
Electric fencing US 572

ANIMAL CONTAINMENT PROPERTIES OF FENCES

The purpose of a fence is to restrict the movement of stock. It must, therefore, be a barrier which either prevents or deters stock from crossing it.

Mechanical fences (or non-electric fences) must physically stop animals by ensuring there are no spaces through which the animal can squeeze and no weakness which can be stretched or developed by stock to make a gap. The fence must also be high enough to prevent jumping. This may mean 2 metres for such animals as deer.

Non-electric fences must be able to withstand the maximum force, which can be produced by the stock.

Prefabricated netting fences act as a physical and visual barrier to stock. The size of the netting is small enough to rule out "pushing through" to all farm livestock bar young lambs. Netting fences are often used in high pressure areas, such as in holding paddocks, lane ways, gateways, etc.

Electric fences form a physiological barrier to stock. They need to get a shock every time they touch the fence, but the fence does not have to be strongly built.

The type of stock will dictate the design of the fence, as different stock have different behavioural characteristics, for example:

- Goats climb up and over angled stays
- Deer "walk the fence-line" and can injure themselves if any stays protrude into the paddock.
- Pigs and rabbits are known to dig under fences.

FENCE DESIGNS FOR THE CONTAINMENT OF ANIMALS

All most all farmed livestock (sheep, cattle, goats, deer, horses, pigs) have a good respect for electric fences, and they are a very effective form of fencing. The placement of the electric wire will depend on the type of stock.

Sheep prefer to push under fences, therefore they need an electric wire about 30 – 45 cm off the ground.

Cattle generally try to push through, or push over fences. To prevent this the electric wire needs to be close to the top.

Barbed wire on the top or second to top wire is used to prevent cattle pushing down on the fence. This is very inefficient as the hide of cattle is very thick, and they soon lose respect for the barbed wire.

Conventional non-electric fences can adequately confine sheep providing the wires are spaced close enough and there are sufficient battens, and wire tension. This is an expensive option compared to electric fencing.

Non-electric fences are acceptable with most cattle, although the fences will be under severe pressure. Bulls will quickly destroy a non-electric fence especially if there are heifers or other bulls in neighbouring paddocks.

Poultry

The small size of poultry means that if conventional fences are used the wires must be close together. Normally netting of some description will be used. It needs to have spaces smaller than about 5 - 10cm square, depending on the breed of poultry.

With the ability to fly (unique to poultry) the fences need to be of a reasonable height, or even with a roof for complete enclosure. Alternatively, the poultry can have their wings clipped to prevent them flying.

If the poultry has sufficient space and food, a 1m high netting fence will be sufficient to keep them confined.

Poultry don't apply much pressure to the fence so the actual construction does not need to be strong (unless it is to prevent predators getting IN).

Ratite (e.g. ostriches & emus)
Ratite are large flightless birds, such as ostriches and emus. These stock will try and push over a fence, followed by trying to scrabble over it. Hence fence height is important.

Deer netting or close-spaced wires of about 2m in height are commonly used.

The birds have a "flighty" temperament and netting is often the preferred fencing material as it provides a better visual barrier.

The flightiness of these birds makes electric fences useless. Emu breeders say the birds would become tangled and die before they learnt to avoid electric fences. In such high-valued birds it is too large a risk to take.

DAMAGE FROM INAPPROPRIATE FENCING

Damage to property or livestock can easily result if the fence is poorly matched to the situation, livestock, topography, etc.

Wire
Wire damage occurs from chipped galvanising as a result of misuse of tools or poor handling of the wire before it was installed.

Over straining of the wire will weaken it, making it prone to breaking if pressure is applied.

Combining different wire types can cause a chemical reaction to occur between the two metals which increases the rate of corrosion of the wire.

Kinked wire is more prone to breaking under pressure, and the galvanising is likely to be damaged, making it susceptible to corrosion.

If the fence is not designed for the type of livestock, e.g. Bulls, the stock will apply pressure and eventually the wire will break.

