RECOMMENDED SPECIFICATION FOR THERMOPLASTIC PIPE JOINTS, PRESSURE AND NON-PRESSURE APPLICATIONS
Prepared by the

UNI-BELL PVC PIPE ASSOCIATION

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SECTION 1 – SCOPE

1.1 This specification covers the requirements for thermoplastic pipe with gasketed joints formed on a continuous pipe length, utilizing elastomeric seal for pressure and non-pressure applications. The seal is to prevent leakage at the joint either from exfiltration or infiltration.

1.2 The test methods described for the joints are not intended to be routine quality control tests but to be reliability or performance requirements conducted in a laboratory on an assembled joint.

SECTION 2 – DEFINITIONS

2.1 JOINTS

The gasketed joint is designed so that when assembled, the elastomeric gasket(s) is compressed radially between the pipe spigot and bell to form a positive seal. The joint shall be so designed to avoid possible displacement of the gasket from the joint during assembly and when in service.

2.1.1 Pressure Pipe Joints: The bell wall thickness at any point between the annular gasket space and the pipe barrel shall conform to the dimension ratio of the pipe. The wall thickness in the sealing portion of the annular gasket space shall be at least the minimum wall thickness of the pipe (see Examples 1 and 2), otherwise the joint design shall be tested to verify that the Hydrostatic Design Basis Category for the joint assembly is not lower than the Hydrostatic Design Basis Category for pipe when tested under the same procedure. The Hydrostatic Design Basis for this joint design shall be established on a representative size at the minimum test level of 10 points and 2,000 hours in accordance with ASTM D 2837, except that the ends shall be restrained. Test pressure levels for establishing Hydrostatic Design Basis shall be calculated on pipe minimum wall dimensions.

Joint design shall require retesting under this section only if the joint design is changed or if the pipe compound is altered in any manner which produces a lower long-term hydrostatic strength when compared with the compound used in the previous validation testing of the joint design.

2.1.2 Non-Pressure Pipe Joints: The pipe and bell shall be homogeneous throughout. The thickness of the wall in the bell shall be satisfactory if it was formed from pipe with standard acceptable wall thickness. See Example 3.

SECTION 3 – JOINT REQUIREMENTS

3.1 All surfaces of the joint upon which the gasket may bear shall be smooth and free of such imperfections, fractures or cracks that could adversely affect sealability.

3.2 DIMENSIONS AND TOLERANCES

The critical sealing dimensions of the bell, spigot and gasket shall be in accordance with the manufacturer's standard dimensions and tolerances. The method of measuring shall be in accordance with ASTM D 2122.

3.3 GASKET COMPRESSION AND MANUFACTURE

All gaskets shall be molded into a circular form or extruded to the proper section and then spliced into circular form and shall consist of a properly processed high grade elastomeric compound. The basic polymer shall be natural rubber, synthetic elastomer or a blend of both, acceptable to the purchaser.
and meeting the physical requirements prescribed with in this specification. The
gasket shall provide an adequate compressive force against the sealing surfaces of the bell
and spigot so as to affect a positive seal under all combination of joint tolerances.
The gasket shall be the only element depended upon to make the joint flexible and
water-tight.

3.3.1 Physical Requirements: The elastomeric compound shall comply with
ASTM F 477.

3.4 LUBRICANT

3.4.1 Pressure Pipe Joint Lubricant: The lubricant used for joint assembly shall be a
water soluble lubricating agent which will not support bacterial growth and will not
adversely affect the potable qualities of the water to be transported. The lubrication shall
not be detrimental to the gasket or the pipe.

3.4.2 Non-Pressure Pipe Joint Lubricant: If a lubricant is required to
facilitate assembly, it shall have no
detrimental effect on the gasket or the pipe
when subjected to prolonged exposure.

SECTION 4 – LABORATORY
PERFORMANCE
REQUIREMENTS

The assembled joints shall be certified by
the manufacturer as having met the following
laboratory performance test.

4.1 PRESSURE APPLICATIONS

4.1.1 Test Conditions: The joint assembly
shall be subjected to a laboratory test of both
internal hydrostatic pressure and an internal vacuum or an external pressure.

4.1.1.1 Internal Hydrostatic Pressure
Test: The assembly shall be subjected to an
internal hydrostatic pressure of 2 1/2 times
rated pressure for 60 minutes without
leakage. The pressure shall then be increased
up to the minimum short-term rupture
requirement of the pipe without leakage.

4.1.1.2 Internal Vacuum or External
Pressure Test: The assembly shall be
subjected to an internal vacuum of 22 inches
of mercury or an external pressure of 10.8
PSIG (25 feet of water head) for 60 minutes
without leakage.

4.1.1.3 Pipe in Concentric Alignment:
The assembly in concentric alignment shall
be subjected to the test conditions of 4.1.1.1
and 4.1.1.2.

4.1.1.4 Pipe In Angularly Deflected
Position, Internal Hydrostatic Pressure
Test: After completing the test in 4.1.1.3, the
assembly shall be deflected angularly to the
maximum amount recommended by the
manufacturer and subjected to the test
conditions of 4.1.1.1 and 4.1.1.2.

4.2 NON-PRESSURE APPLICATIONS

4.2.1 Test Conditions: The joint assembly
shall be subjected to a laboratory test of both
internal hydrostatic pressure and an internal vacuum or external pressure.

