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Flares for combustion of biogas

Torchères pour les installations de biogaz

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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This document was prepared by Technical Committee ISO/TC 255, *Biogas*.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

Flares for combustion of biogas are amongst others applied at industrial plants like food and beverage industries, waste water treatment plants, waste plants, landfill sites, small scale plants next to agricultural companies and small-scale household systems.

Biogas is normally a by-product produced by amongst others wastewater treatment plants, food & beverage plants, waste plants, landfill sites, small scale plants next to agricultural companies and small-scale household systems. The main ingredients are approximately 50 ~ 65 volume % of methane and approximately 30 ~ 50 volume % of carbon dioxide and also contains many other ingredients, such as water vapor, hydrogen sulphide, ammonia, nitrogen, oxygen, siloxanes, and hydrocarbons. Methane is one of the main initiators of the greenhouse effect. Biogas will not only pollute the environment, but also causes serious potential safety hazards. Therefore, centralized processing of anaerobic methane is needed. In case the biogas output cannot be used to generate energy or upgraded to biomethane, because of economic reasons or in case the energy production installation does not work properly, the biogas or biomethane is collected and combusted in a flare. The methane percentage of biogas or biomethane to be combusted in a biogas flare can vary from 5 volume % to (almost) 100 volume %. Biogas flares have the function of improving workplace safety, increasing the social identification, reducing the odour pollution and reducing the greenhouse effect.

This document about flares for biogas plants is applicable for combustion of biogas as defined in ISO 20675. The main purposes of this document are to ensure safe flares, to prevent health hazards because of dangerous gases and explosive atmospheres and to reduce the emission of the strong greenhouse gas methane.

The availability of a standard for biogas flares is necessary in order to:

— ensure that flares are built, operated and maintained safely;

— facilitate development of regional and national regulations and incentive programs to regulate methane emissions;

— moderate communication between the different biogas parties through meaningful discussions;

— contribute to reinforcement of biogas flares' safety and business competitiveness with recognized terms and definitions that clarify actors' expectations related to procurement;

— contracts and services as well as reporting on biogas related action plans, road maps, etc.;

— contribute to the use of standards by facilitating their development and furthering users' understanding and application of standards.

Flares for combustion of biogas

1 Scope

This document applies to the design, manufacture, installation and operation of flares for the combustion of biogas. Test methods and performance requirements are also included.

Biogas systems are amongst others applied at industrial plants like food and beverage industries, waste water treatment plants, waste plants, landfill sites, small scale plants next to agricultural companies and small-scale household systems.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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.

ISO 13577-2:2014, *Industrial furnaces and associated processing equipment — Safety — Part 2: Combustion and fuel handling systems*

ISO 13577-4, *Industrial furnace and associated processing equipment — Safety — Part 4: Protective systems*

ISO 16852, *Flame arresters — Performance requirements, test methods and limits for use*

ISO 20675, *Biogas — Biogas production, conditioning, upgrading and utilization — Terms, definitions and classification scheme*

ISO 23551-1, *Safety and control devices for gas burners and gas-burning appliances — Particular requirements*

IEC 60730-2-5, *Automatic electrical controls— Part 2-5: Particular requirements for automatic electrical burner control systems*

IEC 60730-2-6, *Automatic electrical controls— Part 2-6: Particular requirements for automatic electrical pressure sensing controls including mechanical requirements*

IEC 62305-2, *Protection against lightning — Part 2: Risk management*

IEC 60079-10-1, *Explosive atmospheres — Part 10-1: Classification of areas — Explosive gas atmospheres*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 20675 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

3.1
open flare
biogas flare from which the burning flame is visible from outside

Note 1 to entry: This is also called external combustion flame burner.

Note 2 to entry: The flame burner combustion is not optimal, the combustion temperature is relatively low.

3.2
enclosed flare
biogas flare which consists of an enclosed combustion chamber, where the flame is invisible from outside

Note 1 to entry: An enclosed flare is normally burning more efficiently with a relatively higher temperature than an *open flare* (3.1), and the burning temperature is sometimes monitored, for example by a temperature sensor such as a thermocouple.

