DATANET ENGINEERING, INC.

Leaking Generator Day Tanks Coming to a Hospital Near You!!!

2018 National Tank Conference

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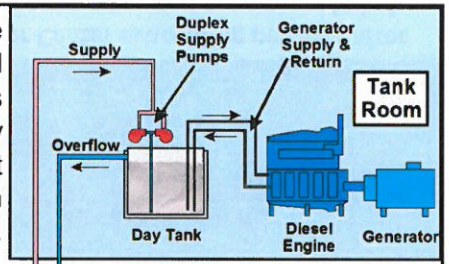
Why are Day Tanks inside?

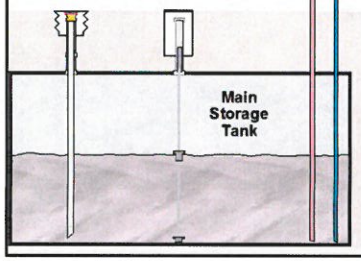
Drawing from NFPA

Generator and day tank are inside and protected from whatever is causing the need for back-up power.

2

Day Tanks provide immediate fuel adjacent to boilers and emergency generators. Most commonly used with generators.





Main Tanks provide bulk of fuel for heating or stand-by power. Tank may be either above or below ground and possibly also inside the building served.

Problems from E-Gen. Day Tanks

- **Life Safety Risks to Bldg. Occupants**
- **Compromises to Environment**
- **Degradation of Back-Up Power Reliability**

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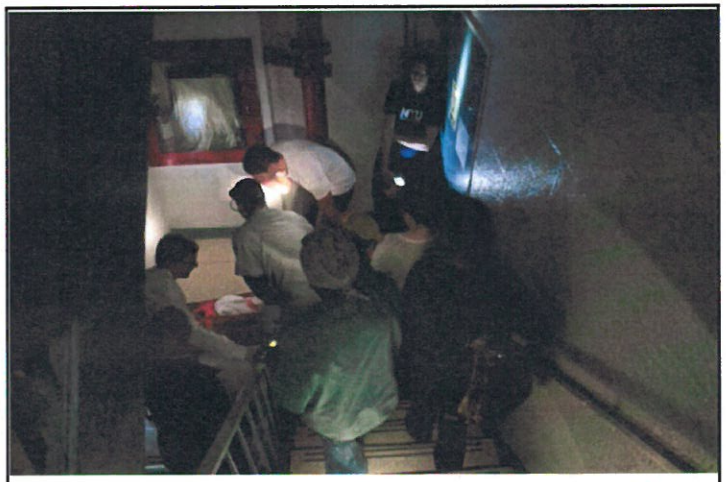
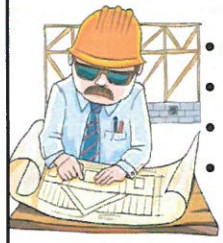


Sloan-Kettering Cancer Center evacuating patients after Hurricane Sandy took out power and generators failed.

Day Tanks Commonly Installed Incorrectly Because of Failure To:



- **Design equipment per code**
- **Install equipment per code**
- **Test equipment per code**
- **Maintain equipment per code**

Problems From Unqualified Personnel

- **Engineers preparing plans & specs**
- **Reviewers approving plans & specs**
- **Contractors installing/testing systems**
- **Bldg. Inspectors signing off installation**
- **Fire Marshalls checking systems**
- **Environmental Compliance Officials inspecting systems**

What Codes Affect Installation of Day Tanks Inside Buildings?

- **NFPA 30,** Flammable & Combustible Liquids Code
- **NFPA 37,** Installation and Use of Stationary Combustion Engines and Gas Turbines
- **NFPA 80,** Fire Doors & Other Opening Protectives
- **NFPA 110,** Emergency and Standby Power Systems
- **NFPA 704,** System for ID of Hazards of Materials for Emergency Response

Let's Review Applicable Codes Under Following Headings:

- Tank
- Fuel Piping
- Tank Room
- Tank Venting
- Controls
- Maintenance

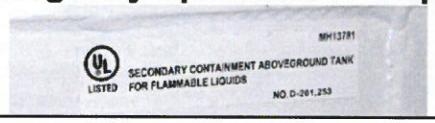
Tank Code Issues:

- Acceptable tanks
- Clearance around tank
- Tightness testing
- Inspection requirements

Tank Codes: Acceptable Tanks

NFPA 30-21.4.2, NFPA 1-66.21.4, IFC-5704.2.9.6.1.1

- Built in conformance with nationally recognized standard & > 60 gallons capacity
- Must bear permanent label of standard, IFC
- Must normally operate ≤ 1 psig
- Emergency operation ≤ 2.5 psig



Tank Codes: Clearances

NFPA 30-24.5.6, NFPA 1-66.24.5.6, IFC-5704.2.9.5

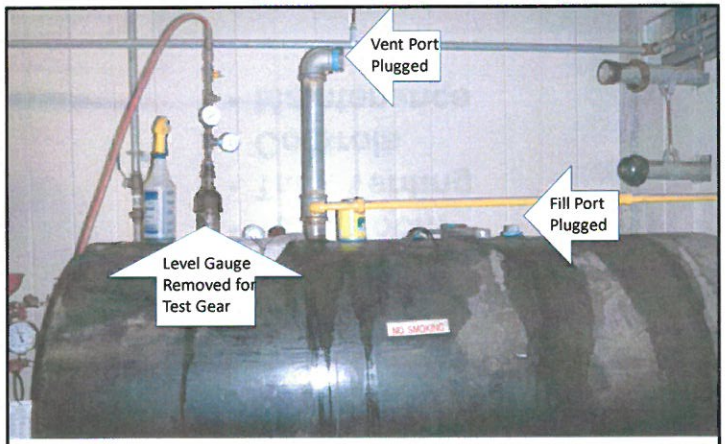
- Need 3' access aisle to tank
- Must extend from exterior of storage tank building into building and around all tanks

Day tank crammed inside corner surrounded by equipment and ***combustible*** items stored in basement mechanical room.

