Tech Tips 037

Flexible PVC Waterstop Specifier Guide

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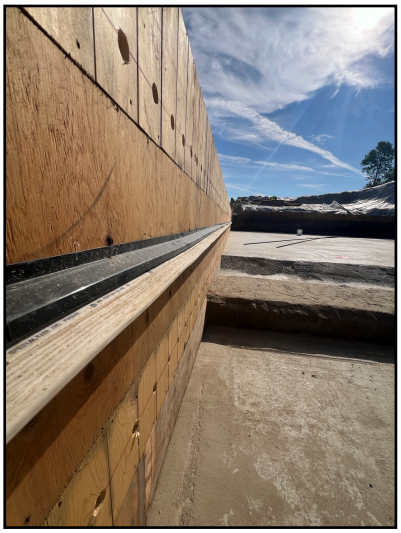

Earth Shield® PVC Waterstop in split wooden form with Keycup® keyway form system.

This document presents an engineering and specifier white paper outlining the typical material properties of flexible PVC waterstop. These properties are representative of high-quality embedded concrete waterstops used in structural, water-retaining, and containment applications in accordance with ACI 318 and ACI 350.

Material Description

Earth Shield® Flexible PVC Waterstop is a plasticized thermoplastic material engineered for installation within concrete joints to prevent fluid migration. Performance is achieved through mechanical embedment, rib geometry, and controlled centerbulb deformation rather than elastomeric rebound.

Ontario Hydro (now Hydro One/OPG) conducted pioneering, large-scale PVC waterstop testing in the 1950s, finding significant property changes (increased strength, decreased elongation) with temperature shifts but confirming good long-term performance with data showing minimal deterioration even after decades, with key aging tests (like CRD C-572) focusing on strength, elongation, and hardness loss, revealing excellent resistance to waterborne chemicals and minimal plasticizer loss in real-world scenarios, establishing benchmarks for PVC waterstop durability.

Key Findings from Ontario Hydro & Related Research:

- **Early Benchmarks (1954):** Ontario Hydro's initial tests established benchmarks for flexible PVC (fPVC) waterstops, noting increases in tensile strength (40-100%) and reductions in elongation (25-70%) when transitioning from warm to cold temperatures (73°F to -15°F).
- **Long-Term Performance:** Decades of service showed PVC waterstops retained mechanical properties and strength, exceeding **100-year life expectations**, with some exhumed waterstops showing virtually no change in physical properties or pressure resistance.

- **Accelerated Aging Effects:**
  - **Heat/Moisture:** High-temperature aging (e.g., 140°F) showed decreasing dimensions, plasticizer content, and increasing hardness, but this rate differed significantly between waterstops in concrete vs. in air.
  - **Water/Chemicals:** PVC proved highly resistant to water absorption, acids, alkalis, and ozone, with tests showing minimal weight/hardness/tensile changes from chemical exposure (e.g., CRD C-572 standards).
  - **Plasticizer Loss:** Mass loss in aging PVC was primarily due to plasticizer loss, but studies on aged waterstops showed good residual stability and function, even after many years.

- **Accelerated Aging Methods:** Tests involved high heat cycles (266°F/ -14°F), UV exposure (ASTM G154), and extended exposure to elevated temperatures (230°F) to simulate decades of use, correlating with field performance.

JP Specialties, Inc. / Earth Shield® Waterstop

Typical Earth Shield® PVC Waterstop Properties

Property	Test Method	Typical Value	Engineering Relevance
Hardness (Shore A)	ASTM D2240	75–80 (Typical: 77)	Optimal balance of flexibility and embedment stability
Specific Gravity	ASTM D792	1.35 – 1.40 (Typical: 1.37)	Indicates plasticized PVC formulation
Tensile Strength	ASTM D638	1,500 – 2,200 psi [Typical 2,100]	Resists joint movement stresses
Ultimate Elongation	ASTM D638	300% – 400% (Typical 350%)	Accommodates differential and transverse movement
Tear Strength	ASTM D624	250 – 400 ppi [Typical 310 lbs/in]	Durability during installation and service
Stiffness in Flexure	ASTM D747	600 – 800 psi (Typical 700 psi)	Moderate stiffness vs elastomeric materials
Drinking Water Safe	NSF 61	Certified	Can be used in potable water
Health and Safety	California Prop 65	Compliant	No health warning on SDS
Effect of Alkali Weight Change	CRD C572-74	0.11%	Conforms
Effect of Alkali Hardness Change	CRD C572-74	±1 point	Conforms

