

NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE SPECIFICATION
FENCE, SMALL MAMMAL DETERRENT
(Ft.)
CODE 382X

PURPOSE OF SPECIFICATION

This document establishes the technical details, workmanship, quality and materials required to construct a fence designed to deter small mammals. The information will be utilized when preparing site-specific specifications for small mammal-deterrent fencing. Guidance may include information about applying different methods listed in the Conservation Practice Standard, details of site preparation and protection, instructions for use of materials described in the Standard, and other information not directly addressed in the Standard.

Specifications for the installation, operation and maintenance of the practice shall be prepared for each treatment unit in accordance with the requirements in the Conservation Practice Standard and the guidance in this Specification. The site specifications shall be recorded in the Conservation Practice Jobsheet and given to the client.

TYPES OF SMALL MAMMAL-DETERRENT FENCES

There are many types of fences suitable for controlling feral animals and wildlife. The fence type described herein has been successfully used on the Big Island of Hawaii to exclude feral cats from Nene habitat at the Ainahou property of Hawaii Volcanoes National Park. A similar construction has been used in Australia by the Arid Recovery staff, and in other places to exclude rabbits, cats and foxes. Each of these fences have provided for wildlife protection and/or vegetation recovery by excluding predators.

• **Small Mammal-Deterrent Fence:**

Feral cats, dogs, mongoose and other mammals of comparable size are targeted for exclusion. The fence must be constructed following these specifications:

Vertical Fence Panels (Figure 1):

1. Use woven wire fence with mesh openings not greater than 6" x 6" as the "foundation wire". If using wire with graduated mesh openings, the small openings will be installed closest to the ground surface. The wire must be between 11 and 14.5 gauge, fixed-knot, high-tensile, bezinal coated. Select the preferred wire gauge and use that throughout the entire project. Do not vary gauge of the foundation wire. Finished height of the foundation wire will be no less than 6-feet (72 inches) above the ground surface. Common material available on the islands that will meet the requirement is 1775-6-12.5 Bekaert solidlock woven wire.
2. Overlay and fasten hexagonal mesh (no greater than 1-inch opening) chicken wire against all parts of the woven wire ("foundation wire"). The chicken wire goes on the outside of the fence when affixed to the posts. All chicken wire will be galvanized and fuse-bonded with polyvinyl chloride (PVC) to resist corrosion. Finished height of the chicken wire will equal the finished height of the foundation wire (no less than 6-feet above the ground surface), plus at least 1-foot to run along the ground on the outside of the fence and be anchored to the ground.

3. Fasten the woven mesh (“foundation wire”) to the PVC-fused chicken wire with stainless steel wire clips or hog-rings. Use of stainless steel for all clips, fasteners, etc is imperative to protect against corrosion. Fasten both wire meshes to all line, brace, corner and gate posts with stainless steel wires, clips or hog-rings.



Figure 1. Close up detail of woven wire and chicken wire overlay. Chicken wire is on the outside of the fence, woven wire is on the inside.

Floppy Top above the Vertical Panels (Figures 2 and 3):

4. At the top of the vertical mesh panels (foundation wire + chicken wire, described in items 1-3 above), construct a “floppy top” using the chicken wire supported by 7- or 9-gauge bezinal soft tie wire, or 12.5 gauge high-tensile bezinal coated wire, supports located at intervals no greater than 6-feet along the horizontal distance of the fence/floppy top. The wire supports need to be formed by hand and cut at the appropriate length to support the full arch of the floppy top.
5. Shape the floppy top into an arch that extends away from the vertical panels in the direction outside of the area protected by the fence. For example, if the area protected from small mammals is located on the left side of the fence, the floppy top will be arched over the right side of the fence (into the area were the small mammals are).
6. The outside end of the floppy top will be located at least 2-feet away from the vertical fence panel.



Figure 2. Floppy top showing the 9-gauge supports for the chicken wire and the arch.



Figure 3. Side view of floppy top construction.