3.3
ignition device
device for automatically igniting the flame in a biogas flare consisting of an ignition transformer, ignition electrode, fuel gas source and its connecting cables, gas pipes, gas nozzle and valves

3.4
flame monitoring device
device consisting of an ultraviolet flame sensor, ionization sensor, similar and flame transmitter to monitor the flame burning status of the biogas flare continuously

3.5
primary air coefficient
ratio of premixed air versus the total flow of air and biogas supplied to a flare

3.6
turn-down ratio
ratio of the maximum combustion flow where the flame is stable and not going outside the flare and the minimum flow

3.7
burning residence time
retention time of biogas in the combustion chamber for an effective oxidation of hydrocarbons

3.8
burner control unit
stand-alone automatic safety system which includes an ignition transformer, ignition electrodes, flame monitoring device, ignition or pilot solenoid valve, main gas valve and all other valves and safety equipment needed to ignite the flame and to monitor the presence of the flame continuously

3.9
combustion yield
percentage of a substance which is combusted

Note 1 to entry: In this document the combustion yield refers to the percentage of methane which is combusted in a biogas flare.

4 Abbreviated terms

AA	Aluminum Alloy
AISI	American Iron and Steel Institute
CO_2	Carbon dioxide
DN	Diameter of Nominal
H_2S	Hydrogen Sulphide
IEC	International Electrotechnical Commission
IP	Ingress Protection

ISO	International Organization for Standardization
ppmv	parts per million by volume
TBT	Technical Barriers to Trade
URL	Uniform Resource Locator
UV	Ultraviolet
WD	Working Draft
WG	Working Group
WTO	World Trade Organization

5 Classifications of flares for combustion of biogas

Biogas is produced by anaerobic digestion of organic matter, gasification of biomass or power to gas from biomass sources.

Biogas mainly comprises methane (range from 15 volume % to 100 volume %), carbon dioxide, nitrogen, oxygen, hydrogen sulphide and/or water and furthermore could contain hydrogen, carbon monoxide, heavier hydrocarbons (including aromatic hydrocarbons), siloxanes and/or other substances.

Biogas can be treated in order to eliminate hydrogen sulphide, siloxanes, water and other substances and be upgraded to a gas with higher methane content. Sometimes the biogas will be pressurized.

A biogas flare can be applied as a safety, environmental and/or process device.

A flare could be used if the biogas produced in biogas plants is not suitable for energy generation or the biogas plant is not functioning properly. A flare can also be applied in case production of energy out of biogas is not feasible and/or for landfill sites with a low percentage of methane.

A typical flare consists of e.g. an ignition system, flame and temperature detection system, flame arrester, windscreen or windproof body and combustion chamber, biogas piping, valves, condensate drainage, electrical control cabinet, installation fixtures, burner head, heat insulation and continuous pilot or start-up ignition burner.

NOTE Direct ignition on the main burner increases the risks and is not allowed in most countries.

A flare can be classified into three main categories: open flare, enclosed flare and enclosed high efficiency flare. The requirements for these categories are as follows:

— An open flare is classified as a flare from which the burning flame is visible from outside. This is also called external combustion flame burner. The flame burner combustion is not optimal, the combustion temperature is relatively low.

— An enclosed flare is classified as a flare which consists of an enclosed combustion chamber, where the flame is invisible from outside. An enclosed flare burns more efficiently with a relatively higher temperature than an open flare, and the burning temperature can be monitored.

— An enclosed high efficiency flare is classified as a flare which consists of an enclosed combustion chamber, where the flame is invisible from outside and the biogas is combusted at a monitored and automatically controlled temperature and retention time which has been scientifically proven to result in the combustion yields mentioned in 6.1 Furthermore, other technologies, such as radiant burner technologies or pre-mixed burners, exist to achieve the combustion yields mentioned in the next chapter.

A flare can be operated continuously (more than 90 % of the hours per year) or in emergency situations. An emergency flare is meant to combust biogas during exceptional situations when the biogas is not utilized. Emergency flares can be either an enclosed flare, enclosed high efficiency flare or open flare. Continuously operated flares can be of the type enclosed flare or enclosed high efficiency flare.

In order to meet climate policy targets, enclosed high efficiency flares should be applied in case of continuous operation.

6 Design and construction of flares for combustion of biogas

The minimum requirements for the design and construction of safe and minimized methane emission flares for combustion of biogas are described in this Clause. Safety regulations on construction sites during construction are not part of this document.

