NATURAL RESOURCES CONSERVATION SERVICE
PACIFIC ISLANDS AREA

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 for livestock and/or wildlife.

CRITERIA

General Criteria Applicable to All Purposes

Design watering facilities with adequate capacity and supply to meet the daily water requirements of the livestock and/or wildlife planned to use the facility. Include the storage volume necessary to provide water between periods of replenishment. Refer to the National Range and Pasture Handbook for guidance on livestock water quantity and quality requirements. For wildlife, base water quantity and quality requirements on targeted species needs.

For livestock water in the Pacific Islands Area, the installation shall have a storage capacity not less than the values in Table 1 during the replenishment interval, based on the predictable dry season or on the reliability of the water source.

Minimum storage capacity for a solar-powered system shall be three days.

Locate facilities to promote even grazing distribution and reduce grazing pressure on sensitive areas.

Design the watering facility to provide adequate access to the animals planned to use the facility. Incorporate escape features into the watering facility design unless local knowledge and experience indicate that wildlife will not be at risk of drowning.

Table 1. Daily Water Requirements

Animal	Gallons per Animal per Day
Beef Cattle	12
Dairy Cow	25
Goat	2
Hog	4
Horse	12
Sheep	2

Include design elements to meet the specific needs of the animals that are planned to use the watering facility, both livestock and wildlife.

Protect areas around watering facilities where animal concentrations or overflow from the watering facility will cause resource concerns. Use criteria in NRCS Conservation Practice Standard 561, Heavy Use Area Protection to design the protection.

Install permanent watering facilities on a firm, level, foundation that will not settle differentially. Examples of suitable foundation materials are bedrock, compacted gravel and stable, well compacted soils.

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

Anchoring. The weight of an empty tank shall be sufficient to resist movement or overturning from wind pressures or the design shall include appropriate anchorage methods.

Wind loadings on tanks, shall be calculated based upon expected conditions for the location. In no case shall the pressure be less than 30 pounds per square foot on the largest side of rectangular tanks or 18 pounds per square foot on projected areas of the cylindrical surfaces of round tanks.

Design watering facilities and all valves and controls to withstand or be protected from damage by livestock and wildlife.

Construct watering facilities from durable materials that have a life expectancy that meets or exceeds the planned useful life of the installation. Follow appropriate NRCS design procedures for the material being used or industry standards where NRCS standards do not exist.

Use the criteria in NRCS Conservation Practice Standard 516, Pipeline, to design piping associated with the watering facility. Include backflow prevention devices on facilities connected to wells and domestic or municipal water systems.

Flow Control valves. Where water is supplied continuously or under pressure to a trough or tank to control the flow of water to the facility and to prevent unnecessary overflows, an automatic water level control, such as a float valve, is required.

Material. Approved construction materials for tanks in the Pacific Islands Area are: plastic-lined corrugated galvanized steel, fiberglass, steel-reinforced concrete, polyethylene, mild steel sheet-metal, and concrete block masonry.

Approved construction materials for troughs in the Pacific Islands Area are: fiberglass, steel-reinforced concrete, polyethylene, mild sheet-metal, galvanized mild steel sheet-metal, concrete block masonry, pre-fabricated galvanized steel, and used heavy equipment tires.

Additionally, the use of used material shall follow policy as outlined in the National Engineering Manual, Part 512.21, Evaluation Procedures.

Plastic liners may be used for existing tanks that have been approved by an NRCS engineer with appropriate engineering job approval authority. Used heavy equipment tires that have been approved by an NRCS engineer with appropriate engineering job approval authority may be used for troughs.

Building Permit. The drawings shall show if a building permit is required for any components of the watering facility. The owner or user is responsible to obtain the required building permit from the appropriate agency and display during construction.

Certification. The manufacturer or installing contractor of the watering facility shall furnish a written guarantee that protects the owner against defective workmanship and materials for not less than one year. Written guarantee shall also state that the installation and/or materials meet NRCS Practice Standards and Specifications.

Criteria Specific to Plastic-lined Corrugated Steel Tanks.

