Uniflare Limited

Unit 19

Runway Farm Technical Park

KENILWORTH CV8 1NQ

Tel +44 1676 529118

Fax +44 1676 529119

enquiries@uniflare.co.uk

UFO-5000-ENV BIOGAS & BIOMETHANE OPEN COMBUSTION FLARE

(ENCLOSED NON VISIBLE)

NATURE ENERGY

NE KOENG BIOGAS

DENMARK

Job No 1806

Document Control Sheet

O&M Manual Reference number	1806/UFO-5000-ENV-BVF/OM/01	
	Number	**Date**
Version	01	30/03/2021
	Initials	**Date**
Manual prepared by	[redacted]	30/03/2021
Checked by		
Approved by		

1 General

- Introduction
- Documentation
- Declaration of Conformity

2 General Description

- Flare stack Type ENV

3 Safety Specifications

- General safety aspects
- The Explosive Limits of Methane
- Sources of Ignition
- Additional Safety measures
- Risk Assessment for working on a gas Collection System

4 Specification & Calculations

- Scope of Supply
- Flarestack Calculations
- Flarestack Description

5 PID's and legend

- PID Legend and Description
- PID Drawings

6 Functional Description

- Function Description

7 Plant operation

- Assembly and Dismantling of a Flarestack
- Putting a Flarestack into Service
- Adjustment

8 Maintenance and Servicing

9 Training Instructions for a Flarestack

10 Troubleshooting

11 Appendices

- General Arrangement Drawings
- DSEAR Zoning Drawings
- Electrical Wiring Diagrams

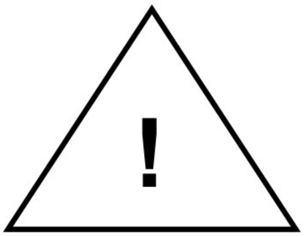
- Component suppliers Data
- Factory Acceptance Tests
- Site Acceptance Tests

General

General

Introduction

The main purpose of a biogas plant is to collect, safely deliver and combust the biogas to the required environmental standards. The production of biogas from anaerobic digestion is a continuous process, the intensity of which is dependent upon the nature and input rate of the waste being treated.



Safety and protection against explosion must therefore be guaranteed!

The necessary monitoring is guaranteed by an efficient safety protocol for the entire plant.

In order to ensure trouble free and safe operation of the plant, it must be professionally installed, commissioned and operated, as well as carefully maintained in accordance with these operating instructions.

The mains supply of the plant, as well as the electrical control between the control panel and the individual components of the plant may only be carried out by a qualified electrician and in accordance with local regulations and codes of practice.

Only personnel who are experienced with the installation, commissioning, operation and maintenance and have the necessary qualifications may work on the plant.

Should the information contained within these Operating Instructions not be clear, or be insufficient, Uniflare Ltd will be happy to provide further information.

Documentation

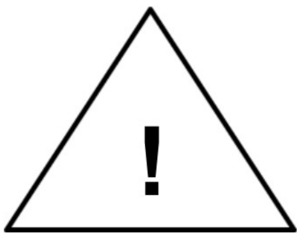
The Operating instructions consist of 1 file, containing 12 chapters:

Abbreviations and symbols used in the operating instructions, are explained in the following list:

Abbreviations:

LEL	Lower explosive limit
UEL	Upper explosive limit
DSEAR	Dangerous Substances and Explosive Atmospheres Regulations

Symbols:



Indication of a source of danger

DECLARATION OF CONFORMITY

We,

UNIFLARE LIMITED,

Declare that the product,

Type: UFO-5000-ENV Biogas & Biomethane Open Combustion Flare (Enclosed Non Visible)

Build number: 1806

Build year: 2021

Complies with the requirements of:

The Machinery Directive	2006/42/EC	As amended
The Low Voltage Directive	2006/95/EC	As amended
The EMC Directive	2004/108/EC.	As amended
The ATEX Directive	2014/34/EU	As applicable

The technical file is held by Uniflare Limited

Signature [redacted] Date: April 2021

Name: [redacted]

Position: Managing Director

Issued at:

Uniflare Limited
Unit 19
Runway Farm Technical Park
KENILWORTH
CV8 1NQ
England
T: + 44 1676 529118, F: + 44 1676 529119
enquiries@uniflare.co.uk

General Descriptions

Flarestack Type UFO-ENV Enclosed Non Visible

The Uniflare UFO-ENV enclosed non visible flarestack is designed for the safe and enclosed combustion of biogas ensuring no visible flame.

The flarestack consists of a galvanised steel, ceramic fibre lined combustion chamber, skid mounted with a stainless steel upper shroud. Combustion is completely concealed within the flare combustion chamber, and temperature is automatically controlled by the PID controller and the adjustment of the air louvres .

All Uniflare UFO-ENV flarestacks are designed to easily accommodate the maximum flow rate.

The equipment is designed with all the necessary safety features for the safe handling and combustion of biogas. The system is constructed according to the requirements of EN 60079 (explosion protection) and is foreseen to be installed outside hazardous areas such as Zone 0, Zone 1 and Zone 2.

Safety Specification

Safety Specification

General safety aspects

Responsibility for plant operation and maintenance work

The following principles are acknowledged for installations designed for the collection, transportation and management of biogas or biomethane:

- Biogas/biomethane recovery and biogas utilisation plants are categorised by the authorities as plants requiring control.
- The responsibility for this lies with the plant operator. He must ensure that the plant is being operated and maintained in accordance with the current safety regulations.
- Everyone concerned with biogas must be aware that there are hidden dangers. It is therefore important that the plant is operated and maintained only by suitably trained, reliable personnel.
- Persons who operate and maintain a gas plant must receive the necessary specialised training, and be aware of the relevant regulations for the prevention of accidents as well as the regulatory directives and relevant codes of practice.
- Personnel should be able to assess the condition and operational status of a biogas plant.
- Operating instruction manuals containing:
  - Points concerning health and safety regulations
  - Technical plant description
  - Instructions for operation and maintenance
  - Servicing and fault finding

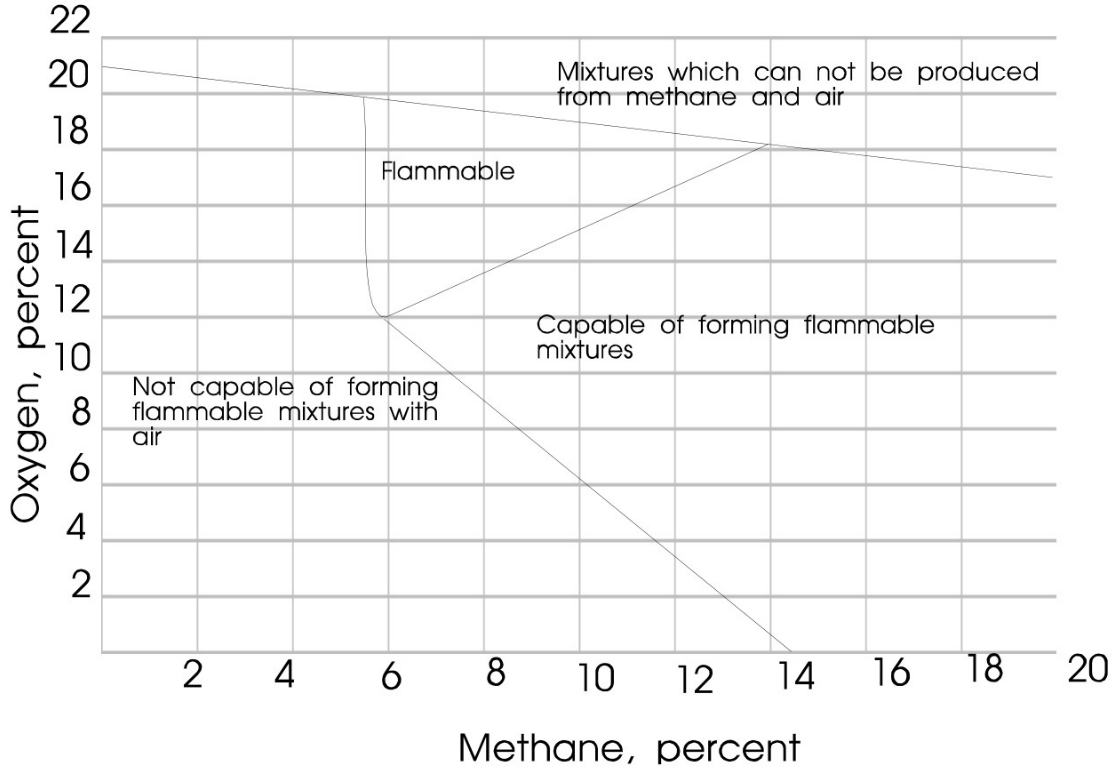
  This information must always be available at the location of the plant and the responsible person should be aquainted with its contents.

The explosive limits of methane CH_4 in biogas

Biogas is a combustible mixture of gases (CH_4 & CO_2 with small quantities of N_2, O_2 & H_2S). The combustible portion of biogas is methane, that forms an explosive mixture with air in concentrations between 5 – 14% by volume. For safety reasons, usually the following upper and lower explosive limits for methane in air are adopted: UEL = 15% vol, LEL = 5% vol. After plant maintenance or initial commissioning, there is a danger of air being present in the gas system, resulting in an explosive mixture.

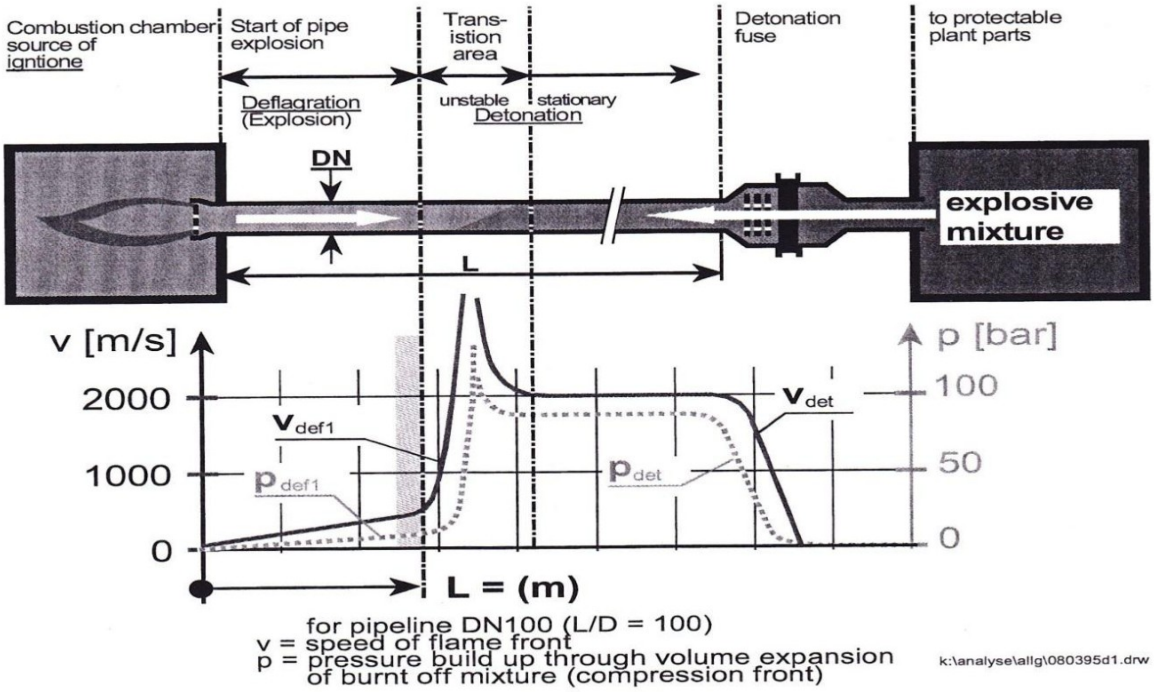
The following diagram illustrates the mixture concentration and the three conditions which can ensue due to the intake of air into pipelines or vessels carrying biogas.

Explosive limits of biogas inside transmission pipes.



A source of ignition can bring about an explosion of an explosive atmosphere. An explosion is combustion which develops very rapidly due to the oxidative reaction. The generation of the flame front can reach a speed of 500 m/sec (> Mach 1.5). This creates a pressure wave where the resultant explosive overpressure is approximately 5 to 6 bar.

In unfavourable cases such as very long straight lengths of unsecured pipework, the explosion can turn into a detonation. In this case the flame front can reach a speed of over 1,500 m/sec (>Mach 4.5) and an overpressure exceeding 50 bar.



Therefore, it is necessary, when taking into consideration the possible sources of ignition, to take three main groups of safety precautions when operating biogas plants.

- Preventative measures in order to prevent or limit the formation of a dangerous, explosive atmosphere, known as **primary explosion protection.**
- Preventative measures in order to prevent the ignition of the dangerous explosive atmosphere, known as **secondary explosion protection.**
- Construction measures in order to limit damage and casualties resulting from an explosion, known as **constructive explosion protection.**

Sources of ignition

These are the sources of ignition that should be considered when undertaking an ignition risk assessment:

- Hot surfaces
- Flames and hot gases
- Mechanically generated sparks
- Electrical apparatus
- Stray electric currents, cathodic protection
- Static electricity
- Lightning
- Electromagnetic fields 9kHz – 300GHz
- Electromagnetic radiation 300GHz – 3 x 106 GHz
- Ionising radiation
- Ultrasonics
- Adiabatic compression, shock waves, gas flows
- Chemical reactions

The most likely sources of ignition on a biogas plant are the flarestack, gas boosters, any electrical equipment, sensors or measurement devices connected into the gas flow. The gas booster could be a source of ignition resulting from bearing or impeller failure, or if solid matter is sucked into the system. Other sources of ignition could be maintenance, such as hot works or drilling and cutting of pipework and vessels.

Safety measures

Preventative measures in order to prevent or limit the formation of a dangerous, explosive atmosphere, known as **Primary Explosion Protection:**

By frequently checking the methane and oxygen content within the biogas, the possibility of an explosive mixture developing is greatly reduced. Permanent monitoring of the biogas with a fixed on-line analyser system is recommended.

