

# THE ELECTRIC FENCE

## Contents

- 1** The Electric Fence
- 2** Mode of Operation
- 3** Components
- 4** Construction
- 5** Maintenance and Troubleshooting

## 1. The Electric Fence

The most common enclosure on today's livestock farms is the electric fence. Farmers in the United States and New Zealand have been using electric fences to enclose their herds since the 1930s.

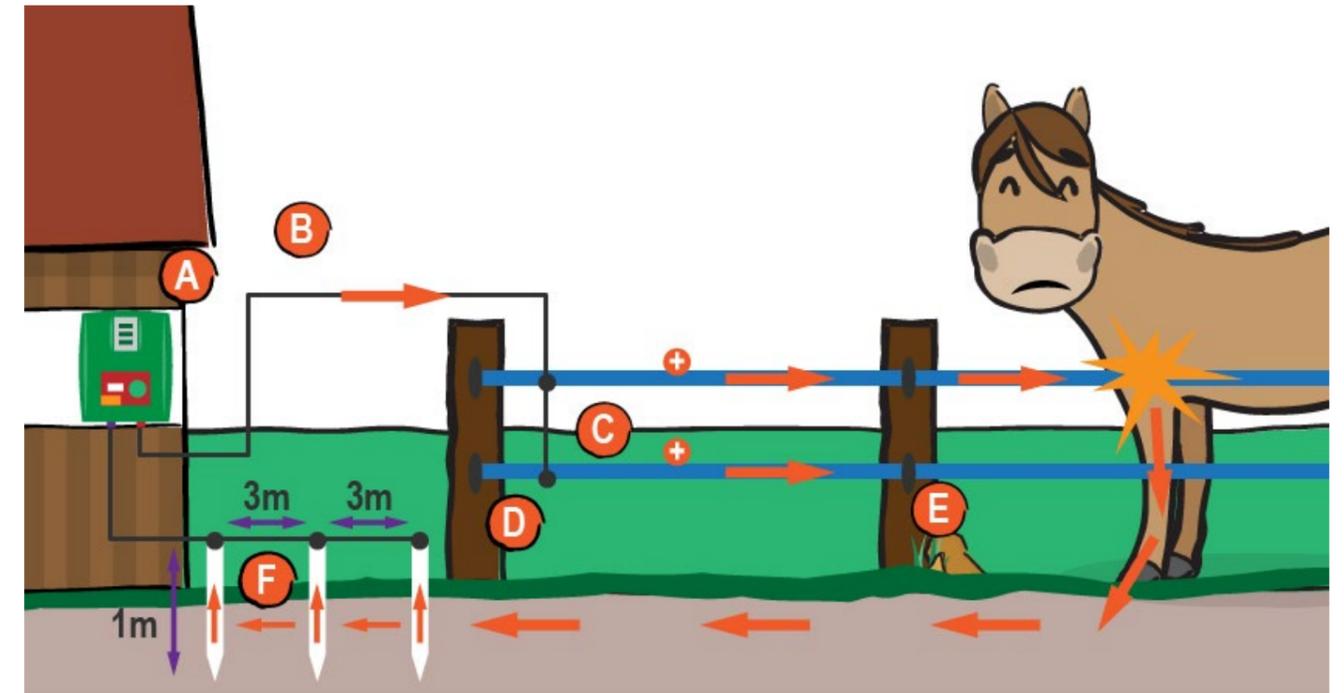
In 1942, the first wire fence energizer was invented by Paul Kolb in Germany. The technology has been pushed and developed further and further, and today there are even solar-powered electric fences and electric fences with GPS transmitters.

In the early days, electric fences were made of conductive steel wire. This was obviously quite expensive, rigid and hard to assemble. Today, fences can be assembled and repaired more quickly, easily and cost effectively using wires woven in plastic in the form of strands, cords and tapes. And in the case of a mobile enclosure, the fences can be disassembled and reassembled with ease.

Litzclip shows you what to watch out for during the construction, maintenance, or repair of electric fences. This way your animals are safe and happy, and you can rest assured it will last in the long run.



## 2. The Operation



**An electric fence consists of the following components:**

- A fence energizer which generates regular current pulses.
- A cable that transmits the electrical impulses to the fence.
- Wires that conduct the electricity interwoven with strands of plastic.
- Several fence posts (made of steel, wood or plastic) that can be moved or replaced depending on your needs.
- Insulators on the fence posts which isolate the electricity from the ground.
- A steel "earth" rod that is driven 1m into moist earth provides the grounding of the electric fence. Strong electrical fences may require up to three ground rods to be driven into the ground at a distance of 3m.
- Additional components are available as needed, such as connectors, gates and gate handles.

