



## **CIRCULAR DEQ-16**

# **STANDARDS FOR HAULED WATER CISTERNS FOR NONCOMMUNITY PUBLIC SYSTEMS**

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This circular can be used for designing cisterns for noncommunity public water systems. A cistern can be broadly defined as an artificial reservoir or tank for storing water. However, for the purposes of this circular, a cistern is a small tank for storing potable water that serves one structure or a small number of connected structures. Normally the cistern is buried. For multiple user or community systems, refer to Department Circulars DEQ-1 and DEQ-3. Cisterns may be utilized only if a potable water source is available for hauling within a reasonable distance from the cistern and meets the requirements of ARM 17.36.336(5)(a). A licensed water hauler must supply the water and the water supply must be from a public water system. All water hauled must be disinfected in accordance with MDEQ regulations.

The purpose of this circular is to provide guidance to those locations having limited access to on-site water supplies such as springs and wells. Specifically, this circular is to provide guidance for the placement, construction, operation, maintenance, cleaning, filling, and disinfection of cisterns.

### **PLACEMENT**

The bottom of the cistern must be above the ground water table.

If the cistern is located outside a building, the cistern must be located at least 10 feet from any building or structure foundation and must be located to avoid roof drainage. The cistern must have positive drainage away from it so as to prevent any surface water from contaminating the interior of the cistern or its water supply. The cistern is required to be at least 50 feet from wastewater treatment drainfields and at least 25 feet from septic tanks or sealed sewer components. Storm sewers, drains, standing water, and similar sources of possible contamination must be kept at least 50 feet from the reservoir.

Precautions must be taken to assure that water cisterns and their accessories will not freeze during winter months. The top of the cistern (excluding the access lid(s)) must be installed deep enough to prevent freezing. In areas where no dependable snow cover is expected, the top of the cistern must be insulated with a high-density insulation board. One inch of high-density insulation board is equal to approximately one foot of earth in insulation value.

### **CONSTRUCTION**

Material: Water cisterns may be constructed of precast concrete, cast-in-place concrete, polyethylene, or fiberglass. Cistern capacity, site topography, and the availability of the different types of cisterns will help determine the most economical type of water cistern for each application.

Usually, a local precast concrete company will manufacture each precast cistern “to order,” casting-in the appropriate size(s) of connection fittings, access(es), overflow(s), and vent(s). The cistern will then be shipped to and installed at its final location.

Cast-in-place concrete contractors will also build cisterns “to order.” However, the cistern will be built in-place. Generally, cast-in-place concrete cisterns are most cost-effective in capacities greater than 5000 gallons.

Polyethylene water cisterns can be cost-effective for small capacities (less than 1500 gallons) and for applications in remote areas. Polyethylene cisterns are usually purchased locally. However, they are not made “to order.”

Fiberglass cisterns are cost-effective for large capacities (2000 gallon to 30,000 gallon) and can be made “to order.”

General Construction: Water cisterns must be watertight and must be made of materials suitable for potable water. A water tightness test must be performed on each water cistern before the cistern is put into service.

The access(es) to all cisterns must be a minimum of 24 inches in diameter to permit an average-sized person to enter and exit, for cleaning and maintenance purposes. **NO CISTERN SHOULD BE ENTERED UNTIL APPROPRIATE MEASURES HAVE BEEN TAKEN TO INSURE THE CISTERN’S AIR QUALITY IS SAFE AS DIRECTED BY OSHA CONFINED SPACE RULES, CODE OF FEDERAL REGULATIONS, TITLE 29-LABOR. NO CISTERN SHOULD BE ENTERED UNLESS THE PERSON ENTERING THE TANK HAS BEEN TRAINED IN CONFINED SPACE ENTRY AND FOLLOWS THE APPROPRIATE SAFETY PROCEDURES FOR ENTRY.** For buried cisterns, the access lid must extend at least 24 inches above the ground surface to prevent surface water from entering the cistern. The access lid must be securely fastened to prohibit unauthorized entry and must be designed to prohibit surface water, precipitation, and insects from entering the cistern. The access lid must be watertight, overlap a framed opening at least four inches high, and extend down around the frame at least two inches. The roof of concrete cisterns with earthen cover must be sloped to facilitate drainage away from the cistern.

All cisterns must be vented to allow the free flow of air into and out of the cistern as the water level inside the cistern changes. The vent must extend to the surface and at least 24 inches above the roof or sod. In areas of high snow, the vent must extend above the expected snow level. The vent opening must be turned down and must be screened with 24-mesh non-corrodible screen to prevent the entry of insects, birds, and other animals.

It is convenient to have a drainpipe and a “Direct-Bury” rated valve to empty the cistern, especially for cleaning. Such a drain may be installed if there is sufficient slope to the ground so the drainpipe daylight to the surface, as, for instance, on a hillside or bank of a nearby coulee or ravine. This pipe must slope slightly away from the cistern and must be at least 2 inches in diameter. It must be set so that the cistern will drain completely. The drain or overflow pipes should discharge over a drainage inlet or splash pad to prevent erosion and promote proper drainage away from the cistern. No drain or overflow may be connected directly to a sewer or a storm drain. All overflow pipes shall be located so that any discharge is visible. The overflow pipe shall open downward and be screened with 24-mesh non-corrodible screen to prevent entry by insects, birds, and other animals.

Precast concrete and cast-in-place concrete construction: All cisterns must be structurally sound and be capable of withstanding loads created by six feet of burial. Precast concrete cisterns must be manufactured to meet ASTM standard C 913 and must be installed in accordance with the manufacturer's recommendations. The walls and floor of precast concrete cisterns must be at least three inches thick, if adequately reinforced with steel rebar, and at least six inches thick, if not reinforced with rebar. Cast-in-place cisterns must have a minimum wall thickness of at least six inches and must be reinforced with steel rebar. Concrete for cisterns must have a water/cement ratio less than 0.45, a 28-day compressive strength of at least 4,000 psi, and must be made with cement conforming to ASTM C-150, Types I, I-II, II, III, or V.

