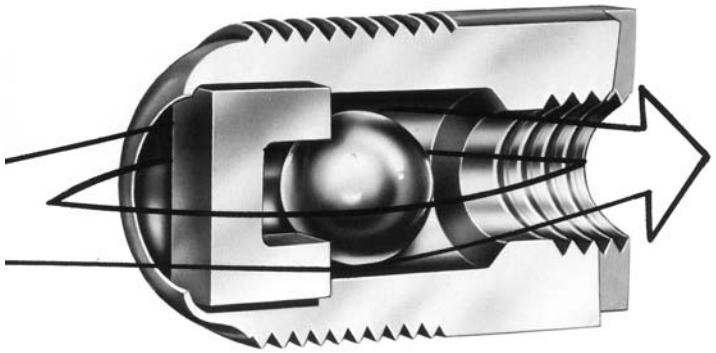
Excess Flow Valves

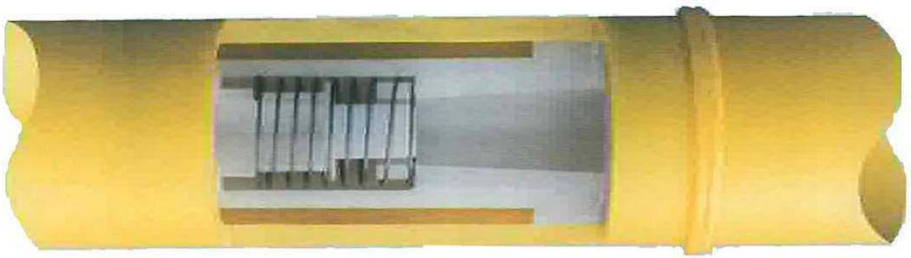
Seth Mackay-Smith
Director of Engineering
UMAC, Incorporated

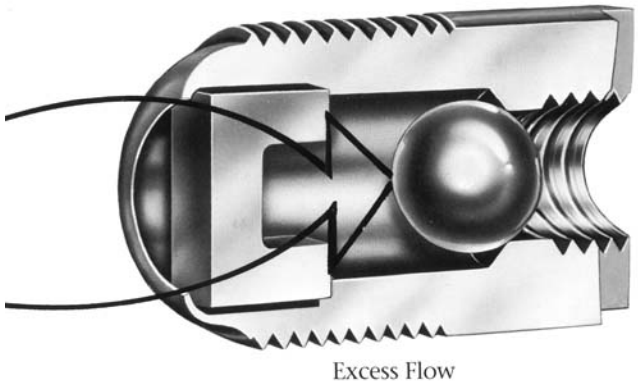
EFV HIGHLIGHTS

- More than 8 million EFVs installed
  - Single service, Single meter
  - Branch service, Multi-meter
  - Commercial
- Type of Operators being supplied
  - Local Distribution Companies
  - Municipal Utilities
  - Master Meter Operators

