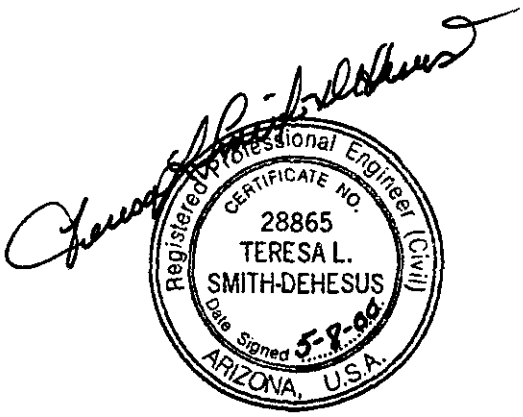
CITY OF SCOTTSDALE ARIZONA

Design Standards Development
for
Pressure Reducing Valves
and
Air Valves



City Contract No.
980064

BLACK & VEATCH
Corporation

B&V Project No.
29914

May 2000

Contents

List of Attachments

1.0 Introduction

1.1 Purpose

The purpose of the design standards development task is to provide the City of Scottsdale detailed technical guidance for design of pressure reducing valves (PRVs) and air valves used in the water distribution system. The guidelines developed will be incorporated by the City into the Design Standards and Policies Manual, or other guidance documents, as appropriate.

1.2 Scope

The scope of the design standards development task involved review and development of design standards for pressure reducing valves (PRVs) and air valves used in the Scottsdale water distribution system. The task included review of the City's current standards manual and interviews with City staff.

- PRV standards were based on the use of Bermad Series 700, Y-Pattern, V-Port valves. Design criteria, a step-by-step selection process, and design details (drawings and design data) were developed as part of the standards guidelines for the PRVs.
- Air valves standards were developed with guidance criteria on use, placement and sizing of the valves.

1.3 Background

The design standards development task is part of the Water System Cyclic Pressure Analysis project being performed by Black & Veatch. This work is a continuation of work performed previously during the Evaluation of PVC C-900 Water Pipe Study.

In 1997 Black & Veatch completed an extensive study of PVC C-900 water pipe used in the Scottsdale water distribution system. The evaluation was performed in response to a series of failures of C-900 water pipe experienced by the City since 1991. The study focused on (1) evaluation of the future use of the C-900 product in the Scottsdale system, (2) determination of the cause(s) of the previous failures, (3) recommendations for the existing inventory of C-900 pipe, and (4) recommendations for peripheral issues affecting the use of C-900 pipe in the system (ie, design, review, construction).

During the initial C-900 evaluation it was found through pressure testing and analysis that cyclic pressures were present in the distribution system and that these pressures were likely being caused by operation of PRVs. The majority of the pipe failures were also determined to be fatigue failures, which were attributed to the presence of cyclic pressure. Among other recommendations resulting from the evaluation, it was recommended that (1) the cyclic pressures in the system be eliminated, (2) a system-wide PRV study be performed to identify if other areas of concern exist in the system, (3) sizing and placement of existing PRVs be reviewed, and (4) design criteria and guidance be developed for PRVs, air valves, and other surge control devices.

The Water System Cyclic Pressure Analysis project was initiated in 1998 to address some of the recommendations of the C-900 evaluation. This work included (1) follow-up detailed testing and analysis of the distribution system area that was reviewed in the previous study and (2) development of the design standards for PRVs and air valves.

This report presents the standards that were developed for the PRVs and air valves used in the water distribution system. This guidance will be incorporated by the City into the Design Standards and Policies Manual, or other guidance documents, as appropriate.

2.0 Pressure Relief Valve Standards

2.1 Overview

The pressure reducing valve (PRV) standards presented herein are based on the use of Bermad Series 700, Y-Pattern, V-Port valves. Design criteria, a step-by-step selection process, and design details (drawings and design data) were developed as part of the standards. It is recommended that the design criteria and selection process be incorporated into the City's Design Standards and Policies Manual.

In the course of developing the PRV standards, the layout of the PRV vaults was also reviewed. Recommended changes to the vault layout and design were incorporated into existing City details where possible and new details were provided where appropriate. It is recommended that the revised and new details prepared as part of these standards be incorporated into the City's standard details and that the City discontinue use of the existing details. The revised and new details include:

- PRV Vault Details (modifications to Detail 2342-1)
- PRV Vault Details (modifications to Detail 2342-2)
- PRV Vault Dimensions (new Detail 2342-3)
- PRV Vault End Wall Section (new Detail 2342-4)
- PRV Vault Tie Rod Pipe Anchor Assembly (new Detail 2342-5)
- PRV Vault Restraint Forces (new Detail 2342-6)
- PRV Vault Fabricated Wall Insert Details (new Detail 2342-7)
- PRV Vault Concrete Wall Inserts for Horizontal Tie Rods (new Detail 2342-8)

2.2 PRV Design Criteria

This section outlines the design criteria for the selection of pressure reducing valve installations. Several different manufactures of PRVs have been approved by the City and installed in the Scottsdale system. For these standards, the City has elected to use the Bermad Series 700, Y-Pattern, V-Port, Pressure Reducing Valve as the basis for the design criteria. If other approved-equal manufacturer PRVs are used, similar analysis

will need to be performed based on the specific parameters and design criteria of the selected valve.

2.2.1 PRV System Parameters

PRV selection is based on the following system parameters:

- The maximum differential pressure across a pressure reducing valve should not exceed 50 percent when the upstream pressure is in the range of 50 to 200 psi. When the upstream pressure is in the range of 200 to 300 psi, the maximum differential pressure may be increased above 50 percent, but the differential pressure should not exceed 55 percent of the upstream pressure. If differential pressures across the pressure reducing valves exceed these recommended percentages, cavitation may be experienced in the piping or the pressure reducing valve.

- The maximum velocity through a pressure reducing valve should not exceed 15 fps and the minimum velocity should not drop below 1.5 fps. Velocities are based upon a full pipe size valve. Preferred regulation velocities of flow through the pressure reducing valves are in the range of 6.0 through 15 fps inclusive.

- The minimum differential pressure across a pressure reducing valve should not be less than 15 percent of the upstream pressure to the valve. This minimum pressure differential is required for the satisfactory operation of pressure reducing valve controls.

- For valves in bypass piping, the downstream pressure setting of the secondary valve in the bypass should be 7 psi greater than the downstream pressure setting of the primary valve in the main line. The difference in downstream pressures to the main and secondary pressure reducing valves is required to assure the operation of the secondary valves when the main valve is no longer needed to satisfy downstream flow demands.

- The design guidelines herein apply to system working pressures up to 200 psi. For system working pressures exceeding 200 psi a design engineer should be retained to review and verify the specific system parameters and the design criteria of the PRV installation. Information for system working pressure exceeding 200 psi presented herein is for reference only.

2.2.2 *Required Design Information*

The following design information is required for selecting the PRV installation:

- The maximum and minimum upstream pressures that will be acting upon the interior of main pipe at the entrance to the pressure reducing valve vault.
- The downstream operating conditions in the interior of main pipe at the exit to the pressure reducing valve vault including:
    a. The maximum and minimum flows needed for the operation of the water system downstream of the pressure reducing valve vault.
    b. The minimum pressure needed for the operation of the water system downstream of the pressure reducing valve vault.
- Inlet and outlet pipe size being used at the pressure reducing valve vault.

In addition to the required design information, specifics about the site of the PRV installation should be recorded. The PRV Site and System Information Worksheet should be completed for each PRV installation to document the design and site-specific information.

2.3 PRV Selection Process

Step 1: Obtain the required design information listed in section 2.2.2 above.

Step 2: Compute the maximum pressure differential in the interior of pipe entering and exiting the pressure reducing valve vault.

- **Condition 1:** If the pressure at the entrance to the valve vault is 200 psi or less and the differential pressure across the valve vault piping is 100 psi (50 percent) or less, see the valving options below.
- **Condition 2:** If the pressure at the entrance to the valve vault is in the range of 200 to 300 psi and the differential pressure across the valve vault piping does not exceed 55 percent of the upstream pressures, see the valving options below.

- **Condition 3:** In the event that differential pressures across the pressure reducing valve vault piping exceed the percentages recommended in section 2.2.1 above, pressure reducing valves in series will be required for main and secondary pressure reducing valve installations. Use the PRV Differential Pressures Table to determine the operating range of valve or valves for the site under consideration.

- **Valving Options:** The following valving may be required dependent upon the design conditions:

  a. If the maximum flow in the main valve piping does not exceed 15 fps and the minimum flow in the piping does not fall below 6.0 fps, a single valve should be able to serve the system. However, the City requires bypass piping on all PRV installations for redundancy and ease of maintenance. Therefore, a bypass valve, or secondary valve, should be installed in all cases and sized identical to the single main valve for this application.

  b. If the maximum flow in the main valve piping is in the range of 15 fps to less than 1.5 fps, a bypass valve or secondary valve is required to serve the system and should be selected to carry the flows below 6.0 fps in the main valve. The secondary valve should be selected for the best fit for compliance of pipe velocities in the range of 6.0 fps to 15 fps inclusive.

Step 3: Select main valve size based upon the flow data included in the PRV Flow Velocities Table to maintain flow velocities in the regulation zone of 6.0 to 15.0 fps for the design flows at pressure reducing station site. If a secondary pressure reducing valve is required (Valving Option b.), repeat the process for the secondary pressure reducing valve. In most instances the actual conditions will dictate that the control of pressure reducing valves will be operating below 6.0 fps.