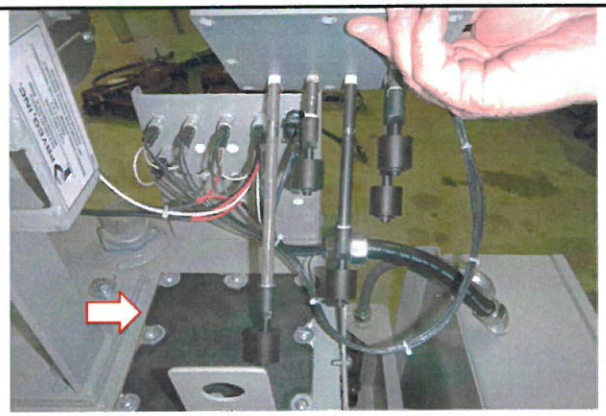
Tank Codes: Tightness Testing

NFPA 30-21.5.2, NFPA 1-66.21.5.2, IFC-5704.2.12

- **Pressure test required before tank place in service despite factory tests**
- **If vacuum was maintained on interstice after tank was set, pressure test requirement might be waived**
- **Test pressure is a function of tank configuration**



Accomplishing pressure test requires plugging all tank ports. Note the use of two pressure gauges on this testing set up for a single wall tank along with a PRV set at the correct pressure.



Day tank controller removed/replaced with blank. Float switches are not sealed. 1/8" sheet stock or larger needed for making temporary blank.

Tank Codes: Inspection Req'ts

NFPA 30-21.8.1, NFPA 1-66.21.8.1

Regular Inspections mandated IAW:

- **STI SP001**
- **API 653**
- **PEI RP 200**
- **STI RP 931**
- **40 CFR 112**

Piping Code Issues:

- **Acceptable pipes**
- **Connections**
- **Low melting point restrictions**
- **Installation**
- **Physical protection**
- **Labeling**
- **Galvanized pipe problems**

Piping Codes: Acceptable Pipes

NFPA 30-27.3, NFPA 37-6.6.3, NFPA 1-66.27.3, IFC-5703.6.2

- **Must be ASME B31 rated pressure piping**
- **Valves, faucets, couplings, flex connectors, fittings & other pressure containing parts shall meet ASME/ANSI B31 except for:**
  - Ductile iron rated for high temp (ASTM A395)
  - Valves shall be ductile iron or steel except:
    - Where valve are internal to tank
    - Melting point/ductility comparable to steel/DI

ASME B31 Power Piping means Schedule 40 steel. This includes all fittings, elbows, tees and other piping components.

Piping Codes: Connections

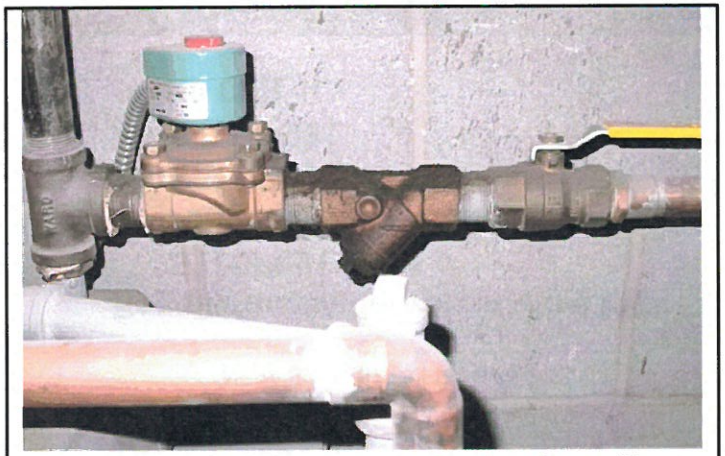
NFPA 30-27.5, NFPA 1-66.27.5, IFC-5703.6

- **Welded**
- **Threaded**
- **Flanged**
- **No sweat fittings**
- **Class I pipe joints inside buildings must be welded**
- **Flex connectors mandatory where subject to movement or vibration**

Piping Codes: Low Melting Point

NFPA 30-27.4.4 & .6, NFPA 1-66.27.4.4, IFC-5703.6.2

- No copper, brass, bronze or aluminum fittings for piping or valving
- Possible to use brass/bronze valves if protected from fire exposure
- Small heating oil systems are exempt from this requirement under NFPA 31
- Class IIIB liquid storage also exempt under certain conditions



Regardless how often it happens, you cannot use low melting point piping and valving components inside a building for a day tank connected to a diesel generator.

Piping Codes: Low Melting Point

When can Brass/Bronze valves be used?

