Standard Specification for Excess Flow Valves for Natural Gas Service[1]

This standard is issued under the fixed designation F2138; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope*

1.1 This specification covers requirements and test methods for excess flow valves for use in thermoplastic natural gas piping systems. However, it is expected that excess flow valves manufactured to the requirements of this specification may also be used in other natural gas piping systems.

1.2 Excess flow valves covered by this specification are designed for insertion into components for natural gas systems such as pipe, tubing, or fittings in sizes from ½ CTS to 2 IPS.

1.3 The tests required by this specification are intended to determine the performance characteristics of an excess flow valve installed in a straight piece of pipe. An excess flow valve could possibly be installed in a straight piece of pipe, in a service tee outlet, as part of a mechanical coupling, or in other configurations. The performance characteristics of the excess flow valve may be significantly different for each installed configuration. Users should conduct their own tests to determine the installed performance characteristics or contact the EFV manufacturer for test data for the installed configuration. Additional guidance on selection and installation of excess flow valves is included in Appendix X1.

1.4 The tests required by this specification are not intended to be routine quality control tests.

1.5 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

1.6 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory requirements prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D1600 Terminology for Abbreviated Terms Relating to Plastics

F412 Terminology Relating to Plastic Piping Systems

F1802 Test Method for Performance Testing of Excess Flow Valves

F2897 Specification for Tracking and Traceability Encoding System of Natural Gas Distribution Components (Pipe, Tubing, Fittings, Valves, and Appurtenances)

3. Terminology

3.1 *Definitions:*

3.1.1 Definitions are in accordance with Terminology F412, unless otherwise specified. Abbreviations are in accordance with Terminology D1600.

3.1.2 *bypass flow, n*—an intentional rate of passage of natural gas through an EFVB after trip, which will allow upstream and downstream pressure to equalize across the device to automatically reset to the open position after removal of a fault condition.

3.1.3 *excess flow valve, EFV, n*—a device installed in a natural gas piping system to automatically stop or limit the passage of natural gas when the rate of passage of natural gas through the device exceeds a predetermined level.

3.1.4 *excess flow valve bypass, EFVB, n*—an EFV designed to limit the flow of gas after trip to a small predetermined level and to reset automatically after the pressure is equalized across the valve.

3.1.5 *excess flow valve non-bypass, EFVNB, n*—an EFV designed to stop the flow of gas after trip and to be reset manually.

3.1.6 *leak rate, n*—the flow of natural gas through an EFVNB after trip.

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

*A Summary of Changes section appears at the end of this standard

3.1.7 *maximum inlet pressure, n*—the maximum pressure, as stated by the EFV manufacturer, at which an EFV is designed to function.

3.1.8 *minimum inlet pressure, n*—the minimum pressure, as stated by the EFV manufacturer, at which an EFV is designed to function.

3.1.9 *pipe, n*—refers to both pipe and tubing.

3.1.10 *reset, v*—changing an EFV from a closed position to an open position.

3.1.11 *temperature rating, n*—the temperature range, as stated by the EFV manufacturer, within which an EFV is designed to function.

3.1.12 *trip, n*—closure of an EFV.

3.1.13 *trip flow, n*—the rate of passage of natural gas through an EFV that will cause the EFV to stop or limit the passage of natural gas.

4. Ordering Information

4.1 Purchasers should consider specifying the following characteristics when ordering an EFV:

4.1.1 EFVB or EFVNB,

4.1.2 Trip flow (see 9.1.1),

4.1.3 Maximum inlet pressure (see Section 7),

4.1.4 Temperature rating range (see Section 8),

4.1.5 Minimum inlet pressure, and

4.1.6 Special considerations for insertion of EFV.

5. Materials and Manufacture

5.1 The physical properties of each material used to produce an EFV shall be available from the EFV manufacturer upon request.

NOTE 1—Materials in long-term contact with natural gas of line quality should be demonstrated to not adversely affect the performance of the EFV.

NOTE 2—Materials should have a demonstrated resistance to environmental stress cracking when exposed, under stress, to chemical compounds encountered in natural gas piping systems. Such compounds include, but are not limited to, antifreeze solutions used to thaw frozen lines. The effects of liquid environments such as antifreeze agents, odorants, and hydrocarbons are known to be deleterious to some plastics, particularly when under service conditions.