The biogas plant is a low calorie flare designed for the safe combustion of biogas. This particular plant is designed to operate with a maximum calorific value of 0.35 MW.

Preventative measures in order to prevent the ignition of the dangerous explosive atmosphere, known as **Secondary Explosion Protection:**

- The gas booster is designed with a spark proof impeller

- All measuring and monitoring units inserted into the gas flow are either intrinsically safe or suitable for the DSEAR zone of their installation
- Before putting the plant into service for the first time, or restarting after a shut-down or maintenance work, measurements must be taken to ensure that no explosive atmospheres are present within any vessels or pipelines.

Construction measures in order to limit damage and casualties resulting from an explosion, known as **Constructive Explosion Protection:**

- Flame arrestors upstream of the flarestack main gas feed prevent a flash back into the gas collection system
- A slam shut valve and flame arrestor is fitted to other sources of ignition such as gas utilisation plant so that the gas supply is isolated in the event of a fault or fire

Additional safety measures

- Do not carry out any work on the electrical, mechanical, gas or pressurised air system unless it is securely prevented from starting, isolated from its energy source and drained of stored energy (including biogas and pressurised air). Isolated the system both mechanically and electrically, lock off the isolators and valves, and fix a notice on the isolator or valve to warn that it should not be started.
- Biogas, biogas condensate and waste may contain substances injurious to health. Always wear protective clothing and wash hands and face after working on landfill or biogas equipment and before eating or smoking. For general activities, protection of broken skin using waterproof dressings or clothing is the most important factor, but where there is a risk of aerosol spray (for example when pressure washing) then eye and face protection is advised to prevent liquid droplets from entering the mouth or eyes. Goggles and a simple paper dust mask will be adequate in most cases. Clothing should be non-infectious once dried and washed, so full coveralls are not essential unless there are associated hazards that demand them.
- Waste treatment and disposal sites may contain items that can cut or pierce the skin. It is recommended that immunisation against tetanus and polio is up to date. Where work means that contact with waste containing syringe needles that can be contaminated by hepatitis B pathogens can occur then immunisation against hepatitis B is recommended. See the item 10 below on what to do if it is likely that pathogens have entered your skin.
- Biogas is potentially flammable and explosive particularly in confined spaces. Do not use equipment that is potentially a source of ignition or smoke or use a naked flame in proximity to biogas. Be aware of the potentially hazardous areas around the site as set out in the site's DSEAR plans
- Heavy vehicles may use waste treatment sites. Always wear high visibility clothing
- The noise level at one metre from a gas booster without sound insulation may be 100dB. Ear protectors should be worn when working in close proximity to a gas booster.

- The ceramic lining of ground flares, especially after heating may be harmful if inhaled. Use a suitable respirator and skin protection when working in proximity to the ceramic lining inside the stack.
- Biogas flares may operate at 1,100°C. Do not touch the combustion components or housing during or after operation. Do not overload the flare with excessive gas flow or excess methane content.
- Do not attempt to start burn sequence immediately after venting as the shroud may be full of inflammable gas. Wait until it has cleared. Incorrect start up procedure may cause the flare shroud to fill with biogas before ignition resulting in a flash back through the combustion air fan. Stand clear of flare shroud during start up. Close the cover of any combustion chamber sight glass.
- Do not enter confined spaces as asphyxiation may occur due to reduced oxygen levels and high carbon dioxide levels. Biogas may contain toxic gases such as hydrogen sulphide which can poison in very small quantities.
- Hydrogen sulphide has a very low odour threshold, with its smell being easily perceptible at concentrations well below 1 part per million (ppm) in air. The odour increases as the gas becomes more concentrated, with the strong rotten egg smell recognisable up to 30 ppm. Above this level, the gas is reported to have a sickeningly sweet odour up to around 100 ppm. However, at concentrations above 100 ppm, a person's ability to detect the gas is affected by rapid temporary paralysis of the olfactory nerves in the nose, leading to a loss of the sense of smell. This means that the gas can be present at dangerously high concentrations, with no perceivable odour. Prolonged exposure to lower concentrations can also result in similar effects of olfactory fatigue. This unusual property of hydrogen sulphide makes it extremely dangerous to rely totally on the sense of smell to warn of the presence of the gas. H2S is classed as a chemical asphyxiant, similar to carbon monoxide and cyanide gases. It inhibits cellular respiration and uptake of oxygen, causing biochemical suffocation.

Typical exposure symptoms for Hydrogen Sulphide include:

CONCENTRATION	RANGE	SYMPTOMS
LOW	0 – 10 ppm	Irritation of the eyes, nose and throat
MEDIUM	10 – 50 ppm	Headache Dizziness Nausea and vomiting Coughing and breathing difficulty
HIGH	50 – 200 ppm	Severe Severe respiratory tract irritation Eye irritation / acute conjunctivitis Shock Convulsions Coma Death in severe cases

- Prolonged exposures at lower levels can lead to bronchitis, pneumonia, migraine headaches, pulmonary oedema, and loss of motor coordination
- Rats may live on waste sites. Leptospirosis, also known as canicola fever, haemorrhagic jaundice, infectious jaundice, mud fever, spirochetal jaundice, swamp fever, swineherd's disease, caver's flu or sewerman's flu, is a bacterial infection resulting from exposure to the Leptospira interrogans bacterium, which is often present in rat’s urine and can live in wet conditions. There is an acute form of human infection known as Weil's disease, where the patient suffers from jaundice.
- Hand-washing is the most important precaution people can take, both for leptospirosis and many other infections. Although the bacteria do not survive for very long on human skin, they can certainly remain viable for long enough to transfer from your hands to your mouth, or into food. Having said that, they are extremely easy to kill!
- The bacteria are extremely small, but so far there is no evidence that they can directly penetrate normal skin - such as that covering most of your body. Mucous membranes are less of a barrier and so it is possible (though far from a certainty) that the bacteria can enter the body via the skin inside the nose

and airway etc. Unless the body is completely immersed or the patient inhales/swallows contaminated fluids, the risks remain very low.

- Domestic soap or antiseptic liquid handwash is very effective, so washing in the normal way is considered perfectly adequate for leptospiral disinfection of skin. Alcohol-based gels and solutions, as used both in hospitals and in many household 'disinfecting hand cleaners' are also very effective and will instantly kill leptospira on skin. If for some reason none of these are available, then using fresh water alone is actually not a good idea - the bacteria will survive on the skin as long as they remain moist, so leaving your skin to dry is the best option. Where you have come into contact with contaminated water, drying your skin will kill leptospira within a few minutes.
- If your skin is broken, the bacteria can potentially enter your bloodstream directly - and so while washing the skin is important to remove the bacteria as soon as possible, it is still likely that some have entered the injury site and will be immune to surface washing. In these cases we advise you contact your local doctor immediately, explain the situation and request a preventative antibiotic dose and/or a blood test (depending on the likelihood that the water was contaminated).
- For general activities, protection of broken skin using waterproof dressings or clothing is the most important factor, but where there is a risk of aerosol spray (for example when pressure washing) then eye and face protection is advised to prevent liquid droplets from entering the mouth or eyes. Goggles and a simple paper dustmask will be adequate in most cases. Clothing will be non-infectious once dried and washed, so full coveralls are not essential unless there are associated hazards that demand them. Workers should be given facilities to wash their hands, including soap or antibacterial gel, so they can remove any contaminant from their skin after an accidental exposure.
- For situations where workers may accidentally immerse themselves (by falling into water) there is no reasonable way to prevent them inhaling and ingesting some water, so protective measures should be used to prevent the fall in the first place - barriers, covers or fall protection harnesses.

TASK / LOCATION	CODE	RISK	ACTION REQUIRED	PERSONAL PROTECTION EQUIPMENT REQUIRED

Risk Assessment for Work on a Biogas collection system

CODE	HAZARD	CODE	HAZARD
1	Falling up to & including 2 metres	12	Exposure to fire
2	Falling over 2 metres	13	Explosion
3	Contact with moving machinery	14	Contact with electricity/electrical discharge
4	Contact with falling/flying/moving objects	15	Exposure to vibration
5	Contact with moving vehicles	16	Exposure to noise
6	Striking against something fixed/stationary	17	Risk of work related upper limb disorders
7	Slip/trip/fall on same level	18	Stooping/twisting of the trunk
8	Trapped by something collapsing / overturning	19	Exposure to hot surfaces
9	Drowning	20	Exposure to sharp surfaces
10	Asphyxiation	21	Exposure to excess of temperature hot/cold
11	Exposure/contact with harmful substances	22	Exposure to radiation

SITE TRAFFIC	3,4, 5,6,8				Speed limit. Fence working area. Warning signs	Safety helmet BS EN 397 (2012) Reflective waistcoat to ISO 20471 Reflective jacket to EN471
WASTE	7,11, 20				Training/Induction. Immunisation against Hepatitis B & Tetanus. No smoking. Wash hands & face before eating or leaving site.	Safety boots to EN ISO 20345 (2011) Gloves to EN 347/2
BIOGAS	10,11,12,1 3				Training/Induction. Do not enter enclosed spaces. No smoking. Get permit for hot work. Wash hands & face before eating or leaving site.	
LEACHATE / CONDENSATE	9,11				Training / Induction. Fence off lagoons. No smoking. Wash hands & face before eating or leaving site.	
INSTALLATION	1,2,3, 4,7,8, 14,18				Training / Induction. Note position of electricity cables, particularly overhead cables. Use trained crane driver.	Safety helmet BS EN 397 (2012) Reflective waistcoat to ISO 20471 Reflective jacket to EN471 Safety boots to EN ISO 20345 (2011) Gloves to EN 347/2
CERAMIC BLANKET WORK Dust. Ceramic fibres up to 20 fibres/cc	11				Training/Induction. Do specific risk analysis for major work.	Disposable dust respirator type A1P2 Cartridge respirator with appropriate dust cartridges or disposable dust respirator (e.g. 3M 8810 or equivalent) Gloves to EN 347/2 Goggles to EN 171/2/3
CERAMIC BLANKET WORK Dust. Ceramic fibres 20 – 200 fibres/cc	11				Training/Induction. Do specific risk analysis for major work.	Full face respirator with high efficiency filters Gloves to EN 347/2

CERAMIC BLANKET WORK Dust. Ceramic fibres More than 200 fibres/cc	11				Training/Induction. Do specific risk analysis for major work.	Full face positive pressure Supplied air respirator. Gloves to EN 347/2
COMMISSIONING, MAINTENANCE & REPAIR	1,2,3, 4,6,7, 8,11,12,13, 14,15,16,17,18,19, 20,21				Training / Induction. No smoking. Wash hands & face before eating or leaving site.	Safety boots to EN ISO 20345 (2011) Flameproof overalls to EN11611/2 Ear defenders to EN 352-1 Face mask to EN136 Goggles to EN 171/2/3

Specification & Calculations

Specification

Scope of supply:

- **Inlet pipework**
- **Main burner gas train**
- **Pilot burner gas train c/w heat tracing and lagging**
- **Propane pilot burner gas train**
- **High temperature flarestack**

Flare stack

The flare will operate with a maximum pressure loss of 75 mbar at full load

Description

Structure

The flarestack is a 5,000 m^3/ hour enclosed non visible combustion ground flare with cyclonic action burners.

The combustion shroud is 6 mm galvanised steel for maximum longevity

The plenum chamber walls and floor are lined with ceramic blanket to reduce heat loss, provide combustion silencing and protect the concrete slab base from heat damage.
The shroud base and mounting skid is galvanised carbon steel.

Features

- Skid mounted robust construction
- High safety standard
- Concealed combustion
- Automatic louvre adjustment
- Minimal on-site preparation
- Quick installation and commissioning
- Low maintenance costs

Safety

The plant is equipped with all necessary safety features for the safe handling and combustion of biogas. The system is designed according to the guideline EN60079 (explosion protection) and is intended to be installed outside hazardous areas such as Zone 0, Zone 1 and Zone 2.

Specification

Uniflare UFO-5000-ENV concealed combustion flarestack

Gas flow rate	max.	5000 Nm^3/hour
	min..	Not Applicable
Calorific throughput	max.	39.89 MW approx
Design methane concentration range		45 – 80% by vol
Expected sound pressure level of flare		
At full load at 10m distance and 2m height		≤ 75 dB(A)
System of protection		IP54 or higher
Diameter		2.530 m
Height		12.650 m

Enclosed Non Visible Flame Flarestack:

- The optimal combustion temperature is controlled automatically by 4 sets of electrically actuated louvres to ensure optimal combustion relative to biogas conditions
- Main construction made of hot dip galvanised steel
- Hot dip galvanised mild steel upper shroud with ceramic fibre insulation
- Stainless steel upper shroud tip
- Combustion air intake by natural draught.
- Fireblaster pilot burner with slam shut valve, flame arrestor and pressure regulator
- ZAI propane pilot burner with slam shut valve, flame arrestor and pressure regulator
- High Voltage electrical ignition with ignition transformer x2
- UV sensor for flame monitoring x2
- Thermocouple for the continuous monitoring of the combustion temperature
- Pneumatic slam shut butterfly valve
- Flame arrestor according to EN standards (ATEX 100) housing of carbon steel and element of stainless steel

PID's and Legend

Machine type	UFO-5000 ENV Enclosed non visible combustion ground flare.
Use environment	Anaerobic digester plant site in open air with restricted access and supervised by trained personnel.
Maximum design emissions Normalised at 0°C, 101.3 kPa and 3% O_2:	Not Applicable
Operation	Unattended
Media	Biogas containing Methane 45% to 80%v/v Hydrogen sulphide 0 to 3 000 ppm
Design Flow assuming 1.292 kg m^{-3} density biogas	5000 m3h-1
Turn down	Not Applicable
Combustion temperature	Not Applicable
Combustion minimum retention time	Not Applicable
Biogas Inlet Flange (BS EN 1092-2: 1997) 1 x DN300 PN16;	
<u>Control system</u> UNIFLARE standard complete with sun & weather protection roof connecting to site control	