4.2.1.1 Internal Hydrostatic Pressure
Test: The assembly shall be subjected to an
internal pressure of 21.7 PSIG (50 feet of
head) for 10 minutes without leakage.

4.2.1.2. Internal Vacuum or External
Pressure Test: The assembly shall be
subjected to an internal vacuum of 22 inches
of mercury or an external pressure of 10.8
PSIG (25 feet of head) for 60 minutes
without leakage.

4.2.1.3 Pipe in Concentric Alignment:
The assembly in concentric alignment shall
be subjected to the test conditions of 4.2.1.1
and 4.2.1.2.

4.2.1.4 Pipe In Angularly Deflected
Position: After completing the test in 4.2.1.3,
the assembly shall be deflected angularly to
the maximum amount recommended by the
manufacturer and subjected to the test
conditions of 4.2.1.1 and 4.2.1.2.

4.2.1.5 Pipe In Shear Loaded Condition:
The joint assembly shall be deflected to 5
percent diametric deflection at the load point,
or to a greater deflection as recommended by
the manufacturer, while being subjected to
the test conditions described in 4.2.1.1 and
4.2.1.2.
The bell shall be supported from the bottom by a flat plate and the deflecting load shall be applied to the top of the spigot with a transverse 1 1/2 inch diameter rod. The point of loading and deflection measurement shall be a distance equal to one-half the pipe diameter from the gasket center line or at the end of the bell, whichever is greater, but not to exceed 12 inches. See Figure 1.

Note - The 5 percent diametric deflection criterion, which was arbitrarily selected for testing convenience, should not be considered as a limitation with respect to in-use deflection.

**SECTION 5 – FIELD STORAGE**

5.1 PIPE

Store pipe in unit packages provided by the manufacturer. Prevent compression, deformation or damage to bell ends of the pipe. Support unit packages with racks or dunnage to prevent damage and bending. When unit packages of pipe are stacked, insure that weight of upper units does not cause deformation to pipe in lower units.

5.2 ELASTOMERIC GASKET

Gaskets should be protected from excessive exposure to heat, direct sunlight, ozone, oil or grease.

**EXAMPLE 1**

Relationship of Bell Dimensions in 2.1.1

\[ S_w = \text{hydrostatic design stress} \]
\[ P_w = \text{pressure rating} \]

shall be determined as follows:

\[ S_w = P_w (D - e) / 2e \]  
(Method D 2837)

\[ e_1 = D_1 [(2S_w / P_w) + 1] \]
\[ e_2 = D_2 / [(2S_w / P_w) + 1] \]
\[ e_3 \geq e_1 \]
\[ e_4 \geq e_1 \]

\[ C_L = \text{center line} \]
\[ D_1 = \text{average outside diameter - pipe} \]
\[ D_2 = \text{average outside diameter - socket} \]
\[ D_3 = \text{average outside diameter - annular gasket space} \]
\[ D_4 = \text{average outside diameter - entry lip} \]
\[ e_1 = \text{minimum wall thickness - pipe} \]
\[ e_2 = \text{minimum wall thickness - socket} \]
\[ e_3 = \text{minimum wall thickness - sealing portion of the annular gasket space} \]
\[ e_4 = \text{minimum wall thickness - entry lip} \]
EXAMPLE 2

Relationship of Bell Dimensions in 2.1.1

\[ \begin{align*}
C_L & = \text{center line} \\
D_1 & = \text{average outside diameter - pipe} \\
D_2 & = \text{average outside diameter - socket} \\
D_3 & = \text{average outside diameter - sealing portion of the annular gasket space} \\
D_3' & = \text{average outside diameter - locking portion of the annular gasket space} \\
D_4 & = \text{average outside diameter - entry lip} \\
e_1 & = \text{minimum wall thickness - pipe} \\
e_2 & = \text{minimum wall thickness - socket} \\
e_3 & = \text{minimum wall thickness - sealing portion of the annular gasket space} \\
e_3' & = \text{minimum wall thickness - locking portion of the annular gasket space} \\
e_4 & = \text{minimum wall thickness - entry lip} \\
S_w & = \text{hydrostatic design stress} \\
P_w & = \text{pressure rating} \\
\text{shall be determined as follows:} \\
S_w & = P_w(D - e) / 2e \quad (\text{Method D 2837}) \\
e_1 & = D_1 [(2S_w / P_w) + 1] \\
e_2 & = D_2 [(2S_w / P_w) + 1] \\
e_3 & = e_1 \\
e_3' & \geq 0.9e_1 \\
e_4 & \geq e_1
\end{align*} \]
EXAMPLE 3

Relationship of Bell Dimensions in 2.1.2

\[ D_1 = \text{minimum inside diameter - pipe barrel} \]
\[ D_3 = \text{average outside diameter - pipe barrel} \]
\[ t = \text{minimum waterway wall thickness - pipe barrel} \]
\[ D_2 = \text{average inside diameter - pipe bell} \]
\[ D_4 = \text{average outside diameter - pipe bell} \]

FIGURE 1

Shear Load Test

*Use restrained end closure

Apply a shear load as shown above, at a point on the spigot of the joint assembly equal to one-half the spigot outside diameter axially away from the gasket enter line or at the end of the bell, whichever is greater, but not to exceed 12 inches, to that extent which results in a minimum diametric deflection of 3 percent of the spigot measured at the point of load application.

The Shear Load Test is a requirement of Section 4.2.1.5 and applies only to non-pressure pipe.