



Roseville Fire Department

Fire & Life Safety Division

316 Vernon Street Suite 480 · Roseville, CA 95678 · (916) 774-5800 · FLSDivision@roseville.ca.us

Fire & Life Safety Standard

Title: Fire Service Underground - Installation and Inspection

Note: This standard is a summary of Roseville Fire Department clarifications of City and State Codes. Information contained herein applies to typical circumstances and may not address all situations.

PURPOSE

This standard was developed with safety as the principal objective, pursuant to the California Fire Code (CFC) Section: 104.1 General Authority and Responsibilities. The fire code official is authorized to render interpretations of the CFC, and to adopt policies, procedures, rules and regulations in order to clarify the application of its provisions. Such interpretations, policies, procedures, rules and regulations shall be in compliance with the intent and purpose of the CFC and shall not have the effect of waiving requirements specifically provided for in the CFC.

SCOPE

This standard applies to the installation of new and existing fire service underground. These systems shall be designed and installed in accordance with the CFC, applicable National Fire Protection Association (NFPA) standards and the City of Roseville Design and Construction standards (COR Standard).

PIPE INSTALLATION OVERVIEW

PVC C-900	Ductile Iron Pipe (DIP)
Pipe Bedding – Class I or Class II (Additional Info pg.11)	Pipe Bedding - 3/8 inch Pea Gravel
- DR 18, Class 150 or greater, shall be used where the water pressure does not exceed 150 psi. - DR 14, Class 200, shall be used where the water pressure exceeds 150 psi. - FDC line from the FDC to the check valve at the service main and from the FDC to the building riser.	DIP shall be installed in accordance with the standards for "Installation of Ductile Iron Water Mains and Their Appurtenances" (ANSI/AWWA C-600), the manufacturer's recommendations, as well as the COR Standard.
Pipe shall have been manufactured within the 18 months prior to installation. (COR Standard)	All underground metal (ductile iron, valves, fittings, copper, brass, etc.) shall be wrapped in 8 mil minimum thickness polyethylene encasement with ends taped off with vinyl pipe wrap tape. (COR Standard)
Pipe and gaskets shall be kept clean and protected against sunlight and heat damage.	Flanged and mechanical joint fitting bolt threads and nuts shall be coated with an approved bituminous material. (COR Standard)
Minimum length of pipe for installation shall be 5 feet. (COR Standard)	Minimum length of pipe for installation shall be 2 feet. (COR Standard)
Pipe showing signs of physical damage or excessive ultraviolet exposure will be rejected and shall be immediately removed from the job site. (COR Standard)	DIP and fittings shall be in conformance with AWWA C110/A21.10, AWWA C153/A21.53 (NFPA 13)
Pipe shall be installed with the manufacturing label showing on the top. (COR Standard)	Intentionally Left Blank
The reference mark or stab line on the spigot end must be flush with the bell end and visible for inspection. (COR Standard)	Intentionally Left Blank
The beveled end of the pipe shall be cut off before placement into a mechanical joint. (COR Standard)	Intentionally Left Blank
Backfill shall be well tamped in layers or puddle under and around pipes to prevent settlement or lateral movement. Backfill shall consist of clean fill sand or pea gravel to a minimum 6" below and to a minimum of 12" above the pipe and shall contain no ashes, cinders, refuse, organic matter or other corrosive materials. Other backfill materials and methods are permitted where designed by a registered professional engineer and approved by the enforcing agency. (NFPA 24, CFC Amendment)	



Roseville Fire Department

Fire & Life Safety Division

316 Vernon Street Suite 480 · Roseville, CA 95678 · (916) 774-5800 · FLSDivision@roseville.ca.us

GENERAL

1. Installation work shall be done by fully experienced and responsible contractors. Contractors shall be appropriately licensed in the State of California to install private fire service mains and their appurtenances.
2. Installation or modification of private fire service mains shall not begin until plans are approved and appropriate permits secured from the authority having jurisdiction.
3. Roseville Fire Department jurisdiction starts at the downstream side of the last valve on the double detector check assembly. Verify design and installation requirements for the portion of the system preceding this point with the Development Services Engineering Division.