See NFPA 30-27.4.4.5

- **When underground; or,**
- **When valving inside building and protected from fire by a 2-hour rated enclosure; or,**
- **Small heating systems under NFPA 31, NFPA 1-11 or IFC 600**

Piping Codes: Installation

NFPA 30-27.6, NFPA 1-66.27.6, IFC-5703.6.8

- **Substantially Supported**
- **Protected Against Physical Damage From:**
  - Settlement
  - Vibration
  - Contraction/Expansion

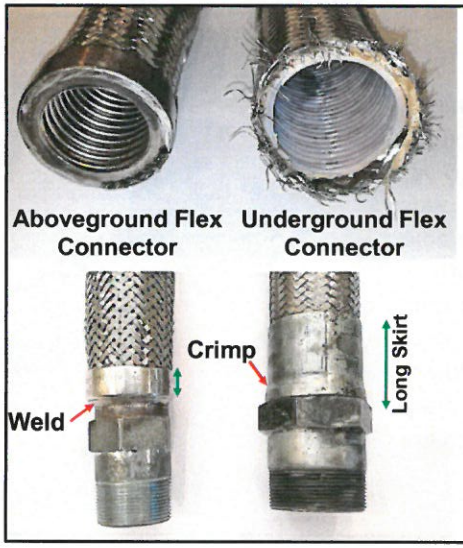
Providing physical protection of piping is not difficult.

There are many excellent and cost effective ways to keep sidewalk and aisleway traffic (including movement of equipment) from damaging fuel piping.

Piping Codes: Proper Support

NFPA 30-27.4 and .6, NFPA 1-66.27.6, IFC-5703.6.8

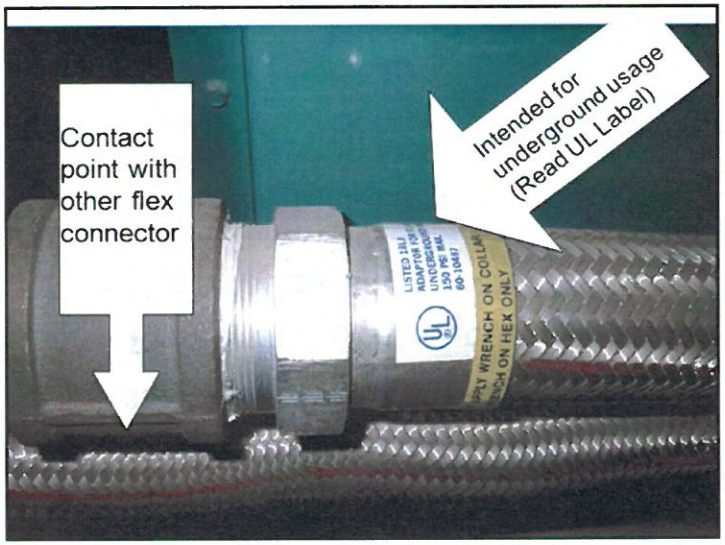
- **Proper and Continuous Support**
- **Physical Damage Protection:**
  - Flex Connectors
  - Pressure/Thermal Relief
  - Oil Safety Valves
  - Bollards
- **MSS-SP-69 Supports**



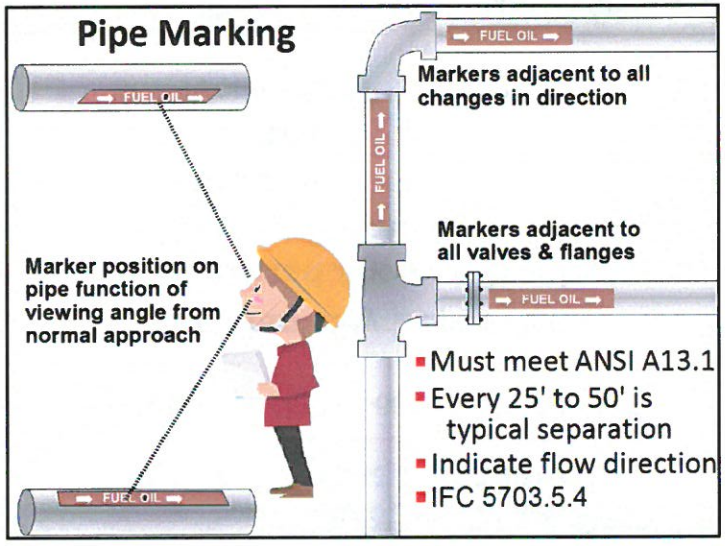
Aboveground flex connector in left photos is fire rated. Note all welded construction.

Underground flex connector in right photos is not fire rated. Interior is a plastic hose that is crimped together.

Easy to tell apart due to difference in skirt lengths.



MSS-SP-69 supports are designed to minimize crevic corrosion and faying damag to pipes. Note the white pads beneath U-bolt and between the bottom of the pipe and the angle iron. Thi spacing allows inspection of the pipe by removal of the support as well as replacement of the pads.



