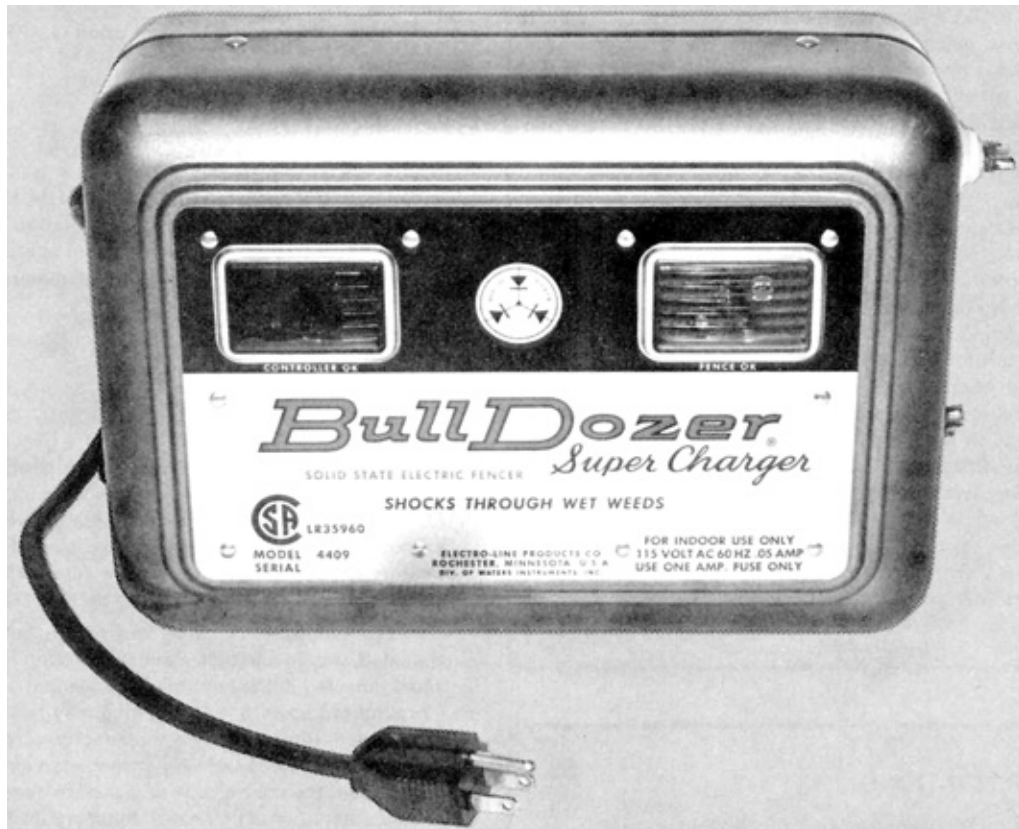


# Evaluation Report 252



## Bull-Dozer 4409 Electric Fence Controller

A Co-operative Program Between



ALBERTA  
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MACHINERY  
RESEARCH  
CENTRE



PRAIRIE AGRICULTURAL MACHINERY INSTITUTE

# BULL-DOZER 4409 ELECTRIC FENCE CONTROLLER

## MANUFACTURER:

Electro-Line Products Company  
P.O. Box 6117  
Rochester, Minnesota 55901  
U.S.A.

## DISTRIBUTOR:

Crist Products Ltd.  
P.O. Box 640  
Broadview, Saskatchewan  
S0G 0K0

## RETAIL PRICE:

\$78.00 (December, 1981, f.o.b. Humboldt)

## SUMMARY AND CONCLUSIONS

The Bull-Dozer 4409 electric fence controller was suitable for use over a wide range of fence conditions.

Peak voltage output on a 5.4 km (3.3 mi) single wire fence varied from 3560 V for a well-insulated, grass-free, dry fence to 950 V for an uninsulated, grass-grown, wet fence. For most normal fence conditions, output was above the 2000 V minimum guard voltage recommended for long-haired animals, while for extreme conditions, it was above 700 V minimum needed for short-haired animals. For most fence conditions, the Bull-Dozer 4409 could be used without wire insulators in this fence length.

Peak voltage output on a 16 km (10 mi) single wire fence varied from 1730 V for a well insulated, grass-free, dry fence to 690 V for an uninsulated, grass-grown, wet fence.

Peak current flow through a cow touching well-insulated 5.4 and 16 km (3.3 and 10 mi) single wire fences varied from 1.82 to 1.21 A for a cow standing in water and from 0.73 to 0.40 A for a normally-grounded cow. The high peak current output indicated that the Bull-Dozer 4409 generated quite an intense shock on fairly long or poorly insulated fences.

