Guidelines for the Installation and Operation of Flare Pilots

What is the difference between a Safety Flare and a Process Flare?

Safety Flare – must be in operation at all times and the flare/waste gas flow cannot be turned off because it is not considered safe to do so. Continued operation without a pilot flame could result in a breach of emissions regulations and/or impact the safety of personnel. Any potential pilot flame disruption must trigger an alarm to the operator for immediate action. This requirement for response to an alarm generally means a flare installed on a remote site with no operator present is not considered a Safety Flare unless there is some form of remote alarm signal.

Process Flare – the flare pilots and flare burner can be extinguished safely. The flow of flare/waste gas can be automatically turned off because it is not connected to any automated overpressure relieving systems. Or the flow of flare/waste gas can be released to atmosphere at the top of the flare stack without impacting emissions regulations or the safety of personnel. Any potential pilot flame disruption must shutdown the system or trigger an alarm to the operator for immediate action. This type of automated shutdown operation may be required for a site without an operator present 24hrs/day.

Section 18 of the CSA B149.3-2020 code has removed the use of the above common terms and instead has added the following text:
"When a provincial or territorial law, act, or regulation requires…"
Any time you see this text, the requirement is basically referencing a Safety Flare that is required to have continuous operation from the provincial regulator. Section 18 is specifically for Flare Pilots only with reference to API 537 for Flares. The design and installation of the Flare itself is outside the approval scope of the B149.3 code and is covered by the requirements from the provincial regulator such as AER in Alberta.

A summary of the Flare Pilot requirements:

1. One CSA 3.16 certified manual shut-off ball valve upstream of the regulators that will shut-off all fuel gas to the appliance as per clause 18.2.1 and located at least 20ft. from the base of the flare.
2. A y-strainer or other type of fuel filter to ensure there is no debris reaching the regulators as per clause 18.3. The y-strainers must be installed so that maintenance can be performed on one strainer/filter without interrupting the operation of all pilot burners.
   Two y-strainers in parallel at the inlet to parallel regulators with upstream and downstream isolation valves is common.

3. Pressure regulator(s) as per clause 18.4. The regulator(s) must be installed so that maintenance can be performed on one regulator without interrupting the operation of all pilot burners.
4. There must be at least one pressure test point with isolation valve and plug installed downstream of each regulator as per clause 18.4.2.
   Ideally, there should be one pressure gauge installed directly downstream of each regulator and upstream of the isolation valve to permit inspecting the setpoint of each regulator separately.
5. The regulators must have vent lines installed to a safe location as per clause 18.6 of the CSA B149.3 code. Alternatively, the regulators must be proven to be installed in a safe location and the operator must be able to safely shut-off gas to the regulators while they are venting.
6. A low pressure or low flow switch or transmitter with an alarm to the operator as per clause 18.3.2. In addition, there must be an alarm for loss of flame on any one pilot and an alarm for any component that could impact the flow of fuel gas to the pilot (eg. high level alarm on a knockout drum) as per clauses 18.3.2 and 18.8.2.
   These alarms can be configured individually or as a single common alarm. These alarms must be configured in a way that will alert the operator to take action.
7. If flexible hoses are installed, they must be CSA certified for use with the fuel gas as per clause 18.7.2.
   Hose attachment points must be installed in such a way to prevent kinking, chafing, and stress on the fittings.
8. All components must be rated for the lowest ambient temperature onsite (typically -40ºC) or have a letter from the manufacturer showing safe operation at lower temperatures than what is shown in their documentation. Alternatively, the flare manufacturer can provide a signed letter showing the component has been proven-in-use based on their field experience. This letter must include the approximate number the manufacturer has installed and for approximately how long they have been operating in the field without issues related to low ambient temperature.
9. The CSA B149.3-2020 code does not include a minimum required number of flare pilots based on the diameter of the outlet of the flare tip where the pilots are installed. The 2015 code included a table that was taken from the API 537 standard for Flare design as follows:
   1 pilot = up to 8in. flare tip
   2 pilots = 9-24in. flare tip
   3 pilots = 25-42in. flare tip
   4 pilots = larger than 42in. flare tip
   *** The industry standard best practice is to have multiple pilots evenly spaced around the flare tip to protect from variable wind directions.*
   The API table includes the following note:
   For toxic gas, the minimum number shall be two.
   This requirement from API 537 is to ensure reliable ignition of toxic gases such as H_2S if one of the pilots were to fail and require maintenance.
   Since the reliable ignition of the Flare Gas is no longer included in the approval scope B149.3-2020 code, this table has been removed. However, the Flare manufacturer must still follow the requirements of the provincial regulator when it comes to reliable Flare operation.
10. Since our primary concern is the safe operation of the appliance, ENEFEN requires the

