Innspill fra Nofence til ny stortingsmelding om dyrevelferd

Nofence er en norsk teknologibedrift med hovedkontor på Batnfjordsøra i Møre og Romsdal som leverer verdensledende teknologi til bruk for husdyr på beite. Husdyr på beite er noe det satses på, både i Norge og EU. I årets jordbruksavtale ble blant annet partene enige om å satse på utmarksbeite, og i EUs nye jordbruksstrategi "from farm to fork" legges det blant annet opp til økt andel økologisk drift. Det kan gi flere dyr på beite i årene som kommer.

Dyrevelferd er en viktig driver for vår teknologi, og god dyrevelferd har vært basis for vår virksomhet helt tilbake fra oppstarten på 1990-tallet.

Nofence har vært i kommersiell bruk i Norge siden 2016-2017 og er også i salg i flere andre land i Europa og verden for øvrig.

De fem prinsippene for god dyrevelferd er viktige ledetråder for oss.

- *Frihet fra sult og tørste – tilgang på friskt vann og en diett som gir god helse og trivsel*
- *Frihet fra fysisk ubehag – lever i et egnet miljø*
- *Frihet fra smerte, skade og sykdom – ved forebygging, rask diagnose og behandling*
- *Frihet fra angst og frykt – lever og behandles slik at de unngår frykt og stress over lenger tid*
- *Frihet til å utføre naturlig atferd – blant annet god nok plass og selskap av dyr av samme art*

Vi mener vår teknologi med virtuelle gjerder er spesielt godt egnet for å legge til rette for punktet om naturlig adferd for dyr. Nofence teknologien gjør at beitedyr lettere kan bevege seg fritt og naturlig på beiteområder. Teknologien virker døgnet rundt også når det er mørkt, så dyrene er ikke avhengig av å se fysiske gjerder for å tilpasse seg beiteområdene.

Videre er det mye som tyder på at beitedyrene beveger seg mer naturlig ved eventuelle rovdyrangrep og skadene ved bruk av vår teknologi kan begrenses i forhold til rovdyrsituasjoner der ordinære gjerder er i bruk. Også ved andre uhell og skader oppdages raskt ved bruk av vår teknologi – det gir mindre smerte, skade og sykdom hos beitedyr.

Med Nofence teknologi har bonden til enhver tid god oversikt over hvor dyrene er, og hvilken tilstand de er i (blant annet ved måling av fart og bevegelse). Det gjør også at eventuelle skader og uhell på beitedyr lettere kan oppdages og tas hånd om. Det gir mindre smerte, skade og sykdom hos beitedyr.

Vår teknologi bruker lyd som en impuls i et virtuelt gjerde. Det betyr at dyrene ikke er avhengig av et visuelt gjerde for å holde seg innenfor definerte beiteområder. Dersom dyrene, mot formodning ignorer lydimpulsen – vil dyr som bryter grensene for beiteområdet motta en strømimpuls. Dersom dyrene «rømmer» fra det definerte beiteområdet – vil både lyd og strømimpuls stoppe og de vil ikke få hverken lyd eller strømimpuls dersom de går tilbake i det definerte beiteområdet. De kan dermed «bryte seg ut» av områder uten å skades – skader forekommer ofte i tilfeller der ordinære gjerder brytes ned ved rømminger.

Nofence er nå involvert i om lag 25 ulike forskningsprosjekter i 15 ulike land i Europa, Nord-Amerika og Afrika. Vi har per dato over 250 millioner timer med operativ drift på dyr, som viser at løsningen er forutsigbar og fungerer godt for alle de tre dyreslagene vi har som målgruppe, storfe, sau og geit.

Vi jobber kontinuerlig med å utvide nettverket vårt og støtter kunnskapsutviklingen og -utvekslingen blant forskere som undersøker fordeler, og eventuelle mangler ved Nofence-teknologien. Se vedlegg: (Nofence – animal welfare) for mer informasjon om disse prosjektene. Vi forventer at resultater fra disse prosjektene vil publiseres fortløpende i de kommende år.

Vi kan også vise til allerede publiserte resultater vedrørende Nofence-teknologi og dyrevelferd. Per nå er resultatene entydig positive når det gjelder økt dyrevelferd ved bruk av virtuelle gjerder.

To store europeiske prosjekter (Super G og GreenGrass) som undersøker fremtidig bruk av beitemark valgte begge å samarbeide med Nofence, på grunn av at vi har den teknologiske løsningen som best forbedrer beitebasert husdyrproduksjon. Som en del av GreenGrass prosjektet undersøkte universitetet i Göttingen effektene av virtuelle gjerder på dyrevelferd når det gjelder atferd og stress (fekal kortisol), de fant ingen negativ effekt av Nofence på storfe. Funnene er publisert i et fagfellevurdert vitenskapelig tidsskrift med tittelen: “Heifers don’t care: no evidence of negative impact on animal welfare of growing heifers when using virtual fences compared to physical fences for grazing”
(https://doi.org/10.1016/j.animal.2022.100614)

I tillegg til de direkte positive resultatene som bruk av Nofence teknologien gir på dyrevelferden hos beitedyr, er det også verdt å nevne at teknologien har en rekke positive effekter på andre områder knyttet til skjøtsel og velferd.

- Nofence gir bøndene bedre oversikt over dyr på beite, og gir dermed en enklere og mer effektive arbeidsdager for bøndene
- Beitingen kan bli mer effektiv og rotere på ulike arealer på mer effektiv måte, dette kan for eksempel ha stor betydning for jordkvalitet og jordens resistens mot tørke mm.
- Nofence kan brukes i skjøtsel av vei/park mm, noe som kan gi bedre beskyttelse for sjelden/vernet flora som man ønsker å ivareta samtidig som man gjennomfører effektivt beite på egnede arealer. Effektiv bruk av dyr på beite kan og gi positive effekter for biodiversitet og oppleves som positivt for befolkningen.
- Nofence kan ha positive effekter når det gjelder krevende beite i skogarealer mm som er utsatt for skogbrann. Beite kan virke preventivt mot skogbrann mm, og færre skogbranner kan gi positive velferdseffekter for ville dyr og planter.

Om ny dyrevelferdsmelding:
Nofence er svært positive til at det er satt i gang et arbeid med ny dyrevelferdsmelding i Norge. Norge er et viktig land når det gjelder dyrevelferd, og vi vet at internasjonale aktører ofte ser til Norge når det gjelder utvikling innen dyrevelferd.

For Nofence er det viktig at den nye dyrevelferdsmeldingen legger til rette for økt bruk av den type teknologi som vi kan tilby. Vi mener økt bruk vil gi betydelige positive effekter for dyrevelferden i Norge. Videre er vi positive til at det utvikles systemer der produsentene belønnes for økt dyrevelferd.

