NATURAL RESOURCES CONSERVATION SERVICE
PACIFIC ISLANDS AREA

CONSERVATION PRACTICE SPECIFICATION

WATERING FACILITY

SCOPE

The work shall consist of furnishing materials and constructing a water tank and/or a watering trough with appurtenances to the dimensions and elevations as shown on the drawings or as staked in the field. Construction shall be in accordance with the plans and these specifications.

INSTALLATION

Building permit. Plans shall be noted that a building permit may be required for tanks and tank sheds, and is the responsibility of the owner or user to obtain the required permits from the appropriate agencies.

Site preparation. The foundation area for the trough or tank shall be cleared of material not suitable for the subgrade. The foundation area and the immediate surrounding area shall be graded and smoothed to permit free drainage of surface water. All backfill for underground pipes shall be compacted to the degree required to prevent settlement after construction is completed.

Materials and workmanship. All materials, placement, anchoring, proportioning and protection shall be as shown on the plans.

Structural Requirements. The exterior of steel tanks shall be galvanized or painted. Interior protective coating shall be provided on steel tanks where the pH of the water stored is 6.5 or lower. Tanks requiring protective interior coatings shall be galvanized or painted with nontoxic paint.

<u>Galvanized Corrugated Steel</u>

Corrugations for metal sheets shall be 2-2/3 inch x 1/2 inch.

Table I shows the relationship of steel gauge number to steel sheet thickness. Minimum thickness for galvanized corrugated steel tanks is shown in Tables II and III.

Table II tanks shall be connected with 3/8-inch diameter bolts as shown in Figures 1, 2, 3, and 4. The 3/8-inch diameter national coarse bolt is 1 inch long. Bolt hole diameters shall not exceed 1/2 inch.

The distance from the edge of the corrugated metal sheets shown in Figures 1, 2, 3, 4, 5, and 6 is the minimum acceptable spacing.

Bolting pattern shall be the same for gauge material thicker than that shown in Table II or Table III.

The bottom ring of the tank should be assembled directly on the base material. Vertical joints of the section plates of the second tank ring shall be positioned approximately above the center of the section plates of the bottom tank ring. This staggering of the section plates shall be followed

throughout the tank construction. Connections shall have the bolt and washer on the inside of the tank with the nut on the outside.

Table I

Conversion of Nominal Steel Gauge to Steel Sheet Thickness

Gauge (no.)	Galvanized Thickness (in.)	Uncoated Thickness (in.)
12	0.109	0.1046
14	0.079	0.0747
16	0.064	0.0598
18	0.052	0.0478

Table II

2-2/3 inch x 1/2 inch Corrugated Steel Water Tanks with 3/8-inch Diameter Bolt Connections

Minimum Wall Thickness - Gauge

Height	Diameter - Feet						
(ft.)	8	12	16	20	24	28	32
2	18	18	18	18	18	18	18
4	18	18	18	18	18	18[1/]	18[1/]
6	18	18	18	18[1/]	18[1/]	18[1/]	18[1/]
8	18	18	18[1/]	18[1/]	18[1/]	16[2/]	16[2/]
10	-	18[1/]	18[1/]	16[1/]	16[2/]	14[2/]	14[3/]
12	-	18[1/]	18[1/]	16[2/]	14[2/]	12[3/]	12[3/]

[1/] Double row, Figure 2.

[2/] Single-double row, Figure 3.

[3/] Double-double row, Figure 4.

Example. A 12-feet diameter, 12-feet high tank will require 18-gauge steel from Table II. The bottom 4 feet of the tank requires the double row pattern as shown in figure 2. The single row pattern shown in figure 1, begins 4 feet from the bottom or above the double bolt pattern and continues 8 feet to the top of the tank.

Tanks exceeding 12 feet in height, 36 feet in diameter, or having different corrugations shall meet the requirements in AWWA D103, Factory-Coated Bolted Steel Tanks for Water Storage.

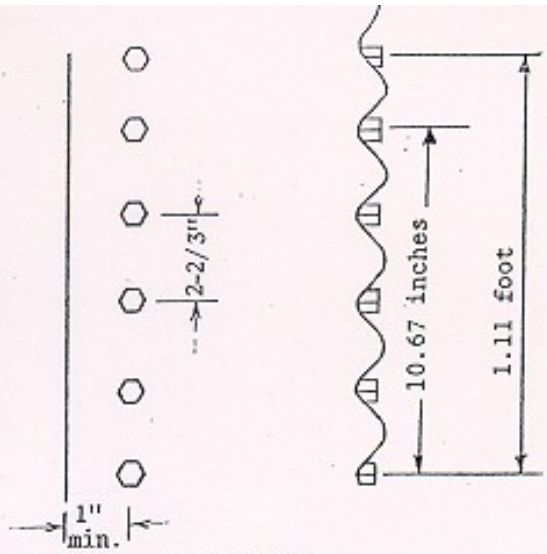

FIGURE 1
Single Row
(5 bolts per foot)
Bolt in bottom of each corrugation.