6. Dimensions

6.1 The EFV shall be of appropriate dimensions for the pipe or fitting in which it is intended to be inserted.

7. Maximum Inlet Pressure

7.1 EFVs manufactured under this specification shall have a maximum inlet pressure of at least 125 psig.

8. Temperature Rating Range

8.1 EFVs manufactured under this specification shall have a temperature rating range of -20 to 140°F (-29 to 60°C).

9. Design Qualification Requirements

9.1 *Performance Requirements:*

9.1.1 *Trip Flow*—The trip flow shall not be less than the minimum trip flow stated by the EFV manufacturer and shall not exceed 1.5 times the minimum trip flow stated by the EFV manufacturer at any given pressure between the minimum and maximum inlet pressures, when tested in accordance with 12.2.

9.1.2 *Leak Rate*—The leak rate of an EFVNB shall not exceed 0.40 standard ft^3/h (0.011 m^3/h) when operating between the minimum and maximum inlet pressures, when tested in accordance with 12.3.

9.1.3 *Bypass Flow*—The bypass flow of an EFVB shall not exceed 20 standard ft^3/h (0.566 m^3/h) at a 10 psig (0.07 MPa) inlet pressure, when tested in accordance with 12.4. At all other pressures between the minimum and maximum inlet pressures, the bypass flow of an EFVB shall not exceed the EFV manufacturer's stated value when tested in accordance with 12.4.

9.1.4 *Pressure Drop*—The pressure drop across the EFV shall not exceed the maximum pressure drop stated by the EFV manufacturer at each flow rate listed in Test Method F1802, section 4.2.3, Pressure Drop at Flow Rates Less than Closure, and at all inlet pressures between the minimum and maximum inlet pressures, when tested in accordance with 12.5.

9.1.5 *Reset*—The EFV shall reset within the parameters stated by the EFV manufacturer at all inlet pressures between the minimum and maximum inlet pressures, when tested in accordance with 12.6.

9.1.6 *Snap Acting Loads*—The EFV shall not close when tested in accordance with 12.7.

9.1.7 *Cycle Testing*—After the cycle testing described in 12.8, the EFV shall meet the requirements of 9.1.1 and 9.1.2 or 9.1.3.

10. Samples

10.1 The minimum sample size for testing against the performance requirements of 9.1.1 – 9.1.5 shall be 25. The minimum sample size for testing against the performance requirements of 9.1.6 and 9.1.7 shall be 6.

11. Specimen Preparation

11.1 The tests required by this specification shall be performed on an EFV inserted in a straight section of pipe. The EFV shall be centered between the pipe ends. There shall be at least five diameters of straight pipe on each side of the EFV, but the total length of the straight section of pipe shall not exceed 18 in. (45.7 cm).

12. Test Methods

12.1 *General:*

12.1.1 EFV testing shall be done in accordance with Test Method F1802, unless otherwise specified.

12.1.2 EFV testing at temperatures other than those listed in Test Method F1802 may be necessary to establish the EFV temperature rating.

12.2 Trip flow shall be determined as described in Test Method F1802, section 10.3, on Trip Flow.

12.3 Leak rate for an EFVNB shall be determined as described in Test Method F1802, section 10.4, Bypass Test or Leak Rate Test.

12.4 Bypass flow for an EFVB shall be determined as described in F1802, section 10.4, Bypass Test or Leak Rate Test.

12.5 *Pressure Drop:*

12.5.1 The pressure drop testing shall be done as described in Test Method F1802, section 4.2.3, Pressure Drop at Flow Rates Less than Closure.

12.5.2 The pressure drop shall be calculated based on test results obtained from the tests described in Test Method F1802. In Test Method F1802, section 10.6.1, System Pressure Drop, the EFV is replaced by an equivalent length of 1 in. (25.4 mm) IPS pipe. However, when using Test Method F1802 to determine the pressure drop across an EFV, the EFV shall be replaced with the same size and length of pipe without the EFV. To calculate the pressure drop, subtract the system pressure drop in Test Method F1802, section 10.6.2, System Pressure Drop, from the total pressure drop in Test Method F1802, section 10.5.7, Total Pressure Drop.