Step 4: Layout the PRV vault per Details 2342-1 through 2342-4.

Step 5: From Details 2342-5 through 2342-8, select the size of horizontal tie rods and concrete wall inserts required to restrain the piping inside the pressure reducing valve vault for the design pressures at the site.

2.3.1 PRV Selection Example 1 – Differential Pressure Requirement Exceeded (Valves in Series Required in Primary and Secondary Piping)

- Given:

  a. Max. upstream pressure to pressure reducing valve vault: 210psi

  b. Min. upstream pressure to pressure reducing valve vault: 180psi

  c. Min. downstream pressure to pressure reducing valve vault: 75psi

  d. Max. flow through the pressure reducing valve vault: 1250gpm

  e. Min. flow through the pressure reducing valve vault: 125gpm

  f. Inlet and outlet pipe size at the pressure reducing valve vault: 10 inches

- Determine the maximum differential pressure across the pressure reducing valve vault:

  a. Max. differential pressure = 210 - 75 = 135 psi

     Note: Maximum differential pressure exceeds 55 percent of the maximum upstream pressure: 0.55 x 210 = 116 psi. The value for the differential pressure can be confirmed by referring to the PRV Differential Pressure Table. Two pressure reducing valves operating in series will be required in the main and secondary piping since too much pressure must be reduced for a single valve.

- Select the valve sizes in the primary and secondary piping systems upon the basis of maintaining the flow in the velocity limits of 1.5 fps to 15 fps. Bermad recommends that the velocity of flow in the valves be in the range of 6.0 to 15 fps for the best flow regulation results.

  However, in those cases when the volume of flow can vary 10 to 1 or greater, it will not be possible to select valves in the recommended flow regulation velocities without having more than two parallel piping systems. The scope of this section is to limit the number of parallel pipes to two pipes, and the velocities of flow in the pipes are not to exceed 15 fps or be lower than 1.5 fps as the recommended velocities by Bermad. When the volume of flow is in a wide range, the main valve sizes are to be selected upon the greatest velocity not exceeding 15 fps, and the secondary valve sizes are to be selected with the smallest velocity being 1.5 fps minimum.

a. Refer to the PRV Flow Velocities Table. Read maximum flow of 1355 gpm for 6 inch main valve. At 1250 gpm flow through a 6 inch valve, the velocity of flow is less than 15fps. The minimum flow through a 6 inch valve, 125 gpm, results in a velocity of flow less than 1.5 fps. A secondary piping system with two smaller valves in series must be provided to handle the flows below the recommended regulation flow range of the primary pressure reducing valve.

b. From the PRV Flow Velocities Table select 4 inch valves in series for the secondary piping system. The low flow of 125 gpm for the system is near 3 fps in the low regulation flow zone for the 4 inch valve. The flow range of the 4 and 6 inch valves are overlapping in the recommended flow regulation zones. Note that the flow (gpm) in the 6 inch valve at 6.0 fps is smaller than the flow (gpm) in the 4 inch valve at 15 fps.

c. Primary valves: Set first valve in series to reduce pressure from 210 psi to 140 psi (70 psi differential). Set second valve in series to reduce pressure from 140 psi to 75psi (65 psi differential).

d. Secondary valves: Set first valve in series to reduce pressure from 210 psi to 140 psi (70 psi differential). Set second valve in series to reduce pressure from 140 psi to 82 psi (58 psi differential and 7 psi greater outlet pressure than used for the series primary valves).

- Thrust Restraint Inside the Pressure Reducing Valve Vault

a. Tie rod selection (Refer to Detail 2342-6)

(1). Inlet and outlet pipe size to pressure reducing valve vault: 10 inches

(2). Maximum operating pressure at site: 210 psi (Use 225 psi for this example) If the table does not include the pressure at site, use the next highest pressure that is included in the table.

(3). From the detail, select four tie rods, 3/4 inch size, to restrain the 10 inch inlet and outlet pipe at each end wall of valve vault.

2.3.2 PRV Selection Example 2 – Differential Pressure Requirement Met (Single Valves in Primary and Secondary Piping Adequate)

- Given:

  a. Max. upstream pressure to pressure reducing valve vault: 140psi

  b. Min. upstream pressure to pressure reducing valve vault: 110psi

  c. Min. downstream pressure to pressure reducing valve vault: 80psi

  d. Max. flow through the pressure reducing valve vault: 4000gpm

  e. Min. flow through the pressure reducing valve vault: 200gpm

  f. Inlet and outlet pipe size at the pressure reducing valve vault: 18 inches

- Determine the maximum differential pressure across the pressure reducing valve vault:

  a. Maximum differential pressure = 140 - 80 = 60 psi

     Note: Maximum differential pressure is less than 50 percent of the maximum upstream pressure: 0.50 x 140 = 70 psi. A single valve can be used in the main and secondary valve piping since the differential pressure involved is less than 50 percent of the maximum upstream pressure to the valve vault. From the given information the range for volume of flow through the valve it would appear that a secondary pressure reducing valve would be required to accommodate the low flow, 200 gpm, through the pressure reducing valve vault.

- Select the valve sizes in the primary and secondary piping systems upon the basis of maintaining the flow in the velocity limits of 1.5 fps to 15 fps.

  a. Refer to the PRV Flow Velocities Table. Select the main valve as 12 inch size; for a maximum flow of 4000 gpm through a 12 inch valve the maximum velocity will be less than 12 fps. Select the secondary valve size as being 6 inches. For the minimum flow of 200 gpm in a 6 inch valve the velocity of flow will be greater than 1.5 fps.

     Comment: From the information in the PRV Flow VelocitiesTable, note that the flow for the 6 inch valve at 15 fps is 1355 gpm, and that the flow in the 12 inch

valve at 1.5 fps is 525 gpm. The valve selections include an overlapping of flow (gpm) in the limits of 1.5 fps to 15 fps of each separate valve. The greater the overlapping of flows in the velocity range criteria, the greater the control of valves will be over the operating pressure range. The overlapping flow range amounts to 1355 gpm minus 525 gpm or 830 gpm. The preferred overlapping flow range would occur in the recommended flow (fps) regulation zone by Bermad, but in this example an 8 inch valve is too large for the 200 gpm flow (velocity of flow in 8" valve at 200 gpm is less than 1.5 fps).

The selection of a 12 and 6 inch valves is considered as being better than having a 12 and 4 inch valve because the minimum flows through the 12 and 6 inch valves results in a velocity of flow exceeding 1.5 fps. The maximum flow for the smaller secondary valve (6 inch) becomes the approximate minimum flow for the larger main valve (12 inch) with the minimum flow velocities in each valve being well above 1.5 fps. If the 4 inch valve was used, the overlapping flow would be considerably less; 593 - 525 = 68 gpm.

b. Primary valve: Pressure settings are 140 psi upstream and 80 psi downstream.

c. Secondary valve: Pressure settings are 140 psi upstream and 87 psi downstream. (Outlet pressure of the secondary valve is 7 psi greater than the outlet pressure of the main valve.)

- Thrust Restraint Inside the Pressure Reducing Valve Vault

  a. Tie rod selection (Refer to Detail 2342-6)

     (1). Inlet and outlet pipe size to pressure reducing valve vault: 18 inches

     (2). Maximum operating pressure at site: 140 psi (Use 150 psi for this example or next greater operating pressure listed in Detail 2342-6.)

     (3). From the detail, select four tie rods, 1 1/8 inch size, to restrain the 18 inch inlet and outlet pipe at each end wall of the valve vault.

3.0 Air Valve Standards

3.1 Overview

The air valve standards presented herein are based the use of combination air valves which are designed to perform the functions of both an Air-Release and Air/Vacuum valve.

It is recommended that the new air valve standards be incorporated into the City's Design Standards and Policies Manual and that the City discontinue use of any existing air valve guidelines. In particular, all references to air release valves in section "E. FITTINGS" of the City's current design standards should be deleted and the information below should be added.

3.2 Air Valve Design Guidelines

Air in the water distribution system must be controlled to prevent problems such as air binding from occurring. Air valves can be used to assist in preventing such problems.

Air valves are not required on piping in distribution systems where hydrants and service connections provide sufficient means for venting trapped air. Where hydrants and service connections will not provide sufficient air venting, air valves are required to automatically release small pockets of air to the atmosphere while the pipeline is under pressure and to aid in filling and draining the pipeline.

These guidelines do not apply to special applications for air valves such as on pumps with suction lift where a hydraulic analysis is required.

3.2.1 Types of Air Valves

The following types of air valves are available:

- Air-Release valves are designed to automatically release small pockets of air while the system is under pressure.

- Air/Vacuum valves are designed to exhaust large quantities of air automatically during pipeline filling and to admit large quantities of air automatically during pipeline draining, pump failure, or pipeline break. Once the valve is closed it will not reopen to release air while the pipeline is operating under pressure.

- Combination air valves are designed to perform the functions of both an Air-Release and Air/Vacuum valves.

Where air valves are required, all valves shall be Combination Air Valves and shall comply with AWWA C512. Three-inch and smaller combination air valves shall be the single body type. Four-inch and larger combination air valves shall be single or dual body type.

3.2.2 Placement of Air Valves

Air valves shall be installed on all transmission mains eight inch and larger at the following locations:

1. High points exceeding one pipe diameter
2. On the drain side of mainline valves.
3. Abrupt changes in downslope.
4. Abrupt changes in upslope.
5. Long ascents, long descents, or horizontal runs which are over a 1/2 mile (2640 feet)
6. At vertical alignment changes in accordance with Detail 2370.

