



Riverside County Fire Department

Private Underground Fire Service Mains Serving Private Fire Hydrants & Fire Sprinkler Systems

Guideline OFM-02

PURPOSE

The provision of adequate water supplies and distribution systems for fire suppression is a fundamental component of risk reduction. The purpose of this guideline is to provide the basic information necessary to meet minimum requirements for the design and installation of private hydrant and/or sprinkler supply underground piping in accordance with the provisions of the 2022 California Fire Code (CFC), the 2022 California Building Code (CBC), 2019 edition of NFPA 24, including California amendments in 2022 CFC Chapter 80, 2022 NFPA 13, 2022 NFPA 13R, including California State amendments, and locally adopted amendments to these codes.

SCOPE

This guideline is applicable to all private underground piping systems serving fire hydrants, fire sprinkler systems, or other water-based fire protection systems within the jurisdiction of the Riverside County Fire Department (RVC). This guideline is **not** applicable to underground piping serving residential fire sprinkler systems designed in accordance with 2022 NFPA 13D and some multi-family residential fire sprinkler systems designed in accordance with 2022 NFPA 13R.

SUBMITTAL REQUIREMENTS

1. General

- A. Plans for all private underground piping systems serving fire hydrants, fire sprinkler systems, or other water-based fire protection systems shall be submitted to RVC for review and approval prior to installation.
- B. All plan submittals and revisions must be electronically submitted via the Riverside County PLUS portal at: <https://rivcoplus.org>
- C. A current (within the past **6 months**), completed Fire Flow Test Report from the municipal water agency servicing the project shall accompany the plans.

2. Information to be provided on the title page.

- A. Applicable codes and standards used for the system design (e.g., 2022 edition CFC, 2022 edition CBC, 2019 edition NFPA 24, etc.).
- B. Project location, including the full legal address of the facility, and building number(s) if applicable; tract or parcel number, APN.
- C. The contractor's name, telephone number, address, and California State contractor's license number and classification. Designer must possess a valid A, C16, C34, and C36 license or be registered as a Professional Engineer (PE- Civil, Mechanical, or Fire Protection). *Note: If the piping plan is designed by a PE, the plan shall contain the name, license number, and classification of the installing contractor, along with the PE wet stamp. If the installing contractor's information is not available at the time the plans are submitted, proof of compliance with this requirement must be provided to the RVC at time of permit issuance. The approved plan may be released to the PE without this information, but a Construction Permit will be withheld until the installing contractor's information is provided.*

3. Additional Required Information on Plans

- A. Location of public mains and all public hydrants within 300 feet of the property line.
- B. Location and type of all valves. Specify the type for each (e.g., post indicator valve (PIV), key gate valve, system control valve, double detector check (DDC) assembly, outside stem and yoke (OS&Y), etc.).
 - a. PIVs or other approved indicating valves, shall be located: a minimum of 40 feet from the building served. Where it is *impractical* to locate control valve(s) 40 feet from the building served, they may be located closer by one of the following alternate methods:
 - 1) For buildings less than 40 feet in height, the PIV may be located not less than the actual height of the building wall facing the PIV.
 - 2) A wall mount indicating valve.
 - 3) An indicating valve located as part of a backflow preventer assembly located at least 40 feet, OR not less than the height of the wall facing the backflow preventer when the building is less than 40 feet in height.
 - 4) Within a fire rated room accessible from the exterior.
 - 5) Other locations and methods described in NFPA 24, Section 6.2 when a specific need is demonstrated, and approved by RVC.
- C. Hydraulic calculations. Hydraulic calculations must accompany the system design plan to demonstrate that the system can supply the required volume and pressure based on the on-site fire protection systems to be installed (e.g., Private on-site fire hydrants, fire sprinkler systems, standpipes, fire pumps, or other systems). Coordination with the architect, general contractor, and/ or other fire protection contractors is strongly advised.
- D. Pipe system layout and fittings information. Provide a scale drawing that accurately depicts the location of all pipe and fittings. Provide pipe size, class, and type; specify lined or unlined if applicable. Materials must be in accordance with NFPA 24, Chapter 10 and rated for the maximum system working pressure, but not less than 150 psi.