PLAN SUBMITTAL

1. Plans for all private underground piping for private hydrants and/or sprinkler supply line(s) shall be submitted to the City of Roseville for review and approval prior to installation. Submittals and revisions must be submitted in a digital format.
2. Water flow test results from within the last 6 months shall be provided.
3. Plans shall be legible and scaled to nationally recognized standards.
4. Provide a master sheet showing only the fire-related underground work, with the entire underground fire water/protection plan presented on a single sheet. This master sheet shall be provided in addition to any necessary more detailed match-line sheets used to show individual areas and connections.
5. Information on the Fire Underground Title Page shall include the following:
 - a) Applicable codes and standards used for the system design (e.g., CFC, CBC, NFPA, etc.).
 - b) Project location, including the full legal address of the facility, and building number(s) if applicable.
 - c) Contractor's name, telephone number, address, and California State Contractor's license number and classification. If the piping plan is designed by a P.E., the plan shall contain the name, license number, and classification of the installing contractor, along with the P.E. wet stamp.
 - d) Information on remaining fire underground plans shall include the following:
 - I. Location of public mains and all public hydrants within 300 feet of the site.
 - II. Location and type of all valves and connections. Specify type for each post indicator valve (PIV), key gate valve, system control valve, double detector check (DDC) assembly, outside screw and yoke (OS&Y), Fire Department Connection (FDC), etc.
 - III. Pipe size, class, and type.
 - IV. Applicable installation details embedded on plans.
 - V. Location/configuration, LR(ft.) of all restraints.
 - VI. Bollard location and detail as applicable.
 - VII. Detail of the in-building riser turn and embedment material.
 - VIII. Type of fittings/joints, methods of connection and rod size.
 - IX. Only fire department water supply pipe and appurtenances shall be depicted on plans.

PIPING

1. **Piping.** All piping used in private fire service mains shall be rated for the maximum system working pressure to which the piping is exposed to but shall not be rated at less than 150 psi. (NFPA 24)
2. **Piping.** Private fire service mains installed under driveways or roadways shall be buried at a minimum depth of 36 inches. (NFPA 24)
3. **Piping.** Private fire service mains supplying fire protection systems within the building shall be permitted to extend horizontally no more than 10 feet cumulatively, as measured from the outside of the building, under the building to the riser location. (NFPA 24)
4. **Piping.** Piping shall be installed a minimum of 12 inches below the bottom of building foundations or footings. (NFPA 24)
5. **Piping.** Pipe joints shall not be located under foundation footings. The pipe under the building or building foundation shall not contain mechanical joints. (NFPA 24, CFC Amendment)
6. **Restraint.** Private fire service mains shall be restrained against movement at changes in direction. (NFPA 24)
7. **Restraint.** Piping shall be mechanically restrained to the length specified in the approved plans, using materials specified. (COR Standard)
8. **Protection of Piping.** Aboveground private fire service mains shall be protected with bollards or other means as approved by the AHJ when subject to mechanical damage. (NFPA 24)



Roseville Fire Department

Fire & Life Safety Division

316 Vernon Street Suite 480 · Roseville, CA 95678 · (916) 774-5800 · FLSDivision@roseville.ca.us

9. **Corrosion.** All bolted joint accessories shall be cleaned and thoroughly coated with asphalt or other corrosion-retarding material after installation. (NFPA 24)
10. **Installation.** When work is stopped, the open ends of piping, valves, hydrants, and fittings shall be plugged or covered to prevent foreign materials from entering. (NFPA 24)
11. **Installation.** Buried nuts and bolts shall be coated with a bituminous material. This includes exposed bolts found on a manufactured appurtenance (i.e., valve bonnets, etc.) "T" bolt heads do not require coating. (COR Standard)
12. **Installation.** Water pipe marking tape shall be placed in all trenches 12-24 inches below finished grade. (COR Standard)
13. **Installation.** A continuous number 12 insulated tracing wire shall be attached to fire service lines and appurtenances. It shall be attached to the top of the pipe with 10 mil vinyl tape every 5 feet. (COR Standard)

APPURTENANCES

1. **Installation.** All valves, fittings, DIP, copper and underground brass shall be wrapped and sealed in an 8 mil minimum thickness clear polyethylene encasement. Use 10 mil pipe wrap tape to secure and seal to the polyethylene encasement. (COR Standard)
2. **Installation.** Buried nuts and bolts shall be coated with a bituminous material. This includes exposed bolts found on a manufactured appurtenance (i.e., valve bonnets, etc.) "T" bolt heads do not require coating. (COR Standard)
3. **Installation.** Pipes shall be mechanically restrained to the length specified in the approved plans, using approved materials. (COR Standard)
4. **Installation.** A continuous number 12 insulated tracing wire shall be attached to service lines and appurtenances. (COR Standard)

