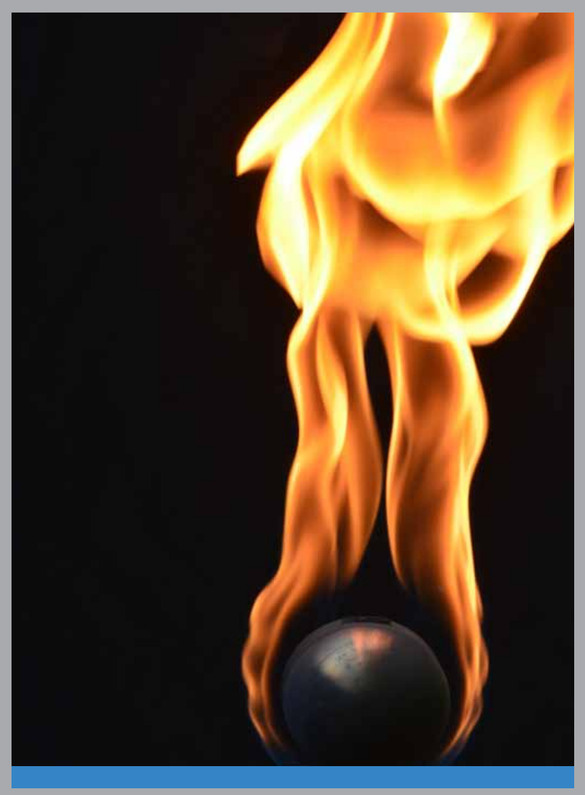
GBA
FLARE SYSTEMS

FLARE AND VENT TIPS
STRUCTURES
PILOT AND IGNITION SYSTEMS
ANCILLARY EQUIPMENT



GBA operates from three main locations: London, Milan and Houston to cover all world markets.

GBA are represented in most countries through a network of established and professional agents, duly selected to meet the high expectations of GBA and our Clients.

Please contact our offices to know which agent is applicable to your location.

www.gba.com

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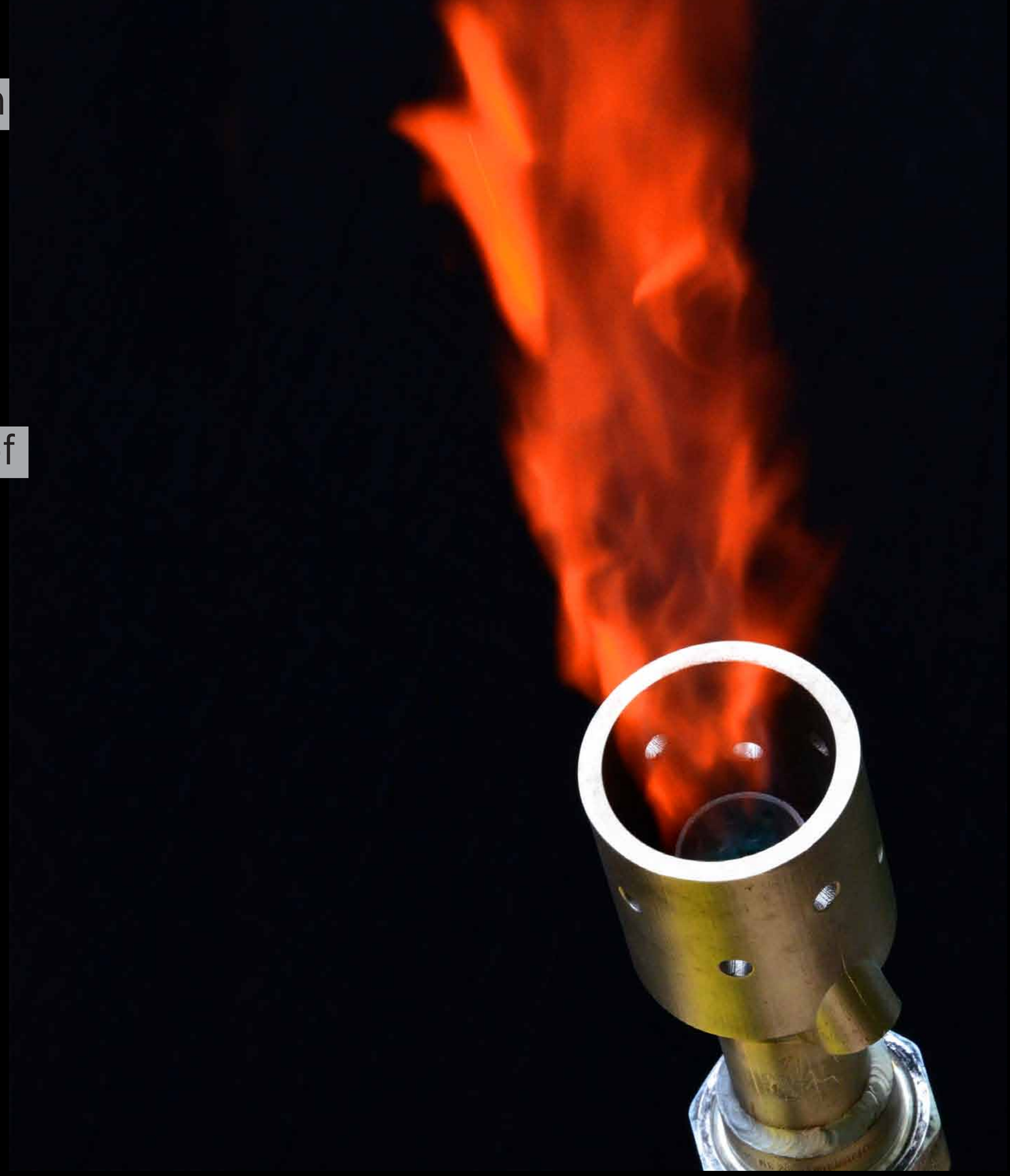