EFV Principle of Operation





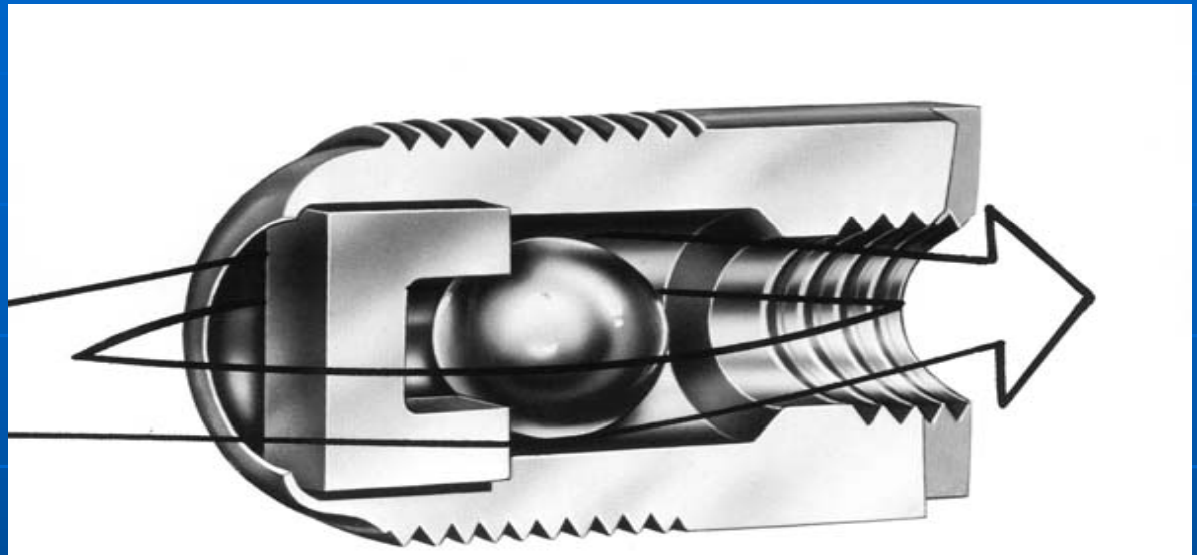


Spring

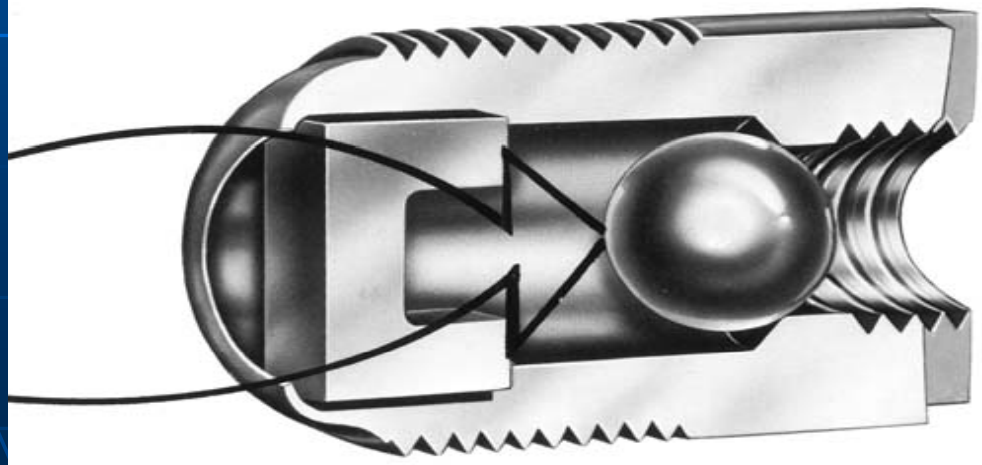
Magnet

Float

Ball and Magnet Design



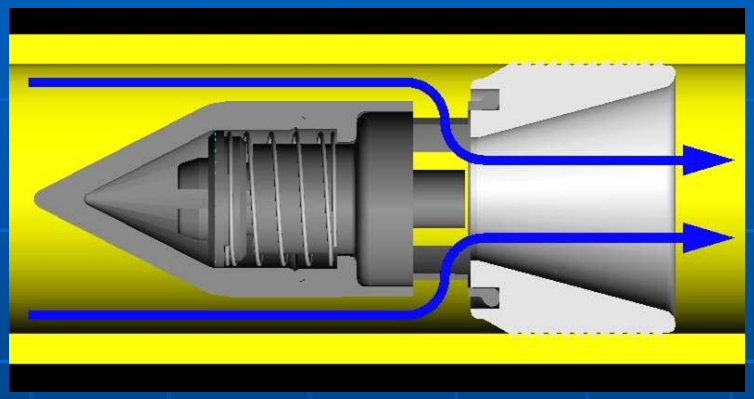
Normal Flow

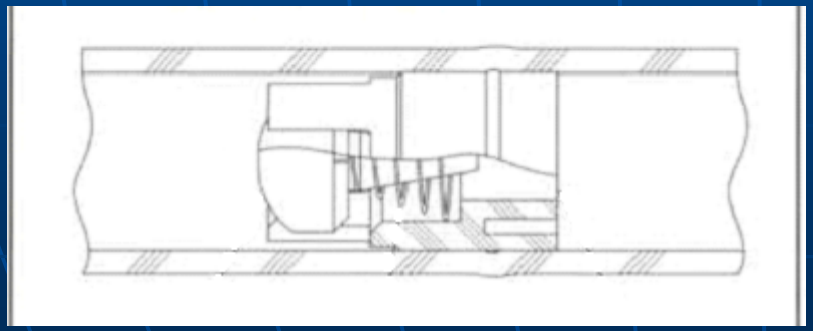


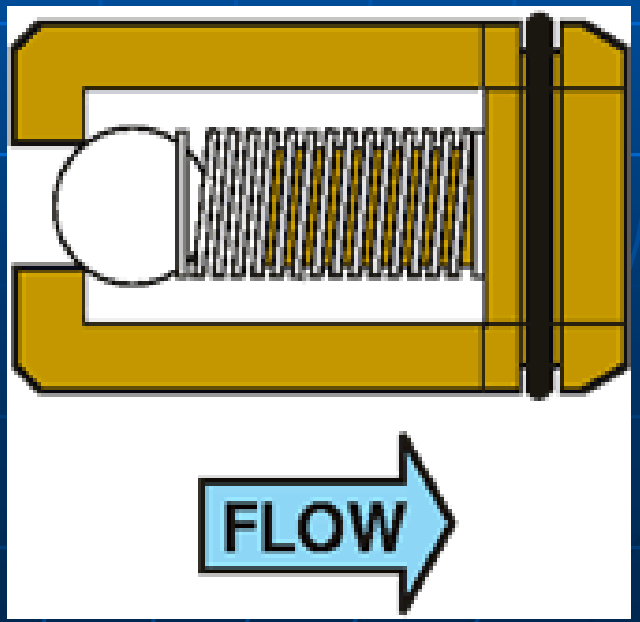
Excess Flow

Diaphragm Design

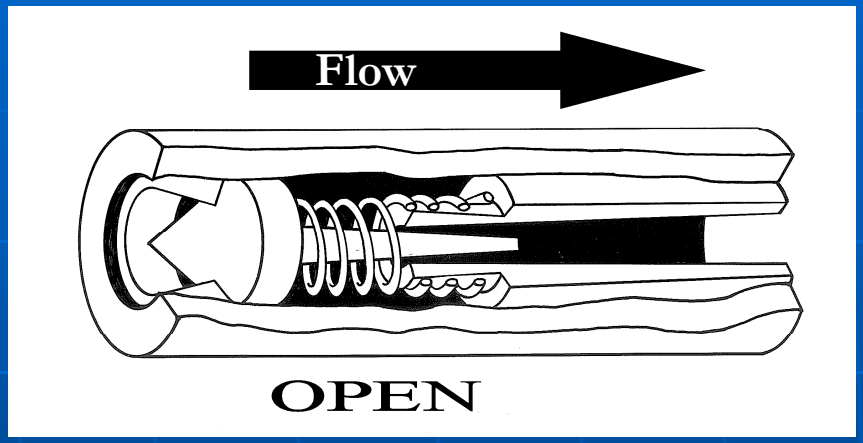
Spring and Float Design

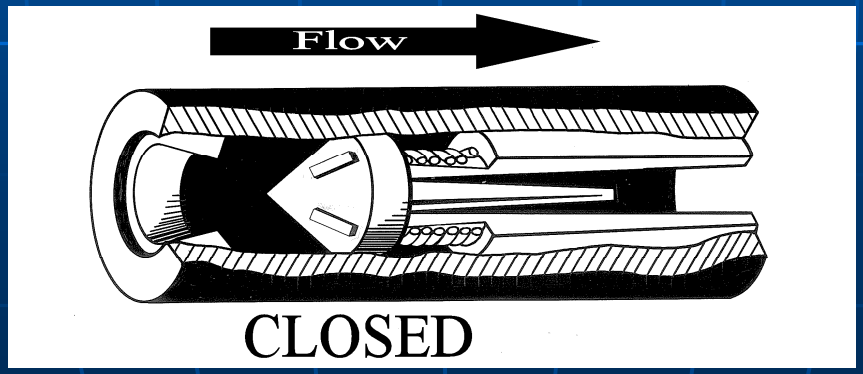




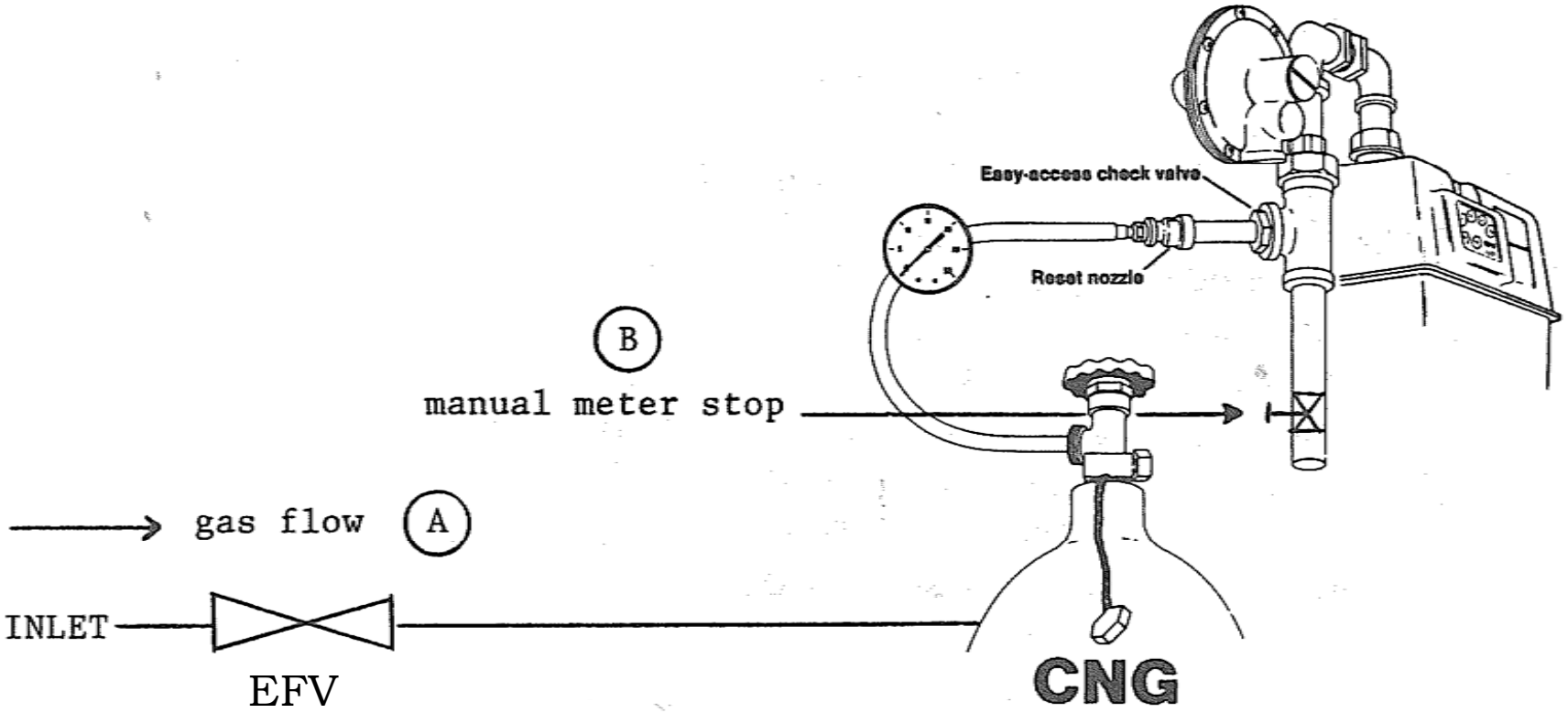


Reset Styles
Bleed-by





Reset Styles
Positive Shut-off



Performance Standards

- MSS SP-115 in 1995 – Design, Performance & Test
- US DOT 192.381 in 1996 - Performance
- ASTM F1802 in 1997 – Test Method
- ASTM F2138 in 2001 – Standard Specification
  - **Pressure**
  - **Temperature**
  - **Trip Flow**
  - **By-pass flow (permissible leakage)**
  - **Design and Production Testing by Manufacturers**

Customer Notification

- DOT 192.383
  - EFVs installed must meet DOT 192.381
  - Single Residential Gas Services
  - Greater than 10psig
  - Continuously throughout the year

PROPOSED EFV INSTALLATION REQUIREMENT – "DIMP"

- EFV must conform to DOT 192.381
- NPRM Subpart P (§192.1011)
  - "Service lines serving single family residences"
  - 10psig or greater
  - Operator experience with contaminants
  - Commercially available
  - Cannot interfere with O&M activities

Excess Flow Valves

Sec. 192.383 Excess flow valve installation.

