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Precast … The Concrete Solution

Septic Tanks: Introduction to Concrete Solutions

Massachusetts Health Officers Association
10/28/2020

Presented by Eric Carleton, P.E., NPCA

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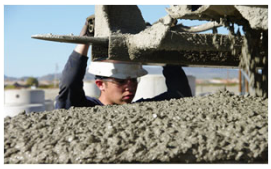
Septic Tanks: Introduction to Concrete Solutions

- Discuss concrete and precast concrete production and manufacturing processes as it relates to tank fabrication, testing, installation, and service life



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Septic Tanks: Introduction to Concrete Solutions

- Review nationally recognized standard AS… …esign req… …concrete tanks

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Septic Tanks: Introduction to Concrete Solutions

- Review benefits to owners and agencies to assure precast tank manufacturers adhere to well documented quality control plans.

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A little history…

- Edward S. Phibrick, 1883 Boston, MA

The first septic tanks appeared in the United States about 1883, when a two-chamber, round, vertical tank equipped with a dosing siphon for discharge was designed by Edward S. Philbrick of Boston, Mass.

American Septic Tank Beginnings

"Use of septic tanks in the United States began about 1883 in Boston, Massachusetts. There, Edward S. Philbrick designed a two-chamber, round, vertical cylindrical tank with a dosing siphon." –MIT Libraries

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Andy Griffith Show Season 3, Ep 27
1962 – 1963
https://www.youtube.com/watch?v=BWcwTYg4LT4

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Industry has expanded

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From 310 CMR 15

15.221: General Construction Requirements for All System Components

(1) All tanks, including septic tanks, distribution boxes, pump chambers, dosing chambers and grease traps, shall be either:

(a) **watertight** through manufacturer's specification and warranty; or

(b) made **watertight** by the manufacturer, equipment supplier or installer using asphalt or synthetic polymer sealer specified by the concrete or synthetic material manufacturer.

(3) Septic tanks, grease traps, pump chambers and dosing chambers shall be equipped with a **watertight access manhole**(s) with a minimum diameter of 20 inches and constructed of durable material.

(11) All septic tanks, tight tanks, pump chambers, dosing chambers and grease traps shall be **watertight**.

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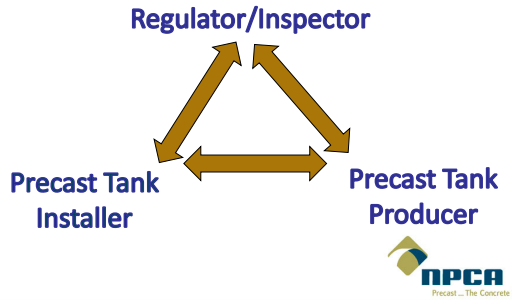
#1 Essential Component to Provide a Watertight Septic Tank System



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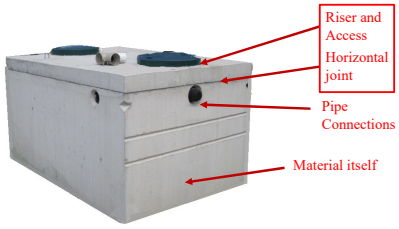
Critical Areas of Septic Tank for Watertightness



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Watertight Tanks

Three areas of focus:

1. Concrete
2. Joints / Risers
3. Pipe Connections

Photo credit: Onsite Installer Magazine Jan 2013 "Keeping Water Out"
http://www.onsiteinstaller.com/editorial/2013/01/keeping_water_out

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Watertight Tanks

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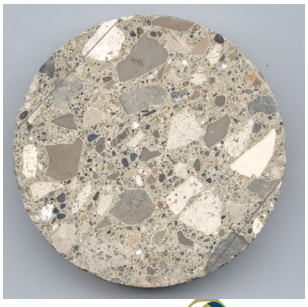
Concrete

PASTE
- Cement
- Water
- SCMs
- Admixtures

AGGREGATES
- Comprises 60-75% of volume and 70-85% of mass
- Coarse
- Fine

Water
- Potable or C1602
- Low permeability
- Low w/c ratio (≤0.45) (Water to Cementitious Ratio)