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

Corrugations. Corrugations for the galvanized corrugated steel shall be 2-2/3 inch x 1/2 inch.

Foundation. A rock foundation pad or a concrete slab is needed for tanks with no metal base.

The rock foundation pad shall be constructed using 1 inch maximum diameter crushed rock or cinders. The minimum thickness of the foundation pad shall be 4 inches. A sand or fine soil cushion shall be placed between the liner and the foundation pad.

Section plates. The base ring of the tank can be assembled directly on the base material. Vertical joints of the second ring section plates 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.

Bolting shall be per the manufacturer's recommendations to ensure a durable connection. In all cases, the bolt head (cap-screw or carriage bolt) will be on the inside of the tank and the nut on the outside with the washer(s) per the manufacturer's guidelines.

Bolting Patterns. Table 2 tanks shall be connected with 3/8-inch diameter bolts as shown in Figures 1, 2, 3, and 4. Hole diameters shall not exceed 1/2 inch.

Table 3 tanks shall have 5/16-inch diameter bolt as shown in Figures 5 and 6. Hole diameters shall not exceed 7/16 inch.

The distance from the edge of the corrugated metal sheets shown in Figures 1 through 6 is the minimum acceptable spacing.

For material thicker than that shown in Table 2 or Table 3, use the same bolting pattern.

Fillet. As a minimum, a 9-inch high fillet of sand or fine soil shall be placed around the inside walls before the lining is installed.

Liners. Plastic liners for tanks shall have a life expectancy that meets or exceeds the planned useful life of the practice. The liner manufacturer must certify that the material used meets NSF/ANSI Standard 61 for potable water. The liner shall have a minimum thickness of 20 mils (0.020 inches).

Tanks with plastic liners shall have a cover or roof, capable or protecting the liner from ultraviolet waves and deterring entry by birds, small mammals, insects, and leaves.

NOTE: Variations from the above criteria for plastic-lined corrugated steel tanks must be designed and approved by a licensed architect, structural engineer, or civil engineer as applicable, for review and acceptance by the State Conservation Engineer.

Table 2. 2-2/3 inch x 1/2 inch Corrugated Steel Tanks with 3/8-inch Diameter Bolt Connections Minimum Wall Thickness - Gauge

	DIAMETER (ft.)						
HEIGHT (ft.)	8ft	12ft	16ft	20ft	24ft	28ft	32ft
2ft	**18**	**18**	**18**	**18**	**18**	**18**	**18**
4ft	**18**	**18**	**18**	**18**	**18**	**18**[1/]	**18**[1/]
6ft	**18**	**18**	**18**	**18**[1/]	**18**[1/]	**18**[1/]	**18**[1/]
8ft	**18**	**18**	**18**[1/]	**18**[1/]	**18**[1/]	**18**[2/]	**18**[2/]
10ft	**-**	**18**[1/]	**18**[1/]	**18**[1/]	**18**[2/]	**18**[2/]	**18**[3/]
12ft	**-**	**18**[1/]	**18**[1/]	**18**[2/]	**18**[2/]	**18**[3/]	**18**[3/]

[1/] Double Row, Figure 2; [2/] Single-double Row, Figure 3; [3/] Double-double Row, Figure 4.

Example of required material thickness and bolt pattern: Using Table 1, a 12-feet diameter, 12-feet high tank, will require 18-gauge steel. 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, just above the double bolt pattern, and continues to the top of the tank.

Table 3. 2-2/3 inch x 1/2 inch Corrugated Steel Tanks with 5/16 inch Diameter Bolt Connections Minimum Wall Thickness - Gauge

	DIAMETER (ft.)						
HEIGHT	15ft	21ft	24ft	27ft	30ft	33ft	36ft
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] Row, See Figure 6.

<u>Criteria Specific to Fiberglass Tanks or Troughs.</u>

Material. Prefabricated fiberglass storage tanks and troughs shall meet one of the following standards:

- AWWA Standard D120-09 (Thermosetting Fiberglass-reinforced Plastic Tanks);
- ASTM Standard D3299-10 (Standard Specification for Filament-Wound Glass-

fiber-reinforced Thermoset Resin Corrosion Resistant Tanks); or

- ASTM Standard 4097-10 (Standard Specification for Contact-Molded Glass-fiber-reinforced Thermoset Resin Corrosion Resistant Tanks).