TAG No.	DESCRIPTION
SECTION 1 INLET PIPEWORK	
HV 01	Hand Operated Butterfly Valve (Isolation) 12” (DN300) Bray Series 30 Wafer Pattern Butterfly Valve
FI 01	Flow indicator manometer (0-5000m³/h)
PI 01	Pressure Indicator Gauge (0 to 250 mbar)
HV 02	Hand Operated Ball Valve (Isolation) ¼” Ball Valve 316 Stainless Steel
SP	Analysis Point (Push Fit Hose Connection) ¼” BSP Tefen QRC
HV 03	Hand Operated Ball Valve (Isolation) ¼” Ball Valve 316 Stainless Steel
TI 01	Temperature Indicator Gauge (0 to +120 °C) C/W Thermowell
PS 01	Pressure Switch (Low Low Pressure) ATEX (Positive Pressure) Dungs GGW 50 A4/2 X (Range 2.5 – 50 mbar)
SECTION 2 MAIN BURNER GAS TRAIN	
MV 01	Modulating Butterfly Valve 12” (DN300) Bray Series 30 Wafer Pattern Butterfly Valve Rotork IQTM250 Electric Modulating Actuator
FSC 01 **ZSC 01** **ZSO 01**	Pneumatically Operated Slam Closed Butterfly Valve 12” (DN300) Bray Series 30 Wafer Pattern Butterfly Valve Pneumatic Spring Return Failsafe Closed Actuator C/W Open/Close Limit Switches
SP	Sample Point (Push Fit Hose Connection) ¼” BSP Tefen QRC
HV 05	Hand Operated Ball Valve (Isolation) ¼” Ball Valve 316 Stainless Steel
PI 02	Pressure Indicator Gauge (0 to 250 mbar)
HV 06	Hand Operated Ball Valve (Isolation) ¼” Ball Valve 316 Stainless Steel
FA 01	Flame Arrester (Main Burner) ATEX 12” (DN300) Protego - FA-E 300 I-1.9 In-Line Deflagration Flame Arrester 5000m³h-1 Flow
TA 01	Temperature Transmitter (High High Temperature) Main Burner Flashback ATEX ‘K’ Type Thermocouple C/W Thermowell
PI 03	Pressure Indicator Gauge (0 to 250 mbar)
HV 07	Hand Operated Ball Valve (Isolation) ¼” Ball Valve 316 Stainless Steel
PS 02	Pressure Switch (Low Low Pressure) ATEX (Positive Pressure) Dungs GGW 150 A4/2 X (Range 30-150mb)
SECTION 4 PILOT BURNER GAS TRAIN C/W HEAT TRACING & LAGGING	
HV 08	Hand Operated Ball Valve (Pilot Isolation Valve) 1” Ball Valve 316 Stainless Steel
HFC 01	Hand Operated Gate Valve (Gas Flow Trim Valve) 1” Gate Valve 316 Stainless Steel
FSC 02 **ZSC 02** **ZSO 02**	Pneumatically Operated Slam Shut Angle Seat Piston Valve Open/Close Limit Switches
SP	Analysis Point (Push Fit Hose Connection) ¼” BSP Tefen QRC
HV 09	Hand Operated Ball Valve (Isolation) ¼” Ball Valve 316 Stainless Steel
FA 02	Flame arrester (Pilot Burner) (ATEX) 1” (DN25) Protego - FA-G 25 IIA In-Line Deflagration Flame Arrester 60m³h-1 Flow

TA 02	Temperature Transmitter (High High Temperature) Pilot Burner Flashback 'K' Type Thermocouple C/W Thermowell
SP	Analysis Point (Push Fit Hose Connection) ¼" BSP Tefen QRC
HV 10	Hand Operated Ball Valve (Isolation) ¼" Ball Valve 316 Stainless Steel
ED 01	Eductor (Gas Air Mixer)
SECTION 5 PROPANE PILOT BURNER GAS TRAIN – DN25PN16	
HV 11	Hand Operated Ball Valve (Pilot Isolation Valve) 1" Ball Valve 316 Stainless Steel
HFC 02	Hand Operated Gate Valve (Gas Flow Trim Valve) 1" Gate Valve 316 Stainless Steel
FSC 03 **ZSC 03** **ZSO 03**	Pneumatically Operated Slam Shut Angle Seat Piston Valve Open/Close Limit Switches
SP	Analysis Point (Push Fit Hose Connection) ¼" BSP Tefen QRC
HV 12	Hand Operated Ball Valve (Isolation) ¼" Ball Valve 316 Stainless Steel
FA 03	Flame arrester (Pilot Burner) (ATEX) 1" (DN25) Protego - FA-G 25 IIA In-Line Deflagration Flame Arrester 60m³h-1 Flow
TA 03	Temperature Transmitter (High High Temperature) Pilot Burner Flashback 'K' Type Thermocouple C/W Thermowell
SP	Analysis Point (Push Fit Hose Connection) ¼" BSP Tefen QRC
HV 12	Hand Operated Ball Valve (Isolation) ¼" Ball Valve 316 Stainless Steel
I 02	ZAI Ionisation Pilot Ignition (Spark Ignition Into Burner) C/W 230V Ignition Transformer
BE 02	Flame Sensor (UV Flame Sensor Into Pilot Burner)
SECTION 6 FLARE STACK	
FL 01	Flare stack Combustion 'Enclosed Non Visible' Flare With Burners
I 01	Ignition (Spark Ignition Into Burner) C/W 230V Ignition Transformer
BE 01	Flame Sensor (UV Sensor Into Burner)
MD 01	Modulating Damper - Electrically Actuated Trox – SP-JZ-B C/W Damper Actuator Belimo – SM24AX
MD 02	Modulating Damper - Electrically Actuated Trox – SP-JZ-B C/W Damper Actuator Belimo – SM24AX
MD 03	Modulating Damper - Electrically Actuated Trox – SP-JZ-B C/W Damper Actuator Belimo – SM24AX
MD 04	Modulating Damper - Electrically Actuated Trox – SP-JZ-B C/W Damper Actuator Belimo – SM24AX
TT 01	Temperature Transmitter (Flare Temp °C PID Adjust & Display) (Flare High Temp) 'N' Type Thermocouple

Please view the P&ID Drawing No 1806-3001A.

Section 1 Inlet pipework

The biogas inlet pipework delivers biogas to the flare through a DN300 pipe at TP 01. Pressure and temperature gauges are provided at PI 01 and TI 01 and the pressure switch PS 01 guards against low pressure. PS 01 will trip and shut down the plant if the inlet pressure falls below the pre-set value. The biogas inlet is isolated by the manually operated valve HV 01. The gas flow is measured by an orifice plate type of flow meter fitted at FI 01.

Section 2 Main burner gas train

The flow rate is controlled automatically by the modulating valve MV 01. Switching of the main gas supply to the flarestack is performed by the fail safe closed pneumatically operated valve FSC 01. FSC 01 is fitted with limit switches, so that the open or closed status of the valve can always be confirmed at the control panel.
Flashback protection to the gas feed is provided by the flame arrestor FA 01, any flashback will be detected by the temperature sensor TA 01 which will shut down the system. Pressure drop across the flame arrestor element can be determined locally from the pressure gauges PI 02 & PI 03.
The flarestack main gas train is also fitted with a pressure switch PS 02, which will shut down the plant in the event of excessive supply gas pressure, which might overload the flarestack.

Section 4 Pilot burner gas train

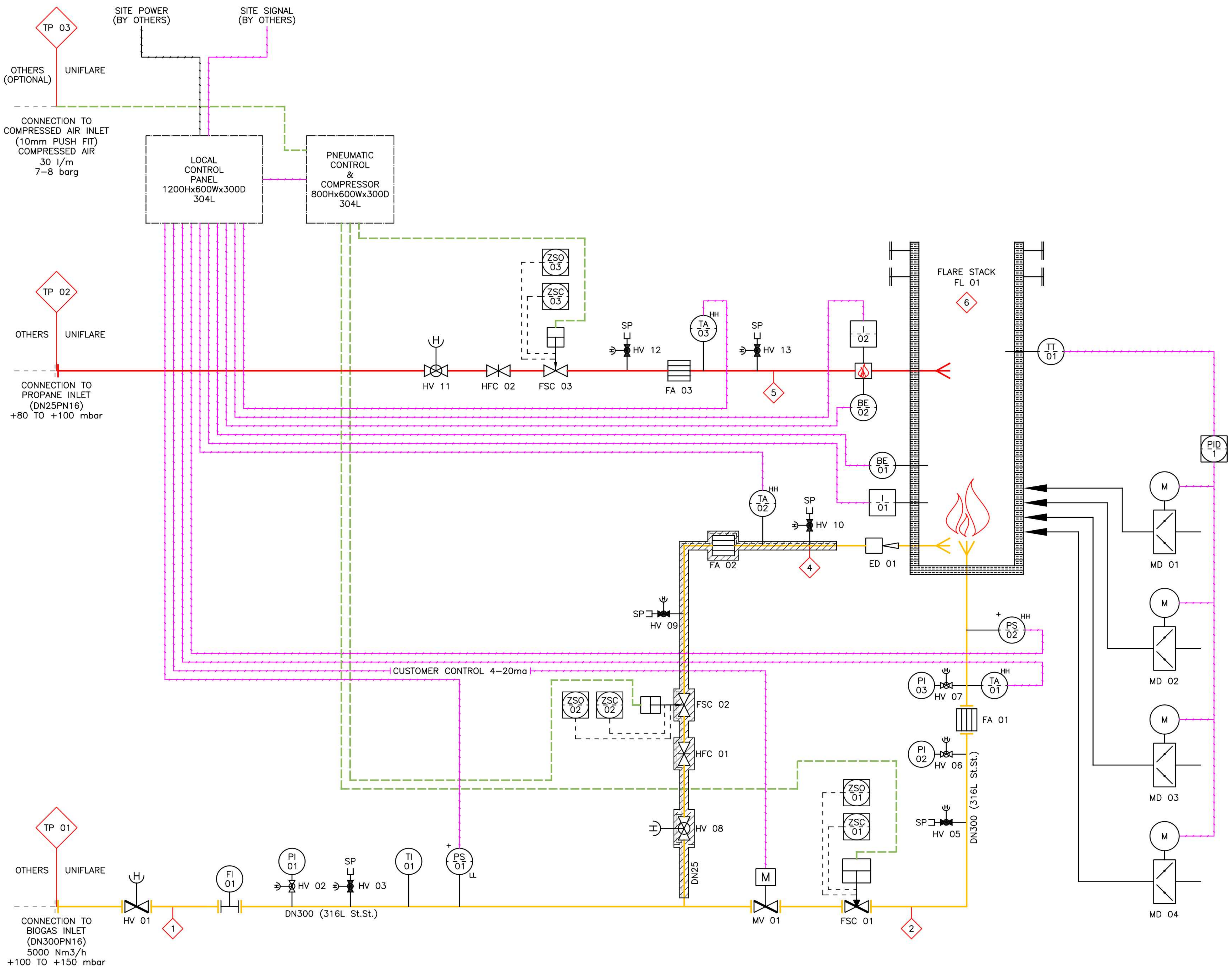
The pilot gas feed is a DN25 pipe which leaves the main gas train just before the modulating valve MV 01. The pilot gas line may be isolated by manual valve HV 08 and the flow rate regulated by manual valve HFC 01. Automatic control of the pilot gas supply is provided by the pneumatically operated fail-safe closed valve FSC 02. The pilot gas feed is protected against flashback by the flame arrestor FA 02; pressure drop across the flame arrestor is measured by using the sample valves HV 09 & HV 10, with thermocouple TA 02 providing an indication of any flashback. Should a pilot flashback be detected, then this will initiate a shut-down of the plant. Before entering the pilot burner, the gas stream passes through the eductor, ED 01 where primary combustion air is mixed with the gas stream.

Section 5 Propane Pilot burner gas train

The propane pilot gas feed is a DN25 pipe which is fed by propane at 80-100 mbar at TP 02. The pilot gas line may be isolated by manual valve HV 11 and the flow rate regulated by manual valve HFC 02. Automatic control of the pilot gas supply is provided by the pneumatically operated fail-safe closed valve FSC 03. The pilot gas feed is protected against flashback by the flame arrestor FA 03; pressure drop across the flame arrestor is measured by using the sample valves HV 12 & HV 13, with thermocouple TA 03 providing an indication of any flashback. Should a pilot flashback be detected, then this will initiate a shut-down of the plant. Before entering the pilot burner, the gas stream passes through the ignitor, I 02 and flame sensor BE 02.

Section 5 Flarestack

The pilot burner is ignited by the high voltage ignition electrode I 01 (or I02 depending on pilot selection). The UV sensor, BE 01 detects when the pilot flame is lit, and the signal then enables the main valve FSC 01 to open. The combustion temperature within the flarestack is detected by the thermocouple TT 01, which provides a signal to the temperature controller PID 1. The temperature controller adjusts the position of the automatic air louvres, MD 01 – MD 04 in order to maintain the flarestack at the set point temperature.



DO NOT SCALE - IF IN DOUBT ASK

NOTES:

THIS DRAWING TO BE READ IN CONJUNCTION WITH DOC No. 1806–3002 (P&ID LEGEND)

PIPEWORK: STAINLESS STEEL 316L METRIC THIN WALL

FLANGES: STAINLESS STEEL PRESSED COLLARS WITH PLASTIC COATED BACKING FLANGES (PN16)

BOLTS:
GALVANISED STEELWORK & STACK: GALVANISED
ALL OTHERS: GALVANISED

KEY:

- BIOGAS
- COMPRESSED AIR
- CONDENSATE
- SIGNAL CABLE
- POWER CABLE
- HEAT TRACING & LAGGING

Rev	Description	Dsgnr	Chkd	Appd	Date
A	FIRST ISSUE	[redacted]			30/03/21

UNIFLARE™ GLOBAL ENVIRONMENTAL TECHNOLOGY

Tel: +44 (0)1676 529118
Fax: +44 (0)1676 529119
enquiries@uniflare.co.uk
www.uniflare.co.uk

Drawn By: [redacted]
Date: 30/03/2021

NE KOENG BIOGAS
NATURE ENERGY

Drawing Title:
GENERAL ARRANGEMENT
UFO–5000–ENV–BVF

Drawing No.: 1806–3001
Scale: N.T.S.
Sheet Size: A2
Rev: A

Functional Description

The unit is designed as a skid mounted flare unit for use on biogas.
The plant is designed to burn at 850 degrees Celsius, and operate within the range 1000 – 5000 m^3/hour (@ 80% CH_4), or 7.98 – 39.89 MW thermal.

