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Evaluation Report 108

Hol-Dem 69 Fence Controller

A Co-operative Program Between

ALBERTA FARM MACHINERY RESEARCH CENTRE

PAMI
PRAIRIE AGRICULTURAL MACHINERY INSTITUTE

HOL-DEM 69 FENCE CONTROLLER

MANUFACTURER:

Electric Service Systems
1800 West 94th Street
Minneapolis, Minnesota 55431
U.S.A.

RETAIL OUTLETS:

Macleods Stores and other retail outlets in the prairie provinces

RETAIL PRICE:

$40.96 (August, 1979, f.o.b. Humboldt)

SUMMARY AND CONCLUSIONS

The Hol-Dem 69 fence controller was suitable for use over a limited range of fence conditions.

While operating on 6 V, peak voltage output on a 5.4 km (3.3 mi) single wire fence varied from 1200 V for a well-insulated, grass-free, dry fence to 40 V for an uninsulated, grass-grown, wet fence. While operating on 12 V, peak voltage output on a 5.4 km (3.3 mi) single wire fence varied from 1300 V for a well-insulated, grass-free, dry fence to 60 V for an uninsulated, grass-grown, wet fence. For some normal fence conditions, output was below the 700 V minimum guard voltage recommended for shod-haired animals, while for all conditions it was below the 2000 V minimum needed for long-haired animals. Effective animal control could be ensured only on shod, well-insulated fences.

Peak current flow through a cow touching a well-insulated 5.4 km (3.3 mi) single wire fence, with the controller operating on 12 V, varied from 0.12 A for a cow standing in water to 0.08 A for a normally-grounded cow. On 6 V operation, the peak current varied from 0.08 A for a cow standing in water to 0.06 A for a normally-grounded cow. The peak current output indicated that the Hol-Dem 69 was suitable only for well-insulated fences shorter than 5.4 km (3.3 mi) in length.

Total charge delivered by the Hol-Dem 69 varied from 0.84 to 2.8 mC.

The Hol-Dem 69 was suitable for cold weather use on shod feeding fences. Peak voltage output at -37°C on a 5.4 km (3.3. mi) single wire fence was about 1105 V, only 8% lower than its output at room temperature.

No durability problems occurred during testing.

RECOMMENDATIONS

It is recommended that the manufacturer consider:

1. Modifications to permit field replacement of the indicator light bulb.

Chief Engineer -- E. O. Nyborg
Senior Engineer -- L. G. Smith
Technical Officer -- *J. M. Williams*

THE MANUFACTURER STATES THAT

With regard to recommendation number:

1. The long life neon bulb installed in the fence controller will continue to operate for 8 to 10 years of uninterrupted service; therefore, replacements by the consumer are not required.

GENERAL DESCRIPTION

The Hol-Dem 69 fence controller is designed for 6 or 12 V battery operation. It is meant to be mounted in a suitable weather-proof enclosure.

The Hol-Dem 69 uses both electrical and mechanical components to produce the charge pulses. A light is provided to indicate shock intensity.

Detailed specifications are given in APPENDIX I.

SCOPE OF TEST

The performance characteristics of the Hol-Dem 69 were determined in the laboratory for a range of simulated fence conditions.* It was evaluated for ease of operation, quality of work, safety and suitability of the instruction manual.

RESULTS AND DISCUSSION

EASE OF OPERATION

Installation: The Hol-Dem 69 is equipped with a voltage selector switch and wire leads for connection to a 6 or 12 V fencer or automotive battery. The manufacturer recommends that the controller be located in a dry building or suitable shelter to protect it from adverse weather.

The controller is connected to the fence with a length of insulated wire. In addition, a suitable ground rod has to be installed and connected to the controller. Depending on ground conditions, a 2 to 3 m ground rod length may be needed.

Fence Condition: The manufacturer recommends that the Hol-Dem 69 be used only on insulated fences.

For cattle fences, in areas with normal ground conditions, a single charged wire fence erected about two-thirds of animal height above ground provides a suitable fence. For very dry or frozen soil, which provide poor ground conditions, a two-wire fence, with one charged wire and one ground wire, may be necessary.

Operation: The Hol-Dem 69 is equipped with one indicator light to show if a charge is being supplied to the fence. When the light flashes normally, it indicates that the fence is properly charged. Conversely, if this light is very dim, it indicates that insufficient charge is being placed on the fence, which may be the result of too long a fence or poor insulation.