Pipe Marking

FUEL OIL

Combustibles are White Letters on Brown Field

GASOLINE

Flammables are Black Letters on Yellow Field

Pipe Marking Size Chart

Pipe OD with Cover	Min. Length Field Color	Min. Ht. Letters
.75"– 1.25"	8"	.5"
1.5"-2"	8"	.75"
2.5"-6"	12"	1.25"
8"-10"	24"	2.5"
>10"	32"	3.5"

Diesel Piping: Galvanized Ban

NFPA 1-11.7.3.1, IFC-604.1.2

- **No galvanized piping, fittings or valving in any diesel fuel system per:**
  - NFPA 110-7.9.3.1
  - EGSA 100T Section 6.15
  - EM 1110-2-4305 8.7
  - ASTM D975
- **No galvanized diesel fuel tanks per 46 CFR § 182.440**

Tank Room Code Issues:

- **Fire extinguishers**
- **Curbs and sealed floors**
- **2-hour wall ratings**
- **Wall openings auto-shut**
- **Fire diamonds**

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Tank Room Codes: Fire Extinguisher

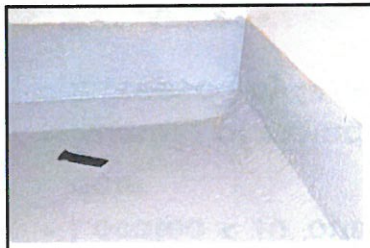
NFPA 30-24.6.1, NFPA 37-11.2, IFC-5706.2.7

- **Must meet min. rating of 20-B:C (IFC)**
- **Minimum rating of 40:B (NFPA)**
- **Located < 10' outside storage room door**
- **Number of extinguishers could be increased by local fire code official**

Tank Room Codes: Curbs & Floors

NFPA 30-24.9.3, NFPA 37-6.3.2.4

- **Floors must be liquid tight except for drains**
- **Connection to wall must be liquid tight up 4"**
- **Use curbs around doors for 4" rule**
- **Open trench can be used to drain to safe location**



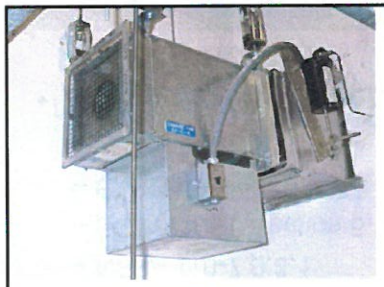
Must have liquid-tight floor in room with day tank. Floor must seal to the walls as shown at the left.

Fuel releases from day tank must be controlled and kept from flowing out into building. A 4" curb is commonly used to achieve this.

Tank Room Codes: 1-3 Hour Walls

NFPA 30-24.5.2, NFPA 37-4.4.2, NFPA 37-6.3.6.2, NFPA 110-7.2.1.1, IFC-63.2.7.2

- **Minimum 1-hr rating rooms ≤1,320 gals.**
- **Minimum 3-hr rating if >1,320 gals.**
- **Compromises to walls, floor and/or ceiling addressed with auto-shut structures**
- **Differences for some sprinklered buildings**



HVAC system in room with AST requires auto-closing fire dampeners on wall penetrations which are missing in top photo.

Bottom photo shows auto-closing dampers in place at wall penetration of a day tank room.

Tank Room Codes: Fire Diamonds

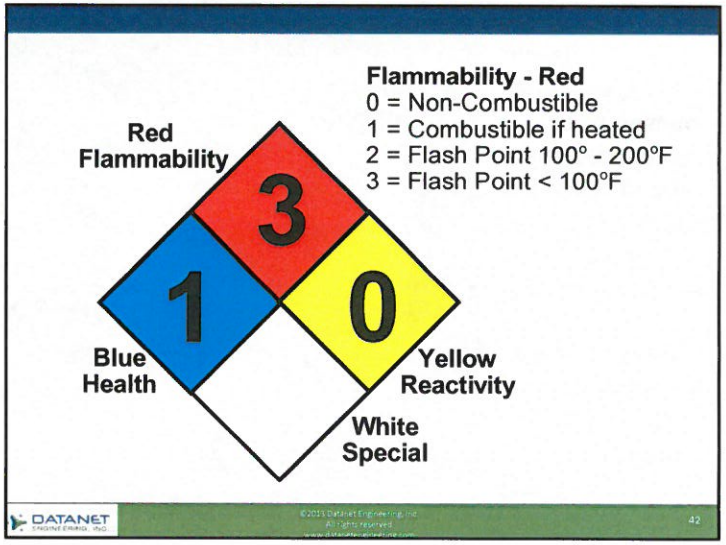
NFPA 30-21.7.2, NFPA 1-66.21.7.2, IFC-5704.2.12

- **Need emergency response diamond per NFPA 704**
- **Sign must be where it can be seen**
- **Sign does not have to be on tank**
- **Markings must be clear for each tank**

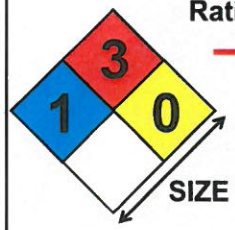
AST Signage Requirements

NFPA 30-21.7.2, NFPA 1-66.21.7.2, IFC-5703.5

- **Color Code Fills**
- **3" Min. High**
  "DANGER-FLAMMABLE LIQUIDS" **– IFC**
- **Piping Per ANSI A13.1 & IFC 5703.5.4**



Tank Room Codes: Fire Diamonds



Distance Where Ratings Are Legible	Size of Adhesive Backed Sign
50'	2½"
75'	5"
100'	7½"
200'	10"
300'	15"

Fire Diamonds are required to be located where first responders will see them when approaching the site. May be on side of building or other location.