RISERS

1. **Installation.** Only one-piece risers shall be installed. (NFPA 24, CFC Amendment, OSFM Interpretation)
2. **Installation.** The one-piece fire riser shall have a thrust block at the vertical change of direction.
3. **Collar.** Where pipe passes through holes in platforms, foundations, walls, or floors, the holes shall be sized such that the diameter of the holes is nominally 2 inches larger than the pipe, for pipe 1 inch nominal to 3 1/2 inch nominal, and 4 inches larger than the pipe, for pipe 4 inch nominal and larger. (NFPA 13)

VALVES

1. **Valves.** All connections to private fire service mains for fire protection systems shall be arranged in accordance with one of the following so that they can be isolated: (NFPA 24)
 - a) A post indicator valve installed not less than 40 feet from the building.
 - b) A wall post indicator valve on risers located within the building, either a non-rising stem gate valve with a wall post indicator or a listed butterfly valve with an indicating handle extending out through the building wall.
 - c) A backflow preventer with at least one indicating valve not less than 40 feet from the building.
 - d) Indicating control valves installed in a fire-rated room accessible from the exterior.
2. **Valves.** All valves controlling connections to water supplies and to supply pipes to water-based fire protection systems shall be listed indicating valves, except as permitted by 6.1.1.3 and 6.1.1.4. (NFPA 24)
3. **Valves.** A listed underground gate valve equipped with a listed indicator post shall be permitted. (NFPA 24)
4. **Valves.** A listed water control valve assembly with a position indication connected to a remote supervisory station shall be permitted. (NFPA 24)
5. **Valves.** For new installations, where more than one non-indicating underground gate valve is installed in a water system, all underground gate valves shall be of the same opening direction. (NFPA 24)
6. **Valves.** Check valves shall be accessible for 5-year inspection. (NFPA 24)
7. **Valves.** Gate valves shall be centered in a one-piece 8-inch riser stock. Riser stock shall be blue PVC C-900. An operator nut extension shall be installed on valves where the operation nut exceeds 40 inches in depth from final grade. Valve extensions shall be continuous and within 24 inches of finished grade. (COR Standard)
8. **Valves.** Valves controlling private fire service water main supplies, backflow assembly valves, post indicating valves and sectional control valves shall be supervised by the building's fire alarm system. (RFD Standard)
9. **Sectional Valves Looped System.** Sectional control valves shall be located so that no more than five fire appurtenances are affected by shut-down of any single portion of the fire service main. Each fire hydrant, fire sprinkler system riser and standpipe riser shall be considered a separate fire appurtenance. In-rack sprinkler systems shall not be considered as separate appurtenance. Sectional control valves shall be indicating valves in accordance with NFPA 13. (NFPA 24, CFC Amendment)



Roseville Fire Department

Fire & Life Safety Division

316 Vernon Street Suite 480 · Roseville, CA 95678 · (916) 774-5800 · FLSDivision@roseville.ca.us

10. **Securing Valves.** Control valves shall be supervised by one of the following methods: (NFPA 24)
 - a) Central station, proprietary, or remote station signaling service.
 - b) An approved procedure to ensure that valves are locked in the correct position. (Existing unmonitored systems)

FDC (Fire Department Connection)

1. **General.** There shall be one FDC per building, unless acceptable to the AHJ. i.e., Self-storage facilities. (RFD Standard)
2. **Location.** With respect to hydrants, driveways, buildings and landscaping, fire department connections shall be so located that fire apparatus and hose connected to supply the system will not obstruct access to the buildings for other fire apparatus. (CFC)
3. **Location.** Fire department connections shall be located on the street side of buildings or facing approved fire apparatus access roads, fully visible and recognizable from the street, fire apparatus access road or nearest point of fire department vehicle access. (CFC)
4. **Location.** Remote fire department connections shall be located and arranged so that hose lines can be attached to the inlets without interference. (NFPA 24)
5. **Location.** Fire department connections shall be located between 10 and 40 feet from an accessible fire hydrant which is located on the same side of the fire apparatus access road or in an approved location. (RFD Standard)
6. **Location.** Fire department connections shall be located not less than 18 inches nor more than 48 inches above the level of the adjoining ground, sidewalk, or grade surface. (NFPA 14)
7. **Location.** The fire department connection shall be on the system side of the water supply check valve. (NFPA 13)
8. **Location.** Remote fire department connections shall not be connected on the suction side of fire pumps. (NFPA 24)
9. **Clear space around connections.** A working space of not less than 36 inches in width, 36 inches in depth and 78 inches in height shall be provided and maintained in front of and to the sides. (CFC)
10. **Valves.** A listed check valve shall be installed in the piping from each fire department connection. (NFPA 24)
11. **Valves.** Control valves shall **not** be installed in the piping from the fire department connection to the fire service main. (NFPA 24)
12. **Valves.** Control valves shall be permitted in the system piping downstream of the fire department connection piping. (NFPA 24)
13. **Signage.** Each remote fire department connection shall be designated by a sign as follows (NFPA 24):
 - a) The sign shall have raised or engraved letters at least 1 inch in height on a plate or fitting.
 - b) The sign shall indicate the type of system for which the connection is intended.
14. **Signage.** Where the system demand pressure exceeds 150 psi, a sign located at the fire department connection shall indicate the required inlet pressure. (NFPA 24)
15. **Signage.** If automatic sprinklers are also supplied by the fire department connection, the sign or combination of signs shall indicate both designated services (e.g., "STANDPIPE AND AUTOSPKR" or "AUTOSPKR AND STANDPIPE"). (NFPA 14)
16. **Signage.** Where a remote fire department connection services multiple buildings, structures, or locations, a sign shall be provided indicating the buildings, structures, or locations served. (NFPA 24) (Approved for self-storage only) (COR Standard)
17. **Signage.** Address identification shall be provided on each fire department connection to indicate the building it serves. The address shall consist of black numbers, a minimum of two inches high on a white reflective background and shall be affixed to the main piping of the fire department connection. Numbers shall be arranged vertically. (RFD Standard)