**GBA Flare Systems is an internationally based supplier of flare equipment to the world's Oil, Gas and Petrochemical Industries, upstream and downstream, offshore and onshore.**

GBA products include flare tips, ignition systems, support structures and associated equipment for use at oil refineries, chemical plants, oil and gas production facilities, power stations and anywhere there is a need to dispose of large volumes of flammable gases quickly and safely.

GBA is staffed by committed personnel many of whom have lengthy track records in the flare industry and are acknowledged experts in this field.

With its own workshop GBA has 100% control of engineering and production of its equipment, thus meeting clients expectations for high quality and timely delivery.

CSF Flare Tip in operation on an FPSO

Derrick Supported Multi-flare System
Ethylene Project in the UAE

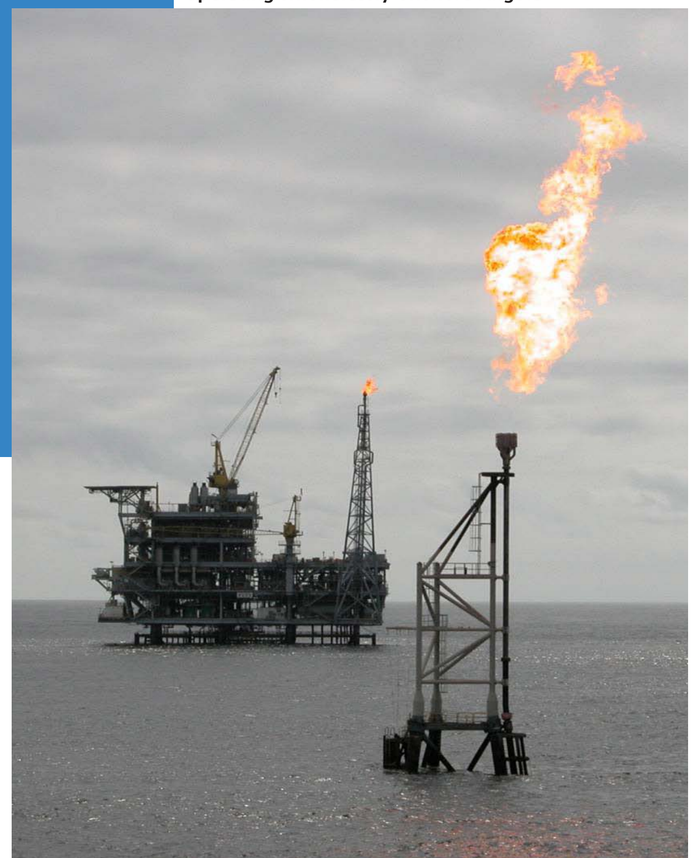
## The Tallest Order

To the right, the three 204m derrick supported demountable multi-flare systems installed at FINA in Antwerp remain the tallest flare structures in Europe and three of the tallest demountable flare stacks in the world.