The Bull-Dozer 4409 was very suitable for cold weather use on feeding fences. Peak voltage output at -35°C on a 5.4 km (3.3 mi) single wire fence was about 2300 V, 35% lower than its output at room temperature.

The Bull-Dozer 4409 had CSA approval for indoor use. No durability problems occurred during testing.

## RECOMMENDATIONS

A need for recommendations was not apparent.

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## GENERAL DESCRIPTION

The Bull-Dozer 4409 electric fence controller is designed for 115 V AC operation. It is meant to be mounted in a suitable weather-proof enclosure.

The Bull-Dozer 4409 contains solid-state electronics, with no moving parts. Lights are provided to indicate operation and shock intensity.

Detailed specifications are given in APPENDIX I.

## SCOPE OF TEST

The performance characteristics of the Bull-Dozer 4409 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 Bull-Dozer 4409 is equipped with a three wire cord and plug for connection to a standard, grounded, 115 V AC receptacle. The controller is CSA approved for indoor use and if mounted outdoors, it must be placed in an appropriate weather-proof shelter. The manufacturer recommends that it be installed in a dry location close to an electrical outlet.

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 ground rod up to 3 m (10 ft) long may be needed.

**Fence Condition:** The manufacturer recommends that the Bull-Dozer 4409 be used only on insulated fences. If the fence is in good repair, the controller is designed to operate effectively with a certain amount of plant growth touching the charged wire.

The manufacturer recommends that for cattle fences, in areas with normal ground conditions, a single charged wire 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 Bull-Dozer 4409 is equipped with two indicator lights. One light indicates that the controller is operating, while a second light flashes to indicate that a charge is being supplied to the fence. 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.

**NOTE:** This report has been prepared using SI units of measurements. A conversion table is given in APPENDIX II.

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

Consistent with safety practice for power line-operated fences, the controller was factory sealed. As a result, if the indicator lights should need replacement, the controller would need factory servicing.

### 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.

Little is known about the physiological effect of shock pulses on animals. In general, the following guidelines are used in assessing fence 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 (1 mi) single wire fence typically varied 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 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 kΩ for a cow standing in water and licking a charged wire to about 4 kΩ for typical ground conditions. If ground conditions are too poor, animal resistance to ground is so great that no shock occurs.

**Peak Voltage Output:** FIGURES 1 and 2 show peak voltage outputs of the Bull-Dozer 4409 for a 5.4 and 16 km (3.3 and 10 mi) lengths of single wire fence over a range of insulation resistances. On a 5.4 km (3.3 mi) fence (FIGURE 1), peak voltage output varied from 3560 V for a well-insulated, grass-free, dry fence to 950 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 all fence conditions, while it was above the 2000 V minimum guard voltage needed for long-haired animals for fence insulation values greater than 1.5 kΩ. From FIGURE 1, it can be seen that the Bull-Dozer 4409 can be satisfactorily used on this length of fence, without wire insulators, in most conditions.

On a 16 km (10 mi) fence (FIGURE 2), peak voltage output ranged from 1730 V for a well-insulated, grass-free, dry fence to 690 V for an uninsulated, grass-grown, wet fence. Voltage output was below the 2000 V minimum required for long-haired animals, but was above the 700 V minimum required for short-haired animals, for most fence conditions.

As can be seen from both FIGURES 1 and 2, plant growth touching an insulated, dry fence did not appreciably reduce the voltage output. The Bull-Dozer 4409 can be expected to operate over a wide range of fence conditions.

**Electrical Charge:** FIGURES 3 to 6 show the current output of the Bull-Dozer 4409 when a cow touches 5.4 and 16 km (3.3 and 10 mi) lengths of well-insulated, single wire, fence. FIGURES 3 and 4 are for an animal resistance of 0.5 kΩ, which represent the