## How it works

The aim of an electric fence is the “psychological barrier.” If an animal (or human :-)) contacts the fencing rope or band, it (he/she) receives an unpleasant but harmless electric shock. The animal associates the fence with the unpleasant shock and learns to stay away from it. (Unlike we humans :-)

The circuit is NOT closed or completed by the fence itself. Only when an animal touches the fence, the circuit is completed and the current flows through the animal and the earth back to the pasture fence device. A clean grounding is therefore vitally important for the fence to work reliably.

## 3. Components of an Electric Fence

### Electric fence energizer

The electric fence energizer is the heart of a pasture fence. It delivers the impulses of electrical current along the fence, which the animal experiences as an electric shock.

The power for the device itself can be supplied from a 230 V power outlet or a 9 V or 12 V battery. There are also multifunctional devices that can be operated at 230 V as well as on a battery. Auxiliary solar operation is also possible.



### The choice of the fence energizer depends on several factors:

1. If there is a 230 V **power outlet** nearby, a network-connected device is definitely preferable. This guarantees a stable and consistent supply of power to the fence. If there is no electricity nearby, a 12 V device is necessary for a device requiring high power, a 9 V device is sufficient for a lower power requirement.
2. The required power of the unit is determined by the length of the pasture fence, the amount of fence along the fence and, of course, the nature of the animals being held. Two electrical quantities are relevant: the **operating voltage** in Volts and the **impulse strength** in Joules.

The **operating voltage** needs to correspond to the voltage at a normal load condition, like when an animal or some type of vegetation touches the fence. You would therefore calculate with an additional resistance of 500  $\Omega$  due to the touch. The minimum load voltage of a fence should not be less than 2,000 V. This voltage is sufficient for animals that have a thin coat and become accustomed to pasture fences. i.e. horses, cattle or pigs. For animals with a thick coat, or for those more eager to escape the fences (sheep, goats and poultry for example) the output voltage should not fall below 4,000 V. However, even without being touched, no fence is free from some discharge. Defective insulators, vegetation, fallen branches, humidity — all of this leads to a reduction in voltage across the fence. In order to guarantee the minimum load voltage, the pasture fence must have a higher output voltage. Strong devices can reach over 10,000 V.

The same is true for the **impulse strength**: for animals with thin fur and smaller fences, smaller impulse energies of up to 1 Joules should suffice. For large fence assemblies, animals with thick fur, or for areas with more predators you will need more powerful equipment with an impulse energy of up to 5 Joules. Side effects: The higher the pulse strength, the greater chance that plant growth that touches the fence is destroyed.

3. Of course, you can also pay attention to the electricity consumption when you purchase a pasture fence (in watts / hour) to keep **operating costs** low ...

You will find detailed information and recommendations on individual fence energizers in the product descriptions in online shops, or you can consult the specialist trade.

[Here you can find fence energizers by AKO.](#)

## The earthing — grounding rods and ground connection cables

As previously described, a **clean grounding** is essential for smooth operation of the electric fence. Since the fence energizer is connected with the fence and the earth, there is a voltage between fence and ground. If an animal standing on the ground touches the fence, the circuit is completed and the current flows through the animal and the earth back to the device. The lower the resistance, the better the current flows. The earth can present very high resistance and thus impair the function of the pasture fence.

The purpose of the grounding is therefore to **minimize the ground resistance**. This is achieved by good conductivity of the earth, several grounding rods, and a careful connection of the grounding rods with the pasture fence. The **conductivity of the earth** is improved by moisture. Dry soil is not suitable for electrical grounding. In dry soil, the earth's resistance can be reduced by using more grounding rods.

The **grounding rods** are made of stainless steel and should be at least one meter long and should be driven 1 meter deep into the earth. If several rods are used, the distance between them must be at least 3 m.

