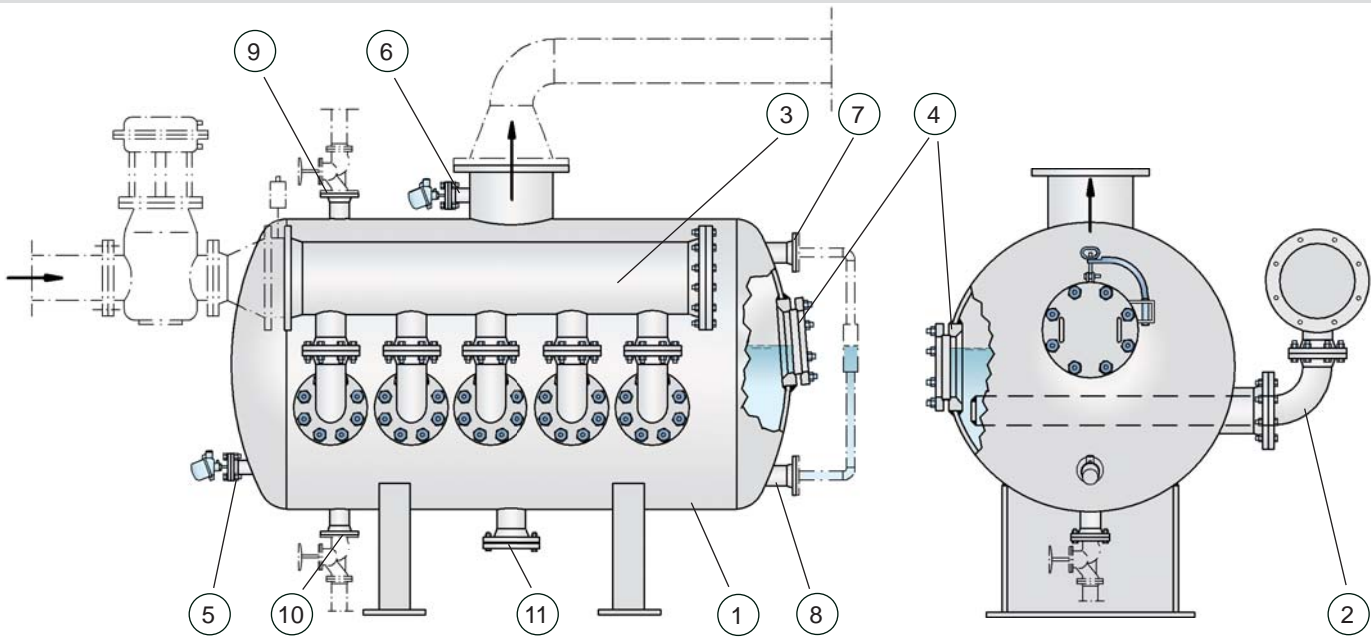


Hydraulic Flame Arresters

deflagration proof, detonation proof and short-time burning proof

PROTEGO® TS/P, TS/E and TS/W



Function and Description

The PROTEGO® hydraulic flame arresters of type TS/... are mainly designed to protect process plants which are connected to waste thermal combustion units. Hydraulic flame arresters of the TS/... series are particularly suitable to protect plants which supply heavily contaminated, sticking, polymerizing or even foaming substances into thermal combustion units. Generally it is necessary to protect the plant against in-line deflagration, stable detonation and endurance burning hazards taking into account the plant's operating conditions.

The PROTEGO® TS/... series of hydraulic flame arresters guarantees flame transmission protection during short time burning, deflagration and stable detonation of gas/air mixtures or product vapour/air mixtures of the relevant explosion groups in all ranges of flammable concentrations up to a service temperature of +60 °C / 140 °F and under an operating pressure up to 1.1 bar / 15 psi (absolute).

Flame arresters of type TS/... are the only hydraulic flame arresters which have been tested and certified for substances of all explosion groups.

Type-approved in accordance with the current ATEX Directive and EN ISO 16852 as well as other international standards.

Hydraulic flame arresters of series TS/... mainly consist of the immersion tank (1) with off gas nozzle and connection nozzles for the sparge pipes, the sparge pipes (2) with elbows and connection flanges as well as the manifolds (3) with connection flanges. To allow measurement of the immersion liquid temperature the tank (1) has a minimum of one nozzle (5), and for measuring the temperature of the off gas there is a minimum of one connection for each exhaust gas nozzle (6) for insertion of temperature sensors. Additionally the tank has two nozzles (7, 8) for level measurement, two nozzles (9, 10) for level control, and one nozzle (11) for draining. Inspection-glasses (4) are included for inspection of the immersion liquid and gas space. The sparge pipes can be pulled out of the hydraulic flame

arrester to allow cleaning of the drill holes and the pipes. At the off gas inlet the manifold has the required flange connection and the relevant number of nozzles for distributing the off gas into required number of sparge pipes.

In PROTEGO® hydraulic flame arresters of type TS/... the flammable mixtures are passed through a water seal with a defined immersion depth. The mixture flow is prorated up and passed to the individual sparge pipes. The sparge pipes have small drill holes and therefore produce defined bubble columns. In case of an ignition in the flowing gas mixture the flame is prevented from transmission into the inlet line. The following parameters have a significant effect on the flame arresting efficiency of the device in case of deflagrations, detonations or short time burning:

- Mixture volume flow,
- Immersion depth from the water seal's surface to the upper edges of the drill holes in the sparge pipes,
- Water temperature in the hydraulic flame arrester
- Sizes, form and density of the bubbles and therefore the precise drill hole diameter in the sparge pipes.

