

**NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD**

WATERING FACILITY

(No.)

CODE 614

DEFINITION

A permanent or portable device to provide an adequate amount and quality of drinking water for livestock and/or wildlife.

PURPOSE

To provide access to drinking water for livestock and/or wildlife in order to:

- Meet daily water requirements
- Improve animal distribution

CONDITIONS WHERE PRACTICE APPLIES

This practice applies to all land uses where there is a need for new or improved watering facilities and water storage facilities for livestock and/or wildlife.

CRITERIA

GENERAL CRITERIA APPLICABLE TO ALL PURPOSES

Watering systems and facilities for livestock shall be planned to include the needed storage, delivery rates, and spacing requirements for the anticipated herd size for the grazing unit, the projected carrying capacity (based on a grazing plan and forage inventory), and/or the highest anticipated demand. In general, livestock water twice a day and drink half of their daily requirement at each watering. Each animal will drink for approximately 5 minutes. It is recommended that a herd take no longer than 2 hours to complete a watering.

For wildlife purposes, design watering facilities with adequate capacity and supply to meet the daily water requirements of wildlife planned to

use the facility. Include the storage volume necessary to provide water between periods of replenishment. Because each facility is unique to species, habitat, topography, and climate; watering facilities must be planned and installed according to a wildlife management plan and adapted to the specific site.

Design the watering facility to provide adequate access to the animals planned to use the facility. Incorporate escape features into the watering facility design where local knowledge and experience indicate that wildlife may be at risk of drowning.

Design and install watering facilities to prevent overturning by wind and animals.

For purposes of this standard, watering facilities include water storage facilities, drinking facilities, and combination drinking and storage facilities. Dependable water supplies include pumping systems powered by electricity, systems served by rural water districts or other public water systems, and ponds and streams that are accessible to livestock that typically do not go dry (Ref. EFH Chapter 11, Table 11-3).

Materials

All materials shall have a life expectancy that meets or exceeds the planned useful life of the installation. Common construction materials are reinforced concrete, steel, fiberglass, brass, plastic and wood. Precast (freeze proof) concrete tanks and factory fabricated fiberglass tanks may be used. All designs shall meet the industry standards for the material being used. Tanks may also be constructed from heavy equipment tires. Used steel tanks (oil, gasoline, etc.) can be used provided the supplier certifies the tank's use for livestock and/or wildlife.

Appurtenances

Shut-off valves shall be installed, where needed, to control and/or cut off flow to repair or protect the line and to preserve the supply in case of pipeline failure.

In watering facilities and storage tanks, proper instrumentation and controls must be installed to regulate inflow and water level. With the exception of windmills or systems that operate on a timer, floats or other automatic shut off valves will be required in order to conserve water. Floats and valves must be designed in a manner to prevent unnecessary restrictions of flows or changes to the system's ability to deliver the flow as designed. All valves and controls must be protected from livestock and/or wildlife and from freezing. Freeze protection may be accomplished by heat tape, earth sheltering, combination insulation and heat sink, an ice prevention valve, or other approved means.

A water level control valve or overflow pipe shall be used to maintain the water level at 1 ½ inches below the top of the facility. The minimum diameter shall be 1 ½ inches. The overflow pipe shall extend a minimum of 10 feet from the outer rim of the facility and be marked or otherwise protected from damage.

Watering facilities shall be equipped with a suitable water supply outlet and drainage outlet.

If a roof is placed over the facility to provide shade, the roof shall meet design requirements for appropriate snow and wind loads and shall be durable to withstand anticipated livestock and wildlife activities.

Watering Facility Definitions

"Water storage facilities" are tanks that hold water and serve other facilities via pipelines. These are usually taller structures and no animals drink from them.

"Combination drinking and storage facilities" are tanks with a wall height such that animals drink from it; however, it shall be large enough to store the drinking water required by the design.