All joints, seams, corners, and pipe fittings shall be reinforced with adequate fiberglass impregnated polyester resins. The top edge of open tanks or troughs shall be reinforced with a steel flange or other acceptable reinforcement.

Workmanship. All surfaces shall be free of cracks, crazes, dry spots, air bubbles, pinholes, pimples, and de-lamination. The exterior surface shall be smooth with no exposed fibers. The top edge of tanks or troughs shall be reinforced with a steel flange or other acceptable reinforcement.

The spray gun or pneumatically applied method shall be used for all reconstructed tank applications.

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

- 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, or
- 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.

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.

Thickness. Minimum thickness for the wall and bottom for fiberglass tanks or troughs is shown in Table 4.

NOTE: Fiberglass tanks greater than 10 feet high or 12 feet diameter must be designed and approved by a licensed architect, structural engineer, or civil engineer as applicable, for review and acceptance by the State Conservation Engineer.

Table 4. Fiberglass Tanks Minimum Wall and Bottom Thickness in Inches

	DIAMETER - FT.						
HEIGHT - 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**

Criteria Specific to Steel-reinforced Concrete Troughs.

Reinforced concrete for a trough or tank shall be built in accordance with PI Conservation Construction Specification 103, Concrete.

The concrete for the entire floor and foundation shall be placed continuously and as one unit. The construction joint formed between wall and floor shall be water tight. The bond area between a floor slab and reinforced concrete wall shall be cleaned and roughened sufficient to insure a good bond.

Criteria Specific to Polyethylene Tanks or Troughs.

Prefabricated polyethylene tanks or troughs shall meet the following standards and regulations: ASTM D1998, Standard Specification for Polyethylene Upright Storage Tanks; NSF/ANSI Standard 61; and FDA Regulation 21 CFR 177.152. The tank must be designed to handle liquid with a specific gravity of 1.1 or greater. The tank must also be designed to prevent UV damage and minimize algae growth.

Criteria Specific to Mild Steel Sheet-metal Tanks or Troughs.

Fabrication of mild steel tanks or troughs shall be built in accordance with PI Conservation Construction Specification 111, Metal Fabrication.

Protective coating. The exterior of steel tanks shall be galvanized or painted. The interior

protective coating shall be galvanized or painted with nontoxic paint.

The gage of the steel shall be as shown on the drawings.

Seams and joints may be bolted, riveted, or butt-welded. The ends of the steel may also be lapped and welded with a fillet weld on both sides. All joints must be of good quality and be watertight. Crimped or soldered joints are not acceptable.

For field fabricated tanks, bolted or riveted joints shall be lapped at least 2.0 inches. Holes shall be drilled or punched for ⅜-inch diameter bolts or rivets spaced at 1½ inch on center, or holes

All welded joints shall be continuously welded in accordance with good welding procedures.

For steel structures with a concrete floor, prior to placement of concrete, the bottom 8.0 inches of the steel wall may be painted with asphalt. Prior to concrete placement, the assembled steel rim shall be leveled and temporarily held at the designed elevation with blocking. The walls shall be embedded a minimum of 4 inches into the reinforced concrete footing.

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.

Criteria Specific to Concrete Masonry (hollow/cinder block) Tanks or Troughs

Troughs may be constructed out of clean concrete masonry blocks. Reinforcement bar must be clean and rust free.

Mortar for concrete masonry shall be freshly prepared and uniformly mixed in a ratio by volumes of 1 part cement, 1/2 part lime putty, and 4-1/2 parts sand. If plastic-type cement is used, the lime putty shall be omitted.

Grout for the cells of concrete hollow-tile blocks shall be of fluid consistency and mixed in the ratio by volumes, 1 part cement, 3 parts sand; or 1 part cement, 3 parts sand, and 2 parts 3/8 inch-minus crushed gravel.

Criteria Specific to Used Large Tire Trough.

