MATERIAL SPECIFICATION

541. Reinforced Concrete Pressure Pipe

1. Scope

This specification covers the quality of reinforced concrete pressure pipe and fittings.

2. Manufacture and Fabrication

The pipe, the materials used in its manufacture, and the methods of fabrication shall conform to the requirements of the following specifications applicable to the specified type of pipe.

a. *Steel Cylinder Type, Pre-Stressed*: AWWA Standard C301 for Pre-stressed Concrete Pressure Pipe, Steel Cylinder Type, for Water and Other Liquids.
b. *Steel Cylinder Type, Not Pre-Stressed*: AWWA Standard C300 for Reinforced Concrete Pressure Pipe, Steel Cylinder Type, for Water and Other Liquids.
c. *Non-Cylinder Type, Not Pre-Stressed*: AWWA Standard C302 for Reinforced Concrete Pressure Pipe, Non-cylinder Type, for Water and Other Liquids.
d. *Steel Cylinder Type, Pre-Tensioned*: AWWA Standard C303 for Concrete Pressure Pipe, Bar-Wrapped, Steel Cylinder Type for Water and Other Liquids.
e. *Low Head Pressure Pipe*: ASTM Specification C 361. The following Specification Sections shall *not* apply:

AWWA C300 and C301, Sections 1.5 and 1.6.
AWWA C302 and C303, Sections 4.2 and 4.3.

3. Design

The actual pipe and fittings shall be designed by the manufacturer to withstand the specified external loads and internal pressures. Designs shall be by either of the following methods as applicable to the type of pipe specified:

a. Indirect Design: ASTM C497 for Standard Test Method for Concrete Pipe, Manhole Sections, or Tile.

Pipe design shall be based on the results of external crushing strength tests on a minimum two-foot length of the pipe or a specimen of equivalent size, design, and materials. The test shall demonstrate the following bearing loads:

1) For pipe manufactured according to ASTM C361, AWWA C300, or AWWA C302, the load required to produce a 0.01-inch crack on foot long.
2) For pipe manufactured according to ASTM C301, the load required to produce a 0.001-inch crack one foot long that is 10-percent greater than the specified three-edge bearing strength, whichever is lower.

In lieu of actual testing for this contract, pipe design may be based on Design Curve previously approved and published by the Natural Resources Conservation Service (formerly the Soil Conservation Service).

b. Direct Design: AWWA C304 for Design of Pre-stressed Concrete Cylinder Pipe or AWWA Manual M9 for Concrete Pressure Pipe.

Pipe design shall be based on structural analysis and design calculations.

c. Standard Design: ASTM C361 for Reinforced Concrete Low Head Pressure Pipe. Pipe design shall be as published in the standard.

4. **Steel Reinforcement**

The steel reinforcements shall conform to the requirements of the specifications cited in Section 2 for the specified type of pipe, *except that* elliptical reinforcing cages or other reinforcements that require special orientation of the pipe during placement will not be allowed.

5. Joints

The pipe joints shall conform to the requirements of the applicable specification for the pipe. They shall be bell-and-spigot type or double-spigot-and-sleeve type and shall have a positive groove in the spigot to contain the rubber gasket. The size and shape of the groove shall be such that it will prevent displacement of the gasket by either internal or external water pressure when the joint is in any position within the required range of movement capability. Joint sleeves, also referred to as "collars" or "coupling bands," shall conform to the requirements for bell rings in the applicable pipe specification.

The joints shall be constructed so as to permit relative movement of the adjoining pipe sections with no reduction of watertightness. The *joint length* and the limiting angle defining the required capability of relative movement at each joint shall be no less than specified.

Joint length refers to the permissible axial movement in the joint, and is defined as the maximum distance through which the spigot can move, relative to the bell or sleeve, from the fully engaged to the fully extended condition of the joint when the adjoining pipe sections are in parallel, concentric alignment. The joint is considered to be fully engaged when the spigot is inserted as far as it will go into the bell or sleeve, and fully extended when it is inserted the least amount that will ensure full confinement of the gasket and complete watertightness.

Joint length specified for double-spigot joints refers to the permissible movement in each of the spigot-to-sleeve connections, not the sum of the two.

The *limiting angle* of the joint is defined as the maximum deflection angle between adjoining pipe sections the joint will permit before the outer surface of the spigot comes into direct contact with inside of the mating bell or sleeve. If both spigot-to-sleeve connections of a double-spigot joint permit angular movement, the limiting angle of the joint is the sum of the two deflection angles permitted by the two connections.

6. Gaskets

The pipe joint gaskets shall conform to the requirements of the specifications cited in Section 2 of this specification. They shall be endless rubber gaskets having circular cross section. The cross-sectional diameter of the gaskets shall conform to the pipe manufacturer's recommendation for the type and size of pipe furnished.

7. Marking

All pipe sections and special fittings shall be marked by the manufacturer with the manufacturer's name or trademark, the date of manufacture, the nominal size, design head, design external load and the structure site for which it was designed and manufactured.

8. Certification

All component materials and actual pipe fabrication shall be tested, inspected, and documented as prescribed in the manufacturing specifications for the type of pipe specified. All documentation noted in the manufacturing specifications shall be submitted to the Engineer. Documentation shall include current test reports on steel and steel wire reinforcing and compression tests of concrete used in the manufacture of the furnished pipe.

For pipe design based on actual external crushing strength tests, the Engineer shall witness the actual test.

For pipe design based on published Design Curves, a copy of the appropriate design curve marked to show the resultant concrete core stress and corresponding three-edge bearing load, and a specification sheet showing all data and dimensions necessary to calculate the resultant core stress, for the pipe furnished shall be submitted to the Engineer.

For pipe design based on structural analysis and calculations, such analysis and calculations shall be submitted to the Engineer. Printouts of such calculations by computer programs shall be sufficiently detailed to enable comparison with standardized procedures and methods.

Drawings, details, and descriptions of the pipe joints as necessary to show that the joint conforms to the specified requirements shall also be submitted.