The controller was sealed from the factory and the indicator light could not be replaced without factory servicing. It is recommended that the manufacturer consider modifications to permit indicator light bulb replacement without chassis disassembly.

*PAMI T7850, Detailed Test Procedures for Electric Fence Controllers.

QUALITY OF WORK

General: Operation of an electric fence controller is quite complex. To be effective, an electric fence has to deliver a minimum guard voltage to overcome the insulation resistance of the hide and hair of an animal. In addition, once the insulation resistance of the animal is overcome, the controller must deliver a pulse of electrical energy to the animal to create a shock. The amount of energy (charge) delivered is related to the current flow and its duration. If too much energy is delivered, the fence will be hazardous to both animals and humans while if not enough energy is delivered, animal control will be ineffective. For safety reasons, the total electrical charge in each pulse of power line-operated controllers should not exceed 1 mC if it has an on-time less than 14.2 ms. For an on-time of 200 ms, 4 mC is the allowable total electrical charge. Electrical regulations do not apply to battery-operated controllers.

Little is known about the physiological effect of shock pulses on animals. In general, the following guidelines are used in assessing fencer performance: the minimum guard voltage needed to overcome animal insulation resistance should be at least 2000 V for sheep and for long-haired cattle, such as Herefords or Charolais. For shorter haired animals, such as most dairy cows, a minimum guard voltage of 700 V is sufficient. The shape of the current pulse affects what the animal feels when it touches an electrical fence, but little reliable information is available. It has been found that shock intensity is more related to the peak current value in a pulse than to the total value of the electrical charge.

Fence conditions determine the guard voltage produced by a fence controller and limit the amount of charge which a controller is capable of delivering to an animal. The insulation resistance of a 1.6 km single wire fence typically varies from about 1 kΩ for an uninsulated, grass-grown, wet fence to well above 500 kΩ for a well-insulated, grass-free, dry fence. The higher the fence insulation resistance, the greater is the length of fence on which a certain controller can be effectively used. To receive a shock from a single wire electrified fence, an animal must be sufficiently grounded to permit current to flow from the fence, through the animal. Typical electrical resistances of cattle vary from about 0.5 kW for a cow standing in water and licking a charged wire to about 4 kW for typical ground conditions. If ground conditions are too poor, animal resistance to ground is so great that no shock occurs.

Peak Voltage Output: FIGURE 1 shows peak voltage outputs of the Hol-Dem 69 for 6 and 12 V operation, on a 5.4 km length of single wire fence over a range of insulation resistances. While operating on 6 V, the peak voltage output varied from 1200 V for a well-insulated, grass-free, dry fence to 40 V for an uninsulated, wet fence with considerable grass touching the charged wire. While operating on 12 V, the peak voltage output varied from 1300 V for a well-insulated, grass free, dry fence to 60 V for an uninsulated, wet fence with considerable grass touching the charged wire. The voltage output was above the 700 V minimum guard voltage needed for short-haired animals, for fence insulation values greater than 18 kΩ on 6 V operation and 11 kΩ on 12 V operation. It was below the 2000 V minimum guard voltage needed for long-haired animals for all fence conditions. From FIGURE 1, it can be seen that the Hol-Dem 69 can not be satisfactorily used on this length of fence. Wet weather reduced the voltage output below the required 700 V minimum guard voltage. A shorter fence is needed to ensure effective animal control.

Electrical Charge: FIGURES 2 to 5 show the current output of the Hol-Dem 69 when a cow touches a 5.4 km length of well-insulated, single wire, fence. FIGURES 2 and 3 are for an animal resistance of 0.5 kΩ, which represent the most extreme condition of a cow standing in water and licking the charged wire, while FIGURES 4 and 5 are for an animal resistance of 4 kΩ, representing more normal ground conditions. The shock intensity is related to the peak current in the pulse; the higher the peak current, the more intense will be the shock.