PIV (Post Indicator Valve)

1. **General.** A breakaway lock shall be installed.
2. **Location.** Where post indicator valves are used, it shall be installed not less than 40 feet from the building. (NFPA 24)
3. **Installation.** Where post indicator valves are used, they shall be set so that the top of each post is 32 inches to 40 inches above the final grade. (NFPA 24)
4. **Installation.** Backflow devices serving two or more buildings shall be equipped with an approved post-indicating valve between the fire sprinkler system riser and the backflow assembly. (RFD Standard)



Roseville Fire Department

Fire & Life Safety Division

316 Vernon Street Suite 480 · Roseville, CA 95678 · (916) 774-5800 · FLSDivision@roseville.ca.us

FIRE HYDRANT

1. **General.** For mains that supply fire hydrants, pipe size shall not be less than 6-inch nominal size. (NFPA 24)
2. **Piping.** Hydrant piping shall be fully restrained ductile iron pipe for the entire length. (COR Standard, W-13)
3. **Location.** Hydrants shall be located not less than 40 feet from the buildings or structures to be protected. (NFPA 24)
4. **Valves.** A listed control valve shall be installed in each hydrant connection. (NFPA 24)
5. **Valves.** Valves shall be a minimum of 15 feet from the hydrant and a maximum of 20 feet. (COR Standard) (NFPA 24)
6. **Valves.** Valves shall be clearly identified and kept free of obstructions. (NFPA 24)
7. **Installation.** The center of a hose outlet shall be not less than 18 inches above final grade. (NFPA 24)
8. **Installation.** The center of a hose outlet shall not be more than 36 inches above final grade. (NFPA 24)
9. **Installation.** Hydrants shall be protected if subject to mechanical damage. (NFPA 24)
10. **Installation.** Hydrants shall be listed with two 2 1/2-inch outlets and one 4 1/2-inch outlet. 4 1/2-inch outlet shall face the fire department access road. (NFPA 24) (COR Standard)
11. **Installation.** Install a concrete collar 8 inches thick 30 inches x 30 inches (COR Standard)
12. **Installation.** Install concrete blocking and support. (COR Standard)
13. **Installation.** All new hydrants to be installed with breakoff check valves. Approved valve: Clow LP619 Hydrant Breakoff Check Valve or equal. (COR Standard)
14. **Installation.** Top bolts shall be hollow break-away bolts. Bottom bolts shall be non-Break-away bolts. (COR Standard)
15. **Installation.** Fire hydrants shall be marked with a blue reflector placed 1 foot off street centerline on the fire hydrant side of the street. (COR Standard)
16. **Installation.** Private hydrants shall be painted gloss white. (COR Standard) (RFD Standard)

INSPECTION SCHEDULING

Inspections shall be scheduled a minimum of 48 hours in advance. To schedule, click here:

[City of Roseville Online Permitting Services \(OPS\) Portal](#)

INSPECTION - VISUAL

1. **General.** No facility is to be backfilled without inspection by the fire department. Improvements installed without proper inspection shall be exposed and inspected as required. (COR Standard)