3.2.3 Air Valve Sizing

Combination air valves shall be sized for the following conditions:

1. Filling the pipeline. The inlet connection shall be a minimum of two inch size and shall have capacity for a filling rate equivalent to 2 fps at a differential pressure of 2 psi.
2. Releasing air under operating conditions. Size of the small orifice shall sufficient to release air equal to two percent of the pipe flow rate and at the operating pressure at the valve location.
3. Draining and pipeline break. The inlet vacuum capacity shall be sized for a minimum drain rate of 2 fps and a line break resulting in gravity flow and a

differential of 5 psi or less depending on the pipe material. The allowable collapsing pressure shall be based on a safety factor of 4.

For water main piping , where normal flow velocity is less than 5 fps, and differential pressure is 50 psi or greater, and the slope does not exceed 5 percent, a 150 psi rated single or dual body combination air valve with the following connection and orifice sizes shall be provided:

Water Main Size (inch)	Valve Size (inch)	Air/Vacum Large Orifice (inch)	Small Orifice (inch)
8, 10, 12	2	2	3/32 min.
14, 16	3	3	1/8 min.
18, 20	4	4	3/16 min.

For larger water main sizes or different flow, pressure, and slope parameters select the combination air valve for the design conditions from valve manufactures catalogs.

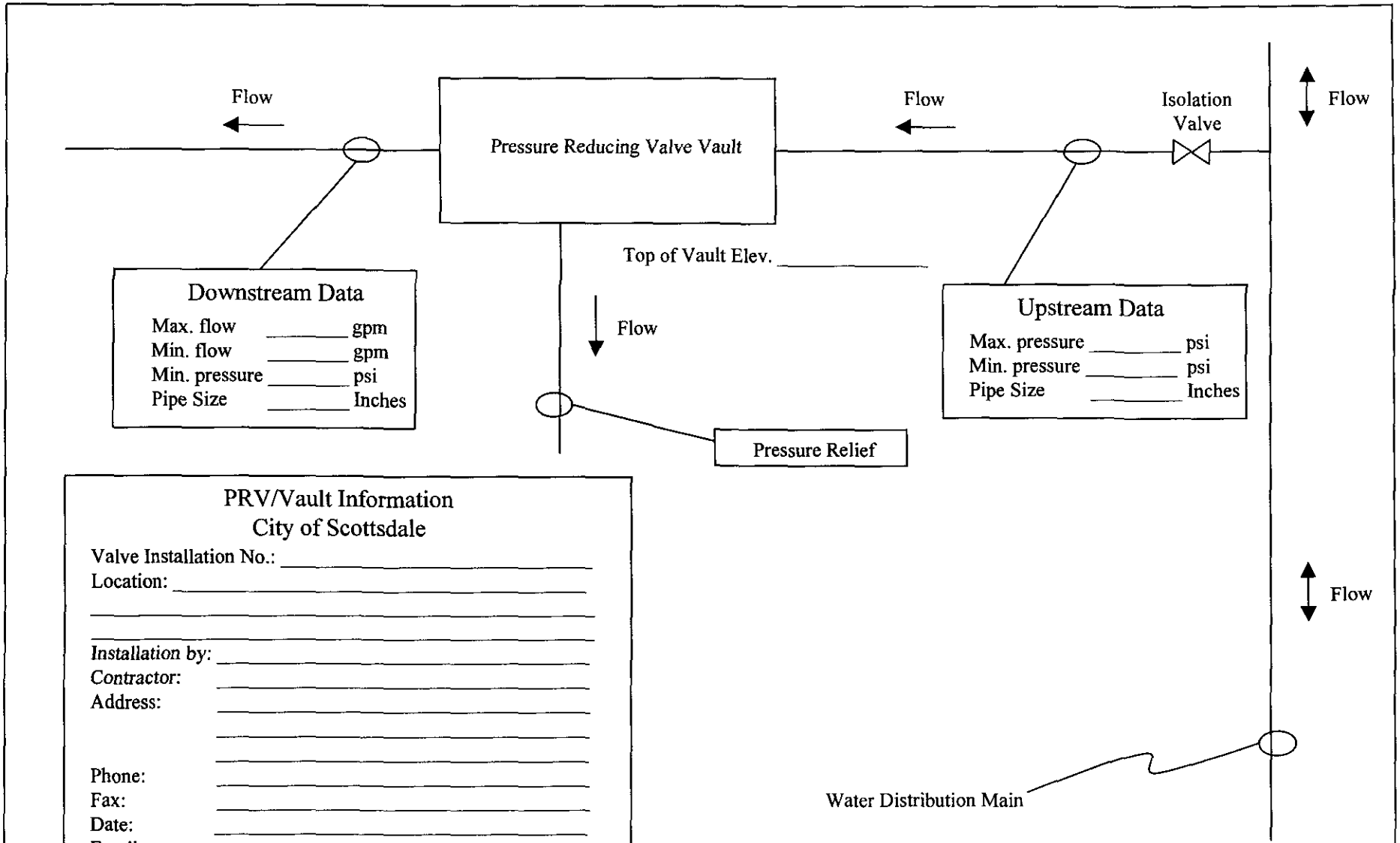
3.2.4 Air Valve Manufacturers

Select the appropriate combination air valve from Apco/Valve and Primer, GA. Industries, Multiplex, or Val-Matic catalog information.

3.2.5 Air Valve Installation

Air valves shall be installed in a manhole in accordance with Detail 2348.

Attachments



City of Scottsdale	Final Draft Design Standards Development	PRV Site and System Information Worksheet

PRV Differential Pressures Table
(for Pressures at Valve Connections)

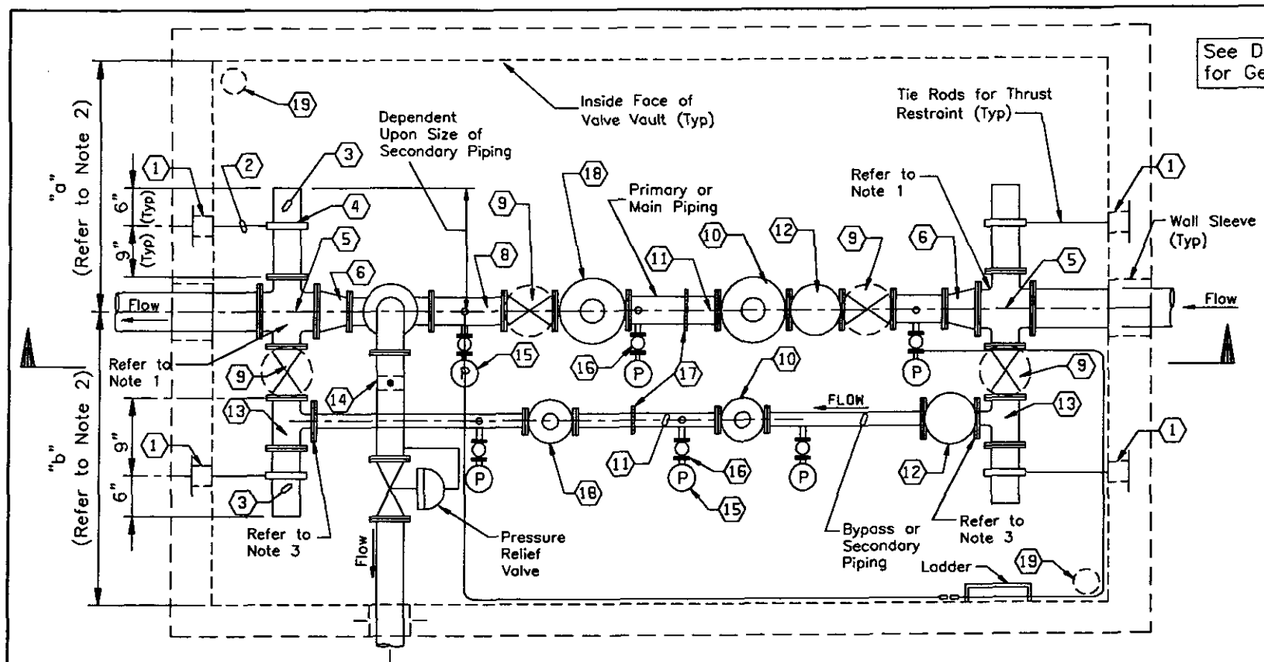
Upstream Pressure	60% Differential		55% Differential		50% Differential		40% Differential		30% Differential	
	Diff. Psi	Outlet Psi	Diff. Psi	Outlet Psi	Diff. Psi	Outlet Psi	Diff. Psi	Outlet Psi	Diff. Psi	Outlet Psi
340	204	136	187	153	170	170	136	204	102	238
330	198	132	182	148	165	165	132	198	99	231
320	192	128	176	144	160	160	128	192	96	224
310	186	124	171	139	155	155	124	186	93	217
300	180	120	165	135	150	150	120	180	90	210
290	174	116	160	130	145	145	116	174	87	203
280	168	112	154	126	140	140	112	168	84	196
270	162	108	149	121	135	135	108	162	81	189
260	156	104	143	117	130	130	104	156	78	182
250	150	100	138	112	125	125	100	150	75	175
240	144	96	132	108	120	120	96	144	72	168
230	138	92	127	103	115	115	92	138	69	161
220	132	88	121	99	110	110	88	132	66	154
210	126	84	116	94	105	105	84	126	63	147
200	120	80	110	90	100	100	80	120	60	140
190	114	76	105	85	95	95	76	114	57	133
180	108	72	99	81	90	90	72	108	54	126
170	102	68	94	76	85	85	68	102	51	119
160	96	64	88	72	80	80	64	96	48	112
150	90	60	82	68	75	75	60	90	45	105
140	84	56	77	63	70	70	56	84	42	98
130	78	52	72	58	65	65	52	78	39	91
120	72	48	66	54	60	60	48	72	36	84
110	66	44	61	49	55	55	44	66	33	77
100	60	40	55	45	50	50	40	60	30	70
90	54	36	50	40	45	45	36	54	27	63
80	48	32	44	36	40	40	32	48	24	56
70	42	28	39	31	35	35	28	42	21	49
60	36	24	33	27	30	30	24	36	18	42
50	30	20	28	22	25	25	20	30	15	35
40	24	16	22	18	20	20	16	24	12	28
30	18	12	17	13	15	15	12	18	9	21