Ta gjerne kontakt for mer informasjon om Nofence og vår teknologi.

Lykke til videre i arbeidet!

Batnfjordsøra, 31.8.2022

Med vennlig hilsen

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Vedlegg: Nofence Animal Welfare

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Introduction

Nofence grazing technology is a digital tool for remote livestock management. The cutting-edge technology, developed and produced in Norway, allows farmers to control, herd, and monitor grazing livestock without the use of traditional fencing or herdsmen.

By offering this tool for simplified livestock management to farmers, Nofence aims to support the regeneration of our soils through promoting the expansion of pasture-based livestock production, extensive grazing systems, and integrated crop-livestock production systems. Within this cause, Nofence seeks to improve farmers' quality of life by reducing the labor time required for fence construction and maintenance.

Foremost, Nofence strives to improve the welfare of domestic animals. Thus, in addition to freeing up time for animal monitoring, the Nofence virtual fencing solution allows for round-the-clock, remote monitoring of all animals via the smartphone application. Further, the virtual fence substitutes traditional fencing, reducing the risk of injuries and death to livestock from entanglement in hazardous barbed wire and wire net fences. By removing physical borders, Nofence opens landscapes, merging fragmented wildlife habitats and reducing the risk of injury from physical fences to wildlife.

Nofence places great value in high product quality and animal welfare standards. Close collaboration with farmers and an animal-centric design based on behavioral observations formed the basis of the Nofence development process. Nofence is currently involved in several research projects investigating the functionality of the technology and its possible effect on animals. Three recently published studies found that Nofence effectively contained animals within the virtual boundary, proving the functionality of the Nofence technology (Aaser et al., 2022; Confessore et al., 2022; Hamidi et al., 2022). Further, the study carried out in 2020 by the University of Göttingen in Germany showed no negative effects of Nofence on behavior and welfare of grazing heifers when compared to heifers fenced with traditional electric fencing (Hamidi et al., 2022). Interestingly, animals were found to return to normal behavior (i.e. grazing, ruminating) faster after receiving an electric pulse from the Nofence collars compared to the electric pulse from the physical fence (Hamidi et al, 2022). Based on behavioral observations, Aaser et al. (2022) did not find negative effects of Nofence on animal welfare either. Similarly, a study conducted in Australia using a different virtual fencing technology found no differences in animal behavior and stress measured by fecal cortisol levels in animals with virtual compared to physical fencing (Campbell et al., 2019). In the following, the functionality of the Nofence virtual fencing technology is explained in detail and measures taken to maintain and improve welfare of domestic animals are explained.

The Nofence Checklist:

- The Nofence system must be predictable and controllable: action and consequence, operant conditioning of the animal.
- The Nofence system is simple, easy to understand and fast to learn for the animal.
- The Nofence system has a secure failsafe mechanism to avoid pain, injury, and distress.
- Nofence recommends that every adult animal in a herd wear a collar.
- Nofence ensures the safety of the animals and allows remote monitoring through:
    - real-time positioning and tracking of all collared animals
    - notifications to the farmer if an animal is not moving for more than 4h
    - recording the number of signals applied to each collar (audio and electrical)
    - notifications in the event of an escape
- Nofence sales employees personally guide interested farmers through the sales process in one-on-one phone calls.
- The Nofence system is easy to learn and understand for the farmer and all necessary information is provided in the form of a well-developed user manual and instruction videos.
- Nofence provides a customer support helpline for any questions and emergencies.
- It is not possible to have access to the Nofence system without being monitored by the Nofence crew.

How Nofence works

The Nofence system consists of a collar to be placed around the animal's neck, a smartphone application, and an online web portal, both connected to a back-end database. The collar and smartphone app communicate via the mobile network, while the virtual fence function is based on satellite navigation. Due to the herd instinct of ungulates, it is necessary that every animal in a herd wear a collar to avoid panic and stressful events. Exceptions may apply for young animals in the herd that are physically unable to support the collar; calves less than 4 months or kids and lambs less than 3 months of age. Animals in these age groups are likely to remain with or in proximity of the mother. Therefore, their lack of fencing will likely not cause unrest in the herd.

The collar

Two different collar versions are currently available for purchase from Nofence. While both collar versions are similar in functionality, they differ in design and weight to fit the respective livestock species (Figure 1).

Figure 1: left: Nofence Cattle Collar and associated charger; right: Nofence Sheep and Goat Collar and associated charger; front: gray neck strap that holds together the chains.

The collar is tightly fitted around the animal's neck with two metal chains that are held together by a rubber neck strap. The neck strap was designed to prevent injuries resulting from heavy strain on the neck from the movement of the collar. The collars contain a GNSS receiver for location tracking, a 3D gyroscope for movement detection, and a modem that enables communication via the mobile phone network.
The batteries are removable and can be exchanged and recharged. Solar panels on the side of the collar further enable recharging while in use, prolonging battery lifetime and reducing the need for animal handling.

The Nofence app

The smartphone application is the communication tool between the user and his collars and provides live information on animal activity and emitted signals. The app shows a status overview, displaying the currently active pastures and collars, and provides separate overviews of all pastures and collars. A step-by-step user guide gives instructions on how to add, edit, and remove pastures and collars. The user can freely define the position, shape, and size of a virtual pasture, using a satellite image map. The GPS location of the respective phone is also displayed. Collars can be assigned to and removed from existing pastures. Pastures and collars can be named individually.

The web portal

In the online portal *MyNofence*, the user can observe the history of collar locations by collar, day, week, etc. Further, the locations in which audio cues and electric pulses were emitted can be displayed on satellite image map. This historical overview provides information on grazing and behavioral patterns to the user.

The virtual fence

The Nofence virtual fencing system is based on operant conditioning of animals to associate an audio cue with an aversive stimulus. When the GNSS positions the animal at the virtual border, the collar emits an audio cue at 82 dB. If the animal shows the desired response, namely turning away from the virtual border and back into the pasture, the audio cue stops (**Figure 2**).

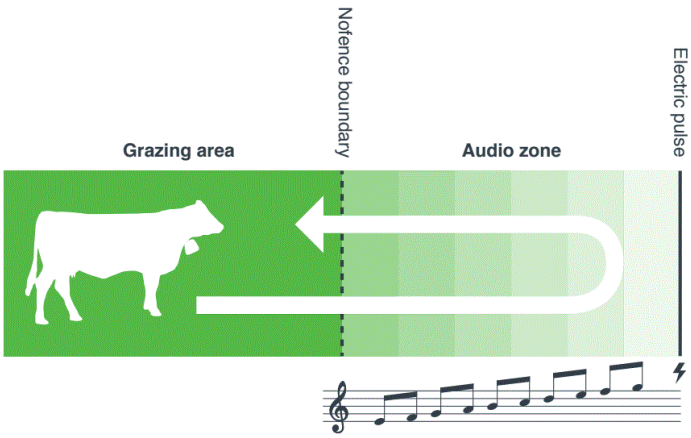

Figure 2: Desired response to the Nofence technology: Animal approaches virtual boundary and returns into virtual pasture upon receiving the audio cue without triggering the electric pulse.