Support materials
If an end assembly was incorrectly built the tension of the fence may lead to the strainer lifting, allowing stock under the fence.

Fences with poorly sited gateways may be prone to having excessive stock pressure, which result in "flattening" the fence and breaking posts in the process.

The use of smaller sized posts, as a cost-saving exercise can result in higher costs if the posts are not strong enough for the stock pressure, especially if not electrified.

Livestock
The biggest risk to livestock from fencing is the poor positioning of gateways. In very large mobs this can cause the death of several hundred sheep at one time, through smothering.

Wire ends left on the fence (rather than cleanly breaking them off) can cause pelt or hide damage.

Barbed wire can also cause hide damage, as well as serious flesh wounds if an animal become tangled.

As mentioned earlier, angle stays that protrude into the paddock can injury the legs of deer that "walk the fence line".

The poor location of tie-backs can cause stock to become caught up and often die.

Wire left at the fencing site, or around the farm anywhere can cause stock to become tangled, or even strangled. The eating of pieces of wire, which cattle frequently do, can cause blockages in the digestive tract, or pierce the stomach wall, which will almost certainly end in death.

Physical impact
Support material, such as posts and strainers, are most likely to be damaged through physical impact from either stock or machinery. Strainers in gateways are the most likely to be damaged, by trailed implements that are wider than the tractor, or from miscalculation for turning. When designing fence lines and gateways consideration for the siting of gates and their size will reduce the chance of damage later.

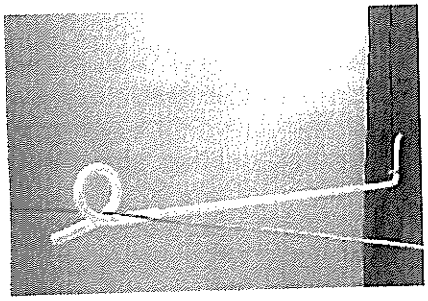
High Tensile wire resists the urge to stretch; the 'load' or stock pressure should be absorbed by the wire not the posts. Pressure from stock is absorbed by the HT wire and allowed to dissipate down the fence, therefore there is less pressure at the point of impact, and less damage to the animal or fence, and the fence is less likely to break.

FENCE MODIFICATIONS

It is possible to remedy some of the problems with inappropriate fences, without having to build a new fence.

Modifications can also be made to make the fence more stock proof, and be able to withstand greater stock pressure (e.g. the ultimate – Bulls)

- Put battens on multi-wire fences
- Maintain fences in good condition
- Put electrical outriggers on conventional fences, either at the top, or lower down (for sheep)
- Add wire, to reduce the gap between wires
- Add posts
- Put netting in high pressure areas
- Attach 'scrim' or windbreak cloth at high pressure areas



One of the many types of outriggers available

NOXIOUS ANIMAL PREVENTATIVE STRUCTURES

Animal pests are a serious threat to farming and the natural environment.

Rabbits have caused major devastation in some areas of the South Island for as long as the land has been farmed. Rabbit fences were built, initially out of Totara battens, then later with small-gauge netting. These fences were (and still are) extremely expensive as they are often very long. The idea was to remove all the rabbits within the rabbit-fenced area, and hopefully prevent re-infestation from the neighbouring land. These fences were partially successful, but the rabbits would eventually burrow under, or the fences would fall into disrepair.

Possums are the single most noxious pest in New Zealand. They are destroying large areas of native bush, damaging production trees, and spreading TB through the cattle and deer herds of NZ. One fencing structure designed (in Australia) to prevent possums getting into blocks of small trees is called the "floppy fence". This fence consists of a 3-wire fence supporting netting which is loose and extends beyond the top and bottom wires.

Possums cannot climb over the top of the netting as they fall back on themselves when near the top. Rabbits can't push under the fence and generally don't burrow beneath it.

Electric fences are frequently used to prevent animal pests. Often the 'hot' wire needs to be close to the ground (for things like feral cats, pigs and rabbits), which leads to problems with long grass short circuiting the fence.