manufacturer to provide a Letter of Reliable Operation which describes how the specific design can withstand severe weather conditions to reliably ignite the flare gas.
For Example:
"The flare pilot configuration and flare tip have been designed to ensure reliable ignition of the flare gas and sustain stable combustion of the pilot gas and flare gas throughout the full range of process conditions, including severe weather conditions."

11. The flare pilots must reliably ignite themselves and provide stable combustion of the pilot gas throughout the full range of process conditions, including severe weather conditions as per clause 18.1.4.
    The API 537 standard defines this as capable of being relit at wind speeds up to 160 km/h (100 mph) under dry conditions and 140 km/h (85 mph) when combined with at least 50 mm (2 in) of rainfall per hour. For all flare pilot designs, the manufacturer shall provide documentation showing they have successfully completed an appropriate test to verify the flare pilot is reliable.
    Note: A typical verification test protocol is included in Appendix A.6 of the API 537 standard.
12. Each pilot must be equipped with at least one dedicated means of ignition as per clause 18.8.1
    Note: Commonly employed ignition systems include: spark ignition at pilot tip, spark ignition of a portion of the pilot gas/air mixture prior to the pilot tip, compressed-air flame-front generator, inspirating flame-front generator.
13. Each pilot must be equipped with a dedicated means of flame detection as per clause 18.8.2.
    Note: Commonly employed pilot-flame detection systems include: thermocouples, flame ionization detectors, optical systems (other than video cameras and monitors viewed by operators), and acoustic systems.
14. For a Safety Flare, the flare automatic ignition system shall not contain any single component that could cause all flare pilots to be taken out of service as per the redundancy requirements of clause 18. In addition, any single component must be able to be repaired/replaced while the remaining pilots are in operation.
    For a flare system with only one pilot, the system design must facilitate rapid repair of any component critical to the operation of the ignition and alarm system (eg. retractable pilot assembly). If this is not possible, an alternate manual ignition system such as a flame front generator and continuous operator supervision may be required.

Additional Requirements for Process Flares

The most common use of Process Flares instead of Safety Flares is on remote sites where no operator is present 24hrs/day. In this scenario, it is not possible to meet the safety hazard alarm response requirements. In this scenario, if there is a flame failure it will typically take too long for the operator to respond even if there is a remote alarm system installed. That means there must be flame detection installed and after a flame failure, there is typically an attempt to automatically relight the flare pilot. If this relight attempt fails, then the system must be configured to safely shut-off the fuel gas to the flare pilots using CSA 6.5 (C/I) certified gas shut-off valves. If the process gas is not safe to release to the atmosphere, then this must also be shut-off using a CSA 6.5 (C/I) certified gas shut-off valve. Typically, these sites will not have a continuous purge gas available, which means a detonation arrestor must also be installed. For this application, the Process Flare design is more like an Incinerator, which may be a more appropriate type of appliance for unattended sites.