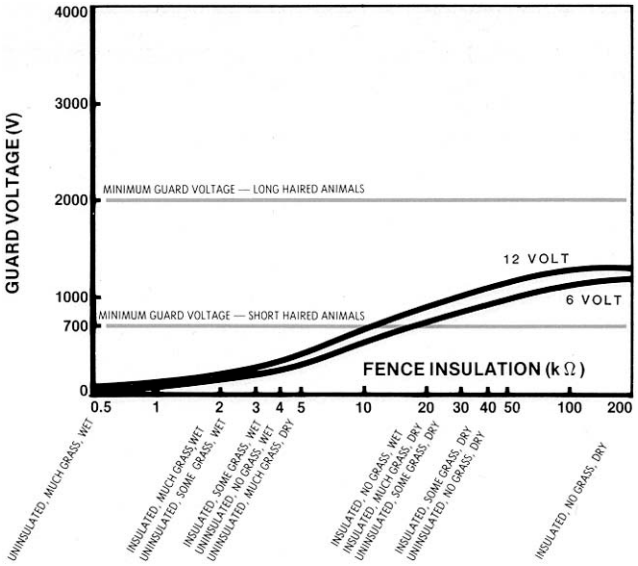

FIGURE 1. Guard Voltage Produced on a 5.4 km Single Wire Fence.

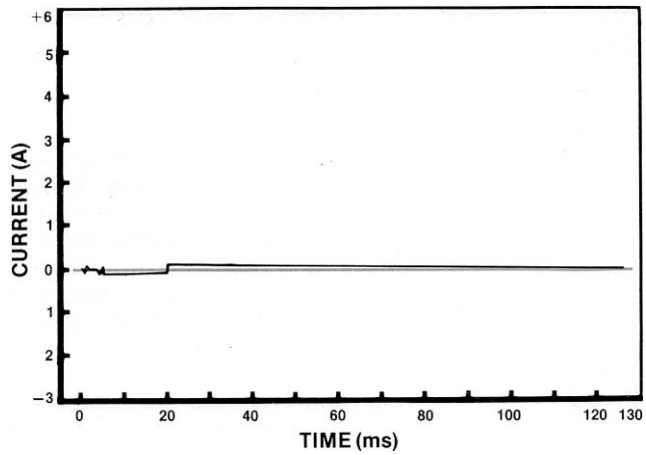

FIGURE 2. Current Delivered to a Well-Grounded COw Touching a 5.4 km Well-Insulated Fence, with the Controller Operated at 12 V.

The peak current delivered by the Hol-Dem 69, on a 5.4 km fence, varied from 0.12 A on 12 V operation, for a well-grounded cow, to 0.06 A on 6 V operation, for a normally-grounded cow. The total charge delivered to the cow varied from 0.84 to 2.8 mC. The shock was inadequate for effective animal control on both 6 and 12 V operation, for this length of fence.

The number of charge pulses delivered per minute on 12 V operation varied from 54 to 60. On 6 V operation, the number of charge pulses varied from 59 to 64. The on-time was also affected by fencer load and varied from about 68 to 127 ms.

Low Temperature Operation: The Hol-Dem 69 could be used to energize cattle feeding wires during low winter temperatures. The peak voltage output of the controller at -37°C on a 5.4 km single wire fence was about 1105 V, only 8% lower than its output at room temperature. A higher peak voltage output-could be expected on a shod feeding fence. The peak voltage output was well above the 700 V minimum required to overcome the insulation resistance of short-haired animals, but was below the 2000 V minimum required for long-haired animals.

Since battery voltage is severely reduced at low temperatures, it is necessary to provide a heated battery enclosure to ensure effective winter operation. As frozen ground is often a very poor electrical conductor, two-wire systems, utilizing a separate ground wire are usually most suitable for winter cattle feeding.

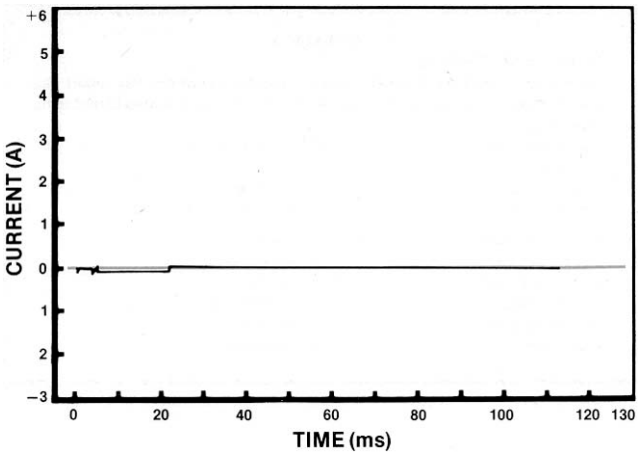

FIGURE 3. Current Delivered to a Well-Grounded Cow Touching a 5.4 km Well-Insulated Fence, with the Controller Operated at 6 V.