6.1 Efficiency of the flare

The combustion yield of the flare shall be at least:

— 99 % for enclosed flares, and

— 99,99 % or less than 10 mg CH_4/Nm^3 in flue gas at a reference of 15 vol % oxygen for enclosed high efficiency flares.

These yields need to be measured on a continuous or regular performance basis by an independent party, using standardized or scientifically proven measurement methodologies which prove that the measured values are representative for the operation of the flare. National standards might impose additional requirements on combustion yields and/or additional protocols for measurement.

Measurement methods have to be scientifically supported (which often is the case for methods included in National or International Standards), to prevent measurements which are not representative for the operation of the flare. Scientifically proven combustion yields shall be proven by measurements.

The flare shall be able to combust the minimum and maximum flow and composition of biogas (or biomethane) expected at the particular installation.

6.2 Pressure

The flare can use the biogas pressure system of the biogas plant to realize sufficient pressure of the biogas if possible and to prevent the use of an additional compressor or blower. When the gas pressure is very low (less than 1,0 kPa or 2,0 kPa) or not stable, an additional compressor or blower may be needed. Generally, the minimum pressure is 1,0 kPa and the maximum pressure is depends on the manufacturer.

The biogas main inlet pipe can be equipped with one or more pressure switches in order to realize pressure sensing automatic ignition. The pressure shall be adjustable over a range reflecting the actual operation of the system. When the pressure achieves the high limit, the flare turns on, when the pressure reaches the low pressure limit the flare shuts down. The supplier of the flare shall determine a safe operating shut-down point in order to prevent a vacuum drawing the flame into the digester. Systems with constant pressure gas holders, such as dual membranes, shall use the gas holder level signal and/or biogas pressure signal to determine the start and stop points of the flares.

Pressure detectors for safety shall comply with IEC 60730-2-6 and the function shall meet the requirement of the protective system according to ISO 13577-4.

6.3 Air supply and gas flow

For the air supply natural draft may be used in order to avoid an additional combustion air blower leading to additional operational requirements. High efficiency flares may utilize air injection for pre-mixing. The flare should be designed in a way to realize sufficient air supply in relation to the gas supplied via the gas burner (for example louvers can be used). The burner design shall enable pre-mixed combustion. The air and the biogas are mixed in order to increase the combustion temperature and reduce the flame length. Alternative technologies to supply air can be used, as long as the applicable combustion yields are achieved. When the flare stops working the gas supply shall be stopped before the air supply is stopped.

6.4 Pilot burner

An ignition burner or pilot burner (next to the main burner) shall be used for auxiliary ignition to prevent the potential explosion danger. The ignition device source can be biogas or bio methane itself or other fuel gas. For safety reasons it is important the gas is combustible.

In some countries it is forbidden to use biogas as fuel for the pilot burner, for example because biogas can be less reliable for a pilot burner, especially in the case of a cold climate or variable feedstocks. In other countries other fuel gases might not be available, so biogas or biomethane is the only option. National legislation shall be reviewed before choosing the type of fuel for the pilot burner.

6.5 Treatment of the gas

The biogas may be treated before combustion in the flare. This depends on the specification of the biogas (composition of the biogas) and the materials used.

The following treatments can be performed:

— desulfurization;

— dewatering;

— removal of siloxanes;

— removal of carbon dioxide (as part of possible biogas upgrading);

— pressurizing.

Flares designed specifically for biogas normally do not require treatment, although it may be required by national emissions regulations, especially regarding sulphur.

6.6 Materials

Materials of construction should be designed to resist heat and corrosion that the particular portion of the flare will see.

Materials in contact with the biogas, such as piping materials, shall be stainless steel AISI 304 or AISI 316, at least AISI 304 when the H_2S concentration is lower than 300 ppmv and stainless steel AISI 316 in case the H2S concentration is 300 ppmv or more. AISI 304 is allowed for materials in contact with biogas with a H2S concentration between 300 ppmv and 600 ppmv in case an independent expert can prove the material is resistant for such concentrations in the specific circumstances.

For valves, drip traps, and flame arresters in the line up to the flare, low copper aluminium (AA-356) is an acceptable material.

Supporting structures should be made of hot dip galvanized steel or stainless steel AISI 304 or AISI 316. The materials of the internally insulated combustion chamber can be AISI 304 or AISI 316.

The main body of the flame burner (directly in contact with the flames) should be high temperature resistant stainless steel (anti-corrosion materials), AISI 309 or 310. An alternative for materials in contact with combustion heat is AISI 347.

