

NATURAL RESOURCES CONSERVATION SERVICE
MONTANA CONSERVATION PRACTICE SPECIFICATION

FENCE (FEET)

CODE 382

POWER FENCE

SCOPE: This specification provides guidance for the installation of permanent power fences. Fencing includes all components required for achieving the objectives of the practice and meeting site conditions.

HIGH TENSILE POWER FENCE

Power fence is an alternative to standard post-and-wire fencing. Livestock must be trained to respect a power fence if it is to be effective. Typically, power fences are designed to be more of a psychological barrier than a physical one.

Power fence is far less visible than conventional fences of equal duty. This is due to relatively thin wire profile and fewer line posts. This becomes a factor when people or animals move through power-fenced areas the first few times after construction.

Flagging should be placed on the wire(s) at eye level of the target species. Place the flags at 25-foot maximum intervals between posts. Because of its durability consider recycling salvaged, plastic bale-twine. A 16-inch length of twine double-wrapped around the wire and tied with a tight square knot will hold its position indefinitely.

MATERIALS AND CONSTRUCTION SPECIFICATIONS

POWER FENCE MATERIALS

Materials used in the construction of fences will be new, except as outlined in the specifications, and will have a minimum life expectancy of **twenty (20)** years. All materials must be in accordance with, equal or exceeding in strength and durability, the requirements listed below.

Wire

All wire for power fence will be high-tensile smooth single strand, 12-1/2 gauge, Class III galvanized per ASTM-854, with a breaking strength of 135,000 psi minimum and should not exceed 200,000 psi maximum. Wire with over 170,000 psi is extremely difficult to work with. The higher PSI rated wire is not hard to work with as long as a good pair of gloves and a vice grip tool are used.

Barbed wire will not be used when constructing power fence.

The maximum length of wire per energizer shall not exceed manufacturer's recommendation of the size, the type of wire, and the energizer used.

Fence Wire Tension

An in-line wire tensioning device or ratchet tensioner must be placed on each wire, between every tie off. On long stretches place the in-line tensioner in the middle of the pull. On multi-wire fences alternating the placement on each side of a post will prevent a dead-short. If devices are placed directly above or below each other, tensioners will get hooked on each other causing a dead-short. Wire tension should be sufficient to keep all wires off the ground and apart from each other to prevent shorting out the fence.

Specification MT382(Power Fence)-2



Figure 1. This is an example of an in-line tensioner.



Figure 2. This is a manual tool for operating the in-line tensioner.



Figure 3. This is a ratchet tool used with the in-line tensioner.

Insulators

Insulators shall be used on all hot wires to attach wire to conductive posts. They will be UV-stabilized plastic, porcelain, or composite materials. Avoid the use of “soft” plastic insulators where the insulator will be placed under strain, as they will wear with time causing a short that is difficult to find. For non-conductive posts with drilled holes, a manufactured cotter key is the preferred attachment method. A wire loop fashioned from a 12-1/2 gauge galvanized wire may be used in lieu of manufactured cotter key. For posts without holes use insulators that fit the need. The insulator must be fastened to the posts so that the wires slide through the fastener with ease.

Energizer

The capacity of the energizer must match the level of control needed. The energizer should guarantee a high-energy pulse, (usually once per one to two seconds) that will effectively control animals over long distances. Energizers are identified by their output energy (measured in joules). When choosing an energizer, determine the power source available. Mains powered energizers are the best choice where you have reliable mains power. Mains/battery-powered energizers combine the advantage of mains power with battery backup. Battery-powered energizers are the logical choice for remote areas. Typical batteries are 12-volt, 6-volt, 9-volt or D-sized batteries. For permanent power fencing, deep-cycle batteries are preferred and should be capable of operating three weeks without recharge. Solar panels are available to charge the battery by converting light directly into electricity. Battery-powered energizers are best when placed in the center of the fence. All energizers should be protected from animals and kept off the ground to protect from insects and moisture. Select the energizer that has the output energy (joules) with the minimum requirements provided below:

1. An output joule rating of 0.7 minimum. Rule of thumb: 1 output joule will power 1-4 miles of wire depending on the vegetation load on the fence with 3 miles per output joule being about average under normal loads. (A Joule is a unit of electrical energy; one joule does about 0.74 ft. lb. of work. Watts x seconds = joules).
2. Cattle, horses – minimum of 0.7 output joules and 4,000 volts measured at all points along the fence.
3. Grizzly Bear – minimum of 0.7 output joules and 5,000 volts measured at all points along the fence.
4. Elk – minimum of 1.5 output joules and 5,000 volts measured at all points along the fence.
5. Sheep, Deer, Bison, Wolf – minimum of 2.0 output joules and 5,000 volts measured at all points along the fence.
6. All energizers will have a lightning arrester, high-impact, weather-resistant case, solid-state circuitry, and a safety-pace fuse.

Lightning Protection

Install Lightning Diverters: Lightning may damage your energizer if it strikes your electric fence. Energizers will have internal lightning diverters that give partial protection against small strikes. Installing an Adjustable Lightning Diverter will give added protection; otherwise disconnect the energizer from the fence and power supply during lightning storms. Adjustable diverters allow the user to adjust the “gap” to meet the energizer output without reducing performance. Lightning always finds the easiest way to the earth. In areas where lightning is a problem, installing an earth system to include a lightning diverter is essential. This can be at any location along the fence, not just at the energizer location. Recent trials have shown that combining the energizer and lightning diverter earth systems not only improves the energizer grounding, but also protects it from lightning damage. The minimum number of earth ground rods is three. Using the diverter does not

guarantee complete protection. In bad lightning areas, grounding the hot fence wires helps significantly (see the recommended earth installation below).