"Drinking facilities" are small troughs or tanks that have no significant storage and provide

drinking space for a limited number of animals. These facilities are dependent on quick recharge. Flow rates must be adequate to supply 2.0 GPM / Drinking Head for large livestock. Flow rates for small livestock such as sheep, pigs and goats are to be based on 0.5 GPM / Drinking Head. The number of drinking head is limited by the drinking space around the facility. The system shall be designed to water all the livestock in the grazing unit within two hours. Freeze-proof tanks and energy-free fountains are also considered to be drinking facilities. When an energy free fountain is used, it shall be the primary source of water for the pasture in order to make the fountain function without freezing.

"Portable watering facilities" are watering facilities that have the ability to be moved to different locations. These facilities work best in situations for distributing grazing, intensive rotational systems and offsite water to minimize use of ponds and streams without the use of a fence to exclude access. These facilities generally are not designed, but shall be selected with adequate capacity to meet the livestock purpose.

Site Selection

Establish water facilities in locations that will minimize adverse impacts on the land.

Locate water in underutilized portions of the grazing unit to reduce grazing pressure on sensitive areas.

The site shall be well drained; if not, drainage measures shall be provided. Areas adjacent to the watering facility or apron, if applicable, that will be trampled by livestock shall be stable. Where needed, added protection shall be installed in accordance with the Oklahoma NRCS Heavy Use Area Protection (561) standard.

Watering facilities may be located to facilitate and control stock movement and generally should be located near the middle of a pasture.

Spacing

Slope, barrier, and pasture design and travel distance are to be included in the design and layout to address grazing distribution.

Spacing requirements in a grazing unit shall be based on the following guidelines:

- Other dependable drinking facilities within the grazing unit,
- The need for water in a given location, and
- Terrain, as described in Table 1:

Table 1. Water Facility Spacing

Type of Terrain	Water spacing (miles)
Rough (slopes > 15%)	1/4 - 1/2
Rolling (8 - 15%)	3/8 - 3/4
Level (<8%)	3/4 - 1

The distribution and spacing of facilities serving wildlife shall be based on the required travel distance to water, proximity to other required habitat components, and the home range, territory size, and distribution of the target species as indicated in Table 1a:

Table 1a

Species	Distribution of Facilities
Antelope	1 per 1-2 square miles
Deer	1 per square mile
Elk	1 per 2-4 square miles
Quail	1 within 0.25 mile of food and cover areas
Turkey	1 within 1 mile of roost areas
Pheasant	1 within 0.5 miles of feeding areas
Dove	1 within 2 miles of feeding areas
Songbirds	1 within 0.25 miles of feeding areas

Storage Capacity for Livestock

A complete watering system includes both the storage part and the drinking part of the facility. Storage and drinking facilities can be provided in combination or they can be provided

separately by connecting the components with pipelines to meet the livestock and/or wildlife demand.

Consumption needs shall be based on the guidelines in Table 2 below:

TABLE 2

Animal	Gallons / 1000 lbs. Live Animal Weight
Beef Cattle	15
Dairy Cattle	20
Goats	25
Horses	15
Sheep	25
Swine	20
Poultry	120
Bison	15

The water system shall provide a total system capacity for a 5-day storage if the supply is dependent upon a windmill or solar system.

A minimum of a 2-day storage shall be provided for systems powered by electricity, by rural water districts or other public water systems.

In order to attain additional distribution of grazing within a single grazing unit and within the confines of the spacing established in Table 1 of this standard, the 2-day storage requirement may be met by more than one facility. However, "combination drinking and storage facilities" used with multiple facilities shall be designed for no less than a 1-day storage.

"Drinking facilities" installed where a system malfunction or interruption in service is immediately evident (i.e. house wells or pipelines tied to livestock feeding operations for poultry, swine, dairy, etc.) are not required to meet the 2 days of storage, however a minimum tank capacity of 100 gallons shall be provided. This 100 gallon storage requirement is waived for freeze-proof tanks and energy-free fountains.