Clause 18.9 – Management Systems

The following list of documentation will generally not be included with the flare manufacturer documentation and must be produced by the owner to ensure they have adequate emergency procedures in place.
a) procedures including event logs for
i) operator response to loss of flame information alarms per Clause 18.8.4, describing re-ignition of flare pilot(s) in the event of loss of flame of one or more flare pilot(s); and
ii) operator response to information alarms per Clause 18.8.5;
b) training on flare pilot operation and procedures; and
c) on-going inspection and maintenance requirements for a flare pilot(s).
The event log and training record retention period shall be 5 years or in accordance with the authority having jurisdiction.

What is not included in the B149.3-2020 code, but ENEFEN is still looking for?

The Annex is specifically focused on requirements for the flare pilot system, but it does not cover requirements for the process/flare gas system.
For a Process Flare, the process gas needs to be able to be shut-off somehow. This is not specifically stated as a requirement for the Safety Flare system, but when the flare is shut down and crews are working on it, there should be a procedure to ensure they are safe.

All flares must have some method to prevent the flame at the flare tip from flashing back into the process/flare gas supply pipe and causing an explosion.
One method is to use a Detonation Arrestor with a high temperature alarm installed at the flare gas connection to the stack. This is commonly used with incinerators, but it is uncommon with flares.
The more common method for flares is to use a continuously flowing Purge/Sweep Gas that is injected into the flare header at the point furthest from the flare stack. For more complex flare header configurations, there may need to be multiple points of injection. The function of the purge gas is to ensure there is no

oxygen present anywhere in the flare header, which effectively prevents flash back. Any gas without oxygen can be used, but natural gas is commonly used because it is easily available in large quantities. The minimum required flow rate of purge gas is specified by the flare manufacturer. At each point of injection, there should be a flow measurement device to monitor the flow rate of the purge gas and confirm it is above the minimum requirement. Ideally, there should be a low flow alarm installed at each injection point.

Documentation

All of the typical documentation for any gas-fired appliance is required:

1. Control Narrative that explains the operation of the flare automatic ignition system. This can be a simple step-by-step description of the operation.
2. P&ID showing the fuel train layout, upstream supply pressure control devices, flare gas KO Drum.
3. Electrical wiring diagram showing the flare automatic ignition system configuration.
4. Bill of Materials showing all valve train components, ignition system components, and any other safety alarm devices.
5. List of all regulator and alarm setpoints configured onsite during commissioning.
6. A combustion report with stack emission readings is not required.

Special documentation for flare pilots includes:

7. Emergency procedures as per clause 18.9.
8. Document showing severe weather testing of the pilot as per clause 18.1.4 and API 537.
9. Letter of Reliable Operation with a description of the flare tip design and confirmation the flare pilot configuration will reliably ignite the flare gas under all operating conditions.