(a) Definitions. As used in this section:

Replaced service line means a natural gas service line where the fitting that connects the service line to the main is replaced or the piping connected to this fitting is replaced.

Service line serving single-family residence means a natural gas service line beginning at the fitting that connects the service line to the main and serving only one single-family residence.

(b) *Installation required*. An EFV installation must comply with the performance standards in §192.381. The operator must install an EFV on new or replaced service lines serving single-family residences after **[INSERT EFFECTIVE DATE OF FINAL RULE]**, unless one or more of the following conditions is present:

(1) The service line does not operate at a pressure of 10 psig or greater throughout the year;

(2) The operator has prior experience with contaminants in the gas stream that could interfere with the EFV's operation or cause loss of service to a residence;

(3) An EFV could interfere with necessary operation or maintenance activities, such as blowing liquids from the line; or

(4) An EFV meeting performance requirements in §192.381 is not commercially available to the operator.

(Israni/PHMSA/Dec2008)

Configurations

- Sizes
  - ½ CTS to 2 IPS
- Service Line Inlet Pressures
  - 5psig to 125 psig
  - EFV rated to 1,000 psi
- Flow Capacity Range
  - 400 CFH to 5,500 CFH at 10 psig
  - 10,000 CFH in final design phase
- Other Sizes and Capacities –Special Order

EFV Assemblies

½ CTS/IPS, ¾ CTS UMAC EFV SERIES

Inlet Pressure		SERIES 350[1] Nom. Min. Trip Point 0.6 SG Gas		Bypass Flow After Trip (Nom. Max) 0.6 SG Gas	
psig	bar	SCFH	SCMH	SCFH	SCMH
5	0.34	350	9.91	18	0.51
10	0.69	400	11.33	20	0.57
15	1.03	430	12.18	23	0.65
20	1.38	460	13.03	25	0.71
30	2.07	530	15.01	28	0.79
40	2.76	600	16.99	32	0.91
50	3.45	650	18.41	35	0.99
60	4.14	700	19.82	37	1.05
70	4.83	730	20.67	39	1.10
80	5.52	780	22.09	41	1.16
90	6.21	820	23.22	46	1.30
100	6.90	860	24.35	50	1.42
150	10.34	1,000	28.32	75	2.12

1. For Pressures over 150 psig (10.34 bar) contact UMAC

Inlet Pressure		SERIES 550[1] Nom. Min. Trip Point 0.6 SG Gas		Bypass Flow After Trip (Nom. Max) 0.6 SG Gas	
psig	bar	SCFH	SCMH	SCFH	SCMH
5	0.34	470	13.31	18	0.51
10	0.69	550	15.57	20	0.57
15	1.03	600	16.99	23	0.65
20	1.38	660	18.69	25	0.71
30	2.07	760	21.52	28	0.79
40	2.76	840	23.79	32	0.91
50	3.45	920	26.05	35	0.99
60	4.14	990	28.03	37	1.05
70	4.83	1,070	30.30	39	1.10
80	5.52	1,120	31.71	41	1.16
90	6.21	1,190	33.70	46	1.30
100	6.90	1,240	35.11	50	1.42
150	10.34	1,430	40.49	75	2.12

1. For Pressures over 150 psig (10.34 bar) contact UMAC

½” CTS UMAC EFV SERIES

Inlet Pressure		SERIES 800[1] Nom. Min. Trip Point 0.6 SG Gas		Bypass Flow After Trip (Nom. Max) 0.6 SG Gas	
psig	bar	SCFH	SCMH	SCFH	SCMH
10	0.69	800	22.65	20	0.57
15	1.03	900	25.48	23	0.65
20	1.38	980	27.75	25	0.71
30	2.07	1130	32.00	28	0.79
40	2.76	1310	37.09	32	0.91
50	3.45	1420	40.21	35	0.99
60	4.14	1530	43.32	37	1.05
70	4.83	1660	47.01	39	1.10
80	5.52	1770	50.12	41	1.16
90	6.21	1860	52.67	46	1.30
100	6.90	1950	55.22	50	1.42

1. For Pressures over 100 psig (6.90 bar) contact UMAC

¾ IPS to 2 IPS

Inlet Pressure		SERIES 300[1] Nom. Min. Trip Point 0.6 SG Gas		Bypass Flow After Trip (Nom. Max) 0.6 SG Gas	
psig	bar	SCFH	SCMH	SCFH	SCMH
5	0.34	400	11.33	18	0.51
10	0.69	450	12.74	20	0.57
15	1.03	490	13.88	23	0.65
20	1.38	540	15.29	25	0.71
30	2.07	620	17.56	28	0.79
40	2.76	680	19.26	32	0.91
50	3.45	740	20.95	35	0.99
60	4.14	800	22.65	37	1.05
70	4.83	860	24.35	39	1.10
80	5.52	910	25.77	41	1.16
90	6.21	950	26.90	46	1.30
100	6.90	1,000	28.32	50	1.42

Inlet Pressure		SERIES 700[1] Nom. Min. Trip Point 0.6 SG Gas		Bypass Flow After Trip (Nom. Max) 0.6 SG Gas	
psig	bar	SCFH	SCMH	SCFH	SCMH
5	0.34	600	16.99	18	0.51
10	0.69	700	19.82	20	0.57
15	1.03	760	21.52	23	0.65
20	1.38	830	23.50	25	0.71
30	2.07	960	27.18	28	0.79
40	2.76	1,060	30.02	32	0.91
50	3.45	1,200	33.98	35	0.99
60	4.14	1,300	36.81	37	1.05
70	4.83	1,410	39.93	39	1.10
80	5.52	1,480	41.91	41	1.16
90	6.21	1,540	43.61	46	1.30
100	6.90	1,600	45.31	50	1.42