12.6 Reset of an EFVB shall be tested as described in Test Method F1802, section 10.7, Reset.

12.7 *Snap Acting Load Test*—A test apparatus shall be assembled consisting of the following components in order: inlet supply pressure connection to EFV, no more than 60 ft (18.3 m) of 1 in. (2.54 cm) NPS pipe, full port ¼ turn ball valve, no more than 2 ft (.61 m) of 1 in. (2.54 cm) NPS pipe, a flow control valve, no more than 4 ft (1.2 m) of 1 in. (2.54 cm) NPS pipe, and a flowmeter venting to atmosphere. Inlet pressure shall be 10 psig (0.07 MPa). With the ball valve open, set the flow control valve so that the flowmeter indicates 75 % of the published EFV minimum trip flow. Completely close the ball valve; then reopen the ball valve completely taking no more than 0.5 s to open.

12.8 *Cycle Testing*—This test shall be performed after all other tests in Section 12 have been completed. The EFV shall be tripped and reset a minimum of 1000 times at the inlet pressure of 125 psi. The EFV shall then be tested in accordance with 12.2 and 12.3 or 12.4.

13. Product Marking

13.1 If the EFV manufacturer intends to sell the EFV to others, the outer surface of the EFV shall be marked with the following:

13.1.1 ASTM F2138,

13.1.2 Manufacturer's name or trademark, and

13.1.3 Coding that will enable the manufacturer to determine the EFV model as well as the date and location of manufacture.

13.2 If the EFV manufacturer inserts the EFV into pipe or a piping component prior to shipment to a customer, the markings shown below shall be placed on the outer surface of the pipe or piping component:

13.2.1 ASTM F2138,

13.2.2 Manufacturer's name or trademark,

13.2.3 Type of EFV: Bypass (EFVB) or Non By-Pass (EFVNB),

13.2.4 Flow direction arrow,

13.2.5 Nominal pipe size, and

13.2.6 Coding that will enable the manufacturer to determine the EFV model as well as the date and location of manufacture.

13.3 If the EFV manufacturer supplies the EFV component to another manufacturer for assembly into other products, the EFV manufacturer shall supply the information required by 13.2 in an agreed upon format such that it can be placed on the outer surface of the final pipe or piping component by the other manufacturer.

13.4 In addition to 13.1, 13.2, and 13.3 as applicable, EFV manufacturers shall mark their component with the 16-character gas distribution component traceability identifier in accordance with Specification F2897. The 16-character code shall be expressed in alpha-numeric format and Code 128 bar code format with a minimum bar thickness value of 0.005 in. or an alternative 1D or 2D bar code symbology as agreed upon between manufacturer and end user. All fittings shall have the 16- character codes marked or affixed to the product, product packaging, or any manner agreed upon between manufacturer and end user.

13.5 The manufacturer shall either ensure that the 16-character gas distribution component tracking and traceability identifier in accordance with Specification F2897 for the pipe or tubing material is visible on the final product, or shall maintain records for the 16-character code for the pipe or tubing materials, as necessary, to confirm the identification of these materials upon request by the end user.

14. Production Testing

14.1 The manufacturer shall test each EFV prior to shipment.

14.2 The following tests shall be performed on each EFV:

14.2.1 Trip flow,

14.2.2 Leak rate for EFVNBs,

14.2.3 Bypass flow for EFVBs, and

14.2.4 Reset testing.

14.3 EFVs that do not meet the manufacturer's published performance requirements for the above tests shall be rejected.

15. Quality Assurance

15.1 When the product is marked with this designation, F2138, the manufacturer affirms that the product was manufactured, inspected, sampled, and tested in accordance with this specification and has been found to meet the requirements of this specification.

16. Keywords

16.1 excess flow valve; (EFV)

APPENDIX

(Nonmandatory Information)

X1. GUIDANCE ON EFV SELECTION AND INSTALLATION

X1.1 *General*—This appendix is intended to assist owners of natural gas systems in the selection of the appropriate EFV for inclusion in a pipeline system and to determine the effects of the EFV installation on the performance of the pipeline system.

X1.2 *EFV Selection*—An EFV should be selected with a trip flow, at the distribution system minimum pressure, above the maximum customer load, and above the meter capacity.

X1.3 *Determining Service Line Configuration*—A basic understanding of the method for designing service lines is essential to understanding the effects of EFVs on service line design. These effects are discussed in X1.4.

X1.3.1 *Service Line Configuration*—This term includes all factors that affect the flow and cause pressure drop along the length of a service line. These factors include:

X1.3.1.1 Main tap and outlet piping,

X1.3.1.2 Service line pipe diameter, wall thickness, and roughness, and

X1.3.1.3 Fittings, couplings, and valves.