If the animal continues to approach or passes the virtual border, the audio cue increases in pitch until, at the highest audio note, the electric pulse is triggered. Due to intelligent firmware design, the electric pulse can only be emitted after the highest pitch of the audio cue has been played. This awards full predictability of the stimulus, allowing the animal full control of the

system. The importance of predictability and controllability of cues for successful conditioning of animals has been stressed in scientific research (Lee et al., 2018). Different studies show that cattle successfully learned to understand the Nofence technology (Aaser et al., 2022; Confessore et al., 2022; Hamidi et al., 2022).

When a collar is assigned to a pasture in the Nofence app, the information is communicated directly to the collar via the mobile network. The virtual fence function will be activated only after the collar location has been registered within the pasture by the GNSS receiver. This safety function allows farmers to secure fencing in new areas when moving livestock, while simultaneously preventing signals from being applied to animals before having entered a new virtual pasture.

Upon first assignment to a new pasture, every collar first enters in a teaching or training mode. In this training mode, the desired response to shut off the audio cue is discontinuing the exiting of the virtual pasture. Whereas in the operating mode the desired response to shut off the audio cue is the active movement to return to the virtual pasture. The training mode allows a soft introduction to new virtual borders, encouraging animals to explore the boundary without allowing escapes (read more under “training of the animals”).

Escaping the virtual pasture

The Nofence system defines an escape as the exit of an animal beyond the virtual border that triggers the audio cue and the subsequent electric pulse three consecutive times (**Figure 3**). In the case of an escape, our unique protocol notifies the user and turns off the fence function. Escaped animals will no longer receive signals and are free to be herded back to the pasture or return of their own volition, without punishment by the virtual fence (**Figure 4**). Upon returning to the virtual pasture, the fence function is restored automatically.

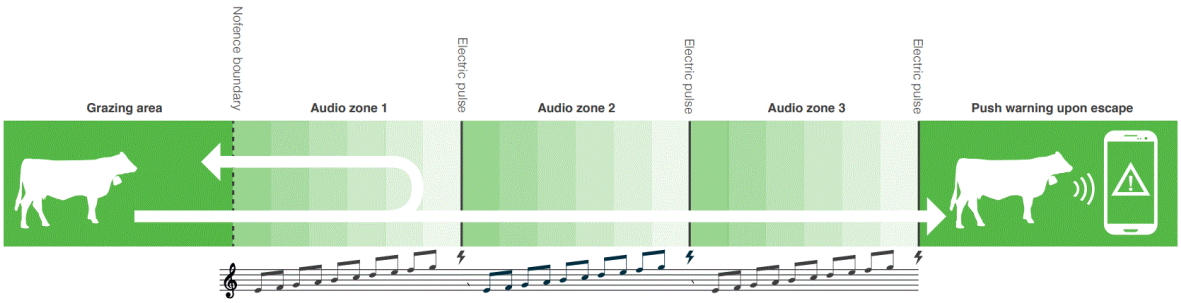

Figure 3: Undesired response; animal exiting the virtual boundary, triggering the escape sequence: As the animal continues out of the virtual boundary, a maximum of 3 audio warnings, each followed by an electric pulse are emitted and the escape notification is triggered.

Figure 4: An escaped animal returning to the virtual pasture (grazing area) without triggering any signal (audio or pulse) from the collar.

Nofence and the five freedoms

The Farm Animal Welfare Council in the UK defined animal welfare as (1) the freedom from fear and distress; (2) the freedom from pain, injury, and disease; (3) the freedom to express normal behavior; (4) the freedom from discomfort; and (5) the freedom from hunger and thirst (FAWC, 2009). These so-called Five Freedoms are today globally recognized as the gold standard of animal welfare. Nofence aims at granting animals these freedoms to ensure the best possible animal welfare.

1. **Freedom from fear and distress**
   A virtual fence must be predictable to the animal. The system should be simple, easy to understand and fast to learn for the animal. The sophisticated firmware enables full predictability of the system and the Nofence training period is of great significance. Animals are conditioned to associate the audio cue with the electric pulse and are thus in full control of the application of the electric pulse.
2. **Freedom from pain, injury, and disease**
   Unlike in a physical fence (wire or netting), animals cannot get entangled or strangled in a virtual fence, thus reducing the risk of injury to the animals. Additionally, the Nofence system tolerates escapes, by shutting down the fence function after three consecutive pulses. This is based on the assumption that, if an animal endured the aversive stimuli three times without showing the desired response, the application of more aversive stimuli will not trigger the desired response. In this case, the remote monitoring allows the farmer to track and locate escaped animals safely. Further, a more dynamic grazing management with frequent moves can help avoid diseases such as worm infections, as are common on continuously stocked pastures.
3. **Freedom to express normal behavior**
   A review of literature investigating behavior of cattle to define normal behavior concluded, that grazing was the most common behavior expressed by cattle (Kilgour, 2012). Nofence provides a solution to promote pasture-based livestock production systems and facilitates grazing for farmers that are unable to fence their grazing lands. Thus, Nofence promotes and supports livestock production systems that allow animals to express normal behavior.
4. **Freedom from discomfort**
   By offering a solution for remote animal monitoring and by freeing time spent on fencing for in-person animal monitoring, Nofence enables farmers to better monitor the wellbeing of their livestock and prevent animals from experiencing discomfort due to undetected issues.
5. **Freedom from hunger and thirst**
   The Nofence technology facilitates dynamic grazing management, thereby reducing the risk of keeping animals on pastures with poor feed availability for management reasons. Further, the system awards control to the animals and allows escapes. Thus, as opposed to providing a solid barrier that can't be broken through, the animals could endure the three pulses and escape from a Nofence virtual enclosure that fails to provide feed. In case of this event, the farmer would be notified about the escape and is able to track his animals on the Nofence app.

Standard Operating Procedure for customer success

Promoting and improving animal welfare is the cornerstone of Nofence. Therefore, a Standard Operating Procedure (SOP) was developed, describing the responsibilities and procedure for overseeing the correct use of Nofence Grazing Technology by members of our customer support team.