Storage Capacity for Wildlife

The effective water storage capacity for any wildlife watering facilities will be no less than the minimum designed storage, as specified by Oklahoma Standard Engineering Drawing 518a. With the exception of meeting the minimum storage requirements described above, the design shall be sized to accommodate the expected and/or anticipated consumptive rates of target and non-target species as described in Table 2a:

TABLE 2a

Species	Number of Animals	Gallons of Water per Day
Antelope	Each	1-2
Deer	Each	1-2
Elk	Each	5-8
Quail	Covey	1-2
Turkey	Flock	2-3
Pheasant	Local Population	2-5
Dove	Local Population	2-5
Songbirds	Local Population	1-2

Flow Rate

Pipelines serving a watering facility shall be adequate to meet the requirements of the watering facility. The type of facility served by the pipeline will influence the pipeline requirements.

The flow rate to a water storage facility is governed by the water source and recharge rate. The recharge rate for all systems except solar powered systems shall be 2.0 times the daily use in a 24 hour period. The recharge rate for solar powered systems shall be such that it delivers 1.5 times the daily livestock need in a 24 hour period.

Drinking Space and Size

For "combination drinking and storage facilities", size requirements are governed by the water demand for the herd and not by drinking space.

For "drinking facilities" the perimeter of the facility shall be a minimum of 1 inch per head in the herd. This requirement is waived for freeze-proof tanks and energy-free fountains. Table 3 below is to be used as a guide to animal space requirements (Divide the facility perimeter by the Drinking Space/Head).

TABLE 3

Animal	Drinking Space per Head (inches)
Beef	20
Dairy	24
Goats	12
Horses	20
Sheep	12
Swine	12
Poultry	3
Elk	20
Deer	12
Antelope	12
Bison	24

Facility height may vary from 22 to 36 inches for horses, beef, and dairy cattle. For sheep and goats, the facility height may vary from 8 to 22 inches.

Water Quality

Water should be of adequate quality for wildlife and/or livestock consumption. Refer to National Range and Pasture Handbook, 600.0603(e) (5) and Table 6 - 8, Water Quality Standards for Livestock.

CONSIDERATIONS

This practice may adversely affect cultural resources and must comply with GM 420, Part 401.

Topography should be evaluated to minimize trail erosion and flooding erosion from tank overflow.

Watering facilities should be accessible to small animals. Escape ramps for birds and small animals should be installed.

During freezing weather, adequate protection for livestock and alternative water supplies should be considered. Systems should be checked regularly to ensure proper operation.

Design fences associated with the watering facilities to allow safe access and exit for area wildlife species. To protect bats and other species that access water by skimming across the surface, fencing material should not extend across the water surface. If fencing across the water is necessary it should be made highly visible.

Wildlife watering facilities should be installed so that a wide range of wildlife species may benefit from its installation.

For watering facilities that will be accessible to wildlife, give consideration to the effects the location of the facility will have on target and non-target species. Also consider the effect of introducing a new water source within the ecosystem in the vicinity of the facility. This should include things such as the concentration of grazing, predation, entrapment, drowning, disease transmission, hunting and expansion of the wildlife populations beyond the carrying capacity of available habitat.

Watering facilities often collect debris and algae and should be cleaned on a regular basis. Consider increasing the pipe sizes for inlets and outlets to reduce the chances of clogging. Maintenance of a watering facility can be made easier by providing a method to completely drain the watering facility.

Steep slopes leading to watering facilities can cause erosion problems from over use by animals as well as problems with piping and valves from excess pressure. Choose the

location of watering facilities to minimize these problems from steep topography.

PLANS AND SPECIFICATIONS

Plans and specifications for watering facilities shall provide the information necessary to install the facility. As a minimum this shall include the following:

- A map or aerial photograph showing the location of the facility
- Detail drawings showing the facility, necessary appurtenances (such as foundations, pipes and valves) and stabilization of any areas disturbed by the installation of the facility
- Construction specifications describing the installation of the facility

If the facility is a component of a system that includes additional conservation practices, the information necessary to construct these additional practices will be a part of the conservation plan.