Figure B.10 a)
Flare pilot valve trains

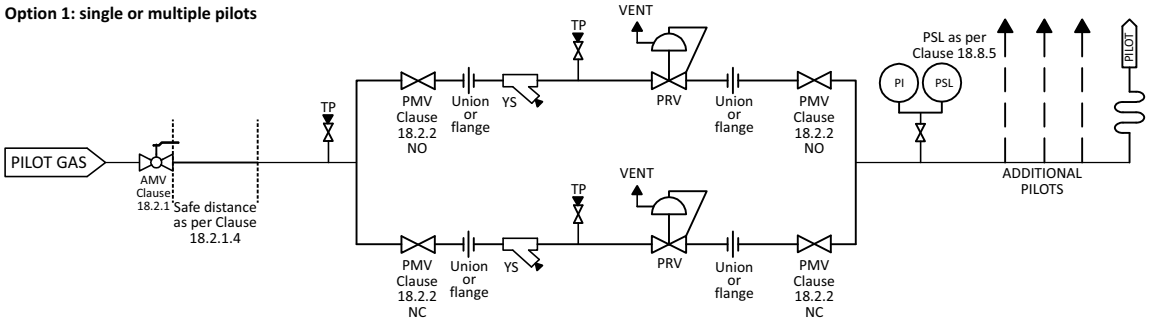


Figure B.10 b)
Flare pilot valve trains

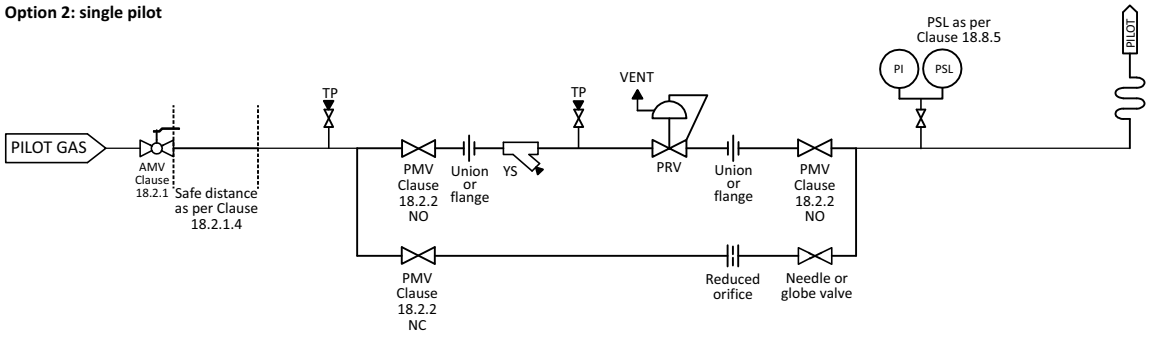


Figure B.10 c)
Flare pilot valve trains