INSPECTION - HYDROSTATIC TEST

1. **Acceptance Requirements.** All piping and attached appurtenances subjected to system working pressure shall be hydrostatically tested at a gauge pressure of 200 psi or 50 psi in excess of the system working pressure, whichever is greater, and shall maintain that pressure at a gauge pressure of ± 5 psi for 2 hours. (NFPA 24)
2. **Acceptance Requirements.** The test pressure shall be read from one of the following, located at the lowest elevation of the system or the portion of the system being tested: (NFPA 24)
 - a) A gauge located at one of the hydrant outlets.
 - b) A gauge located at the lowest point where no hydrants are provided.
3. **Acceptance Requirements.** The trench shall be backfilled between joints before testing to prevent movement of pipe. (NFPA 24)
4. **Acceptance Requirements.** Where required for safety measures presented by the hazards of open trenches, the pipe and joints shall be permitted to be backfilled, provided the installing contractor takes the responsibility for locating and correcting leakage. (NFPA 24)
5. **Working Pressure.** For existing system modifications or repairs that cannot be isolated, hydrostatic testing shall be limited to visual evidence of leakage at system working pressure. (NFPA 24)

INSPECTION - FLUSH

1. **Acceptance Requirements.** Flushing shall occur prior to hydrostatic test. (NFPA 24)
2. **Acceptance Requirements.** Underground piping, from the water supply to the system riser, and lead-in connections to the system riser, including all hydrants, shall be completely flushed before the connection is made to downstream fire protection system piping. (NFPA 24)
3. **Acceptance Requirements.** The flushing operation shall be continued until water flow is verified to be clear of debris. (NFPA 24)



Roseville Fire Department

Fire & Life Safety Division

316 Vernon Street Suite 480 · Roseville, CA 95678 · (916) 774-5800 · FLSDivision@roseville.ca.us

4. **Acceptance Requirements.** The velocity of approximately 10 feet/sec was used to develop Table 10.10.2.1.3 because this velocity has been shown to be sufficient for moving obstructive material out of the pipes. (NFPA 24)
5. **Acceptance Requirements.** Where the flow rates established in Table 10.10.2.1.3 are not attainable, the maximum flow rate available to the system shall be acceptable. (NFPA 24)
6. **Acceptance Requirements.** All control valves shall be fully closed and opened under system water pressure to ensure operation. (NFPA 24)
7. **Acceptance Requirements.** Each hydrant shall be fully opened and closed under system water pressure. (NFPA 24)

PVC BEDDING INFORMATION

Class I Bedding Material

Manufactured angular, granular material, such as crushed stone or gravel, with little or no fines. Particle sizes typically range from 1/4 inch to 3/4 inch, with angular embedment material generally not exceeding 3/4 inch. Provides excellent stability and load-bearing capacity with minimal compaction effort.

Class II Bedding Material

Coarse sands and gravelly soils with little or no fines, including well-graded sands and gravel-sand mixtures (GW, GP, SW, and SP per ASTM D2321). Rounded or sub-rounded particles, with rounded rock generally not exceeding 1 1/2 inches. Provides excellent pipe support when properly compacted and conforms easily to the pipe invert.

Table 10.10.2.1.3 Flow Required to Produce Velocity of 10 ft/sec (3.0 m/sec) in Pipes