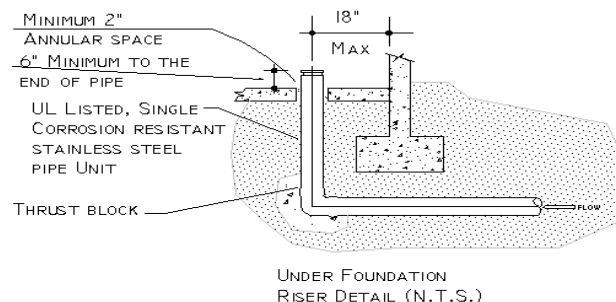
- E. Protection of ferrous pipe and accessories. Provide a statement and/or detail that demonstrates the following:
- a. Ferrous pipe, and fittings shall be coated with asphaltic sealant or equivalent to inhibit corrosion.
 - b. Ferrous pipe and fittings (excluding stainless steel 316) shall be encased in loose-fitting polyethylene *tubing* (pipe shall **not** be wrapped in polyethylene sheets). Exposed edges, cuts, and tears shall be tightly taped to inhibit water infiltration. Where joints are present in tubing, a minimum one-foot overlap shall be provided. Tubing shall extend a minimum of one foot beyond transition between areas where ferrous pipe or fittings are used and where non-ferrous pipe begins.
- (NOTE: The designer may provide an alternate methodology for evaluation and approval during the plan review process, along with an appropriate justification).*
- F. Thrust block locations, and design details, or specify alternate means of mechanical restraint as otherwise permitted by 2019 NFPA 24.
- Horizontal thrust blocks shall be designed and provided to:
 - Provide a flat bearing surface placed against undisturbed soil. Where it is not possible to place the bearing surface against undisturbed soil, the fill between the bearing surface and undisturbed soil must be compacted to at least 90% Proctor density.
 - Resist expected forces based on pipe size, expected system pressure (200 psi), and based upon a “silt” soil type.
 - Comply with the HORIZONTAL THRUST BLOCK BEARING AREA (SQUARE FEET) AND BEARING SURFACE DIMENSIONS Table provided elsewhere in this guideline.
 - The designer may use an alternate alternative thrust block design when specific soil test results have been provided by the soils engineer and provided during the plan submittal process. Alternative designs are subject to approval by RVC.
 - Vertical (gravity) pipe restraint shall be designed and provided:
 - When pipe is installed in a vertical position, mechanical restraint is the preferred method of preventing pipe movement. If gravity thrust blocks are used, design details and associated calculations must be provided on the plan to demonstrate that the thrust block is capable of withstanding expected forces.
- G. Fire Department Connection (FDC) location and related details.
- a. FDCs shall be on the street/ address side of the building and located adjacent to the approved fire department public or private access road. The FDC shall be oriented to allow hose lines to be readily and conveniently connected to a fire engine pulling water from a public fire hydrant and does not require hose lines to crossfire department access roads or a drive entry approach. The FDC shall contain a minimum of *two* 2½” inlets. When the sprinkler demand is 500 g.p.m. or greater (including the interior hose stream demand) or a standpipe system is included, *four* 2½” inlets shall be provided. The FDC shall be a listed assembly.
 - b. FDC’s shall be located between 20 feet and 100 feet from a public hydrant. When approved, the FDC may be located within 100 feet of a private hydrant if the FDC is

connected to the fire sprinkler system by a dedicated pipe that connects on the system side (i.e., downstream) of the sprinkler system check valve OR an aboveground check valve is provided between the FDC and fire hydrant to prevent a looped condition.