The main gas control valve material of flame burner should be made of corrosion resistant materials or should have sufficient corrosion allowance (e.g. applicable for cast iron steel). For the seal fluorine rubber or nitrile-base rubber are suitable for use. Except AISI 304 or AISI 316 also AA 356 is suitable as corrosion resistant material.

For enclosed flares when a lining or refractory ceramic fibre module is used, a top rain cover shall be used to prevent erosion or corrosion of the material. When a stainless-steel body is used there is no need to apply a rain cover. If the flare has a refractory lining, protection of rain ingress shall be applied to protect the refractory.

The materials of the structure, the burner, the combustion chamber and the pipes shall be designed with a life time of at least ten years based upon the composition of the gas for the specific location.

6.7 Flame arresters

The flare shall have a flame arrester placed between the main gas valve and the burner to prevent propagation of the flames to the gas source and/or the gas storage. Flame arresters shall be in accordance with ISO 16852.

The distance between the flame arrester and the gas burner shall not exceed the value specified by the supplier of the flame arrester.

In order to prevent detrimental effects to the gas source and/or gas storage caused by possible sparks from equipment such as compressors or blowers, it is recommended to place an additional flame arrester upstream of this equipment.

One or more additional flame arresters are needed in cases where sparks from equipment can cause risks to the gas source and/or gas storage. For example, this can be the case if the equipment is upstream from the maximum distance between flame arrester and gas burner, as mentioned before.

Many types of flame arresters can only stop a flame for a prescribed period of time. The flame arresters shall either be equipped with some means of thermal shut-off that is activated by a continuous burn on the flame arrester or alternatively the burner nozzle pressure shall be monitored and switch off when the flare burner pressure falls below a specified value to prevent back burning.

Flame arresters shall be maintained on a regular basis and for this reason shall be equipped with manual valves.

6.8 Burner control unit, ignition transformer, flame monitoring device

The flare shall be equipped with an automatic burner control unit in order to start and monitor the combustion process. The automatic burner control unit shall comply with IEC 60730-2-5.

The burner control unit shall consist of a shut-off valve for the main gas line, a shut-off valve for the ignition gas line and a flame detector. Furthermore, it consists of an ignition transformer, ignition electrodes, flame monitoring device, ignition or pilot solenoid valve and other safety equipment needed to ignite the flame and to monitor the presence of the flame continuously.

The ignition transformer transmits a high voltage to a spark rod, spark plug or ignition electrodes. Cables that have been properly sized and insulated for the output voltage of the ignition transformer shall be used. An ultraviolet sensor or similar device is used to monitor the status of the flame (flame monitoring device). When no flame is detected the safety shut-off valve shall be closed immediately.

6.9 Safety valves and other valves

Safety shut-off valves shall be installed in the line going to the flare. The shut off valve shall be actuated pneumatically, hydraulically, electrically, or should be a diaphragm valve actuated by the biogas pressure, with means for electrically closing the valve.

The safety shut down valve shall be activated to prevent unsafe conditions at the flare. At a minimum it shall shut based on detecting a flame or high or low pressure.

If a by-pass flare is used to facilitate maintenance, this by-pass flare line shall have the same safety devices as the primary biogas supply line.

Automatic valves shall be quick-shut-off type pneumatic valve, slow or hydraulic slow opening- quick closing valve, in order to prevent the danger of flame back flash. For larger enclosed flares (>DN40), hydraulic slow opening and quick shut off valve both are recommended, for quick close purposes, proper valves shall be selected. Safety valves shall also prevent also an uncontrolled influx or air into the gas system.

Manual or automatic valves shall be placed at strategic locations in order to insulate (block-in) parts of the process for maintenance.

A manual valve shall be installed in order to stop the gas flow in case of emergencies or to enable maintenance. The valve shall be quarter-turn in order to minimize the time required to operate in case of emergency.

To avoid creating an explosive atmosphere inside the flare pipework in accordance with IEC 60079-10-1 there shall be at least two automatic (safety) valves (refer to ISO 23551-1) in series in the pipework leading to the flame. The automatic (safety) valves shall fulfil the requirements of ISO 13577-2:2014, 4.2.2.6.

Furthermore, an automatic valve shall be present to open or stop the main gas flow. This valve shall be closed when gas detection or leak detection alarm signals are created.