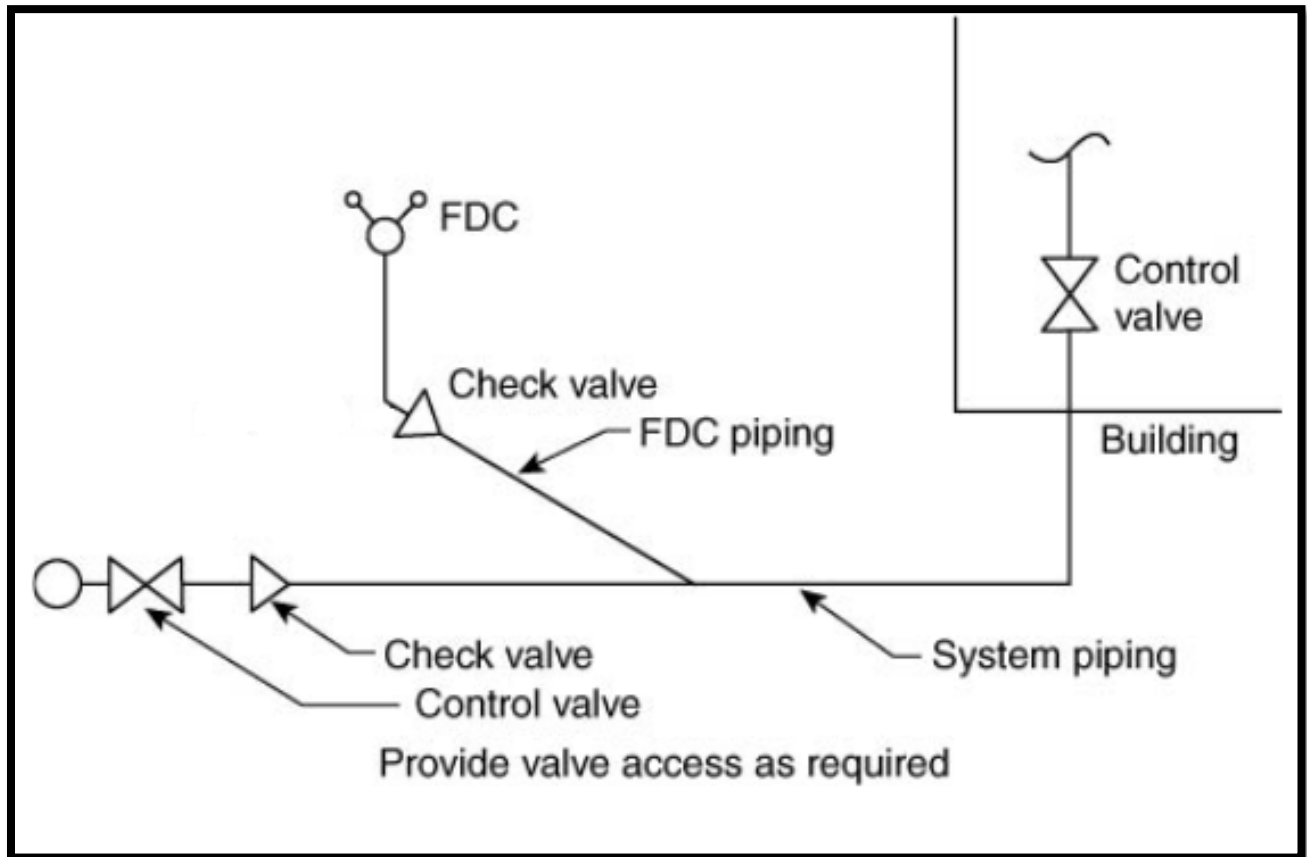
Nominal Pipe Size		Flow Rate	
in.	mm	gpm	L/min
2	50	100	380
2½	65	150	570
3	75	220	833
4	100	390	1500
5	125	610	2300
6	150	880	3350
8	200	1560	5900
10	250	2440	9250
12	300	3520	13,300



