Chapter 16

Flares and Stacks

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Flares (FLR)

A flare system is composed of several parts: a flare tip, a seal, an ignition system, a knock-out drum and a riser stack.

The flare tip may be either smokeless or non-smokeless. Smokeless flare tips have nozzles for injecting steam at the exit of the tip. The high velocity steam inspirates air into the flame resulting in more complete combustion and therefore no smoke. Non-smokeless flare tips do not have these steam injection nozzles.

Flares are also classified as continuous and emergency. Continuous flares handle a continuous and steady flow of flare gas. Emergency flares are designed to safely burn a sudden large release of combustible gases that are not normally vented. Continuous flares are normally smokeless and emergency flares non-smokeless.

The flare seal is a device for preventing air from diffusing down the stack and creating a combustible mixture with the flare gas inside the stack. Flare gas is ignited at the exit of the flare tip by one or more pilots. Should any of these pilots go out, the ignition system would reignite them.

The flare vendor would supply all of the above components for a new installation. The vendor may also be requested to supply a knock-out drum. This device disengages entrained liquid from the flare gas. If this liquid is not removed, it travels up the stack, is ignited and falls flaming to the ground creating a fire hazard. If the flare is elevated, the final component of the flare system is the riser stack. The stack is characterized by its method. A ground flare requires no stack.

The diameter of the flare tip and the height of the stack which supports it (if it is an elevated flare) are determined by process conditions and by safety considerations. The diameter and thickness of the flare stack is determined by structural considerations such as loadings and method of support.
**Derrick-supported flare stack includes stack, support structure, flare tip, molecular seal and ignition system. Design based upon process conditions or given sizes.**

Derricks are used to support tall stacks. Generally, derrick supported flare stacks are cheaper than self-supporting stacks at heights above 200 FEET [60 M]. Derricks are used instead of guyed stacks when land is limited.

| **Shell Material:** | Default: *CS*  
| CS - Carbon steel  
| SS - Stainless steel  |
| **Gas-Mass Flow Rate:** | Enter either mass flow rate or diameter and length (height) of flare.  
| **Bottom Section Diam.:** | For single diameter stacks, enter dimensions in bottom section data.  
| Max: 96 INCHES [2,400 MM]  
| **Bottom Sect’n Length:** | For single diameter stacks, enter dimensions in bottom section data.  
| **Middle Sect’n Diam:** | For single diameter stacks, enter dimensions in bottom section data.  
| Max: 96 INCHES [2,400 MM]  
| **Middle Sect’n Length:** | For single diameter stacks, enter dimensions in bottom section data.  
| **Top Sect’n Diameter:** | For single diameter stacks, enter dimensions in bottom section data.  
| Max: 96 INCHES [2,400 MM]  
| **Top Section Length:** | For single diameter stacks, enter dimensions in bottom section data.  
| **Gas Temperature:** | Default: *100* DEG F [*40* DEG C]  
| **Molecular Weight:** | Default: *40*  
| **Bottom Sect’n Thick.:** | For single diameter stacks, enter dimensions in bottom section data.  
| **Middle Sect’n Thick:** | For single diameter stacks, enter dimensions in bottom section data.  
| **Top Sect’n Thickness:** | For single diameter stacks, enter dimensions in bottom section data.  
| **Exit - % Sonic Velocity:** | Enter the gas exit velocity as a percent of sonic velocity. Default: *20*  
| **Flare Type:** | Default: *SMOKELESS*  
| SMOKELESS - Standard smokeless flare  
| AIR ASSIST - Air assisted smokeless flare  
| NONSMOKE - Non-smokeless flare  
| **Radius Radiat. Inten:** | Minimum radius at which a person would be exposed to the allowable radiation.  
| **Allow. Radiat. Inten:** | Allowable radiation intensity at the specified minimum radius. Default: *1,500* BTU/H/SF [4,500 W/M2]  
| **Gas Heat Content:** | Default: *20,000* BTU/LB [*46,500* KJ/KG]  

**Type:** DERRICK
Chapter 16: Flares and Stacks

**Flares (FLR) - continued**

**Description**

Guyed flare stack includes stack, supports, flare tip, molecular seal and ignition system. Design based upon process conditions or given sizes.