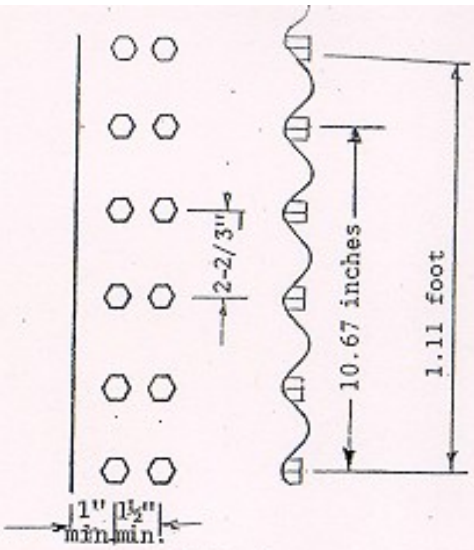

FIGURE 2
Double Row
(10 bolts per foot)
Bolt in bottom of each corrugation.

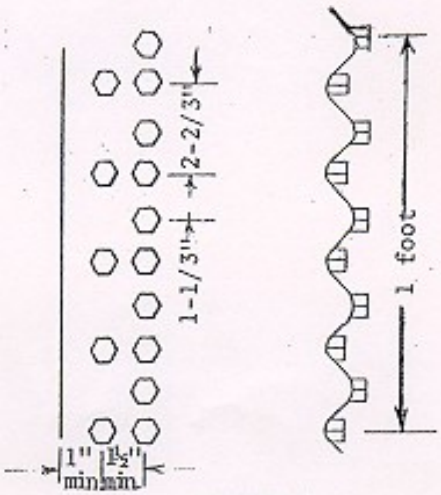

FIGURE 3
Single-double Row
(15 bolts per foot)
Bolt in top and bottom of each corrugation.
Single bolt may be in top or bottom corrugation.

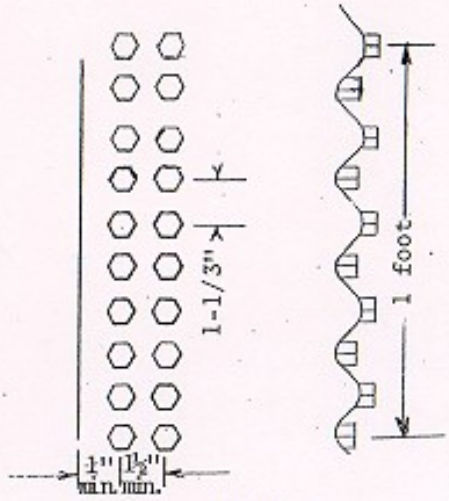

FIGURE 4
Double-double Row
(20 bolts per foot)
Bolt in top and bottom of each corrugation.

Table III tanks shall have 5/16-inch diameter bolt connections as shown in Figures 5 and 6. Bolt hole diameters shall not exceed 7/16 inch.

Table III
2-2/3 inch x 1/2 inch Corrugated Steel Water Tanks with 5/16 inch Diameter Bolt Connections

Minimum Wall Thickness - Gauge

Height	Diameter - Feet						
(ft.)	15	21	24	27	30	33	36
3'-7"	18	18	18	18	18	18	18
7'-1"	18	18[1/]	18[1/]	18[1/]	18[1/]	16[1/]	16[1/]
10'-8"	18[1/]	18[1/]	16[1/]	16[1/]	-	-	-

[1/] Double bolted, Figure 6.

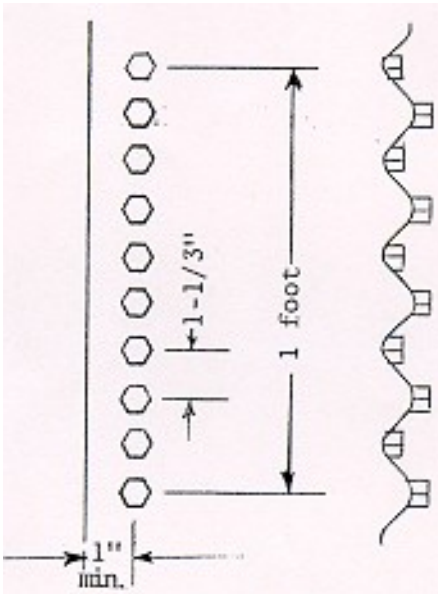

FIGURE 5
Single Row
(10bolts per foot)
Bolt in top and bottom
of each corrugation.