150m Demountable Riser Structure
Supporting 3 smokeless flare tips in Thailand

CSF-7-14 Flare Tip
Being tested at maximum flow in Alaska

CSF-9-14-VS Variable Slot Sonic Flare
Operating smokelessly offshore Angola



Three 204m Derrick Supported Demountable Multi-flare System
Installed at FINA Antwerp, Belgium

## Quality Assurance

All companies within the GBA group have Quality Management Systems certified to ISO 9001 which clearly demonstrates GBA's commitment to the quality of its products and services.

# ONSHORE AND OFFSHORE FLARE AND VENT TIPS

CSF-6-8-HL-14 HP/LP Flare Tip
FPSO offshore Nigeria

## CSF High Pressure Sonic Flare Tips

The GBA CSF is a multi-nozzle sonic high pressure flare tip designed to give superior performance where low thermal radiation and smokeless combustion is required.

At the heart of the CSF is an advanced sonic nozzle which ejects the gas through a narrow annulus thus maximising gas/air contact and minimising mixing depth.

## Flare Tip design for long life

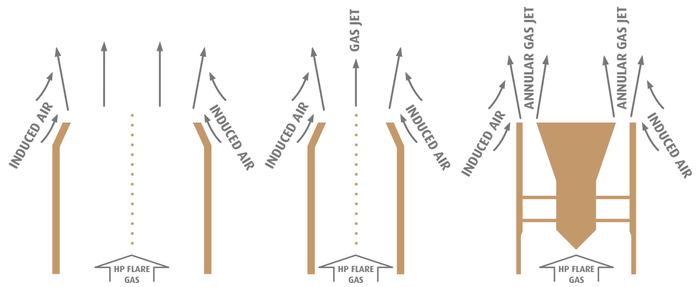
GBA is aware that a long service life is essential in order to comfortably span the extended periods between shutdowns now commonly employed in the industry.

The use of windshields, careful selection of materials and their thickness, weld design/location and using velocity seals in all flare tips, result in long flare tip life.

CSF-7-8 HP Flare Tip
Offshore Qatar

CSF-7-14 Flare Tip
Gas plant Alaska

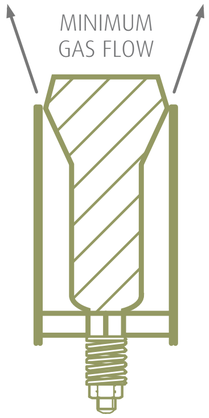
For most applications the CSF flare tip is provided with multiple sonic nozzles in order to give the optimum flare tip performance in terms of lowest emitted radiation, shorter flame lengths & smokeless combustion. However, for less demanding applications a single nozzle version is available. Many CSF flares are supplied in an HP / LP configuration where an LP stream is discharged co-currently with the HP stream, this offers advantages in terms of reduced radiation & better smokeless performance over separate flare tips.