- c. FDCs (and PIVs, and backflow assemblies) shall be provided with a minimum horizontal circumference of 3 feet of clear space and 78 inches of clear vertical space. These devices must be readily visible and accessible from the fire access roadways. Vegetation may be used to screen backflow assemblies on the side that does not face the fire department access roadway.
- d. FDC inlets shall be between 18" and 48" above adjacent grade to the inlets.
- e. FDCs and PIVs, shall be painted OSHA Safety Red. Backflow assemblies are to be painted Safety Red (Stainless steel components may be left unpainted) unless otherwise specified by the local water purveyor.
- f. FDCs, PIVs, and DDCs, shall have durable, legible signs clearly indicating the address of the facility they serve or, where appropriate, their function (e.g., "123 Main Street - Sectional Valve 1 of 2" or "123 Main Street - Fire Sprinkler System #1 Control Valve"). Signs shall be securely attached to the device.
- g. FDC inlets shall be provided with National Standard Threads (NST).
- h. FDC shall be provided with impact protection in accordance with CFC 312 when the location is subject to vehicle impact.

H. Sectional Valves. Large underground private fire service mains serving more than 5 appurtenances shall have post indicating type sectional control valves at appropriate points to permit isolation of the system in the event of a break or during repair or extension. Each fire hydrant, fire sprinkler riser, and standpipe riser shall be considered a separate fire appurtenance.

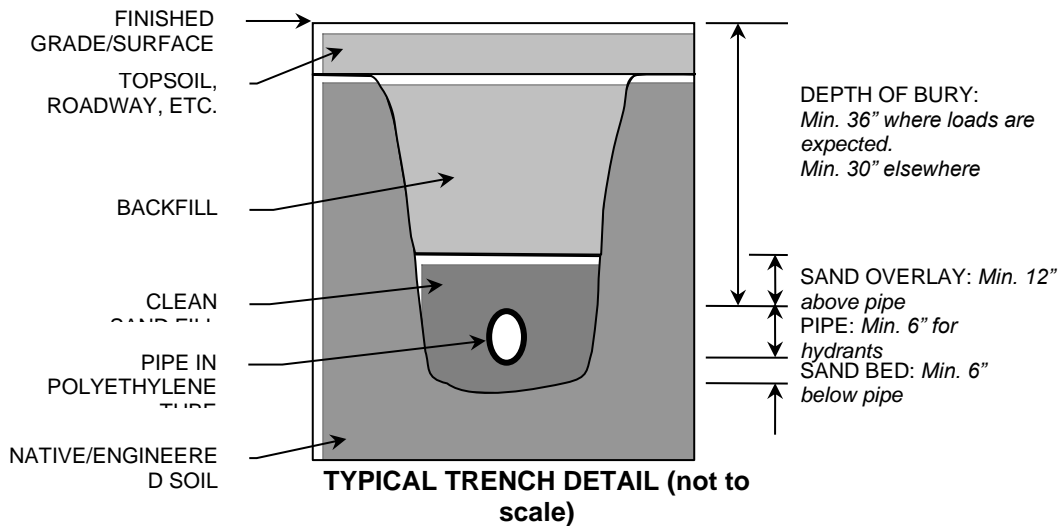
I. Provide a fire riser detail(s). When a pipe runs under footings or foundations of the building, a single corrosion resistant stainless steel pipe unit assembly is required. The pipe shall terminate a maximum of 18 inches from the exterior wall and six inches above the finished floor. A minimum of 2 inches clearance (annular space) shall be provided where the pipe passes through a floor or wall.



- J. Provide fire hydrant specifications. All fire hydrants shall provide for National Standard Threads (NST). RVC requires the following as a minimum.
 - Residential Development: One 4" outlet, one 2-1/2" outlet
 - Commercial Development: One 4" outlet, two 2-1/2" outlets
 - Special Circumstance (only when specified by RVC): Two 4" outlets, two 2-1/2" outlets.

- K. Fire Hydrant Location. Hydrants must be located no more than three feet from the edge of a fire access roadway and cannot be located in areas where they will be visually or operationally obstructed (behind fences or walls, in bushes, behind parking spaces, etc.). Clearance shall be provided to a distance no less than three feet from the perimeter of the hydrant. For additional requirements see: RVC Guideline - Fire Department Access & Water Requirements for Commercial & Residential Development

- L. Provide a typical trench detail/section showing the depth of bury and thickness of clean fill sand or pea gravel bedding (12") above and (6") below the pipe. (See Typical Trench Detail)



- M. The attached “NOTES FOR UNDERGROUND PIPING FOR PRIVATE HYDRANTS AND SPRINKLERS” shall be placed, verbatim, on all underground plans. Specific notes pertaining to “THRUST BLOCK SIZE AND INSTALLATION” (See Note #18) are only required to be placed, verbatim, on underground plans that use thrust blocks as the restraining method.

