Text in Red is for information and/or guidance. Designer should remove all red text in the final specification documents. Designer should fill in all blue information in the final specification documents.

Section 00 00 00

Polyvinyl Chloride (PVC) Pipe for Water Service

# PART 1 GENERAL

1.01 SCOPE

1. This specification section includes all materials, equipment, labor, and incidentals required for the supply and installation of polyvinyl chloride (PVC) or molecularly-oriented polyvinyl chloride (PVCO) pipe and fittings, 4-inch diameter to 60-in diameter for use in potable and non-potable water systems.

1.02 RELATED SECTIONS

1. Section 00 00 00: Trenching, Backfilling, and Compaction
2. Section 00 00 00: Valves and Appurtenances
3. Section 00 00 00: Submittals
4. Section 00 00 00: Hydrostatic Testing and Acceptance
5. [Add Other Section References as Needed]

1.03 REFERENCES

The Contractor and/or Pipe Manufacturer shall follow the standards listed below, except as otherwise specified herein. The latest revision or edition in effect at the time of bid opening shall be utilized.

1. American Society for Testing and Materials (ASTM)
	1. D1784 – Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
	2. D2241 – Polyvinyl Chloride (PVC) Pressure-Rated Pipe (SDR PR Series)
	3. D2774 – Practice for Underground Installation of Thermoplastic Pressure Piping
	4. D3139 – Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
	5. F477 – Elastomeric Seals (Gaskets) for Joining Plastic Pipe
2. American Water Works Association (AWWA)
	1. C605 – Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water
	2. C651 – Disinfecting Water Mains
	3. C900 – Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 in. through 60 in. (100 mm through 1500 mm), for Water Transmission and Distribution
	4. C907 – Injection-Molded Polyvinyl Chloride (PVC) Pressure Fittings, 4 in. through 12 in. (100 mm through 300 mm), for Water, Wastewater, and Reclaimed Water Service
	5. C909 – Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe, 4 in. through 24 in. (100 mm through 600 mm) for Water, Wastewater, and Reclaimed Water Service
	6. M23 – PVC Pipe – Design and Installation
3. National Science Foundation (NSF)
	1. 61 – Drinking Water System Components – Health Effects
4. Uni-Bell PVC Pipe Association
	1. UNI-PUB-8 – Tapping Guide for PVC Pressure Pipe
	2. UNI-PUB-9 – Installation of PVC Pressure Pipe
	3. Handbook of PVC Pipe Design and Construction

1.04 QUALIFICATIONS

1. The Pipe Manufacturer shall be a member of the Uni-Bell PVC Pipe Association.
2. The pipe and fittings shall be designed, manufactured, and installed in accordance with industry standards and shall comply with the specification requirements herein.

1.05 SUBMITTALS

1. Conform to the requirements of Section 00 00 00 – Submittals.
2. Submit product data on pipe, fittings, gaskets and appurtenances as required to ensure products meet the requirements of this specification.

1.06 DELIVERY, STORAGE, AND HANDLING

1. Pipe shall be shipped so as to not bend, dent, or otherwise damage the pipe during transport.
2. Contractor shall take all necessary precautions to prevent damage to pipe and fittings during delivery and unloading.
3. Owner shall observe and inspect unloading of pipe to ensure proper unloading procedures are followed.
4. Under no circumstances will pipe be allowed to be rolled, pushed, or dropped off from any height for delivery, storage, or installation. Any pipe found to have been damaged due to improper handling procedures truck will be immediately marked for identification and removed from the jobsite at the Contractor’s expense.
5. Stacking of pipe shall be performed in accordance with Pipe Manufacturer’s recommendations.
6. Once pipe has been unloaded, it shall be stored as near to its point of installation as possible. Contractor shall limit moving or restacking of pipe prior to installation. Contractor shall keep track of any moving or restacking of pipe materials during installation and make such records available to Owner and Pipe Manufacturer if needed.
7. Where necessary, because of ground conditions, store pipe on wooden sleepers, spaced suitably and of such widths as not to allow deformation of pipe at point of contact with sleeper or between supports.
8. Pipe shall not be stored close to heat sources or hot objects such as heaters, boilers, steam lines, and engine exhaust.
9. If pipe is to be exposed to direct sunlight for extended periods (in excess of two years from the date of manufacture), then Contractor shall cover/shade pipe utilizing canvas or other opaque materials. Black plastic will not be acceptable as a shading material.
10. Gaskets shall be protected from exposure to excessive heat, prolonged direct sunlight, and oil and grease. Contractor shall not store gaskets near electrical motors or transformers or other sources of ozone.
11. Material storage shall be performed in accordance with Pipe Manufacturer’s recommendations.