This is generally the least expensive support system for flare stacks over 50 FEET tall. However, a large unobstructed area around the stack must be provided so that there will be no interference with the guy wire.

**Type**

**GUYED**

- **Shell Material:** Default: *CS*
  - CS - Carbon steel
  - SS - Stainless steel

- **Gas - Mass Flow Rate:** Enter either mass flow rate or diameter and length (height) of flare.

- **Bottom Section Diam.:** For single diameter stacks, enter dimensions in bottom section data.
  - Max: 96 INCHES [2,400 MM]

- **Bottom Sect’n Length:** For single diameter stacks, enter dimensions in bottom section data.

- **Middle Sect’n Diam.:** For single diameter stacks, enter dimensions in bottom section data.
  - Max: 96 INCHES [2,400 MM]

- **Middle Sect’n Length:** For single diameter stacks, enter dimensions in bottom section data.

- **Top Sect’n Diameter:** For single diameter stacks, enter dimensions in bottom section data.
  - Max: 96 INCHES [2,400 MM]

- **Top Section Length:** For single diameter stacks, enter dimensions in bottom section data.

- **Gas Temperature:** Default: *100* DEG F [*40* DEG C]
  - Molecular: Default: *40*

- **Bottom Sect’n Thick:** For single diameter stacks, enter dimensions in bottom section data.

- **Middle Sect’n Thick.:** For single diameter stacks, enter dimensions in bottom section data.

- **Top Sect’n Thickness:** For single diameter stacks, enter dimensions in bottom section data.

- **Exit - % Sonic Velocity:** Enter gas exit velocity as a percent of sonic velocity. Default: *20*.

- **Flare Type:** Default: *SMOKELESS*
  - SMOKELESS - Standard smokeless flare
  - AIR ASSIST - Air assisted smokeless flare
  - NONSMOKE - Non-smokeless flare

- **Radius Radiat. Inten:** Minimum radius at which a person would be exposed to the allowable radiation.

- **Allow Radiat. Inten:** Allowable radiation intensity at the specified minimum radius. Default: *1,500* BTU/H/SF [*4,500* W/M2]

- **Gas Heat Content:** Default: *20,000* BTU/LB [*46,500* KJ/KG]
Self-supported flare stack includes stack, flare tip, molecular seal and ignition system; one, two or three segments of different length and diameter.

This flare is generally used for stack heights up to 50 FEET and when the availability of land does not permit guyed stacks, self-supporting stacks are cheaper than derrick supported stacks for stack heights up to 200 FEET [60 M].

**Shell Material:** Default: *CS*
- CS - Carbon steel
- SS - Stainless steel

**Gas - Mass Flow Rate:** Enter either mass flow rate or diameter and length (height) of flare.

**Bottom Section Diam.:** For single diameter stacks, enter dimensions in bottom section data.
- Max: 96 INCHES [2,400 MM]

**Bottom Sect'n Length:** For single diameter stacks, enter dimensions in bottom section data.

**Middle Sect'n Diam.:** For single diameter stacks, enter dimensions in bottom section data.
- Max: 96 INCHES [2,400 MM]

**Middle Sect'n Length:** For single diameter stacks, enter dimensions in bottom section data.

**Top Sect'n Diameter:** For single diameter stacks, enter dimensions in bottom section data.
- Max: 96 INCHES [2,400 MM]

**Top Section Length:** For single diameter stacks, enter dimensions in bottom section data.

**Gas Temperature:** Default: *100* DEG F [*40* DEG C]

**Molecular:** Default: *40*

**Bottom Sect'n Thick:** For single diameter stacks, enter dimensions in bottom section data.

**Middle Sect'n Thick:** For single diameter stacks, enter dimensions in bottom section data.

**Top Sect'n Thickness:** For single diameter stacks, enter dimensions in bottom section data.

**Exit - % Sonic Velocity:** Enter gas exit velocity as a percent of sonic velocity. Default: *20*.

**Flare Type:** Default: *SMOKELESS*
- SMOKELESS - Standard smokeless flare
- AIR ASSIST - Air assisted smokeless flare
- NONSMOKE - Non-smokeless flare

**Radius Radiat. Inten:** Minimum radius at which a person would be exposed to the allowable radiation.

**Allow Radiat. Inten:** Allowable radiation intensity at the specified minimum radius. Default: *1,500* BTU/H/SF [*4,500* W/M2]