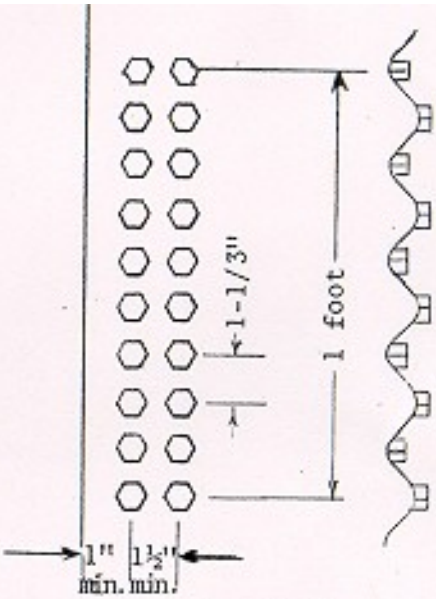

FIGURE 6
Double Row
(20 bolts per foot)
Bolt in top and bottom
of each corrugation.

Tank liners shall have the life expectancy that meets or exceeds the planned useful life. The Food and Drug Administration approved 25 mil vinyl liner and 20 mil vinyl liners have been previously installed. Minimum liner thickness shall be 20 mils. Tanks with plastic liners shall have a cover or roof.

Rock foundation pad or other foundation material is needed for tanks with no metal base. These foundation pads shall be constructed using 1-inch maximum diameter crushed rock or cinders. The minimum thickness of the foundation pad shall be 4 inches. A 9-inch minimum height fillet of sand or fine soil, shall be placed around the inside of the walls before the lining is installed. A sand or fine soil cushion shall be placed between the liner and the foundation pad.

Other foundation materials such as concrete slabs may be used. In all cases, the 9-inch high fillet of sand or fine soil shall be placed around the inside walls before the lining is installed.

Flat Steel Plate

Minimum thickness for bolted flat steel plate tanks is shown in Tables II and III.

Minimum wall thickness for welded flat steel plate tanks shall be approved by the State Conservation Engineer. A ring stiffener shall be attached to the top of welded flat steel plate tanks.

Redwood Tanks

All redwood tanks shall be manufactured from clear, all-heart redwood with a minimum 2-inch nominal thickness (1-1/2-inch finished thickness). The tanks shall be reinforced around the circumference with painted, plastic coated, or galvanized 1/2-inch steel rods spaced as required to withstand static water pressure.

Redwood tanks shall have chime joists installed to transfer the load of the tank and contents from the floor to the foundation. The chime joists shall be large enough to provide a minimum of 1-inch clearance below the staves to allow for free circulation of air. The weight of a redwood tank will not be borne by the staves.

Concrete slabs, concrete piers, and walls or other approved materials, such as prefabricated support supplied by the manufacturer, shall be used as a foundation for redwood tanks.

The piers or pier wall shall have a sufficient bearing area on the ground so that the following foundation loading will not be exceeded:

Soil Material	Foundation Loading (lbs./sq. ft.)
Dense pahoehoe	20,000
Fractured pahoehoe	12,000
Aa lava flows	10,000
Granular soils (cinders, sand, etc.)	4,000
Cohesive soils (clays and silty clays)	2,500
Valley alluvium	1,000

Fiberglass Tanks

Plastic and fiberglass structures shall be made of ultraviolet resistant materials or shall have a durable coating to protect the structure from deterioration due to sunlight.

Fiberglass water troughs and tanks shall be protected from sunlight by one of the following procedures:

1. Covering the interior and exterior surfaces with a nontoxic-gel coat at least 20-mil thick of white or pastel shade in the manufacture of the trough or tank.
2. Painting the interior and exterior surfaces black followed by a coat of white or other light-colored, nontoxic, waterproof paint; the black to block out ultraviolet rays and the light-colored paint to reflect heat.
3. For tanks with a top cover or under a roof that shields the interior of the tank from sunlight, painting of the interior is not required.

Minimum wall thickness for fiberglass tanks is shown in Table IV. Tanks of this material exceeding 10 feet in height or 12 feet in diameter shall be individually designed and the wall thickness determined by structural analysis.