Control and Instrumentation

FI 01	Flow indicator manometer (0-5000m³/h)
PI 01	Pressure Indicator Gauge (0 to 250 mbar)
TI 01	Temperature Indicator Gauge (0 to +120 °C) C/W Thermowell
PS 01	Pressure Switch (Low Low Pressure) ATEX (Positive Pressure) Dungs GGW 50 A4/2 X (Range 2.5-50mb)
MV 01	Modulating Butterfly Valve 12" (DN300) Bray Series 30 Wafer Pattern Butterfly Valve Rotork IQTM250 Electric Modulating Actuator
FSC 01	Operated Slam Closed Butterfly Valve 12" (DN300) Bray
ZSC 01	Pneumatically Series 30 Wafer Pattern Butterfly Valve Pneumatic Spring
ZSO 01	Return Failsafe Closed Actuator C/W Open/Close Limit Switches
PI 02	Pressure Indicator Gauge (0 to 250 mbar)
FA 01	Flame Arrester (Main Burner) ATEX 12" (DN300) Protego - FA-E 300 I-1.9 In-Line Deflagration Flame Arrester 5000m³h-1 Flow
TA 01	Temperature Transmitter (High High Temperature) Main Burner Flashback ATEX 'K' Type Thermocouple C/W Thermowell
PI 03	Pressure Indicator Gauge (0 to 250 mbar)
PS 02	Pressure Switch (Low Low Pressure) ATEX (Positive Pressure) Dungs GGW 150 A4/2 X (Range 30-150mb)
FSC 02	Pneumatically Operated Slam Shut Angle Seat Piston Valve Open/Close
ZSC 02	Limit Switches
ZSO 02	
FA 02	Flame arrester (Pilot Burner) (ATEX) 1" (DN25) Protego - FA-G 25 IIA In-Line Deflagration Flame Arrester 60m³h-1 Flow
TA 02	Temperature Transmitter (High High Temperature) Pilot Burner Flashback 'K' Type Thermocouple C/W Thermowell
ED 01	Eductor (Gas Air Mixer)
FSC 03	Pneumatically Operated Slam Shut Angle Seat Piston Valve Open/Close
ZSC 03	Limit Switches
ZSO 03	
FA 03	Flame arrester (Pilot Burner) (ATEX) 1" (DN25) Protego - FA-G 25 IIA In-Line Deflagration Flame Arrester 60m³h-1 Flow
TA 03	Temperature Transmitter (High High Temperature) Pilot Burner Flashback 'K' Type Thermocouple C/W Thermowell
I 02	ZAI Ionisation Pilot Ignition (Spark Ignition Into Burner) C/W 230V Ignition Transformer (Rev B)
BE 02	Flame Sensor (UV Flame Sensor Into Pilot Burner)
I 01	Ignition (Spark Ignition Into Burner) C/W 230V Ignition Transformer (Rev B)
BE 01	Flame Sensor (UV Sensor Into Burner)

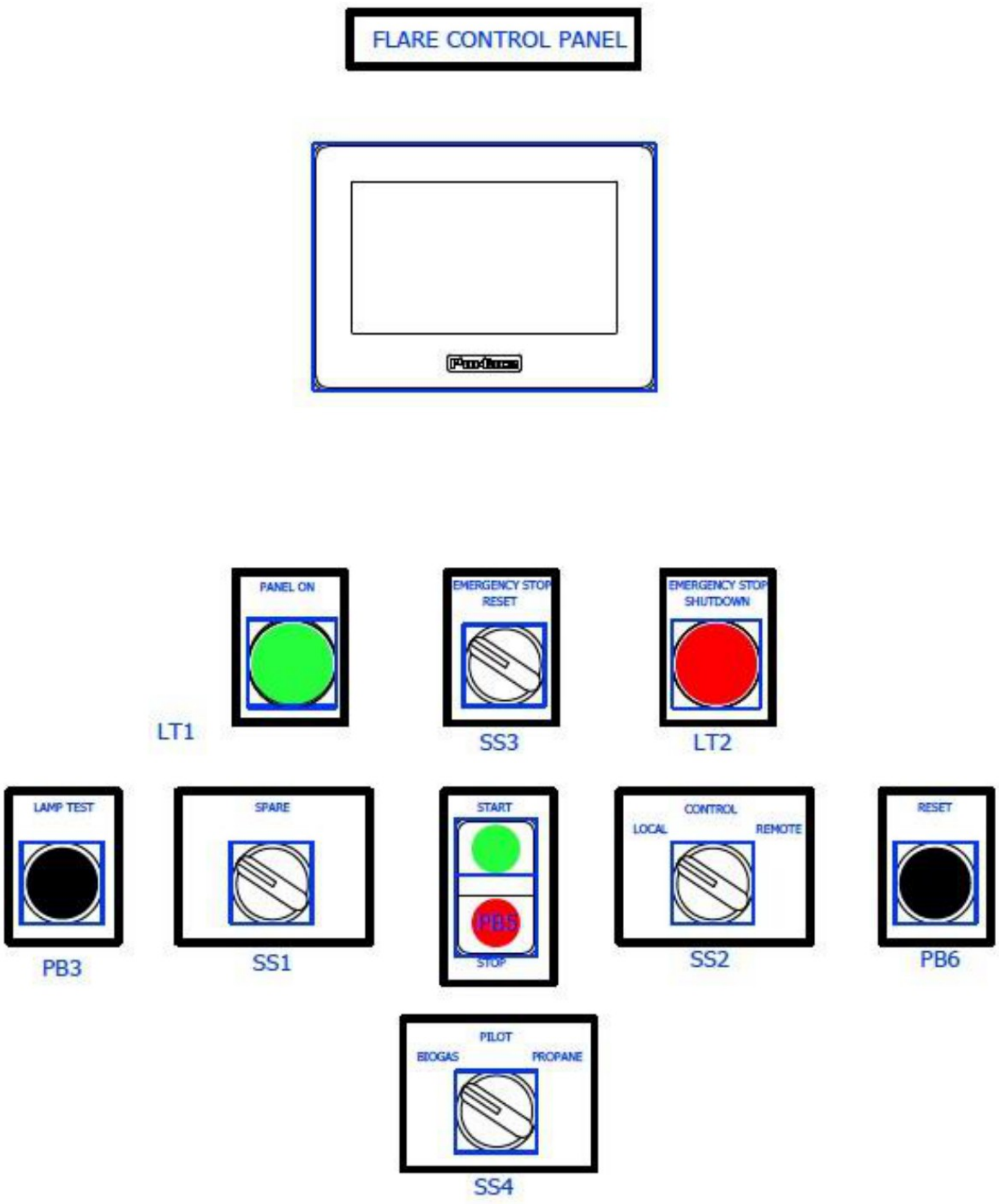
MD 01 Modulating Damper - Electrically Actuated Trox – SP-JZ-B C/W Damper Actuator Belimo – SM24A

MD 02 Modulating Damper - Electrically Actuated Trox – SP-JZ-B C/W Damper Actuator Belimo – SM24A

MD 03 Modulating Damper - Electrically Actuated Trox – SP-JZ-B C/W Damper Actuator Belimo – SM24A

MD 04 Modulating Damper - Electrically Actuated Trox – SP-JZ-B C/W Damper Actuator Belimo – SM24A

TT 01 Temperature Transmitter (Flare Temp °C PID Adjust & Display) (Flare High Temp) ‘N’ Type Thermocouple



Activity Indicators

- LT1 Panel on
- Flame on (on Pro Logic HMI panel)
- Main valve Open/Closed (on Pro Logic HMI panel)
- Pilot valve Open/Closed (on Pro Logic HMI panel)
- Propane pilot valve Open/Closed (on Pro Logic HMI panel)
- Flare temperature (on PID controller display)

Controls

- PB3 Lamp test button
- PB4/5 Start/Stop button
- SS2 Control Local/Remote selector switch
- SS3 Pilot Biogas/Propane selector switch
- PB7 Reset button
- Panel isolator
- Flare temperature controller (on Pro Logic HMI panel)
- Emergency stop shutdown

Shutdown Indicators

- LT2 Emergency stop shutdown
- High temperature (on Pro Logic HMI panel)
- Flame fail (on Pro Logic HMI panel)
- Pilot flashback (on Pro Logic HMI panel)
- Main burner flashback (on Pro Logic HMI panel)
- Low gas supply pressure (on Pro Logic HMI panel)
- High flarestack pressure (on Pro Logic HMI panel)

Flare Start-Up
Start Signal generated externally

The flare start signal will be initiated by the customer, either locally at the control panel or remotely. The option for local or remote control is selected on the control panel (switch SS2).

The desired pilot is selected on the selector switch SS3.

The ignition transformer I-01 (or I02) will be activated and the fail-safe closed pilot valve FSC-02 (or 03, depending on pilot selection) will open and the ignition sequence will start.

Following opening of the pilot burner valve FSC 02 (03), the ignition transformer I 01 (02) is then energised (this is a 15 seconds on, 15 seconds off timing sequence). The system then looks for the flame sensor BE 01 (02) to indicate that a flame has been established on the pilot burner. Once the pilot flame has been established for 20 seconds, and ignition is established and proven via the UV sensor BE01 (02) signal, the ignition transformer I01 (02) will be switched off. The main burner valve FSC01 will now open and allow gas to the main burners. The temperature signals from the type 'N' thermocouple in the flarestack TT01 will be displayed on the control panel. The flare combustion temperature is automatically controlled by the automatic air louvres (MD 01 - 04) at the base of the stack.
If the stack temperature exceeds a pre-set high alarm temperature level for two minutes the high temperature alarm is energised and the flare cycle is terminated.
The main or pilot burner flame arrester flashback sensors FA01, FA 02 or FA03 will stop the flare immediately.
A flame fail alarm is generated when the system fails to light the pilot within the set time period or when the system has been flaring normally then the flame established signal is lost for a set period (this pre-set period is set so that if the flame on signal flickers then the system continues to run, thus eliminating false flame fails). If a genuine flame fails occurs the system will illuminate the flame fail lamp but continue to run starting the ignition sequence again, if this is successful then lamp will be switched off and the system continue as normal, should this attempt fail after 30 minutes the flare system with be stopped, displaying the flame fail lamp.
The main gas valve is the fail-safe closed type and is pneumatically operated.

Temperature Control

Flare temperature can be set on the Pro-Face HMI screen in the face of the control panel. The PLC will then adjust the automatic louvres in the base of the stack to achieve the set-point temperature.

Shut Down

There are 3 ways of shutting down the gas flare

- Manual
- Automatic
- Emergency

When the gas flare is stopped by turning off either locally on the control panel or remotely, the main burner slam shut valve FSC01 will close and cut off the gas supply to the main burners.
The following conditions will cause the gas flare to shut down automatically:

- Flare out of temperature
- Ignition cycle fail
- Power interrupt
- Flame fail

When an auto shutdown is invoked the main burner slam shut valve FSC-01 will close and cut off the gas supply to the main burners and from the inlet pipe.
Following certain auto shutdowns the gas flare will restart automatically when the fault condition has been rectified.

Alarm Indications are provided on the Local Control Panel or Pro Face Touch Panel

- Emergency stop shutdown
- Low gas supply pressure
- High temperature
- Flame fail
- Pilot flashback
- Propane pilot flashback
- Burner flashback

All alarm signals available for remote use

Emergency stop shut-down

The emergency stop shut down lamp will be illuminated if the emergency stop button on the front of the control panel has been pressed. Once the fault condition has been rectified, then the emergency stop button can be reset and the system started again.

Low gas pressure

This alarm is triggered by pressure switch PS 01 and means that the gas supply is not delivering sufficient air pressure to the flarestack. Once the fault condition has been rectified, then the reset button can be used to reset the alarm lamp and the system started again.

High Temperature

If the combustion temperature within the flarestack exceeds a pre-set value (set during commissioning to protect the ceramic fibre combustion chamber lining) then the plant will shut down. Temperature is detected by the thermocouple TT-03 fitted in the side of the combustion chamber. Once the temperature has dropped below the shut-down value, then the manual louvres should be adjusted to lower the combustion temperature when the plant is restarted. When the fault condition has been rectified, pressing the reset button should extinguish the 'flare high temp' warning lamp and allow a re-start of the plant.
High temperature shut downs can be due to a number of reasons, such as blockage of the air louvre actuator or increasing the biogas flow rate too rapidly.

Pilot Burner Flashback

If a flashback occurs down the pilot gas line, it will be stopped by the flame arrestor FA02 (or FA03) but the temperature signal from the temperature sensor TA02 (or TA03) will initiate a shut-down, flagging up the 'pilot flashback' warning lamp on the control panel.
Flashbacks can be caused by sudden loss of gas supply pressure, low gas quality or oxygen in the gas supply.
When the condition that caused the main burner flashback alarm has been rectified, then the alarm can be cleared by pressing the reset button and the system re-started.

Main Burner Flashback

If a flashback occurs down the main gas line, it will be stopped by the main flame arrestor FA01, but the temperature signal from the temperature sensor TA01 will initiate a shut-down, flagging up the 'burner flashback' warning lamp on the control panel.
Flashbacks can be caused by sudden loss of gas supply pressure, low gas quality or oxygen in the gas supply.
When the condition that caused the main burner flashback alarm has been rectified, then the alarm can be cleared by pressing the reset button and the system re-started.

Flame Fail

The Flame can fail for a number of reasons but the most likely reason will be that the gas has methane content below that at which combustion can be sustained.
The Operator should first check this as soon as he finds the flame has extinguished and will not re-light. If the calorific value of the syngas is low it may be that the pilot will not ignite, or upon ignition, will operate with an unstable flame.
A set of timers controls the period of sparks that are given to light the flare. The sparking time can be set and the time over which ignition is attempted can also be set.
Once the condition that caused the flame failure has been rectified, the reset button will clear the alarm lamp and the plant may be re-started.

High Flare Pressure

The pressure switch PS02 is installed to protect the combustion chamber against overload. If too high a pressure is detected, then the plant will shut down, flagging up a 'high flare pressure' alarm on the HMI screen. The plant may be reset and restarted once the flarestack supply pressure is reduced to an acceptable level.