Acceptable Posts, Spacing, Ground Wire Anchors, and Post Treatment (Figure 4):

7. Overall vertical fence height will be no less than 6-feet tall. Refer to Table 2 for appropriate post lengths and requirements.
8. All posts (line, corner, brace) will be either copper naphthenate (CuNap) double-treated wood, galvanized steel, or a combination of either. Refer to the Tables 1 and 2 for details on post treatment and specifications. The copper naphthenate treatment for wood posts lasts longer than CCA (chromated copper arsenate) in saturated and brackish soil conditions.
9. Line posts will be spaced at intervals between 8 to 10 feet along the length of the fence.
10. Install a length of hexagonal PVC-fused chicken wire along the ground on the outside of the fence (the side with the small mammals) to a horizontal distance of at least 1-foot. The wire will be anchored to the ground in 2 evenly-spaced intervals between every line post. For example, if the line post spacing is 8 feet, the ground chicken wire can be anchored at 3-feet on either side each line post. If bedrock is encountered, run the chicken wire on top of it and drill the anchor pins into the rock to secure the wire. Water crossings will be encountered, and specific on-site guidance for installation will be provided by the NRCS State Rangeland Management Specialist or designee.



Figure 4. Ground lay with chicken wire and anchored to ground with fill placed over the wire.

Gates (Figures 5 and 6):

11. Gates should be of sufficient width to access the wetland complexes with machinery or equipment in order to maintain the integrity and function of the constructed ponds and wildlife habitat.
12. Gates can be either pre-fabricated tubular steel (e.g., Powder River type), hand-constructed wire with stays to retain their shape, chain link, or any other type that will maintain the ability of the fence to deter small mammals.
13. Because gates are often a main ingress/egress point for predators, all gates will have mesh openings not greater than 6" x 6" size and will be covered with the PVC-fused chicken wire. If the gates selected do not come from the manufacturer with mesh openings (e.g., 2" x 4" welded mesh), they will be covered with the foundation wire + PVC-fused chicken wire. At all gate hinges and openings, the foundation wire + chicken wire of the adjacent fence will overlap the hinge and opening locations at least 8-inches.
14. Once the gate is hung, if it does not come in close contact with the ground surface, the foundation wire + chicken wire will extend below the gate and come in contact with the ground surface, or a concrete sill will be installed at the bottom (see Figure 5) to prevent predator entry underneath each gate.

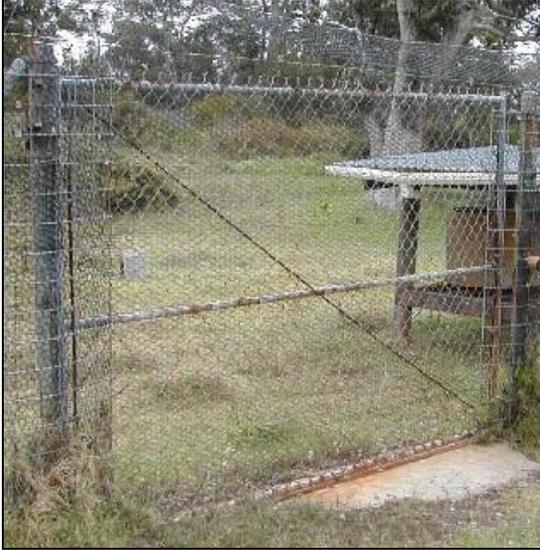


Figure 5. Access gate. Notice the concrete sill on the ground to prevent predator entry.



Figure 6. Close-up of access gate showing the use of mesh overlaps to prevent predator entry.

Additional Requirements:

15. Refer to Tables 1 through 9 for material and installation specifications and requirements.

MATERIAL SPECIFICATIONS

All materials used in the construction of this Small Mammal-Deterrent fence will have a minimum life expectancy of ten (10) years. Small Mammal-Deterrent fences will be constructed that equal or exceed the strength and durability of a fence built in accordance with the materials specifications in the following tables:

- Table 1 Material Specifications for Corner Braces and Gate Posts
- Table 2 Material Specifications for Line Posts
- Table 3 Material Specifications for Wire