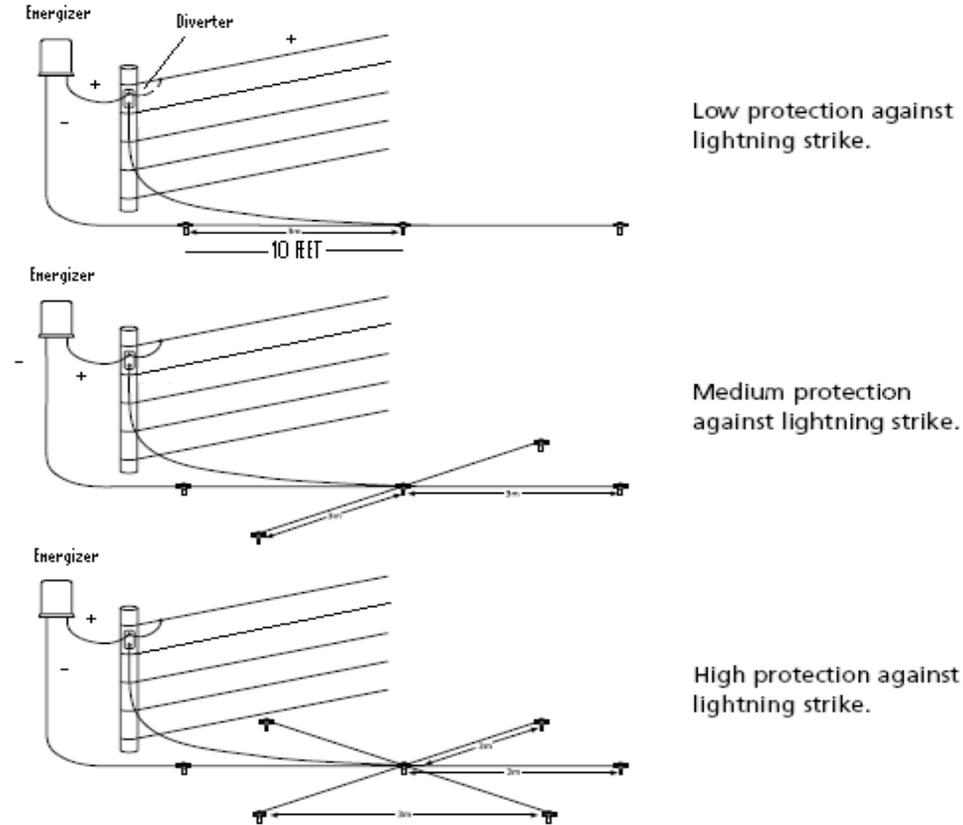


Figure 4. Line drawing of an earth ground installation system.

Connections

All permanent connections must be clamped using Joint Clamps to ensure tight wire connections.

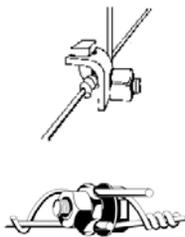


Figure 5. These are two different styles of connector joint clamps for permanent connections.

Grounding

All power fences must have an adequate ground. Poor grounding is the leading cause of power fence problems. Moist soil is a good conductor of electricity, so power fences on irrigated pastures rarely require ground wires. Grounding in these situations would be for the energizer only.

Where soil conditions are dry (dryland pastures, rangeland, and frozen conditions) animals may not be adequately shocked unless ground wires are included in the system.

Specification MT382(Power Fence)-4

The number of ground rods required for an adequate ground may vary. A simple rule of thumb is one rod for every five joules of stored energy with three rods being a minimum. A maximum reading of 0.2kv on a volt meter in dry conditions will determine if an adequate ground has been achieved.

- 10 feet minimum between ground rods
- At least 3 ground rods required
- Grounds rods should be at least 6 feet in length
- 1 Wire connecting all ground rods

To ground an energizer, run an insulated galvanized wire from the ground post of the energizer to a 6-foot galvanized pipe or rod, driven into the ground a minimum of 5-1/2 feet. If soil limitations prohibit this depth, use more rods. Galvanized pipe must be at least 3/4-inch in diameter, and galvanized steel rods must be at least 1/2-inch in diameter. If multiple rods are needed for an adequate ground, driven rods should be spaced at least 10 feet apart. Grounding rods should be a minimum of 30 feet from buried electrical or telephone earth, metal pipes carrying domestic or stock water, dairy shed pipe work, steel buildings, etc. Energizers should be connected to the ground rods with 12-1/2 gauge galvanized insulated or heavy-duty underground cable wire attached with ground rod clamps. Connect all rods together using one continuous galvanized wire.

When using a hot-ground system, all ground wires should be connected by the use of insulated cable and those ground wires attached to the earth ground (galvanized ground rods). Carry the ground through all gates, additional fences, etc., with insulated galvanized cable. If the ground cannot be carried through, additional ground rods will be placed at appropriate intervals along the fence to achieve an adequate ground. Locate the ground rods anywhere along the fence that a 6-foot depth can be obtained. Attach ground rods together with bare galvanized wire unless the potential exists for a short. In this situation, use insulated or heavy-duty underground galvanized wire with equal or greater diameter as fence wire.

Try to locate ground rods near permanent moisture if possible to receive a higher flow of electrons. Locate ground rods where they are not likely to interfere with cultivation or traffic, and where they will not be damaged from or cause injury to livestock.

Line Posts

See **TABLE 1-Line Post Requirements for Power Fence** below for recommended types, sizes, spacing, setting depths and coatings.

