Precast Concrete Septic Tanks

Rock Solid Tanks, Rock Solid Treatment
Background

- Nearly 85 million Americans – more than 25% of the country - are being served by the onsite industry and that number is growing.

- Centralized treatment systems are often at capacity and there is minimal to no funding to expand or repair these systems.

- Bottom Line…CUSTOMERS NEED BIG BANG FOR THEIR BUCK
Septic Tank is the Heart of the System

A well manufactured and maintained precast concrete septic tank can exceed the life of the home.
Topics

• Background
• Applicable Standards
• Septic Tank Design
  – Forces
  – Manufacturing
  – Connections
• Septic Tank Installation
  – Excavation Considerations
  – Bedding
  – Backfill
• Post Installation
• Case Studies
Applicable Standards

Tanks are built to strict standards and specifications. Some common standards include:

- ASTM C1227
- ASTM C890
- ASTM C913
- CSA B66
- IAPMO/ANSI
- Municipal, County and State Regulations
Applicable ASTM Standards

Tanks should be specified to meet the requirements of:
ASTM C 890
  • Standard Practice for Minimum Structural Design Loading for Monolithic or Sectional Precast Concrete Water and Wastewater Structures
ASTM C 1227
  • Standard Specification for Precast Concrete Septic Tanks
ASTM C 913
  • Standard Specification for Precast Concrete Water and Wastewater Structures
Other ASTM Standards

ASTM C 1719

- Standard Test Method for Installed Precast Concrete Tanks and Accessories by the Negative Air Pressure (Vacuum) Test Prior to Backfill
Other Standards

CSA B66
- Prefabricated Septic Tanks and Sewage Holding Tanks - Plumbing Products and Materials

IAPMO/ANSI Z1000-2013
- Prefabricated Septic Tanks

Municipal, County and State Regulations
- Various State Regulations May Govern Design of Tanks
Use NPCA as a resource!

- Web site tools at [www.precast.org](http://www.precast.org)
  Universally Recognized
  Amongst Precast Companies
- Can act as dictating code amongst varying local codes
- Strictly adheres to ASTM codes
SEPTIC TANK DESIGN
Forces to Consider

• Live Loads
  – Traffic
  – Water Table
  – Contents of Tank

• Dead Loads
  – Soil Loads
  – Weight of Structure
Lateral Forces

- Soil Loads
- Water Loads
- Wheel and Surcharge Loads
- All Dependent on Depth

- Precast concrete can withstand these forces.
- Tank is designed for certain depth.
- Manufacturer can design for deeper depths

ASTM C 890

- Standard Practice for Minimum Structural Design Loading for Monolithic or Sectional Precast Concrete Water and Wastewater Structures
Buoyancy

• In high water table sites, this must be considered in the design.

• Precast concrete has a higher specific gravity than other alternative materials. Higher resistance to buoyant forces.
Live Loads

- Normal Live Loads (Lawn Tractor)
- Driveway Loads
- HS20 Loading
- Water Table
- Contents of Tank
Dead Loads

- Soil
- Weight of Tank
Forces on an underground structure
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Manufacturing a Quality Septic Tank

- Mix Design
- WallThicknesses
- Reinforcing
- Handling
- Quality Control/Quality Assurance
Mix Design – Start with a Good Recipe

• Major Components
  – Cement
  – Aggregates
  – Water
  – Admixtures
Cement

The majority of cement used in the manufactured concrete products industry is governed by ASTM C 150, “Standard Specification for Portland Cement.”
Aggregates


Makes up 60-75% of volume and 70-85% of...
Water

Admixtures

- Admixtures are used to reduce the cost of concrete construction, achieve certain properties in concrete, maintain certain qualities of concrete while placing, curing in adverse weather conditions.
- ASTM C494 - “Specification for Chemical Admixtures for Concrete”
Start with Strong Mix – Compressive Strength

- Design is based on 28-day $f'_c$
- Performance is based on actual $f'_c$
- All standards based on $f'_c$ not mix designs
- Water-cement ratio will dictate compressive strength as well as porosity, permeability and durability.
Minimum $f'_c$ Requirements

- NPCA
- ASTM C 1227
- PCA
- ACI 318
- 4,000 psi
- 4,000 psi
- None
- None
Pre- $f'_c$

- Movement can Cause Micro-Cracks
- Designs are not Valid
- Concrete may be Very Weak
- Lifting may be Hazardous
Minimum Wall Thickness

- NPCA
- ASTM C 1227
- PCA
- ACI 350

- 3-inches
- None
- None
- 4 inches
How Thin is Thick Enough?