Inlet Pressure		SERIES 1100[1] Nom. Min. Trip Point 0.6 SG Gas		Bypass Flow After Trip (Nom. Max) 0.6 SG Gas	
psig	bar	SCFH	SCMH	SCFH	SCMH
5	0.34	1000	28.32	18	0.51
10	0.69	1100	31.15	20	0.57
15	1.03	1230	34.83	23	0.65
20	1.38	1310	37.09	25	0.71
30	2.07	1530	43.32	28	0.79
40	2.76	1670	47.29	32	0.91
50	3.45	1870	52.95	35	0.99
60	4.14	2030	57.18	37	1.05
70	4.83	2180	61.73	39	1.10
80	5.52	2300	65.13	41	1.16
90	6.21	2450	69.38	46	1.30
100	6.90	2550	72.21	50	1.42

Inlet Pressure		SERIES 1800[1] Nom. Min. Trip Point 0.6 SG Gas		Bypass Flow After Trip (Nom. Max) 0.6 SG Gas	
psig	bar	SCFH	SCMH	SCFH	SCMH
5	0.34	1,800	50.97	18	0.51
10	0.69	2,000	56.63	20	0.57
15	1.03	2,250	63.71	23	0.65
20	1.38	2,500	70.79	25	0.71
30	2.07	2,800	79.29	28	0.79
40	2.76	3,100	87.78	32	0.91
50	3.45	3,400	96.28	35	0.99
60	4.14	3,800	107.60	37	1.05
70	4.83	4,100	116.10	39	1.10
80	5.52	4,300	121.76	41	1.16
90	6.21	4,500	127.43	46	1.30
100	6.90	4,700	133.09	50	1.42

Inlet Pressure		SERIES 5500[1] Nom. Min. Trip Point 0.6 SG Gas		Bypass Flow After Trip (Nom. Max) 0.6 SG Gas	
psig	bar	SCFH	SCMH	SCFH	SCMH
10	0.69	5500	156	20	0.57
15	1.03	6200	176	23	0.65
20	1.38	6800	193	25	0.71
30	2.07	7500	212	28	0.79
40	2.76	8400	238	32	0.91
50	3.45	9300	263	35	0.99
60	4.14	10000	283	37	1.05

Inlet Pressure		SERIES 2600[1] Nom. Min. Trip Point 0.6 SG Gas		Bypass Flow After Trip (Nom. Max) 0.6 SG Gas	
psig	bar	SCFH	SCMH	SCFH	SCMH
10	0.69	2600	73.62	20	0.57
15	1.03	2700	76.45	23	0.65
20	1.38	3000	84.95	25	0.71
30	2.07	3600	101.94	28	0.79
40	2.76	4000	113.27	32	0.91
50	3.45	4400	124.59	35	0.99
60	4.14	4900	138.75	37	1.05
70	4.83	5300	150.08	39	1.10
80	5.52	5700	161.40	41	1.16
90	6.21	6000	169.90	46	1.30
100	6.90	6200	175.56	50	1.42