All concrete cisterns must be constructed from materials approved for potable water including form oil, gaskets, and joint sealant. Many commercially-available form oils are not approved for, nor intended for use on, potable water systems. The cistern manufacturer must keep on file information showing these materials are approved by their manufacturers for potable water applications. The cistern manufacturer (or contractor for cast-in-place) must guard against the use or accidental exposure to any toxic materials or substances during all phases of manufacturing, curing, testing, and delivery operations.

Pre-cast concrete roof structures must be made watertight. Consider installation of an impermeable membrane roof covering and consider draping the membrane over the sides of the cistern to protect the seam between the roof and the wall. The connection between a pre-cast roof and the sidewalls must be watertight. The seal must be approved for use in potable water applications.

All joints, connections, and other seams between component parts shall be sealed with nontoxic waterproof material that meets NSF standard 61 or equivalent to prevent the loss of stored water and the infiltration of surface or ground water. Fittings or couplings which extend through the walls or the cover of cisterns should be cast in place by the manufacturer.

Polyethylene and fiberglass cisterns: All polyethylene and fiberglass tanks used for cisterns must be specifically manufactured for potable water in accordance with NSF standards or other nationally recognized standards for potable water. Documentation from the manufacturer stating that the cisterns are approved for potable water must be available for inspection.

Polyethylene and fiberglass cisterns must be installed according to the manufacturer's specific instructions. Particular attention must be paid to bedding material, backfill material, testing, and operation.

Painting and cathode protection: Painting and cathodic protection will comply with Section 7.0.16 of Department Circular DEQ-1.

## **OPERATION and MAINTENANCE**

A hauled water cistern should be sized to provide a minimum of three days average 24-hour demand.

The cistern must be inspected periodically to insure that the lids and access hatch are operating properly and that no deterioration has occurred to any part of the cistern. Pumps, wiring, floats, and piping must also be checked periodically for indications of failure or leaking. Cisterns located within a flood plain must have inspection procedures which address hazards from flooding, buoyancy, or other flood issues.

## **CLEANING AND DISINFECTION**

After initial construction of the cistern (or placement if cistern is pre-cast, polyethylene, or fiberglass), or after any maintenance, the cistern must be flushed to remove any sediment and thoroughly disinfected. This includes pump or float replacement or any plumbing work that has occurred within the cistern.

Prior to filling and using a cistern, it must first be cleaned and disinfected. Cleaning of all types of cisterns requires sweeping and removing all debris, dirt, and dust from the inside of the cistern. If this requires entering the cistern, every precaution must be taken to prevent suffocation and breathing toxic fumes. **NO CISTERN SHOULD BE ENTERED UNTIL APPROPRIATE MEASURES HAVE BEEN TAKEN TO ENSURE THE CISTERN'S AIR QUALITY IS SAFE AS DIRECTED BY OSHA CONFINED SPACE RULES, CODE OF FEDERAL REGULATIONS, TITLE 29-LABOR. NO CISTERN SHOULD BE ENTERED UNLESS THE PERSON ENTERING THE TANK HAS BEEN TRAINED IN CONFINED SPACE ENTRY AND FOLLOWS THE APPROPRIATE SAFETY PROCEDURES FOR ENTRY.** It is also recommended that the interior be cleaned with a pressure cleaner.

Disinfection of a cistern may be accomplished by using a solution of household bleach at a concentration of between 100-200 ppm. Common household bleach containing approximately 5 percent chlorine by weight may be used. Approximately four oz. Chlorine per five gallons of water will provide the proper concentration. All inside surfaces must be brushed with this solution. Allow a contact time of 12 to 24 hours.

The cistern must then be filled with water from a potable water source. Faucets and water taps must be turned on in the dwelling. After the water has run for a few minutes, turn off all the faucets and taps and again let the water stand for 12 to 24 hours. This will disinfect all the water lines of the delivery system.

After the allotted time, the cistern must be emptied and the water lines drained. The chlorinated water used for disinfection must not be discharged to a stream, river, or other waterway where damage to aquatic life may occur. The chlorinated water must not be drained to a sewer system. The cistern must now be filled a second time from a potable water source. This water should now be ready for use. If the cistern is constructed from concrete, it may be desirable to use at least three loads of water prior to drinking the water. The water may still have a "chalky" appearance and may also have a slight "cement taste."

Two or more successive samples taken at 24-hour intervals must indicate microbiologically satisfactory water before the facility is placed into operation. Another guideline is to drain, clean, and disinfect a cistern approximately every five years, especially if a water sample indicates contamination.

## **FILLING**

The water supply used to fill the cistern must be a potable source that is hauled in a container that is properly constructed and has been cleaned and disinfected. The cistern must be filled from potable water sources provided by public water supplies and hauled by either a licensed water hauler or the owner in accordance with the water hauling regulations. Hoses, as well as the water hauling tanks used for filling the cistern, need to be cleaned and disinfected periodically to ensure the water hauled remains potable. The disinfection guidelines outlined above describe the process to clean and disinfect hoses and hauling tanks. These hauling tanks must only be used for hauling potable water and must never be used for the hauling of any toxic chemicals or poisons. If the tanks are used regularly, only occasional disinfection is necessary. If the tanks are used periodically, then disinfection prior to each use must occur. The hose to fill the cistern must never be placed inside the cistern where the hose can be submerged in the water causing possible contamination.