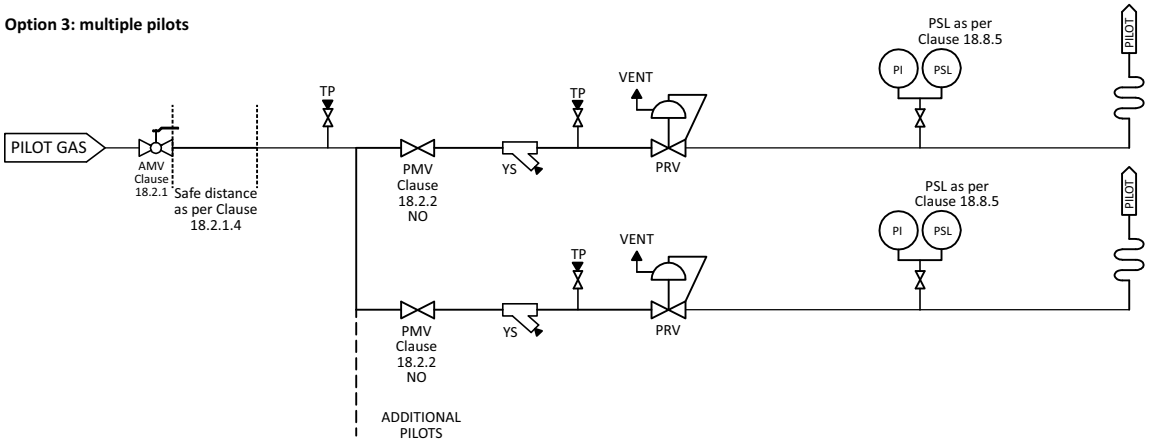


Figure B.11 a)
Flame front generators

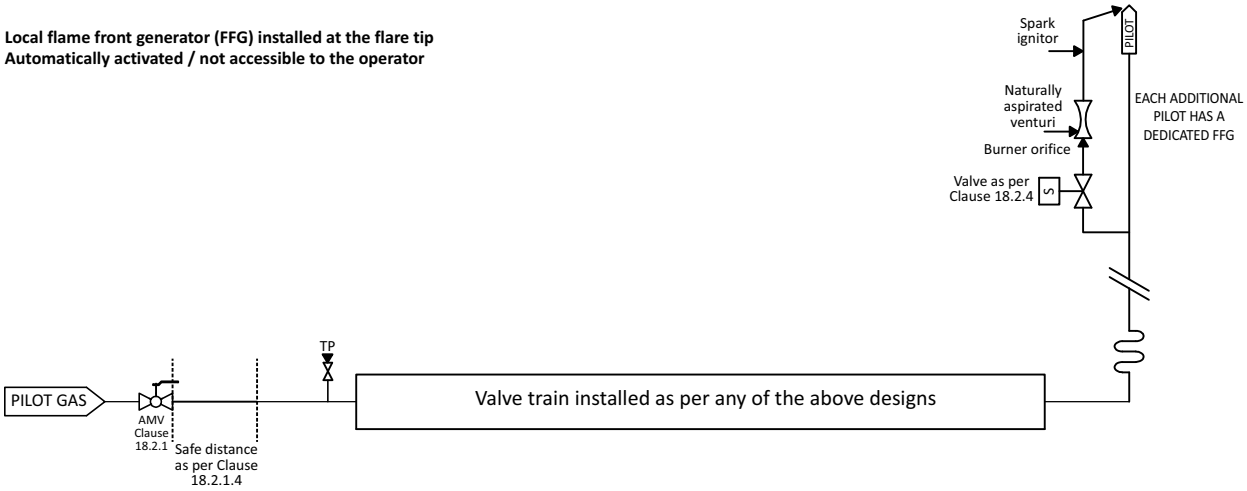


Figure B.11 b)
Flame front generators

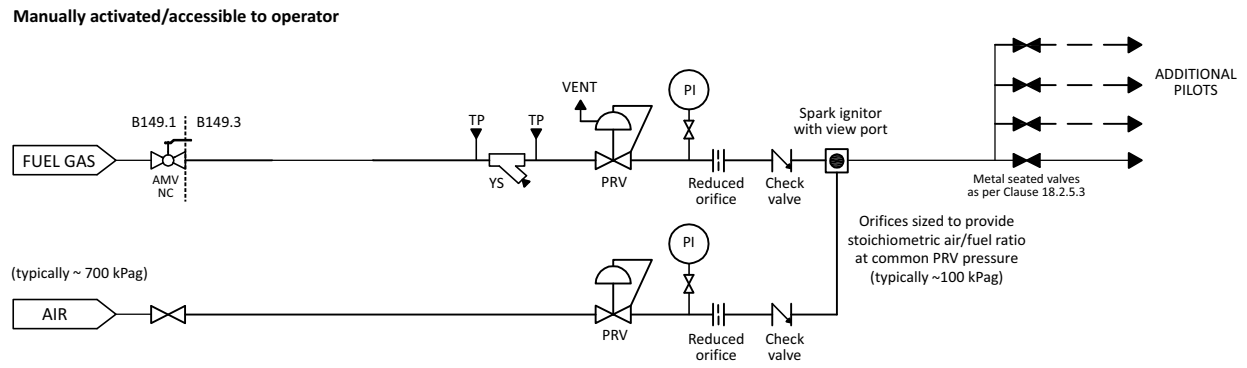