If the mixture ignites under certain operating conditions within the hydraulic flame arrester and burns directly on the liquid surface prevention of flame transmission can only be guaranteed for a limited amount of time. Therefore a number of temperature sensors are installed in the gas space and when reaching a specified temperature they trigger appropriate emergency functions upstream in the system connected (shut down, inerting, etc.).

A high accuracy volume flow meter must be installed as an essential technical safety element. It has to guarantee that the maximum allowable volume flow, on which the design of the hydraulic flame arrester has been based, is recorded and limited so that emergency functions are triggered if the off gas volumes exceed the safe level. In addition, a minimum flame-transmission-proof immersion height is necessary, i.e. an

adequate water level must be guaranteed by suitable measuring equipment.

The pressure loss of a hydraulic flame arrester at maximum volume flow equals losses at inflow and outflow of approximately 12 to 18 mbar / 4.8 to 7.2 In W.C. plus the immersion depth, e.g. 350 mm = 35 mbar / 13.8 In = 14.1 In W.C., so the total is between 47 and 53 mbar / 18.9 and 21.3 In W.C.

Instrumentation

The efficiency and function of the PROTEGO TS/... hydraulic flame arrester requires measurement and control equipment for the filling level, volume flow and temperature of the system. It is necessary to maintain the minimum operating immersion depth and measure the maximum mixture volume flow, maximum gas temperature and minimum water temperature. If the safe operational envelope is exceeded, the measurement and control equipment must quickly initiate automatic emergency functions. Measurement and control safety equipment must be explosion proof and approved for zone 0.

Measurement and control equipment is not part of standard scope of supply.

Maximum Volume Flow

The maximum allowable operating volume flow is calculated by multiplying the number of sparge pipes by the maximum allowable operating volume flow for each sparge pipe at its immersion depth.

In special cases it may not be necessary to measure the volume flow provided that the volume flow limitation is guaranteed by other components in the system such as a conveyor system or a choke in combination with a decompression device.

Level Measurement and Level Control

The operating immersion depth should be kept constant by a controlled automatic water supply so that the level does not fall below the minimum immersion depth.

Temperature Measurement and Limitation

In order to prevent endurance burning in the arrester the off gas supply must be stopped automatically when the temperature exceeds $T = 80^{\circ}\text{C} / 176^{\circ}\text{F}$ at the gas outlet. Temperature sensors monitor the mixture temperature.

If the water temperature falls below $T < 10^{\circ}\text{C} / 50^{\circ}\text{F}$ (danger of freezing) or rises above the limiting temperature in the gas space, a quick action gate valve must shut automatically and stop the off gas supply.

As an option temperature sensors can be supplied.

Design Types and Specifications

The hydraulic flame arresters are designated by explosion groups, diameters and numbers of sparge pipes. They are designed in modules and type tested for the corresponding explosion groups.

For explosion group IIA (NEC group D)

Types TS/P 1000 / 40" or TS/P 2000 / 80"

For explosion group IIB3 (NEC group C)
Types TS/E 1000 / 40" or TS/E 2000 / 80"

For explosion group IIC (NEC group B)
Types TS/W 1000 / 40" or TS/W 2000 / 80"

The number of sparge pipes depends on the design volume flow.

Example: TS/E-1000-5 is a hydraulic flame arrester for substances of explosion group IIB3 (NEC group C) with a diameter of 1000 mm / 40" and 5 sparge pipes.

Dimensions

Standard diameters of TS/... series hydraulic flame arresters are 1000 mm / 40" and 2000 mm / 80". Alternatively diameters from 600 mm / 24" to 3000 mm / 120" are available depending on the off gas volume flow. Hydraulic flame arresters with diameters from 2000 mm / 80" and larger have a restriction plate to prevent wave motions in the sparging zone. All outlet headers and inlet headers as well as internal are components relevant for technical safety, and it is therefore not allowed to change their design and function nor that of the hydraulic flame arrester!

Material Selection

The material selection is determined by the exhaust air process data. Tank designs of steel, stainless steel, coated steel or steel lined with ECTFE or resin are available depending on the application. The sparge pipes are made of stainless, hastelloy or plastic.

Flange Connection Type

The standard flange connections are made to EN 1092-1; Form B1. Optionally, the connecting flanges can be made according to any international standard.

Selection and Design

The static immersion depth and the resistance due to dynamic flow in the sparge pipes and the off gas supply lines create the total pressure loss. The manufacturer's advice about technical safety is absolutely necessary in any case!

For particularly corrosive mixtures the hydraulic flame arrester may be coated. The materials of tank, installations and sparge pipes have to be selected according to the corrosive properties of the mixture.

Data Necessary for Specification

The following operational data is required for the technical safety of the hydraulic flame arrester design:

Off gas volume flow taking into account the maximum possible volume flow (m^3/h or CFH)

Off gas composition (vol.%)

Operating temperature ($^{\circ}\text{C}$ or $^{\circ}\text{F}$)