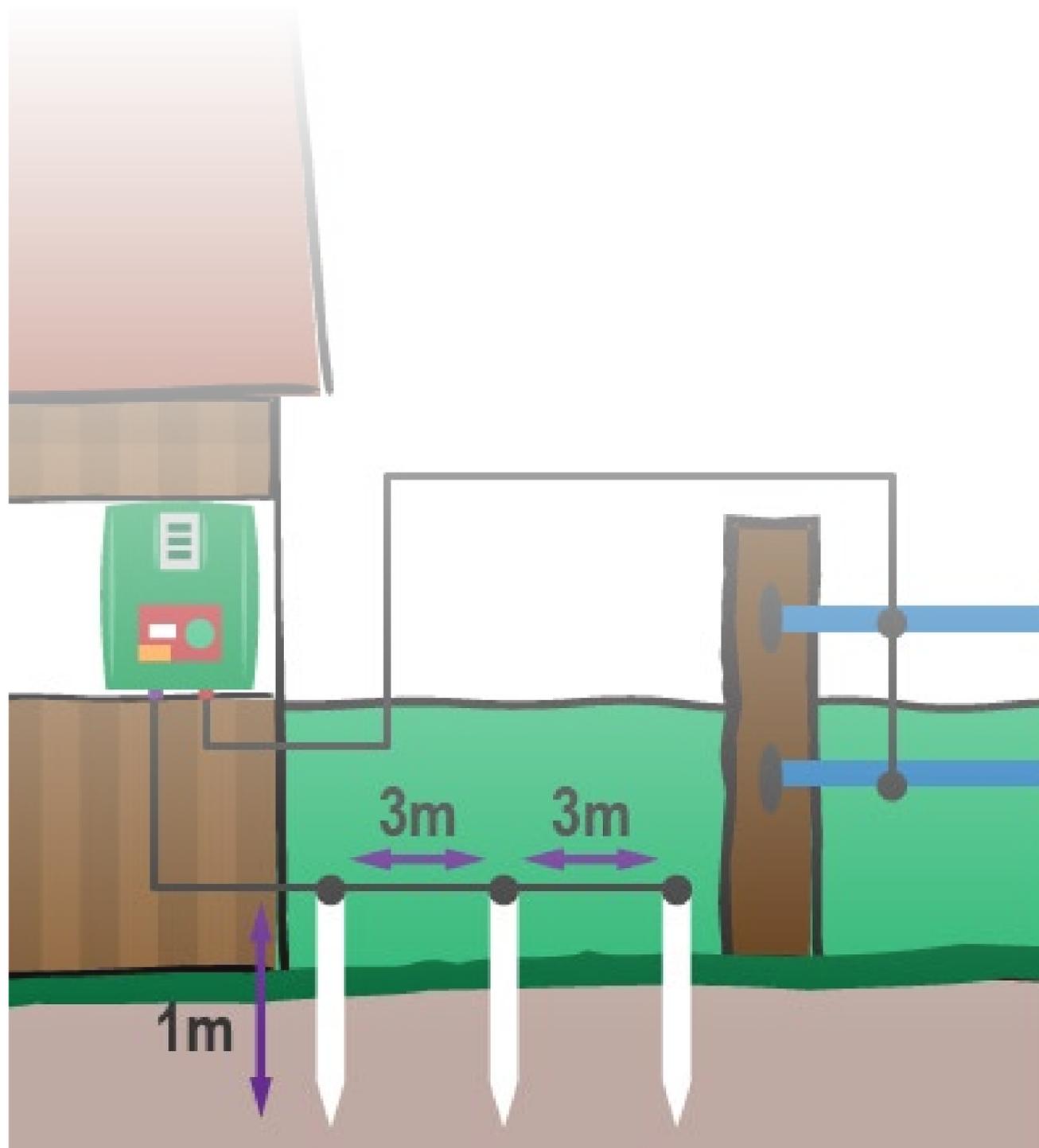
The grounding rods are then connected underground in series with a **high-voltage cable**. The first grounding rod is then connected to the ground terminal of the fence energizer.

**Pulse energy** plays a role when considering the number of ground rods. For 1 Joule electric fences, a ground rod of 1m is usually sufficient. For 2 to 5 Joule electric fences, at least 2 or 3 1m ground rods should be used.

And don't forget to keep at least **10m distance from other grounding systems**. Otherwise, a flashover of voltage may occur.

## Conductor material

The conductor material transports the current through the fence.



[Grounding accessories at AKO](#)

In certain respects, it is „the fence“.

If you build a **solid fence** that will last several years, solid wire made of steel or iron is suitable for it. Wire is very stable and has a high conductivity. However, it is also very expensive and difficult to set up and to tighten.

For all **other fences**, I recommend you use conductor materials made of plastic. Here, thin, conductive wires are interwoven with plastic ropes or tapes. That makes the conductor material flexible, stretchable, light, inexpensive, and the fence is quickly and easily mounted and disassembled. And the risk of injury to animals is very low.

**When choosing the right conductor material, the following things have to be considered:**

The larger the pasture, the **longer the fence**, the longer the distance the electricity has to travel to ensure the minimum output voltage at the other end of the fence. The decisive criterion for this is the resistance of the conductor material, stated in  $\Omega/m$ . The lower the resistance, the less power is lost along the way. Conductor material with more than  $3 \Omega/m$  is only suitable for smaller fences. Fences made of conductive material less than  $1 \Omega/m$  can be several kilometers long. The recommended maximum fence length is usually given in the product description of the conductor material.

The woven wires are usually made of **stainless steel** or **tin-plated copper**. Stainless steel is not as good as copper, but it is more resistant to breaking. Cheaper conductor materials for smaller fences are primarily made of **stainless steel**.