4. Underground Service for NFPA 13R Systems

Underground service shall comply with one of the following two designs based upon the parameters described:

- A. The system design shall comply with 2022 NFPA 13 and 2019 NFPA 24 (see Sections 1 through 3 above) when:
 - 1) Serving more than one R-1, R-2, or R-4 occupancy, *OR*
 - 2) The FDC is located between the city supply and sprinkler riser check valve.

- B. The system design shall comply with 2022 NFPA 13R and the California Plumbing Code (CPC) when:
 - 1) Serving a single R-1, R-2, or R-4 occupancy, *AND*
 - 2) The FDC is located downstream of (i.e., after) the sprinkler system riser check valve. The underground system may be interconnected with the building's domestic water supply line or may be a dedicated fire line. The FDC shall comply with relevant requirements listed in this guideline including, but not limited to, identification, painting, location, and orientation.

Riverside County Fire Department

NOTES FOR UNDERGROUND FIRE SERVICE MAINS SERVING PRIVATE FIRE HYDRANTS & SPRINKLER SYSTEMS

INSPECTION REQUIREMENTS

Four RVC inspections are required for underground piping serving sprinkler systems, standpipes, and/or private hydrants: 1) Pre-pour inspection; 2) Hydrostatic/Rough testing; 3) Flush; 4) Final inspection. Email RRUOFMSCHEDULING@FIRE.CA.GOV to schedule all inspections and include pertinent information (Permit #, location, type of inspection and desired date of the inspection).

1. **Pre-pour inspection:** Thrust block excavation shall be completed but thrust blocks shall not be poured. All pipes shall be in place and exposed for visual inspection. Pipe shall be laid on a minimum six-inch bed of clean sand. Trenches shall be of a sufficient depth to allow the required cover above pipe. Ferrous pipe and fittings shall be encased in polyethylene tubing (**not wrapped**) and tightly taped to inhibit water infiltration. Ferrous joints (except for stainless steel 316) shall be coated with asphaltic sealant or other corrosion retarding material. See items 10 – 18 below for detailed requirements.
2. **Hydro Testing:** Thrust blocks shall be in place. Pipe shall be center loaded with clean sand to prevent uplift, but all joints shall remain exposed. The system shall be hydrostatically tested at 200 psi (or 50 psi over maximum static pressure, whichever is greater) for a duration of at least two hours prior to the arrival of the RVC inspector. See item 16 for detailed requirements. A date/ time stamped photograph of the pressure gauge is required for the inspection. See items 10 - 24 for detailed requirements.
3. **Flush Inspection:** All portions of the underground system shall be flushed to remove debris prior to connection to overhead piping. Flow shall be through a minimum of a four-inch hose or pipe, unless otherwise approved by the RVC inspector prior to scheduling the flush. The flow velocity must be sufficient to remove debris and a minimum of 10 fps. Where flow rates required for 10 fps are not attainable, the maximum flow rate to the system shall be acceptable. Flush duration is at the discretion of the inspector and until clear water is being continuously discharged from all outlets. Sufficient personnel equipment must be on-site and ready in order minimize the amount of time needed to flush the system. Hose or pipe shall be restrained to prevent injury and damage. Discharged water shall be collected or diverted in accordance with applicable SWPPP/NPDES provisions. The local public works department, water district, and/or other applicable agency shall be notified of the scheduled flush by the contractor.
4. **Final Inspection:** Upon completion of the flush inspection and prior to final sprinkler or site inspection, all detector check assemblies, control valves, and fire department connections (FDC) shall be clearly labeled with the address(es) served by the device. Address signs shall be securely attached to the device and be of a durable, fade-resistant material which is visible and legible from the fire lane. FDC and four-inch hydrant outlets shall be unobstructed and oriented toward the fire lane with Blue Dots installed. Valves shall be locked in the open position with breakaway locks. All PIV valves and private hydrants shall be painted OSHA safety red. Hydrant and FDC caps shall be in place. See items 6 – 9, 19 – 24 for detailed requirements.