PRV Flow Velocities Table

(For Bermad Series 700 Valve, Y-Pattern, V-Port Plug)

Valve Size (Nominal) Inches	Flow Area ft^2 *	Flow Volume											
		@ 1.5 fps		@ 3.0 fps		@ 6.0 fps		@ 9.0 fps		@ 12 fps		@ 15 fps	
		gpm	mgd	gpm	mgd	gpm	mgd	gpm	mgd	gpm	mgd	gpm	mgd
2	0.023	16	0.022	31	0.045	62	0.089	93	0.134	124	0.178	155	0.223
2 ½	0.033	22	0.032	44	0.064	89	0.128	133	0.192	178	0.256	222	0.32
3	0.051	34	0.049	69	0.099	137	0.198	206	0.297	275	0.396	344	0.495
4	0.088	59	0.085	118	0.171	237	0.341	356	0.512	474	0.683	593	0.853
6	0.201	136	0.195	271	0.39	542	0.78	813	1.17	1,084	1.56	1,355	1.95
8	0.347	234	0.336	468	0.673	935	1.35	1,405	2.02	1,870	2.69	2,338	3.36
10	0.548	369	0.531	739	1.06	1,480	2.13	2,215	3.19	2,955	4.25	3,693	5.31
12	0.777	525	0.753	1,047	1.51	2,095	3.01	3,140	4.52	4,190	6.03	5,236	7.53
14	0.939	633	0.91	1,266	1.82	2,530	3.64	3,795	5.46	5,060	7.28	6,330	9.1
16	1.227	827	1.19	1,654	2.38	3,310	4.76	4,960	7.14	6,615	9.52	8,270	11.9
18	1.553	1,046	1.51	2,093	3.01	4,185	6.02	6,280	9.03	8,370	12.05	10,465	15.06

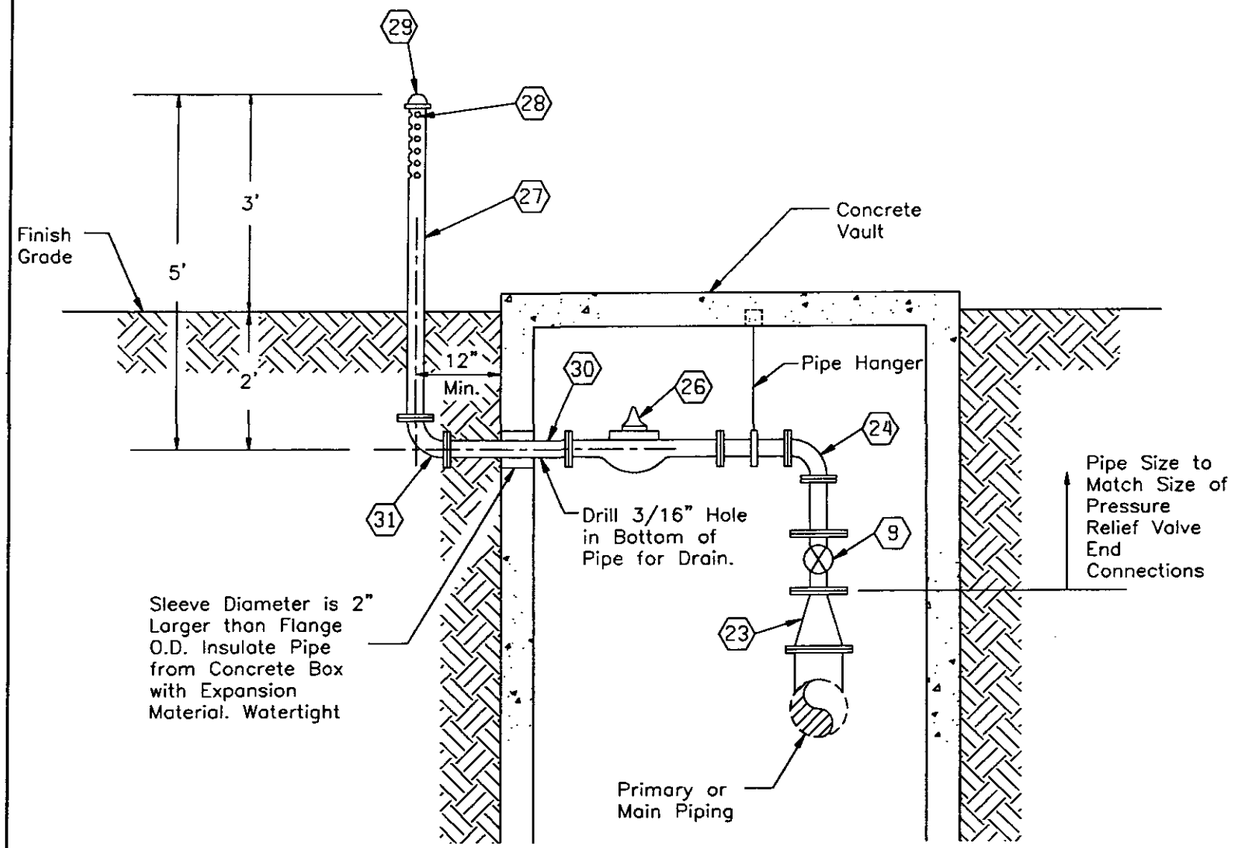
* Flow area is based upon schedule 40 steel pipe



LIST OF MATERIALS

1. Wall Insert for Tie Rods; Eight Required for Pipes 4" and Larger Entering and Exiting the Valve Vault
2. Tie Rod; Eight Required for Pipes 4" and Larger Entering and Exiting the Valve Vault
3. Blind Flange by Plain End Ductile Iron Pipe; Four Required
4. Tie Rod Pipe Anchor Assembly; Four Required. See Drawing 2342-5
5. D.I.P. Cross; Minimum Outlet Size is Four Inches; Two Required
6. D.I.P. Eccentric Reducer, Flat on Top; Two Required
7. D.I.P. Tee, Run and Outlet Sizes Match Primary or Main Piping Size, Resilent Seated Gate Valve in Riser
8. Centerline of Primary or Main Piping in Valve Vault
9. Resilent Seated Gate Valve, OSY; Five Required
10. Pressure Reducing Valve, Bermad Model 724, or Approved Equal, When Flow Through Primary and Secondary Pipes Require Two Pressure Reducing Valves in Series. Bermad Model 723-20-VIT, or Approved Equal when Primary and Secondary Pipes Require Single Pressure Reducing Valve Only
11. Flange by Grooved End DIP, Minimum Thickness Class 53; Two Required for Each Primary and Secondary Pipe
12. Double Basket Strainer, One Required for Each Primary and Secondary Pipe
13. Tee; 4"x4"x4" Minimum Size; Run and Branch Sizes to Match Size of Secondary Piping Greater than 4" Size; Two Required
14. Pipe Hanger
15. Pressure Gauge with Snubber, Typical
16. Ball Valve, Typical
17. Victaulic Coupling, One Required for Each Primary and Secondary Pipe
18. Pressure Reducing Valve, Bermad Model 724, or Approved Equal, when Flow Through Primary and Secondary Pipe Requires Two Pressure Reducing Valves in Series
19. 4" Galv. Steel Vent Pipe with Cap. Drill 1/4" Holes 1" O.C. in Top 12" of Pipe. Strap Pipe to Wall. Install Vents in Unpaved Areas Only
20. 3'x3' Utility Vault Galv. Steel Access Door, Model 3636 or Approved Equal. Center Over Main Valves for Removal. For Piping 14" and Larger, Install 4'x4' Double Leaf Access Hatch, Model 4848 or Approved Equal.
21. 3'x3' Utility Vault Galv. Steel Access Door, Model 3636 or Approved Equal. Place in Corner with Ladder for Inspection
22. Galv. Access Ladder Bolted to Wall, 6" Stand Off
23. Saddle w/ 1" Corp., 3/8" Brass Reducer, 3/8" Brass Tee w/ Oil Filled 0-200 Pressure Gauge. Install 3/8" Stainless Tubing Strapped to Wall as Shown w/ Oil Filled Gauges Mounted at Access Door. Gauges to be Readable from Outside Vault.