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Compression and Long-Term Recovery Performance

Property	Test Method	Condition	Typical Value
Compression Set	ASTM D395	22 hrs @ 70°C	25% – 40%
Compression Set	ASTM D395	22 hrs @ 100°C	40% – 60%
Recovery Behavior	Cyclic Compression (Reference)	Ambient	Moderate (non-elastomeric)
Creep Resistance	ASTM D2990 (Reference)	Long-Term Load	Moderate plastic creep over time

Performance in ACI 318 & ACI 350 Concrete Joint Systems

Flexible PVC waterstops have a proven multi-decade performance history in civil infrastructure, wastewater, and containment structures. Unlike elastomeric materials, sealing reliability is derived from full concrete encasement, ribbed anchorage fins, and centerbulb deformation to accommodate shear, transverse, and differential movement across construction and expansion joints.

Specifier Comparison: Flexible PVC vs TPV Waterstop

Evaluation Criteria	Flexible PVC Waterstop (≈77 Shore A)	TPV Waterstop (≈87 Shore A)	Specifier Interpretation (ACI 350)
Compression Set (ASTM D395 @ 70°C)	25–40%	15–30%	Lower compression set favors TPV, but embedded PVC relies on mechanical seal, not gasket rebound
Elastic Recovery	Moderate (thermoplastic)	Excellent (elastomeric)	Critical mainly in large cyclic movement

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Evaluation Criteria	Flexible PVC Waterstop (≈77 Shore A)	TPV Waterstop (≈87 Shore A)	Specifier Interpretation (ACI 350)
Creep & Long-Term Deformation	Moderate creep over decades	Low creep	TPV preferred for high-movement joints; PVC proven in static containment
Weldability & Splice Integrity	Excellent thermal welding; 80–90% parent strength	Excellent (heat weldable grades)	Both suitable, PVC has longest historical track record
Chemical Resistance (Containment)	Good to Excellent (alkalis, water, wastewater)	Superior broad-spectrum resistance	TPV favored in aggressive chemical environments
Plasticizer Migration	Possible (very long-term)	None	50+ year design life
Historical Service Life	50+ years documented in civil infrastructure	100+ Emerging but strong performance history	PVC has the longest embedded containment track record
Cost Efficiency	Very High	Moderate to High	PVC often selected for large infrastructure projects

Property	Flexible PVC Waterstop	TPV Waterstop (≈87A)
Compression Set (70°C)	25–40%	15–30%
Elastic Recovery	Moderate	Excellent
Chemical Resistance	Good	Superior
Plasticizer Migration	Possible (Long-Term)	None
Weldability	Excellent (Thermal Welding)	Excellent (Thermal Welding)
Cost Efficiency	Very High	Moderate–High

Engineering Interpretation for Containment & Water-Retaining Structures

For most structural and water-retaining concrete joints, flexible PVC waterstop remains a highly reliable and cost-effective solution when properly installed, welded, and fully consolidated in concrete. While TPV offers lower compression set and superior elastic recovery, flexible PVC provides exceptional weld integrity, proven longevity exceeding 50+ years in buried applications, and strong compatibility with standard construction practices.

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Flexible PVC waterstop continues to dominate specifications due to its proven multi-decade performance, excellent weldability, and reliable sealing when fully embedded in properly consolidated concrete. Unlike exposed gasket systems, embedded waterstops function as a mechanical barrier rather than a compression gasket, which significantly reduces the performance impact of higher compression set values.

TPV waterstop materials provide superior elastic recovery, lower compression set, and enhanced chemical resistance, making them advantageous in structures subjected to aggressive chemicals, ozone exposure, or large cyclic joint movement. However, for most wastewater, potable water, and below-grade containment applications, flexible PVC remains a highly reliable and cost-effective specification-grade solution.

Recommended Specification Guidance

For standard ACI 350 applications (wastewater, reservoirs, and below-grade structures): Flexible PVC waterstop is typically sufficient and widely specified. For high-movement joints, aggressive chemical containment, or ozone-rich environments: TPV waterstop may provide enhanced long-term resilience.

Company Contact and Technical Support

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