1. For Pressures over 100 psig (6.90 bar) contact UMAC

- Branch Services
- Commercial/Industrial
- Residential Multiple Meter

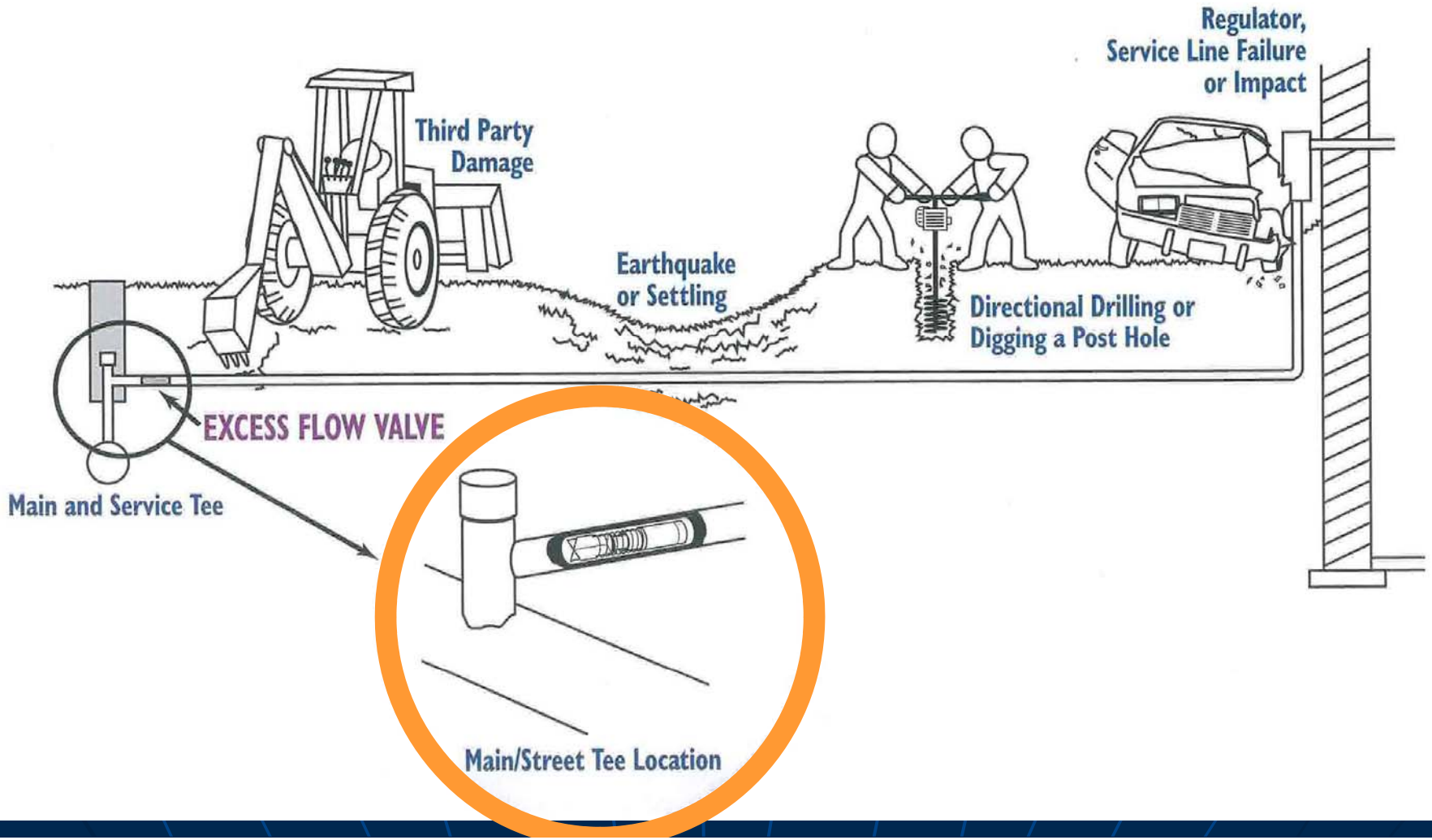
Inlet Pressure		SERIES 1800[1] Nom. Min. Trip Point 0.6 SG Gas		Bypass Flow After Trip (Nom. Max) 0.6 SG Gas	
psig	bar	SCFH	SCMH	SCFH	SCMH
5	0.34	1,800	50.97	18	0.51
10	0.69	2,000	56.63	20	0.57
15	1.03	2,250	63.71	23	0.65
[illegible]					
30	2.07	2,800	79.29	28	0.79
40	2.76	3,100	87.78	32	0.91
50	3.45	3,400	96.28	35	0.99
60	4.14	3,800	107.60	37	1.05
70	4.83	4,100	116.10	39	1.10
80	[illegible]	4,300	[illegible]	41	[illegible]
[illegible]					
100	6.90	4,700	133.09	50	1.42

Inlet Pressure		SERIES 5500[1] Nom. Min. Trip Point 0.6 SG Gas		Bypass Flow After Trip (Nom. Max) 0.6 SG Gas	
psig	bar	SCFH	SCMH	SCFH	SCMH
10	0.69	5500	156	20	0.57
15	1.03	6200	176	23	0.65
20	1.38	6800	193	25	0.71
30	2.07	7500	212	28	0.79
40	2.76	8400	238	32	0.91
50	3.45	9300	263	35	0.99
60	4.14	10000	283	37	1.05

Inlet Pressure		SERIES 2600[1] Nom. Min. Trip Point 0.6 SG Gas		Bypass Flow After Trip (Nom. Max) 0.6 SG Gas	
psig	bar	SCFH	SCMH	SCFH	SCMH
10	0.69	2600	73.62	20	0.57
15	1.03	2700	76.45	23	0.65
20	1.38	3000	84.95	25	0.71
30	2.07	3600	101.94	28	0.79
40	2.76	4000	113.27	32	0.91
50	3.45	4400	124.59	35	0.99
60	4.14	4900	138.75	37	1.05
70	4.83	5300	150.08	39	1.10
80	5.52	5700	161.40	41	1.16
90	6.21	6000	169.90	46	1.30
100	6.90	6200	175.56	50	1.42

1. For Pressures over 100 psig (6.90 bar) contact UMAC

EFV Installation Location



Operating Limitations/Anomalies

- Application may be technically possible, but is it feasible?
- Fouling by Contamination
  - Viscous contaminants
  - Liquids
  - Dry contaminants not generally an issue
- Improper Sizing
- Widely Fluctuating Loads
- Low System Pressure
- Attention to O&M Procedures

“3 Factors to Sizing a UMAC EFV”

#1 “Will the EFV Trip when I don’t want it to?”

The Nominal Minimum Trip Point (SCFH) of the EFV must be greater than the Maximum anticipated customer gas load (SCFH) at the Minimum Design Pressure of the system.

#2 “Will I have enough pressure at the service regulator?”

Ensure that the total pressure drop across the EFV and service piping at the Maximum anticipated customer load (SCFH) and Minimum Design Pressure will satisfy the minimum pressure requirements to the service regulator.

#3 “How long a service line can I have and assure the EFV will trip if there is a pipe break?”

At the Minimum Design Pressure of the system, the maximum anticipated length of service pipe must not be longer than the Maximum Recommended Length of Service to be used downstream of the EFV for the given diameter pipe.