# PART 2 PRODUCTS

2.01 PIPE

1. PVC pipe shall be manufactured and supplied in accordance with AWWA C900. PVCO pipe shall be manufactured and supplied in accordance with AWWA C909.
2. PVC pipe for potable water use shall meet the requirements of NSF 61.
3. Pipe shall have lay lengths between 14 and 22 feet unless otherwise specified by the Owner.
4. The pipe shall be made of PVC compound having a cell classification of 12454 in accordance with ASTM D1784.
5. Pipe shall be homogenous throughout, free of voids, cracks, inclusions, and other defects.
6. Pipe shall have markings at intervals of 5ft or less including:
	1. Nominal pipe size and
	2. OD base (e.g. CIOD or IPS)
	3. PVC
	4. Dimension ratio
	5. Pressure class in psi
	6. Hydrostatic integrity test pressure
	7. AWWA designation
	8. Pipe Manufacturer’s name or trademark
	9. Production run record or lot code
	10. Mark of certifying agency (for potable water service) or “NOT FOR POTABLE USE” (for non-potable water service)
	11. Maximum allowable axial joint deflection in degrees
7. Pipe for potable water use shall be blue, yellow, or white in color. Pipe for recycled or reclaimed water use shall be purple in color. Pipe for other non-potable water uses shall be green or white in color.
8. Pipe outside diameters shall be equal to those of cast iron unless otherwise specified by the Owner.

2.02 PIPE DESIGN

AWWA M23 outlines the procedure for determining an appropriate Pressure Class (PC) for pipe. The designer should consider factors including internal pressures and external loads when designing the pipeline system.

1. Pipe shall be supplied to meet the pressure requirements of the project as follows:
	1. Working Pressure (Pw) of \_\_\_ psi

Working pressure is the maximum anticipated, sustained operating pressure applied to the pipe exclusive of hydraulic transient pressures.

* 1. Occasional Surge Pressure (Pt) of \_\_\_ psi

The occasional surge pressure is caused by emergency operations, usually as a result of a malfunction (such as power failure, sudden valve closure, or system component failure). The occasional surge pressure plus the pipe’s working pressure must not exceed the pipe’s short-term rating, which is 1.6 times the PC.

* 1. Recurring (cyclic) Surge Pressure (Pt) of \_\_\_ psi

The recurring/cyclic surge pressure occurs frequently and is inherent to the design and operation of the system (such as normal pump startup or shutdown and normal valve opening or closure). The recurring/cyclic surge pressure plus the pipe’s working pressure must not exceed the pipe’s long-term rating, which is the PC. Designer should refer to AWWA M23 and PVC Pipe Handbook for discussion of cyclic design theory and design process.

* 1. Field Hydrostatic Test Pressure (Pft) of \_\_\_ psi

The hydrostatic test should typically be 1.25 times the stated anticipated maximum sustained working pressure of the pipeline (measured at the highest elevation of the test section) or 1.5 times the stated sustained working pressure (measured at the lowest elevation of the test section), whichever is greater. In no case should the test pressure exceed the rated working pressure for any joint, thrust restraint, valve, fitting, or other connected appurtenance of the test section.