Table IV
Fiberglass Tanks
Minimum Wall and Bottom Thickness - Inches

Height	Diameter - Feet						
(ft.)	6	7	8	9	10	11	12
4	3/16	3/16	3/16	3/16	3/16	3/16	3/16
6	3/16	3/16	3/16	3/16	1/4	1/4	1/4
8	3/16	1/4	1/4	1/4	1/4	1/4	5/16
10	1/4	1/4	1/4	1/4	5/16	5/16	5/16

Fiberglass tank material shall meet the requirements of National Bureau of Standards Voluntary Product Code PS-15-69.

Anchorage. The weight of an empty tank shall be sufficient to resist overturning from wind pressures or the design shall include secure anchorage or a raised drain outlet that retains sufficient weight of water for stability.

Wind loadings shall be calculated based on a minimum pressure of 30 pounds per square foot on the largest side of rectangular tanks and 18 pounds per square foot on projected areas of the cylindrical surfaces of round tanks.

Minimum water level for cylindrical corrugated steel tanks is shown in Table V.

Table V
Cylindrical Corrugated Steel Tanks
Minimum Water Level in Tank – Inches

Height (ft.)	Diameter - Feet 8	12	15	16	20	21
4	2	*	*	*	*	*
6	2	*	*	*	*	*
7'-1"	*	2	2	*	*	*
8	4	2	*	2	*	*
10	*	4	*	2	*	*
10'-8"	*	*	2	*	*	2
12	*	4	*	2	2	*

*Does not correspond to Table III or Table IV.

Minimum water levels for cylindrical fiberglass tanks are shown in Table VI.

Table VI
Cylindrical Fiberglass Tanks
Minimum Water Level in Tank – Inches

Height	Diameter - Feet						
(ft.)	6	7	8	9	10	11	12
4	2	2	2	2	2	2	2
6	4	4	2	2	2	2	2
8	6	4	4	4	2	2	2
10	10	8	6	4	4	2	2

The weight of empty steel tanks can be calculated using the information on Table VII and Table VIII.

Table VII

Weights in Pounds/Sq. Ft. for Sheet Metal

Uncoated Black Sheet Steel	
Gage	lbs/ft^2
000 (3/8")	15.00
7 (3/16")	7.65
10	5.63
12	4.38
14	3.13

Galvanized Flat Steel	
Gage	lbs/ft^2
8 (3/16")**	7.03
10	5.78
12	4.53
14	3.28
16	2.66

Table VIII

Galvanized Corrugated Steel

Gage	Dimension of Corrugation	lbs/ft^2
10	2-1/2x 1/2*	6.31
12	2-1/2x 1/2	4.94
14	2-1/2x 1/2	3.58
16	2-1/2x 1/2	2.90
18	2-1/2x 1/2	2.35
10	2-2/3x 1/2*	6.31
12	2-2/3x 1/2	4.94
14	2-2/3x 1/2	3.58
16	2-2/3x 1/2	2.90
18	2-2/3x 1/2	2.35
12	3x3/4	5.23
14	3x3/4	3.79
16	3x3/4	3.07
18	3x3/4	2.49

* Actually, standard 2-1/2 corrugated sheets have 9 corrugations exclusive of side lap and cover a width of 24 inches; therefore, the corrugation pitch measures approximately 2-2/3 inches.

** Thickness equivalent for 8-gage galvanized sheet is 0.1681. Weights for 3/16 inch galvanized sheet are not listed in common tables. Use 8-gage where tables call for 3/16 inch.

WORKMANSHIP

All construction shall be performed in a workmanlike manner, and the job site shall have a neat appearance when finished.

The flat bottoms and top edges of tanks and troughs shall be level.

BASIS OF ACCEPTANCE

The acceptability of this practice shall be determined by inspections to insure compliance with all the provisions of this specification and to the drawings.

CONSTRUCTION OPERATIONS

Construction operations shall be carried out in such a manner and sequence that erosion and air and water pollution are minimized and held within legal limits.

The owner, operator, contractor or other persons will conduct all work and operations in accordance with proper safety codes for the type of construction being performed with due regards to the safety of all persons and property.

SAFETY

Landowners or operators, sponsoring organizations, and contractors shall be liable for damage to utilities and damage resulting from disruption of service caused by construction activities. The Natural Resources Conservation Service makes no representation on the existence or non-existence of any utilities. Absence of utilities on the drawings is not assurance that no utilities are present at the site.

It is the responsibility of the landowner or operator to determine if there are buried or overhead utilities in the vicinity of the proposed work. They should take proper procedures to insure that the utilities shall not be jeopardized and that equipment operators and others will not be injured during construction operations.