Before the sale

As part of this SOP, every potential customer is contacted by phone to discuss the suitability of the Nofence technology for their production system. The three key questions posed to every lead are listed below.

1. **Type of operation:**
   Nofence grazing technology is not suitable for every type of livestock production system. e.g. Mob grazing with small herd sizes require small paddocks that may not be feasible with Nofence.
2. **Mobile coverage on premises:**
   A secure connection to the cellular network must always be always granted for all collars to ensure proper functioning of the communication between collar and app.
3. **Number of animals:**
   The number of animals should equal the number of collars, as every adult animal in a herd is recommended to wear a collar. This information must be transferred to the customer. Exceptions apply for young stock as mentioned above.

Onboarding the customer

During the onboarding process, customers are provided information material on different channels. Nofence has created several instructional videos that are publicly available on Youtube.com for farmers to watch. Links to the videos are provided directly to the customers. Further, the user manual serves as an instructional guide, containing all information in written form. Finally, the app provides a guide and links to the instruction videos.

Monitoring and customer support

Continuous monitoring of pulses and audio signals by the support team ensures safety and welfare of animals in up-and-running systems with Nofence. The SOP provides guidance to Nofence employees on how to effectively monitor customers and animals. Our support team is available via email to all customers. Internal protocols ensure an efficient handling of issues. Further, in the case of unusually high signal applications or other discrepancies from the norm, customers may be contacted by the support team according to the SOP. If it is not possible to contact the customer, Nofence may deactivate collars remotely. However, any remote

interference by Nofence is a last resort only and animal safety and welfare must be secured beforehand. To this day, Nofence has not remotely deactivated a collar.

Training of the animals

The aim of the Nofence system is to contain animals within the virtual pasture without the application of the electric pulse. Animals with Nofence collars learn to associate the audio cue with the aversive stimuli. The animals are then conditioned to orient themselves by the audio cue and prevent the application of the electric pulse by respecting the virtual boundary. A comprehensive training protocol is provided in the Nofence user guide and through online learning videos.

In the collar firmware, a teaching mode ensures safe and quick learning, followed by the fence mode to ensure secure containment within the virtual boundary. Teach mode and fence mode differ in the definition of the appropriate response. In teach mode, the appropriate response to the audio cue is stopping and not continuing to exit the virtual paddock. In fence mode, the appropriate response is defined as returning to the virtual paddock. The collar automatically changes from teach mode to fence mode once the animal has shown the appropriate response to the audio cue 20 times. Every time an animal is assigned a new pasture, the collar reverts to teaching mode.

The electric pulse

Appertaining to animal welfare standards, the electric pulse must be as low as possible to avoid pain and injury to the animal, while at the same time being sufficiently aversive to provoke the desired response of returning to the virtual pasture. Experimental trials were conducted to investigate the pulse intensity required to meet these criteria and animal reactions to different pulse intensities. The Nofence technology has been evaluated in Norway by The Norwegian Food and Safety Authorities and the collars were tested by the Norwegian University of Life Sciences, NMBU. The evaluation concluded that use of the Nofence technology did not breach any of the Norwegian laws and regulations concerning animal welfare.

The aim was for the electric pulse to meet the following criteria:
1. The pulse is aversive enough for the animal to avoid it and respect it in normal situations.
2. When criteria 1 is met, the pulse must not be any stronger than necessary.

Below you may find the assessment from the Norwegian Food Safety Authority as well as the reports from the Norwegian University of Life Sciences, NMBU.

- Assessment from Norwegian Food Safety Authority Cattle & Sheep
- Assessment from Norwegian Food Safety Authority Goat
- Nofence Cattle Report 2018
- Nofence Sheep Report 2018

Developing the electric pulse: NMBU trials

Part of the experiment conducted at NMBU was to test three different strengths of electric pulse to meet criteria 1 and 2 mentioned above.

A) **Weakest strength**: 1.5 kV, 0.1 Joule loading with 0.5 second duration. Resulting in 2-3 pulses. One pulse delivers approximately 0.1 Joule.

B) **Medium strength**: 1.5 kV, 0.2 Joule loading with 0.5-1 second duration. Resulting in 1-2 pulses with approximately 0.2 Joule`s strength.

C) **Highest strength**: 3 kV, 0.3 Joule loading with 1 second duration. Resulting in 1-2 pulses with approximately 0.3 Joule`s strength.

The study found that in the group with the weakest electric pulse (A), 4 heifers escaped out of the virtual fence, whereas in the other groups (B, C) no animals escaped. Further, the number of audio cues and electric pulses were much higher for heifers in group A compared to group B and C. These findings suggest that the weakest electric pulse was too low.
The group with the strongest electric pulse (C) received the lowest number of audio cues and electric pulses and spent least time in the zone near the virtual border. However, the time spent in this zone did not differ between group A and B. This indicates that the strength of the pulse in group C was altering their behavior and caused them to avoid the boundary zone, whereas the strength of the pulse in group B successfully kept them within the virtual pasture but did not lead them to avoid the boundary zone. Based on these results it was decided to continue with the medium strength (B) electric pulse.

Read the full report here: Nofence Cattle Report 2018

Technical information

The strength of the electric pulse in the Nofence collar can be described on a technical basis as follows (see product sheets for further description).

Sheep and goat collar: In 0.25 sec about 10 smaller pulses of 1.5 kV will be delivered to the object (i.e. the animal), combining to an energy of 0.1 Joules. If the pulse is delivered to the chain, without a conducting object between them, it will reach 3 kV. So even if the pulse is delivered to the animal at 1.5 kV, we still operate with 3 kV as the answer to how strong the output is.

Cattle collar: In 0.33 sec about 10 smaller pulses of 1.5 kV will be delivered to the object (i.e. the animal), combining to an energy of 0.2 Joules. The same principle as above applies; if the pulse is delivered to the chain only, it will reach 3 kV.

Literature review on virtual fencing in general

The five freedoms defined by the Farm Animal Welfare Committee (FAWC) in the UK constitute the gold standard in animal welfare[1]. According to the FAWC, animals should be awarded freedom from hunger and thirst; freedom from discomfort; freedom from pain, injury, and disease; freedom to express normal behavior; and freedom from fear and distress. Pasture-based systems provide a more natural environment for ruminants to express normal behavior, such as grazing and ruminating, which is limited in mixed rations with low fiber proportions. Management systems with limited or no access to pasture have been found to increase the risk of different diseases, e.g. mastitis and metritis, and lameness in cows[2].
Currently, the use of electric fencing and barbed wire is the status quo in pasture-based systems. Injuries to livestock as well as wildlife from barbed wire and, to some extent, electric fences are common. Electric fences for cattle usually power 10,000 V. However, little control can be exerted over how much electrical power is supplied to the target, while the fence is susceptible to malfunction due to grounding or because the current is diverted.
Contrastingly, the electrical pulse from a Nofence collar is tightly controlled, as mentioned above. While the aversive stimuli is required for the success of a fencing solution, the biggest difference between Nofence and a traditional fence is the associative learning approach. Using an audio cue that precedes the aversive stimuli, animals are conditioned to avoid the aversive stimuli by reacting to the audio cue.