Once all pressure limit states have been considered, the designer should select a PC and DR Ratio based on the controlling condition as outlined in AWWA C900 and the following table:

|  |  |  |
| --- | --- | --- |
| Pressure Class (PC) | Occasional SurgePressure Capacity | Dimension Ratio (DR) |
| 80 | 128 | 51 |
| 100 | 160 | 41 |
| 125 | 200 | 32.5 |
| 150 | 240 | 27.5 |
| 160 | 256 | 26 |
| 165 | 264 | 25 |
| 200 | 320 | 21 |
| 235 | 376 | 18 |
| 250 | 400 | 17 |
| 305 | 488 | 14 |

1. Pipe shall be supplied to meet the external loading requirements of the project as follows:
	1. Designed for a Type \_\_\_ trench in accordance with AWWA C605
	2. Maximum calculated deflection of 7.5%
	3. Live loads as calculated per AWWA M23 based on the profile shown on the plans
	4. Depth of cover as shown on the plans
	5. Trench width as shown on the plans
	6. Modulus of soil reaction (E’), bedding constant (K), and soil density (γ) shall be based on design and site conditions.

Trench widths should be kept to a minimum to ensure economical design and construction. For most projects, a minimum trench width of OD + 12 in. or 18 in. total (whichever is greater) is sufficient. Modulus of soil reaction and bedding constant values can be determined in accordance with the AWWA M23 manual. A soil density value of 120 pcf is utilized for most installations.

2.03 FITTINGS

1. PVC fittings shall be supplied in accordance with AWWA C900 and/or C907. PVCO fittings shall be supplied in accordance with AWWA C909 and/or C907.
2. Fittings may also be supplied as ductile iron fittings in accordance with AWWA C110 and/or C153.

2.04 PIPE JOINTS

1. Joints shall be gasket, bell and spigot and push-on type conforming to ASTM D3139.
2. Gasket materials shall meet requirements of ASTM F477.
3. Joint lubricant shall be approved by the Pipe Manufacturer, water soluble, non-toxic, and NSF approved for potable water applications.
4. Restraining of joints against thrust shall be accomplished by either integral joint restraint systems provided by the Pipe Manufacturer, external restraint systems, or thrust blocking.
5. Size and type of restraint will depend on pressures, pipe size, type of fitting/appurtenance, profile, soil type, and depth of cover. Contractor shall ensure that all external joint restraint systems are installed correctly including appropriate torqueing of bolts.
6. Thrust forces will be calculated as per AWWA M23 manual.

# PART 3 EXECUTION

3.01 GENERAL

1. Install pipe, fittings, specials, and appurtenances in accordance with AWWA C605, M23, UNI-B-9 and in accordance with the Pipe Manufacturer’s recommendations.
2. Lay pipe to the lines and grades as indicated on the Plans.
3. Tapping of pipe shall be in accordance with AWWA C605, M23, UNI-B-8 and Pipe Manufacturer’s recommendations. Direct tapping shall only be permitted for 6-inch through 16-inch (DR 18 and DR 14). Tapping of other sizes or classes of pipe will require the use of a tapping saddle.

3.02 PIPE HANDLING

1. Handle pipe and piping materials with care to avoid damage.
2. Prior to installation, each pipe length shall be carefully inspected for damage.
3. All pipe, fittings, and appurtenances shall be thoroughly cleaned before installation and shall be kept clean until installation and backfilling has completed.
4. Use only nylon ropes, slings, or other lifting devices that will not damage the surface of the pipe.
5. Keep the pipe clean and free of debris, dirt, animals, and trash during and after laying operations.
6. At the close of each operating day, seal the open end of the pipe using a gasketed night cap.

3.03 PIPE INSTALLATION

1. Do not drag pipe over gravel or rock. Avoid striking rocks or hard objects when lowering pipe into the trench.
2. Placement of pipe and fittings into the trench should be done with ropes and skids, slings on a backhoe bucket, or by hand.
3. Pipe or fittings shall not be thrown into the trench and no part of the pipe shall be allowed to take an unrestrained fall onto the trench bottom.
4. Joint sockets shall be carefully cleaned before pipes are lowered into trenches.
5. Pipe trenches and excavation shall be kept free of water during pipe laying operations and other related work. If high groundwater levels are expected or encountered, Contractor is to ensure that a minimum depth of cover of 1.5 times the pipe diameter will be maintained over the pipe once it has been installed or provide other methods approved by the Owner and Pipe Manufacturer of preventing flotation of the pipe.