Development of plans will be guided by Engineering Field Handbook, Chapter 5, and shall be in accordance with National Engineering Manual, Parts 541 and 542.

Wildlife watering facilities typically include excavated or embankment ponds, concrete lined watering basins, tanks or troughs, springs or seeps, and guzzlers.

Plans and specifications for wildlife watering facilities shall include the following requirements, references, or standard drawings as applicable:

- Outside dimensions of concrete liners will be no less than 6 feet by 6 feet and no greater than 12 feet by 12 feet. Designed water depths will be between 1 foot and 2 feet. Slopes will be 3 horizontal to 1 vertical or flatter. Concrete will be 4 inches in thickness and textured to provide solid footing for hoofed wildlife species. Concrete and other materials and installation requirements will be the same as those described in the Oklahoma

NRCS Lined Waterway or Outlet (468) standard.

- Constructed wildlife guzzlers with catchment structure, underground storage tank and watering trough. Refer to Oklahoma Standard Engineering Drawing 518a and 518b.
- Prefabricated, commercially available wildlife water guzzlers as described in the list of "Pre-Approved Structures, Components, and Appurtenances" in Section 4 of the Field Office Technical Guide are approved for use by wildlife.

OPERATION AND MAINTENANCE

A written O&M plan specific to the type of installed watering facility shall be provided to the landowner. Maintenance items should be performed within 5 days from the time they are noticed. The plan shall include, but not be limited to, the following provisions:

- check for debris, algae, sludge or other materials in the facility which may restrict the inflow or outflow system;
- check for leaks and repair if any leaks are found;
- check the automatic water level device to ensure proper operation;
- check to ensure that adjacent areas are well protected against erosion;
- check to ensure the outlet pipe is freely operating and not causing erosion problems; and
- prepare guidance for winter weather, such as adding material in the storage area to allow for ice expansion without damage.
- a schedule for periodic cleaning of the facility.

REFERENCES

- Manual of Steel Construction, American Institute of Steel Construction
- Timber, National Design Specification for Wood, American Forest and Paper Association
- Concrete, ACI 318, American Concrete Institute
- Masonry, Building Code Requirement for Masonry Structures, ACI 530, American Concrete Institute
- Facilities for Watering Livestock and Wildlife, USFS, BLM January 1989 2400-Range, MTDC 89-1.
- Brigham, William and Stevenson, Craig, 1997, Wildlife Water Catchment Construction in Nevada, Technical Note 397.
- Tsukamoto, George and Stiver, San Juan, 1990, Wildlife water Development, Proceedings of the Wildlife Water Development Symposium, Las Vegas, NV, USDI Bureau of Land Management.
- Yoakum, J. and W.P. Dasmann. 1971. Habitat manipulation practices. Ch. 14 in Wildlife Management Techniques, Third Edition. Ed. Robert H. Giles, Jr. Pub. The Wildlife Society. 633 pp.
- National Engineering Handbook, Part 650 Engineering Field Handbook, Chapters 5, 11 & 12, USDA Natural Resources Conservation Service.
- National Range and Pasture Handbook, Chapter 6, Page 6-12, Table 6-7 & 6-8, USDA-Natural Resources Conservation Service.
- National Research Council, 1996 Nutrient Requirements of Domestic Animals, National Academy Press.

**NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE GENERAL SPECIFICATIONS**

WATERING FACILITY

(No.)

CODE 614

CONSTRUCTION SPECIFICATIONS

Watering facilities shall be constructed to the dimensions, elevations, and grades as specified on the plans, drawings, or job sheets.

These specifications are generally applicable to livestock and do not include the requirements for wildlife guzzlers, shallow troughs, and other specially designed facilities for wildlife. The Watering Facility standard refers to specific drawings for these types of facilities.