ELECTRIC FENCE ENERGISERS

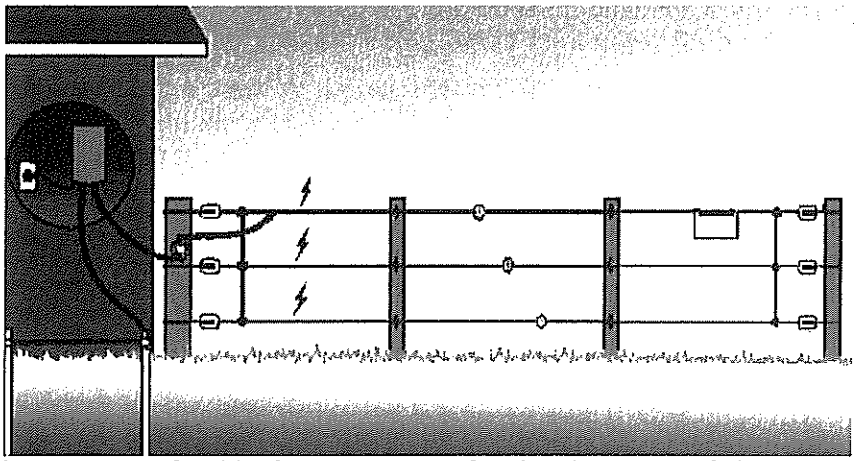
Energisers are an electric 'ticking box' for electrifying fencing. They apply a large voltage (3,000 – 10,000) for a short time.

Energiser standards:

- Peak output of no more than 10,000 volts
- Time between pulses at least 1.0 seconds
- Pulse shall not last longer than 50 milliseconds.

MAINS

Mains powered energisers are the most cost efficient and effective means of powering fence wire.



Mains energisers are preferable for permanent fencing because of the greater power and no battery maintenance. Mains powered units can generally power a greater length of fence (due to the greater power)

They work off AC power, or Alternating Current – the same as household appliances.

The major disadvantage of mains energisers is that if the power goes off for any length of time the stock quickly learn they can escape, especially if being held under pressure (e.g. cell grazing)

The energiser unit is also not portable.

BATTERY

Battery powered energisers range from low powered energisers for temporary fencing to high powered solar/battery models for multi-wire permanent systems. Battery life is directly related to the battery's capacity and the output power of the energiser.

Battery's are intended for temporary fencing and remote areas. Many of the units are portable making them ideal for strip grazing where there is no mains powered fences available.

One major disadvantage is that the rate of discharge can vary with conditions.

SOLAR

Solar powered kits consist of an energiser and solar panel(s). Purchased as a kit, the solar panel will complement the particular energiser to adequately charge the battery, which in turn powers the energiser even in periods of little or no sun.

All battery energisers are suitable for solar panels. The choice of battery for a Solar Power system is important. The recommended battery type is a deep cycle (also called Low Loss, Leisure, Marine) Battery. It is designed for deep discharging without permanent damage and for trickle charging from a solar panel charging system.

These kits are ideal for isolated areas and long fence lines where no mains power is available.

Once installed, only periodic checking is necessary.

Solar units have a high initial cost and must be protected from stock, and can not be shaded, e.g. they will need to be fenced off away from trees, gullies, or any thing that will cast a shadow at some stage during the day.

MATCHING THE ENERGISER WITH THE SITUATION

The main factors dictating the size of the energiser are:

- Animal species, as discussed earlier
- Natural vegetation – more vegetation, larger energiser. In some cases there may be no vegetation concern, if the electric wire is only on the top of fences and no in contact with vegetation.
- Fence length – the longer, and more wires, the larger the energiser.

The situation will often control what type of energiser is best suited. Some common situations include:

- Home farm for permanent fencing – mains energiser
- Temporary fencing, without access to permanent electric fences – battery energiser
- Very isolated permanent fencing – solar powered battery energiser. In some cases it may be more suitable to run a leadout wire from a mains energiser, for several kilometres, instead of using a very large (expensive) battery unit.