X1.3.2 *Service Line Flow and Maximum Length*—Maximum service line length is typically determined by graphing flow versus service line length for a given service line configuration. A longer service line will have decreased flow due to the increased friction along the inside diameter of the pipeline. This increased friction also results in an increased pressure drop. When the pressure drop along the length of the service reaches the maximum acceptable value determined by the operator, the graph ends and the maximum service line length for the service line configuration is established. The maximum service line length for 1/2 CTS pipe with the same tap, fittings, couplings, and valves for one company may be different from another company due to different maximum acceptable pressure drops. A typical graph is shown in Fig. X1.1.

X1.3.3 *Service Line Configuration Selection*—Owners of gas distribution systems will typically have a graph, like the one shown in Fig. X1.1, for each service line configuration. A customer will have a known maximum load and required service line length. The service line configuration is selected by identifying the least cost configuration that will meet the maximum customer load at the required service line length.

X1.4 *EFV Installation Effects on Service Lines*—The inclusion of an EFV in a service line may cause a change in the graph of flow versus length. The EFV may add pressure drop and restrict flow through the service line. Fig. X1.2 shows a typical graph of service line flow versus length with and without an EFV. This change in the graph of flow versus length for a given service line configuration requires operators of distribution systems to consider the following:

X1.4.1 *Effect of Service Line Length on Proper Functioning of EFV*—If the same EFV is selected for use with a given service line configuration, regardless of the service line length, the EFV may not trip for a service line break on long services. For a 25 ft (7.6 m) service line length, an EFV with a trip flow above the flow curve must be selected to avoid unintentional closure. However, if the same EFV is used on a 125 ft (38.1 m) service line length, the EFV may not close on a line break at the riser, due to the restriction of flow through the service. Operators of gas distribution systems may need to specify