Table 1. Material Specifications for Corner Braces and Gate Posts

Wood	
Specifications for Acceptable Wood Material	<ul style="list-style-type: none"> • Untreated posts of kiawe, koa, or eucalyptus (insultimber). • Redwood, cedar, or pine posts treated with a copper naphthenate double-treatment.
Rot Treatment	<ul style="list-style-type: none"> • Wood posts set in concrete will be treated to prevent rot. (Note: When cutting treated wood posts, be sure to paint the cut end with approved preservative to prevent rot from entering the post at the cut).
Corner Braces and Gate Posts	<ul style="list-style-type: none"> • Minimum length is 9 feet, including minimum 3 feet set in the ground. • Minimum diameter: 5 inches at top or smaller end. • Compression Member (horizontal or diagonal brace) of corner brace or gate assembly: <ul style="list-style-type: none"> • Minimum length: 8 feet. • Minimum diameter: 4 inches.
In-Line Braces (pull post or strainers)	<ul style="list-style-type: none"> • Can be either horizontal or diagonal in design. • Minimum length is 9 feet, including minimum 3 feet set in the ground. • Minimum diameter: 5 inches at the smaller end. • Compression Member (horizontal or diagonal brace) of in-line brace assembly: <ul style="list-style-type: none"> • Minimum length: 8 feet • Minimum diameter: 4 inches.
Steel	
Corner Braces and Gate Posts	<ul style="list-style-type: none"> • Steel Pipe: • Minimum length is 9 feet for Small Mammal-Deterrent, including minimum 3 feet set in ground. • Minimum diameter: 3 inches. • Equivalent weight of 7.58 pounds per linear foot. • Angle iron with the brace member welded or bolted to the in-ground posts, may also be used. Minimum size: 2" X 2" X 1/4". • Compression Member (horizontal or diagonal brace) or corner brace or gate assembly: <ul style="list-style-type: none"> • Minimum diameter steel pipe: 2½ inches. • Minimum size angle iron: 2" X 2" X 1/4". • Posts will be set in concrete.
In-Line Braces (pull post or strainers)	<ul style="list-style-type: none"> • Can be either horizontal or diagonal in design. • Steel pipe: • Minimum length is 9 feet for Small Mammal-Deterrent, including minimum 3 feet set in ground. • Minimum diameter: 3 inches. • Compression Member (horizontal or diagonal brace) of in-line brace assembly: <ul style="list-style-type: none"> • Minimum length: 8 feet • Minimum inside diameter: 3 inches. • Posts will be set in concrete.

Table 2. Material Specifications for Line Posts

Wood	
Specifications for Acceptable Wood Material	<ul style="list-style-type: none"> • Untreated posts of kiawe, koa, or eucalyptus (insultimber). • Redwood, cedar, or pine posts treated with a copper naphthenate double treatment.
Rot Treatment	<ul style="list-style-type: none"> • Wood posts set in concrete will be treated to prevent rot. (Note: When cutting treated wood posts, be sure to paint the cut end with approved preservative to prevent rot from entering the post at the cut).
Minimum Length and Diameter	<ul style="list-style-type: none"> • Minimum length is 8 feet, including minimum 2 feet set in ground. • Minimum diameter: 3 inches at top or smaller end.
Steel	
Specifications	<ul style="list-style-type: none"> • Steel line posts must conform to ASTM Standard A702-89. • Standard "T," "U," or "Y" section steel posts weighing not less than 1.33 pounds per foot of length, exclusive of anchor plate, may be used in lieu of wood line posts. Post length must be at least 8 feet for small mammal-deterrent fences (2 feet buried + 6 feet above ground). Use of steel pipe, minimum 2 inch diameter, is acceptable. • Steel line posts will be rolled from high carbon steel and will have a protective coating. The coating may be either galvanized by the hot dip process or painted in accordance with Commercial Standard 184 with one or more coats of high-grade, weather-resistant steel paint or enamel applied and baked. • Steel posts will be studded, embossed or punched for the attachment of wire to the posts.