JOULE RATINGS

"Joule" is the standard unit for energy. The power flow of 1 watt for 1 second delivers 1 Joule.

Energiser output, expressed as pulse energy, is measured in Joules. The pulse energy is the electrical energy available in 1 pulse.

The key criteria is not the Peak Voltage Output but the energy which it releases with a specified resistance.

JOULES OUTPUT AVAILABLE

Energy output provides an indication of the ability to handle fence load, (a function of the length and number of wires), and leakage.

Output joules is available energy to power the fence.

As an approximate guide, 1 Joule of output energy will power 10 kilometres of single fence wire. The length of fence an energiser can electrify effectively will vary considerably depending on the type of fence, number of wires, climatic conditions, vegetation, etc.

Example: 15km of 5 wire fences = 7.5 Joules energiser.

STORED JOULES

Stored energy is the energy (measured in Joules) held within the energiser and discharged with each output pulse.

The stored Joules value provides a useful first guide as to how powerful an energiser is. It gives a consistent measure of energiser performance since it is independent of fence load. Indicators like voltage, current and output energy change according to the fence load conditions. The higher the Stored Energy figure, the more powerful the energiser.

Stored joules is the energy stored internally and when released to the fence terminal it decreases by about a third. If the design and construction of the fence is not of top quality, the energy could decrease to about half or less of the stored energy. Hence quoting stored energy is misleading.

The common range of values for stored Joules, in energisers is 48 Joules at the top of the range (of mains energisers), down to 0.1 Joules in battery powered energisers.

HIGH AND LOW MODE

On a mains energiser unit a high and low mode of energy output has been developed, which is called Full and Reduced Power. The low mode delivers a reduced energy output which is intended for dry, or summer conditions when the high output level can cause the grass to set fire.

This feature is designed entirely for the prevention of fire. It is not available on all mains powered units.

On a battery energiser unit the high, medium (in some units) and low option gives a reduced pulse speed as a means of conserving power.

THE APPLICATION OF JOULE RATINGS

Under varying conditions some of the different Joule ratings are more relevant than others

Climatic
As far as electric fencing is concerned the most important climates are either wet (and hence a good earth) or dry (and a poor earth). In dry climates the joule rating needs to be greater to compensate for the poor earth. The opposite applies in wet climates.

Corrosive
Fences in coastal conditions are subjected to corrosive forces from the salt-laden air. This increases the resistance on the wire and thus a greater joule rating is needed. Corrosive resistance may also result from two different types of metals coming in contact, causing accelerated corrosion.

Geographical
The siting of the energiser unit in relation to the farm has a major effect of the size of the unit needed. Ideally the energiser should be in the centre of the farm. This gives the most efficient use of the Joules. If the energiser unit is situated at one end of the farm, as is common with may farms, the Joule rating needs to be bigger as is pushing the current further, therefore being subjected to greater resistance.

Livestock sensitivity
Different species of stock vary in how they 'feel' the electric shock. In general, wool, hair and feathers are not good conductors of electricity.

Bulls are relatively insensitive to electric shocks therefore the size of the shock needs to be greater to discourage bulls from putting pressure on the fence. Smaller animals will generally be more sensitive to shocks.

The size of the animals 'contact' with the ground (e.g. their feet) is the major factor determining the size of the shock they feel. The better the contact (or greater the feet size) the bigger the shock they feel. For example horses, which have a good contact, are particularly sensitive (even more when they are shod).

EARTHING SYSTEMS

Poor earthing is the single most common cause of poor fence performance. For an electric fence to be effective, the electrons travelling from the energiser , along the wire must be able to complete their circuit, through the ground and back to the earth terminal on the energiser.

Large energisers exerting more power, long fences being subjected to proportionally more leakage will require more earthing.

Soil itself is not a good conductor of electricity, therefore the earthing system must be installed in a site that has damp soil all year round.