EFV Sizing Considerations

- MINIMUM Operating Design Pressure
- Consider pipe diameter and length when sizing EFV
- Consider Anticipated Design Load
  - Use Customer Meter Plate Rating
    - EFV Trip at 20% Over Plate Capacity
    - Consider Future Load Growth Potential

EFV Sizing Example #1 Residential

- Service: ½”CTS x 75’
- Meter: 250CFH
- Sizing: 250 + 20% = at least 300CFH
- EFV: 400CFH Minimum

Inlet Pressure		SERIES 350[1] Nom. Min. Trip Point 0.6 SG Gas		Bypass Flow After Trip (Nom. Max) 0.6 SG Gas	
psig	bar	SCFH	SCMH	SCFH	SCMH
5	0.34	350	9.91	18	0.51
10	0.69	400	11.33	20	0.57
15	1.03	430	12.18	23	0.65
20	1.38	460	13.03	25	0.71
30	2.07	530	15.01	28	0.79
40	2.76	600	16.99	32	0.91
50	3.45	650	18.41	35	0.99
60	4.14	700	19.82	37	1.05
70	4.83	730	20.67	39	1.10
80	5.52	780	22.09	41	1.16
90	6.21	820	23.22	46	1.30
100	6.90	860	24.35	50	1.42
150	10.34	1,000	28.32	75	2.12

1. For Pressures over 150 psig (10.34 bar) contact UMAC

EFV Sizing Example #2 Residential

- Service: 1”CTS x 150’
  - Minimum Service Design Pressure = 10 psi
- Meter: 630CFH
- Sizing: 630 + 20% = at least 750CFH
- EFV: 1100CFH Minimum

Inlet Pressure		SERIES 1100[1] Nom. Min. Trip Point 0.6 SG Gas		Bypass Flow After Trip (Nom. Max) 0.6 SG Gas	
psig	bar	SCFH	SCMH	SCFH	SCMH
5	0.34	1000	28.32	18	0.51
10	0.69	1100	31.15	20	0.57
15	1.03	1230	34.83	23	0.65
20	1.38	1310	37.09	25	0.71
30	2.07	1530	43.32	28	0.79
40	2.76	1670	47.29	32	0.91
50	3.45	1870	52.95	35	0.99
60	4.14	2030	57.18	37	1.05
70	4.83	2180	61.73	39	1.10
80	5.52	2300	65.13	41	1.16
90	6.21	2450	69.38	46	1.30
100	6.90	2550	72.21	50	1.42

1. For Pressures over 100 psig (6.90 bar) contact UMAC

UMAC High Volume EFV Approach

High Volume EFVs

- **Single Meters**
- **Multiple Meters**
- **Branch or Split Services**
- **Commercial Applications**

EFV Sizing Example #3 Commercial

- Service: ¾” IPS x 80’
- Meter: 2 x 425CFH
- Sizing: 850 + 20% = at least 1020CFH
- EFV: 2000CFH Minimum

Inlet Pressure		SERIES 1800[1] Nom. Min. Trip Point 0.6 SG Gas		Bypass Flow After Trip (Nom. Max) 0.6 SG Gas	
psig	bar	SCFH	SCMH	SCFH	SCMH
5	0.34	1,800	50.97	18	0.51
10	0.69	2,000	56.63	20	0.57
15	1.03	2,250	63.71	23	0.65
20	1.38	2,500	70.79	25	0.71
30	2.07	2,800	79.29	28	0.79
40	2.76	3,100	87.78	32	0.91
50	3.45	3,400	96.28	35	0.99
60	4.14	3,800	107.60	37	1.05
70	4.83	4,100	116.10	39	1.10
80	5.52	4,300	121.76	41	1.16
90	6.21	4,500	127.43	46	1.30
100	6.90	4,700	133.09	50	1.42
150	10.34	5,270	149.23	75	2.12
200	13.79	6,135	173.72	88	2.44
250	17.24	6,900	195.39	115	3.26
300	20.69	7,635	216.20	130	3.68
350	24.14	8,360	236.73	155	4.39
400	27.59	8,900	252.02	175	4.96
450	31.03	9,455	267.74	185	5.24
500	34.48	9,955	281.89	195	5.52
550	37.93	10,360	293.36	215	6.09
600	41.38	10,725	303.70	240	6.80
650	44.83	11,090	314.03	260	7.36
700	48.28	11,315	320.40	275	7.79
720	49.66	11,360	321.68	290	8.21

