

# GRAND FIRE PROTECTION DISTRICT NO. 1

## Cisterns and Underground Tank Systems Alternate Water Sources for Rural Fire Protection Requirements Revision 04/09/2009)

Grand Fire Protection District No. 1 encourages property owners and requires new developers to provide water storage for fire protection utilizing existing rivers, streams, ponds, lakes and underground cisterns. In all applications NFPA Standard 1231 and 1142, Colorado State Forest Service Dry Hydrant Manual and Fire District specifications should be followed.

**All systems should be designed by a professional engineer and constructed to ensure operational capability. It will be required that all property owners / developers provide the Fire District with detailed construction plans including cross section drawings showing the design, materials and layout for review and modification as deemed appropriate prior to construction or installation. Certifications of the water supply and letters of permission for use will be required in all cases.**

### Cisterns and Underground Tank Systems

#### Draft versus Gravity Discharge

Drafting from a cistern can be difficult due to bad weather conditions, air leaks, and high elevation. Cold weather makes hard suction hoses stiff and snow can cause truck positioning to be difficult. Air leaks at fittings are always possible, causing no prime or loss of prime. High elevation with low atmospheric pressure makes it difficult to draft from large cisterns buried deeply in the ground to prevent freezing. With gravity feed cistern located approximately 50 feet above the discharge pipe; little or no priming is required and air leaks cease to be an irritation. The entire tank volume can be used even in deeply buried large diameter tank installations. Ice formation in lines is minimized with proper soil cover. Gravity discharge is very desirable if the topography at the cistern site will allow the tank to be positioned well above the truck fill site.

#### Tank Style

All tanks should be of filament wound and ribbed fiberglass construction conforming to ASTM 4021 standards for underground tank applications. Tanks should be rust proof with unlimited operational life expectancy and meet NFPA 1231 standards. No metal or steel tanks are allowed. Tanks may be interconnected to meet needed capacity.

#### Storage Capacity

In order to meet ISO requirements and provide lower insurance premiums the fire department is required to be able to deliver at least 250 gallons of water per minute throughout the area within 5 minutes of the arrival of the first apparatus, and maintain at

least that rate of flow without interruption for a 2 hour period. Therefore, all tanks and cisterns should provide a minimum of 30,000 gallons of water capacity at one location. Water storage capacity locations should be spaced no more than 3 miles apart.

### Tank Size

The diameter and overall length shall be indicated in feet and inches on any drawings submitted.

### Tank Bury Depth

The tank should be designed to support the necessary backfill cover over the top to prevent freezing or be equipped with a heating device as required.

### Buoyancy

Buoyancy deals with the possibility that any underground tank may actually try to float out of the ground, much like a fishing bobber. This situation is complicated when a tank is left empty or when there is ground water near the area that may collect under the cistern. It is recommended to place the tank in a dry area not subject run off or water table fluctuations. When this is not possible, a concrete under slab or concrete blocks (“deadmen”) can be cast in place below the tank such that the tank can be anchored with cables or straps to the concrete structures. This type of system must be engineered for each individual site and will significantly add to the cost of the system. Consult your engineer regarding the best overall cistern placement.

### Berming and Insulating

In many applications it may be necessary to bury the tank with only half the diameter below grade, and then berm the backfill up over the top to a depth to prevent freezing. It may be necessary to insulate the top of the tank to prevent freezing. Consult with your engineer regarding these decisions

### Insulation

The top of the cistern shall be insulated to a depth of half it’s diameter with closed cell flexible high density foam sheets, spray urethane, or similar products. The insulation thickness shall be sufficient to keep the cistern frost free and must cover the shell between the ribs and the top half of both heads. The insulated top portion will then be draped with a 6 mil poly sheeting moisture barrier prior to backfill. (Flexible insulation can be fitted much tighter to the curved tank walls than rigid board type foam insulation. The insulation material chosen must be suitable for burial and be water resistant).

### Manway

The manway should be no less than 24 inches in diameter and extended above the surrounding grade no less than 6 inches. The manway shall have a rust proof safety ladder mounted and the cover shall incorporate a tamper resistant padlock hasp, capable of accepting two padlocks for independent access by the owner / developer and Fire

District. The owner / developer will be required to provide a Knox brand padlock. The owner / developer should request a Knox Authorization order form from the Fire District.