Tinned copper is an excellent conductor, but it is not as stable as stainless steel. Therefore, a mixture of the two types of wire is

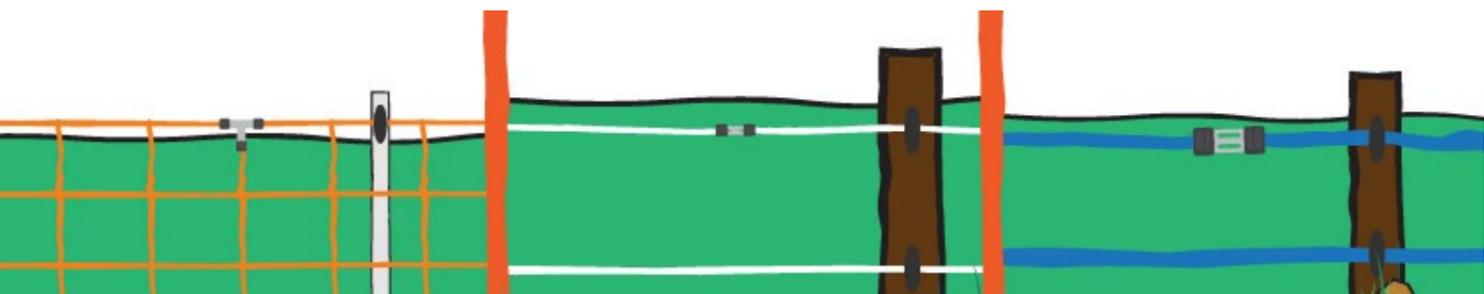
inserted into better quality conductor materials. These conductor materials are also suitable for large pastures.

So:

Cost-effective conductor material for short pasture fences = higher ohm value and wires made of stainless steel.

High-quality conductor material for long pasture fences = low ohm value and wires made of stainless steel and copper.

There are **three different types of synthetic conductive material on the market**: a litz wire, rope and band (also known as tape).



A **litz wire** is a thin cable with a 2 to 3 mm diameter. It is very easy to use and cost effective. Therefore, they are very well suited for mobile fences. Nets for i.e. sheep or poultry consist of such wire.

A **pasture fence rope** is thicker and consists of more conductive wires than cable. Averages of 6 to 8 mm are customary. Ropes are more stable than cable and also more visible to animals. Thus, pasture fence ropes are particularly suitable for larger animals, e.g. cattle. Pasture fence ropes are used in areas where there are stronger weather influences, since they are quite insensitive to wind and snow, for example.

The **pasture fence band** (or tape) is available in thickness of 12.5 mm, 20 mm, and 40 mm. It is mainly used for paddocks, often in combination with a rope, because the bands are very stable and can easily be seen by the animals. Thanks to the use of wide band, there is less contact between animals and the pasture fence. It is somewhat

more susceptible to weather conditions, but can be countered with careful and regular (re-)tightening of the band. The thinner bands are also used for cattle.

Tapes are not suitable for sheep: in order to get an electric shock, the animal must have skin contact with the conductor. Thin ropes and strands penetrate much better through the dense, insulating fur (wool) than wide bands.

The conductor material is connected to the pasture fence by a **fence connection cable**.



[Conductor material at AKO](#)

[Fence connection cable at AKO](#)

## Electric Fence Posts

Which electric fence posts you will use, depends on the local conditions. For example: the soil, the size of your pasture and the scenic appearance, and the type of electric fence.

Basically, **electric fence posts perform two different tasks:**

1. The **corner or solid fence post** forms the framework of your fence. These posts must be very stable since they need to withstand the physical tension of the pasture fence material.
2. The extender posts only carry the conductor material, so they are not exposed to any tension. However, they must be stable enough not to fall or break when animals run into the fence.

The following posts are used depending on the **type of the electric fence:**

1. **Permanent fences** often remain in place for several years. Here, wood posts, recycled posts or steel T-posts are usually used. All posts are driven deep into the ground, ideally up to one third of their total length. Recycled posts can be treated like wood posts (ie: sawn, drilled, etc.) If the ground is too hard for wood or recycling posts, T-posts made of stainless steel may be used.
2. **Semi-fixed fences** are generally put up at the beginning of the season and taken down again at the end of the season. Wood posts, recycled fence posts, or T-posts are used as sturdy corner posts. The rest of the posts in between can be made of plastic. Plastic posts are fully insulated and very easy to assemble and dismantle.

3. **Mobile fences** are put up and taken down several times per year as required. Therefore, easily installed plastic poles or even T-posts are used most of the time. Reinforced, long plastic poles or T-posts should be used for the corner posts. Both variants usually have knobs over the entire length so that accessory parts, in particular insulators, can simply be clipped on where needed.

The **distance between posts** should be, as a rule, 4 to 5 m. Depending on the terrain, the distances can also be shorter or longer.