Wood posts can provide strength, but require insulators.

Fiberglass posts shall be a composite of marble, fiberglass, and polymer resins that have been treated by thermosetting (heat treatment).

Composite posts are typically constructed of wood and plastic plus UV-inhibitors. They are non-conductive posts requiring no insulators.

PVC posts are constructed of poly vinyl chloride plus UV-inhibitors. They are non-conductive posts requiring no insulators.

Steel line posts are acceptable, but require insulators that attach to the posts. If the insulator becomes broken or fails, a dead-short will result. Therefore, steel posts are not recommended in fences at a greater distance from the farmstead, or for areas of high wildlife pressure. Steel posts shall not be used if the fence is constructed to deter bears and/or wolves. In this case, fiberglass, composite, PVC or wood posts are the only acceptable materials.

On vertical angles (extreme downward pull) use porcelain insulators or equivalent that are capable of holding the wire under that strain. On extreme upward pulls, a short piece of fiberglass, composite, or insul timber post tied down to a deadman, is preferred.



Figure 6. On sharper corners fasten the live wire on the inside of the post to stop it from touching the post.



Figure 7. If the angle is not too great, the use of in-line insulators on the outside of the post may suffice. They do tend to wear with time and may cause a short in the fence.

TABLE 1. Line Post Requirements for Power Fence

Wood posts do not need to be new materials (Railroad Ties, Power Poles are adequate); however, all posts shall meet the minimum criteria for durability and protective coating. Wood posts need to be sound and free from decay, with all limbs trimmed substantially flush with the body. Line posts must be of sufficient length to meet fence height, setting depth requirements, plus 2 inches.			
LINE POST TYPE	MINIMUM DIAMETER/WEIGHT	MINIMUM SETTING DEPTHS	MINIMUM PROTECTIVE COATING, OTHER
Wood – juniper, cedar	3-1/2 inches inside the bark	24 inches	None
Wood – other than above	3-1/2 inches inside the bark	24 inches	Complete penetration of the sapwood with approved treatment materials. Pressure-treated, entire length of post.
Fiberglass round section	.63-inch diameter .75-inch diameter > 1 inch diameter	16 inches 16 inches 16 inches	For 3 wire fences or less For 4 - 5 wires > 5 wires
Standard “T” steel rolled with high carbon steel and studded, embossed, or punched for wire attachment, with anchor plate.	1.25 pounds per foot of length, exclusive of anchor plate.	16 inches – Top of the anchor plus one knob, minimum of 16 inches.	Hot-dipped galvanized, or one or more coats of high grade, weather-resistant steel paint, or enamel-applied and baked.
PVC – T design	1-1/2 inches x 1-1/2 inches	16 inches	Recommended only for pastureland conditions.
Composite posts – non-conductive (wood/plastic) Plus UV inhibitors.	1-1/8 inch diameter 1-1/4 inch diameter 1-5/8 inch diameter	16 inches	≤ 3 wires 4-5 wires > 5 wires, up to 6 feet high

NOTE: Chromated Copper Arsenate (CCA) treated wood post chemicals are unlikely to cause significant water or soil contamination, but restricting the timing of the installation may be advisable in some locations and a sufficient solution to eliminate potential impacts to ESA listed species. Wood posts are to be produced in accordance with “Best Management Practices for Treated Wood in Aquatic and Other Sensitive Environments” issued by the Western Wood Preservers Institute.

Line Post Spacing

Line posts are required to keep the bottom wire above the ground at the recommended height, and/or to keep all wires at the recommended spacing intervals. Refer to the section on **Fence Height and Wire Spacing** for guidance. It is recognized that line post spacing will vary based on site conditions. Generally a distance of 100 feet apart would be a maximum.

Setting Posts

Posts shall be set to the minimum depths listed in **TABLE 1–Line Post Requirements for Power Fence**. Wood posts shall be driven or set in holes and backfilled with compacted earth or poured concrete. Earth backfill around posts shall be thoroughly tamped in layers no thicker than 4 inches and shall completely fill

Specification MT382(Power Fence)-6

the posthole to the ground surface. Concrete backfill around posts shall be rodded into place in layers no thicker than 12 inches and shall completely fill the post hole to ground surface. Backfill, either earth or concrete shall be crowned up around posts at the ground surface.

Steel line posts shall be driven solidly into the ground until the plate is covered plus 1 knob, minimum of 16". If soil conditions prevent firmly settling line posts in the ground, jack-leg (buck), or wire cribs may be used.

Fiberglass and composite posts shall be driven or installed according to the manufacturer's directions. The use of a pilot-hole driver may be necessary in rocky terrain.

Stay Requirements:

- Stays will not be used on fences with two wires or less.
- Non-conductive stays can be used on fences with three wires or more, typically in locations where the wires are too close to the ground and a post is not desired.

Brace and Anchor Posts

Posts must be of sufficient length to meet fence height, setting depth requirements, plus 6 inches.

See TABLE 2—Brace Post Requirements for Power Fence. Braces are required at all gates and corners with definite angles (horizontal and vertical) greater than 15 degrees. A single railroad tie ($\geq 9 \times 7$ inches) or 8-inch diameter round post may be used in lieu of a standard "H" or diagonal brace on ends, gates and corners in the following conditions:

Top wire height is ≤ 36 inches high
Tension on each wire is ≤ 200 lbs.

Buried Depth is as follows:

Soil	9" x 7" tie	8" round
Clay	4.5 feet	5.5 feet
Sand	3.5 feet	4.5 feet
Gravel	3.5 feet	4.0 feet

Ensure that the tie is placed with the widest portion (9") towards the direction of the pull.

