



MATERIAL SPECIFICATION FOR POLYVINYL CHLORIDE WATERSTOPS

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1204.01 SCOPE

This specification covers the polyvinyl chloride waterstops for joints in concrete structures.

1204.01.01 Specification Significance and Use

This specification is written as a municipal-oriented specification. Municipal-oriented specifications are developed to reflect the administration, testing, and payment policies, procedures, and practices of many municipalities in Ontario.

Use of this specification or any other specification shall be according to the Contract Documents.

1204.01.02 Appendices Significance and Use

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner. Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

1204.02 REFERENCES

When the Contract Documents indicate that municipal-oriented specifications are to be used and there is a municipal-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.MUNI, unless use of a provincial-oriented specification is specified in the Contract Documents. When there is not a corresponding municipal-oriented specification, the references below shall be considered to be the OPSS listed, unless use of a provincial-oriented specification is specified in the Contract Documents.

This specification refers to the following standards, specifications, or publications:

ASTM International

D412-16e1	Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers - Tension
D624-00(2020)	Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers
D2240-15e1	Standard Test Method for Rubber Property - Durometer Hardness

1204.05 MATERIALS

1204.05.01 General Requirements

The waterstops shall be extruded from a polyvinyl chloride compound to meet the performance requirements given in this specification. Reworked polyvinyl chloride may be used but reclaimed polyvinyl chloride will not be permitted.

1204.05.02 Physical Requirements

The waterstop shall meet the requirements specified in Table 1. All tests shall be made on specimens prepared from the extruded waterstops.

When required, the thickness of specimens shall be reduced to between 1.5 and 3.0 mm by buffing, or slicing.

The extruded material shall be dense, homogeneous, of smooth surface, and free from porosity and other imperfections.

1204.07 PRODUCTION

1204.07.01 General

The waterstops shall be of the shape and dimensions specified in the Contract Documents. The cross-section of the waterstop shall be uniform along its length and shall be symmetrical transversely so that the thickness at any given distance from either edge of the waterstop will be uniform.

All splices in the waterstop shall be watertight.

1204.07.02 Quality Control

1204.07.02.01 Testing Procedures

1204.07.02.01.01 General

Testing procedures shall be according to the relevant ASTM standards indicated in Table 1, except that modulus of elasticity, effect of alkali, accelerated extraction, cold bend, and low temperature impact resistance shall be determined according to the procedures described in the following clauses.

1204.07.02.01.02 Modulus of Elasticity

Conformance shall be determined on the average of the results from tests on three specimens. Testing shall be carried out according to the following:

- a) Each specimen shall be 25 mm in length and of the full cross-section of the finished waterstop.
- b) The specimen shall be clamped in the testing machine in such a manner as to form a cantilever beam with the 25 mm dimension as the beam width.
- c) The specimen shall be held between the bulb and the nearest rib on either side of the bulb.
- d) The load shall be applied at the rib farthest from the clamp, across the full width of the specimen by a rigid blade type loading head of 0.8 mm contact edge radius.
- e) With the load value being that obtained for a deflection rate of 5 mm/min the modulus of elasticity of the material shall be calculated from the following formula.

$$E = \frac{4P \times L^3}{\Delta \times b \times t^3}$$

Where

- E = modulus of elasticity, kilopascals
- P = applied load, kilonewtons
- L = span length, millimetre
- Δ = deflection under applied load, millimetres
- b = width of the specimen 25 mm
- t = average thickness of the specimen, millimetres

1204.07.02.01.03 Effect of Alkali

Testing shall be carried out according to the following:

- a) Three specimens shall be cut from the waterstop, each having a mass of 75 grams.
- b) The specimens shall be washed in tap water, rinsed with distilled water, wiped with a clean cloth, and allowed to dry in laboratory air for approximately one hour.
- c) The mass of each specimen shall be recorded to the nearest 0.001 gram.
- d) Using a Shore durometer, Type A, a durometer reading shall be taken according to ASTM D2240.
- e) The specimens shall be completely immersed in a freshly made solution containing 5.0 grams of chemically pure sodium hydroxide and 5.0 grams of chemically pure potassium hydroxide in one litre of distilled water kept at 21 to 24 °C. The solution shall be replaced every 7 Days.

- f) At the end of 7 Days and at the end of 28 Days the specimens shall be removed, rinsed with distilled water, the surfaces wiped with a clean cloth, and allowed to dry in laboratory air for approximately one hour.
- g) The mass shall be measured and recorded at the end of 7 Days and at the end of 28 Days. The durometer hardness shall be measured and recorded at the end of 7 Days. Mass changes shall be recorded as a percentage of the original mass and the hardness change in durometer units.

1204.07.02.01.04 Accelerated Extraction

Testing shall be carried out according to the following:

