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# Design and Construction of Concrete Tanks for Refrigerated Liquefied Gas Containment, Part 2

**ACI Spring 2012 Convention**
**March 18 – 21, Dallas, TX**

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**Thomas Howe** has 30 years of experience in pressure vessel and storage tank design and construction with KBR and Chicago Bridge & Iron. Tom has been with KBR's vessel mechanical technology group since 1990 and has been working with KBR's LNG Technology group since 2001. His current role as LNG Tank Engineer includes tank sizing and spacing studies, generation of tank specifications, scope of work definition, preparation of tank subcontract bid packages, technical evaluations of proposals, review of technical drawings and calculations and construction support. Tom is a Civil Engineering graduate of the University of Houston and is a registered Professional Engineer in the State of Texas. Tom is a member of the ACI 376 committee, "Code Requirements for Design and Construction of Concrete Structures for the Containment of Refrigerated Liquefied Gases and Commentary."

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## ACI 376 Chapter 12 - Commissioning

- **12.1 - Scope**
- **12.2 - Testing**
- **12.3 - Pressure/vacuum testing**
- **12.4 - Nitrogen purging**
- **12.5 - Tank cooldown**
- **12.6 – Settlement and movement monitoring**
- **12.7 – LNG tank fill methods**
- **12.8 – Decommissioning**
- **12.9 – Recordkeeping**
- **12.10 - Nameplate**

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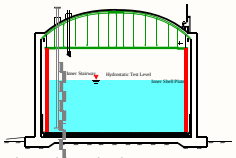
## 12.2 -Testing

- Testing of the primary container for leak tightness is required using either:
  - Visual inspection at hydrotest
  - Local pressure/vacuum testing
  - NDT methods



- Hydrotesting is required for the primary containment up to the design liquid level where foundation conditions permit but not less than 1.25 times the product load.
- Testing for leak tightness of secondary containment is normally not required.

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## 12.2 – Testing (continued)

- Hydrotesting considerations
  - performed after concrete has reached the specified strength and age.
  - performed after prestressing, grouting completed.
  - performed after QA testing of concrete.
  - shall not exceed 30 days unless agreed by Owner.
  - fresh water spray required after seawater hydrotest.
  - shall conform to water quality requirements.
  - shall conform to corrosion protection requirements.
  - cleaning and drying after hydrotest

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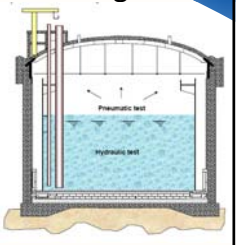
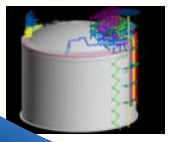
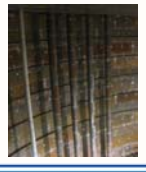
## 12.3 - Pressure/ Vacuum Testing

- Pressure Testing
  - Concurrent with hydrotest or separately.
  - Test pressure of 1.25 times the tank design pressure and held for 1 hour.
  - Test pressure reduced to design pressure and tank inspected for leaks.
- Pressure and vacuum relief testing
- Pumpwells tested to ASME B31.3





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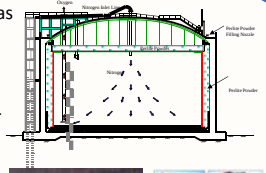
## 12.4 – Purging into service

- Continuous purge using nitrogen gas
  - Complete procedure required for purging operation.
  - Oxygen level to be 8% or less.
  - Tank to be dry with no standing water.
  - Inner tank purged first followed by annular space.
  - Complete when $0_2$ less than 8 % and dew point below required level for 12 hours.
  - Maintain a nitrogen positive pressure until cooldown.



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## 12.5 – Cooldown

- Complete step by step procedure required for cooldown operation.
  - Assignment of duties.
  - Type and source of cooldown gas.
  - Cooldown rates and temperature limitations.

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## 12.6 – Settlement and Movement Monitoring

- Monitor tilt and differential settlement of the foundation before, during and after hydrotest and at first fill of RLG.
- Monitor inner tank lateral and rotational movement for use during and after cooldown.

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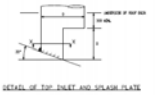
## 12.7 – Filling methods

- Top fill splash plate to avoid liquid on walls, deck and provide distributed discharge of liquid and removal of entrained vapor.



- Top and bottom fill to avoid stratification where rollover is a consideration.

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