Plant Operation

Assembly and Dismantling of a Flarestack

IMPORTANT: AFTER ASSEMBLING OR REASSEMBLING ANY GAS CARRYING COMPONENT CHECK FOR LEAKS WITH A SOAPY WATER SPRAY.

1. Install the plant base on a flat reinforced concrete base. Fix to concrete base with anchor bolts if necessary. Consult with a structural engineer if the plant is in an exposed and windy area and increase the number of anchor bolts using clamping plates as necessary.

2. Take any protective wrapping off of the top shroud.

ALWAYS WEAR A PROTECTIVE FACE MASK, GOGGLES AND GLOVES WHEN HANDLING CERAMIC FIBRE BLANKET.

3. Make sure that the ceramic blanket liner is not damaged. If necessary repair with ceramic fibre and cement.

4. The emission monitoring ports MUST be protected with ceramic blanket, especially when the ports are galvanised or painted.

5. CERAMIC BLANKET SHRINKS UP TO 20% WHEN HEATED SO IT MUST BE COMPRESSED TO MAKE A GOOD JOINT. New stacks are often lined so that the ceramic blanket lining is proud at the joining flanges to allow for shrinkage and to prevent hot spots occurring at the joint. Check that the ceramic blanket is proud

Ceramic lining stands proud of the flange in order to give a compressed, sealed joint.

6. Lower the top shroud onto the base ensuring that the blanket at the joint is compressed slightly. Ensure that the ceramic heat shield on top of the burner riser is not damaged and that the burner incomer pipe is covered in 50 mm ceramic blanket.

Ceramic fibre lining prior to assembly of the stack

7. The ¾" BSP thermocouple sockets should face the Flame Arrester.

8. Use galvanised M16 x 45 bolts, washers and nuts to fasten the top shroud to the base.

9. Fit the thermocouple into the ¾" BSP socket. Only finger nip the wing bolt to hold the thermocouple in place to avoid crushing it. Do not overtighten.

10. If not already in place fit the pilot, UV sensor and ignition cable.

DISMANTLING IS THE OPPOSITE OF THE ABOVE, HOWEVER MAKE SURE THAT THE CERAMIC BLANKET HEALTH AND SAFETY NOTICE IS READ BEFORE DISMANTLING AS SPECIAL PRECAUTIONS MAY BE REQUIRED WHEN HANDLING CERAMIC BLANKET AFTER IT HAS BEEN IN USE AT TEMPERATURES GREATER THAN 900° C. ALWAYS WEAR A FACE MASK WHEN HANDLING CERAMIC FIBRE BLANKET.

Putting a Flarestack into Service

Install and assemble the biogas plant and test that it is correctly earthed, check that the electricity supply is correct and that the motors rotate correctly. Ensure that there is sufficient condensate drainage.

The control panel should only be opened by qualified electricians who will be able to reverse the rotation of the motor if necessary.

1. Open drain cocks and plugs to release any water that may have accumulated in the gas pipe system.
2. Close all drain cocks except in the one to the condensate drainage system if fitted.
3. Close the ¼" ball valves on the gas sample points. These are only opened when a gas sample is being taken. Where a permanent on-line gas analyser is fitted the feed and return are closed then opened a quarter turn. The ¼" ball valves on the pressure gauges can be closed or opened. Some operators prefer to keep the valves closed to save wear on the gauges and only open for taking readings. This may lead to confusion as an isolated gauge will continue to show the last reading which will change due to temperature changes.
4. Open the wellhead gas valves on the gas collection system and the gas valves on the plant.
5. Close the valve on the engine supply pipe(if fitted). The plant is first run and adjusted without the engine supply facility enabled.
6. Close the pilot regulating valve, then open approximately one and a half turns.
7. Close the pilot air regulating sleeve, then open approximately one quarter
8. Switch the power supply on; the Panel On lamp should light.
9. Test that the lamps are all working by pressing the lamp test button. All the lamps should light.
10. The air supply to the main gas valve should be adjusted so that the valve opens as slowly and as reliably as possible. To do this adjust the compressor air regulator to give a supply pressure to the main gas valve of approximately 6 bar and adjust the hand valve on the air receiver so that it is only just cracked open.
11. Turn the VENT/FLARE selector switch to vent
12. Check that the emergency stop button(s) are out. Rotate and pull to release it if necessary.

13. Press green start button to start the flare.

14. Let machine run only until the air has been pumped out of the gas supply pipeline and the gas analyser readout shows more than 25% methane and less than 4% oxygen.

15. Immediately press booster stop button.

16. Let fan run down and stop.

17. It is better to start the flare at about half flow for initial commissioning.

18. Wait 10 minutes then turn the selector switch to FLARE.

DO NOT ATTEMPT TO START FLARE SEQUENCE IMMEDIATELY AFTER VENTING AS SHROUD MAY BE FULL OF INFLAMMABLE GAS. WAIT UNTIL IT HAS CLEARED. METHANE IS LIGHTER THAN AIR AND IT WILL VENT OUT OF THE TOP OF THE STACK. EXPERIENCE IS THAT TEN MINUTES IS SUFFICIENT.

STAND CLEAR OF FLARE DURING START UP CYCLE IN CASE THE IGNITION OF A BUILD UP OF GAS IN THE FLARE CAUSES A FLASH BACK THROUGH THE AIR DAMPER(S)

19. Press booster start button. After the gas booster/exhauster has run for a short while the pilot igniter will spark and if the gas is more than 25% methane it should light.

20. If the pilot fails to ignite and the gas is more than 25% methane close the pilot regulating valve a quarter turn. Leave while the machine attempts to ignite the pilot burner. If the pilot still fails to light then repeat the process. Record the valve setting in the commissioning notes. If the methane level is low then the air sleeve on the pilot may need to be closed.

21. After the pilot has been lit a short while the air control louvres will start to open so that when the flare fully ignites it will not overheat before the temperature controller has time to react.

22. When the louvres, which let combustion and cooling air into the flare, are partially open the main gas valve will open and the flare will ignite.

23. After 30 minutes running or before if drainage failure is suspected (by water being blown out of the burner, oscillating vacuum gauge readings or liquid being heard in the pipeline) check condensate drainage. Gas booster impeller failure is caused by excess liquid entering the booster.

24. Full load means at the maximum flow rate of gas containing the maximum percentage of methane burning at the maximum design temperature with about 2 times as much air as is needed for stochiometric combustion. Thus if the flare is burning at half the maximum design flow rate then the shroud is

twice as big as it needs to be. If the percentage of methane is half of the maximum design percentage as well then the shroud is four times as big as it needs to be. At these lower energy input levels the amount of combustion air, cooling air and excess air needed is reduced thus reducing further the size of the shroud required.

To provide optimum combustion conditions Uniflare Limited's burners are designed to be adjustable in terms of flame injection angle and port loadings. Secondary air input is modulated by a temperature controlled air damper louvre system operated by a PID controller. In order to prevent incomplete combustion it may be necessary to prevent the air supply from closing off completely when the stack is heating up. This may be done by adjustment of the actuator clamp onto the louvre spindle. It may be necessary to re-locate the thermocouple to read the highest temperature in the combustion zone.

Commissioning comprises the adjustment of these variables to provide efficient combustion. Basically this is when the emissions of carbon monoxide, nitrous oxide and unburnt hydrocarbons are at a minimum; and this is when the exhaust is as clear and hot as possible. It is not necessarily so that the hottest temperature produces the cleanest exhaust. Although a flare may be designed to withstand a certain temperature it may not be best to run it at that temperature. Uniflare Limited's flares designed for 1,000°C or 1100°C operation use 1260°C Alumina silicate ceramic lining. Uniflare Limited's flares designed for 1200°C operation use 1400°C Zirconia ceramic lining. When completed the settings should be recorded.

25. Prior to setting the flare in full time use, the control options must be set. The unit has three principle modes of operation, i.e. VENT or FLARE. In the FLARE mode gas will pass to the pilot burner and spark ignition will proceed. Should the unit fail to light it will shut down after 30 minutes.

The unit can be run as an active VENT should gas quality prevent flaring. Alternatively the unit can be put onto the FLARE UTILISATION mode in which case if the flame is extinguished, due to low methane levels, it will continue running the booster to allow generation to continue while attempting to ignite periodically. The choice of VENT, FLARE, FLARE UTILISATION is based upon whether or not it is more important that the rig should be kept running to prevent migration into sensitive properties adjacent to the site or shutdown to prevent the distribution of smells into the locality. Each site has its own particular priority.

The VENT or FLARE options must be selected manually by the operator. The flame can fail for a number of reasons but the most likely reason will be that the gas has a methane content below that at which combustion can be sustained. The operator should first check this as soon as he finds the flame has extinguished and will not re-light. If the methane content is below approximately 25% it may be that the pilot will not ignite, or upon ignition, will operate with an unstable flame. A set of timers controls the period of sparks that are given to light the flare. The sparking time can be set and the time over which ignition is attempted can also be set. It is not advisable that the customer attempt to adjust these variables until he is fully familiar with the unit. The commissioning engineer will explain the choices and set the unit up as the customer requires. The other reasons may be that all the gas is going to the engine. The vent facility is controlled from the front of the panel by a selector switch.

To stop the flare:

1. Press the stop button on the control panel
2. Press any emergency stop button
3. Switch off the electricity supply
4. Close the inlet gas valve. (Please note this will take several seconds before the plant shuts down on low pressure, which is measured after the gas booster)

Adjustment

There are several different ways of controlling gas flow depending on the components and control specification of the particular gas plant:

1. Flow can be altered by the setting of the valves on the biogas collection or delivery system or the gas inlet isolation and regulation valve or the burner or outlet regulation or trim valve.
   Closing one or more valves on the biogas collection or delivery system will increase the vacuum in the field pipeline.
   Closing the gas inlet isolation and regulation valve will decrease the vacuum in the gas supply pipe but increase the vacuum in the condensate knockout vessel which may lead to water being sucked up the drain into the gas exhauster.

Combustion Control

Combustion is controlled by a PID temperature controller in the control panel reading the flare temperature via the thermocouple and adjusting the motorised air damper louvres accordingly. In general the louvres open to let in more air to lower the temperature. The temperature controller is factory set with a high temperature shut down. It may be necessary to alter the settings during commissioning in order to obtain a cleaner burn, reduce NO_x or to reduce temperature oscillations. Rapid temperature changes may lead to premature failure of the thermocouple.

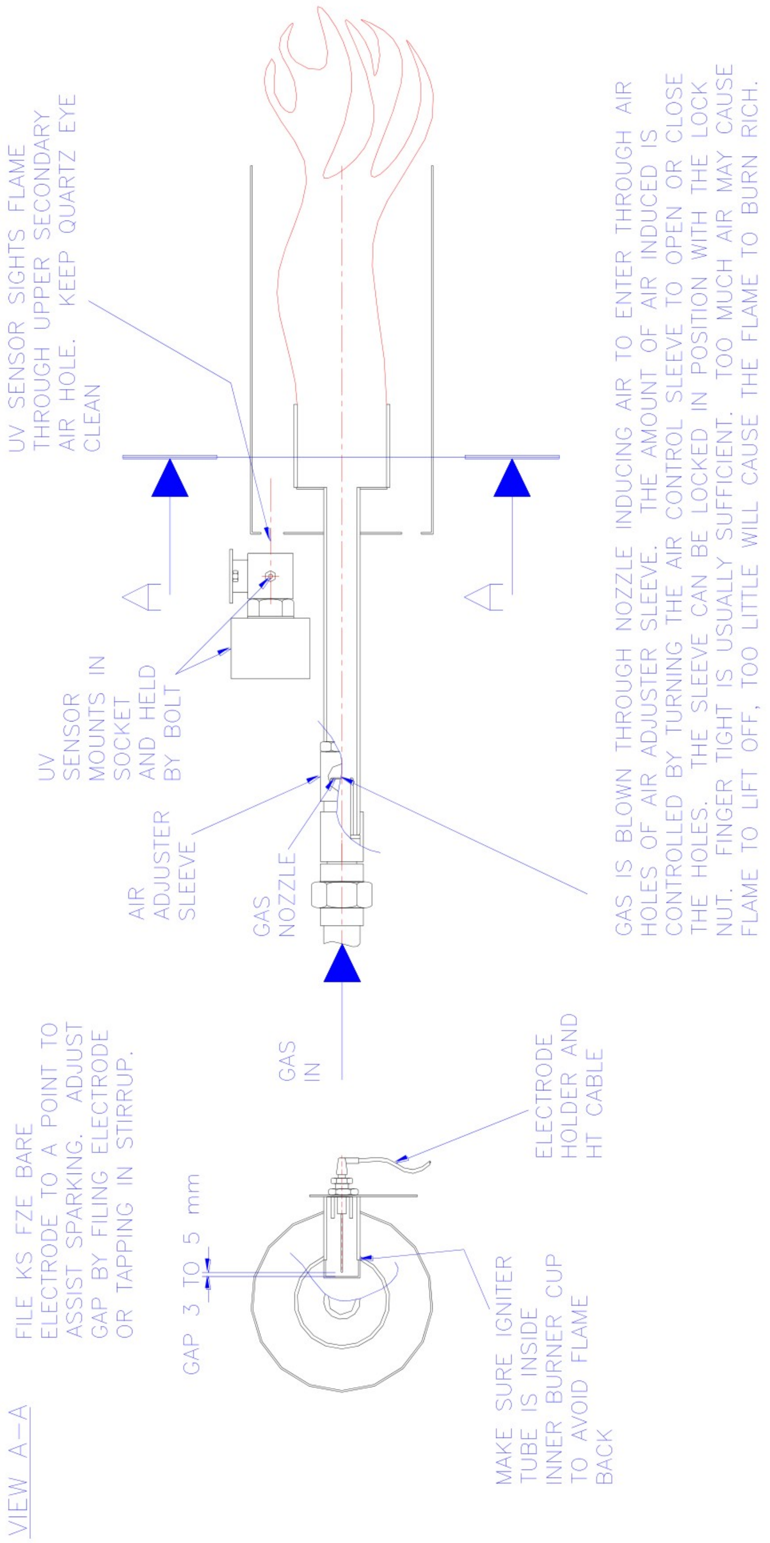
In conditions of low gas flow rates and / or with low methane values in the landfill gas then the flare may have difficulty in maintaining very high temperatures and a clean burn. If this is the case then red or yellow flame or smoke will be seen coming from the stack. To avoid this adjust the flare as per Putting into Service.