The effect of this conditioning and the emission of electrical pulses on the animal has been addressed in multiple research projects:

- Two studies were done by Eftang and Bøe (2018) on cattle and sheep, to investigate whether the livestock could be confined successfully with virtual fencing, the intensity of the electrical pulse required to successfully contain cattle, and whether sheep were able to successfully understand the Nofence technology. In conclusion, all animals were successfully trained in using the system and successfully confined by the Nofence virtual fence. The strength of the aversive stimuli was set in accordance with findings from this study.
- Similarly, a more recent study by Aaser et al. (2022) found that all cattle were successfully confined by a virtual fence without any indication of negative effects on animal behavior based on observations, suggesting that there is no negative effect on animal welfare. The number of electrical impulses decreased rapidly within a short timeframe and animals responded appropriately to the auditory cue. The study concludes with “long term welfare implications are expected to be minimal”.
- In a study by Grinnell et al. (2021) investigating the effects of Nofence virtual fencing on welfare of heifers, no difference in herbage consumption was found between heifers confined using Nofence compared to a standard electric fence. In the same study, Hamidi et al. (2021) found that all heifers were successfully trained and confined with the Nofence technology. Unpublished results from this study show no difference in animal welfare

[1] https://www.gov.uk/government/groups/farm-animal-welfare-committee-fawc (last accessed 28.05.22)
[2] https://pureadmin.qub.ac.uk/ws/portalfiles/portal/127810644/Arnott_et_al._2015a.pdf (last accessed 28.05.22)

between the virtual and the physical fence groups based on animal behavior and fecal cortisol measurements. Animals were found to return to normal behavior, such as grazing or ruminating, faster after receiving an electrical pulse from the collar, than after the pulse from the physical fence, indicating that the pulse emitted from the collar was less shocking.

Similarly, studies done with other virtual fencing technologies have found no effects on animal welfare:

- Campbell et al. (2019): "Cattle were maintained within their allocated area by both fence types across the 4-week period and those with the virtual fences were responding correctly to the audio cue with an average of 71.51 ± 2.26% of all cues across all animals being audio only. There was individual variation in rate of learning. The electric tape groups in cohort 1 showed a greater increase in body weight over 4 weeks than the virtual fence groups ($P < 0.001$) but this difference was not confirmed in cohort 2. The fence type statistically influenced the total daily lying time ($P = 0.02$) with less lying in cattle from the virtual fence groups but this difference equated to an average of <20 min per day. There were no differences between fence types in FCM concentrations ($P = 0.39$) and the concentrations decreased across time for all cattle ($P < 0.001$). These results indicate that virtual fencing technology effectively contains animals in a prescribed area across 4 weeks without substantial behavioral and welfare impacts on the cattle."
- Campbell et al. (2017) found that the animals were attentive to the audio cue, not the location of the fence.
- Marini et al. (2022): "The results of this study indicated that using a virtual fence to restrict access to pasture to create targeted grazing is as effective as using an electric fence."; "The similarity in pasture consumption between the groups indicated that the virtual fence does not affect normal grazing behavior of sheep, nor discourage them from grazing up to the fence line. "
- Lee et al. (2009): In this study, cattle was found able to avoid the electrical pulse within 3 to 4 sessions. The heifers did not show any undesirable response, such as continuing forward, after receiving the electrical impulse. "In week 2 when the virtual fence boundary had moved, cattle required only one reminder of the meaning of the audio cue to return to the same level of learning they achieved in week 1."
- At the moment, Nofence is involved in multiple research projects in several countries that are investigating the effects on animal welfare in various settings. (Provide research project overview?)

Below you may find a list with the latest relevant scientific publications from around the world regarding virtual fencing. This list contains research projects using various manufacturers of virtual fencing technology and foundational research regarding stimuli applied in virtual fencing.

Marini et al. (2022)
https://www.publish.csiro.au/AN/AN21459
DOI: 10.1071/AN21459
using Agersens eShepherd technology

- "The results of this study indicated that using a virtual fence to restrict access to pasture to create targeted grazing is as effective as using an electric fence."
- "The similarity in pasture consumption between the groups indicated that the virtual fence does not affect normal grazing behaviour of sheep, nor discourage them from grazing up to the fence line. "

Campbell et al. (2019a)
https://www.frontiersin.org/articles/10.3389/fvets.2019.00445/full
DOI: 10.3389/fvets.2019.00445
using Agersens eShepherd technology

- "These results indicate that virtual fencing technology effectively contains animals in a prescribed area across 4 weeks without substantial behavioral and welfare impacts on the cattle."
- "The current study assessed the effects of a virtual fence, in comparison to an electric tape fence, to contain eight groups of eight 12–14 month old steers [...]. Cattle were maintained within their allocated area by both fence types across the 4-week period and those with the virtual fences were responding correctly to the audio cue with an average of 71.51 ± 2.26% of all cues across all animals being audio only."
- "There was individual variation in rate of learning."
- "The electric tape groups in cohort 1 showed a greater increase in body weight over 4 weeks than the virtual fence groups ($P < 0.001$) but this difference was not confirmed in cohort 2."
- "The fence type statistically influenced the total daily lying time ($P = 0.02$) with less lying in cattle from the virtual fence groups but this difference equated to an average of <20 min per day." There were no differences between fence types in FCM [fecal cortisol metabolite] concentrations ($P = 0.39$) and the concentrations decreased across time for all cattle ($P < 0.001$)."

Campbell et al. (2019b)
https://www.mdpi.com/2076-2615/9/1/5
DOI: 10.3390/ani9010005
using Agersens eShepherd technology

- "All animals approached the virtual fence over the trial duration and received both audio cues and electrical stimuli, but individual animals differed in how often they tested the virtual boundary."
  individual animal variation in tolerance and curiosity
- "Over time, animals learned to respond to the audio cue alone to avoid receiving an electrical stimulus."
  all animals learned the appropriate response
- "Following fence deactivation all animals re-entered the previously excluded area."
  indicating that the aversive stimulus is not creating a general fear of the area and that animals understand the association of the (absence of the) cue and the (absence of the) stimulus

Campbell et al. (2020)
https://www.mdpi.com/2076-2615/10/6/1069
DOI: 10.3390/ani10061069
using Agersens eShepherd technology

- "A commercial trial was conducted in South Australia to assess whether virtual fencing technology could exclude 20 cattle from an area of regenerating saplings, across 44 days, using a contoured fence line. The results demonstrated that the cattle were able to rapidly learn the virtual fencing cues, responding primarily to the audio cue alone, and were excluded from the regenerating area for 99.8% of the trial period. Behavioral time budgets measured by automated devices on the leg changed across the trial duration, but in no consistent pattern. At the trial conclusion, the feed available in the protected zone was double the quantity and quality of the grazed zone. Thus, virtual fencing technology using pre-commercial prototypes was shown to protect an environmental asset within a paddock from cattle grazing in the presence of a large feed differential."