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SCM's & Admixture Materials

Pozzolanic or Hydraulic
- Fly Ash
- Slag
- Silica Fume
- Metakaolin
- *Ground Glass*

Chemical Admixtures
- Air Entraining
- Water Reducing
- Plasticizer
- Accelerators
- Retarders
- Corrosion Inhibitors
- Coloring
- Densifiers

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Concrete - SCC
Self-Consolidating Concrete

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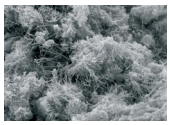
Additional Treatments

15.221: General Construction Requirements for All System Components
(b) made **watertight** by the manufacturer, equipment supplier or installer using asphalt or synthetic polymer sealer specified by the concrete or synthetic material manufacturer

- **Integral Admixtures**
  - Crystalline
  - Repellant (polymers)
- **Coatings**
  - Damp proofing or water proofing
  - Asphalt, epoxies, urethanes, acrylics
  - Proper Application (& preparation)



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From 310 CMR 15

15.226: Construction of Septic Tanks

(2) Tank construction materials shall meet the following minimum specifications or an ASTM equivalent standard:

(a) Concrete

1. Concrete Strength f'c 4,000 PSI @ 28 days. Density 140 PCF
2. Cement, Portland Type I or III per ASTM C150-96
3. Admixtures per ASTM C233-95
4. Reinforcing per ASTM A615 for wire fabric. Grade 40/60 R'd or equivalent.
5. **Design loading H-10**
6. Minimum wall thickness: four inches; three-inch thickness is allowable if reinforced.
7. **The tank shall be watertight.**

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Watertight Tanks

Three areas of focus:

1. Concrete
2. **Joints / Risers**
3. Pipe Connections

Photo credit: Onsite Installer Magazine Jan 2013 "Keeping Water Out" http://www.onsiteinstaller.com/editorial/2013/01/keeping_water_out

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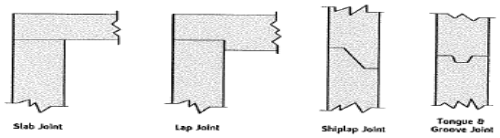
Watertight Tanks

Joint Sealant

Must conform to ASTM C990 – Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants



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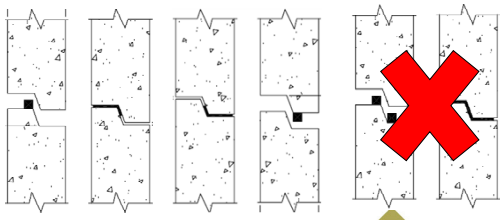
Watertight Tanks

Proper application of joint sealant. Different applications depending on nature of tank



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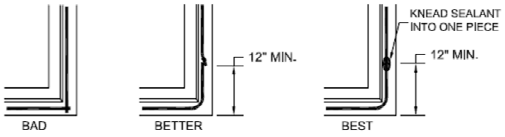
Watertight Tanks

Joint Sealant

Recommended Practice



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Watertight Tanks

Joint Sealant

Proper sealant overlap, **none of the above**.

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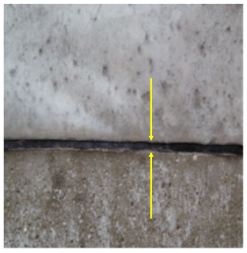
Watertight Tanks

Joint Sealant

3/8" maximum gap between two mating joint surfaces BEFORE sealant is applied.

ASTM C 1227 Section 10.3.1



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Watertight Risers

The lower section of the riser assembly may be:
(A) cast into the tank lid; or
(B) sealed to the top of the tank with butyl sealant meeting ASTM C 990 to provide a watertight seal.