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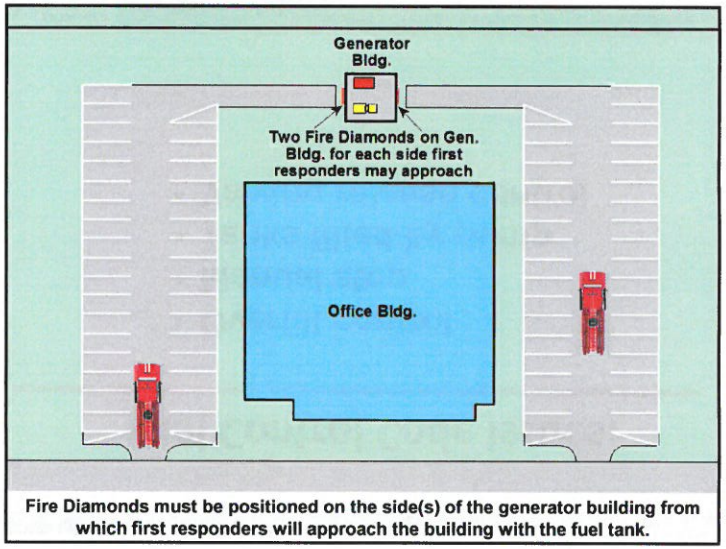
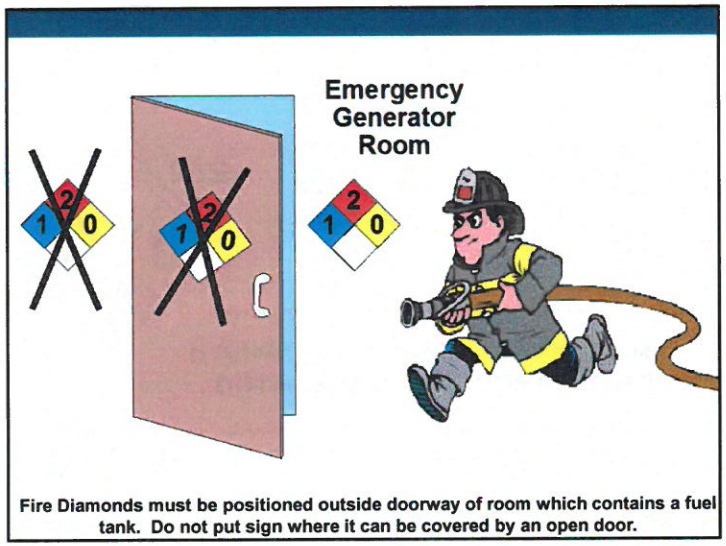


Fire Diamonds must be positioned on the side(s) of the generator building from which first responders will approach the building with the fuel tank.



Fire Diamonds must be positioned outside doorway of room which contains a fuel tank. Do not put sign where it can be covered by an open door.

Fuel Control Code Issues:

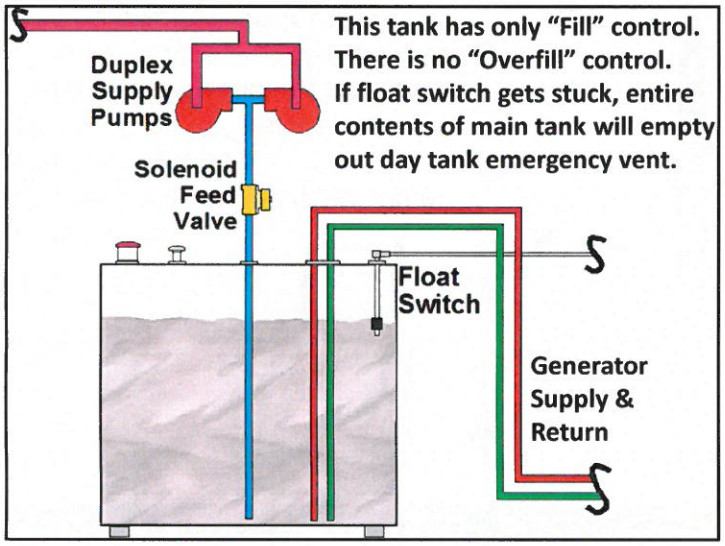
- Overfill control
- Manual stop
- Tanks filled by pump
- Valving release control

Tank Room Codes: Overfill

NFPA 30-22.11.4.5, NFPA 1-66.21.7.2, IFC-5704.2.9.5

- Alarm set when tank is 90% full
- Auto-shut off valve stops flow when level reaches 95% full
- Must prevent overfill into building

Don't forget to look on roofs for day tanks. Note wooden supports and other code violations.
This tank has only "fill" control. When float switch got stuck, pump overfilled it with several thousand gallons of No. 2 diesel.



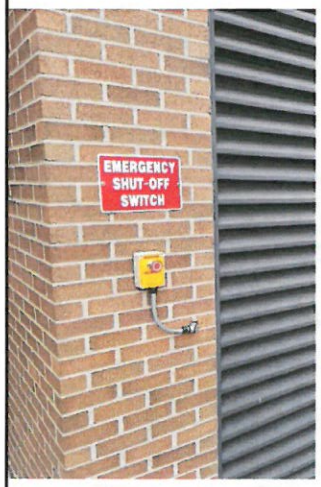
This tank has only "Fill" control. There is no "Overfill" control. If float switch gets stuck, entire contents of main tank will empty out day tank emergency vent.