Table 3 -- Material Specifications for Wire

	Specifications
Acceptable Materials	<p><u>Woven "Foundation" Wire:</u> A minimum of 72" height, no greater than 6" x 6" woven wire mesh using fixed-knot, high-tensile, bezinal coated wire. Use of 11-gauge wire is preferred, but wire no lighter than 14.5-gauge is acceptable. This foundation wire is to be located on the inside of the fence, and will be paired and overlain with:</p> <p><u>PVC-Fused Hexagonal "Chicken Wire" Mesh:</u> The chicken wire will be galvanized and fuse-bonded with PVC. It will be a minimum of 72" vertical height + at least 12" distance along the ground on the outside of the fence. Mesh openings not to exceed 1" in diameter. Additional mesh will be used to create the "floppy-top" arch that extends to the outside of the fence. The arch terminus will be at least 2-feet away from the vertical fence panels, and will be held rigid by the floppy-top support wires described below.</p> <p><u>Fasteners and Clips:</u> All fasteners and clips used to join the woven "foundation" wire to the PVC-fused chicken wire will be stainless steel. All clips used to join the mesh wires to all posts will be stainless steel.</p> <p>Staples may be used on wood posts:</p> <ul style="list-style-type: none"> • Gauge: Will be nine (9) or heavier polished (bright) hard wire. • Length: The shanks will be 1½ inches long for softwoods and 1¼ inches long for hardwood posts. • Will be driven diagonally with the wood grain to avoid splitting the post. Space should be left between the staple and the line post to permit movement of the wire. <p><u>Floppy-Top Support Wires:</u> The chicken wire floppy top will be supported by 7- or 9-gauge bezinal coated soft tie wire, or 12.5 gauge high-tensile bezinal coated wire. These supports will need to be cut and formed by hand to make the support braces for the arch. The arch of the floppy top will extend to the outside of the fence.</p>
ASTM Standards	<ul style="list-style-type: none"> • The wire must also conform to the following ASTM Standards to which the Federal Specification is correlated to: A116-00. • High Tensile Wire must conform to ASTM Standards: A854/A854M-98 and A679/A679M-00.
Galvanization	<ul style="list-style-type: none"> • Where stainless steel, PVC fusion, or bezinal coating is not specifically required, all remaining wire will be of new galvanized material. • The wire will have a Class 3 galvanization (zinc coating of 0.80 oz/sq.-ft. or 244 g/m² of wire surface). NOTE: Aluminum coating has at least 3 to 5 times the corrosion resistance than zinc coating.

INSTALLATION SPECIFICATIONS

The fence will be installed in accordance with proper safety procedures. The completed job will be workmanlike and present a good appearance. If brush or rock clearing, grading or other land work is to be done in conjunction with the fence installation, appropriate grading and erosion control measures will be undertaken or installed. Installation requirements are detailed in the following tables:

- Table 4 Installation Specifications for Corner Braces and Gate Posts
- Table 5 Installation Specifications for In-Line Horizontal (H) Braces
- Table 6 Installation Specifications for In-Line Diagonal Braces
- Table 7 Installation Specifications for Line Posts

Table 4. Installation Specifications for Corner Braces and Gate Posts

Parameter	Specifications
Design and Installation	<ul style="list-style-type: none"> • Design and install corner braces and gate posts first. (NOTE: These are the major components of a fence; therefore, close attention to the quality of their placement, material, and construction is necessary). • The installation of the fence will conform to any provided figures, drawings or photographs. • Consider the general landscape topography and fencing angles during the design phase to ensure that adequate fence height is achieved during construction. Pay close attention to potential access areas and design taller fence sections where predators may gain access in creative ways. For example, do not locate the fence where predators may climb adjacent obstacles such as trees, or where they may utilize adjacent topography or natural features to jump over the fence. If trees or natural features are close to the fence and may enable predator access, consider removing the trees/natural features, or relocate the fence.
Horizontal Movement	<ul style="list-style-type: none"> • All in-ground posts will be placed to the required depth and will be firmly embedded so there is less than one inch (1") of horizontal movement at the top of the post when a horizontal force of 80 lbs. Is applied. • Steel pipe, angle iron, U, T, or Y steel in-ground posts will be set in concrete.
Soil Conditions and Vegetation Considerations	<ul style="list-style-type: none"> • Soil conditions; e.g., low strength (sandy or wet soils), rockiness, steepness, or high shrink-swell capacity; may dictate a change in the normal design of a fence and require larger, longer, and deeper posts, more braces, straddle jacks or rock cribs may have to be used. • Remove adjacent vegetation (e.g., trees or shrubs) which may enable predator access into the fenced area. If obstructing vegetation cannot be removed (or should not be removed), seriously consider realigning or relocating the fence to provide optimal predator deterrence.
Bracing	<ul style="list-style-type: none"> • Bracing is required at all corners and gates and at all significant changes in the direction of the fence; usually at angles equal to or greater than twenty degrees (20°).
Post Length	<ul style="list-style-type: none"> • Minimum length of 9 feet, including minimum 3 feet set in the ground.