The earthing system should be positioned a good distance from the energiser

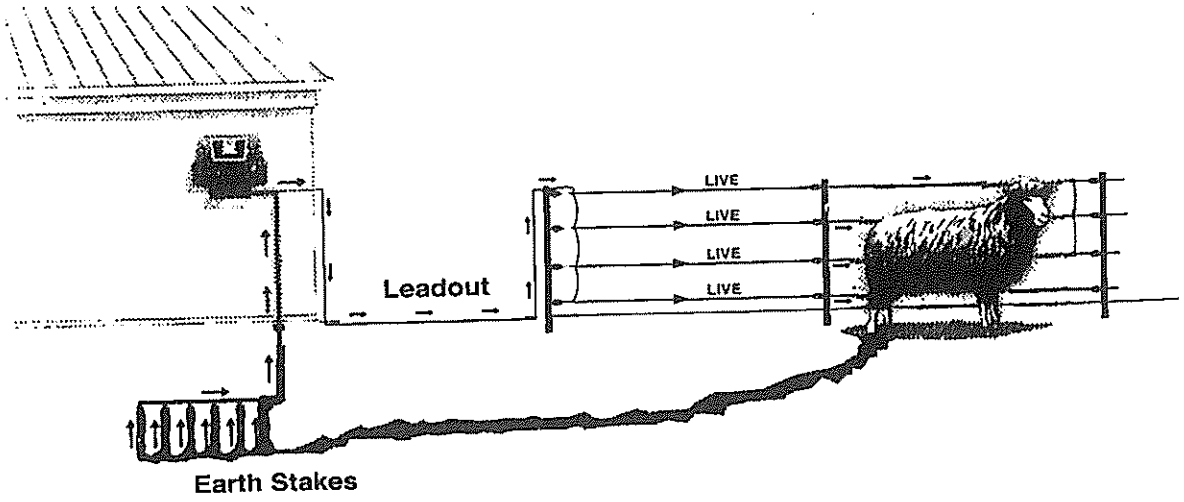
For drier conditions:
- Install more earth rods, or
- Use one of the other earthing systems.

In moist soils an adequate earth system will be:
- Three 2m lengths of 25mm galvanised water pipe, spaced 3 metres apart.

All earth stakes should be connected by one single continuous wire, attached by clamps.

ALL LIVE WIRE SYSTEM

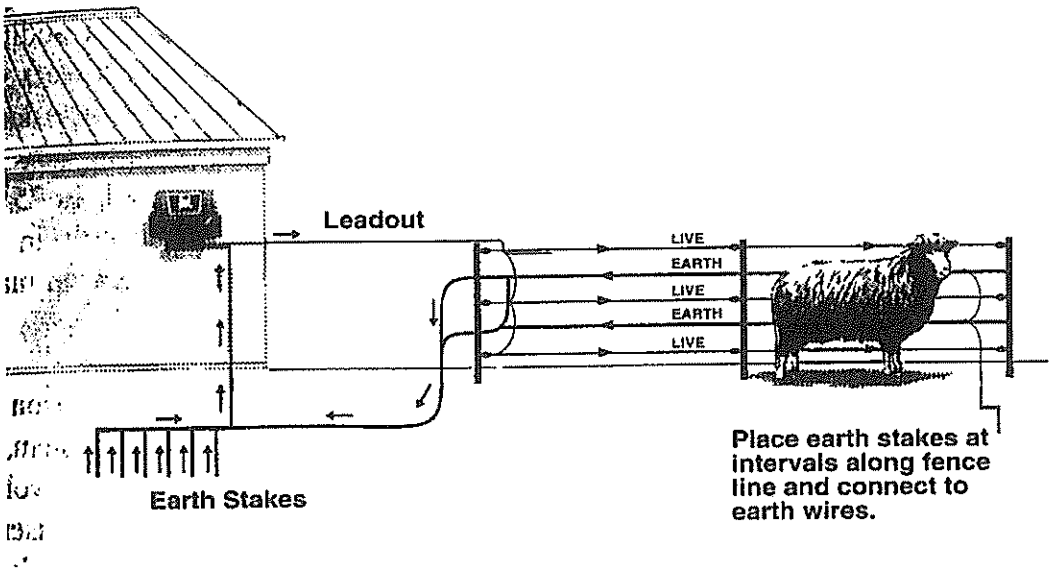
The all live system should be used where there is relatively even rainfall and where there is some green vegetation most of the year, or in areas with highly conductive soils.



