GS EP SAF 253](#)). In this context, **fired heaters shall always be located in the process and utility fire zone** and distance between **fired heater** and other equipment located in other fire zones shall be as per [GS EP SAF 021](#) and [GS EP SAF 253](#). Within the process and utility fire zone, distances between **fire heaters** and other equipment shall be as per table below, unless applicable local regulations impose otherwise:

Safety rules for fired heaters

Rev.: 05

Effective date: 05/2015

Page: 11 of 39

Equipment	Minimum distance (m)
Other fired process heater	7.5
Main pipe-ways main/secondary	30/7.5
Oily water basins	45
Heater ESD valve	15
Electrical/Power station	15/30
Other utilities (air, water, water inj., etc.)	15
Overhead power lines	45
Process equipment	30*
Compression $P > 70$ barg / $P \leq 70$ barg	60 / 30*
Diesel storage	30
Fuel gas skid	30
Main flare header	45
Control room	30
Vents	30**

Note *: Distance increased to 45 metres for heaters larger than 10 MW.

Note **: Indication only; depends upon dispersion and radiation calculation.

5.1.2 Offshore

The general principles exposed above (fire zone segregation and location outside hazardous areas created by other equipment, refer to § 4.1.1) are also applicable offshore.

In addition, **fired heaters** shall be located on the upper deck.

The presence of any equipment above a **fired heater** in a radius of 5 metres extending around its external wall shall be prohibited.

Fired heaters should be preferably grouped with other machinery (gas turbine driven compressors, generator sets, etc.), as far as feasible from process area and upwind (with respect to prevailing wind) from process equipment.

In case of a complex of different platforms, linked together by bridges heaters should also be upwind wellheads platforms and (if any) other process platforms.

If, for reasons of available space, it proves impossible to install the **fired heater** outside the hazardous areas generated by other equipment, the **fired heater** can be shielded from said hazardous area by a fire wall. The fire wall shall be rated H 120 (Refer to **GS EP SAF 337**) for fire resistance and shall offer blast resistance characteristics compatible with the worst heater explosion scenario (blast resistance for an explosion occurring outside the area delineated by the fire wall is not required).

The concept of minimum distance is not applicable in offshore, however a minimum path 3 metres wide shall be left between **fired heaters**, from skid edge to skid edge. In addition **fired**

Safety rules for fired heaters

Rev.: 05

Effective date: 05/2015

Page: 12 of 39

heaters shall be located outside the crane(s) normal swing zones. In the case of a **fired heater** fitted with a flame tube, sufficient room reservation shall be made to allow for maintenance (flame tube dismantling and lay-down).

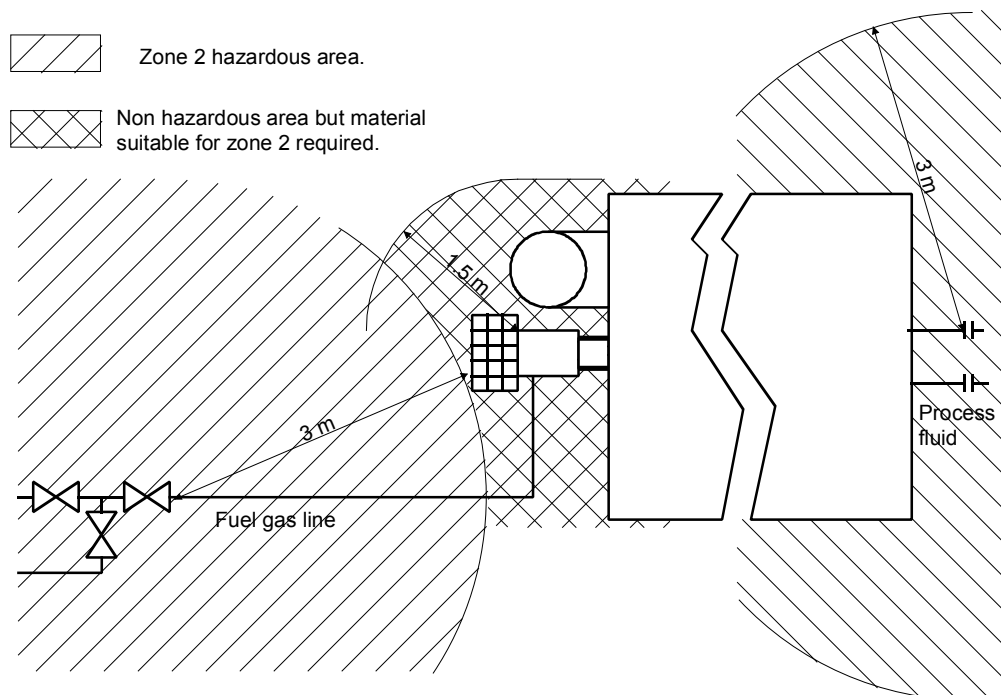
5.2 Hazardous areas

5.2.1 Areas classification

GS EP SAF 216 shall be adhered to. In essence:

- Applicable to all type of **fired heaters** (Class A or Class B) it shall be considered that the fuel gas line(s) and appurtenances (flanges, filters, valves, instrument tapplings, etc.) generate a 3-metre wide Zone 2 classified area around themselves.

Figure 1 - Hazardous areas around fired heaters



- Burners do not generate** classified area and shall therefore be located at least 3 metres off the closest joint pertaining to the fuel gas system (1), however all electrical material located within 1.5 m of the burner shall, be nevertheless suitable for operation in Zone 2 hazardous area.
- As a consequence of what precedes, air intakes for natural draught **fired heaters** can be located in the immediate vicinity of the burner, as long as they are outside the Zone 2 hazardous area generated by the fuel lines.
- Fired heaters** themselves do not generate hazardous area.
- Class A heaters (i.e. flammable substances on the process side) generate a 3-metre wide Zone 2 classified area around the incoming/outgoing process streams flanges. Burners shall be at least 3 metres away from process flanges.