Used heavy equipment tires that have been approved by the NRCS engineer, with appropriate engineering job approval authority, may be used for troughs. Tires shall be cleaned and free of chemicals such as ethylene glycol or calcium chloride. Only tires without aftermarket chemical puncture sealer may be installed.

CONSIDERATIONS

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 by avoiding the use of single wire fences and using fencing materials such as woven wire or by adding streamers or coverings on the fence.

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.

Consider the following guidelines in Table 5 for materials commonly used for watering facilities.

Table 5. Minimum Material Requirements

Concrete	3000 psi compressive strength
Galvanized Steel	20 gauge thickness
Plastic	Ultraviolet resistance
Fiberglass	Ultraviolet resistance

Where water is supplied continuously or under pressure to the watering facility consider the use of automatic water level controls to control the flow of water to the facility and to prevent unnecessary overflows.

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 overuse 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

The design (drawings and specifications) for watering facility shall describe the requirements for applying the practice according to this standard. As a minimum, the design shall include:

- A plan view, map, and/or an aerial photograph showing the location of the facility;
- Detail drawings showing the facility, necessary appurtenances (such as foundations, pipes and valves, and sizes) and stabilization of any areas disturbed by the installation of the facility;
- and construction specifications describing the installation of the facility.

OPERATION AND MAINTENANCE

The Pacific Islands Area Operation and Maintenance plan for this practice specific to the type of watering facility shall be prepared for and reviewed with the landowner. As a minimum it shall be site-specific and include the following items in the plan:

- a monitoring schedule to ensure maintenance of adequate inflow and outflow;
- checking for leaks and repair as necessary;
- if present, the checking of the automatic water level device to insure proper operation;
- checking to ensure that adjacent areas are protected against erosion;
- if present, checking to ensure the outlet pipe is freely operating and not causing erosion problems;
- and a schedule for periodic cleaning of the facility.

REFERENCES

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.

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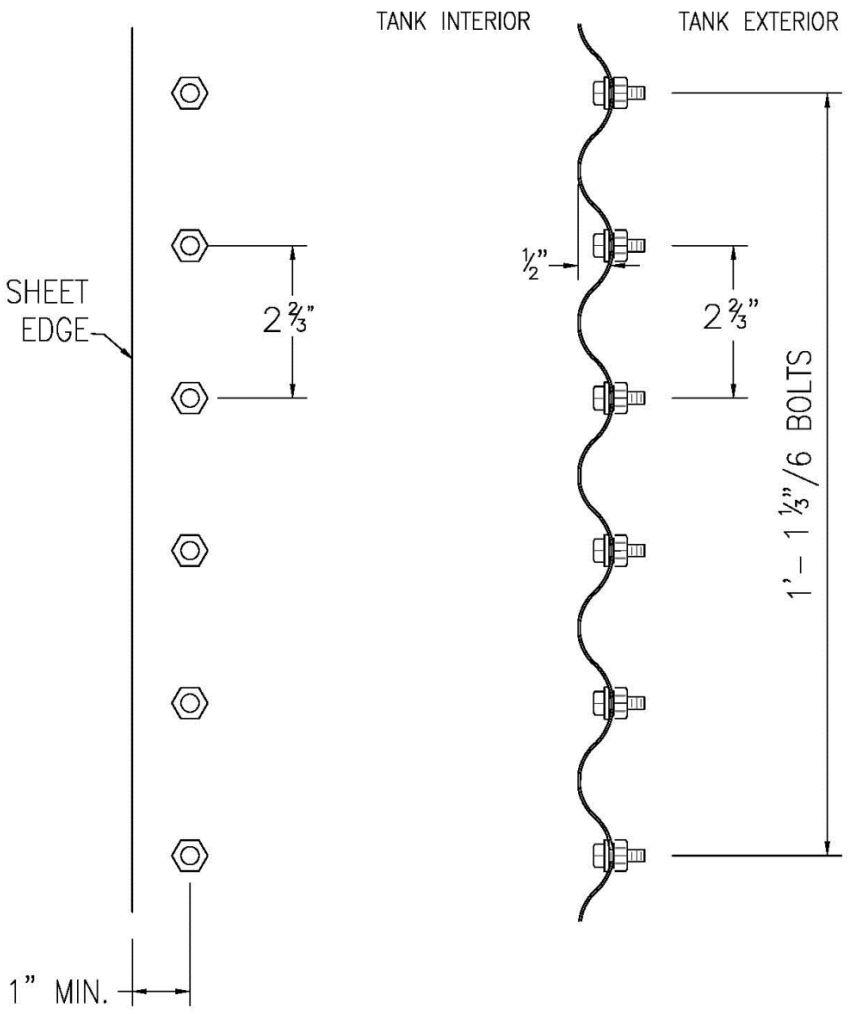
National Engineering Handbook, Part 650 Engineering Field Handbook, Chapters 5, 11 & 12, USDA Natural Resources Conservation Service.