6.10 Control system

The control system of the flare shall include the automatic burner control system, ignition or pilot control system, shut-off valves and flame detector. The safety system shall be an independent system. An independent manual control system shall guarantee the safety. The manual control system can open or close the pipes to the flare manually in case of emergencies.

The control system shall be connected to the pipeline pressure signals and gas holder pressure signals. The flame burner reduction is accounted for the proportion of maximum burning flow and minimum burning flow (flame is invisible at outside).

The automatic control system shall be able to achieve functions as follows: the flare can be controlled manually or remotely according to the following signals: gas holder level signal, and/or biogas pressure signal. The operation status signal i.e. combustion OK, valve open, fault etc., can be displayed and transferred to the control unit, including a maximum of four automatic restarts after which a qualified maintenance provider shall investigate the failure.

The design of the control cabinet depends on customer's demand. The control cabinet shall be equipped with heating devices, automatically start when the temperature is below 5 °C and should be located outside the explosion zone. The cabinet shall be equipped with sufficient ventilation provisions.

For control cabinets installed outdoors, its protection grade should not be less than IP55 plus a rain cover or roof. Also electrical equipment and cables shall be suitable for outdoor application. The location of control cabinets shall be selected considering national standards specifically regarding classification of hazardous areas.

The longitude of the signal cable which transfers the flare transmitter signal should not be over 50 meters and electromagnetic interference shall be avoided.

6.11 Flow measuring and gas analysis

For flares with a capacity of more than 100 Nm^3 biogas per hour a flow meter shall be present in order to register the quantity of gas in the burner. This flow meter is not necessary placed directly next to the flare, it is also allowed to deduct the flow by calculations from a flow meter elsewhere in the biogas system. This flow meter shall be calibrated at a frequency specified by the supplier, a common frequency is every two years. The requirement for a flow meter is not applicable for emergency flares (less than 10 % of the hours per year) with a capacity of less than 500 Nm^3 biogas per hour.

The efficient combustion of methane shall be monitored, for example by measuring the methane content of the biogas to ensure the right ratio of methane and oxygen or the temperature of the flue gas

6.12 Condensate removal

Accumulation of water in the flare system and pipes shall be prevented. At the bottom of the flare device, a drainage device shall be installed to collect and discharge the condensate water. The device for discharging condensate water shall be designed in a way that no biogas will escape. Equipment and instructions for condensate removal shall focus on preventing the escape of biogas as much as possible.

6.13 Insulation and heating

On locations where frost can occur, equipment, pipes, valves and other equipment and instruments which can contain humid gas or condensate shall be insulated and/or heated (for example by tracing) sufficiently.

6.14 Heat protection

At the bottom of the flare a protection shield shall be used if needed to prevent safety risks because of heat materials. The flare height should be calculated based on ground level radiant heat to ensure that personnel are properly protected when working around the flare.

6.15 Buildings and cabinets

In case (a part of) the equipment is installed in rooms, appropriate ventilation measures shall be taken in order to prevent gases are accumulating taking into account the different densities of the constituents in biogas (methane, carbon dioxide, hydrogen sulphide, etcetera).

National authorities can impose requirements for the rate of ventilation per hour to determine the room as non-hazardous regarding explosions. In contexts where such requirements are not fulfilled or not present, all electrical equipment shall be explosion proof.

Floors of these buildings and cabinets shall be tight and sealed in order to prevent leakages of fluids such as compressor oil and to prevent soil pollution.

Heating measures shall be taken in order to prevent damage in geographical areas with low ambient temperatures (e.g. frost).

6.16 Lightning protection and earthing

The flare shall be protected against lightning and properly earthed in accordance with IEC 62305-2 and good industrial practices. The foundations and structures shall comply with the outcome of the before mentioned calculations.

6.17 Strength and stability calculations

Before installation of the flare and the civil foundation strength and stability calculations shall be executed by a suitable and certified company or authority, taking into consideration amongst others weights, soil conditions, wind loads and earth quakes. For projects with big wind load, additional support can be used. National legislation shall be considered for the strength and stability calculations and for the way of executing the calculations.

6.18 Distances to other objects

The minimum distances between flares on the one hand and digesters, gas storage, buildings etcetera on the other hand in combination with the height of flares and other objects are mentioned below. There can be deviation from the minimum distances specified if thermal radiation calculations show that smaller distances are safe.