See compressor and filter instructions for adjustment to air pressure.

Pilot Adjustment

To adjust the pilot flow rate use the gate valve on the gas train. In general the gate valve should be opened only 1 to 2 turns depending on the gas pressure and composition. To adjust the air gas mixture adjust the bunsen burner type gas/air eductor mixer valve near the pilot burner. For poor quality biogas the air holes in the valve should be closed completely.

(Drawing)


UV SENSOR SIGHTS FLAME THROUGH UPPER SECONDARY AIR HOLE. KEEP QUARTZ EYE CLEAN
GAS IS BLOWN THROUGH NOZZLE INDUCING AIR TO ENTER THROUGH AIR HOLES OF AIR ADJUSTER SLEEVE. THE AMOUNT OF AIR INDUCED IS CONTROLLED BY TURNING THE AIR CONTROL SLEEVE TO OPEN OR CLOSE THE HOLES. THE SLEEVE CAN BE LOCKED IN POSITION WITH THE LOCK NUT. FINGER TIGHT IS USUALLY SUFFICIENT. TOO MUCH AIR MAY CAUSE FLAME TO LIFT OFF, TOO LITTLE WILL CAUSE THE FLAME TO BURN RICH.
A
A
UV SENSOR MOUNTS IN SOCKET AND HELD BY BOLT
AIR ADJUSTER SLEEVE
GAS NOZZLE
GAS IN
FILE KS FZE BARE ELECTRODE TO A POINT TO ASSIST SPARKING. ADJUST GAP BY FILING ELECTRODE OR TAPPING IN STIRRUP.
ELECTRODE HOLDER AND HT CABLE
GAP 3 TO 5 mm
MAKE SURE IGNITER TUBE IS INSIDE INNER BURNER CUP TO AVOID FLAME BACK
VIEW A–A

Setting igniter spark gap using spare electrode Ø 3.5 mm. The gap should be 3mm to 5mm. The electrode should be filed to a point in the same direction as the axis not across it.

Maintenance

Schedule of maintenance activities	Date issued	Rev No.	Date revised
This schedule is based on average working conditions. Maintenance experience will show if it is necessary to change the maintenance frequency of certain components. Should you notice any changes in operation or abnormalities please contact your service provider.	**30/04/2021**		
	Many of the checks require a certain level of qualifications, training and competency and should only be carried out by a suitable training and competent person / company. Where possible please seek advice from the manufacture or service provider.		

Activity	Tag No.	Daily	Weekly	3 mnth	6 mnth	12 mnth	hours run
Check installation for abnormal lubricant leaks, condensate leaks.		X					
Check installation, loose bolts and connections, damaged components,			X				
Check for changes in flame condition. Noise, Smoke, Flame etc.			X				
Check Compressor operation and installation pneumatic air leaks, etc.			X				
Check Flare temperature reading (800DegC) record any changes.			X				
Check flow where available and record any changes.			X				
Check Gas Quality readings. Record and report any changes.			X				
Check for any damage on components, instrumentation.			X				
Check pneumatic valves ensure that the valve indicator is either fully open or fully closed depending on flare status. If the valve is not seated it could allow gas to pass.			X				
Check control panels for fault, error or maintenance messages		X					
Check pressure drop across flame arresters and record levels. Clean elements when pressure drop affects gas flow.				X			
Clean flame arrester elements. Replace if necessary.						X	
When plant is shut down record all manual valve positions then open and close them to check for correct operation over full range. Return valves to recorded position before restarting plant.				X			

Maintenance

Activity	Tag No.	Daily	Weekly	3 mnth	6 mnth	12 mnth	hours run
Lubricate all hinges, locks and moving parts				X			
Check UV sensor mA reading.				X			
Change UV sensor bulb.						X	
Check flare pilot operation.				X			
Remove main and pilot flame arrestors, clean or replace. Inspect inlet filter where fitted.				X			
Check security of all holding down bolts.						X	
Check oil level in compressor, top-up if necessary.				X			
Drain condensate from compressor tank, check condition of any in line filters and drain if required.				X			
Inspect all external wiring runs for signs of deterioration and damage.			X				
Inspect all internal wiring for signs of deterioration and damage. Check terminals for tightness.				X			
Check glands for security inspect panel wiring and ensure all cables are tight.				X			
Check operation and security of MCB's, isolators, timers, relays, controllers.				X			
Check thermocouple operation				X			
Check all indicator lamps function and any external lighting on the system				X			
Check operation of any emergency stop buttons/safety switches				X			
Check operation of compressor, record cut in/out pressures				X			
Check operation of air louvers through full range				X			
Inspect ignition circuit and check operation.				X			
Inspect ignitor (probe) check condition of ceramic insulation inside tip and ensure spark is adequate during operation				X			
Check auto shutdown system (flame failure)				X			
Check control panel display for any alarm signals				X			

Training Instructions

TRAINING INSTRUCTIONS

For more detailed training please contact Uniflare Limited, who run training training programmes and issue certificates on completion.

Read 'Section 2: HEALTH & SAFETY'.

The gas exhauster and flare is but one component in a biogas control system including gas wells, collection mains, digester systems, monitoring points and a monitoring and control strategy all designed to safely dispose of the gas before it can escape to the surrounding environment and to work until the biogas source is incapable of producing any more methane

The production of methane in a anaerobic process is dependant on the type (putrescible or non putrescible) and humidity of the waste and the amount of oxygen, i.e. aerobic (oxygen present) or anaerobic (no oxygen present) present in it.
The escape of the gas to the environment is dependant on the gas pressure in the anaerobic proccess, the permeability of the cap and surrounds and the atmospheric pressure.

Excessive gas pumping from the anaerobic processmay cause air to be sucked through the cap or surrounds into the waste creating aerobic conditions which will lessen the production of methane but not the propensity of the waste to produce it and is therefore wasteful of the energy used to operate the gas exhauster and flare.

Flame propagation at normal pressure and temperature may occur in a methane-air mixture of a composition between 5.3% (lower limit) and 14.9% (upper limit). Increased temperature will widen these limits e.g. at 400°C the limits are 4.8% and 16.6%. Vitiation by carbon dioxide and other non-flammable gases in the anaerobic processgas will of course narrow these limits but for safety purposes the limits 5% to 15% are used.

It is possible therefore to create a flammable mixture in the waste or gas collection pipework by excessive pumping; avoid this.

The requirement of the gas control system is no escape of anaerobic process gas to the surrounding environment as measured by gas analysis at the monitoring bores and by smell and as much production of methane as possible. To this end the flow through the flare and through each well is controlled by use of regulating valves which are adjusted over a period of time until the extraction of gas from the site is balanced with the above requirement.

On sites where the cap or the retaining surrounds is permeable then it may be impossible to achieve gas migration control without sucking air into the waste. This is to be avoided by improving the impermeability of the cap and surrounds.

The flare stack is the heart of the anaerobic process gas plant. Its purpose is to treat the collected gas by thermal oxidation to remove odour and reduce its environmental impact. It cannot destroy or create atoms it changes their molecular structure.

This is the chemical equation for the thermal oxidisation of methane:

CH_4	+	$2O_2$	⇨	CO_2	+	$2H_2O$
Methane in theanaerobic processgas	Mixed with	Oxygen in the air	At high temperature oxidises to	Carbon dioxide	&	Water vapour

Where:
C = Carbon
H = Hydrogen
O = Oxygen

There are three keywords in combustion:

- Time
- Temperature
- Turbulence

If not enough oxygen (air) is mixed with the gas for sufficient time at a high enough temperature then the carbon (C) in the anaerobic process gas is either not completely oxidised to carbon dioxide or is only partially oxidised and forms carbon monoxide (CO).
Too much time at a high temperature and nitrogen (N), mostly from the air, will be oxidised to form oxides of nitrogen (NOx) a pollutant.

Environmental Agency maximum design emissions Normalised at 0°C, 101.3 kPa and 3% O_2:	Carbon monoxide (CO) 50 mg Nm^{-3} Oxides of nitrogen (NO_x) 150 mg Nm^{-3} Total Volatile Organic Compounds as carbon (VOCs) 10 mg Nm^{-3} Non-Methane Volatile Organic Compounds (NMVOCs) 5 mg Nm^{-3}

The approximate ignition temperature for a stochiometric mixture of methane is 700°C, hydrogen is 550°C, and carbon monoxide 570°C. Stochiometric means a mixture with exactly the correct ratio of fuel and oxygen as in the equations above for complete combustion. Using air as the source of oxygen gives the stochiometric ratio of 9.55 volumes of air per volume of methane. Anaerobic process gas is a mix mainly of methane and carbon dioxide and to ensure that every molecule of methane has sufficient oxygen to burn flares are designed to thoroughly mix the anaerobic process gas with air and are also operated with excess air. Excess air is used to cool the combustion chamber if necessary.

Unless there is sufficient fuel air mixing there will be pockets of sub-stochiometric fuel air mix. When the carbon in these pockets is heated in the absence of oxygen it glows as bright red yellow flames until either it has enough oxygen to complete combustion or the temperature drops and combustion is incomplete. The retention time spoken about is taken from the time when there is no visible flame.

The results of enclosed flare monitoring at test sites carried out on behalf of the Environment Agency and published in their "Guidance for Monitoring Enclosed Landfill Gas Flares, Table 2.3a, Page 10" (Please see below) show that flares with temperatures at the monitoring point near or above 1000°C tended to have higher NO_x emissions. One very high temperature flare (1162°C) at site F emitted 149 mg Nm^{-3} of NO_x only just meeting EA requirements. The flare at site J had, at 14 mg Nm^{-3}, the lowest NO_x emissions of the 10 flares tested. It also had the lowest CO values at <2 mg Nm^{-3}, whereas the site G flare with exit temperature of 992°C tested at 253 mg Nm^{-3} CO. These figures and perusal of Table 2.3a show that high exit temperatures tend to increase emissions of some pollutants and not necessarily reduce others. This data flies in the face the statement in "Guidance on Landfill Gas Flaring Version 2.1, Section 2.12 Retention Time, page 15 ", which states " The minimum recommended retention time is 0.3 seconds at a minimum temperature of

1,000°C. " That said the author goes on to say, "However, alternative criteria offering equivalent performance may also be acceptable for example, a longer retention time combined with a lower temperature."

The turn down ratio of a pre-aerated burner is determined by flashback down the mixing tube at the lowest flow and lift-off of the flame from the top of the burner cup at the highest flow. This range is usually about 1:4 for a Bunsen burner burning constant calorific value gas but Uniflare burner systems have a mix of burner types and adjustments to increase this range. At high flow rates the burner system is cooled by the incoming gas and air. At low flow rates this cooling effect is less and the burners will themselves run hotter even though the heat input is less. Burner life may be shortened if the flare is operated for extended periods at low flow rates much as a diesel engine's life will be shortened if operated at low loads although for a different reason. Burner cup replacement is a straightforward operation on Uniflare flares.

"Turn-down is the ratio of a minimum gas flow to maximum gas flow under which satisfactory operating conditions will be maintained. Turndown depends upon the range of rates of heart release for which the flare is designed, and permissible exit velocities from the burner tip. The turndown ratio will therefore effect the flare emission significantly. In general, manufacturers quote ratios of 4:1 or 5:1, based on heat release, for a flare operating under good combustion conditions and a range of methane concentrations of around 20-60% by volume. It is possible to turn a flare down to achieve a 10:1 turn-down, or greater, but the emission standard is unlikely to be met and such a turn-down is difficult to achieve because of the variability in methane content. The optimum requirement is a chamber that can take the maximum turndown without overheating and the minimum turndown without being too cool. A low rate of heat release will not allow high combustion temperatures to be achieved." (Environment Agency Guidance on anaerobic process Gas Flaring 4.8.7 Page 24)

Determinand	Measured value									
Site	A	B	C	D	E	F	G	H	I	J
Inlet gas										
Methane (%) [a]	55	56	45	44	33	54	36	39	36	46
Carbon dioxide (%) [a]	39	41	31	32	30	43	30	34	23	37
Oxygen (%) [a]	0.4	<0.1	0.2	4.4	7.0	0.9	6.2	0.6	7.0	1.8
Nitrogen (%) [a]	5.0	3.2	24	20	30	1.9	28	21	34	15
Hydrogen sulphide (ppm) [a]	<5	587	23	30	85	1416	33	89	5	18
Carbon monoxide (ppm) [a]	<2	11	24	45	786 [c]	40	530 [c]	56	36	194
Emissions										
Temperature (°C) [a]	513	956	588	986	1208	1162	992	849	738	862
Oxygen (%) [a]	17.3	12.6	15.3	11.0	5.1	6.4	11.5	12.4	14.3	11.5
Carbon dioxide (%) [a]	2.6	5.7	4.1	8.6	14.7	12.4	8.3	5.8	5.3	8.3
Moisture (%) [a]	3.1	5.6	3.6	15.0	13.0	16.3	8.4	15.3	7.2	12.2
Carbon monoxide (mg/m^3) [b]	1042	617	2178	27	32	34	253	34	99	<2
Oxides of nitrogen (as NO_2) (mg/m^3) [b]	75	111	43	92	99	149	82	59	63	14
Total VOCs (as C) (mg/m^3) [b]	21	3	2	<2	2	<2	10	6	17	<2
Hydrogen chloride (mg/m^3) [b]	36	9.5	4.6	7.4	11	4.2	36	7.4	4.9	16.2
Hydrogen fluoride (mg/m^3) [b]	21	2.5	0.4	2.5	0.7	1.6	7.8	2.5	0.5	0.5
Sulphur dioxide (mg/m^3) [b]	482	239	63	30	43	359	181	61	58	83

[a] On-site measurement.

[b] Averaged emission by laboratory analysis at reference conditions of standard temperature and pressure (STP), i.e. 3 per cent oxygen, 273K, 101.3 kPa, dry.