Table 5. Installation Specifications for In-line Horizontal (H) Braces

	Specifications
Placement	<ul style="list-style-type: none"> • H compression posts will be installed at least 5 feet above the ground level and at least 6 inches from the top of the in-ground posts.
Attachment	<ul style="list-style-type: none"> • H compression members will be secured to the in-ground posts with steel pins or dowels (rebar) or notched and spiked to the in-ground posts.
Spacing	<ul style="list-style-type: none"> • Depending on the topography and design, in straight sections, brace units (pull posts) will be spaced at intervals from 66 feet to 990 feet.
Anchor Post	<ul style="list-style-type: none"> • The anchor (end) post of an H-brace will be set with a one-inch (1") lean away from the direction of pull.
Brace Wire	<ul style="list-style-type: none"> • A 12.5 gauge, doubled, smooth, twisted, diagonal brace wire will be installed four inches (4") from the top of the brace post to four inches (4") from the bottom of the anchor (end) post. A twist stick will be used to tighten the brace wire assembly and will be left in place.

Table 6. Installation Specifications for In-line Diagonal Braces

	Specifications
Selection Considerations	<ul style="list-style-type: none"> • Diagonal braces using 12.5 gauge, doubled, twisted, smooth wire or wood or steel posts can be used in lieu of two horizontal braces. • Diagonal braces are structurally equal to the horizontal fence brace. The diagonal brace requires one less post, is 8% more resistant to overturn, 25% less expensive, and requires only about half the labor to install.
Design and Installation Principles	<ul style="list-style-type: none"> • In the design and installation of a diagonal brace or strainer, several principles should be kept in mind: <ul style="list-style-type: none"> • Make the diagonal brace as long as possible (minimum of 8'). • Be sure that the end of the diagonal brace in contact with the ground is free to move forward and is not blocked by a stake or post. • The diagonal brace can bear against the corner post in any location from the middle of the post to the top of the post. However, the best place to have the diagonal brace contact the corner post is within six inches (6") from the top. • When installing a diagonal strainer, the corner post should be set first, then the diagonal brace installed, then the bottom holding wire brace installed, and then the fence wires attached and tensioned. If this procedure is followed, the lower wire brace will not have to be twisted to tighten. • If one diagonal strainer will not hold the fence tension, a second diagonal strainer should be installed w/ each strainer taking half of the fence tension. • When using the diagonal strainer as a line brace, care must be exercised not to over-tension the brace wires. The vertical post can be jacked out of the ground if the wires are tensioned too much.

Table 7 -- Installation Specifications for Line Posts

	Specifications
Minimum Depth and Setting	<ul style="list-style-type: none">• Line posts will be set at least two feet (2') in the ground.• All fence posts will be erect within 2 inches (2") of plumb. All fence posts will deviate no more than 3 inches (3") of centerline.
Spacing	Maximum post interval will not exceed 10 feet.
Locations	<ul style="list-style-type: none">• All fence posts, particularly line posts, will be located on high points of corridor or grade breaks to prevent the woven wire course from "bellying".

BASIS FOR ACCEPTANCE

After the fence has been installed, a site inspection will be made to determine if the location, materials, design and installation were adhered to based on all site-specific documentation.