For the open flare, consideration should be given to the fire protection distance, the flare installation height and the influence of thermal radiation. A thermal radiation calculation shall prove that the applied distances are safe for human beings. For the enclosed flare, the main body of the flare height is mainly considered concealing and insulating the flame.

— The flame or the flue gas outlet height should be at least 4 m.

— The radius of 5 m around the flare shall be kept free of combustible materials (such as bushes, trees). The distance to buildings and traffic routes shall be at least 5 m for enclosed types. Exceptions can be made after completion of thermal radiation calculations by an independent expert. For open gas flares and high throughput flares greater distances are usually necessary.

The required safety distances between gas flares and e.g. gas holders and hazardous areas shall be observed. The gas flare should be positioned in a way that the flame is blown away from the gas holder, buildings and traffic routes taking the prevailing wind direction into account.

A biogas flare shall not be placed on the lowest point of the direct surroundings.

7 Operations and maintenance requirements

7.1 Operations and maintenance manual

The manufacturer of the flare shall develop and provide the user a manual for operations and maintenance in English and in the local national language where the flare will be installed.

This manual shall describe at least the following:

— Safety instructions

— Emergency procedures

— Risks of operation

— Operations instructions (a.o. procedures for start and stop)

— Monitoring and logbooks

— Maintenance schedules

— Regular inspections

— Efficiency evaluations

7.2 Testing of the flare

Before site acceptance tests described below all vessels, piping and valves shall be tested at no less than 1,5 times the maximum operating pressure with an allowed deviation of +/−10 % for at least one hour.

Before initially starting up the flare (and also before starting up after shut down, modifications and maintenance) the automatic leak detection (and if applicable gas detection) shall be tested as well as the function of the automatic safety shut-off valve of the flare and the generation of alarms. This can be tested in the software before starting up with gas. The automatic valve shall be opened and closed automatically based upon the specified pressures.

The purging of the flare with inert gas shall be tested before starting operations with gas or biogas.

Often the flare is part of another gas installation and the flare shall start automatically in case of emergencies. These automatic starts shall be tested to ensure they are operating properly.

The automatic burner control system shall be tested by executing the following steps:

— start conditions before validation

— air supply starts (if applicable)

— ignition line solenoid valve opens → electrode produces spark

— pilot burner starts

— pilot flame is detected by flame monitoring device → electrode stops sparking →

— open main gas valve

— establish the main burning flame

— normal combustion (automatic or manual adjustment of the burning load)

— the main fire flame extinction (including the main fire flame failure)

— close gas supply

— close air supply (if applicable)

— purge the pipes and combustion chamber (if applicable) downtime.

7.3 Operation of the flare

Operators are not allowed to manually operate the flare, unless all proper safety provisions are enabled during manual operation.

To avoid burns and other accidents operators and other personnel shall be prevented from touching devices or materials having high temperatures. Operators and maintenance staff shall be properly trained and instructed. Specific attention during the training shall be paid to safety aspects of toxic substances in biogas especially for the hazards associated with hydrogen sulphide H_2S and ammonia (NH_3), which differ from natural gas.

The flare shall be permanently ready for operation and be able to combust the maximum biogas production.

After unsuccessful start-up or a failure, a maximum four (4) restarts are allowed, after which a qualified maintenance provider shall investigate the failure.

When the flare stops on purpose or due to a breakdown (or electrical power supply failure), the gas supply valve shall always be closed.

Venting via emergency vent is an ultimate remedy in case of an emergency and the biogas cannot be applied in a different way and cannot be combusted by a flare. The emergency vents shall have different controls in order to ensure equipment can be protected at all times. Emergency vents shall be designed to ensure safe release of raw biogas. This would include evaluation of adequate height and location.

7.4 Maintenance and inspection of the flare

The flare system shall be inspected by a qualified service provider on a regular basis in order to determine deterioration of materials, valves, gaskets, instruments etcetera. The frequency of these inspections shall be described in the operations manual by the supplier before the start of the operation. A yearly inspection by a qualified service provider is recommended.

Before the start of maintenance an operator or maintenance technician shall make sure that the valves of gas supply are closed and properly locked and tagged (lock out tag out procedures), the temperatures of materials are safe, the absence of gases and the percentage of oxygen are detected and it has be made