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.

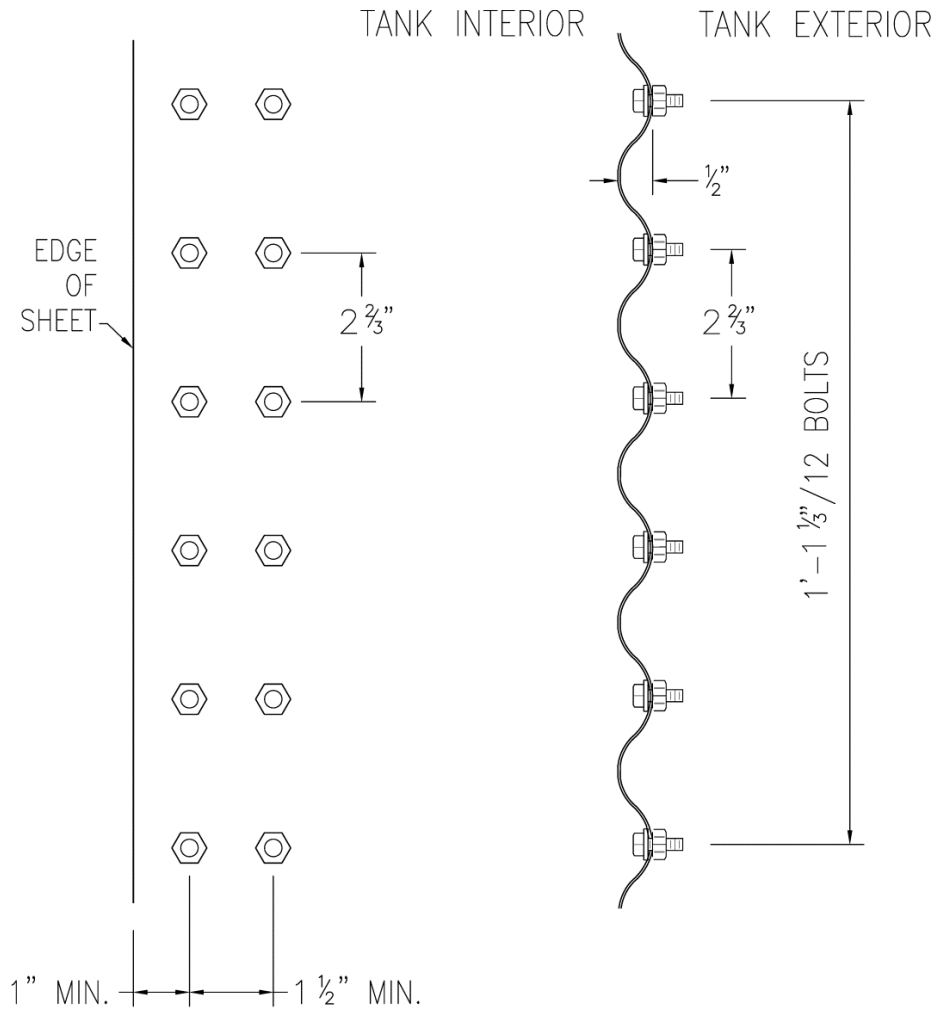
NRCS PI Supplemental Construction Specifications, November 2006.

National Engineering Manual, Part 512.21, Evaluation Procedures.