Wood



Plastic



Recycled



T-Post

[Fence posts at AKO](#)

## Insulators

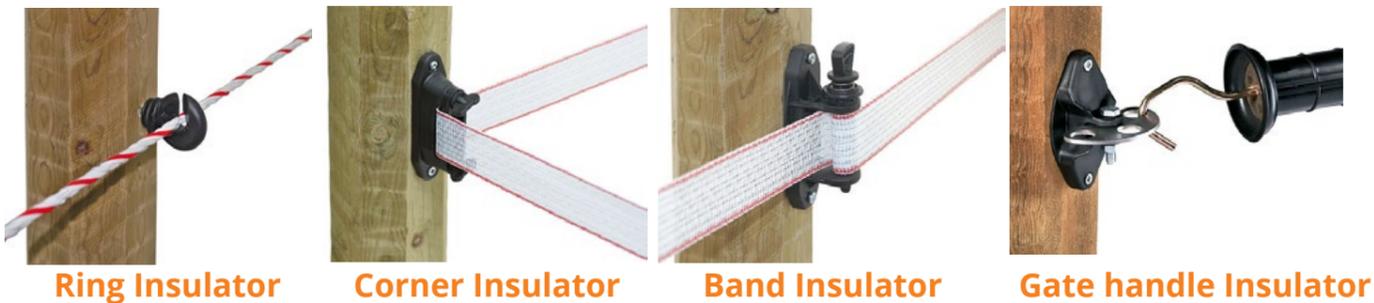
Insulators separate the conductor material from the fence posts so that the current is not discharged into the earth via the posts. The larger the insulators, the better their insulation properties.

Similar to the posts, **insulators also satisfy two different tasks:**

1. **Insulators**, which stretch and maintain, are placed on the corner along with tension posts.
2. **Guiding insulators** are attached to the posts and keep the conductor material at the correct height so that the elasticity of the fence is not compromised. The conductor material on the posts shouldn't be held in place at all by the insulators and should move freely in the insulator.

In addition, there are a **number of different insulators** to choose from depending on the shape of the pole, the method of connection or the type of conductor material.

The most common guide insulator is the classic **ring insulator**. **Corner insulators** are particularly stable as they must withstand the pull of the conductor material. They are also used at the beginning and at the end of the conductor material. There are special insulators for **electric ropes and bands**. For the gate handles you also need special gate grip insulators.



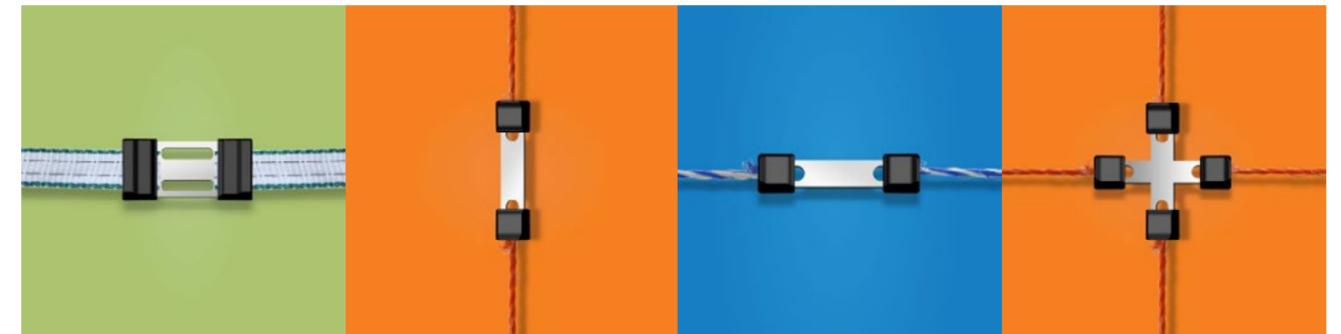
[Insulators at AKO](#)

## Connector

Connectors are used in many places in the electric fence. Most obviously, they serve as the **connection between two current-carrying conductor materials**. For example, connecting the end of a pasture fence rope with the beginning of the next rope. If you would simply tie the two ends of the ropes together, the power flow can no longer be guaranteed and the wires would break. The connectors therefore allow for the electricity to flow unhindered.

You need connectors to **repair cracked or damaged conductor material**. If the wires are broken in one place in the conductor material, you can just cut it and connect the ends with a connector again.

The simplest, fastest and most economical connectors are Litzclip® connectors. They are available for strands, ropes, tapes and nets. They can be attached without tools and without the help of an additional person. Simply thread the conductor material in on both sides, pull the plastic cap over it, and you're done.



Connectors are also used at the **beginning of a conductor material**. The conductor material must be mounted somehow on the post insulator. You can use a Litzclip® here, too. Simply cut open one side with a side cutter and clip it on the insulator. Don't worry — it will hold! If you're working with pasture fence tape, you can also use the Litzclip® gate handle connector.



And at the **end of the conductor material**, I recommend you attach a Litzclip® gate connector so you can simply add tension to your pasture fence and re-tension it with a few movements at any time.

The use of pasture fences require a regular tensioning since it is somewhat more vulnerable to wind and weather.



[Connectors at AKO](#)

## Lightning protection, fence switches and FI circuit breakers

The electric current of a pasture fence is unpleasant, but it is harmless for animals and humans.

