INTERNATIONAL STANDARD

ISO 22580

First edition
2020-07

Flares for combustion of biogas

Torchères pour les installations de biogaz

Reference number
ISO 22580:2020(E)

Contents

Page

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

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).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see www.iso.org/iso/foreword.html.

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.