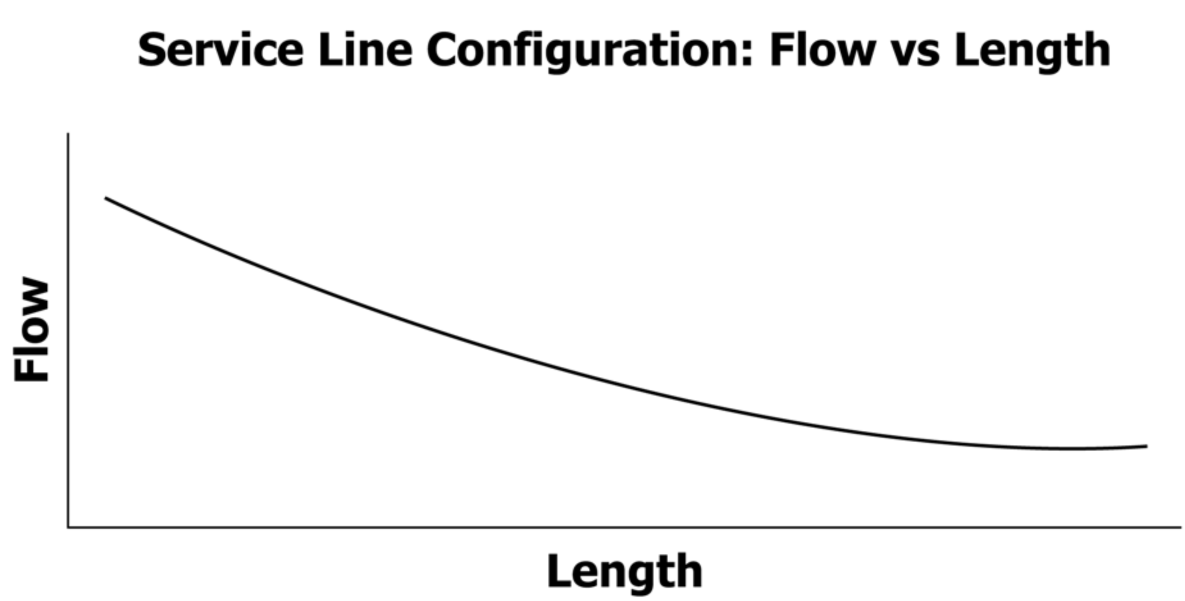

FIG. X1.1 Service Line Configuration: Flow Versus Length

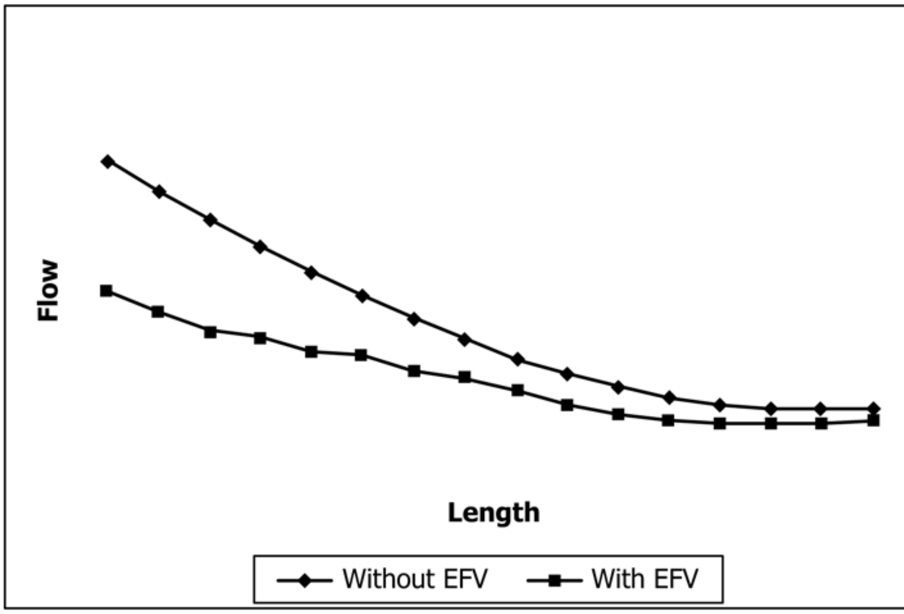

FIG. X1.2 Service Line Configuration: Flow Versus Length

different EFVs for the same service line configuration, based on the length of the service line.

X1.4.2 *Effect on Flow Capacity*—Fig. X1.2 shows a reduction in flow caused by the inclusion of an EFV. The amount of reduction can vary based on the design of the EFV, installation location, and the length of the service line. Operators of gas distribution systems are cautioned to ensure there will be adequate flow to meet the maximum customer demand after the inclusion of an EFV. It may be necessary to install a service line configuration with a larger diameter to ensure adequate flow to the customer.

X1.4.3 *Effect on Minimum Pressure for Accurate Functioning of Meter/Regulator Equipment*—The inclusion of an EFV will add a pressure drop to the service line configuration. As discussed in X1.3.2, the maximum service line length for a given service line configuration is established when the pressure drop reaches the maximum acceptable value determined by the operator. The additional pressure drop caused by the EFV may result in a reduction of the maximum service line length.

X1.4.4 There are several industry formulas that can be used to determine the maximum protected service line length when an EFV is installed. For any of these formulas use the following data that can be obtained from the EFV manufacturer:

(1) The maximum trip flow rate allowed by the manufacturer's published trip flow range at a specific inlet pressure (this pressure should be the minimum anticipated distribution system pressure),

(2) The maximum pressure loss across the EFV corresponding to the maximum trip flow rate from above, and

(3) The minimum Inside Diameter of the service line per the specified tolerance limits.

X1.4.4.1 Perform a flow calculation, taking into account the pressure loss across the EFV. If the calculated protected length of the service line is less than the actual service line length, the entire service line may not be protected by the EFV.

NOTE X1.1—This calculation will determine maximum protected line length for a service line with an EFV installed under the worst case conditions. The use of typical or nominal values may result in a misapplication of the excess flow valve, which may allow conditions under which the EFV will not activate in response to a line rupture.

X1.5 *Specific Gravity Considerations*—EFVs are typically designed for gas with a specific gravity of 0.6. During propane air peak shaving operations, the specific gravity of the gas delivered to customers may be greater than 0.6. Owners of gas distribution systems should be aware of the effect of propane air peak shaving operations on distribution system specific gravity.

SUMMARY OF CHANGES

Committee F17 has identified the location of selected changes to this standard since the last issue (F2138–09) that may impact the use of this standard.

(1) Specification F2897 was added to Referenced Documents.

(2) 13.4 and 13.5 were added.