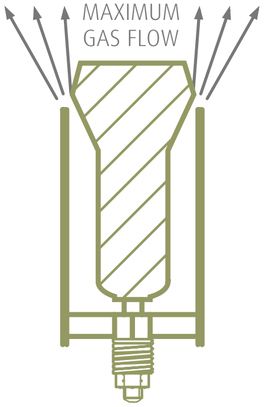


## CSF-VS Variable Slot Flare Tips

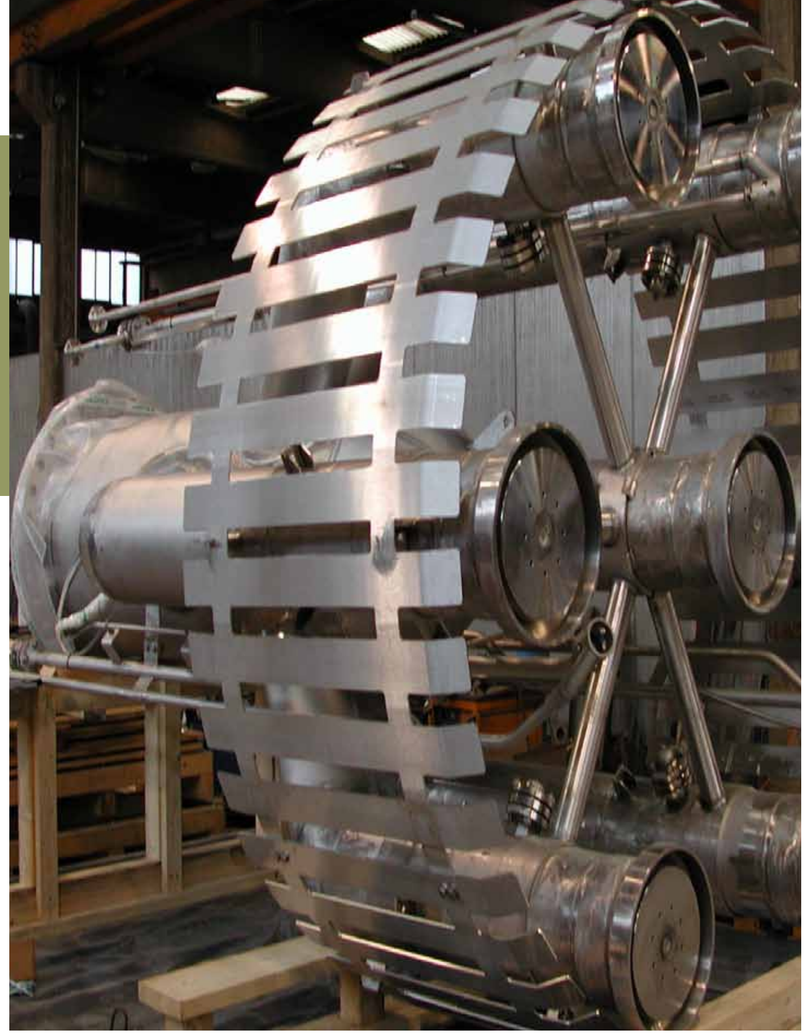
Where low thermal radiation and smokeless combustion is required under high turndown conditions, the GBA CSF-VS variable slot sonic high pressure flare tip is the best solution.

With its unique ability to automatically vary the gas discharge slot width in response to changes in the flare gas flow rate, the CSF-VS flare tip adapts to a wide range of operating conditions providing smokeless operation from purge to maximum relief.




The CSF-VS tip is proven in many applications to provide a safe, flexible, effective solution to meet the modern operators requirement for a smoke-free flame without requiring any external utilities.



CSF-9-14VS Variable Slot Flare Tip
Khursaniyah, KSA

## CAF Air Assisted Flare Tips

The GBA CAF range of flare tips is designed to provide for smokeless combustion of low-pressure heavy waste gases where no process steam is available.

This tip achieves clean combustion through the injection of primary air into the base of the flame with the help of an electrically driven fan located at grade.

CAF-36-30 Air Assisted Flare Tip
Olefins plant

CSV-7-10 Vent Tip
Underground gas storage project, Germany

## Cold Vent Tips

GBA can also supply sonic and sub-sonic vent tips and carbon dioxide snuffing systems.

These are based on the proven equivalent flare tips and provide significant advantages in terms of excellent dispersion characteristics and low radiation in the event of ignition.

If the event of accidental ignition GBA can provide snuffing systems using CO2 injection to rapidly and safely extinguish the flame.

CO2 Snuffing System
Offshore Nigeria

3-OFF GCT Series Flares
Al-Jubail, KSA

## GCT Steam Assisted Flare Tips

With its robust and flexible design the GBA GCT flare tip provides a good all-round solution for most low pressure smokeless flare applications, and it is routinely used in refineries and chemical plants where steam is readily available.

Smokeless combustion is achieved through an upper steam manifold feeding a set of injection nozzles located around the circumference of the tip. Steam is injected at high pressure directly into the flame. This is supplemented by a centre steam nozzle located within the tip body.

GCT-AJ 66/50C and GCT-42C Steam Assisted Flare Tips
Clustered flare stack project, Thailand

Ultra Low Noise GAJ-36 Tip
with special winterisation features
Sweden

GCT-AJ-84/66C Advanced Smokeless Flare Tip being installed
Qatar LNG

## GCT-AJ High Capacity Low Noise Steam Assisted Flare Tips

The GCT-AJ flare tip offers maximum smokeless capacities with minimum noise impact. The GCT-AJ achieves this by using an advanced annular jet (AJ) inducer to inspirate large quantities of air into the root of the flame envelope via the multiple internal steam/air tubes. The AJ inducer not only entrains air very efficiently but also generates less noise than conventional steam jets. The noise signature is further reduced by using a composite noise shield to absorb and reflect the sound upwards and away from grade.