DETAIL NO. 2342-1	City of Scottsdale Standard Details	APPROVED BY: Scottsdale Standards & Specifications Committee	PRESSURE REDUCING VALVE VAULT DETAILS	DETAIL NO. 2342-1



PRESSURE RELIEF OUTLET ASSEMBLY DETAIL

NOT TO SCALE

LIST OF MATERIALS

- (9) Flg NRS Resilient Wedge Gate Valve, Inside Epoxy Coated, Low Zinc Stem w/ Handwheel, Size to Match Size of Pressure Relief Valve Quantity Included on Detail 2342-1.
- (23) Flg Connecting Piece or Concentric Reducer as Required
- (24) DIP Flg x Flg 90° Elbow
- (26) Flg Pressure Relief Valve Bermad Model 730-I-U or Approved Equal, Epoxy Coated w/ Valve Position Indicator
- (27) SCH 40 Steel Pipe (Painted Desert Beige)
- (28) 6 Rows 2" O.C. of 3-1" ø Holes, 180° Spray Pattern
- (29) SCH 40 Steel Cap (Threaded)
- (30) SCH 80 Steel Pipe
- (31) SCH 80 Steel Elbow

GENERAL NOTES

1. For 4" and Smaller Primary and Secondary Pipe Sizes, the Outlet Size for Pipe Cross Fittings Shall be 4" Minimum. For Secondary Piping Greater than 4", the Outlet Size for Pipe Cross Fittings Shall Match the Size of Secondary Piping.
2. For Dimensions "a" and "b" for Different Valve Vault Sizes Refer to PRV Vault Dimensions; Detail 2342-4.
3. Provide Eccentric Reducers, Flat on Top, Two Locations when Bypass or Secondary Piping is Smaller than 4".
4. Minimum Pipe Bury Depth for Mains 12" and Smaller is 36"; for Mains 14" and Larger the Minimum Bury Depth is 48".
5. All Piping Entering and all Interior Piping Inside the Valve Vault, Except where Victaulic Couplings are Required, shall be Flanged, Ductile Iron Pipe. Flanges shall be in Compliance with ANSI/AWWA C115/A21.15, Flat Faced.
6. All Pipe and Valves shall be Rated per System Working Pressure.
7. Pilot Lines for all Controls will be Stainless Steel Tubing.
8. Stainless Tubing Bends shall be Uniform and Made with a Tubing Bender.
9. Bypass Line (Small PRV) Shall be 4" Min. D.I.P.
10. Air Vents and Pressure Relief Valve Outlet Riser Pipe Shall not be Located within 12 feet of an Existing Edge of Pavement or within 2 Feet of a Barrier Type Curb or 2' Back of Sidewalk.
11. Pressure Relief Valve for Pressure Reducing Valves shall be Sized to Carry the Maximum Flow Downstream of the Pressure Reducing Valve Vaults with a Maximum Flow Velocity of 35 fps.
12. Wall Inserts and Tie Rods shall be Selected for the Maximum Test Pressure or the Maximum Working Pressure (whichever is Greater) in Pipe Upstream to the Valve Vault. Refer to PRV Site and System Information Worksheet.
13. When System Working Pressure Upstream to the Valve Vault Exceeds 175 psi, Extra Precautions shall be Exercised in Coordinating the Pressure Ratings of all Piping, Valves, Strainers, and their End Connections.
14. Design Guidelines in Details 2342-1 through 2342-8 Apply for System Working Pressure up to 200 psi. For System Working Pressure Exceeding 200 psi, Consult Design Engineer.
15. All Concrete Structures Used in the Construction of the Valve Vaults Shall be Designed by a Structural Engineer Licensed in the State of Arizona.

DETAIL NO. 2342-2	City of Scottsdale Standard Details	APPROVED BY: Scottsdale Standards & Specifications Committee	PRV VAULT DETAILS	DETAIL NO. 2342-2

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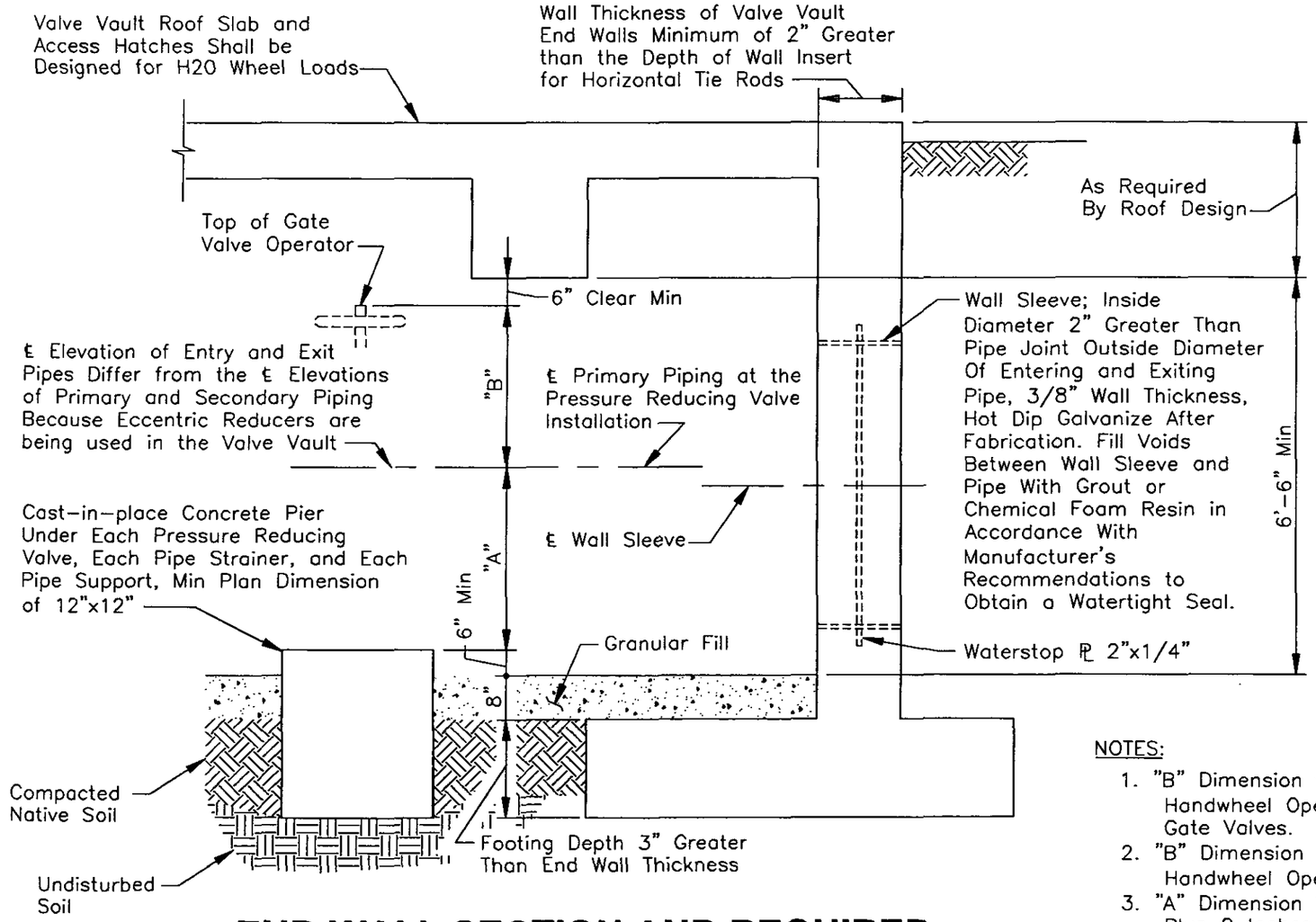
Estimated Pipe Size Entering and Exiting Valve Vault (inches)	Estimated Main or Primary Pipe Size (inches)	Interior Valve Vault Plan Dimensions (feet)	Minimum Dimensions[1, 2]	
			"a" (inches)	"b"[3] (inches)
12	4	20x8	36	60
12	6	24x8	36	60
12 to 16	8	24x9	42	66
16 to 20	10	26x9	42	66
18 to 24	12	30x9.5	42	72
18 to 24	14	32x9.5	42	72
24 or 30	16	36x10	45	75

1. Refer to primary and secondary piping plans in valve vaults for dimensions "a" and "b" on Detail 2342-1.
2. Final vault dimensions should provide a minimum clearance of 24" between the concrete wall and any exterior portion of piping or valves installed in the direction parallel to the primary piping.
3. When main and bypass PRVs are the same size, dimension "b" may need to be increased to provide the required clearance.

DETAIL NO. 2342-3	City of Scottsdale Standard Details	APPROVED BY: Scottsdale Standards & Specifications Committee	PRV VAULT DIMENSIONS	DETAIL NO. 2342-3



END WALL SECTION AND REQUIRED VERTICAL CLEARANCES

NOT TO SCALE

TABLE OF VERTICAL DIMENSIONS

Pressure Reducing Valve Size in Primary Piping Inches	Dimension "A" Inches	Dimension "B" Inches
3	11	23
4	12	24
6	17	30
8	23	38
10	24	48
12	28	54
14	29	34
16	29	37

NOTES:

1. "B" Dimension for Primary Piping Size 12" and Smaller is Based Upon Handwheel Operated, Outside Screw and Yoke (OS&Y) Resilent Seated Gate Valves.
2. "B" Dimension for Primary Piping Sizes 14" and Greater is Based Upon Handwheel Operated, Non-rising Stem (NRS) Resilent Seated Gate Valves.
3. "A" Dimension is Based on Depth of Double Basket Screen by S.P. Kinney Plus 2 Inches Grout Installed in the Primary Piping. Double Basket Screens in the Secondary Piping may Require Higher Concrete Supports.
4. "A" and "B" Dimensions are Measured at the Centerline of Primary Piping.
5. Refer to Detail 2342-2 for Minimum Bury Depth of Water Mains Exterior to the Valve Vault.