Figure B.11 c)
Flame front generators

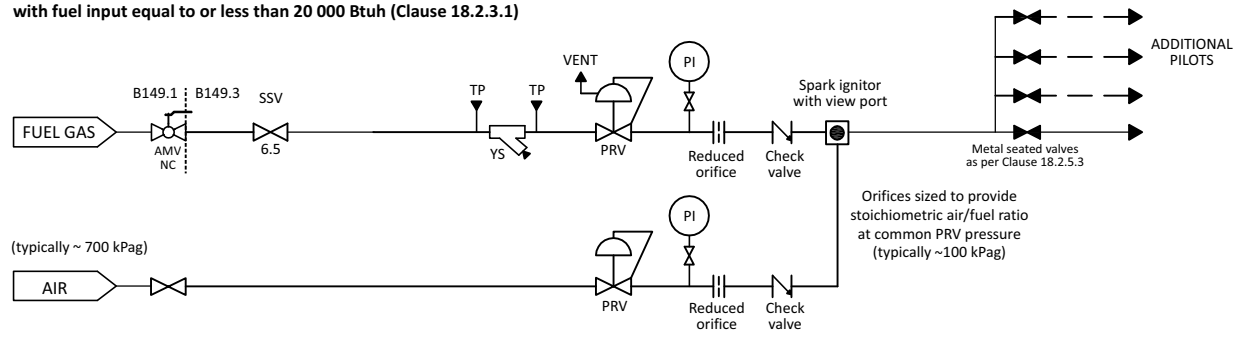


Figure B.11 d)
Flame front generators

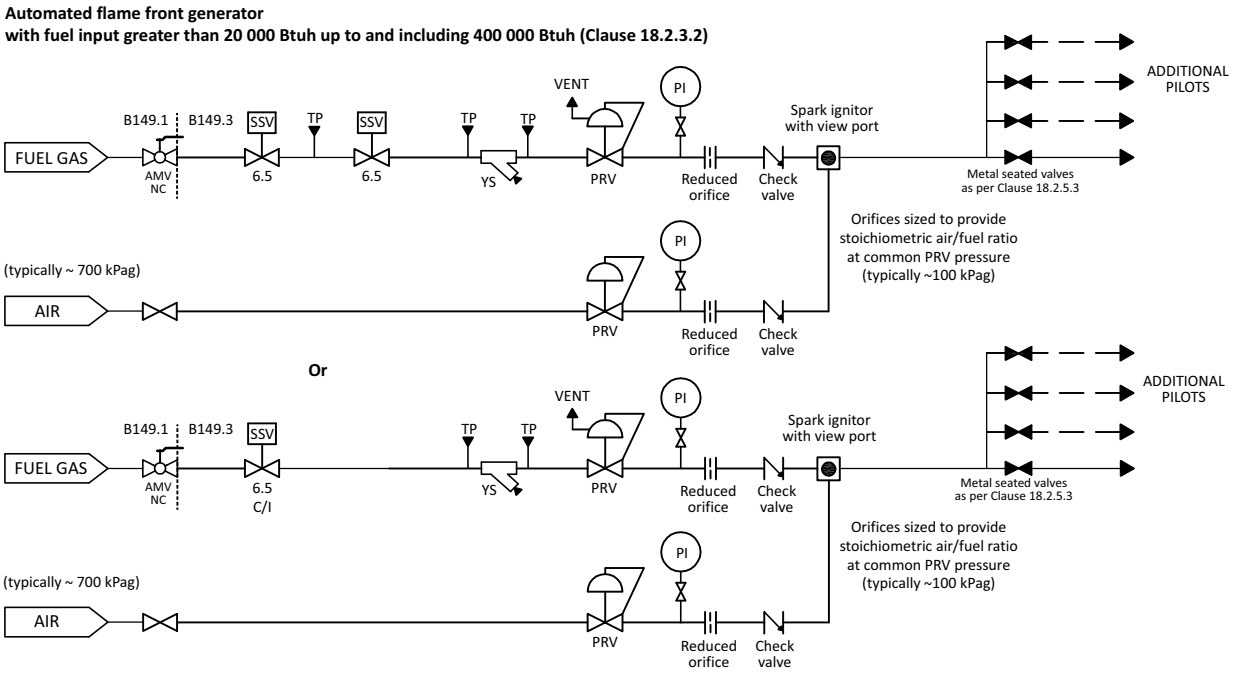
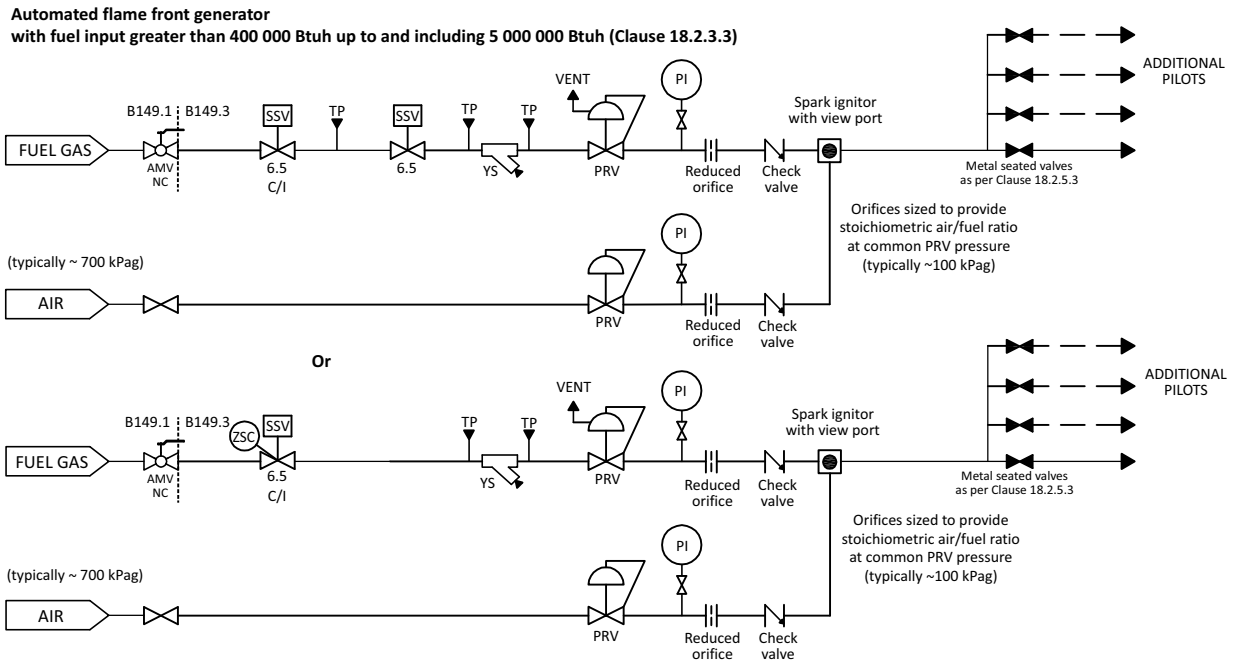