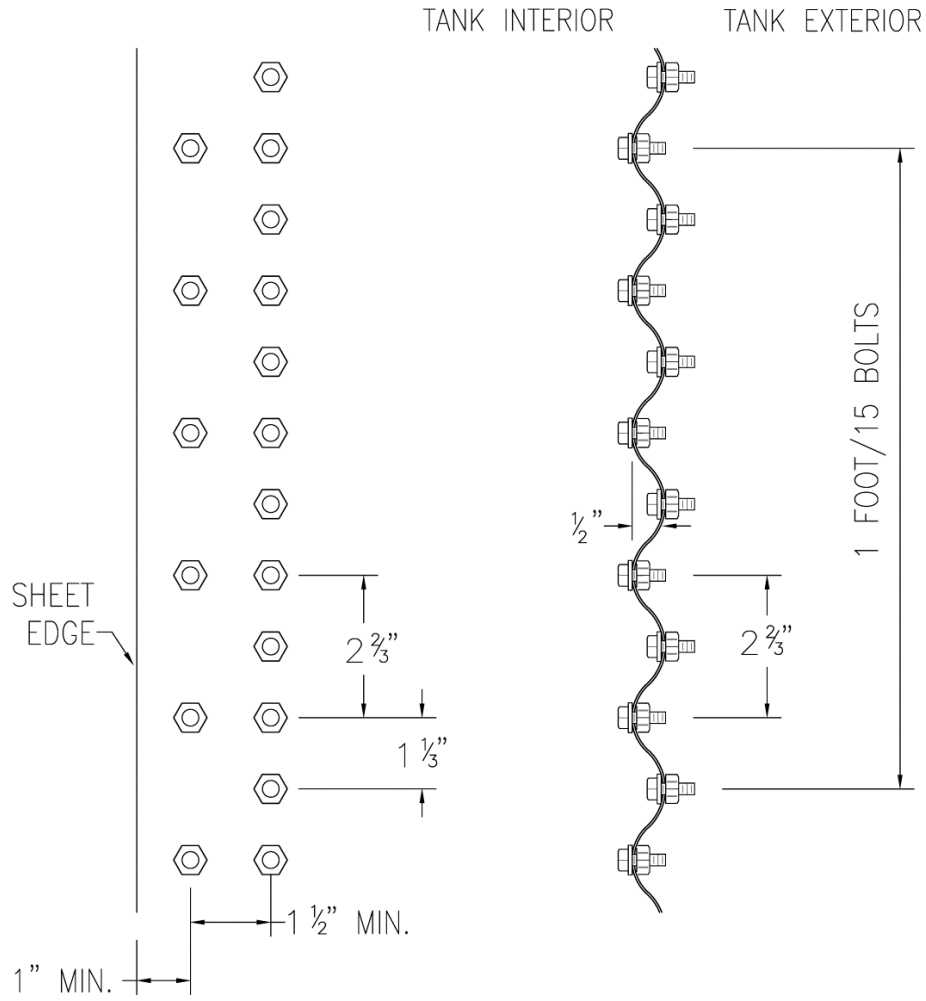
NOTE: Bolt in bottom of each corrugation.