Plumbing

For combination overflow/drain outlets, a coupling shall be set level with the bottom of the facility to permit unscrewing the overflow pipe to allow drainage of the facility. A swivel connection may also be used to allow drainage of the facility. Drain plugs for fiberglass tanks should be located near the bottom of the tank. All plumbing shall be new galvanized steel, copper, bronze, or plastic pipe and fittings. All plastic pipe shall comply with the Oklahoma NRCS Irrigation Water Conveyance (430-DD) standard. Pipe fittings may be PVC Schedule 40 unthreaded, Schedule 80 threaded, or galvanized steel.

Foundation

The foundation shall be prepared by leveling, smoothing, and compacting the area where the facility is to be constructed. The base shall be free of debris and rocks or pebbles larger than 3/8 inch in size. When specified, a layer of sand or fine gravel shall be placed between the bottom floor and subgrade. On moderately to high shrink/swell soils or a linear extensibility of 3 or more, a minimum of a 4" layer of 3/8 inch crushed rock or concrete sand shall be used under the facility for a base, it

shall be saturated to consolidate the sand or crushed rock base. The material shall be free of organic material, excess fines, and rock larger than 3/8 inch in size.

The drainpipe shall be positioned before final grading of the foundation.

Reinforced Concrete

Reinforcement shall be placed as shown on the plans and shall be free of oil and other foreign matter such as loose coatings of rust, scale, or dirt. Reinforcing steel for concrete walls shall be secured in place by tying the vertical bars to the horizontal bars. The vertical bars shall be fastened in position as needed for rigidity. The vertical bars shall be placed so that the horizontally projecting leg is 2½ to 3 inches below the finished surface of the floor slab. The floor slab reinforcement shall be tied in place so that it is 2 to 2½ inches below the finished surface of the floor slab. The slab reinforcement shall rest on the horizontally projecting legs of the vertical bars. Welded wire, as shown on the standard drawing, or fiber reinforcement can also be used.

The concrete shall be good quality using sound and clean aggregates. A job or ready-mix concrete shall consist of approximately 1 part cement, 2 parts sand, and 4 parts coarse aggregate (1 ½ inch maximum size). The water-cement ratio shall be no more than 6 gallons of water to 1 sack of cement when dry aggregates are used. If the sand and gravel used is moist, the water shall be reduced to no more than 5 gallons per sack of cement.

Concrete shall be placed to the lines and grades as shown on the plans or as staked in the field. Unless otherwise specified, the concrete shall produce strength of not less

than 3,000 psi in 28 days. All concrete is to consist of a workable mix that can be placed and finished in an acceptable manner. The concrete shall be delivered to the site and discharged into the forms within 1 ½ hours after the introduction of the cement to the aggregates unless a mix design with set retarder is approved for use by the technician.

Concrete shall not be placed when the outside temperature is below 40 degrees or above 90 degrees Fahrenheit. Concrete placed during cold weather shall be protected from freezing during the curing period. The concrete shall be cured by covering it with burlap, canvas, or other suitable material and kept from drying out for at least 7 days. The concrete may be cured by coating the surface with an approved white-pigmented curing compound.

The concrete for the floor slab shall be placed after the vertical bars, the intervening tie bars, and the slab reinforcement are in place. Care shall be used in placing the concrete to avoid segregation. The top of the floor slab shall be troweled to a reasonably smooth finish.

Unless the entire facility can be poured at one time, the bond area between the floor slab and the wall shall be left untroweled and shall be thoroughly cleaned to insure a good bond between the floor and wall.

The concrete shall be consolidated in the forms as it is placed to ensure a tight bond to reinforcing steel and to yield dense concrete reasonably free of voids. Either metal or wood forms may be used. After the forms are removed, all exposed voids shall be filled with cement-sand mortar. The entire wall surface shall be wet rubbed to accomplish a dense smooth surface.

Concrete Walls

Reinforced concrete walls shall have a minimum thickness of 6 inches, and the reinforcing shall consist of 3/8 inch round bars spaced on 8-inch centers in both directions. The vertical bars shall have a 15-inch leg projection horizontally into the floor with the vertical leg extending to within 2 inches of the top of the wall. Bars shall be placed so as to have a minimum cover of 2 inches. Where horizontal wall bars meet or are spliced, there shall be an overlap of at least 12 inches.