A bedlog brace can be used in lieu of a standard "H", diagonal, etc., in all of the applications that a single post can be used. When used, the following minimum specifications will be used.

Post diameter is equal to or greater than specified for a single brace, (9" x 7" or 8" round). Buried depth is a minimum of 40 inches and maximum top wire height of 40 inches. This application can be used in all upland soils. Do not use in moist conditions.

The "bedlog" must be a minimum of 6 inch x 3 inch x 48 inches. (Two, 2 x 6 inch boards nailed together will meet the requirements). The bedlog must have "full treat" and be buried 3 inches in front of the post.

Disturb as little soil in front (towards pull) of the bedlog as possible. It is best if the bedlog is placed first and then the post is driven. There is no need to adhere bedlog to post.

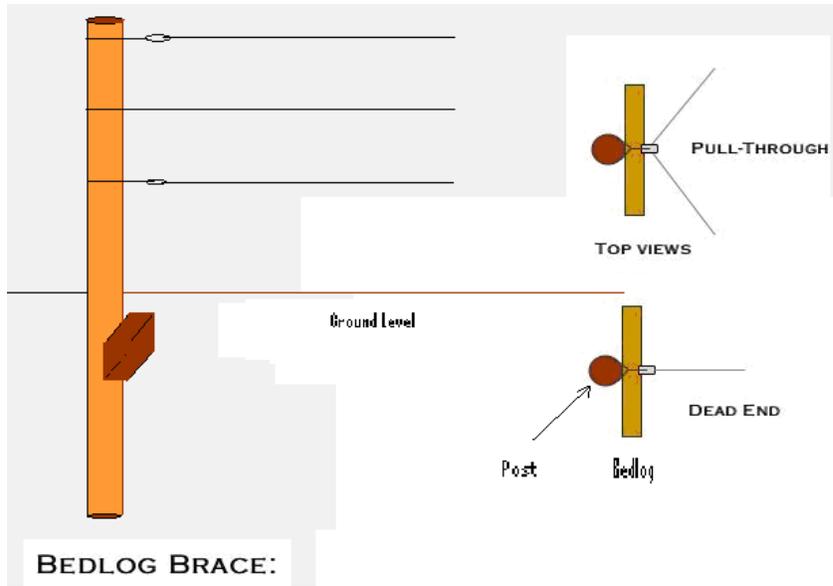


Figure 8. A picture of a Bedlog Brace.

TABLE 2. Brace Post Requirements for Power Fence

Posts do not need to be new materials, (Railroad Ties, Power Poles are adequate); however, all posts shall meet the minimum criteria for durability and protective coating. Wood posts need to be sound and free from decay, with all limbs trimmed substantially flush with the body. Steel pipe will be free of corrosion and pitting.				
BRACE POST TYPE	MINIMUM DIAMETER/WEIGHT	MINIMUM SETTING DEPTHS	MINIMUM LENGTH	MINIMUM PROTECTIVE COATING, OTHER
Wood – juniper, cedar	5 inches inside the bark 6 inches when fence height exceeds 6 feet	3 feet	Buried depth + height of fence + 6 inches	None
Wood – other than above	5 inches inside the bark 6 inches when fence height exceeds 6 feet	3 feet	Buried depth + height of fence + 6 inches	Complete penetration of the sapwood with approved treatment materials. Pressure-treat, full length.
Steel – round	2-3/8 inches - OD 3.65 lbs./ft. or equivalent	3 feet	Buried depth + height of fence + 6 inches set in 12" diameter concrete or welded to compression brace	Free from corrosion and pitting

NOTE: Chromated Copper Arsenate (CCA) treated wood post chemicals are unlikely to cause significant water or soil contamination, but restricting the timing of the installation may be advisable in some locations and a sufficient solution to eliminate potential impacts to ESA listed species. Wood posts are to be produced in accordance with “Best Management Practices for Treated Wood in Aquatic and Other Sensitive Environments” issued by the Western Wood Preservers Institute.

There is no maximum distance between brace spacing. It is recommended not to exceed 1/2-mile between gates for ease of livestock management.

Specification MT382(Power Fence)-8

Recommended brace types include the standard “H” or Diagonal brace. A single post may be used following the specifications listed above. Additional bracing requirements are listed below.

- Less than or equal to 90 degree corners – 3 post brace – horizontal or diagonal
- Greater than 90 degree corner – 4 post brace, double H or double diagonal
- Rock jack
- Jack leg brace – Wet, shallow, etc.,
- Rock Cribs
- Single tie (9” x 7” or 8” round) as specified above.

See PDF drawings at:

http://www.nrcs.usda.gov/wps/portal/nrcs/detail/mt/technical/engineering/?cid=nrcs144p2_056924

TABLE 3. Brace Member (Compression) Requirements for Power Fence

BRACE MEMBER TYPE	MINIMUM DIAMETER/WEIGHT	MINIMUM LENGTH
Wood, horizontal (treatment, same as other wood.)	3-1/2 inches	6 feet
Wood, diagonal (treatment, same as other wood.)	3-1/2 inches	8 feet
Steel, round, horizontal pipe or tubular steel	2 inches OD, 2.25 lb./ft. or equivalent. If using steel anchor and brace posts this post will be welded to anchor and brace post.	6 feet
Steel, round, diagonal pipe or tubular steel	2 inches OD, 2.25 lb./ft. or equivalent.	8 feet

NOTE: Brace member (compression) horizontal distance will be a minimum of 1 foot longer than the anchor post (vertical) is high, minimum of 6 feet. An 8-foot tall deer fence will require a 9-foot horizontal brace. The corresponding diagonal brace length will be a minimum of 1.3 times the length of what the horizontal brace would have been (9 ft. x 1.3 = 12 feet).