All fence wires are live or neutral and the electrical circuit is completed through the animal.

EARTH WIRE RETURN SYSTEM

Wires alternate between live and earth, so the circuit is competed when the animals touches both wires or a live wire and the ground. The energiser is connected to both the earth and live fence wires.



Recommended in extremely dry soils with poor conductivity.

This system requires a very high standard of construction and must be well maintained because if live and earth wires come in contact the fence becomes ineffective.

BENTONITE EARTH SYSTEM

In extremely dry conditions or soil with poor conductivity the earthing can be improved by using: A mixture of bentonite and salt in 75mm diameter holes, 1.2m deep with stainless steel rods in the centre, which are connected to other earth takes and the energiser.

The salt is an excellent conductor and attracts moisture, which the bentonite retains.

TESTING AN EARTHING SYSTEM

The earth system should be tested annually, during the dry season.

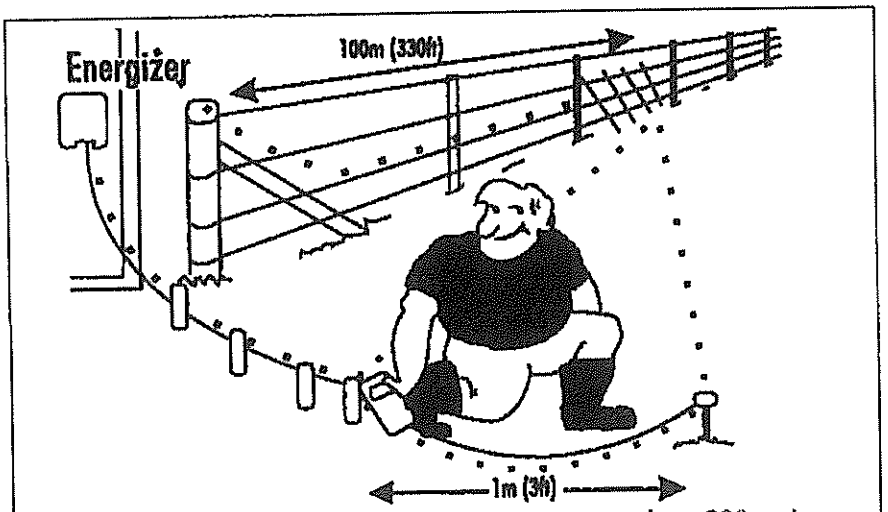
The quickest way to test your earth is to touch the earth system with your other hand on the ground. If you feel a shock, then your earth system is not working properly.

If you prefer not to get a shock, use a digital volt meter with the following method:

1. At least 100m away from the energiser, heavily short circuit the fence by laying several steel stakes or lengths of pipe against the fence.

2. Using the Voltmeter first check the fence voltage is below 2kV (if possible), then check your earth system by:
   - Inserting the voltmeter's earth rod into the ground to the full extent of the lead (at least 1 meter from any energiser earth peg), and
   - Hold the hook of the voltmeter against the earth rod furthermost from the energiser.

3. Ideally there should be no reading, however, a reading of up to 200 volts (0.2kV) is acceptable. Anything higher than this indicates better earthing is required.



Inadequate Earth System: Reading is greater than 200 volts.

IMPROVING EFFICIENCY

If an earthing test indicates better earthing is required, you can:

- Add more earth rods
- Find damper ground for earth rods
- Water the ground where the earth rods are initially.
- Ensure all earth pegs are connected by one continuous wire.
- Use double insulated lead out cable if the wire will come into contact with soil, yards, water pipes or buildings.