- a) Five tensile test specimens according to ASTM D412 Die C, each weighed to the nearest 0.001 gram, shall be placed in a one litre tall form beaker with spout.
- b) The beaker shall be filled to within 50 mm of the top, with a solution made by dissolving 5.0 grams of chemically pure potassium hydroxide in one litre of distilled water. The specimens shall be completely immersed and the top of the beaker covered with a watch glass.
- c) The beaker shall then be placed in a constant temperature bath and the temperature of the solution maintained between 60 and 65 °C. The solution shall be changed every 24 hours, with the new solution being warmed to 65 °C before replacing the old.
- d) A 6 mm diameter glass tube shall be inserted in the spout of the beaker to within 12 mm of the bottom of the beaker. Air shall then be gently bubbled through the solution at the rate of about one bubble per second.
- e) Once daily each of the five specimens shall be removed from the beaker, rinsed lightly with distilled water, and then superficially dried with a clean cloth. Ten minutes after the specimens have been thus dried, the group of five specimens shall be weighed and mass recorded.
- f) The sequence of testing shall be carried out continuously for a period of not less than 14 Days.
- g) After the 14 Day period, provided the specimens have reached constant mass, they shall be tested for tensile strength and elongation. Constant mass is assumed to have been achieved when the masses of the group of specimens on three successive weigh-ins do not differ from each other by more than 0.05% of the original mass. Prior to being tested for tensile strength and elongation, the specimens shall be removed, rinsed, stored for ten minutes and weighed. If the tests for tensile strength and elongation cannot be made within one hour after completion of the weigh-ins indicating the achievement of constant mass, the specimens shall be stored immersed in a fresh alkali solution at room temperature. Tensile strength shall be calculated from the total load at failure, the nominal width, and the thickness as determined prior to the extraction test. The tensile strength and elongation shall be determined not more than 72 hours after the weigh-ins which demonstrated that constant mass had been achieved.
- h) If constant mass has not been achieved after 90 Days, the exposure shall be terminated, the specimen tested for tensile strength and elongation, and a note added to the report indicating the mass losses between the last successive weigh-ins and the fact that constant mass, as here defined, was not achieved.

1204.07.02.01.05 Cold Bend

Three specimens, each between 1.5 and 3.0 mm thick, 25 mm wide, and 150 mm long shall be cooled to 10 °C then immediately bent through 180 degrees around a 6 mm diameter mandrel. Any cracking shall constitute a failure.

1204.07.02.01.06 Low Temperature Impact Resistance

Testing shall be carried out according to the following:

- a) Three specimens from a finished waterstop, each 100 to 150 mm long and of full cross-section, shall be rigidly clamped in a horizontal position in such a manner as to form a cantilever beam of length equal to the cross-sectional width. There shall be a minimum of 125 mm vertical clearance below the unsupported section of the beam.
- b) The test assembly and specimens shall be cooled to a temperature of -35 °C.
- c) At that temperature the unsupported section shall be struck centrally with a 3.6 kg steel ball dropped freely through 1.5 m.

Any cracking or chipping of the specimen shall constitute failure.

1204.07.03 Test Certificates

Two certified copies of the manufacturer's test results for the lot numbers shall be provided for all shipments to the Contract or storage depots. One copy shall be included with the shipment and a second copy shall be sent to the Contract Administrator.

1204.07.04 Acceptance or Rejection

All waterstops failing to meet any of the requirements of this specification shall be rejected. Rejected materials shall be expeditiously removed and replaced with acceptable materials at no additional expense to the Owner.

1204.07.05 Marking

All waterstops shall be identified as to the manufacturer by means of a colour. These colours shall be registered with the Owner and shall be used in all waterstops produced by the respective manufacturer.

The waterstop shall be marked with the lot number.

1204.07.06 Packaging

The waterstop shall be packaged as coils in containers so constructed as to ensure safe delivery. The inside diameter of the coil shall be at least 300 mm.

The waterstop in the coil shall be of continuous length.

The waterstop shall be clearly identified by affixing labels to the coils and containers. The labels shall indicate the following:

- a) Manufacturer's name.
- b) Trade name.
- c) Lot number.
- d) Coil number.
- e) Length of the waterstop in the coil.
- f) Size.

1204.08 QUALITY ASSURANCE

The Owner may perform such inspection, sampling, and testing at such times and locations deemed necessary to determine the acceptability of the waterstops.

1204.09 OWNER PURCHASE OF MATERIAL

1204.09.01 Measurement and Payment

Payment at the price specified in the purchasing order, in metres along the length of the waterstops for the type specified, shall be full compensation for all labour, Equipment, and Material to supply the waterstops to the destination at the time specified.

Where material is sampled by the Owner's representative after packaging, measurement shall be made of the original quantity as packed.

**Table 1
Physical Requirements for Waterstops**

Property	Physical Requirements	Test Procedure
Tensile Strength, Mpa	minimum 10 average of 5 specimens	ASTM D412 Die C
Ultimate Elongation, %	minimum 275 average of 5 specimens	ASTM D412 Die C
Tear Resistance, N/mm	minimum 44 average of 3 specimens	ASTM D624 Die B
Modulus of Elasticity, MPa	minimum 24	See Modulus of Elasticity clause
Effect of Alkali 7 Day - mass increase, % - mass decrease, % - hardness change, points 28 Day - mass increase, % - mass decrease, %	maximum 0.25 maximum 0.10 ± 5 maximum 0.40 maximum 0.30	See Effect of Alkali clause.
Accelerated Extraction Tensile Strength, MPa Ultimate Elongation, %	minimum 90 minimum 250	See Accelerated Extraction clause
Cold Bend	Pass	See Cold Bend clause
Low Temperature Impact Resistance	Pass	See Low Temperature Impact Resistance clause

**Appendix 1204-A, November 2021
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS**

Note: This is a non-mandatory Commentary Appendix intended to provide information to a designer, during the design stage of a contract, on the use of the OPS specification in a municipal contract. This appendix does not form part of the standard specification. Actions and considerations discussed in this appendix are for information purposes only and do not supersede an Owner's design decisions and methodology.

Designer Actions/Considerations

The designer should specify the following in the Contract Documents:

- Waterstop shape and dimensions. (1204.07.01)

The designer should ensure that the General Conditions of Contract and the 100-Series General Specifications are included in the Contract Documents.

Related Ontario Provincial Standard Drawing

OPSD 3950.100 Joints, Concrete Expansion and Construction, on Structure