GENERAL REQUIREMENTS

5. Installation, inspection, and testing shall conform to 2019 editions of NFPA 13 and NFPA 24. RVC jurisdiction typically begins at the downstream side of the last valve on the detector check assembly. Verify design and installation requirements for the portion of the system preceding this point with the local water district.
6. Vegetation shall be selected and maintained in such a manner as to allow immediate location of, and unobstructed access to; all hydrants, control valves, fire department connections, and other devices or areas used for firefighting purposes.
7. A minimum three-foot horizontal and 78" vertical clearance shall be provided around all hydrants and post indicating valves. A minimum three-foot clearance shall be provided on at least one side of a detector

check assembly to allow proper operation of the device. The front of FDC and the adjacent fire access roadway shall be free of any obstructions.

8. Any future modification to the approved private underground piping system is subject to review, inspection, and approval by the RVC.
9. Approval of this plan shall not be interpreted as approval of any information or project conditions other than those items and requirements identified in RVC Guideline, and applicable sections of the 2022 edition of NFPA 13 and 2019 edition of NFPA 24. This project may be subject to additional requirements not stated herein upon examination of actual site and project conditions or disclosure of additional information.

PIPE AND TRENCH REQUIREMENTS

10. A 6-inch bed of clean fill sand or pea gravel shall be provided below the pipe and 12-inches above the pipe (total of 18 inches plus outer diameter of the pipe).
11. Pipe shall be buried at least 36" where subject to loading (e.g., driveways, parking lots) and at least 30" elsewhere.
12. All pipes shall be approved for use in fire service systems. Class 150 will be used at a minimum, and class 200 pipe shall be used where the water pressure exceeds 150 psi. The use of galvanized pipe is prohibited when a portion of the system is buried.
13. All ferrous pipe and fittings shall be protected with a loose 8-mil polyethylene tube. Wrapping the pipe in polyethylene sheeting is not acceptable. The ends of the tube and any splices made for tees or other piping components shall be tightly sealed with two-inch tape that is approved for underground use.
14. All ferrous fittings (except for 316 stainless steel) shall be cleaned and thoroughly coated with asphalt or other corrosion retarding material after assembly and prior to the installation of polyethylene tube.
15. Thrust blocks, or another approved method of thrust restraint, shall be provided wherever pipe changes direction.
16. A minimum two-inch clearance shall be provided where the pipe passes through slabs or walls. Underground system shall terminate at the riser flange and placed a maximum of 18 inches from an exterior wall and 6 inches above the slab.
17. Pipe running under a building or building foundation shall be stainless steel and shall not contain mechanical joints.

THRUST BLOCK SIZE AND INSTALLATION

18. Thrust block design shall be capable of withstanding the imposed forces, based upon pipe size, water pressure, type of fitting, and soil type. Horizontal thrust block dimensions must comply with the table provided (see below).
Alternatively, the designer may use an alternate design approach, when specific soil test results have been provided by soils engineer and provided during the plan review process. Alternative designs are subject to approval by RVC.

HORIZONTAL THRUST BLOCK BEARING AREA (SQUARE FEET) AND BEARING SURFACE DIMENSIONS^{1 3}				
NOMINAL PIPE SIZE	FITTING TYPE			
	90 Degree	45 Degree	22.5 Degree	11.25 Degree
3"	3.5	2	1	1
Bearing Surface H X W (ft)²	2 X 2	1.5 X 1.5	1 X 1	1 X 1
4"	5	3	1.5	1
Bearing Surface H X W (ft)²	2 X 3	1.5 X 2	1 X 2	1 X 1
6"	10.5	6	3	1.5
Bearing Surface H X W (ft)²	3 X 4	2 X 3	1.5 X 2	1 X 1.5
8"	18	10	5	2.5
Bearing Surface H X W (ft)²	4 X 4.5	3 X 4	2 X 3	1 X 1.5
10"	27.5	15	7.5	4
Bearing Surface H X W (ft)²	5 X 5.5	3 X 5	2.5 X 3.5	2 X 2
12"	39	21	10.6	5.5
Bearing Surface H X W (ft)²	5 X 8	4 X 5.5	3 X 4	2 X 3