Figure B.11 e)
Flame front generators



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Flame front generators

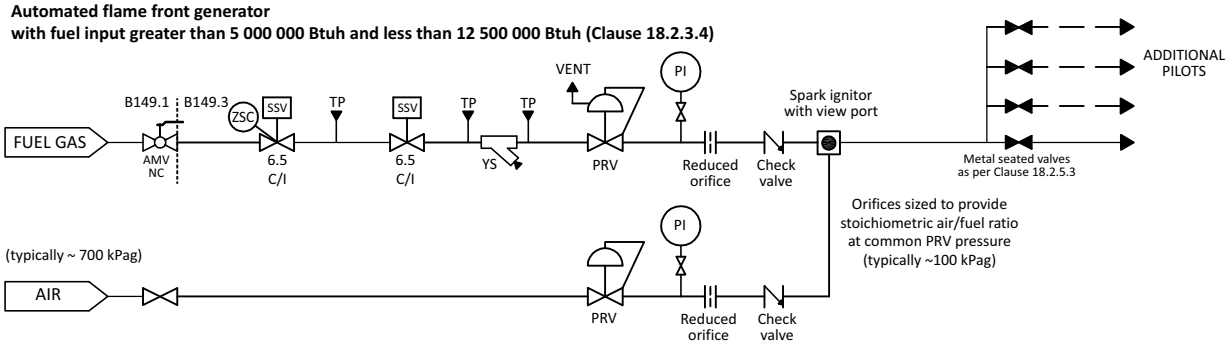

Figure B.11 g)
Flame front generators