STANDARD OPERATING PROCEDURE

Proof of Structural Design Test for Precast Septic Tanks by the Negative Air Pressure (Vacuum) Method

1.0 PURPOSE

1.1 The purpose of the procedure is to establish the means by which to verify the structural capacity of a precast concrete septic tank due to external forces.

2.0 REFERENCES

2.1 ASTM C1227, “Standard Specification for Precast Concrete Septic Tanks”


3.0 EQUIPMENT REQUIRED

3.1 Air supply (compressor or vacuum) capable of drawing a vacuum pressure of at least 10” of mercury (Hg).

3.2 A vacuum measuring device is required and may be a vacuum gauge or mercury manometer accurate to within 0.5” Hg.

3.2.1. Vacuum gauges should be calibrated annually to ensure the accuracy of the test.

4.0 SEQUENCE OF OPERATIONS

4.1 The tank to be tested should be selected from inventory and is intended to be representative of tanks made on the same size mold and made from the same materials and methods. In other words, tanks represented by the proof test shall be made from the same mix design, use the same reinforcing, and have the same dimensions and member thicknesses.

4.2 The tank shall be inspected prior to testing for compliance with the shop drawing and for signs of cracking or other defects. Tanks found to be defective shall be repaired or rejected.
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4.3 Pipe seal pockets may be filled with grout if it is suspected that they will not withstand the maximum vacuum pressure to be applied.

4.3.1. A target vacuum pressure may be determined from the attached "Uniform Load Comparison for Vacuum Load Test".

4.3.2. The tank shall rest on a yielding foundation (i.e. sand bed) in order to assure that the tank dead load does not control the bottom slab design.

4.3.3. The top and bottom slab may have a greater structural capacity than the side walls. Since vacuum pressure is equally applied to all surfaces, additional uniform load may be applied to the top slab, if desired, in order to increase the allowable capacity of the top and bottom slabs over and above the capacity of the side walls.

4.4 Once the tank has been inspected and is properly sealed and prepared for testing, the tank shall be subjected to a gradually increasing vacuum pressure until the target value is reached.

4.4.1. Watertightness may be evaluated during the proof test by applying a vacuum level of 4"Hg and holding it for 5 minutes. This test is passing if the tank holds 90% of the vacuum during the 5th minute duration. Note: This criteria exceeds the vacuum test requirements of ASTM C1227 but is consistent with the NPCA "Best Practices Manual for Precast Concrete On-Site Wastewater Tanks."

4.5 If the target vacuum pressure is achieved without collapse, the vacuum should be held for approximately one minute, after which the pressure may be gradually released. Note: some tests have shown that dropping the pressure too fast may result in the formation of cracks in the tank.

4.6 Once the vacuum source is removed, all interior and exterior surfaces of the tank shall be inspected for the presence of cracks or spills. Minor cracks, less than .006" that DO NOT pass through the wall or slab, are considered acceptable.

4.7 Test results shall be evaluated by a Licensed Professional Engineer to determine the allowable live loads and placement depth of the tank under various soil conditions. A minimum safety factor of 1.5 shall be used to evaluate the structural capacity of the tank.
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5.0 RECORDS

5.1 The results of each vacuum test performed shall be documented on the Septic Tank Vacuum Test Report. Supporting documentation shall include:

5.1.1. Detailed shop drawing of the tank showing all dimensions and reinforcing. (required)

5.1.2. Photographs of the test set-up and performance. (Recommended but not required)

5.2 Records shall be maintained for a minimum of three (3) years in accordance with NPCA Quality Control Manual for Precast Plants.
## Uniform Load Comparison for Vacuum Load Test

<table>
<thead>
<tr>
<th>Vacuum Pressure (inches Hg)</th>
<th>Equivalent Uniform Load (wet)</th>
<th>Allowable Load (psf)</th>
<th>Convert inches of mercury from test to allowable uniform load</th>
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</thead>
<tbody>
<tr>
<td>6</td>
<td>430</td>
<td>286</td>
<td>13</td>
</tr>
<tr>
<td>7</td>
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<td>334</td>
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<td>573</td>
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<table>
<thead>
<tr>
<th>Earth Fill (ft)</th>
<th>Allowable live load adjusted for sq. ft. (psf)</th>
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<tbody>
<tr>
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<td>266</td>
</tr>
<tr>
<td>1.0</td>
<td>334</td>
</tr>
<tr>
<td>1.5</td>
<td>262</td>
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<tr>
<td>2.0</td>
<td>142</td>
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<td>2.5</td>
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<td>3.0</td>
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</table>

**Earth Load**

- Effective Pressure (Dry): 40 psf
- Effective Pressure (Saturated): 80 psf

<table>
<thead>
<tr>
<th>Water Table Depth</th>
<th>Soil Depth Below Grade</th>
<th>Lateral earth pressure based on water table depth (psf)</th>
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<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
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<td>440</td>
<td>400</td>
<td>360</td>
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</tr>
</tbody>
</table>

*For the calculation of lateral earth pressure based on water table depth.*
SEPTIC TANK VACUUM TEST REPORT

Manufacturer: ____________________  Test Date: ________
Address ________________________  Report By: ___________
City, State Zip ____________________

TANK DESCRIPTION  (Attach detailed drawings)
Model No:  __________________________  Volume and/or working capacity: ________  Mfg Date: ________
Outside Dimensions: Length________  Width ________  Height ________
Member Thickness: Top Slab ________  Base Slab ________  Walls ________
Compartments:  __ Dual  ________  __ Single  ________  __ Walls  ______
Seam:  ____ Mid  ____ Top
If top seam does cover slab interlock with top of wall?  ____ Yes  ____ No
Joint Sealant Brand/Size: _________________________
Pre Seals Brand/Type: _________________  No. of Inlet Seals: ________  No. of Outlet Seals: ________

MIX DESIGN
Mix No: ________  W/C Ratio ________
Fibers:  ____ No  ____ Yes  Brand/Type ________  Dosage ________/cy

REINFORCING STEEL
Rebar:  ____ Grade 40  ____ Grade 60  ____ None
Wire Fabric:  ____ Smooth (ASTM A185)  ____ Deformed (ASTM A497)  ____ None

CONCRETE TEST RESULTS
Slump: ________  % Air: ________  Temp: ________  Unit Weight: ________
Compressive Strength: ________ psi @ ________ Days

WATERTIGHTNESS TEST
Tank withheld 4" of mercur for 2 minutes without loss of vacuum:  ____ Yes  ____ No

STRUCTURAL TEST
Vacuum measuring device:  ____ Manometer  ____ Gauge: Date of last gauge calibration ________
Tank tested to failure:  ____ Yes  ____ No
Maximum vacuum pressure tested ________ inches Hg.  Additional load applied to top slab ________ psf
Tank was inspected after the load was applied and there were no signs of cracks:  yes  no (describe below)

DELTA ENGINEERS