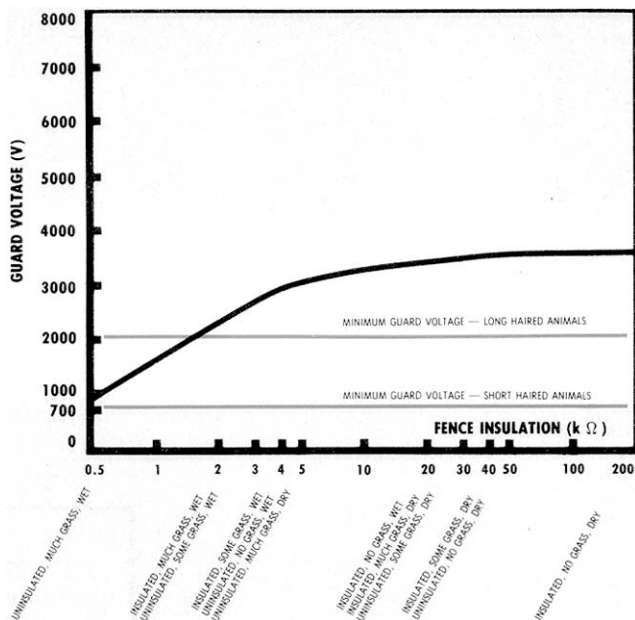


FIGURE 1. Guard Voltage Produced on a 5.4 km Single Wire Fence.

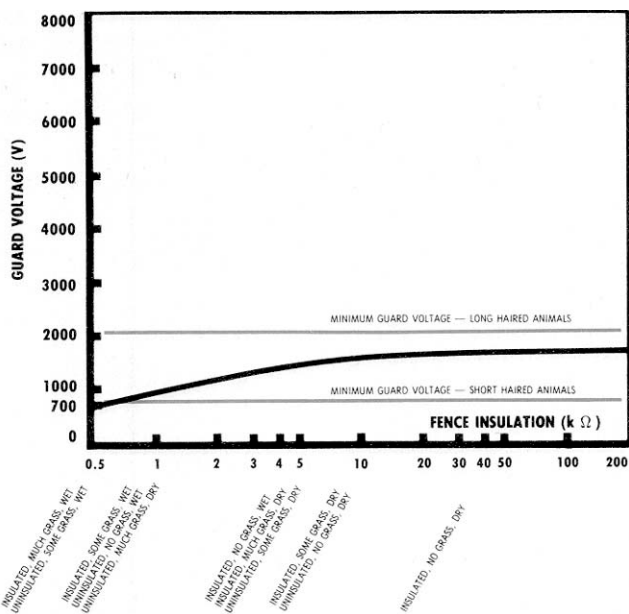


FIGURE 2. Guard Voltage Produced on a 16 km Single Wire Fence.

most extreme condition of a cow standing in water and licking the charged wire, while FIGURES 5 and 6 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.

The peak current delivered by the Bull-Dozer 4409 varied from 1.8 A for a well-grounded cow touching the 5.4 km (3.3 mi) fence to 0.40 A for a normally-grounded cow touching the 16 km (10 mi) fence. The Bull-Dozer 4409 gave quite an intense shock on fairly long or poorly insulated fences.

About 50 charge pulses per minute were delivered. The number of pulses did not vary with fence load, however, the on-time was affected by load. On-time varied from about 0.39 to 7.7 ms.

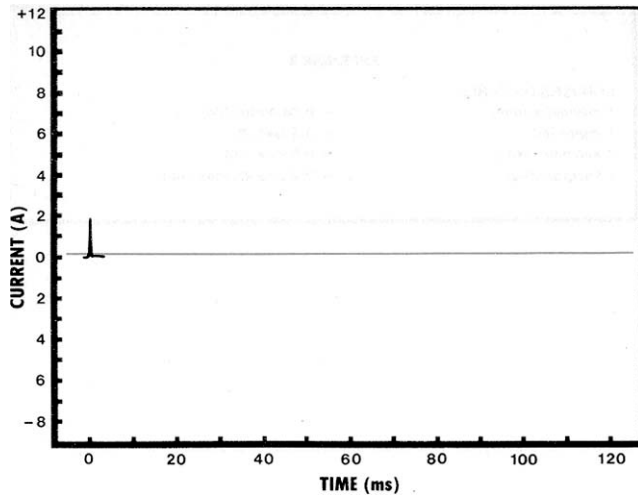


FIGURE 3. Current Delivered to a Well-Grounded Cow Touching a 5.4 km Well-Insulated Fence.