Nevertheless, electricity can always be **life-threatening**. Particularly when using 230 V fence energizers connected to a socket in the house, stable or other buildings. You should take as many safety precautions as possible in order to avoid the risk of a life-threatening electric shock.

It is imperative to install a **FI protection switch** between the wall socket and fence energizer. Should a problem in the power circuit appear (so that the electricity provided cannot flow back to the energizer), the residual current circuit breaker „immediately“ — within milliseconds — separates the energizer from the power supply through the outlet. Whew — life saved.



A **lightning protection device** is highly recommended. Electric pasture fences are excellent lightning conductors due to the grounding, which is why lightning strikes can often occur. The excessive voltage of a lightning strike destroys the pasture fence. When this happens:

- the fence is no longer functional and you may have to catch your animals again and,
- you will have to buy a new pasture fence.



It is even worse if the energizer is connected to a socket because the lightning strike can flow directly into the socket and can trigger a house fire. Of course, as stated above, a residual-current circuit breaker can help.

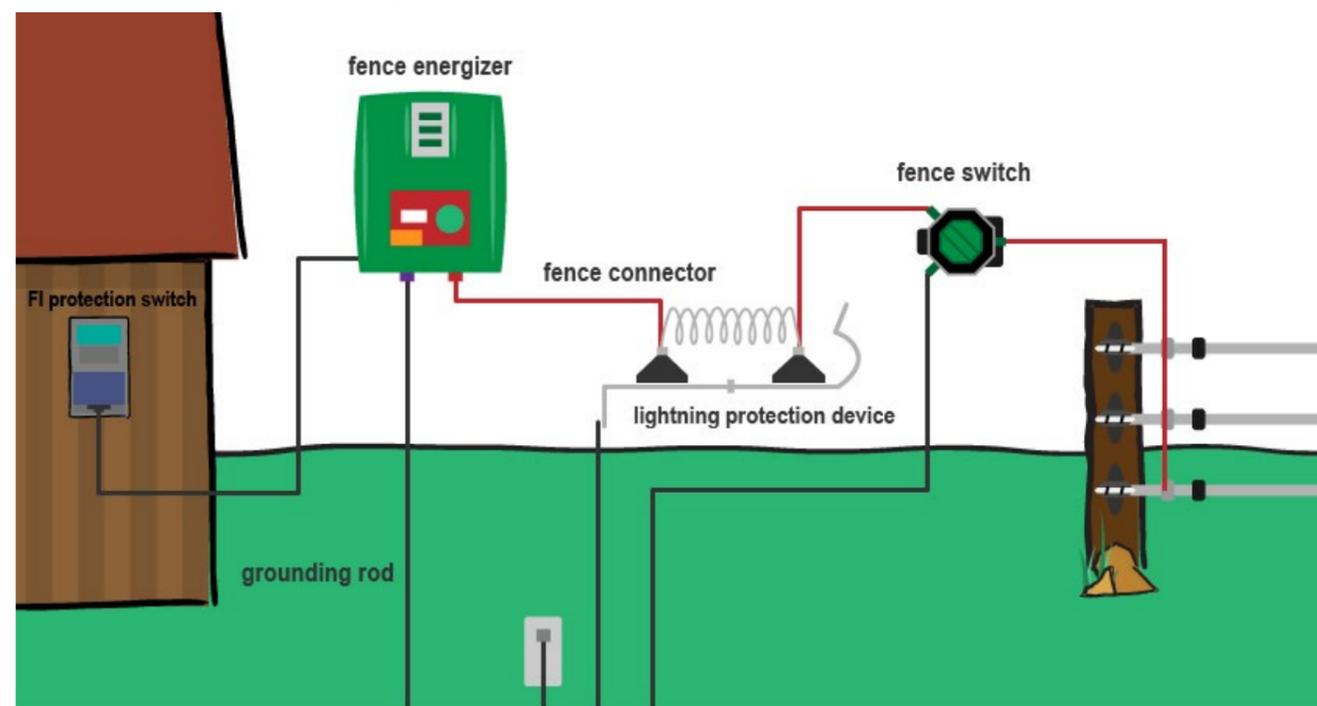
The lightning protection device is installed between the fence and the electric fence energizer and connected to the ground. Because electricity travels the way of least resistance, the power is caught at the „additional resistance“ protection device and sent into the ground before it reaches the energizer. Phew — we were lucky.

As a last safety link in the chain, you can also install a **fence switch** between fence and lightning protection device. For example, in case of threatening thunderstorm, you can turn the fence off with the switch (do not tell the animals). The fence switch is also grounded and thus directs the flash directly into the ground before the lightning protection device. Check after a lightning strike whether lightning protection and fence switches are still functional. Fence switches are also useful if you've fenced several animals separately. Then you can quickly switch off individual couplers on site.



[Lightning protection at AKO](#)  
[Switches at AKO](#)

**The entire current protection chain then looks as follows:**



## The gate

Of course, you have to enter your fenced pasture somehow.