SAFETY CONSIDERATIONS

Warning signs

Electric fences bordering public thoroughfares are required (by law) to have a warning sign:

- At least 200mm x 100mm,
- Every 90 metres
- Displaying "Electric Fence" or a warning symbol
- Lettering must be at least 25mm high

Safety requirements

- Only one energiser may electrify any one fence at any one time.
- The energiser earth stakes must be at least 10 metres away from any power supply earth peg, underground telephone or power cable or underground water pipe.
- Avoid any fence line passing under, or running parallel to power lines. If unavoidable, the crossing should be at right angles, and shouldn't be more than 2 metres above the ground.
- Earthing material should be made of galvanised steel, no thinly electroplated or painted steel.
- The earthing wire should be 2.5mm High Tensile galvanised steels, or it is now possible to get special earthing wire which is stainless steel, 3.15mm.

Radio and telephone interference

The Post and Telegraphic Act prohibits electrical interference to Telecom lines and the responsibility lies with the land owner to prevent any audible interference. Where possible, avoid running under the telephone wires or parallel to underground telephone cables for any distance.

To avoid radio interference:

- The earthing system must be working perfectly
- The energiser must be well away from the mains power supply earth, and neither should be connected to water pipes.
- Avoid having the electric fence wires running for any distance parallel to telephone wires or power lines
- Ensure that all joins on the fence are "figure 8" or "reef knots"
- Ensure all cut-out switches are in good order with no loose connections.
- Use only top quality insulators.
- Under gateways use double insulated cable or leadout cable threaded through plastic piping for physical protection in strong backfill.
- To eliminate sparking along the fence, spray grass touching the fence line with a herbicide
- The energiser earth wire must not touch buildings which can act as a broadcast aerial. Use leadout cable to isolate the earth wire.

LIGHTNING DIVERTERS

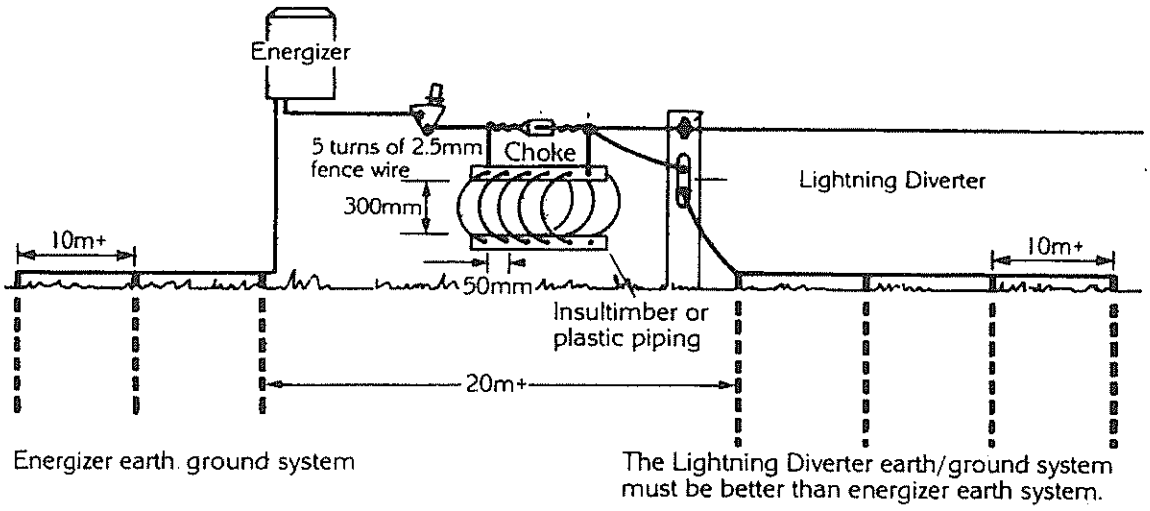
The chance of a lightning strike on an electric fence is moderately high in some places. Lightning strikes can damage energisers.