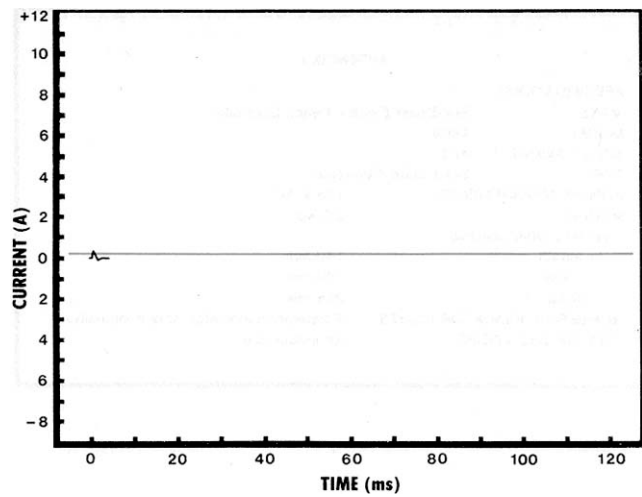


FIGURE 6. Current Delivered to a Normally-Grounded Cow Touching a 16 km Well-Insulated Fence.

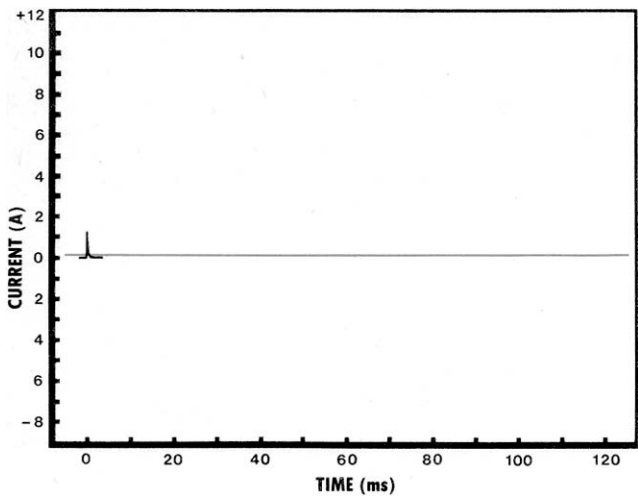


FIGURE 4. Current Delivered to a Well-Grounded Cow Touching a 16 km Well-Insulated Fence.

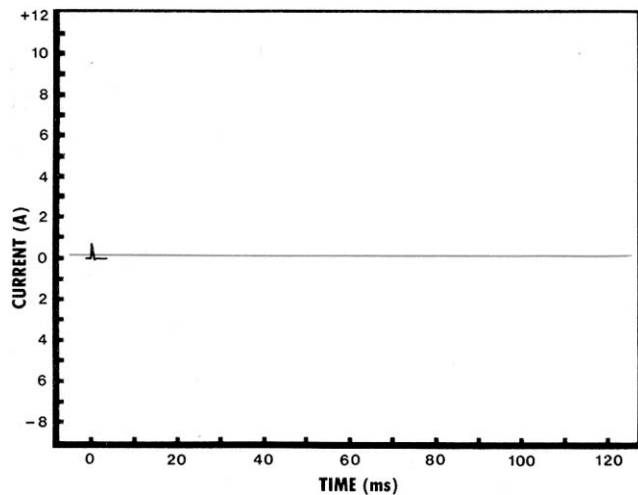


FIGURE 5. Current Delivered to a Normally-Grounded Cow Touching a 5.4 km Well-Insulated Fence.

**Low Temperature Operation:** The Bull-Dozer 4409 could effectively be used to energize cattle feeding wires during low winter temperatures. The peak voltage output of the controller at  $-35^{\circ}\text{C}$  on a 5.4 km (3.3 mi) single wire fence was about 2300 V, 35% lower than its output at room temperature. Since the peak voltage output was well above the 2000 V minimum required to overcome the insulation resistance of long-haired animals, the Bull-Dozer 4409 was very suitable for feeding enclosures.

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.

#### SAFETY

The Bull-Dozer 4409 had CSA approval for indoor use.

The instruction manual clearly outlined safety considerations. 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 suitable fence configurations.

#### 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: Bull-Dozer Electric Fence Controller  
 MODEL: 4409  
 SERIAL NUMBER: 473  
 TYPE: Solid State Electronic  
 POWER REQUIREMENTS: 115 V AC  
 WEIGHT: 3.5 kg  
 OVERALL DIMENSIONS:  
 -- length 140 mm  
 -- width 290 mm  
 -- height 205 mm  
 NUMBER OF INDICATOR LIGHTS: 2 (operation indicator, shock intensity)  
 TYPE OF ENCLOSURE: for indoor use

**APPENDIX II**

**CONVERSION TABLE**

1 millimetre (mm)	= 0.04 inches (in)
1 metre (m)	= 3.3 feet (ft)
1 kilometre (km)	= 0.6 mile (mi)
1 kilogram (kg)	= 2.2 pounds mass (lb)



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