**There are two possibilities:**

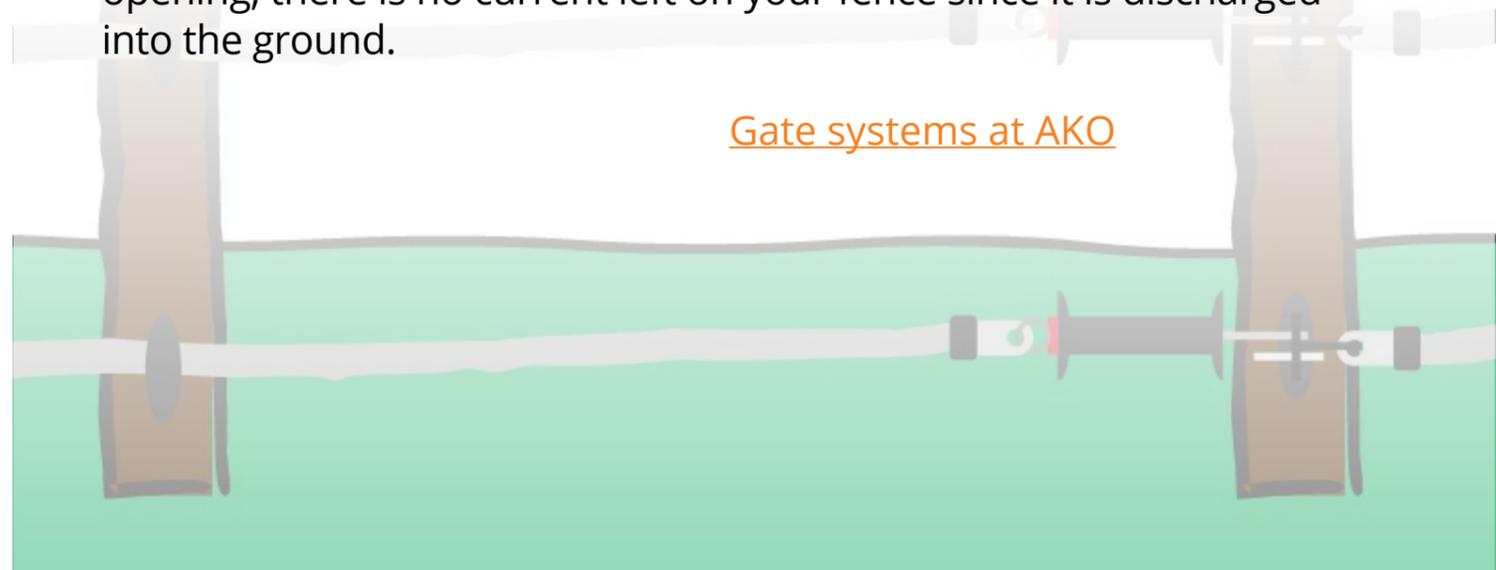
Either you install a **proper gate**, for example out of steel, which makes sense only with a permanent fence, or there is a spot somewhere on your fence where you can **open the conductor material**. No matter which version you choose — the two gate posts must be stable, **fixed fence posts**.

If you make a **passage way by interrupting the pasture fence tape or rope**, connect the ends of the conductor material with the Litzclip® gate handle connector on a gate handle, then simply hang it on a corner insulator on the fence post. As a result, **current conduction through the gate is ensured**. Gates and openings in pasture fences are often weak points in the current flow if they are not properly connected. The conductor material in the pass through area can provide good tension through the tension spring integrated in the gate handle. At the other end, the conductor material must of course be firmly attached to the gate fence post.

If you want the power supply in your pasture fence to be secured even after you have unhooked the gate handles, you have to connect the fence with a high voltage insulated ground cable, before and after the opening.

Caution: If you place the conductive material on the ground during opening, there is no current left on your fence since it is discharged into the ground.

[Gate systems at AKO](#)