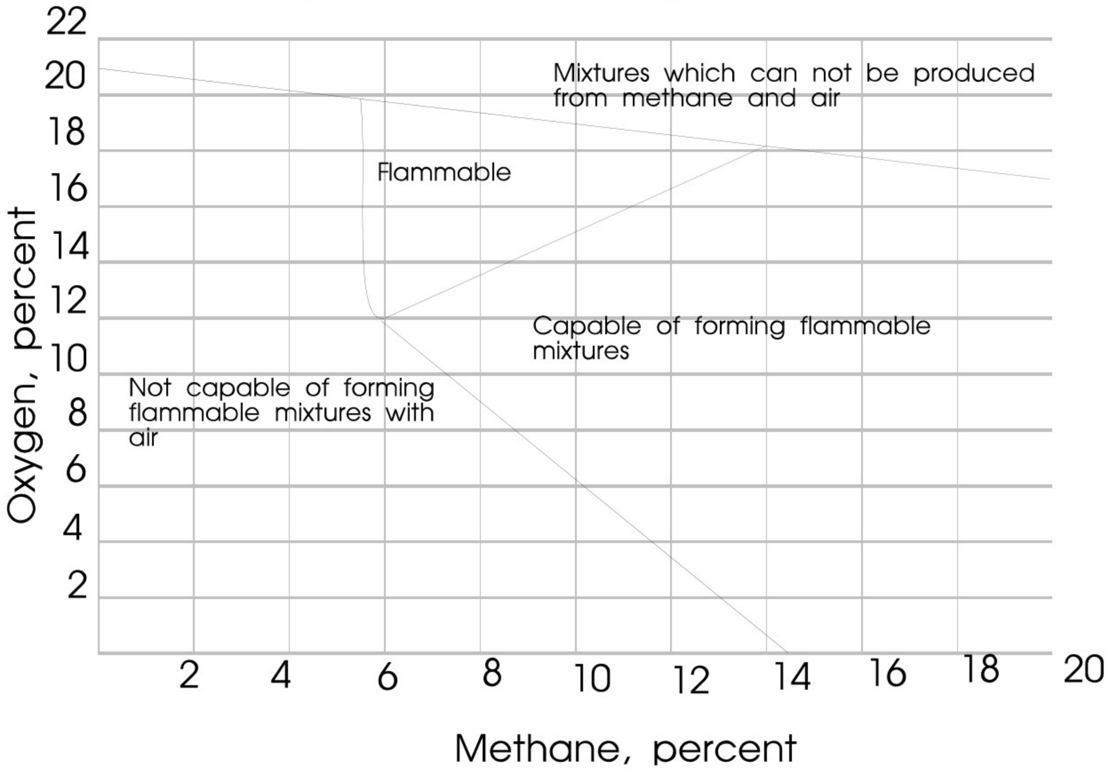
[c] Result may be affected by possible interference due to the presence of hydrogen.

This is the chemical equation for the thermal oxidisation of hydrogen sulphide:

H_2S	**+**	**1.5 O_2**	⇨	**SO_2**	**+**	**H_2O**
Hydrogen sulphide in theanaerobic processgas	Mixed with	Oxygen in the air	At high temperature oxidises to	Sulphur dioxide	&	Water vapour

Please note that H_2S is not the only source of sulphur in anaerobic processgas.

Explosive limits of biogas inside transmission pipes.



The relationship between the quantitative composition and flammability of mixtures of methane, air and nitrogen.*

* Taken from Limits of Flammability of Gases and Vapours by [redacted] and [redacted]

TROUBLE SHOOTING

WARNING. This fault finding and rectification must only be carried out by trained personnel and where necessary by a qualified electrician. Wear appropriate personnel protection equipment

PROBLEM	INDICATOR LAMPS OR TEXT	STATE	CHECK	POSSIBLE CAUSE	POSSIBLE SOLUTION
Flare fails to start or stops	Panel On	OFF	Check door isolator switch is on.	Isolator is switched off	Switch on
			Check voltage across each phase of supply, check switches and fuses.	Power cut or power is switched off or one or more mains fuses have blown or mains trip has tripped.	Investigate cause and reinstate
			Press lamp test button to see if lamps have failed	Power may be on but indicator lamp has failed	Change lamp bulb(s)
	Panel On	ON	If no other lamps lit press lamp test button to see if lamps have failed	Power may be on but indicator lamp has failed	Change lamp bulb(s)
	Emergency Stop	ON	Check emergency stop button	Emergency stop may have been pressed	Find out why emergency stop button was pressed. When safe to do so reset button by turning and pulling
	Low Pressure	ON	Closed valve or blockage	A closed valve or blockage upstream reducing pressure. Faulty switch, wiring or IS barrier	Investigate cause and rectify. Press the RESET button on the control panel door and press start

	High Suction	**ON**	Closed valve or blockage upstream of gas plant	A closed valve or blockage upstream of gas plant. Faulty switch, wiring or IS barrier	Investigate cause and rectify. Press the RESET button on the control panel door and press start
	Flame Fail	**ON**	Closed valve	Closed valve, most likely downstream	Investigate cause and rectify. Press the RESET button on the control panel door and press start
			Press reset button to reset then press start and check methane level in gas	The methane level of the incoming gas has fallen below combustible levels due to excessive extraction.	Balance gas extraction rate to the methane production rate.
			UV sensor function	An obscured or dirty quartz eye lens or a faulty UV sensor, flame watcher or wiring	Investigate cause and rectify. Press the RESET button on the control panel door and press start
			Transformer function	The ignition transformer is damaged	Check the ratio of resistances across the transformer. If this is not 20:1, replace the transformer

Flare fails to start or stops	**Flame Fail**	**ON**	Check that the igniter is sparking, a buzzing or arcing noise can usually be heard. If not check that the pilot is securely bolted in the correct position, that the electrode gap is correct and that the ignition cable and adapter cap are fitted correctly and not shorting out.	The spark gap on the ignition electrode is not correct, the ignition transformer is damaged, the connection to the electrode is poorThe ignition transformer is damaged	Investigate and rectify. The spark gap should be 3 to 5mm. See pilot burner drawingCheck the ratio of resistances across the transformer. If this is not 20:1, replace the transformer
			Methane quality in incoming gas	The methane level of the incoming gas is below combustible levels due to low methane production from the waste, excessive extraction flow rates, air ingress into the line due to pipe line leaks or breakage or excessive extraction flow rates.	Options are, provided they are in compliance with the gas control strategy and the Environmental Agency's guidelines; 1/ Wait until methane levels have risen to combustible levels before starting flare again, 2/ Vent for a short while to purge air and low methane gas from system, 3/ Vent continuously. Venting will most likely cause an odour problem.

			Gas and air supply to pilot or main burner if open flare	Too little gas; solenoid not opening, solenoid filter blocked, pilot line flame arrester blocked, control valve not open enough. Too high gas velocity blows our flame; control valve open too much. Too much air giving lean fuel, air sleeve is open too much.	Investigate cause and rectify. Press the RESET button on the control panel door and press start. Gas valve and air sleeves only opened a little
	High Temp	**ON**	Thermocouple, PID controller and air damper function	Lack of secondary combustion/cooling air through air damper: Air damper jam; Thermocouple failure; Incorrect PID setting; Too rapid a change in gas flow rate: Component or wiring failure.	Investigate cause and rectify. Press the RESET button on the control panel door and press start
Flare fails to start or stops	**Pilot flashback**	**ON**	Flame arrester for heat damage function of alarm	Gas burning on flame arrester element. This requires sufficient air (oxygen) in the gas and a gas velocity less than the flame velocity of the burning gas.	Investigate cause and rectify. Replace flame arrester element. Press the RESET button on the control panel door and press start
	Burner flashback	**ON**	Flame arrester for heat damage function of alarm	Gas burning on flame arrester element. This requires sufficient air (oxygen) in the gas and a gas velocity less than the flame velocity of the burning gas.	Investigate cause and rectify. Replace flame arrester element. Press the RESET button on the control panel door and press start

	Any Optional Fault	ON	Cause	Function, sensor or wiring fault	Investigate cause and rectify. Press the RESET button on the control panel door and press start
Gas flow is less than before			Valve settings on plant and system against previous settings.	Valves have been closed.	As necessary readjust valves to previous or required setting.
			Differential pressure across filters and flame arrester against the previous values.	There is a blockage in one or more of the following: Filter, or Flame Arrester.	Remove and clean blocked components.
			Inlet pressure gauge against previous reading and for oscillation	Gas collection pipes may have become blocked or waterlogged.	Investigate cause and rectify. Press the RESET button on the control panel door and press start
				Gas availability from the site has reached its limit.	Balance gas extraction rate to the methane production rate.

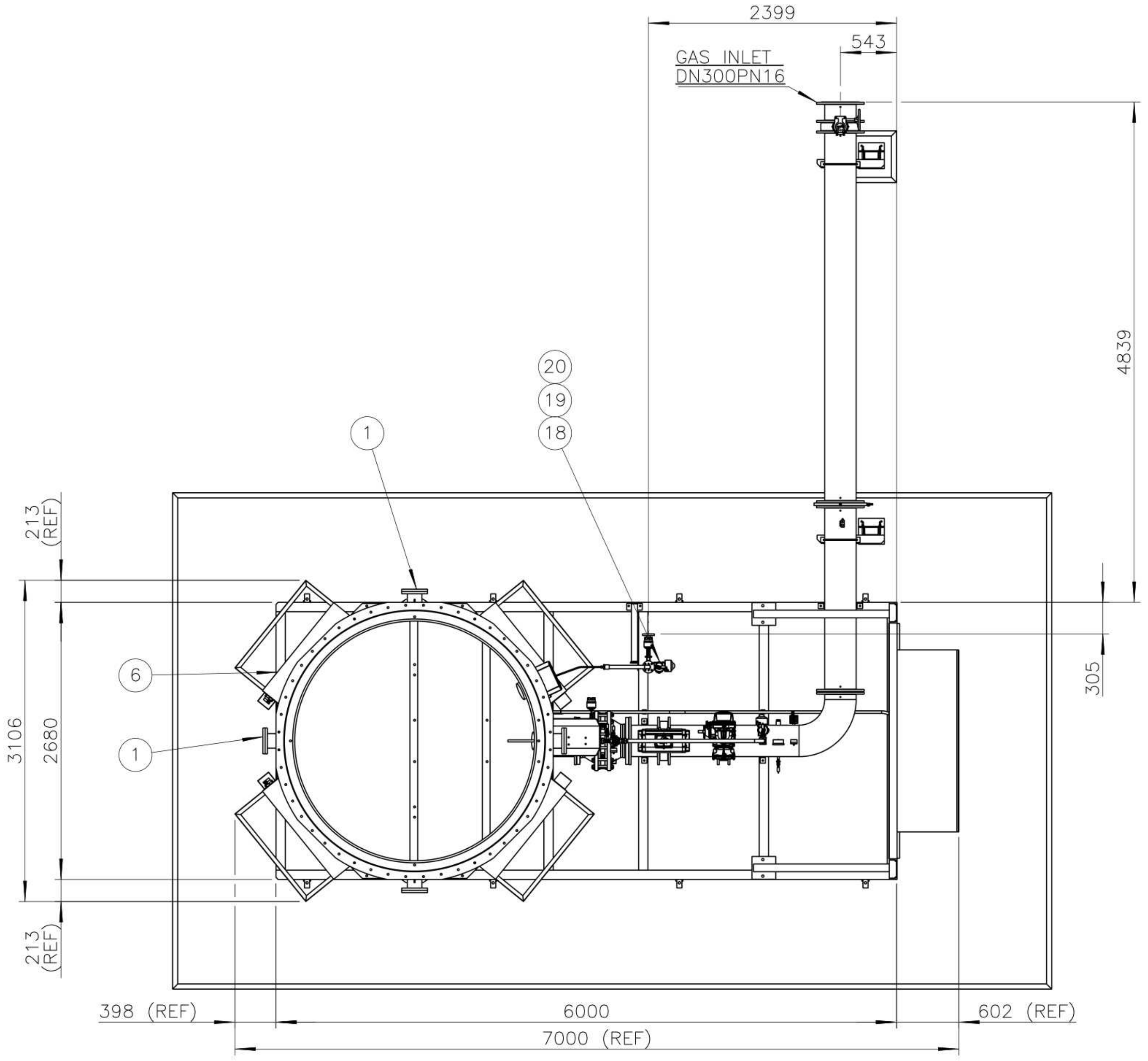
Water sprays out of the FLARE or is heard in the pipework			Inlet pressure gauge against previous reading and for oscillation. Check the condensate drainage system for malfunction.	A blockage or failure in the condensate drainage system. It may be caused by a high water table allowing water to be drawn into the system up the drain.	Stop the plant immediately and rectify before damage is done to the booster
Flame and/or flow meter reading surges and/or pressure gauge reading oscillate.				A slug of condensate has formed in a low point in the gas collection system and is being periodically sucked up and dropped by the gas exhauster.	The drainage of the gas collection system must be rectified.
Yellow or orange flame and or black smoke issues from flare			Thermocouple, PID controller and air damper function	Lack of secondary combustion/cooling air flow through air damper: FLARE failure, Air damper jam; Thermocouple failure; Incorrect PID setting; Too rapid a change in gas flow rate: Component or wiring failure.	Ensure that the temperature control air damper louvers are working freely and that the burners are in good condition.