## PF Pipe Flare Tips

The GBA PF flare tip provides a flexible method of low pressure, high volume waste gas disposal and utilises a well proven technology that ensures a safe and efficient means of combusting relief flow rates from maximum emergency conditions to turndown.

Flame stability is guaranteed under all wind conditions through the use of a series of flame retention lugs around the periphery of the tip and through the auxiliary stabilising effect of the purpose designed pilots. To further enhance its operating life the PF flare tip is provided with external wind deflectors, which eliminate the low pressure zone created on the downwind side of the flare and consequently minimise flame impingement.

PF-12
Offshore Qatar

## Special Flare Applications

GBA have extensive experience covering a wide spectrum of special flare applications. The below list is a summary of some of the special flare solutions GBA can offer:

- Gas Assisted (GA) flare tips for smokeless combustion
- Gas Assisted (GA) flare tips for low calorific value gases
- Acid Gas Flare Tips (using exotic alloys)
- Water Assisted flare tips for both smokeless combustion and radiation reduction
- Ammonia Flares
- Staged Flare Systems
- Syngas / High Hydrogen Flares
- Cryogenic Flares (LNG Plants)
- Liquid Flares (Condensate and LNG/cryogenic)
- Burn Pit Flares
- 2-Phase Flares
- Crude Oil / Mud Burners

**GLNG-80 in operation**
**LNG project, Yemen**

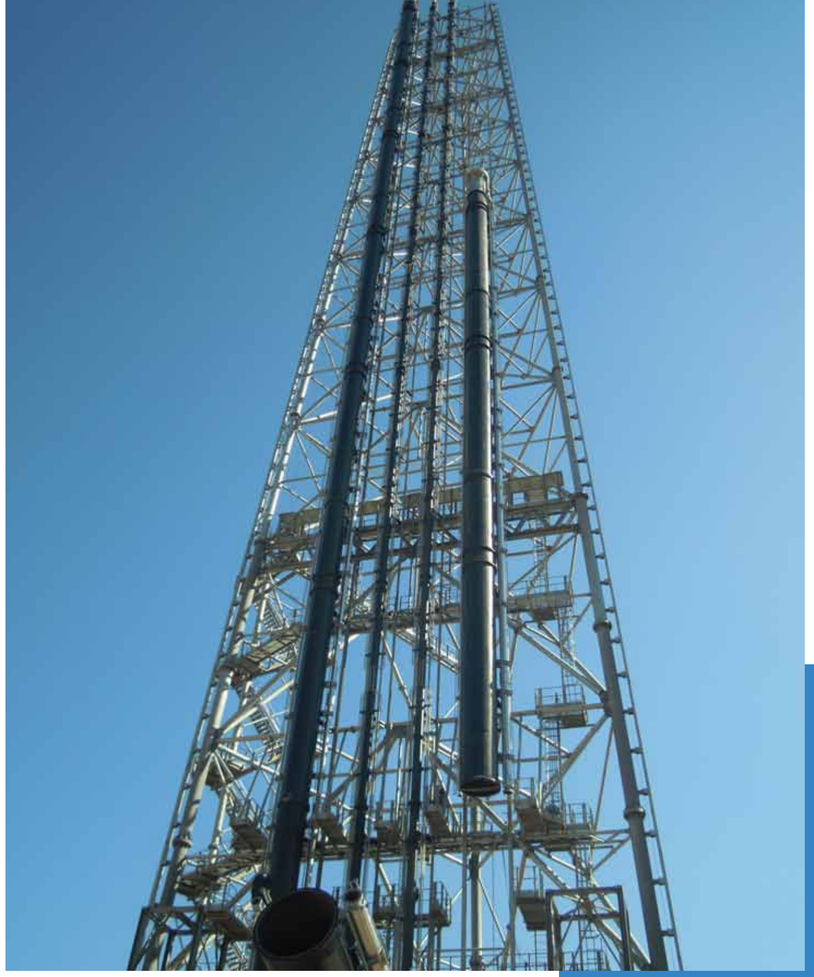
Smokeless Liquid Condensate Burner
Onshore oil and gas terminal