FIGURE 1 – SINGLE ROW



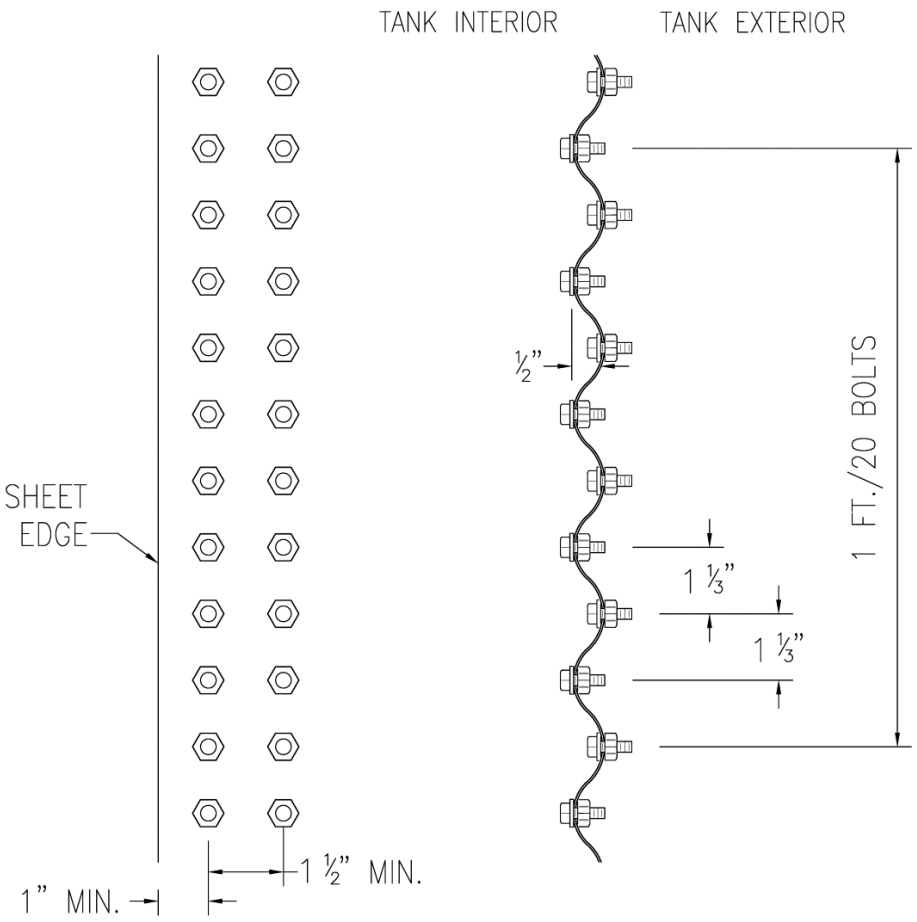
NOTE: Bolt in bottom of each corrugation.

FIGURE 2 – DOUBLE ROW



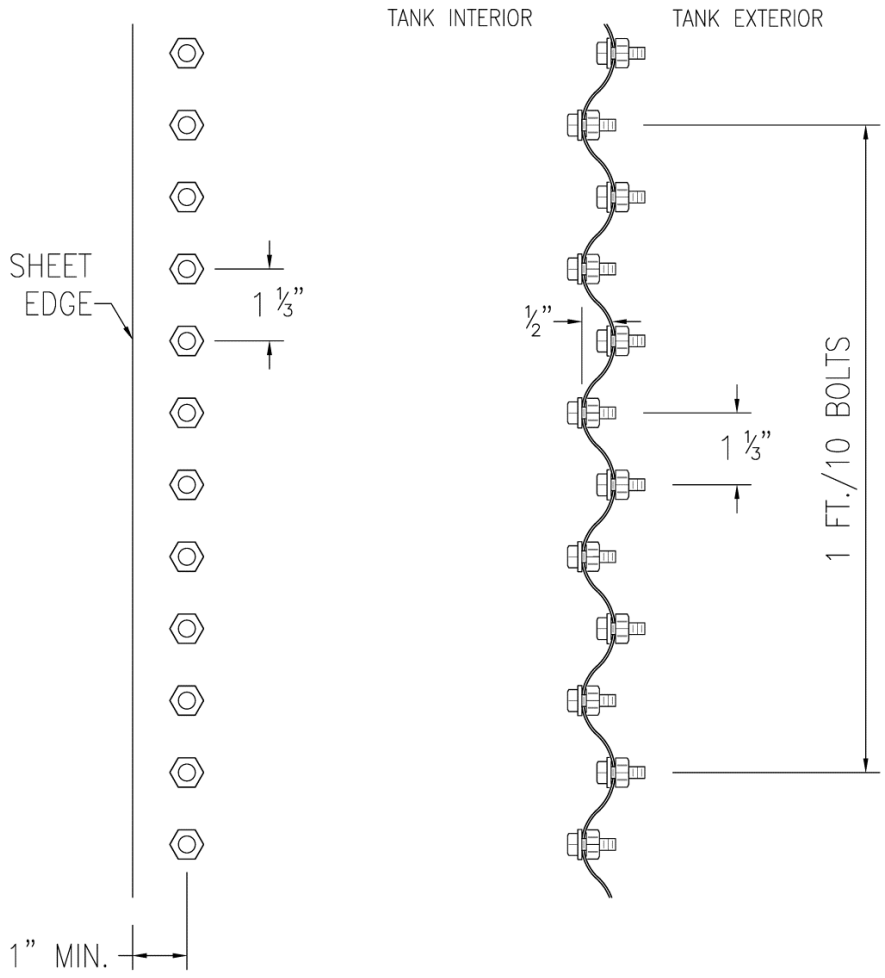
NOTE: Bolt in top and bottom of each corrugation; single bolt may be in top or bottom corrugation.