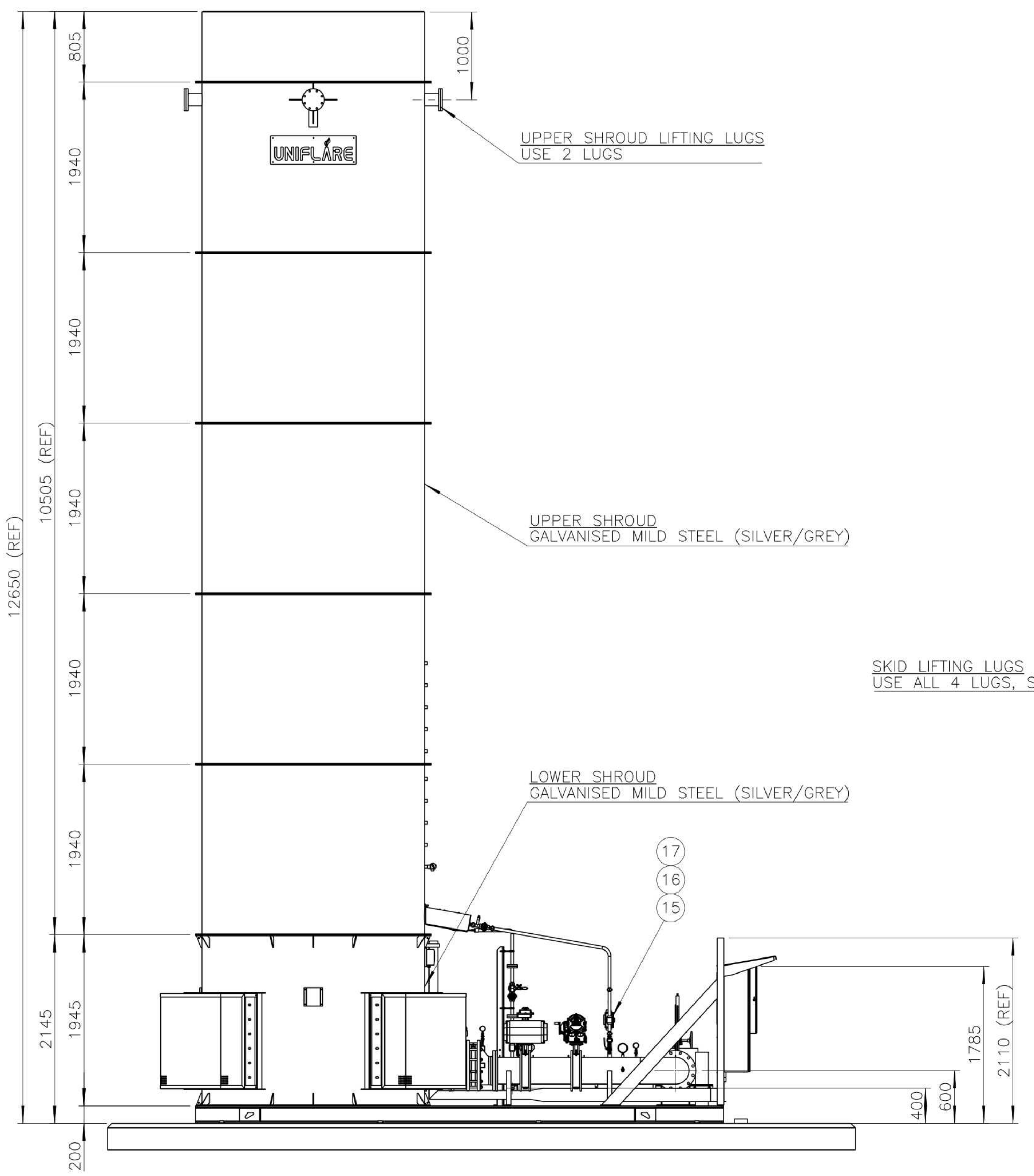
Yellow or orange flame and or black smoke issues from flare (continued)					Increase the air let in through the temperature control air damper either by adjustment of the actuator clamps onto the louver spindle. When adjusting the louver spindle make sure that the actuator cannot overpower the louvers causing them to fail. Decrease the combustion temperature set point of the PID temperature controller. The best combustion is not necessarily at the highest temperature. Adjust PID controller to avoid large temperature swings Adjust operation to avoid sudden changes in flow rate Check gas flow and quality to see if flare is operating outside its specification. i.e. overloaded

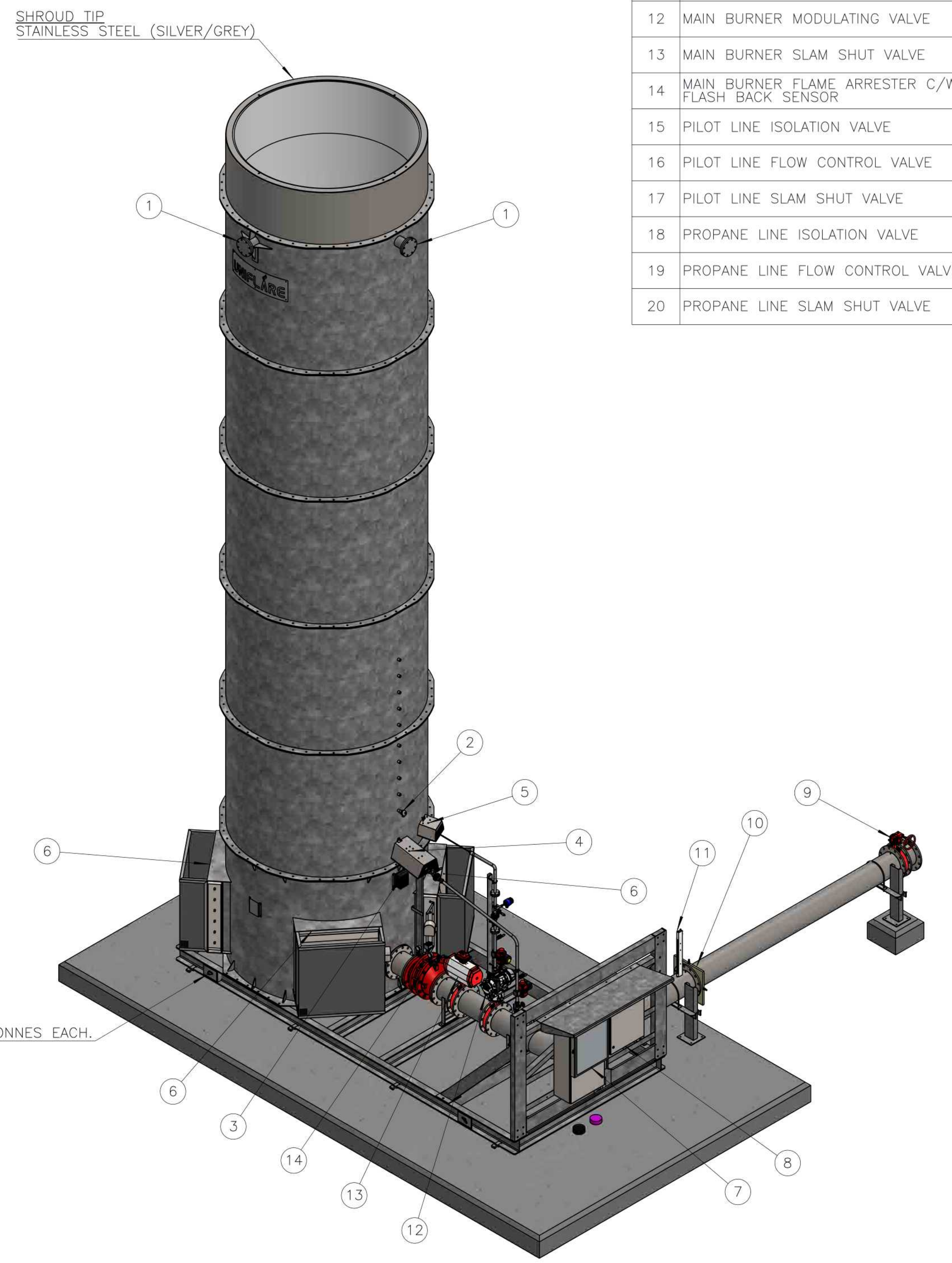
Flare lights with a whoosh or flash back through louvers			Check that the pilot gas flow rate is as high as can be allowed to ensure reliable pilot lighting.	This is caused by the combustion area filling with gas before being lit by the pilot.	Adjust the speed of opening of the pneumatically operated main gas valve by closing down the valve on the air receiver (not the regulator) so it is only just open. STAND CLEAR OF FLARE AIR DAMPER LOUVERS WHEN TESTING
Gas temperature at inlet is higher than usual				Possible fire in landfill Sun heating exposed pipe particularly black plastic	Rectify

Appendices

- General Arrangement Drawings
- DSEAR Zoning Drawings
- Electrical Wiring Diagrams
- Component suppliers Data
- Factory Acceptance Tests
- Site Acceptance Tests







ITEM No.	DESCRIPTION	QTY
1	DN125 EMISSIONS TEST PORT	4
2	COMBUSTION THERMOCOUPLE	1
3	IGNITION TRANSFORMER	1
4	FIRE BLASTER C/W PILOT FLAME ARRESTER & FLASH BACK SENSOR	1
5	ZAI & UV PROPANE FIRE BLASTER	1
6	AUTOMATIC COMBUSTION AIR DAMPER	4
7	CONTROL PANEL C/W VANDAL COVER	1
8	PNEUMATIC CONTROL PANEL	1
9	INLET MANUAL ISOLATION VALVE	1
10	ORIFICE PLATE FLOW METER	1
11	ORIFICE PLATE MANOMETER	1
12	MAIN BURNER MODULATING VALVE	1
13	MAIN BURNER SLAM SHUT VALVE	1
14	MAIN BURNER FLAME ARRESTER C/W FLASH BACK SENSOR	1
15	PILOT LINE ISOLATION VALVE	1
16	PILOT LINE FLOW CONTROL VALVE	1
17	PILOT LINE SLAM SHUT VALVE	1
18	PROPANE LINE ISOLATION VALVE	1
19	PROPANE LINE FLOW CONTROL VALVE	1
20	PROPANE LINE SLAM SHUT VALVE	1

FLARE WEIGHTS
MAIN SKID : 4 TONNES
UPPER SHROUD : 6 TONNES
TOTAL : 10 TONNES

PIPEWORK
STAINLESS STEEL 316L (SILVER/GREY)

STEELWORK
GALVANISED MILD STEEL (SILVER/GREY)

DO NOT SCALE - IF IN DOUBT ASK

NOTES:

Rev	Description	Dsgnr	Chkd	Appd	Date
A	FIRST ISSUE	[redacted]			30/03/21

UNIFLARE™
GLOBAL ENVIRONMENTAL TECHNOLOGY

Tel: +44 (0)1676 529118
Fax: +44 (0)1676 529119
enquiries@uniflare.co.uk
www.uniflare.co.uk

Drawn By: [redacted]
Date: 30/03/2021

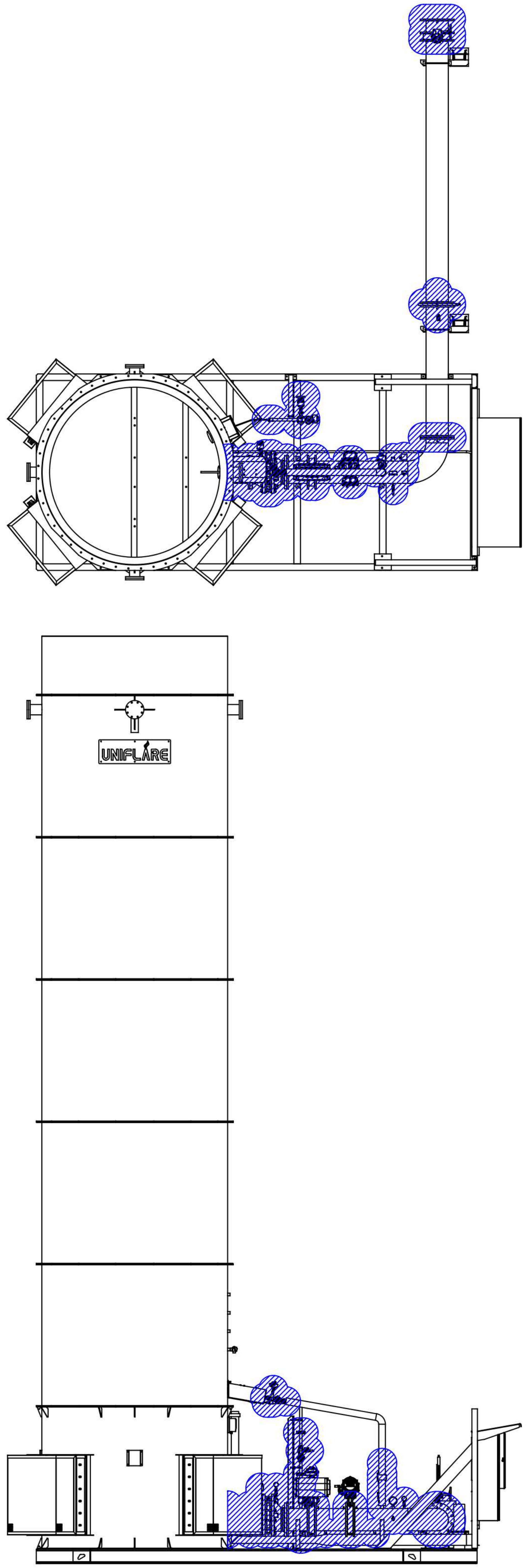
Project Name: NE KOENG BIOGAS NATURE ENERGY

Drawing Title: GENERAL ARRANGEMENT UFO-5000-ENV-BVF

Drawing No.: 1806-2001
Scale: 1:60
Sheet Size: A2
Rev: A

DO NOT SCALE - IF IN DOUBT ASK

NOTES:



HATCHED AREAS SHOW, WHERE APPLICABLE, A ZONE 2 AREA OF 100mm AROUND FLANGES & FITTINGS (FOR A MAXIMUM PRESSURE OF 80mbarg), AND 200mm AROUND FLANGES & FITTINGS (FOR A MAXIMUM PRESSURE OF 350mbarg). THESE ZONES ARE CALCULATED AS PER BS 60079.

Rev	Description	Dsgnr	Chkd	Appd	Date
A	FIRST ISSUE	[redacted]			30/03/21

UNIFLARE™
GLOBAL ENVIRONMENTAL TECHNOLOGY

Tel: +44 (0)1676 529118
Fax: +44 (0)1676 529119
enquiries@uniflare.co.uk
www.uniflare.co.uk

Drawn By: [redacted]

Date: 30/03/2021

Project Name: NE KOENG BIOGAS NATURE ENERGY

Drawing Title: GENERAL ARRANGEMENT UFO-5000-ENV-BVF

Drawing No.: 1806-2501

Scale: 1:50

Sheet Size: A2

Rev: A