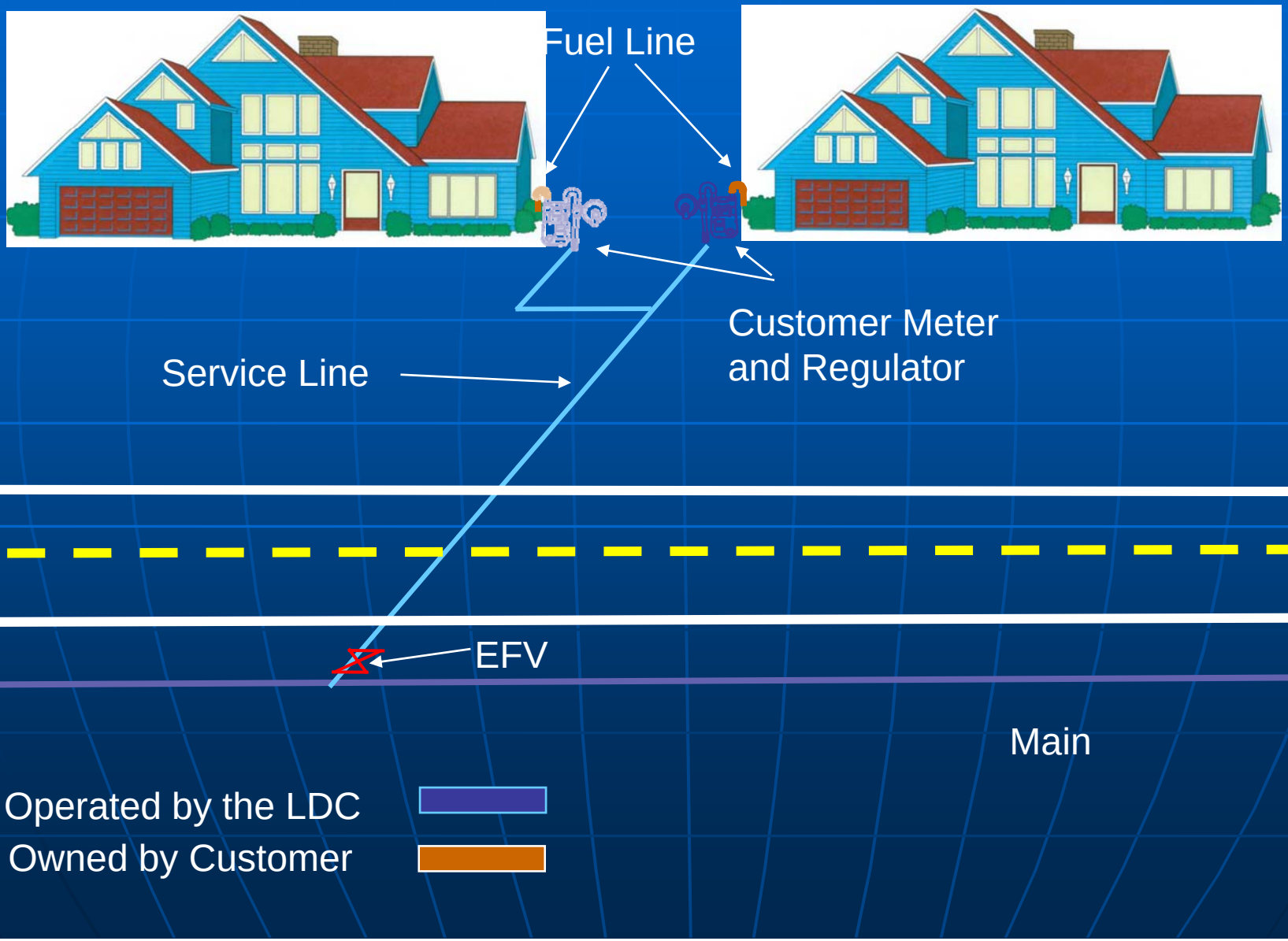
EFV Sizing Example #4 Commercial

- Service: ¾” IPS x 90’
- Meter: 2 x 175CFH
- Sizing: 350 + 20% = at least 420CFH
  - Future Load Considerations
- EFV: 2600CFH Minimum

Inlet Pressure		SERIES 2600[1] Nom. Min. Trip Point 0.6 SG Gas		Bypass Flow After Trip (Nom. Max) 0.6 SG Gas	
psig	bar	SCFH	SCMH	SCFH	SCMH
10	0.69	2600	73.62	20	0.57
15	1.03	2700	76.45	23	0.65
20	1.38	3000	84.95	25	0.71
30	2.07	3600	101.94	28	0.79
40	2.76	4000	113.27	32	0.91
50	3.45	4400	124.59	35	0.99
60	4.14	4900	138.75	37	1.05
70	4.83	5300	150.08	39	1.10
80	5.52	5700	161.40	41	1.16
90	6.21	6000	169.90	46	1.30
100	6.90	6200	175.56	50	1.42

1. For Pressures over 100 psig (6.90 bar) contact UMAC

FV Installation Options – Branch Services to Single Family homes



“Mother-Daughter” (Duplex)
MULTI – FAMILY
Branch Service

- **Service: 3/4 IPS x 50’**
- **(2) 275 CFH or (2) 425 CFH meters**
- **MINIMUM SERVICE Inlet Pressure: 5 psig**
- **EFV: UMAC Series 1800**

COMPANY "E"

EFV Size and Capacity	Minimum Trip Flow Rate (SCFH)		
	b.) 10	c.) 60	d.) 125
1/2 CTS Low Capacity	490	893	1210
1/2 CTS Medium Capacity	924	1563	2301
1/2 IPS Low Capacity	787	1381	1888
3/4 CTS Low Capacity	602	1064	1458
3/4 CTS Medium Capacity	794	1461	2016
3/4 CTS High Capacity	1390	2295	3347
3/4 IPS Low Capacity	568	1000	1459
3/4 IPS Medium Capacity	878	1535	2195
3/4 IPS High Capacity	1436	2586	3798
1 CTS Low Capacity	624	1091	1574
1 CTS Medium Capacity	1073	1916	2472
1 CTS High Capacity	2407	4196	7461
1 IPS Low Capacity	606	1072	1535
1 IPS Medium Capacity	883	1595	2194
1 IPS High Capacity	1436	2586	3798

EFV Sizing Summary

- MINIMUM Operating Design Pressure
- MAXIMUM Load Design Capacity
- Service Line Size:
  - Diameter
  - Length
- Future Load Growth

Other Information

- Warranties and Design Life
  - Free from defects upon shipment
  - Lifetime
  - 10 year excavation warranty
- How many EFVs operate as a result of damage?
  - Not generally recorded
  - Extrapolated data specific to manufacturers
    - 50 per year
    - More than 900 per year

EFV Benefits

- Prevent accidents
  - Save Lives
  - Prevent property damage
- Make area safe
- Can replace costly curb valve installation
- Reduce unburned methane release
  - EPA STAR Top Three Partner Reported Opportunities (PROs)

Summary of UMAC EFVs

- Solid Operating Track Record
  - 35 years
  - Over 5 million installed
- 25% of Production are High Volume EFVs
- Far along the experience curve with both single family service and branch/ multi-service applications
- Experience with Commercial Applications more limited
- Support of operator's right to choose proper locations

QUESTIONS