NOTE: Chromated Copper Arsenate (CCA) treated wood post chemicals are unlikely to cause significant water or soil contamination, but restricting the timing of the installation may be advisable in some locations and a sufficient solution to eliminate potential impacts to ESA listed species. Wood posts are to be produced in accordance with “Best Management Practices for Treated Wood in Aquatic and Other Sensitive Environments” issued by the Western Wood Preservers Institute.

Brace Assembly

All line wires shall be dead-ended on the anchor post either directly for ground wires or to an insulator if hot wires. Wire ends are double-wrapped around the anchor posts, stapled, and secured with an appropriate tie-off type for high-tensile wire. Hot wires are run through an insulator and tied or crimped as appropriate for high-tensile wire.

Horizontal Brace Members

Horizontal brace members (compression braces) shall be at least 6 feet in length and notched into the top half of the brace post and anchor post, below the top 6 inches of the brace and anchor post. Fences taller than 4 feet – the brace post will be in the top 1/3 of the post and no closer than 6 inches from the top of the post. Steel dowels, spike, etc., can be used, rather than notching, to attach brace between anchor posts and brace post.

Diagonal Wooden Brace Members

The top end of wooden diagonal brace members shall be notched into the post being braced (anchor post) approximately 6 inches below the top of the post. Secure the brace member to the bottom brace post as well to prevent sideways movement. Steel dowels, spike, etc., can be used, rather than notching, to attach

diagonal brace member between anchor posts and brace post. In lieu of a vertical buried brace, the diagonal compression brace will rest on a rock, disk or other sound structure a minimum of 1 foot square that is capable of preventing the brace from contacting the soil surface.

Bracing Wire

Brace wires (or guy wires) shall be formed from two complete loops of:

1. No. 9 gauge smooth wire;
2. No. 12-1/2 gauge double-strand smooth or barbed wire; or,
3. A single strand of No. 12-1/2 gauge high-tensile smooth wire.

Brace wires shall extend from a point approximately two inches below the top of the brace post to as close to ground level as possible on the anchor post. Never have the brace wire on the brace post higher than the top of the anchor post or it will pull the anchor post up to that level (see Figure 9). The brace wires shall be double-wrapped around each post, stapled, and spliced together. A stout stick, pipe, etc., about 18 to 24 inches long, is placed mid-way along the brace wires, and all four wires are twisted together so the brace wires tightly secure the compression brace and provide needed rigidity. If a diagonal brace is used, tie the wire from the bottom of the diagonal brace back to the bottom of the anchor post. Twist the wires together and secure against the brace member on the opposite side from the fence wires. Ratchet tensioners may be used in lieu of a tightening stick. Secure the tensioning device between one strand of high tensile wire and tighten.

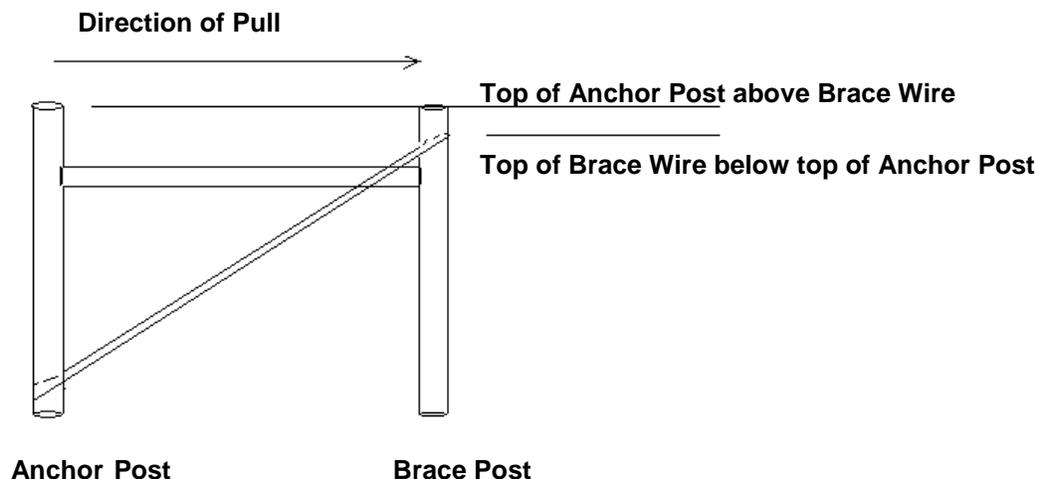


Figure 9. This picture is showing brace wire height in relation to top of anchor posts.

Fence Height and Wire Spacing (for fences used to manage livestock – not applicable for exclusion fences and or special use fences).

Height of fence will be 42 inches + or – 6 inches. ***If wire height exceeds 44 inches, provisions must be made at identified crossings for wildlife movement both over and under the fence.*** These areas will not exceed 1/4-mile apart and there must be a minimum of one per fence. The fence in these designated locations will not exceed 42 inches at the top wire. The bottom wire will be a minimum of 14 inches, 16 inches if Antelope are present. Minimum distance for chosen wildlife crossing is that distance between two posts or one rod (16.5 feet), whichever is greater.

It is absolutely critical that livestock are trained to respect power fence prior to placing them in pastures where power fencing is utilized.