¹ The values shown are based upon a maximum pressure of 200 PSI and a Silt Soil Type with a horizontal bearing strength of 1500 lb./ft². A safety factor of 1.5 is built into the values.

² Width must be 1X to 2X of the Height.

³ The thrust block bearing surface must be flat and perpendicular to the imposed force from the fitting.

FDC REQUIREMENTS

19. FDC's shall comply with all of the following:

- a. FDCs shall be on the street/ address side of the building and located adjacent to the approved fire department public or private access road. The FDC shall be oriented to allow hose lines to be readily and conveniently connected to a fire engine pulling water from a public fire hydrant and does not require hose lines to crossfire department access roads or a drive entry approach. The FDC shall contain a minimum of *two 2½"* inlets. When the sprinkler demand is 500 g.p.m. or greater (including the interior hose stream demand) or a standpipe system is included, *four 2½"* inlets shall be provided. The FDC shall be a listed assembly.
- b. FDC's shall be located between 20 feet and 100 feet from a public hydrant. When approved, the FDC may be located within 100 feet of a private hydrant if the FDC is connected to the fire sprinkler system by a dedicated pipe that connects on the system side (i.e., downstream) of the sprinkler system check valve OR an aboveground check valve is provided between the FDC and fire hydrant to prevent a looped condition.
- c. FDCs (and PIVs, and backflow assemblies) shall be provided with a minimum horizontal circumference of 3 feet of clear space and 78 inches of clear vertical space. These devices must be readily visible and accessible from the fire access roadways. Vegetation may be used to screen backflow assemblies on the side that does not face the fire department access roadway.
- d. FDC inlets shall be between 18" and 48" above adjacent grade to the inlets.
- e. FDCs and PIVs, shall be painted OSHA Safety Red. Backflow assemblies are to be painted Safety Red (Stainless steel components may be left unpainted) unless otherwise specified by the local water purveyor.

- f. FDCs, PIVs, and DDCs, shall have durable, legible signs clearly indicating the address of the facility they serve or, where appropriate, their function (e.g., "123 Main Street - Sectional Valve 1 of 2" or "123 Main Street - Fire Sprinkler System #1 Control Valve"). Signs shall be securely attached to the device.
- g. FDC inlets shall be provided with National Standard Threads (NST).
- h. FDC shall be provided with impact protection in accordance with CFC 312 when the location is subject to vehicle impact.

HYDRANT REQUIREMENTS

- 20. Private fire hydrants shall be listed with a minimum of one 4" and one 2-1/2" outlet for residential developments. A minimum of one 4" and two 2-1/2" outlets are required for commercial developments. The 4" outlet shall face the fire department access road. All outlets shall be provided with National Standard Threads (NST). Private hydrants shall be painted OSHA safety red.
- 21. A minimum three-foot horizontal and 78" vertical clearance shall be provided around all hydrants.
- 22. Fire hydrant supply piping shall be a minimum of six inches in diameter. The lowest valve operating nut shall be a minimum of eighteen inches above grade and the hydrant flange shall be a minimum of two inches above grade.
- 23. A keyed gate valve shall be provided for each hydrant in an accessible location. Keyed gate valves shall be located within six to ten feet of the hydrant in an area that is unobstructed and clearly visible. Valves shall not be located within parking stalls.
- 24. All fire hydrants shall have a "Blue Reflective Pavement Marker" indicating their location per the RVC Guideline – Fire Department Access & Water Requirements for Commercial and Residential Development. Private hydrants and markers are to be maintained in good condition by the property owner.