Roseville Fire Department

Fire & Life Safety Division

316 Vernon Street Suite 480 · Roseville, CA 95678 · (916) 774-5800 · FLSDivision@roseville.ca.us

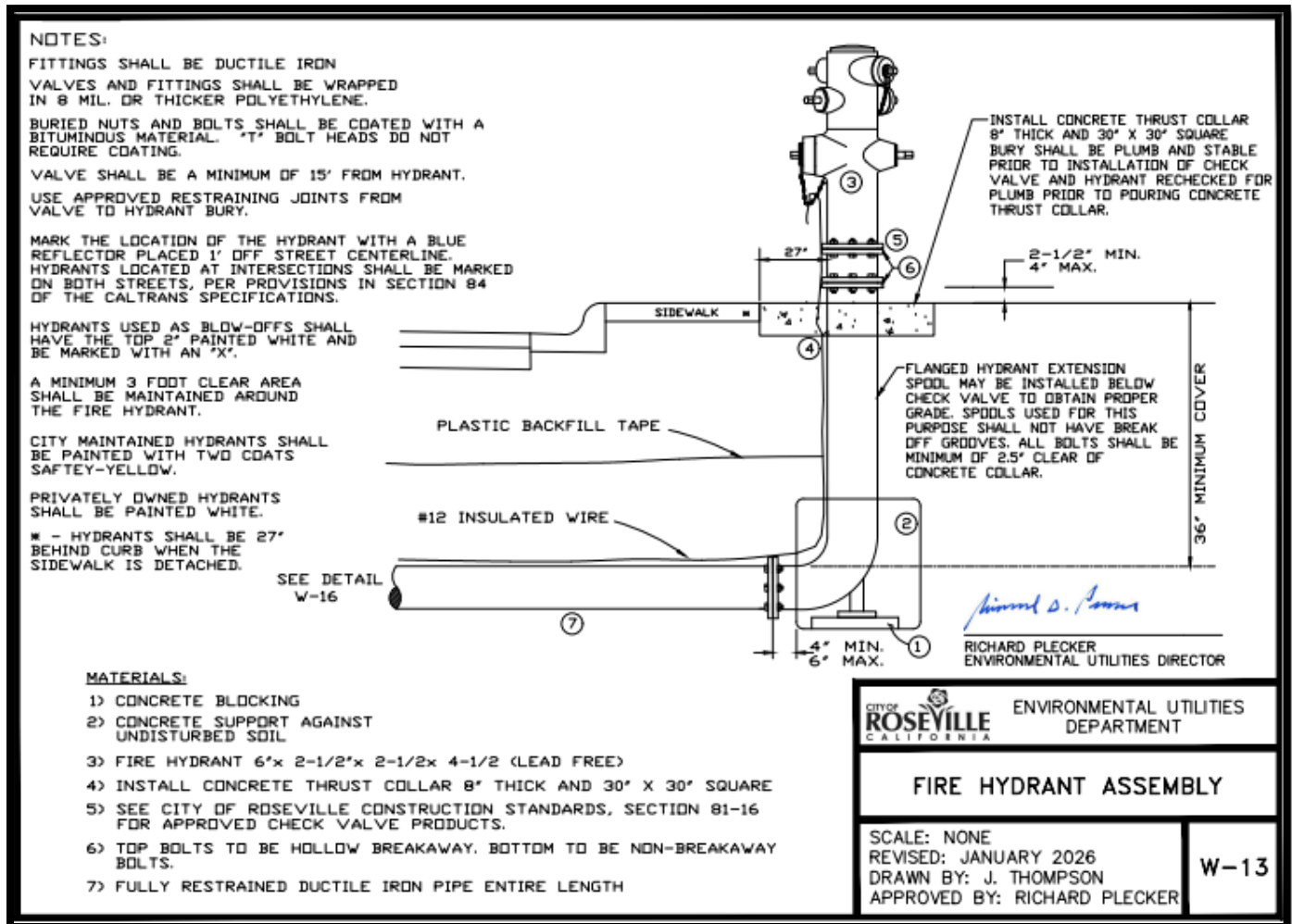




Roseville Fire Department

Fire & Life Safety Division

316 Vernon Street Suite 480 · Roseville, CA 95678 · (916) 774-5800 · FLSDivision@roseville.ca.us





Roseville Fire Department

Fire & Life Safety Division

316 Vernon Street Suite 480 · Roseville, CA 95678 · (916) 774-5800 · FLSDivision@roseville.ca.us

NOTES:

NO WATER SHALL BE DRAWN THROUGH THE BACKFLOW DEVICE UNTIL IT HAS BEEN TESTED BY THE ENVIRONMENTAL UTILITIES DEPT.

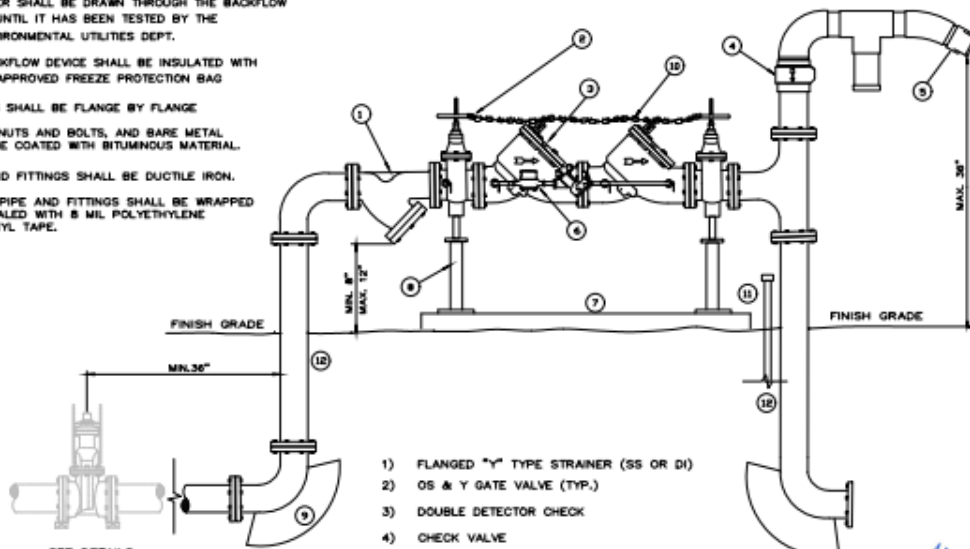
THE BACKFLOW DEVICE SHALL BE INSULATED WITH A CITY APPROVED FREEZE PROTECTION BAG

FITTINGS SHALL BE FLANGE BY FLANGE

BURIED NUTS AND BOLTS, AND BARE METAL SHALL BE COATED WITH BITUMINOUS MATERIAL.