Facilities originally constructed with a concrete floor and a steel sidewall, which has deteriorated, may be reconstructed as concrete facilities provided all of the following requirements are met:

1. The floor is determined to be sound with no signs of deterioration.
2. The steel sidewall shall be removed to the floor surface unless it can be used as a form for a new concrete wall.
3. The contact area for the concrete replacement wall with the floor surface shall be thoroughly cleaned for a good bonding surface. Waterstop or other similar products should be used to prevent seepage or leakage from the cold joint.
4. Reinforcement shall be as stated for "Concrete Walls" except that the horizontal projection into the floor shall not be required. Instead, the vertical bars shall be anchored in 3-inch deep drilled holes in the floor. Wall thickness shall be 6 inches.
5. Concrete and reinforcing steel placement shall be as stated in the General Specifications above.

Concrete Silo Stave Walls

Concrete silo stave walls shall be installed according to plans. The cement grout for finishing the inside of the slab shall be mixed to a creamy consistency. The grout shall not be allowed to dry or set-up between the application of the successive coats. Once the application is completed, curing shall be the same as for the other concrete. The floor and apron are not to be connected as a continuous pour.

The concrete silo staves for all facilities 10 feet in diameter and larger shall be 10 inches wide by 30 inches high by 3 5/8 inches thick. The staves shall be of interlocking tongue and groove construction. The hoops shall be 9/16 inch galvanized steel rod with lugs and nuts. The number of hoops required is as follows:

Tank Diameter (ft.)	Number of Hoops
16	2
>16-22	3
>22	4

The inside of the facility shall be finished by applying 3 successive coatings of Portland cement and water grout.

Metal Side Walls

Metal walls shall be installed according to the plans, and all joints shall be made watertight. In areas where the water causes rapid deterioration of the metal wall, coatings as approved by the state conservation engineer shall be used to provide a longer life structure.

Metal walls shall be made of new material selected from one of the following:

1. Galvanized corrugated steel 16 gauge or thicker.
2. Ungalvanized or galvanized sheet steel with a minimum thickness of 1/8 inch (10 gauge, 0.1345 inches thick is greater than 1/8 inch).

Ungalvanized material shall be treated with a rust preservative treatment.

Metal walls shall be embedded at least 2 inches into the concrete floor, and the floor at this junction shall be made at least 2 inches thicker directly below the metal wall to compensate for the wall depth into the floor. This additional thickness shall extend at least 6 inches each direction from this junction. The part of the metal wall that extends into the concrete floor shall be coated with asphalt or similar coating before the floor is poured. The coating shall extend approximately 2 inches above the finished floor. The same treatment shall be given any metal pipes which extend through the concrete floor. The top edge of the metal wall, except smooth steel 3/16 inch (7 gauge or thicker) and corrugated galvanized steel of 12 gauge or thicker, shall be strengthened and protected either by a rolled edge or by welding to it, a pipe with ½ inch minimum diameter or angle iron with minimum dimensions of 1" x 1". After welding, the edge shall be protected against rust by a rust preventative treatment.

Fiberglass Facilities

The facility shall be made of glass reinforced polyester to the manufacturer's design for the intended purpose. Facilities shall be made of ultraviolet resistant materials or have a durable coating to prevent deterioration due to sunlight and to keep the facility serviceable. Minimum

thickness of the walls and floor shall be ¼ inch. The top edge of the facility rim shall be protected with a 1 to 2 inch molded flange or other acceptable reinforcement.

Pre-cast Concrete and Prefabricated Facilities

Pre-cast concrete tanks and prefabricated energy-free fountains require approval of the state conservation engineer. This may be by individual analysis or by inclusion on the state's pre-approved structures list. Manufacturers may submit designs of structures for inclusion in the state's list of pre-approved structures.