Tank Room Codes: Manual Stop

NFPA 110-5.6, NFPA 1-11.7.3.1, IFC 604.1.2

- ALL installations shall have remote manual stop station
- Must prevent inadvertent/unintentional operation
- Located outside room with prime mover
- Located near outdoor generators
- Must be clearly labeled in weatherproof enclosure

Manual Stop Emergency Shut Off switch is just outside door of generator room and properly labeled.

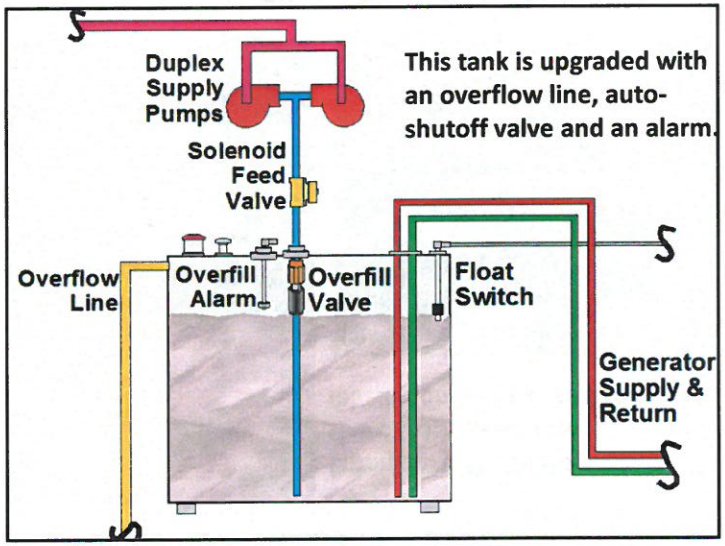


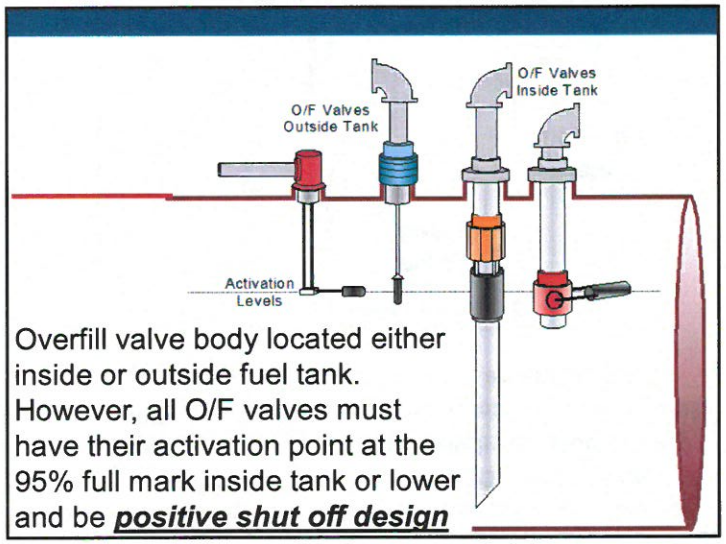
Emergency Shut Off switch for this outdoor generator is properly labeled on nearby outdoor wall.

Tank Room Codes: Pump Filling

NFPA 37-6.5.4, NFPA 1-11-7.1, IFC-5704.2.12

- **Day tank must have <u>all</u> the following:**
  - **High level alarm**
  - **High level auto-shutoff valve**
  - **Overflow line**
- **Overflow line must drain to main tank**





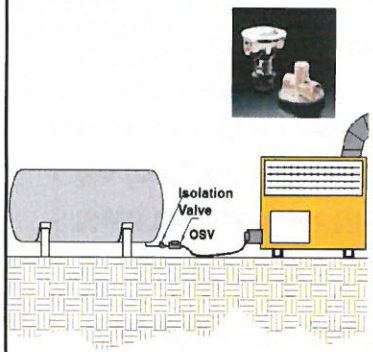
Overfill valve body located either inside or outside fuel tank. However, all O/F valves must have their activation point at the 95% full mark inside tank or lower and be ***<u>positive shut off design</u>***

Tank Room Codes: Valve Controls

NFPA 30-24.14.8, NFPA 1-66.24.14.8,
IFC-5704.2.9.5.1

- **Need valves to control fuel in event of a pipe break to include:**
  - Solenoid valves
  - Fire valve
  - Oil Safety Valve (OSV)

Oil Safety Valves (OSV)



Requires minimum fuel suction pump vacuum before opening and staying open. Any leak in pipe that releases vacuum causes it to stay closed. OSV can also function as a pressure regulator if there is booster or supply pump at the tank

Venting Code Issues:

- **Discharge Outdoors**
- **Emergency Vent Req'ts**
- **Emergency Vent Extensions**

Venting Codes: Outdoor Discharge

NFPA 30-24.1.3, NFPA 1-24.1.3, NFPA 37-6.7, IFC-5704.2.7.3.3

- **All vents must discharge outdoors**
- **Vent lines must have no sags/traps**
- **Discharge 5' from building opening**
- **Discharge 15' from air makeup louvers**
- **Discharge 2' above roof line**

OSHA 29 CFR 1910.106 Flammable & Combustible Liquids Standard

- **1910.106(b)(3)(iv)(c)** Location and arrangement of vents for Class II or Class III liquids. Vent pipes from tanks storing Class II or Class III flammable liquids shall terminate outside of the building and higher than the fill pipe opening. Vent outlets shall be above normal snow level. They may be fitted with return bends, coarse screens or other devices to minimize ingress of foreign material.