GLNG-80 LNG Liquid Burner
LNG project, Yemen

# GBA STRUCTURES - ONSHORE

## GBA Flare Structures

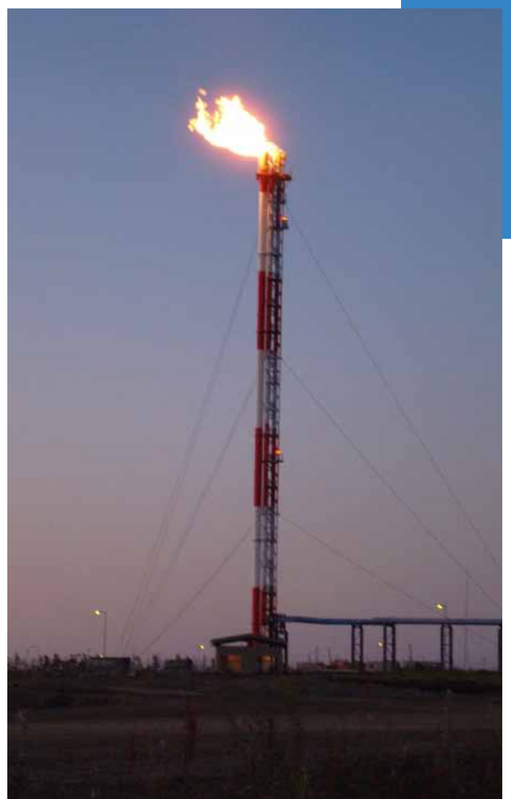
Although GBA made its name by designing and building some of the world's tallest flare structures, GBA has also built examples of every conceivable type of flare structure: free-standing derricks, guyed derricks, guyed risers (single and twin), self-support, offshore fully welded structures and multi-riser demountable structures.



Demountable Derrick Structure during dismounting
Cartagena,Spain

32m Self Supported Structure
Morecambe Bay, UK

160m 8 Riser Demountable Flare
Al-Jubail, KSA



CSF HP & CAF LP Flare Tips on an 80m Guyed Derrick
Sakhalin Island

### Elevated Flares

GBA specialises in demountable flares where individual risers and tips can be dismounted for maintenance without affecting the operation of the remaining flares. Demountable flares are not only used for duty/stand-by configurations but also where it is required to group flares together to minimise the real-estate requirements of multiple separate stacks. GBA has grouped up to 8 risers together in a single structure and supplied up to 200m height.

If in doubt about the structure design for any application GBA can advise the optimum selection.

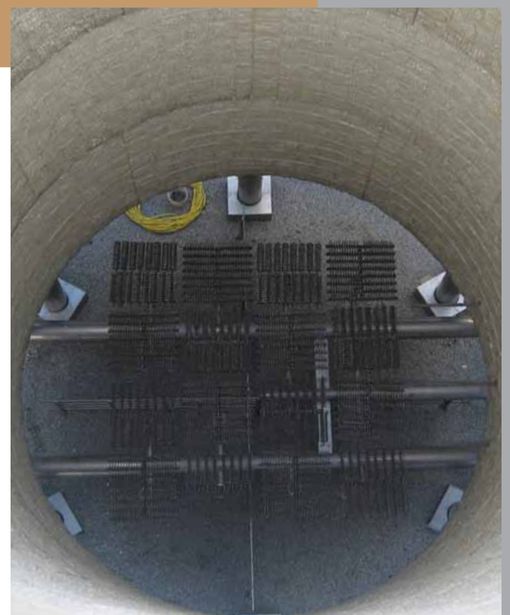
130m Derrick Structure single lift
Hammerfest LNG project, Norway

105m Fixed Derrick Supported Structure
Ethylene project, UAE

109m Guyed Flare Stack
Mongstad, Norway

15t/h Enclosed Ground Flare
Mugardos, Spain

15t/h Enclosed Ground Flare
Mugardos, Spain



Looking down onto GFIN EGF Ground Flare Burner Matrix
Mugardos, Spain

## EGF Enclosed Ground Flares

The GBA EGF Enclosed Ground Flare provides concealed, low noise, smokeless flaring of waste streams generally without the need for additional utilities such as steam or power. It achieves this by using the GFIN matrix burner in combination with advanced air management techniques & using burner staging as appropriate. Thermal radiation emission is negligible enabling the EGF to be located close to or even within the plant it serves.