Specification MT382(Power Fence)-10

Systems may be all hot wires, or alternate hot and ground, depending on soil moisture conditions. For irrigated pasture, all hot wires are generally used where soil is moist at all times. One hot wire should be sufficient for controlling cattle on irrigated pastures. For dryland pasture, rangeland, or frozen conditions, an alternate hot and ground wire-design are recommended. To avoid electrocution of birds, never space wires closer than 6 inches apart; especially on the top two wires. The following tables provide recommended wire spacing for different types of livestock and purposes.

Cattle

There are several designs of electric fence available to use for cattle control. One electrified (hot) wire can be an effective pasture subdivision control in areas where soil is moist at all times (irrigated conditions, exclusive early spring use, etc.). Two or three wires are generally used for cross fencing, and four or more for boundary fences. All hot systems can be used in irrigated situations.

The height of the bottom wire can vary depending on whether it is desired to keep calves inside the fence, or let them creep out. A minimum of 16 inches off the ground is recommended for areas where antelope reside.

TABLE 4. Recommendations for Power Fence for Cattle

CATTLE: HEIGHT OF WIRE FROM EARTH SURFACE AND CHARGE: (+) HOT AND (-) GROUND WIRES					
NUMBER OF LINE WIRES 1	TOP 36" – 26"	SECOND	THIRD	FOURTH	USE CROSS-FENCE/IRRIGATED ONLY
2	30" (+)	24" (-)			Cross-fence
3	36" (+)	26" (-)	16" (+)		Cross-fence
4	42" (+)	32" (-)	23" (+)	14" (-)	Cross-fence/external
4*	42" (+)	33" (-)	25" (+)	16" (-)	Cross-fence/external

* Recommended design for areas where antelope reside.

Sheep

Sheep are more difficult to control with power fencing than other livestock, and training is critical if sheep are to be controlled. Fence design may need to be more elaborate than with cattle. Additional wires may be desirable for predator control.

TABLE 5. Recommendations for Power Fence for Sheep

SHEEP: HEIGHT OF WIRE FROM EARTH SURFACE AND CHARGE: (+) HOT AND (-) GROUND WIRES						
NUMBER OF LINE WIRES	TOP	SECOND	THIRD	FOURTH	FIFTH	USE
4	32" (+)	24" (-)	16" (+)	8" (-)		Cross-fence
5	36" (+)	26" (-)	18" (+)	12" (-)	6" (+)	Cross/External

Bison

TABLE 6. Recommendations for Power Fence for Bison

BISON: HEIGHT OF WIRE FROM EARTH SURFACE AND CHARGE: (+) HOT AND (-) GROUND WIRES								
NUMBER OF LINE WIRES	TOP	2ND	3RD	4TH	5TH	6TH	7TH	USE
4	46" (+)	36" (-)	26" (+)	16" (-)				Cross-fence
5	52" (+)	42" (-)	32" (+)	24" (-)	16" (+)			Cross-fence
6	68" (+)	56" (-)	45" (+)	34" (-)	25" (+)	16" (-)		Cross-fence
7	72" (+)	62" (-)	52" (+)	42" (-)	32" (+)	24" (-)	16" (+)	Exclosure/Cross (20' post spacing maximum)

Horses

TABLE 7. Recommendations for Power Fence for Horses

HORSES: HEIGHT OF WIRE FROM EARTH SURFACE AND CHARGE: (+) HOT AND (-) GROUND WIRES							
NUMBER OF LINE WIRES	TOP	2ND	3RD	4TH	5TH	USE	
2	42" (+)	32" (-)				Cross-fence	
3	48" (+)	38" (-)	28" (+)			Cross-fence	
4	48" (+)	38" (-)	28" (+)	18" (-)		External	
5	48" (+)	38" (-)	30" (+)	24" (-)	18" (+)	External	

Deer

The most common designs for deer and elk exclusion are:

1. 7--15-wire vertical power fence; and,
2. 8-wire slanted power fence.

TABLE 8. Recommendations for Power Fence for Deer and Elk

DEER AND ELK: HEIGHT OF WIRE FROM EARTH SURFACE AND CHARGE: (+) HOT AND (-) GROUND WIRES																
NO. OF LINE WIRE	TOP	2ND	3RD	4TH	5TH	6TH	7TH	8TH	9TH	10TH	11TH	12TH	13TH	14TH	15TH	USE
7	72" (+)	60" (-)	48" (+)	38" (-)	28" (+)	20" (-)	10" (+)									Exclosure
8	84" (-)	74" (+)	64" (-)	54" (+)	44" (-)	34" (+)	24" (-)	12" (+)								Exclosure
15	96" (+)	88" (-)	80" (+)	72" (-)	64" (+)	56" (-)	50" (+)	44" (-)	38" (+)	32" (-)	26" (+)	20" (-)	14" (+)	8" (-)	2" (+)	Exclosure

Specification MT382(Power Fence)-12

TABLE 9. Recommendations for Power Fence for Deer Slant Enclosure

DEER SLANT ENCLOSURE: HEIGHT OF WIRE FROM EARTH SURFACE AND CHARGE: (+) HOT AND (-) GROUND WIRES									
NUMBER OF LINE WIRES	TOP	2ND	3RD	4TH	5TH	6TH	7TH	8TH	USE
8 (55" high)	12" (+)	12" (-)	12" (+)	12" (-)	12" (+)	12" (-)	12" (+)	6" (-)	Enclosure

This fence is designed to protect high value crops. It is both a physical and psychological barrier to deer due to the three-dimension nature.

The fence design slants away from the crop side. Height of fence on deer side is 55 inches.

Line posts: 6 feet in length, buried 18 inches. Post is placed between the 6 and 7 wire, spaced 40 feet apart.

Line rails (slanted): 92 inches in length, spaced 30 feet apart.