DETAIL NO. 2342-4	City of Scottsdale Standard Details	APPROVED BY: Scottsdale Standards & Specifications Committee	PRV VAULT END WALL SECTION	DETAIL NO. 2342-4

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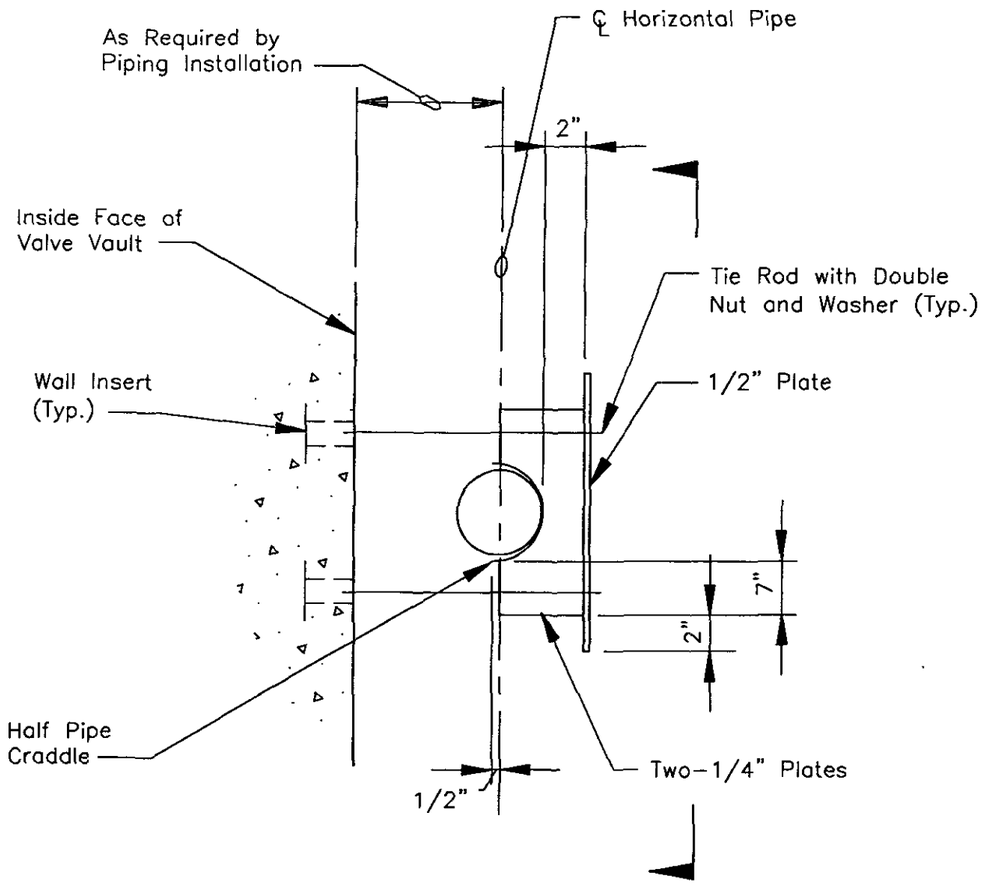
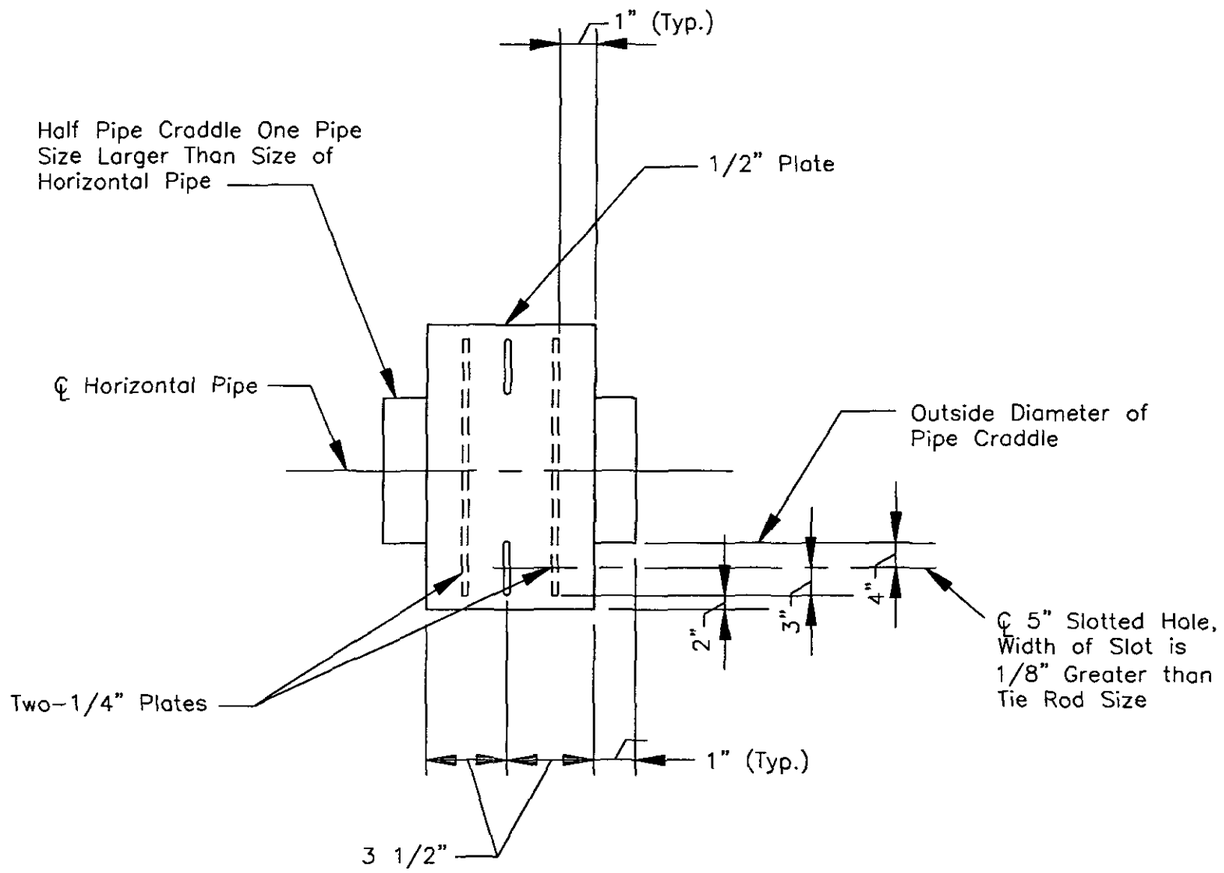


ELEVATION

NOT TO SCALE



SECTION

NOT TO SCALE

NOTES:

1. Assemble with 1/4" Continuous Fillet Welds.
2. Hot–Dip Galvanize After Completing Fabrication.
3. Shapes, Plates, and Bars shall be ASTM A36.
4. Steel Pipe shall be ASTM A53.
5. Refer to Detail 2342–1 for Use and Location of Anchor Assembly.

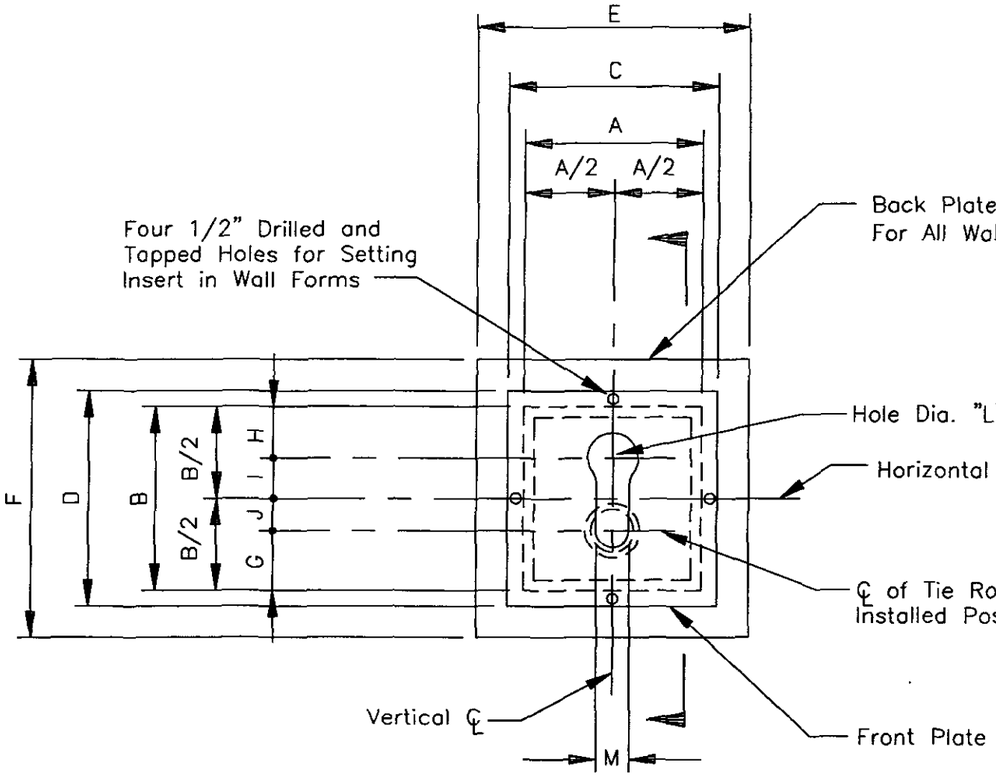
DETAIL NO. 2342-5	City of Scottsdale Standard Details	APPROVED BY: Scottsdale Standards & Specifications Committee	PRV VAULT TIE ROD PIPE ANCHOR ASSEMBLY	DETAIL NO. 2342-5