Verdon et al. (2021a)
https://www.frontiersin.org/articles/10.3389/fanim.2021.663963/full
DOI: 10.3389/fanim.2021.663963
using Agersens eShepherd technology

- This study investigated the "effectiveness of virtual fencing technology to contain groups of Angus heifers within grazing cells defined by semi-permanent electric side-fences and virtual front and back-fences, compared to groups of heifers contained in cells defined only by electric fencing."
- "The virtual front and back-fences successfully contained one group of heifers in their grazing cell, but the second group of heifers spent an increasing amount of time in the exclusion zone during the second and third allocations and consequently received an increasing number of audio and electrical stimuli. There were no effects of electric or virtual-fence treatment on live weight change or pasture utilization. By grazing heifers in adjacent paddocks our experimental design may have produced a motivation for some heifers to cross the virtual boundary to regain close contact with familiar conspecifics. Despite this, valuable learnings were gained from this study. Most notably, virtual fencing should not be used to manage cattle that have close visual contact to other mobs. We conclude that the successful application of virtual fencing technology needs to accommodate the natural behaviors of cattle."

Verdon et al. (2021b)
https://www.sciencedirect.com/science/article/pii/S0022030221004811
DOI: 10.3168/jds.2020-19797
using Agersens eShepherd technology

- "Milk production, live weight, and the time cows spent standing and lying did not differ between the electric and virtual fence periods. Milk cortisol concentrations, activity, and the times spent ruminating and grazing were comparable between the electric and early virtual fence periods (i.e., d 1–3 with a virtual fence). However, at d 4 to 6 with a virtual fence, activity (steps taken and motion index) and time spent grazing were lower, and time spent ruminating was greater, compared with an electric fence. Further, least significant difference tests suggest milk cortisol concentrations were higher at d 5 with a virtual fence than at d 8 with an electric fence and d 1 with a virtual fence. We conclude there is no evidence of behavioral and welfare effects of virtual fencing on dairy cows in the days immediately following implementation of the technology in a simple intensive grazing regimen, but a longer study is required to fully elucidate effects beyond this period."

Colusso et al. (2020)
https://www.mdpi.com/843324
DOI: 10.3390/ani10101767
using Agersens eShepherd technology

- ABSTRACT: "A virtual fence (VF) system is being evaluated for commercial implementation in the Australian livestock industries. For this to work in dairy systems, cows will require training to learn the association between paired stimuli for livestock containment. We aimed to understand if cow learning and response to VF stimuli would differ when trained as individuals or in groups in a controlled experimental environment. Twenty-three dairy cows were trained to a VF as individuals or in groups of 5–6, and then moved to the alternate context to test the retention of learning. Cows trained in groups were more likely to interact with the VF when tested as individuals, indicating they might rely on the response of their conspecifics rather than directly receiving stimuli themselves. It is important that all individuals learn the association between stimuli to ensure they remain within a boundary, and to minimise potential welfare implications on animals that do not learn. However, training individual cattle is impractical, therefore, further work should evaluate effective group training protocols that provide the time and space for all individuals to learn the VF."

Ranches et al. (2021)
https://doi.org/10.1093/tas/txab161
DOI: 10.1093/tas/txab161
using the Vence Inc. technology

- "... cows spent the greatest ($P < 0.01$) time in the VF management zones during run 1 followed by run 5, with runs 2, 3, and 4 with the least amount of time spent in the VF management zones, implying that cows did not de- velop a negative association with VF management zones and the feed attractant placed in this area. Auditory and electric stimuli applied to cows during runs 2, 3, and 4 followed that same pattern and were positively correlated ($r = 0.88$; $P < 0.001$). Cows received the greatest ($P \leq 0.01$) number of stimuli during run 2, which decreased over runs 3 and 4 (Table 2), implying that cows have quickly learned to avoid the VF area …"
- "In summary, the use of VF collars was effective at preventing cows from entering the VF management zones and, therefore, consuming the feed attractant. Additionally, the use of VF collars did not negatively impact the cow behavior, as observed by the resump- tion of behaviors upon removal of collars. Further, cows did not develop a negative association with the VF management zone; in fact, cows quickly learn to avoid the VF management zone upon stimuli.

Research with Nofence

Scientific publications

Is Virtual Fencing an Effective Way of Enclosing Cattle? Personality, Herd Behaviour and Welfare. (2022)
https://www.mdpi.com/2076-2615/12/7/842
Hedeselskabet & Aarhus University, Denmark
Aaser MF, Staahltoft SK, Korsgaard AH, Trige-Esbensen A, Alstrup AKO, Sonne C, Peroldi C, Bruhn D, Frikke J, Linder AC

- "In conclusion, the Nofence virtual fencing system was effective at confining the herd of cattle to the desired area. No indications that virtual fencing negatively affected animal welfare were found based on the behavioural observations in this study."
- "In this study there was a positive correlation between the number of warnings and the number of electric impulses received. As such, this study suggests that an individual receiving a higher number of warnings will also receive a higher number of electric impulses. Likewise, a decrease in the number of warnings received over time will result in the individual receiving fewer electric impulses, i.e., fewer stressful events. However, the results also indicated that the ratio between the number of electric impulses and the number of auditory warnings decreased with time, showing that this relationship between the number of warnings and impulses may be subject to change as the cows improve their response to the auditory warnings alone."
- "Thus, as expected and in accordance with previous studies, the results of this study clearly showed that the cows learned to respond correctly to the virtual fencing system [8,14]. As the number of warnings and thereby electric pulses decreased rapidly over time when the cows learned to respond appropriately to the auditory cues, enabling to avoid the virtual border, the long-term welfare implications are expected to be minimal, as has also been suggested by multiple other studies [5,13,18,28,34].