### Draft Discharge Piping

The diameter of the draw or suction pipe should be no less than 6 inches and must incorporate an antivortex device if suction is required. The plumbing must deliver at least 1,000 gallons per minute (GPM) for  $\frac{3}{4}$  of the cistern capacity. The draw pipe system should include a safety “break-away” connection directly above the tank if required. All plumbing shall be schedule 80 plastic or schedule 40 welded steel piping. The draw pipe system shall be firmly supported by a subsurface steel platform suitable for anchoring in soil or concrete. **The suction connection shall be a 6 inch NST female long handled swivel with strainer and chained plug.** The center line of the draw pipe discharge shall terminate 24 inches above grade. (Larger piping may be specified if extremely high volume pumping is anticipated. See NFPA 1231 for typical specifications) *See Fire Protection System #1 Standard Dry Hydrant or Fire Protection System #2 Draft – Minimum Lift for details.*

### Gravity Discharge Piping

If gravity discharged is to be used a Mueller Super Centurion fire hydrant must be provided and plumbed to the tank discharge in accordance with standard practices. Fire hydrants need to be mountain type with a 6 inch barrel manufactured by Mueller Super Centurion 250 (preferred) or Waterous. One 4  $\frac{1}{2}$  inch NST fire department connection and two 2  $\frac{1}{2}$  inch NST outlets per hydrant are required. Fire hydrants are to be installed with the traffic flange at the same elevation as the edge of the pavement (road surface) or the back of a walkway. The approach to the fire hydrant should be a level-walking surface free of obstructions at least five feet wide including the backside. Testing of the fire hydrants will be required. The International Fire Code tables B105.1 and C105.1 provide further guidance on flows and fire hydrant distribution. All piping must be buried below frost line. *See Fire Protection System Example #2 Gravity Discharge to City Hydrant for details.*

### Vent

The vent should be of the inverted “J” style, fabricated from Schedule 80 plastic pipe or equivalent, with a recessed bug screen mounted at the top of the tank. The vent shall be the same size as the draw pipe or gravity discharge line. The vent should terminate a minimum of 24 inches above grade. (The vent must always be a big or bigger than the largest discharge fitting to guarantee neither a pressure nor vacuum condition is created in the tank during pump out or refilling.

### Automatic Water Refill Well

All supplies shall have a built in water supply from a dedicated exempt fire well, a feed from an approved domestic source, or other approved system. Refill shall be automatic, or by a Fire District approved manual control. An approved system to indicate that the supply is full will also be required. We request a fire well be in place for the filling of the

tank system. Exempt fire wells can be permitted through the Colorado Division of Water Resources.

### Refill Pipe

The refill pipe shall be no less than 3 inches schedule 80 plastic pipe to be mounted at the top of the tank. A 2 ½ inch NST female swivel with strainer and chained plug shall be provided and terminate horizontally, 24 inches above grade. A clapper multiport high volume filling manifold maybe required. The refill pipe can be installed in combination with the vent pipe with diverter.

### Level Indication

Various types of direct reading mechanical or solar powered electrically lighted displays are available and preferred. Visual inspection through the open manway or peep hole is the most common and least expensive. Consult your engineer or the Fire District for this requirement.

### Bollards

All discharge and draft piping shall be protected by pipe bollards filled and buried in concrete.

### Signage

The gravity / draft pipe or fire hydrant shall be marked with signage as follows:  
“Fire Hydrant” “Fire Department Use Only”

### Access

The gravity / draft pipe or fire hydrant shall be accessible year round and maintained by the owner / developer for use at all time. Snow removal will be the responsibility of the owner / developer. The area must be adequate for the positioning of departments fire apparatus at discharge point and include sufficient space to accommodate the filling of water tenders. Acceptable turnaround areas built for fire apparatus at or near the discharge point will be mandatory.

### Tank Maintenance

It will be the responsibility of the owner / developer to maintain the water system and ensure the water level is at full capacity at all times. Wells with float shut off mechanisms are encouraged.

### Testing

The water system must be tested by the Fire Department upon completion to verify the working order and must be capable of delivering at least 1,000 gallons per minute for ¾ of the tank capacity.