Nominal Pipe Size Entering and Exiting Valve Vault (inches)	100 psi		125 psi		150 psi		175 psi	
	Force Across Pipe Joint (lbs.)	Size & # of Tie Rods Req'd Each End Wall of Valve Vault	Force Across Pipe Joint (lbs.)	Size & # of Tie Rods Req'd Each End Wall of Valve Vault	Force Across Pipe Joint (lbs.)	Size & # of Tie Rods Req'd Each End Wall of Valve Vault	Force Across Pipe Joint (lbs.)	Size & # of Tie Rods Req'd Each End Wall of Valve Vault
2, 3	Use two 5/8" tie rods with double bolt pipe clamp, Grinnell figure 295 & weldless eye nut, Grinnell figure 290, each valve vault end wall							
4, 6	Use minimum of four 5/8" tie rods for restraint at each valve vault end wall for pressure 275 psi and lower							
8	6,575	5/8" (4)	8,220	5/8" (4)	9,865	5/8" (4)	11,510	5/8" (4)
10	9,850	5/8" (4)	12,315	5/8" (4)	14,780	5/8" (4)	17,240	3/4" (4)
12	13,900	5/8" (4)	17,365	3/4" (4)	20,840	3/4" (4)	24,310	7/8" (4)
14	18,720	3/4" (4)	23,405	3/4" (4)	28,085	7/8" (4)	32,765	7/8" (4)
16	24,160	7/8" (4)	30,205	7/8" (4)	36,245	1" (4)	42,285	1" (4)
18	30,300	7/8" (4)	37,870	1" (4)	45,440	1 1/8" (4)	53,020	1 1/8" (4)
20	37,120	1" (4)	46,400	1 1/8" (4)	55,680	1 1/4" (4)	64,960	1 1/4" (4)
24	52,850	1 1/8" (4)	66,060	1 1/4" (4)	79,270	1 3/8" (4)	92,480	1 1/2" (4)
30	81,280	1 3/8" (4)	101,600	1 1/2" (4)	121,920	1 5/8" (4)	142,240	1 7/8" (4)

Nominal Pipe Size Entering and Exiting Valve Vault (inches)	200 psi		225 psi		250 psi		275 psi	
	Force Across Pipe Joint (lbs.)	Size & # of Tie Rods Req'd Each End Wall of Valve Vault	Force Across Pipe Joint (lbs.)	Size & # of Tie Rods Req'd Each End Wall of Valve Vault	Force Across Pipe Joint (lbs.)	Size & # of Tie Rods Req'd Each End Wall of Valve Vault	Force Across Pipe Joint (lbs.)	Size & # of Tie Rods Req'd Each End Wall of Valve Vault
2, 3	Use two 5/8" tie rods with double bolt pipe clamp, Grinnell figure 295 & weldless eye nut, Grinnell figure 290, each valve vault end wall							
4, 6	Use minimum of four 5/8" tie rods for restraint at each valve vault end wall for pressure 275 psi and lower							
8	13,150	5/8" (4)	14,800	5/8" (4)	16,440	3/4" (4)	18,085	3/4" (4)
10	19,700	3/4" (4)	22,170	3/4" (4)	24,630	7/8" (4)	27,095	7/8" (4)
12	27,790	7/8" (4)	31,260	7/8" (4)	37,730	1" (4)	38,210	1" (4)
14	37,445	1" (4)	42,130	1" (4)	46,810	1 1/8" (4)	51,490	1 1/8" (4)
16	48,325	1 1/8" (4)	54,370	1 1/8" (4)	60,410	1 1/4" (4)	66,450	1 1/4" (4)
18	60,590	1 1/4" (4)	68,160	1 1/4" (4)	75,740	1 3/8" (4)	83,310	1 3/8" (4)
20	74,240	1 3/8" (4)	83,520	1 1/2" (4)	92,800	1 1/2" (4)	102,080	1 1/2" (4)
24	105,700	1 5/8" (4)	118,910	1 5/8" (4)	132,120	1 3/4" (4)	145,330	1 7/8" (4)
30	162,560	1 7/8" (4)	182,880	2" (4)	203,200	2 1/4" (4)	223,530	2 1/4" (4)

Refer to PRV Site and System Information Worksheet for Pipe Size Entering Pressure Reducing Valve Vault and Detail 2342-2, General Notes, for Selecting Required Tie Rod Sizes.

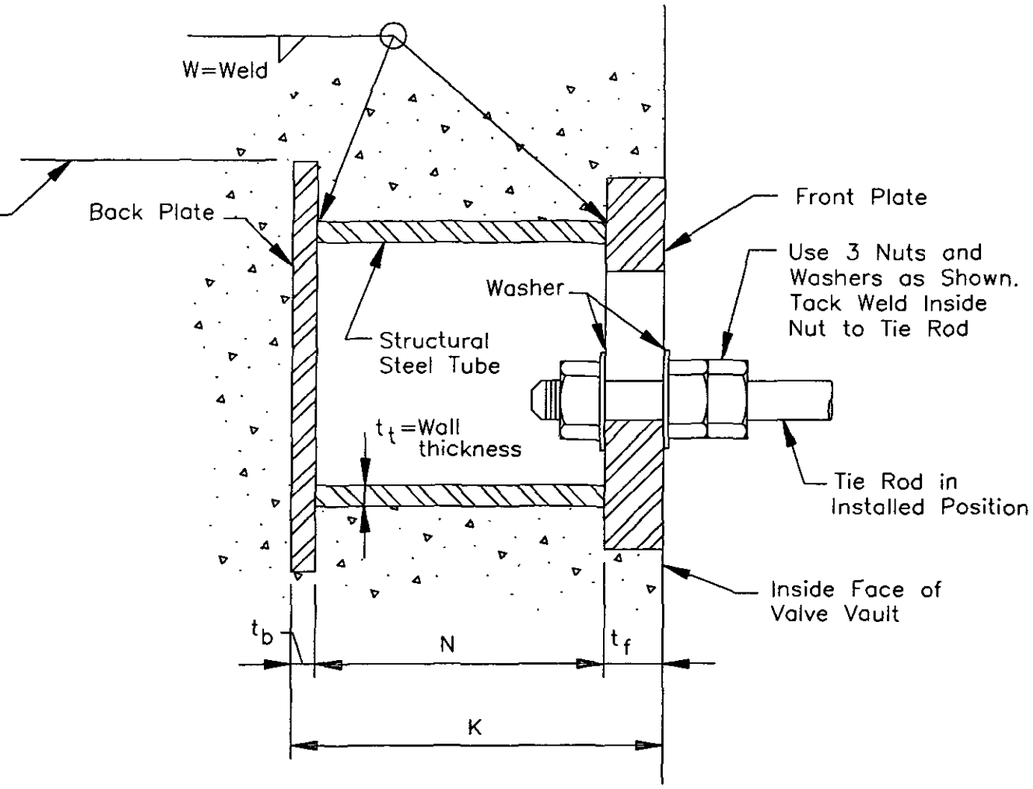
DETAIL NO. 2342-6	City of Scottsdale Standard Details	APPROVED BY: Scottsdale Standards & Specifications Committee	PRV VAULT RESTRAINT FORCES	DETAIL NO. 2342-6



ELEVATION *

NOT TO SCALE

* Looking at Face of Concrete Wall.



SECTIONAL ELEVATION FABRICATED WALL INSERT

NOT TO SCALE

NOTES:
1. Hot-Dip Galvanize After Fabrication.
2. Shapes, Plates, and Bars shall be ASTM A36.
3. Square and Rectangular Structural Tubing shall be ASTM A500, Grade B or C.
4. Tie Rods shall be in Compliance with ASTM A307.
5. For Dimensions of Fabricated Wall Inserts, Refer to Detail 2342-7.