Here the day tank Emergency Vents highlighted in red discharge directly into the building. Any problem with the filling will result in fuel flowing out the E-vents and down the corridor

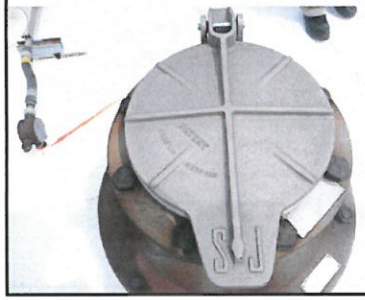
This is how the vents should discharge from two in-door day tanks outside at a location where they can be checked.

Venting Codes: E-Vent Req'ts

NFPA 30-22.7, NFPA 1-66.22.7, IFC-5704.2.7.4

- **Must be sized per NFPA 30 & API 2000**
- **No frangible tank roofs inside building**
- **E-Vent device must be:**
  - UL Listed
  - Proper opening pressure
  - Proper airflow listing
- **Protected tank (i.e. UL 2085) E-vents can discharge in building if allowed by local code**

This is **not** how the normal and emergency vents should discharge from the basement day tank. There are hidden traps in inaccessible ceilings inside building.

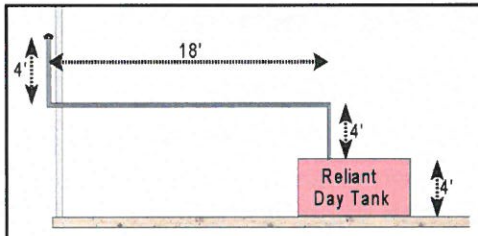


Neither of these E-vents are UL listed. There is no grandfathering of these devices. If they are not the proper size and UL-listed, they cannot be used.

Venting Codes: E-Vent Extensions

NFPA 30-22.7.4, NFPA 1-66.22.7.4, IFC-5704.2.7.4

- **Calculations for flow/pressure based on E-vent being ≤ 12" above tank**
- **Discharging outdoors requires extension of E-vent piping**
- **Airflow pressure drop calcs mandated to establish if larger pipe sizes are needed**



At this site, the length of run for the emergency vent was a total of 26' of 4" piping with two 90° elbows. This is added to the initial nozzle discharge from the tank and the discharge into the atmosphere. The pressure drop calculations showed that at minimum required air flow, the pressure in the tank exceeded 2.5 lbs/in^2. By merely switching to 6" piping, the pressure dropped below 2.5 lbs/in^2 at the required air flow. Thus, no modifications were needed on the tank nozzles.

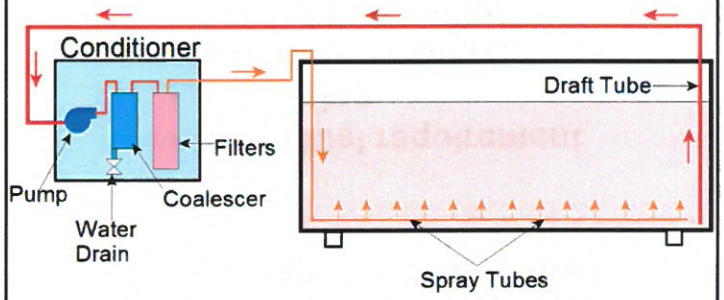
Maintenance Code Issues:

- **Clean fuel requirement**
- **Fuel aging**
- **Mandatory maintenance**
- **Annual fuel testing**

Options for Addressing Aging of Emergency Generator Fuels:

- Avoid using biodiesel blends > 5%
- Connect generator day tank to large heating oil tanks used by boiler plant (fuel will always be fresh)
- Convert generators to burn natural gas
- Or—Install Fuel Conditioning System

Fuel Conditioning System Lay Out



Examples of Fuel Conditioners


Algae-X

Simplex


C&I

How Does Fuel Become Contaminated?

- Water – Condensation, leaks and from deliveries
- Microbial Growth – Spores from air or water but has to have water to proliferate
- Particulate Matter – Vent location, tank corrosion, fuel deliveries
- Fuel Breakdown – Natural deterioration accelerated by heat, temperature changes and water

Fuel Storage Maintenance

COOL FULL DRY

- Every 10 degree C increase in temp doubles reaction rates
- Smaller ullage decreases condensation potential
- There are **no** benefits of water in your tanks—only costs

Ways to Clean a Fuel Tank:

Least Expensive

1. Merely pumping water out
2. Vacuuming water and particulate out along floor
3. Vacuuming fuel from tank, filtering out sediment and water, and returning clean fuel to dislodge more sediment
4. Installing fuel conditioning system to accomplish same as #3 above with permanent equipment
5. Remove tank from service, filter all fuel from tank into temporary tank, have personnel enter and pressure wash tank, and return fuel to tank

Most Expensive

Maintenance Codes: Clean Fuel

NFPA 110-7.9.2, NFPA 1-11.7.3.1, IFC-604.1.2

- **System design/ops/maintenance shall provide clean fuel to generator**
- **Fuel must be kept cool and dry**
- **Water:**
  - **Checked frequently**
  - **Removed immediately**
- **Indications of bacteriological contamination addressed immediately**