# ANCILLARY EQUIPMENT

## Water Seals and Knock-Out Drums

**Water Seals**
The Water Seal provides a positive means of flashback prevention in addition to causing the upstream system header to operate at a slight positive pressure at all times. This is especially of use when an elevated flare is used in combination with another flare or with a flare gas recovery system. The GBA Water Seal design incorporates advanced features to ensure smooth gas flow without pulsation. These features have been successfully retrofitted to existing equipment to solve pulsation problems.

**Knock-out Drums**
Knock-Out Drums are designed to effectively remove hydrocarbon liquids from the main relief gas to prevent the possibility of carryover and "flaming rain" from the flare tip.

Vertical Knock-out Drum
Refinery, Singapore

## Flare Steam Control

The automatic control of steam flow to a smokeless flare can be achieved by the use of a remote infrared sensor, which detects flame quality changes and provides the process variable signal for steam control allowing only the correct amount of steam necessary for the required smokeless capacity.

Alternatively ultrasonic flare gas mass flow meters can be employed to control the steam flow using algorithms incorporating the flare gas molecular weight.

Steam Control Skid
Petrochemical plant UAE

## Purge Minimisation

To prevent air ingress into the riser two types of seals can be provided: a Molecular Seal bolted below the flare tip or an Air Lock Seal (Velocity type) within the flare tip.

**Molecular Seal**
The Molecular Seal works by relying on the density difference between the purge gas and air. In this way only a very low continuous purge flow is necessary to maintain conditions within the seal. The Molecular Seal maintains safe conditions in the upstream riser for several hours in the event of a loss of purge gas.

**Air Lock Seal**
The Air Lock Seal (ALS) is a conical device located as an integral part of the flare tip. When a flare tip operates with very low flare gas flows, air will tend to enter the tip due to both wind action and by decantation and will slowly diffuse down the inside walls of the tip. The Air Lock Seal design locally increases the velocity of purge gas through the seal, thereby moving any air back out of the tip. GBA install Air Lock Seals in all flare tips to minimise purge gas consumption and maximise flare tip operating life.

MS-48 and MS-20 Molecular Seals
Refinery, Thailand

Water Seal Drums
Petrochemical plant, Saudi Arabia

LED Medium Intensity
Obstacle Light (MIOL)

## Aircraft Warning Lights

GBA supplies state of the art LED based Aircraft Warning Lights that offer the prospect of never needing replacement/attention. These units are available in Medium and Low Intensity format. When conventional lights are used, GBA has developed a unique demounting system specifically designed for flare stack applications and which enables replacement from grade, without shutting down the flare.

# PILOTS AND IGNITION SYSTEMS

## GBA Pilots and Ignition Systems

GBA flare pilots and ignition systems are designed to resist extreme weather conditions whilst minimising fuel gas consumption. GBA pilots are designed to meet the latest requirements specified in ISO 25457 (API 537).

Specifically, GBA have developed the LCHW pilot that has the lowest possible fuel consumption (1 Nm3/hr each) and is stable at windspeeds in excess of 150 mph (250 km/h). We also offer the GBA CHT-SS pilot, a continuously sparking unit that uses a side stream of flare gas as its fuel.

These advanced pilots use the CHT High Energy solid state ignition system to provide a reliable source of ignition.

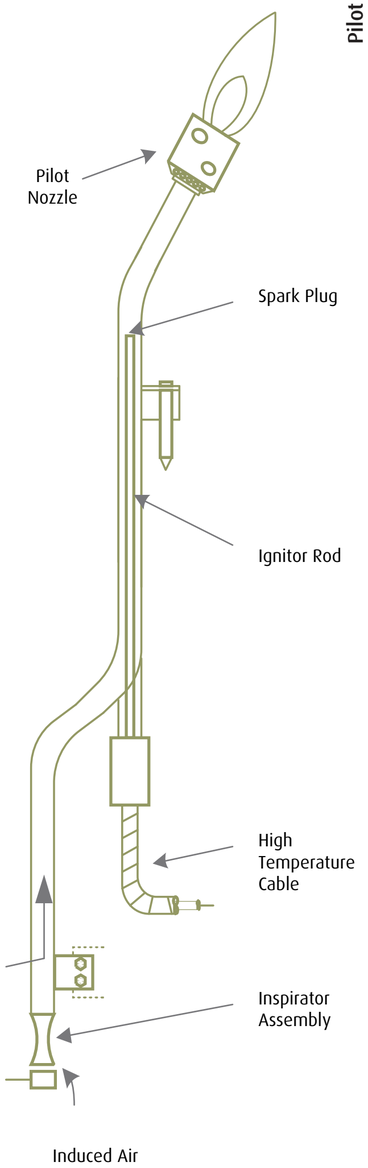
GBA also supplies the well tried and tested Flame Front Generator (FFG) in both forced draft (uses compressed air) and natural draft (inspirates its own air) versions.