DETAIL NO. 2342-7	City of Scottsdale Standard Details	APPROVED BY: Scottsdale Standards & Specifications Committee	PRV VAULT FABRICATED WALL INSERT DETAILS	DETAIL NO. 2342-7

Tie Rod Size (inches)	Maximum Load (lbs. per rod)	Dimensions (inches)									
		A	B	C	D	E	F	G	H	I	J
5/8	4040	4	6	6	8	6	8	1 7/8	1 7/8	1 1/8	1 1/8
3/4	6040	4	6	6	8	6 1/2	8 1/2	1 7/8	1 7/8	1 1/8	1 1/8
7/8	8380	4	6	6	8	7 1/2	9 1/2	1 7/8	1 7/8	1 1/8	1 1/8
1	11,040	4	6	6	8	7 1/2	9 1/2	1 7/8	1 7/8	1 1/8	1 1/8
1 1/8	13,860	5	7	7	9	8 1/2	10 1/2	2	2	1 1/2	1 1/2
1 1/4	17,780	6	8	8	10	10	12	2 1/2	2 1/2	1 1/2	1 1/2
1 3/8	21,060	6	8	8	10	10 1/2	12 1/2	2 1/2	2 1/2	1 1/2	1 1/2
1 1/2	25,860	6	8	8	10	11 1/2	13 1/2	2 1/2	2 1/2	1 1/2	1 1/2
1 5/8	31,140	6	8	8	10	12	14	2 5/8	2 5/8	1 3/8	1 3/8
1 3/4	34,880	6	10	8	12	12	16	2 7/8	2 7/8	2 1/8	2 1/8
1 7/8	43,300	6	10	8	12	13 1/2	17 1/2	3 1/8	3 1/8	1 7/8	1 7/8
2	45,840	6	10	8	12	13 1/2	17 1/2	3 1/8	3 1/8	1 7/8	1 7/8
2 1/4	60,420	8	12	10	14	16 1/2	20 1/2	3 1/2	3 1/2	2 1/2	2 1/2

Tie Rod Size (inches)	Maximum Load (lbs. per rod)	Dimensions (inches)				Weld Size (inches)	Washer Size (inches)	Structural Steel Tube Size (inches)	Dimensions (inches)		
		K	L	M	N	W			t(t)	t(f)	t(b)
5/8	4040	5	1 7/16	3/4	3 1/2	1/4	1 5/16	6x4	1/4	1	1/2
3/4	6040	6	1 19/32	7/8	4 1/8	1/4	1 15/32	6x4	1/4	1 1/4	5/8
7/8	8380	7	1 7/8	1	4 7/8	1/4	1 3/4	6x4	1/4	1 3/8	3/4
1	11,040	8 1/2	2 1/8	1 1/8	6 1/4	1/4	2	6x4	1/4	1 1/2	3/4
1 1/8	13,860	9 1/2	2 3/8	1 1/4	7	1/4	2 1/4	7x5	1/4	1 3/4	3/4
1 1/4	17,780	11	2 5/8	1 3/8	8 1/8	3/8	2 1/2	8x6	3/8	2	7/8
1 3/8	21,060	12	2 7/8	1 1/2	8 3/4	3/8	2 3/4	8x6	3/8	2 1/4	1
1 1/2	25,860	13 1/2	3 1/8	1 5/8	10	3/8	3	8x6	3/8	2 3/8	1 1/8
1 5/8	31,140	15	3 1/4	1 3/4	11 1/4	3/8	3 1/8	8x6	3/8	2 1/2	1 1/4
1 3/4	34,880	15 1/2	3 1/2	1 7/8	11 11/16	5/8	3 3/8	10x6	5/8	2 9/16	1 1/4
1 7/8	43,300	17 1/2	3 5/8	2	13 1/4	5/8	3 1/2	10x6	5/8	2 3/4	1 1/2
2	45,840	18	3 7/8	2 1/8	13 5/8	5/8	3 3/4	10x6	5/8	2 7/8	1 1/2
2 1/4	60,420	20 1/2	4 1/8	2 3/8	15 1/4	*	4	12x8	5/8	3 1/2	1 3/4

Refer to Detail 2342-2, General Notes, for Selecting Required Tie Rod Sizes. Refer to Detail 2342-4 for Details of Wall Inserts.

* Full penetration weld required

DETAIL NO. 2342-8	City of Scottsdale Standard Details	APPROVED BY: Scottsdale Standards & Specifications Committee	PRV VAULT CONCRETE WALL INSERTS FOR HORIZONTAL TIE RODS	DETAIL NO. 2342-8

REVISED 5/22/94

NOTE: IF STAND PIPE IS WITHIN 8 FEET OF THE EDGE OF PAVEMENT ON STREETS NOT HAVING VERTICAL CURB, INSTALL A VERTICAL OBJECT MARKER PER COS DETAIL 2133, TYPE "C" ON APPROACH SIDE OF THE STAND PIPE.

1/8" MESH SCREEN WITH STAINLESS STEEL CLAMP

2" GALVANIZED 90° ELBOW

COVER PER M.A.G. STD. DETAIL 313

BACK OF CURB OR SIDEWALK

8"

6"

2" SCH 80 GALVANIZED PIPE

2' MIN.

2" SCH 80 PVC 90° ELBOW

8"

2" GALVANIZED 90° ELBOW

2" COMBINATION AIR/ VACUUM RELEASE VALVE

CONCRETE THRUST BLOCK PER MAG STD. DET. 380

2" BRASS NIPPLE

CONCRETE BOX PER MAG STD. DETAIL 320-4. EXTENSION SECTIONS AS NECESSARY.

2" BRASS 90° ELBOW

2" SOFT TYPE "K" COPPER PIPE. EXTEND LINE BEYOND PAVEMENT WHEN MAIN LINE IS IN STREET.

12" ABC BASE

2" CORP STOP IPT X PAC-JOINT, COS SPEC.

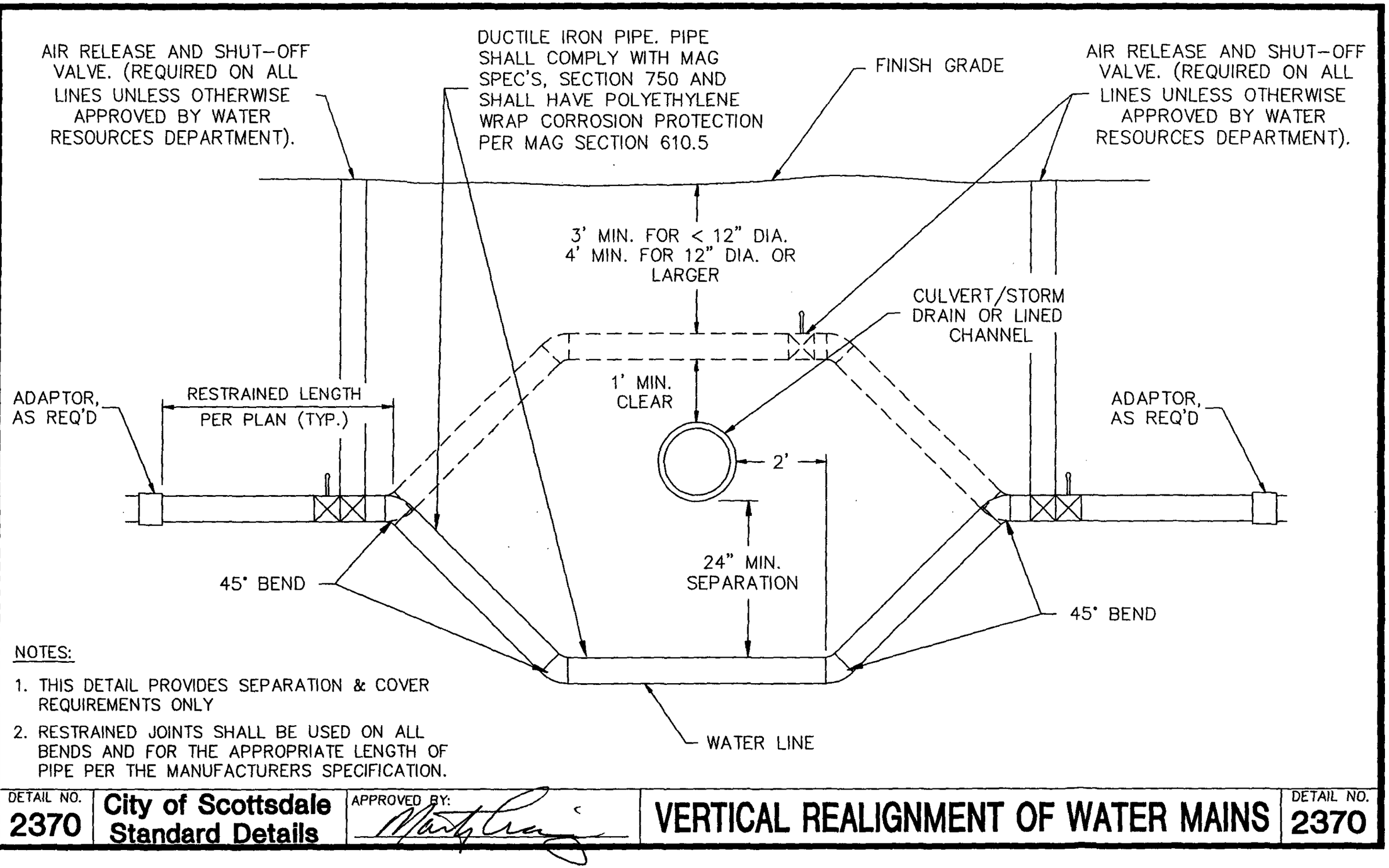
CONCRETE SUPPORT

DOUBLE STRAP BRASS SADDLE PER COS SPEC. WELD-O-LET FOR CEMENT LINED STEEL CYLINDER PIPE.

2" CURB STOP, PACK JOINT X IPT

DETAIL NO. 2348	City of Scottsdale Standard Details	APPROVED BY: Marty Craig	2" AIR/VACUUM RELEASE VALVE	DETAIL NO. 2348

REVISED 6/27/95



NOTES:

1. THIS DETAIL PROVIDES SEPARATION & COVER REQUIREMENTS ONLY
2. RESTRAINED JOINTS SHALL BE USED ON ALL BENDS AND FOR THE APPROPRIATE LENGTH OF PIPE PER THE MANUFACTURERS SPECIFICATION.

DETAIL NO. 2370	City of Scottsdale Standard Details	APPROVED BY:	VERTICAL REALIGNMENT OF WATER MAINS	DETAIL NO. 2370