

MATERIAL SPECIFICATION

537.Non-Metallic Waterstops

1. Scope

This specification covers non-metallic waterstops for use in joints of concrete structures.

2. Classification

- a. Classes: Non-metallic waterstops shall be of the following classes, as specified:

Class I shall be fabricated of either natural or synthetic rubber.

Class II shall be fabricated of vinyl chloride polymer or copolymer.

- b. Types: Non-metallic waterstops may be either split or solid and shall conform to the following types, as specified, (see Figure 1):

Type A shall have ribbed anchor flanges and a smooth web. Flanges may be of uniform thickness or may have either a converging or a diverging taper toward the edges.

Type B shall have ribbed anchor flanges and a smooth web containing a hollow tubular center bulb having: (1) a wall thickness equal to at least one-half ($\frac{1}{2}$) the web thickness, and; (2) the inside diameter (D) specified in the specifications or shown on the drawings. Flanges may be of uniform thickness or may have either a converging or a diverging taper toward the edges.

Type C shall have a single, circular bulb-type anchor flange at each edge and a smooth web.

Type D shall have a single, circular bulb-type anchor flange at each edge and a smooth web containing a hollow tubular center bulb having: (1) a wall thickness equal to a least one-half ($\frac{1}{2}$) the thickness of the web, and; (2) the inside diameter (D) specified in the contract.

Type E shall have ribbed anchor flanges and a web molded or extruded in the form of a round or U-shaped bulb of the dimensions specified in the contract or shown on the drawings. The web bulb shall be connected at the open-end of the "U" by a thin membrane having a minimum thickness of $\frac{1}{64}$ -inch and a maximum thickness of $\frac{1}{5}$ of the web thickness and design to: (1) prevent infiltration of wet concrete into the bulb, and; (2) tear when expansion of the joint occurs. Flanges may be of uniform thickness or may have either a converging or a diverging taper toward the edges. Auxiliary positioning or nailing flanges may be provided as long as the functioning of the web bulb is not altered.

Type F shall have ribbed anchor flanges with a minimum of two (2) extra heavy ribs, designed to resist displacement of the waterstop during concrete placement on each flange, and a smooth web having a positioning or nailing flange attached at the center.

Type G shall be of special design conforming to the details shown on the drawings.

- c. Sizes: Waterstops of Types A through F shall be of the sizes specified in the specifications or shown on the drawings and listed in Table 1 of this specification. Type G waterstops shall have the dimensions shown on the drawings.

3. Physical Requirements

The extruded or molded materials shall exhibit the properties specified herein when tested by the methods specified in Section 4 of this specification.

a. Class I Waterstops

- 1) The hardness as determined by the Shore A durometer method shall be a minimum of 60.
- 2) The specific gravity shall be a maximum of 1.2.
- 3) The tensile strength shall be a minimum of 2500 pounds per square inch (psi).
- 4) The ultimate elongation shall be a minimum of 450 percent.
- 5) The compression set shall be a maximum of 30 percent.
- 6) The water absorption in weight measurements shall not exceed five (5) percent.
- 7) The decrease in tensile strength and ultimate elongation after aging shall not exceed 20 percent.
- 8) There shall be no sign of failure due to brittleness at a temperature of -35°F.

b. Class II Waterstops

- 1) The hardness as determined by the Shore A durometer method shall be a minimum of 60.
- 2) The specific gravity shall be a maximum of 1.4.
- 3) The tensile strength shall be a minimum of

1400 pounds per square inch (psi).

- 4) The ultimate elongation of the web shall be a minimum of 280 percent and the flanges shall be a minimum of 200 percent.
- 5) There shall be no sign of failure due to flange brittleness at a temperature of 0°F nor of web brittleness at a temperature of -35°F.
- 6) The decrease in either tensile strength or ultimate elongation after accelerated extraction shall not exceed 15 percent.
- 7) Results of alkali exposure:
 - a) After immersion for seven (7) days, the sample shall exhibit no loss of weight and a maximum weight gain of 0.25 percent, and the hardness measured by the Shore A durometer method shall not vary more than 5 points either plus or minus from the untreated sample.
 - b) After immersion for 30 days, the sample shall exhibit no loss of weight and a maximum weight gain of 0.40 percent, and the dimensions of the treated sample shall not vary by more than one (1) percent from the untreated sample.

4. Test Methods

Testing shall be conducted by the methods cited herein. All cited test methods are included in ASTM as follows:

- a. Hardness shall be determined by ASTM D 2240.
- b. Specific gravity shall be determined by ASTM D 792.
- c. Tensile strength shall be determined by ASTM D 412 for Class I waterstops and ASTM D 638 for Class II waterstops.