3.04 JOINT MAKING

1. Install push-on joints as defined in AWWA C900.
2. Inspect the gasket, pipe spigot bevel, gasket groove, and sealing surfaces for damage or deformation. In cases when gaskets are supplied separately from pipe, Contractor is to ensure that gaskets supplied are designed for the pipe in use.
3. Clean the gasket of all extraneous matter.
4. Apply a thin film of joint lubricant to the inside of the gasket and the outside of the spigot prior to entering the spigot into the bell. Lubricated spigots ends shall not come in contact with soil or backfill material.
5. Insert the spigot end of the pipe carefully into the bell until the reference mark on the spigot is flush with the bell. If two reference marks are present, the mark closest to the spigot end shall be considered the minimum insertion mark, and the second mark shall be considered the maximum insertion mark. Under no circumstances will the spigot be inserted into the bell past the reference mark or maximum insertion mark.
6. For small diameter pipe, use the bar and block method for joint assembly or other method approved for use by the Owner and Pipe Manufacturer.
7. For large diameter pipe, use mechanical assistance such as hydraulic pipe pullers, jacks, pulleys, come-alongs, or a backhoe bucket. Observation by a spotter will be required when assembling joints for large diameter pipe to prevent over-insertion.
8. When using a field cut plain end piece of pipe, bevel the end with a beveling tool, wood rasp, or power sander to the same angle and length as provided on the factory-finished pipe. Redraw the insertion line on the spigot using a factory-marked spigot as a guide.
9. Angular changes in pipe alignment shall be achieved by either fittings, joint deflection, or longitudinal bending of the pipe.
10. Joint deflection shall not exceed the Pipe Manufacturer’s recommendation.
11. Field assembly of pipe fittings shall follow the Pipe Fittings Manufacturer’s recommendations.
12. Mechanical joints shall be assembled per the Pipe and/or Fittings Manufacturer’s recommendations as well as the recommendations of the mechanical joint supplier.

3.05 LONGITUDINAL PIPE BENDING

1. Controlled changes in direction may be accomplished by longitudinal bending of the pipe barrel.
2. Pipe Manufacturer will be consulted prior to start of construction for recommendations on longitudinal bending.
3. When longitudinal bending of pipe is utilized, Contractor shall use manual force alone to achieve prescribed bending. Mechanical means shall not be utilized to achieve longitudinal bending of the pipe.
4. When the desired change of direction in the pipeline exceeds the maximum allowable deflection specified, the longitudinal bending shall be made throughout a number of pipe lengths.
5. Contractor will ensure that pipe joints will not be over-pulled or over-inserted during longitudinal bending operations.

3.06 CLEANING, DISINFECTION, AND TESTING

1. All finished installations shall be pressure tested in accordance with AWWA C605 and the specifications herein.
2. Pipe shall be backfilled and braced to prevent movement during pressure testing. Testing of exposed or unburied pipe will not be permitted without the explicit approval of the Owner and Pipe Manufacturer.
3. Joint restraint at fittings should be permanent and constructed to withstand test pressure. If concrete thrust blocks are used, sufficient time must be allowed before testing to permit the concrete to cure.
4. Test ends should be restrained to withstand thrusts developed while under pressure.
5. The pipe shall be filled slowly from the lowest point on the line. Flow velocity during line filling should not exceed 1 ft/s.
6. All air should be expelled from a pipeline during filling and again before acceptance tests are conducted.
7. All fixtures, devices, or other accessories which are to be connected to the lines and which would be damaged if subjected to the test pressure shall be disconnected and ends of the branch lines are plugged or capped as required during the testing procedures.
8. Make-up water allowances shall not exceed the limits of AWWA C605. Any leaks that may occur shall be repaired in accordance with the recommendations of the Pipe Manufacturer to the satisfaction of the Owner, and the system shall be retested until no leaks are found.
9. Once the pipe has been successfully pressure tested, it shall be flushed and disinfected. Flushing should be done at flow rates sufficient to provide a velocity in the pipe of at least 2.5 ft/s. Disinfection of lines should comply with AWWA C651.

**END OF SECTION**

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| Revision Log |
| DATE | NAME | SUMMARY OF CHANGE |
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