Double Deer Fences

The Double Deer Fence consists of two separate electric fences spaced 38 inches apart. The outer power fence consists of at least one or two wires on fiberglass posts outside of an inner power fence. The outer fence is 18 inches high (24 inches high if two strands are used, the bottom wire at 12 inches) above the ground. The inner fence has a minimum of two wires at 12 and 28 inches above ground, or a maximum of seven wires, depending upon grounding conditions and amount of pressure from deer. Both fences are constructed of high-tensile 12-1/2 gauge smooth wire attached to fiberglass or other insulated posts. A clearing greater than 12 feet in front of the outer fence is critical to allow deer to see the fence. Follow all NRCS specifications for a power fence, except for the wire heights indicated above, and the need for 4-foot posts.

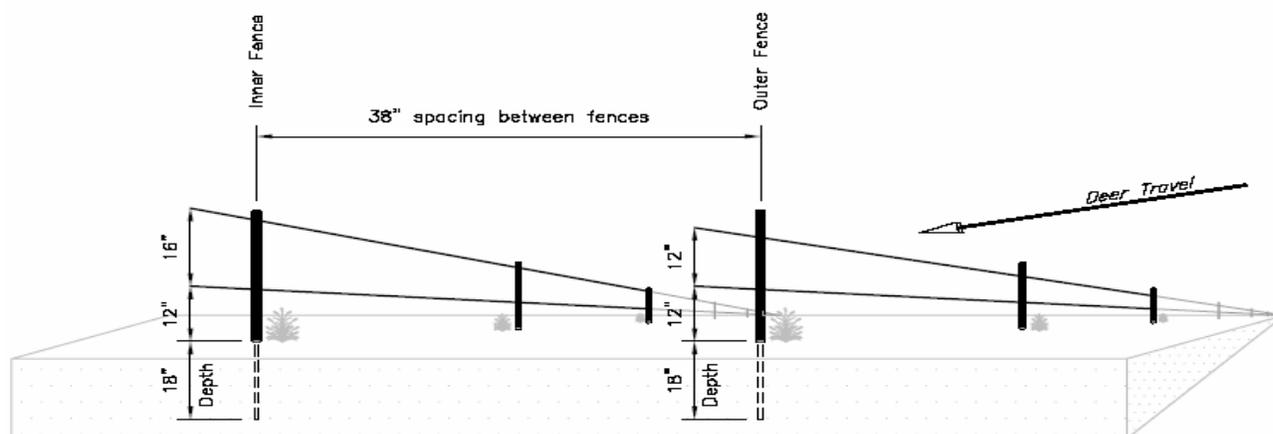


Figure 10. Double Deer Fence.

Griz/Wolf/Predator

This type of fence is intended to protect lambing, calving, apiary (beehive) areas and additional animal security areas from predation or harassment by bears and/or wolves. For additional construction requirements, refer to previous sections of this specification.

Line posts: At 40-foot intervals minimum. If fiberglass line posts are used, minimum buried depth is 18 inches. If wooden line posts are used, minimum buried depth is 24 inches.

TABLE 10. Recommendations for Power Fence for Griz/Wolf/Predator

GRIZ/WOLF/PREDATOR: HEIGHT OF WIRE FROM EARTH SURFACE AND CHARGE: (+) HOT AND (-) GROUND WIRES												
NUMBER OF LINE WIRE	TOP	2 ND	3 RD	4 TH	5 TH	6 TH	7 TH	8 TH	9 TH	10 TH	11 TH	USE
11	72" (+)	64" (-)	56" (+)	48" (-)	40" (+)	32" (-)	26" (+)	20" (-)	15" (+)	10" (-)	6" (+)	High predator areas
9	72" (+)	62" (-)	52" (+)	42" (-)	32" (+)	24" (-)	18" (+)	12" (-)	6" (+)			
7	54" (+)	42" (-)	32" (+)	24" (-)	18" (+)	12" (-)	6" (+)					Calving, lambing moderate - low predator risk
7	42" (+)	36" (-)	30" (+)	24" (-)	18" (+)	12" (-)	6" (+)					Allows ungulate passage over.
5	58" (+)	46" (-)	34" (+)	22" (-)	10" (+)							

Beehive Protection

TABLE 11. Recommendations for Power Fence for Beehive Protection

BEEHIVE PROTECTION: HEIGHT OF WIRE FROM EARTH SURFACE AND CHARGE: (+) HOT AND (-) GROUND WIRES																
NO. OF LINE WIRE	TOP	2 ND	3 RD	4 TH	5 TH	6 TH	7 TH	8 TH	9 TH	10 TH	11 TH	12 TH	13 TH	14 TH	15 TH	USE
15	96" (+)	88" (-)	80" (+)	72" (-)	64" (+)	56" (-)	50" (+)	44" (-)	38" (+)	32" (-)	26" (+)	20" (-)	14" (+)	8" (-)	2" (+)	Exclosure
7	54" (+)	42" (-)	32" (+)	24" (-)	18" (+)	12" (-)	6" (+)									Exclosure

TABLE 12. Recommendations for Portable Fencing (not cost-shared)

Temporary Electric (polywire, polyrope, polytape)	Cattle	Deterrent	1	26 – 36"	26-36"
	Sheep/Goats	Deterrent	3	30 – 32"	10,10,10-12
	Horses	Deterrent	2	40"	24,16
	Hogs	Deterrent	2	12"	6,12

Specification MT382(Power Fence)-14

SPECIAL CONSIDERATIONS FOR FENCES IN SAGE GROUSE HABITAT

Consult with Montana NRCS biologists and/or sage grouse coordinators for possible exceptions to the following special considerations:

- No new fences within 0.6 miles of active or historic (“confirmed inactive”) leks without approval by NRCS Area Biologist. Approved fences will have fence markers installed. No new fences within the High Risk (Red) areas identified by the Sage Grouse Fence Collision Risk Tool without approval by NRCS Area Biologist. Approved fences will have fence markers installed.
- Vinyl fence markers (3-inch segments) used on fences are only needed on the top wire. White markers are recommended, but alternating white and black markers or using reflective tape on markers is optional. Use of white and black markers is recommended in areas that tend to have snow during the breeding season in March and April (white and black markers need to be adjacent to each other). Spacing between markers should be approximately 3 to 4 feet. PVC pipe strung through the top wire in one foot segments is an excellent alternative to vinyl fence markers.
- Fences that will be marked include:
 - new fences in sage grouse habitat ([see link to sage grouse habitat maps](#)).
 - existing fences within 0.6 miles active or historic leks.
 - existing or new fences in identified, higher risk winter habitat and High Risk (Red) areas identified by the Sage Grouse Fence Collision Tool.
 - existing or new fences on ridgelines and at low saddle points where sage grouse are common.
 - existing or new fences in known high use movement areas (e.g., to and from alfalfa fields).
- Flat-topped wood posts provide raptor perch sites – consider having posts with cone tops (purchase after-market). It is recommended that all wood posts within 0.6 miles of a lek should be treated with cones placed on the top of the post or have a nail driven into the center of the post to prevent raptor perching.
- Metal/fiberglass/PVC posts are preferable to wooden posts to discourage raptor perching.
- Markers will be placed on the top wire of new fences as the fences are being installed. If a new fence is installed without simultaneously marking the fence, sage grouse losses could potentially be high due to the unfamiliarity of the new fence to the birds.

Splicing

1. Recommended splicing procedures are "Figure-8" wrap wires minimum of three wraps and break off tab or use crimp (compression fittings).
2. Additional approved methods are crimping and a reef knot. To crimp wires together, overlap ends of each wire about 2 inches then place a minimum of two compression fittings over both wires and firmly crimp the fittings. Bend the ends of wire to assure these crimps do not slip.
3. A “Reef Knot” is formed by looping one end around the other loop and securing the ends by either a compression fitting or by wrapping and breaking off the tips.

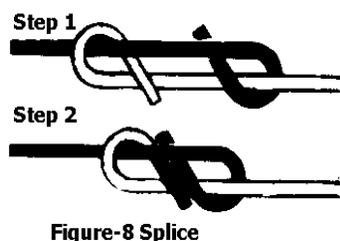


Figure 11. This illustration shows a Figure-8 Splice.



Figure 12. This illustration shows a Reef Knot Splice or Square Knot.

Staples

Staples should only be used to fasten the cold wire to the posts. Staples shall be driven into the post at a 45-degree angle. Staples at gates shall be driven just deep enough to snug the line wire without bending it. In all locations “in-line” where staples are used, the line wire shall be loose in the staple.

Cut-Off Switches

Install cut-off switches as often as needed to allow for isolation of fence sections for maintenance or management of livestock. Typical installation occurs at gates, fence spurs, road crossings, etc.

Crossing Draws or Streams

When the fence crosses landscape depressions, draws, or swales and the bottom-line wire is higher than desired, the use of a “deadman” may be necessary to maintain fence height. The “deadman” can be a steel post driven at an angle with a hole in it to tie a piece of wire to a non-conductive post with the wires attached. When crossing live streams or very deep draws, the fence may be dead-ended on each side of the crossing by use of line braces. The section across the stream may be removable, a breakaway-type, or swinging picket-type fence, etc. The voltage and ground must be carried through to the other side or provisions made to bring that portion of the fence to similar standards.

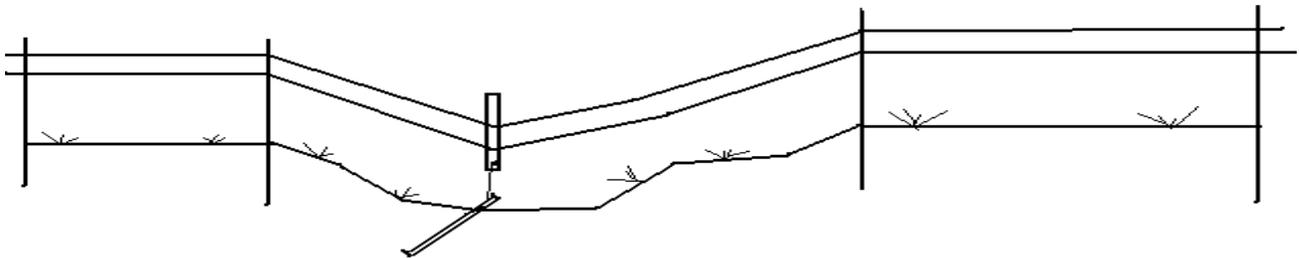


Figure 13. This illustration shows the use of a deadman when crossing a draw.

Fault Finding

Portable voltmeters are necessary for monitoring fence-line voltage, checking for shorts and other troubleshooting needs.

Monitor the fence voltage with a Digital Volt Meter. Some volt meters have features that actually point in the direction of the problem. If the fence has less than the recommended minimum voltage, check that:

1. The energizer earth is functioning properly.
2. The energizer is capable of providing the desired amount of power.
3. There are no shorts in the fence.
4. Vegetation growth is not causing power loss.
5. The wiring is adequate.
6. Battery is charged.