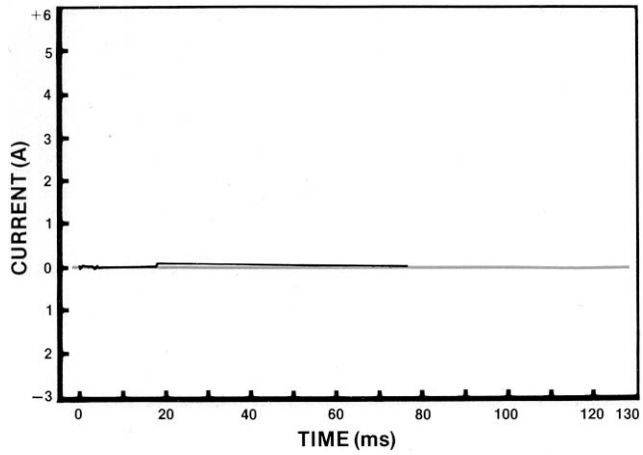

FIGURE 4. Current Delivered to a Normally-Grounded Cow Touching a 5.4 km Well-Insulated Fence, with the Controller Operated at 12 V.

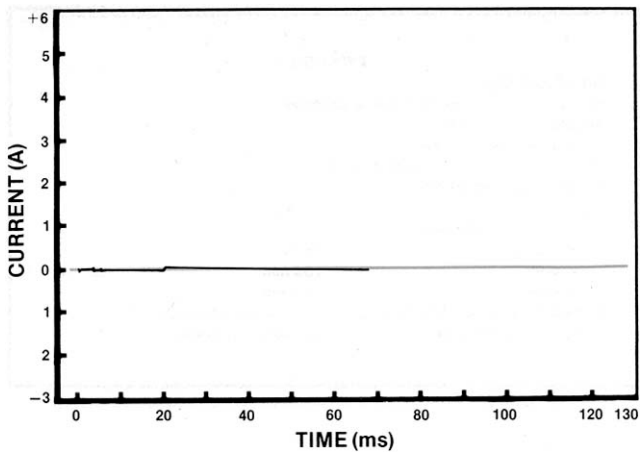

FIGURE 5. Current Delivered to a Normally-Grounded Cow Touching a 5.4 km Well-Insulated Fence, with the Controller Operated at 6 V.

Battery Consumption: A 12 V, 70 amp-hour battery will operate the Hol-Dem 69 about 4 months, depending upon the naturally-occurring discharge rate and the load on the controller. The consumption rate increased considerably as the load on the controller increased. A 6 V fencer battery will operate the controller about 4 months. The battery should be regularly checked to ensure effective controller performance.

SAFETY

No safety problems were evident if the manufacturer's instructions were followed.

INSTRUCTION MANUAL

The instruction manual was clear, concise and well illustrated. It outlined installation, safety considerations and operation, as well as illustrating types of fences suitable for various livestock.

DURABILITY RESULTS

The intent of the test was functional evaluation. An extended durability evaluation was not conducted. No problems occurred during functional testing.

APPENDIX I

SPECIFICATIONS

MAKE:	Hol-Dem Fence Controller
MODEL:	69
SERIAL NUMBER:	270603
TYPE:	Electro-Mechanical
POWER REQUIREMENTS:	6 or 12 V DC
WEIGHT:	2.1 kg
OVERALL DIMENSIONS:	
-- length	248 mm
-- width	155 mm
-- height	141 mm
NUMBER OF INDICATOR LIGHTS:	1 (for shock intensity)
TYPE OF ENCLOSURE:	for indoor operation

APPENDIX II

SI UNITS AND SYMBOLS

(a) In keeping with the Canadian metric conversion program, this report has been prepared in SI units. For comparative purposes, the following conversions may be used:

1 millimetre (mm)	= 0.039 inches (in)
1 metre (m)	= 3.28 feet (ft)
1 kilometre (km)	= 0.62 mile (mi)
1 kilogram (kg)	= 2.2 pounds (lb)

(b) The following symbols are used in this report:

electric current	= ampere (A)
electric potential	= volt (V)
electric charge	= coulomb (C)
electric resistance	= ohm (Ω)
pulse time	= second (s)

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