

**METHANE REDUCTION FLARES, MINIMUM TECHNICAL SPECIFICATIONS REQUIRED FOR
PENNSYLVANIA EQUIPMENT APPROVAL**

1. Purpose:

This document provides the technical specification that shall be followed pertaining to the construction of a Methane Reduction Flare approved for use on coal mining operations within the Commonwealth of Pennsylvania. All Methane Reduction Flare systems shall be approved per the Safety Laws of Pennsylvania for Underground Bituminous Coal Mines, Act 55, Section 350. The technical requirements for approval are outlined below and are based on applicable national and/or international standards and as developed by the MRF Work Group convened by the Department. A Pennsylvania BOTE approval number shall be issued for approved MRF. This document has been reviewed and approved by the Task Force established under ACT 55 Section 350 (d).

2. Scope: Applicable to surface mounted Methane Reduction Flare(s) operated on an active mine and drawing gas from gob, caved areas, or areas not intended to be accessed that have not been sealed.

3. General Conditions and Functional Requirements:

- a. A Methane Reduction Flare may be used in conjunction with an auxiliary gob gas extraction pump, fan, or blower.
- b. Any open electrical conductor to a device associated with a required safety or the safe operation of the flare shall initiate a flare shutdown.
- c. The system shall lock-out upon a safety shutdown and not attempt to restart. However, permissive conditions can allow a restart.
- d. If the system is shut down by any safety mechanism, an on-site response shall be required in order to restart the flare. Remote starting of the flare system *after a safety shutdown* is NOT permitted.
- e. A hazard analysis shall be included in the equipment approval package.
- f. Multiple Methane Reduction Flares may be connected to a single well.
- g. A single or multiple Methane Reduction Flare(s) may be connected to multiple wells.
- h. The Methane Reduction Flare shall operate in four states: (*Reference Items 7. Safety Shutdown/Permissive Conditions Clarifications and 8. Definitions: Operational Process, System Response*)

4. Hardware, Control, and Mechanical Requirements:

- a. Main power disconnect switch.
- b. All components must fail to a safe position or configuration.
- c. A remote telemetry system.
- d. Control panel temperature control if required by the manufactures' recommendations.
- e. Uninterrupted Power Supply (UPS) or battery backup.
- f. Supply isolation valves, one located at the inlet and a redundant valve installed according to the system designer, valves must meet the following criteria:
 - i. Fail safe, position is closed.
 - ii. Transmit open/closed valve position to a controller.
 - iii. Closing time shall be approximately 5 seconds.
 - iv. Rated as flame safe by a recognized organization.

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- g. Detonation Arrestor and Flame Arrestor shall meet the following criteria:
 - i. All arrestors must be temperature monitored on hot side.
 - ii. Inlet detonation arrestor.
 - iii. Flare stack inlet detonation or flame arrestor.
 - iv. Must be certified by a recognized organization.
 - h. Lightning protection per NFPA 780 as applicable to this application. (Edition as adopted by the Commonwealth)
 - i. Any additional safeties not listed as determined by the design engineer for safe operation.
 - j. Devices and equipment shall be applied within manufacturer's rated temperature limits.
 - k. Suitable measures to protect against ignition under hazardous conditions.
 - l. Measures to prevent condensation or ice from interfering with the safe operation of the system.
 - m. A listed burner control module shall be utilized.
5. Control System Shutdown Safeties:
- a. Low pipe methane level (< 25%).
 - b. High pipe oxygen level (>9.0%)
 - c. High flare stack temperature (all stack thermocouples shall initiate).
 - d. Low Flare Stack Temperature after Start-up sequence.
 - e. Low flame temperature.
 - f. Inlet detonation arrestor or flare detonation/flame arrestor High temperature.
 - g. Loss of flame detection.
 - h. High ambient methane level, >1.0%, sensor(s) location determined by flare operator.
 - i. Emergency stop button (normally closed/maintained) located near the control panel.
 - j. Low gas flowrate set point determined by flare operator.
 - k. High heat release rate.
 - l. Blower VFD fault (if applicable).
 - m. Inlet or flare stack isolation valve out of commanded position.
 - n. Pilot failure (3 attempts unless any other safety inhibits operation).
 - o. PLC failure or lockup shall fail to a safe state.
6. Testing Requirements:
- a. Factory test data shall be provided prior to field inspection and commissioning.
 - b. A new flare manufacture that is seeking approval for a Methane Reduction Flare to be used on a ventilated section of an active mine, shall first operate the system on a sealed portion for six months before final approval is given. Monthly alarm, fault, and event logs shall be provided to the Department during this evaluation time period.
7. Safety Shutdown/Permissive Clarifications:
- a. Safety shutdowns are conditions that will not safely resolve themselves without the on-site intervention of a trained operator. A safety shutdown can occur in (INITIATED), (ACTIVE), or (INACTIVE) states.
 - b. Permissive conditions, when permissive conditions return to operating limits, the

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system may safely undergo an automatic, unattended restart and return to (ACTIVE) state. The system must be in (INITIATED) or (ACTIVE) at the time the permissive condition is cleared to allow an automatic restart. Listed below are some examples of permissive operational conditions:

- i. Power loss, restart on restoration.
- ii. Low Methane Content- As described, system restarts when CH₄ levels return to acceptable range.
- iii. High/low Ambient temperature outside operational envelope.
- iv. Low inlet gas pressure if fed from an external source such as an auxiliary gob gas extraction pump, fan, or blower.
- v. Low gas temperature at shutdown valves.
- vi. Allowed time period. Some systems may be restricted to running a limited number of hours per day, per week, or per year. The system can automatically start/stop in accordance with the defined schedule.

8. Definitions: "Operational Process, System Response":

State	Description
OFF	Main power to the Methane Reduction Flare is intentionally turned off. No power present at the main breaker. Power on skid may be present from on board UPS or Battery.
OFF	Power present at Methane Reduction Flare, controls are not powered.
OFF	Controls are powered, modem is transmitting data as required. Combustion sequence has not been initiated. The Master Fuel Trip Relay is not powered.
INITIATED	Combustion sequence has been initiated; no safety shutdowns are present. System will automatically move to (ACTIVE) when all system permissive conditions are satisfied. The Master Fuel Trip relay is powered.
ACTIVE	All permissive conditions are met, no safety shutdowns are present. Flare is running, gas is being burned. Loss of a permissive condition causes the system to revert to (INITIATED) or (INACTIVE).
INACTIVE	A safety shutdown condition has occurred. System will remain in lockout (INACTIVE) until a trained operator arrives at site and determines the cause of the shutdown and takes the necessary corrective action to ensure that conditions are within specified operating limits prior to restarting. Operating the manual reset function returns the system to (INITIATED) if cause of shutdown is successfully remediated.

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INACTIVE	A safety shutdown causes the system to cease flow of gas and combustion.
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Approved by the Task Force [Established by authority of ACT 55 Section 350 (d)]

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