**Pilot Sensing**

GBA offers pilot sensing using the following techniques:

- Thermocouples
- Ionisation Rod
- Remote Infra-red

Flame Front Generator Ignition System (FFG) with fuel gas control
Onshore gas terminal project, Turkmenistan




Pilot Gas / Purge Gas Skid
Petrochemical plant, UAE

The key to the success of the CHT pilot is that the ignitor rod is continuously gas cooled.

CHT Pilot Nozzle
Testing at our works

# GBA WORKSHOP

## Our fabrication shop

GBA Construzioni is wholly owned by the GBA group of companies and operates a Quality Management System to ISO 9001. It holds approvals to PED, DIN 18800 and other major standards.

Flare Tips in GBA's dedicated stainless steel shop

Trial Assembly of Derrick Structure


Flare Risers ready for shipping out

## Fabrication

The majority of GBA's equipment is fabricated at our own manufacturing plant located in the north of Italy (Parma).

The GBA workshop, covering 15,500m$^2$, is almost completely dedicated to the production of flare systems and has a segregated stainless steel shop for the fabrication of flare tips and stainless steel components.

The factory has sufficient area to enable the trial assembly and fit-up of very large flare derrick structures and riser pipes.

Depending on workload & other factors GBA also employs other qualified & reputable fabricators around the world.

# GBA's client list is extensive and includes most of the world's oil majors and also the world's leading engineering contracting companies.

**Here is a list of some of our clients:**

**OPERATORS**

ADCO
ADNOC
AGIP
ANADARKO PETROLEUM
ARAMCO
BOROUGE
BRITISH PETROLEUM
CHEVRON
CONOCO PHILLIPS
DOW CHEMICAL
EKB (ETZEL)
ENI
EXXON
FINA
GASCO
GDF SUEZ
HELLENIC PETROLEUM
IBN ZAHR
IPLOM
KNPC
KOC
LUKOIL
MAERSK OIL
MOBIL OIL
MOTOR OIL HELLAS
NESTE OIL
NIGERIA LNG
NIOC
NORSK HYDRO
ONGC
PDVSA
PEMEX
PETROBEL
PETRONAS
PETROVIETNAM
PHILLIPS PETROLEUM
POLIMERI EUROPA
QATAR GAS
QATAR PETROLEUM
RAFFINERIA DI LIVORNO
RASGAS
REPSOL YPF
SADAF
SARAS
SDAG
SHELL
SYRIAN GAS COMPANY
SINGLE BUOY MOORINGS
SONATRACH
STATOIL
TAMOIL
TEXACO
TOTAL
TRACTEBEL GAS
TUPRAS

**EPCS**

ABB
AIR LIQUIDE
AKER KVAERNER
AMEC
ATLAS ENGINEERING
AXSIA HOWMAR
BECHTEL
CHAGALESH
CHIYODA
CTCI
CW SINGAPORE
DAELIM
DAEWOO
ENPPI
FARAB
FLUOR DANIEL
FOSTER WHEELER
GS E&C
HOWE-BAKER
HYUNDAI
IHC GUSTO
IOEC
JACOBS
JGC CORPORATION
KEYSTONE ENGINEERS
LINDE
M W KELLOGG
MACDONALD ENG.
MODEC
MUSTANG ENG.
OCEAN ENERGY
OIEC
PARAGON ENG.
PARSONS INTERNATIONAL
PDIL
PETRO-MARINE INC.
SADRA
SAIPEM
SAMSUNG
SKEC
SNAMPROGETTI
STONE & WEBSTER
TECNICAS REUNIDAS
TECHNIP
TECNIMONT
THRONSON ENG.
TRI-OCEAN
WORLEY PARSONS
W S NELSON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