PIPE AND FITTINGS SHALL BE DUCTILE IRON.

BURIED PIPE AND FITTINGS SHALL BE WRAPPED AND SEALED WITH 8 MIL POLYETHYLENE AND VINYL TAPE.



SEE DETAILS
W-15 AND W-16
FOR VALVE

- 1) FLANGED "Y" TYPE STRAINER (SS OR DI)
- 2) OS & Y GATE VALVE (TYP.)
- 3) DOUBLE DETECTOR CHECK
- 4) CHECK VALVE
- 5) SIAMESE 45 DEGREE FDC WITH END CAPS
- 6) WATER METER
- 7) 3 1/2" THICK REINFORCED CONCRETE SLAB WITH #4 REBAR 12" ON CENTER
- 8) SUPPORTS 2-TYP. SHALL BE BOLTED DOWN WITH A MINIMUM OF TWO BOLTS EACH
- 9) THRUST BLOCK (TYP.)
- 10) 1/4" NON CASE HARDENED CHAIN WITH BREAKAWAY LOCK BETWEEN VALVES.
- 11) VALVE TAMPER SWITCH CONDUIT TO BUILDING FIRE CONTROL ROOM
- 12) ONE CONTINUOUS PIECE

Richard D. Plecker
RICHARD PLECKER
ENVIRONMENTAL UTILITIES DIRECTOR



ENVIRONMENTAL UTILITIES
DEPARTMENT

FIRE PROTECTION ASSEMBLY

SCALE: NONE
REVISED: JANUARY 2026
DRAWN BY: R. VAN NESS
APPROVED BY: RICHARD PLECKER

W-2



Roseville Fire Department

Fire & Life Safety Division

316 Vernon Street Suite 480 · Roseville, CA 95678 · (916) 774-5800 · FLSDivision@roseville.ca.us

Pipe	Type PVC/DI	Configuration	Lr (high) (Feet)	Lr (low) (Feet)
6"	PVC	90 horizontal	22	
6"	PVC	45 horizontal	18	
6"	PVC	22 ½ horizontal	18	
6"	PVC	11 ¼ horizontal	18	
6"	PVC	DEAD END	58	
6"	PVC	45 vertical	24	18
6"	PVC	22 ½ vertical	18	18
6"	PVC	11 ¼ vertical	18	18
6"	DI	90 horizontal	26	
6"	DI	45 horizontal	18	
6"	DI	22 ½ horizontal	18	
6"	DI	11 ¼ horizontal	18	
6"	DI	DEAD END	89	
6"	DI	45 vertical	37	18
6"	DI	22 ½ vertical	18	18
6"	DI	11 ¼ vertical	18	18
8"	PVC	90 horizontal	30	
8"	PVC	45 horizontal	18	
8"	PVC	22 ½ horizontal	18	
8"	PVC	11 ¼ horizontal	18	
8"	PVC	DEAD END	76	
8"	PVC	8x6 reducer	32	
8"	PVC	45 vertical	31	
8"	PVC	22 ½ vertical	18	
8"	PVC	11 ¼ vertical	18	
8"	DI	90 horizontal	34	
8"	DI	45 horizontal	18	
8"	DI	22 ½ horizontal	18	
8"	DI	11 ¼ horizontal	18	
8"	DI	DEAD END	116	
8"	DI	8x6 reducer	49	
8"	DI	45 vertical	48	18
8"	DI	22 ½ vertical	23	18
8"	DI	11 ¼ vertical	18	18
12"	PVC	90 horizontal	42	
12"	PVC	45 horizontal	18	
12"	PVC	22 ½ horizontal	18	
12"	PVC	11 ¼ horizontal	18	
12"	PVC	DEAD END	107	
12"	PVC	12x8 reducer	57	
12"	PVC	12x6 reducer	78	
12"	PVC	45 vertical	44	18
12"	PVC	22 ½ vertical	21	18
12"	PVC	11 ¼ vertical	18	18
12"	DI	90 horizontal	49	
12"	DI	45 horizontal	20	
12"	DI	22 ½ horizontal	18	
12"	DI	11 ¼ horizontal	18	
12"	DI	DEAD END	164	
12"	DI	12x8 reducer	87	
12"	DI	12x6 reducer	119	
12"	DI	45 vertical	68	18
12"	DI	22 ½ vertical	33	18
12"	DI	11 ¼ vertical	18	18