FIGURE 3 – SINGLE/DOUBLE ROW



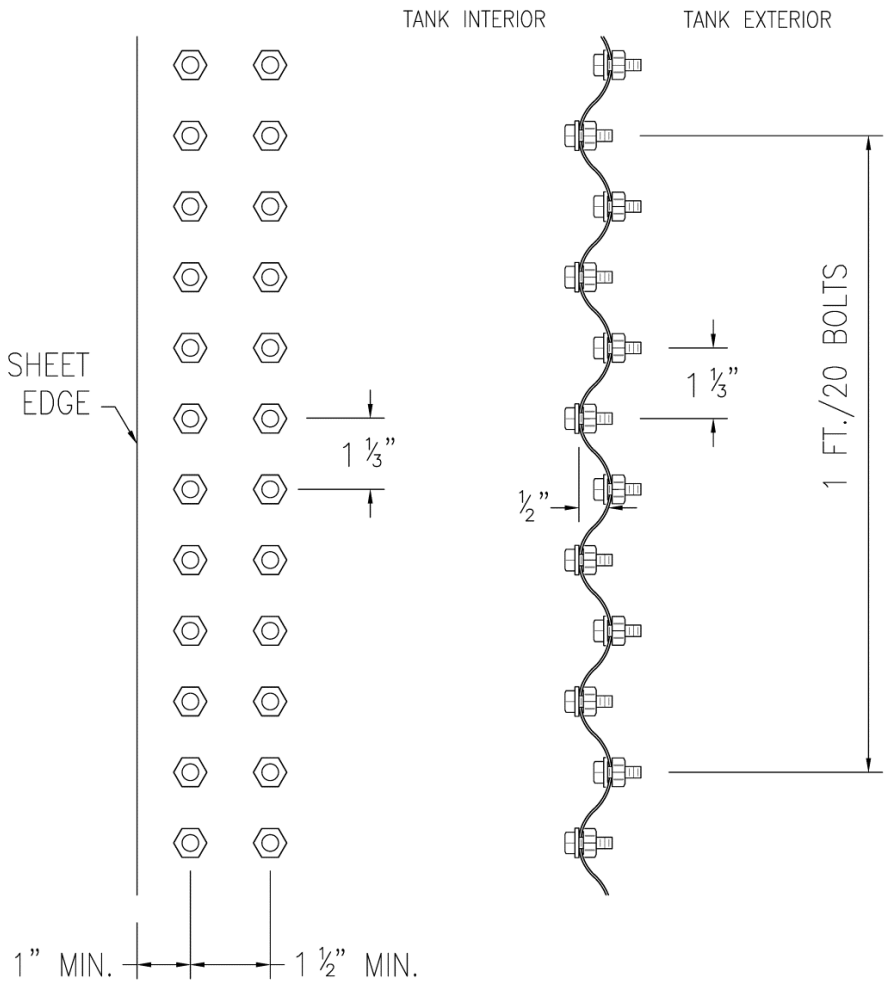
NOTE: Bolt in top and bottom of each corrugation.

FIGURE 4 – DOUBLE/DOUBLE ROW



NOTE: Bolt in top and bottom of each corrugation.

FIGURE 5 – SINGLE ROW



NOTE: Bolt in top and bottom of each corrugation.

FIGURE 6 – DOUBLE ROW