Pre-cast concrete freeze proof tanks supplied by a pond shall have a minimum of 4 feet of head from the planned permanent water level (considering evaporative and seepage losses) to the lip of the tank. A substantial area of the pond shall be fenced to protect the pond banks, water quality, and wildlife. To prevent freezing, a 2-foot layer of soil is required over the tank. A bulkhead shall be installed to prevent soil from spilling into the tank. If the pre-cast bulkhead needs to be extended, the extension shall be constructed of sound, durable materials with sufficient foundation and/or anchoring to resist overturning.

Prefabricated energy-free fountains shall meet all manufacturers' recommendations; this includes minimum and maximum herd capacity.

Prefabricated commercially available wildlife guzzlers will be installed so that the watering area (trough, ramp, etc.) are accessible for use by the targeted wildlife species, as identified in the wildlife habitat management plan.

These type facilities must meet all the criteria listed in the appropriate Job Sheet.

Heavy Equipment Tire Trough.

Heavy equipment tires used for troughs shall be of suitable quality to perform as intended for the useful life of the practice. The tires shall be free of chemicals injurious to livestock and certified by the supplier as safe for livestock. If this type of tank or facility is to be used to water horses, the operator should be cautioned about the possible ingestion of rubber.

The hub shall be either filled with concrete reinforced with polypropylene fibers (FRC) or have 3/8" reinforcing bars placed on 12" centers in both directions and filled with concrete. The concrete shall meet the requirements stated previously in this specification.

The top edge of the tire shall be cut so that the lip is a maximum of 8" wide.

Water Storage Facilities

Closed top facilities shall be vented in accordance with the manufacturer's recommendations.

Circular commercial storage facilities fabricated from steel or fiberglass material may be used. They shall have a maximum height of 16 feet and a maximum diameter of 20 feet.

Sidewall height and minimum thickness for steel shall be as follows:

2.5' to 4.0'	16 gauge galvanized corrugated steel or 10 gauge sheet steel with a rust preventative coating.
4.1' to 6.0'	16 gauge galvanized corrugated steel or 7 gauge sheet steel with a rust preventative coating.
6.1' to 16.0'	¼ inch steel plate with a rust preventative coating.

Sidewall height and minimum thickness for fiberglass shall be as follows:

2.5' to 5.0'	¼" (1/32" tolerance)
5.1' to 12.0'	5/16" (1/32" tolerance)
12.1' to 16.0'	3/8" (1/32" tolerance)

All joints and seams shall be suitably reinforced.

Storage facilities may require protection against overturning and sliding from wind forces. This may be accomplished by maintaining a minimum required water depth in

the facility or by installing suitable rod anchors into the soil or rock underlying the facility. Storage depth for stability may not be counted in storage needs for livestock water.

Refurbished Steel Tanks

Used steel tanks (oil, gasoline, etc.) are acceptable provided the wall thickness meets the requirements stated under Water Storage Facilities. Tanks shall be refurbished at a commercial tank refurbishing facility and be certified as safe for storing livestock water.

Aprons

Facilities with reinforced concrete or metal walls shall have a 30-inch wide concrete apron which is an extension of the floor and have the same thickness as the floor. Facilities with concrete silo stave walls shall have a 30-inch wide concrete apron. The apron shall be separated from the stave sidewall by using a bituminous or cork expansion material with a minimum thickness of 3/8-inch.

One of the following three aprons shall be used for fiberglass, pre-cast concrete, freeze-proof tanks, and heavy equipment tire facilities:

- 30-inch wide by 5-inch thick concrete apron separated from the sidewall of the facility with a 3/8 inch minimum thickness of bituminous or cork expansion material.
- 60-inch wide by 6-inch thick apron of coarse gravel or crushed rock.
- Fiberglass tanks may also be placed on existing concrete pads provided the minimum dimensions of an apron meet the criteria above and the tank is adequately anchored.

Energy-free fountains require a 30-inch wide by 5-inch thick concrete apron.

All concrete for aprons shall meet the requirements stated previously in this specification and be reinforced with a minimum of 10 gage, 6-inch by 6-inch welded wire mesh or polypropylene fibers (FRC).