Heifers don't care: no evidence of negative impact on animal welfare of growing heifers when using virtual fences compared to physical fences for grazing. (2022)
https://doi.org/10.1016/j.animal.2022.100614
University of Göttingen, Germany
Hamidi D, Grinnell NA, Komainda M, Riesch F, Horn J, Ammer S, Traulsen I, Palme R, Hamidi M, Isselstein J

From the same project:
The effect of virtual fencing technology on grazing behaviour: differences in herbage consumption
Proceedings of the 21st EGF Symposium on "Sensing – New insights into grassland science and practice"
University of Göttingen, Germany
Grinnell NA, Hamidi D, Horn J, Riesch F, Komainda M, Ammer S, Traulsen I, Isselstein J

- “This study aimed to determine whether the application of novel VF technologies in cattle grazing systems affects grazing animal forage intake. For this, 24 heifers (Simmental, age average: 462 days, live weight average: 396 kg) in 6 experimental groups were equipped with NoFence VF collars (® Nofence, AS, Batnfjordsøra Norway). Control groups had only physical fences (PF) and received inactive VF collars. In 3 periods of 12 days, one control and treatment group each were grazed on adjoining paddocks (866.5 ± 32.7m2) for 5h daily. Forage biomass samplings were done on days 1, 8, and 12 of each period in both paddocks. Herbage dry matter accumulation was determined by manual clipping near the soil surface. Data analysis showed that sampling time affected dry matter availability and, thus, herbage intake (HI) ($P<0.001$).”
- “However, there was no significant difference in HI between treatments. Therefore, it can be concluded that the VF technology did not affect HI of grazing heifers, even though” heifers were naive to the technology.
- no difference in herbage intake detected between young heifers grazing in conventional electrical fencing and those grazing in virtually fenced pastures

Training cattle with virtual fences on permanent pastures
Proceedings of the 21st EGF Symposium on "Sensing – New insights into grassland science and practice”
University of Göttingen, Germany
Hamidi D, Grinnell NA, Horn J, Riesch F, Komainda M, Ammer S, Traulsen I, Isselstein J

- “In this study, the virtual-fencing technology (Nofence) was used to manage heifer grazing in an attempt to establish a training protocol. The heifers had not experienced virtual fencing previously.”
- “Two treatments (four heifers per group) were compared in three repetitions (each of 12 days). One virtual-fence-line, which is set up by GPS coordinates (the collars send acoustic signals followed by an electric impulse as a warning if the animals approach the line), separated the pasture of the virtual-fence-group into accessible or non-accessible areas. The control group had a physical-fence- line.”
- “Training was divided into three sections: visual support of the virtual fence by a physical barrier (first 2 days), only virtual border without visual support, moving the virtual-fence-line (on day 8). Results showed that each heifer was able to learn the virtual fencing cues. The main aspects of cattle behaviour on pasture were not affected by the physical/virtual-fence-line.”
- no difference in cattle behavior detected between young heifers grazing in conventional electrical fencing and those grazing in virtually fenced pastures
- all animals learned to associate the audio cue with the electrical stimulus

Application of Virtual Fencing for the management of Limousin cows at pasture. (2022)
https://doi.org/10.1016/j.livsci.2022.105037
University of Florence, Italy
Confessore A, Aquilani C, Nannucci L, Fabbri MC, Accorsi PA, Dibari C, Argenti G, Pugliese C

Current research projects with Nofence

Nofence is currently engaged in multiple research projects with different institutions in several countries (table 1). To support research of the technology, its effects on farmers, animals and the environment, and its possible applications in modern agriculture, Nofence awards a discount to researchers and research institutions. To foster relationships with and among researchers in the area of virtual fencing, Nofence has organized webinars where research methods and results can be shared in a community. A platform on social media allows researchers to connect and share their experiences. Nofence regularly follows up on projects through personal communication.

Table 1: Overview of ongoing research using the Nofence virtual fencing technology.

Country code	University / Institution / Company	Project objectives
BE	Ku Leuven	Virtual fencing for flexible management of nature reserves with large and small ruminants. Impact on animal welfare and behavior (Evy Tuytelaers). Investigate if it is possible to derive and differentiate animal behavior types from the GPS data (Paulien Vanderghinste). Focus on effect of virtual fencing/flexible grazing on soil parameters (Noor Verbeke) and plant population (Liese Sanchez)
CA	University of Alberta	Using emergent technologies to pursue precision ranching of livestock on western rangelands. (A robust test (and demonstration) of virtual fencing technology and its application to western Canadian grazing lands.)
CA	Trent University	Rotational grazing in cover crops by using virtual fencing. Characterize the impact of grazing cover crops (vs ungrazed cover crops) on dynamic soil health variables.
DK	HEDESELKABET	Managing 60 ha of coastal protected nature area on the east side of Fanø. Test and evaluate Nofence on: 1. Animal welfare and nature management, 2. The quality of the grazing and the impact on biodiversity, 3. Interface issues such as public traffic, other livestock and wildlife.
FR	IDELE	Studying the viability of Nofence for grazing in small paddocks as the animals are in more frequent contact with the virtual boundaries than on large plots. Study the effect on animal stress.

FR	Chambre d'agriculture Ile-de-France	Test the viability of Nofence technology for rotational grazing. Promote local trade in Paris region, normally mostly producers of cereals and crops, diversifying production including livestock.
DE	Georg-August-University Goettingen	**GreenGrass -** Innovative grassland utilization for sustainable agricultural intensification at the landscape scale. Conception of a transdisciplinary collaborative research project to develop innovative grazing systems that will secure and enhance the provision of ecosystem services.
IT	DAGRI, University of Florence - VISTOCK	**VISTOCK** project: Precision approach in extensive grazing land management. Economic benefits, improvement of pasture conditions (e.g. soil fertility, organic matter content), reduction of pasture degradation and improvement of animal intake.
IT	DAGRI, University of Florence - BOSCOLAMENTO	**BOSCOLAMENTO** project: Test Nofence for the grazing management of Maremmana cattle in an agrosilvopastoral system. 30 hectares composed of pastures and forest grazing systems. Test VF in a Mediterranean agrosilvopastoral system and evaluate the effectiveness of innovative grazing management by optimizing the forage supply from multiple resources.
NO	Inland Norway Univesity of applied science	**CARNIFOREGRAZE** Test the viability of Nofence for grazing in carnivore forests for sustainable production of food, timber and biodiversity.
NO	NIBIO, NMBU, NORSØK	**SUCCEED** Project: Sustainable systems with cow-calf contact for higher welfare in dairy production. How to integrate cow-calf contact (CCC) systems into modern dairy farming.
ES	Neiker	The objective of the project was to improve the profitability of extensive livestock farms by optimizing the management of livestock and grasslands.
CH	University of Bern, Agroscope	Will test technical reliability and impact on animal welfare and the stress load of dairy cows during the use of VF. Time series analysis of the activity rhythm will be performed. Moreover, milk yield and milk cortisol concentration will be monitored to assess the stress exposure on a physiological level.