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Watertight Extended Risers

The joint connections of precast riser assemblies may be sealed with butyl sealant meeting ASTM C 990 and/or externally wrapped per ASTM C877

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Watertight Tanks

Three areas of focus:

1. Concrete
2. Joints / Risers
3. **Pipe Connections**

Photo credit: Onsite Installer Magazine Jan 2013 "Keeping Water Out"
http://www.onsiteinstaller.com/editorial/2013/01/keeping_water_out

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Watertight Connectors

Pipe to Tank Connections

Basic Function – Prevent Infiltration and Exfiltration

- Provide a permanent flexible connection between pipe and tank.
- Provide for angular deflection of pipe.
- Provide for shear deflection of pipe.
- Provide sure, simple connection for installer.

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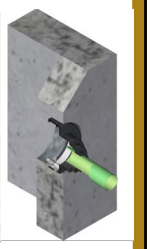
Watertight Connectors

Must conform to:

ASTM C1644 – Specification for Resilient Connectors Between Reinforced Concrete On-Site Wastewater Tanks and Pipes.



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Watertight Connectors?

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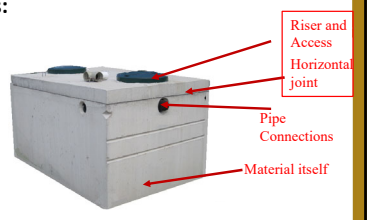
Critical Areas of Septic Tank for Watertightness

Three areas of focus:

1. Concrete
2. Joints / Risers
3. Pipe Connections



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From 310 CMR 15

15.226: Construction of Septic Tanks

(2) Tank construction materials shall meet the following minimum specifications or an ASTM equivalent standard:

(a) Concrete

5. **Design loading H-10**

(3) Tanks, covers, connections and piping shall be designed and constructed so as to withstand an anticipated **minimum H-10 loading**. Any tank installed in a location *where there is the potential* for vehicles or heavy equipment to pass over it shall be designed to withstand an **H-20 loading.**

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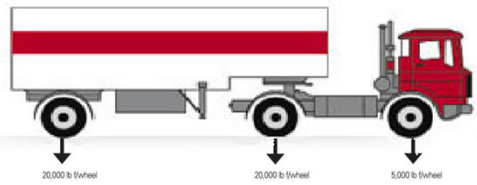
AASHTO (ASCE) Vehicles



Load	Back	Front
HS-5 (A4)	8000 #/Axel (4000 #/Wheel)	2000 #/Axel (1000 #/Wheel)
HS-10 (A8)	**16000 #/Axel (8000 #/Wheel)**	**4000 #/Axel (2000 #/Wheel)**
HS-20 (A16)	**32000 #/Axel (16000 #/Wheel)**	**8000 #/Axel (4000 #/Wheel)**
HS-25 (A20)	40000 #/Axel (20000 #/Wheel)	10000 #/Axel (5000 #/Wheel)

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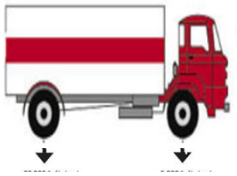
ASCE (AASHTO) Vehicles

HS = H



Load	Back	Front
H-5 (A4)	8000 #/Axel (4000 #/Wheel)	2000 #/Axel (1000 #/Wheel)
H-10 (A8)	**16000 #/Axel (8000 #/Wheel)**	**4000 #/Axel (2000 #/Wheel)**
H-20 (A16)	**32000 #/Axel (16000 #/Wheel)**	**8000 #/Axel (4000 #/Wheel)**
H-25 (A20)	40000 #/Axel (20000 #/Wheel)	10000 #/Axel (5000 #/Wheel)
A0.3 (Sidewalk)	300 #/sq. ft.	