## 4. The Construction of an Electric Fence

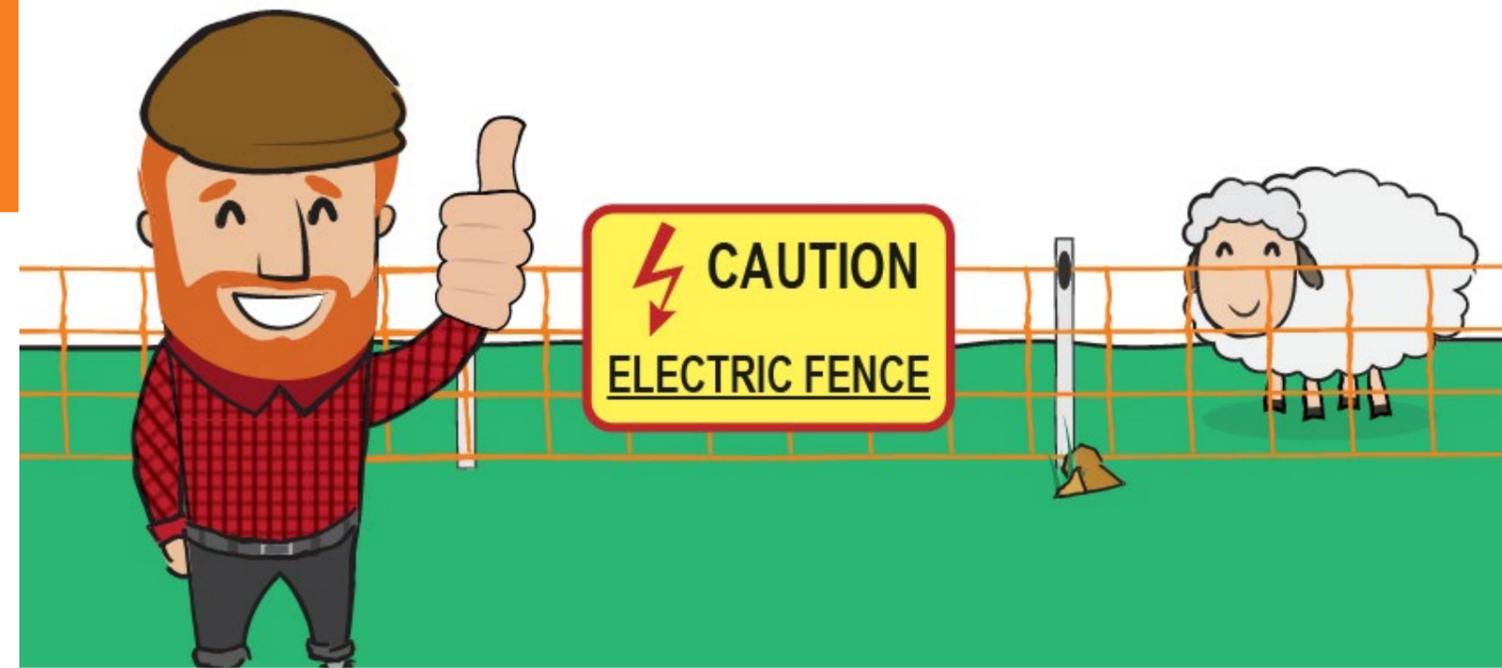
A smooth construction starts with a careful plan! Consider carefully what you need, the topography of your land, and how long your fence will need to be in place.

For a specific list of requirements, I recommend the [online electric fence calculator from AKO](#).

When you have everything together, begin by setting the **piles**. Then you attach the **insulators** at the required height of the posts. Fasten the **conductor material** at the starting point and guide it through the insulators. Connect the ends of the conductor material if necessary with a Litzclip connector. You can connect the ends of the wire, as described above, to the gate handle on the fence post. Remember that you must not create a closed circuit. The circuit closes only when an animal standing on the ground touches the fence.

Select a suitable location for your **fence energizer**, e.g. a house wall protected by the roof (don't forget your Residual Current Device.) Drive the **grounding rods** into damp ground at least 10 meters away. If more than one grounding rod is used, connect the grounding rods in series with one another (3m apart) and to the ground terminal of the pasture fence device.

Install the **lightning protection** and, if necessary, the **fence switch** and ground it. Connect the fence connector of the energizer to a fence connection cable with lightning protection and a fence switch with the conductor material. Finished!



After this, add some **warning signs** — warning signs have to be added on public roads!

After that you can **switch on** your electric fence.

[Warning signs at AKO](#)

## 5. Regular Maintenance and Troubleshooting

Also a pasture fence must be regularly maintained and repaired when needed. If you use high-quality materials from the outset, you improve the reliability of your pasture fence.

### Regular maintenance

Check the run of your fence regularly and:

1. Remove vegetation or fallen branches that connect the lowest line of the fence to the earth. This grounding causes current to be lost.
2. Re-tension strands, ropes and tapes regularly. They are affected by wind, weather and the animals.
3. Check that all conductive materials are properly connected and that there is no current being lost, keeping watch for brittle insulators or loose fence connector cables.
4. Look for places where the metal wires in the conductor material are broken. Cut the conductor material at those places and connect the ends again with a Litzclip®.

### Troubleshooting

If you recognize that your fence is not conducting enough electricity and you have already checked the above mentioned maintenance instructions, you should now proceed with a thorough troubleshooting within the circuit. For this, a fence inspector and a digital voltmeter are needed. Check first if the fence energizer is still functioning (battery still full?) or if the 230V supply cable is working. If so, check the fence cable to the lightning protection and fence switch and then the fence system and the grounding.

You can download a great step-by-step guide here at AKO:  
[Tips & Tricks for Troubleshooting the Electric Pasture Fence](#)

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*I wish you lots of fun and success with your electric fence!*  
*Alexander Beichert*