CH	Agroscope	to be determined, project starts 2022/23
USA	Munch Bunch Goats & USDA (University of Minnesota)	Test possible containment system for goats in rotational and targeted grazing without the use of physical fences. Effectiveness of containment, time, and labor costs will be measured and compared to older management techniques.
USA	New Mexico State University	Use of Nofence in Digital Ranching. We seek to explore integrations of data fusion, analytics and visualization dashboards to enhance livestock grazing management in conservation, restoration or agricultural production programs.
UK	Precision Gazing	Testing Nofence as an enabler for land regeneration through managed grazing. Monitoring increase in productivity whilst reducing inputs and improving work/life balance for farmers.
UK	Agri-Food and Biosciences Institute	Assessment of calf welfare and behavior in virtual fencing systems. Appraisal of virtual fencing in rotational grazing systems for sheep, beef, and dairy cattle. Appraisal of virtual fencing in extensive upland systems for sheep and beef cattle
Europe	SUPER G	Super G is a EU H2020 project “Developing sustainable permanent grassland systems and policies” involving 21 partners from 14 countries across Europe. As part of the project, we have undertaken surveys and workshops with farmers throughout Europe asking about their interests in novel technologies for improving grassland management.
SI	SUPER G, University of Ljubljana	recreating the Irish Super G trials in SLovenia to investigate suitability of VF in Slovenia and animal welfare questions
SE	RISE	Investigating how cattle welfare, behavior, activity and stress-response is affected when learning and using virtual fencing technology compared to electric fences. In-depth knowledge requested by the Swedish Board of Agriculture for a possible approval of the technology in the future.
ES	IMIDRA	Extensive livestock farming for the recovery of a landscape proactive. Local innovation to face global change. The general objective of this project is to achieve the transformation of the classic firebreak structures, whether they are linear strips or components of the agricultural landscape that previously had other uses (boyal meadows, ravines, mowing meadows, etc.), usually treated by mechanical clearing , in silvopastoral structures managed

		with extensive grazing, integrated into diverse, multifunctional landscapes and managed with the strategic objective of preventing catastrophic events, especially large fires.
FI/SE	Ålands Hushållningssällskap & RI.SE	The aim of the project is to investigate whether virtual fencing can be a way to increase interest in natural pastures as feed. We only want to test the system in Åland conditions to ensure that it meets the standard according to Åland's animal welfare legislation.
AT	ARGE VENN, Federal Agricultural Research Station (HBLFA) Rotholz	virtual fencing in the Austrian alpine region to counteract succession: assessing welfare of goats while using a virtual fencing system: "With this scientific study, we aim to answer basic animal welfare questions for the application of the Nofence virtual fencing system in comparison to an electrical tape fence in order to clarify whether or not it is a reasonable option for further and larger field studies and finally its approval under the Austrian animal welfare regulations."
DE	Gut & Bösel	to be determined, starts 2022/23

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Appendix

Product Sheet Cattle Collar

PRODUCT SHEET - C2.1 CATTLE COLLAR

Nofence collar for cattle

Electrical Specification
Input voltage: 3,4V - 4,2V
Power consumption: 500uA to 1,5A
Audio warning level: 82dB @1m
Electric pulse level: 0,2J@3kV (max) Duration=1,0sec
Solar charging max peak power: 2291mW

Communication interface
Bluetooth
LTE Cat-M1 and 2G
GNSS Receiver - Glonass and GPS

Environmental
Ingress Protection: IP67 (@ 0,25m depth in 0,5 hrs)
Temperature range: -25 to +65°C (Operating and storage)

Physical
Dimension (box): 153,5 x 145,4 x 54,2 mm
Weight collar unit 858g
Weight battery 450g
Weight neck strap 138g
Total weight, carried by animal: 1446g

See Nofence user manual for instructions on the use and maintenance of this product.

Product Sheet Sheep and Goat Collar

PRODUCT SHEET - SG2.1 COLLAR Nofence

collar for sheep and Goat

Electrical Specification

Input voltage:	3,4V - 4,2V
Peak power consumption:	1,5A
Audio warning level:	82dB @1m
Electric pulse level:	0,1J@3kV (max) Duration=0,5sec
Solar charging max peak power:	1385,3mW

Communication interface

Bluetooth™
LTE Cat-M1 and 2G
GNSS Receiver - Glonass and GPS

Environmental

Ingress Protection:	IP67 (@ 0,25m depth in 0,5 hrs)
Temperature range:	-25 to +65°C (Operating and storage)

Physical

Dimension (box):	84,8 x 90,5 x 109,0 mm
Weight collar unit	292g
Weight battery	192g
Weight neck strap	21g
Total weight, carried by animal:	505g

See Nofence user manual for instructions on the use and maintenance of this product.

NOFENCE AS
Evjevegen 8
6631 BATNFJORDSØRA

Your ref:
Our ref: 2016/185015
Date: 22.12.2020
Org.no: 985 399 077

Norwegian Food Safety Authority

Mattilsynet

ASSESSMENT OF NOFENCE GRAZING TECHNOLOGY ON CATTLE AND SHEEP

The Norwegian Food Safety Authority accepts that the effect on animal welfare by using Nofence Grazing Technology on cattle and sheep as described by Nofence AS, is in line with the Norwegian Animal Welfare Act. However, this virtual fence technology by Nofence AS is not subject to any approval by the NFSA or any other official animal welfare authority in Norway.

The welfare of the animals will be evaluated by our inspectors in each individual case if inspections are carried out on the farm. So even if the technology itself is considered as in line with the AWA, the use on one individual farm or on one individual animal may not be in line with the act.

In the summer of 2019 the NSFA carried out 17 inspections on farms that participated in the Nofence-pilot; 9 herds of cattle and 7 herds of sheep. The overall impression was good.

Our approach is:

- All methods used to restrict free movements of animals should have as little negative effect on animal welfare as possible
- The least stressful method should always be used when possible
- Correct use is crucial; competence, and follow-up of the farmer by Nofence AS

Yours Sincerely

Torunn Knævelsrud
Head of Unit for Animal Welfare

This document has been electronically approved, and sent without signature.
Documents that require a signature will also be sent as a paper copy.

www.mattilsynet.no

Norwegian Food Safety Authority
Seksjon dyrevelferd

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The Norwegian Food Safety Authority does not have a formal approval authority in Norway, however they have been working closely with Nofence in the assessment of Animal Welfare. Based on the research conducted at NMBU and site visits, The Norwegian Food and Safety Agency found that Nofence complies with the Norwegian Animal Welfare Act.