- d. Ultimate elongation shall be determined by ASTM D 412 for Class I waterstops and ASTM D 638 for Class II waterstops.
- e. Compression set shall be determined by ASTM D 395.
- f. Water absorption shall be determined by ASTM D 570.
- g. Tensile strength and ultimate elongation after aging shall be determined by ASTM D 412 for Class I waterstops and ASTM D 638 for Class II waterstops.
- h. Brittleness shall be determined by ASTM D 746 for Class II waterstops.
- i. Accelerated extraction shall be accomplished by procedures outlined by United States Army Corps of Engineers (USACE) Concrete Research Division (CRD) C 572 under the following conditions:
 - 1) Samples shall not be less than $\frac{1}{16}$ inch nor more than $\frac{1}{8}$ inch in thickness;
 - 2) The immersion medium shall be a solution prepared by dissolving five (5) grams of chemically pure sodium hydroxide and five (5) grams of chemically pure potassium hydroxide in, one (1) liter of water;
 - 3) The samples shall be immersed in the medium for 14 days at a temperature of $145^{\circ}\text{F} \pm 5^{\circ}\text{F}$;
 - 4) During the period of immersion, air shall be gently bubbled through the medium from a $\frac{1}{4}$ -inch diameter glass tube at an approximate rate of one (1) bubble per second;
 - 5) Fresh medium shall be provided each day;
 - 6) Samples need not be dipped in acetone.
- j. The effects of alkalis shall be determined by USACE CRD C 572 under the following conditions:
 - 1) Sample shall have a maximum thickness of $\frac{1}{4}$

- inch;
- 2) The immersion medium shall be as described in (i) above;
 - 3) Fresh medium shall be provided every seven (7) days;
 - 4) The samples shall be immersed in the medium for a period of 30 days;
 - 5) Samples need not be dipped in acetone.

5. Condition

Waterstops shall be extruded or molded in such a manner that the material is dense and homogeneous throughout and free from voids, tears, thins, indentations, or other imperfections. Unless otherwise specified, waterstops shall be symmetrical in shape and uniform in dimensions and shall be furnished in continuous strips of minimum length of fifty (50) feet. Factory splices shall have a minimum tensile strength of fifty (50) percent of the unspliced section.

6. Packaging and Storing

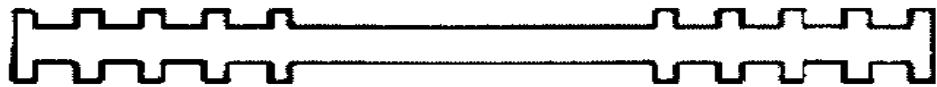
Waterstops shall be packaged and stored by methods that will provide protection from prolonged exposure to direct sunlight and/or excessive heat.

Table 1 Sizes of Waterstops		
Size Designation	Web Thickness (T) Inches	Width (W) Inches
1	$\frac{1}{16}$	5¼
2	$\frac{3}{32}$	3¾
3	$\frac{3}{32}$	5¼
4	$\frac{3}{32}$	5¼
5	$\frac{3}{32}$	6
6	$\frac{1}{8}$	4
7	$\frac{1}{8}$	5 ¼
8	$\frac{1}{8}$	6
9	$\frac{5}{32}$	4
10	$\frac{5}{32}$	4 ½
11	$\frac{5}{32}$	9
12	$\frac{3}{16}$	4
13	$\frac{3}{16}$	5
14	$\frac{3}{16}$	6
15	$\frac{3}{16}$	9
16	$\frac{1}{4}$	6
17	$\frac{1}{4}$	9
18	$\frac{3}{8}$	5
19	$\frac{3}{8}$	6
20	$\frac{3}{8}$	9
21	$\frac{1}{2}$	6
22	$\frac{1}{2}$	9
23	$\frac{1}{2}$	12

Figure 1

TYPES OF NON-METALLIC WATERSTOPS

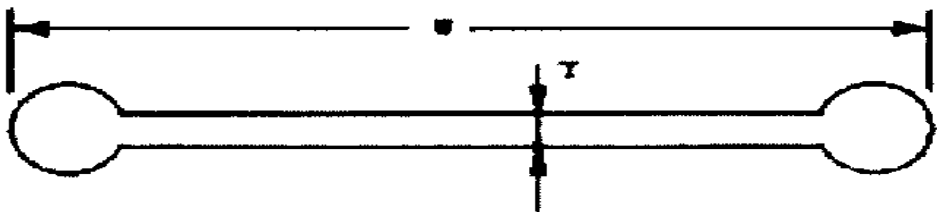
TYPE A



TYPE B



TYPE C



TYPE D



TYPE E



TYPE F