- NCPA & ASTM C 1227 Require 1-inch Minimum Concrete Cover (2-inch (+))
- ACI 318 Requires 3/4-inch Minimum Concrete Cover (1.5-inch (+))
- Concrete Must be Watertight
- Lift System Requirements
- Maintaining Minimum Thickness with Tapers
- Lid and base thickness designed based on conditions and applicable specifications.
Wall Tapers

Highest Deflection Area

Minimum Wall Area

NPCA
Precast ... The Concrete Solution
Connections

Joint Sealant

Pipe to Tank Connections

Concrete to Concrete
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.
Connectors

Must conform to:

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

Required by ASTM C1227
Connectors

Why do connectors leak?

- Insufficient Compression of Rubber....

Quality Installation is Key to Success!
Leaks – Between Rubber and Pipe

• Clamp not tightened correctly –
• Recommend using a T-Handle Torque Wrench to install clamps instead of a screwdriver or power tools.
• Clamps must be tight but not over-tightened
• Follow manufacturers requirements
Leaks – Between Rubber and Pipe

- Mud on pipe
- Mud, Concrete, Debris between rubber and clamp
- Rubber/Throat Clamp not square to pipe – Either tighten clamp on pipe first before defecting pipe or align boot square to the pipe before tightening clamp.
Connectors

Leaks – Between Concrete & Rubber

• Poor consolidation
• Poor mix design
• Insufficient concrete strength
Connectors

Rubber/Throat Clamp not square to pipe – Either tighten clamp on pipe first before deflecting pipe or align boot square to the pipe before tightening clamp.
Joint Sealant

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

Required by ASTM C1227
What Makes Precast Concrete Structures Watertight?

Joint Configurations

- Slab Joint
- Lap Joint
- Shiplap Joint
- Tongue & Groove Joint
A Good Quality Joint (watertight tank)

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

ASTM C 1227-05 Section 10.3
What Makes Precast Concrete Structures Watertight?

Recommended Practice

BAD

BETTER

BEST

12” MIN.

KNEAD SEALANT INTO ONE PIECE
What Makes Precast Concrete Structures Watertight?
SEPTIC TANK INSTALLATION
Site Truck Considerations

• The installation site must be accessible to large, heavy trucks weighing up to 80,000 lbs. (36,000 kg).

• Most trucks will need to get within 3 to 8 feet (1 to 2.5 m) of the excavation to be unloaded.
Site Considerations

• The construction area should be free of trees, branches, overhead wires or parts of buildings that could interfere with the delivery and installation of the on-site wastewater tank.

• Construction equipment traffic should be minimized while precast delivery truck is onsite.

• Site should consider both movement of the truck and movement of the crane. Both need to be considered.
Depth Considerations

• Most residential grade septic tanks are limited in depth of bury and traffic loading

• Other tanks can be buried deeper, consult with manufacturer before specifying tank
Bedding and Backfill

• The tank must be placed on 4” of granular material leveled in all directions over a firm and suitable sub base.

• It is important to make sure the bedding is level to distribute the load over the entire tank.

• The sub base must be capable of bearing the weight of the tank and its contents.
Excavate Safe Hole
Bedding

4"

Agg no larger than 1 1/2"
Backfill

- 4" depth
- 24" height
- Agg no larger than 1 1/2"
AFTER THE INSTALL
ASTM C 1227-10a

• 9.1 Proof testing is used to demonstrate the strength of the tank to resist anticipated external and internal loads.

• 9.1.1 Proof testing, when required by the purchaser, shall be performed in such a way as to simulate the actual anticipated loads.
Testing in Action
Testing in Action
Performance Testing For Watertightness

• **Vacuum Testing**
  - ASTM C 1227-13
    • Seal the empty tank and apply a vacuum to 4” of mercury.
    • The tank is approved if 100% of vacuum is held for 2 minutes.
  
    • Seal tank, apply a minimum vacuum of 4” mercury
    • It may take some time to stabilize the vacuum due to various factors (it is permissible to continue vacuum until stable at 4”)
    • Shut off vacuum pump. Tank is approved if there is no pressure drop for 5 minutes
    • If the tank fails the test, it may be repaired and retested.
Performance Testing For Watertightness

• ASTM C 1227 Test Method
  – Seal the tank, fill with water
  – Let stand for 24 hours
  – Refill the tank
  – Monitor tank for 1 hour
  • if there is no water loss tank is approved

NPCA Recommended Water Testing
  – Fill tank to 2” above the top of the cover inside riser
  – Allow it to stand for 24 hours
  – Absorption may explain water loss
  – If visibly leaking, repair tank, refill, allow to stand 1 hour
  – No visible leakage is allowed
Watertight Testing: In-Plant
Watertight Testing: In Field
Watertight Testing: In Field
Manhole Access Ways

- Manholes Should be Accessible for Servicing Easily
- Should be Above Ground
- Should be Locked

• SAFETY
Homeowner Consideration

- Septic Knowledge
  - What
  - Where
  - Why
  - How

- Service
CASE STUDIES