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Precast Concrete Structural Design

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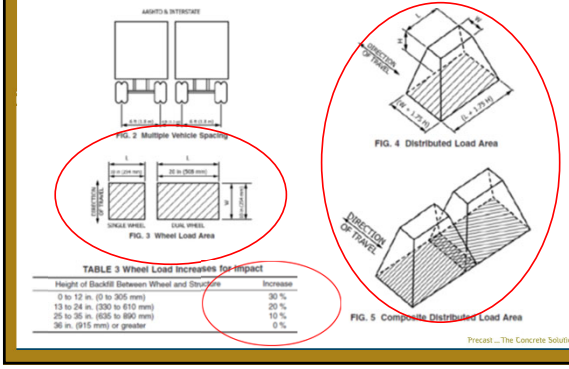
Precast Concrete Structural Design



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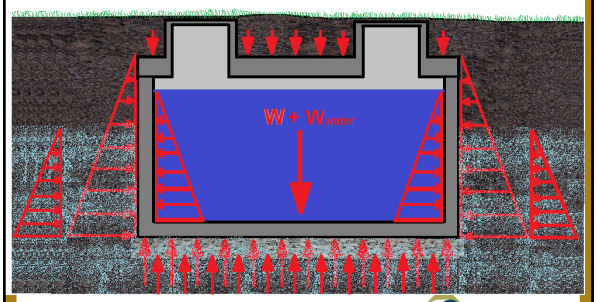
Precast Concrete Structural Design



Rationally Designed for all Loading Conditions

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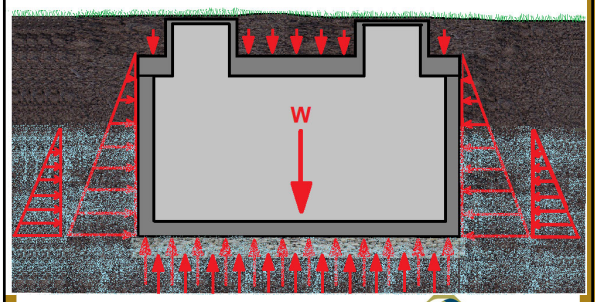
Precast Concrete Structural Design



Rationally Designed for all Loading Conditions

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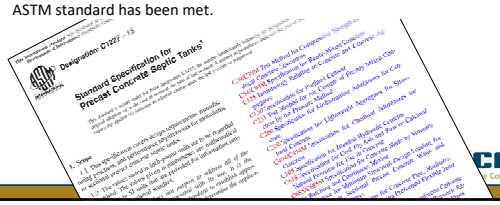
From 310 CMR 15

15.226: Construction of Septic Tanks

(2) Tank construction materials shall meet the following minimum specifications or an ASTM equivalent standard:

(4) Septic tanks shall be manufactured in accordance with a quality control/quality assurance program. The program for concrete tanks shall be in conformity with ASTM standard C 1227-**96** or an ASTM equivalent standard. Concrete tanks shall be embossed with a seal stating that this ASTM standard has been met.


Designation: C1227 – 13

Standard Specification for Precast Concrete Septic Tanks

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Quality Control Program

Precast concrete onsite wastewater structures ~~should~~ shall be manufactured and tested in accordance to ASTM C1227. Pipe to structure connections shall be in accordance to ASTM C1644.

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Quality Control Program

Precast concrete septic tank structures ~~should~~ shall be manufactured by producers employing a written quality control program.

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Quality Control Program

Made to Specification
Quality Management System

SAY WHAT YOU DO
DO WHAT YOU SAY
PROVE IT

Precast concrete onsite wastewater structures should be manufactured using a written quality control program

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Quality Control Program

Manufacturing

Materials
Batching
Casting
Curing
Testing
Handling, Storing, Shipping

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Quality Control Program

Product

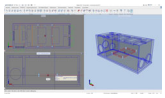
Design

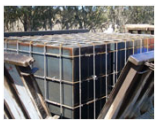
Tolerance

Testing

- Water
- Vacuum

Repair





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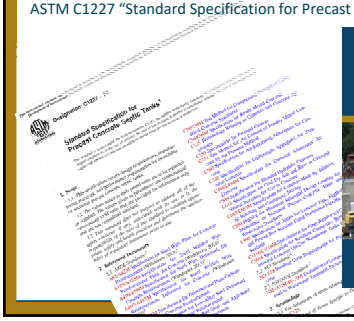
Quality Control Program

Septic Tank Specific Requirements

Plants producing septic tanks shall document proof of conformance with ASTM C1227 "Standard Specification for Precast Concrete Septic Tanks",



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THANK YOU!

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