**Gas Heat Content:** Default: *20,000* BTU/LB [*46,500* KJ/KG]

### Table: Description and Type

<table>
<thead>
<tr>
<th>Description</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Self-supported flare stack</td>
<td>SELF-SUPP</td>
</tr>
</tbody>
</table>
**Flares (FLR) - continued**

<table>
<thead>
<tr>
<th>Description</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Horizontal ground flare includes flare tip and horizontal stack (30 FEET [10 M]) only; burn pit not included. Design based upon process conditions or sizes.</td>
<td>HORIZONTAL</td>
</tr>
</tbody>
</table>

This is an inexpensive flaring arrangement if land is plentiful and cheap.

**Shell Material:** Default: *CS*
- CS - Carbon steel
- SS - Stainless steel

**Gas - Mass Flow Rate:** Enter either mass flow rate or diameter and length (height) of flare.

**Bottom Section Diam.:** For single diameter stacks, enter dimensions in bottom section data.
- Max: 96 INCHES [2,400 MM]

**Bottom Sect'n Length:** For single diameter stacks, enter dimensions in bottom section data.

**Middle Sect'n Diam.:** For single diameter stacks, enter dimensions in bottom section data.
- Max: 96 INCHES [2,400 MM]

**Middle Sect'n Length:** For single diameter stacks, enter dimensions in bottom section data.

**Top Sect'n Diameter:** For single diameter stacks, enter dimensions in bottom section data.
- Max: 96 INCHES [2,400 MM]

**Top Section Length:** For single diameter stacks, enter dimensions in bottom section data.

**Gas Temperature:** Default: *100* DEG F [*40* DEG C]

**Molecular:** Default: *40*

**Bottom Sect'n Thick:** For single diameter stacks, enter dimensions in bottom section data.

**Middle Sect'n Thick.:** For single diameter stacks, enter dimensions in bottom section data.

**Top Sect'n Thickness:** For single diameter stacks, enter dimensions in bottom section data.

**Exit - % Sonic Velocity:** Enter gas exit velocity as a percent of sonic velocity. Default: *20*.

**Flare Type:** Default: *SMOKELESS*
- SMOKELESS - Standard smokeless flare
- AIR ASSIST - Air assisted smokeless flare
- NONSMOKE - Non-smokeless flare

**Radius Radiat. Inten:** Minimum radius at which a person would be exposed to the allowable radiation.

**Allow Radiat. Inten:** Allowable radiation intensity at the specified minimum radius. Default: *1,500* BTU/H/SF [*4,500* W/M2]

**Gas Heat Content:** Default: *20,000* BTU/LB [*46,500* KJ/KG]
### Flares (FLR) - continued

<table>
<thead>
<tr>
<th>Description</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recuperative thermal oxidizer for low concentration non-chlorinated waste gas.</td>
<td>THRMOX LC</td>
</tr>
</tbody>
</table>
| **Mat'l of Construction:** Default: *CS* (Carbon steel)**  
  **Standard Gas Flow:** Low concentration non-chlorinated waste gas; burner, box, stack, exchanger blower. Max: 20,000 CFM  
  **Gas Heat Content:** Default: *13.00* BTU/CF [*484* KJ/M3]  
  **Gas Oxygen Content %:** Min: 0.0; Default: *14.00* |

Vapor control flare for storage and loading. Includes stack, burners, seal drum, flare, sensors, etc. | STORAGE |
| **Mat'l of Construction:** Default: *CS*  
  **Standard Gas Flow:** Max: 12,000 GPM [775 L/S]  
  **Gas Heat Content:** Min: 50 BTU/CF [1,860 KJ/M3]; Default: *50* BTU/CF [1860 KJ/M3] |
# Stacks (STK)

<table>
<thead>
<tr>
<th>Description</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stack height to 200 FEET [60 M] and diameter to 60 INCHES [1500 MM].</td>
<td>STACK</td>
</tr>
</tbody>
</table>

**Material Selection:** Default: *CS*
- CS - Carbon steel
- SS - Stainless steel

**Height:** Range: 30 - 200 FEET [10 - 60 M]

**Diameter:** Range: 24 - 60 INCHES [600 - 1500 MM]