This damage can be minimised by:

- Disconnecting the energiser from the fence line and unplugging it from the power supply during electrical storm, and
- Installing a Lightning Diverter Kit

The lightning is transferred to the earth system rather than through the energiser, reducing the chance of damaging the energiser. The lightning diverter is destroyed, but costs only a few dollars to replace. Much cheaper than replacing an energiser.

INSTALLATION



Mounting instructions are included with each kit.

It is impossible to actually "test" a lightning diverter, as putting a similar sized charge through the wire will either destroy the diverter (if it is correctly installed) or damage the energiser (an expensive exercise). The only way to partly test it is to check it is correctly installed.

Using the kit does not guarantee complete protection and will not protect the energiser against a direct strike, or lightning travelling via a power supply.

LIGHTNING CHOKE

The choke causes a blocking effect for the extremely high voltage of the lightning so that is jumps the silicon carbide discs inside the diverter and is diverted to ground.

The choke is a few turns of wire, about 300mm in diameter, through which a normal pulse flows uninhibited.

US 572 Demonstrate knowledge of electric fencing components and systems

Level	3
Credits	5
Version	4

Purpose People credited with this unit standard are able to: identify electric fencing components; demonstrate knowledge of the uses of electric fences for animal containment; demonstrate knowledge of the performance characteristics of different types of electric fence energizers; describe types of joule ratings and their applications; and describe safety considerations for electric fence earthing system installations.

Subfield	Agriculture
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Accreditation	Evaluation of documentation and visit by NZQA, industry and teaching professional in the same field from another provider.
Standard setting body (SSB)	Agriculture Industry Training Organisation

Accreditation and Moderation Action Plan (AMAP) reference 0052

This AMAP can be accessed at http://www.nzqa.govt.nz/framework/search/index.do.

Special notes

Product use manuals are available from manufacturers and should be consulted in all training situations.

Elements and performance criteria

Element 1

Identify electric fencing components.

Performance criteria

1.1 Insulators are identified and described in terms of their functions, materials, and performance.

Range insulator types – wooden and steel post, end, insultube, thread through;
materials – porcelain, fibreglass, plastic, insulating timber.

1.2 Electric fence support posts are described in terms of types and function.

Range fibreglass, plastic, hardwood, steel standard, timber post, concrete post.

1.3 Sundry components are described in terms of their use.

Range cut-off switches, line clamps, under-gate cable, outriggers, insulated droppers, earth pegs, energizer.

Element 2

Demonstrate knowledge of the uses of electric fences for animal containment.

Performance criteria

2.1 Electric fences are described in terms of their uses.

Range keeping stock in, keeping predators out.

2.2 Electric fences are described in terms of their features that contribute to livestock containment.

Range physical, psychological.

2.3 Electric fences are described in terms of their advantages.

Range construction, skill required for installation.

2.4 Electric fences are described in terms of the suitability of wire types for animal containment purposes.

Range high tensile, aluminium, 4mm mild, netting.

Element 3

Demonstrate knowledge of the performance characteristics of different types of electric fence energizers.

Performance criteria

3.1 Power supplies are described in terms of the difference in continuance of supply.

Range solar, wind, water, battery, mains.

3.2 Battery and mains energizers are compared in terms of performance.

3.3 Energizers are matched with supply need and control requirements of animal type.

Element 4

Describe types of joule ratings and their applications.

Performance criteria

4.1 Joule ratings are compared in terms of required applications.

4.2 The variations of joule ratings are described for livestock control under varying conditions.

Range climatic, corrosion, geographical, livestock sensitivity.

4.3 Resistance of wire is described according to wire type.

Range high tensile, aluminium, 4mm mild.

Element 5

Describe safety considerations for electric fence earthing system installations.

Performance criteria

5.1 Prevention of radio and telephone interference and placement of caution signs are described in accordance with manufacturer's installation instructions.

5.2 Safety protocols are described in accordance with manufacturer's installation instructions.

Rangeearthing materials, placement of pegs in relation to mains earth, single wire, multiple energizers, wire type.