Maintenance Codes: Maintenance

NFPA 30-21.8, NFPA 1-66.21.8, IFC-5704.2.7.4

- **Each day-tank must be inspected and tested per STI SP001**
- **All vents, E-vents, overfill & other control devices recertified annually to assure functionality**
- **Follow STI SP001 and NFPA 110 checklists for periodic inspection requirements**

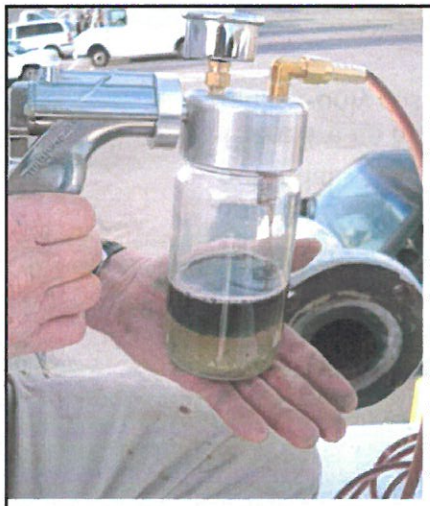
SP001 Periodic Inspections Annual

- **Accomplish annual check AND document**
- **Include all monthly inspection requirements**
- **Exterior -- clean & repaint as necessary**
- **Check operability of:**
  - All vents,
  - Grounding, electrical & CP systems,
  - Spill Containers, insulation & level gauges
  - Settlement & Tank Damage
  - Overfill and Leak Detection Systems

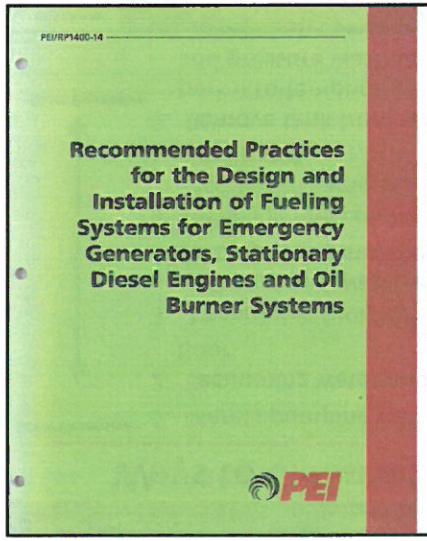
Maintenance Codes: Fuel Testing

NFPA 110-8.3.7, NFPA 1-11.7.3.1, IFC-604.1.2

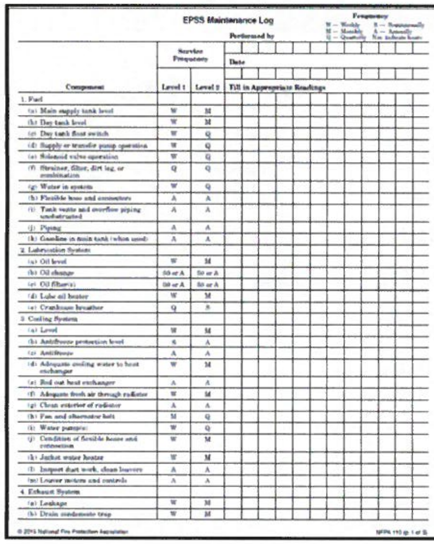
- **Sample/test fuel annually**
- **Ensure fuel meets ASTM D 975 especially for:**
  - Water
  - Sediment
  - Microbial growths



Checking with a vacuum sampler can provide far more information on contaminants inside a tank. The vacuum hose can be pulled up after sampling floor and show what is in different strata within tank.



Good source on Proper Installation of Day Tanks: PEI RP 1400 Available at PEI.org



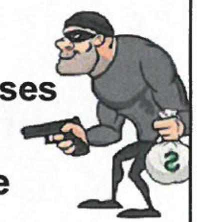
Critical maintenance tool is the EPSS Log in NFPA 110. It is three pages long and has detailed steps weekly, monthly, quarterly, semi-annually and annually.

* 71 components checked annually

* 21 components checked weekly

Consequences of Day Tanks Not Being Installed/Maintained/Inspected Per Code

- Owner is robbed
- False sense of security
- Completely avoidable releases
- Unacceptable risks to environment, safety and life



AST Environment—The Wild West

- Poor enforcement
- Few certifications for installers
- Engineers continue to crank out plans/specs pieced from items off internet

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Can Things Get Any Worse?

- Some states require older USTs replaced with ASTs
- New emergency generator ASTs popping up like mushrooms after a spring rain

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But Things Are Changing

- Feds & States have been learning from their mistakes
- New regs are here nationally/locally
- Insurance companies are demanding AST inspections or else

Before You Run Off:

- World of difference between USTs--ASTs
- ASTs are far more complicated than USTs
- Releases from ASTs can make national news when they light off or leak badly

There Are a Few Pitfalls with ASTs

- Making a mistake can end your business
- To err is human, to forgive is not corporate policy
- Fuels degrade faster in ASTs than USTs

Three solutions for AST problems: Education, Education & Education

Class room activities must address real-world fuel system problems

Class room work must then be underpinned and reinforced with real-world demonstrations and hands-on practice with actual fuel system equipment

Each student removes ATG probe as part of test of this AST overfill alarm

A critical aspect of inspections is certification. The next STI Aboveground Inspector Course at Datanet Training Center is Dec 10-14, 2018

For Course Information on Upcoming UST and AST Classes, Contact the National Petroleum Training Institute at 855-955-NPTI Or www.NPTInstitute.com

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