

# Evaluation Report

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## Smith-Roles EF-2 Electric Fence Controller

A Co-operative Program Between



# SMITH-ROLES EF-2 ELECTRIC FENCE CONTROLLER

## MANUFACTURER AND DISTRIBUTOR:

Smith-Roles Ltd.  
P.O. Box 90746th Street and Millar Avenue  
Saskatoon, Saskatchewan  
S7K 3M5

## RETAIL PRICE:

\$105.00 (December, 1981, f.o.b. Humboldt with 110 V AC adaptor)

## SUMMARY AND CONCLUSIONS

The Smith-Roles EF-2 electric fence controller was suitable for use over a wide range of fence conditions. Wire insulators were unnecessary for short fences while plant growth did not appreciably affect controller performance in most conditions.

Peak voltage output on a 5.4 km (3.3 mi) single wire fence varied from 2340 V for a well-insulated, grass-free, dry fence to 1250 V for an uninsulated, grass-grown, wet fence, in the "NORM" voltage switch position. The "HI" switch position produced a peak voltage output of 3230 V for a well-insulated, grass-free, dry fence to 1880 V for an uninsulated, grass-grown, wet fence. The output was above the 2000 V minimum guard voltage required for long-haired animals for most fence conditions.

Peak voltage output on a 16 km (10 mi) single wire fence varied from 1170 V for a well-insulated, grass-free, dry fence to 820 V for an uninsulated, grass-grown, wet fence, in the "NORM" switch position. The "HI" switch position produced peak voltage output of 1690 V for a well-insulated, grass-free, dry fence to 1190 V for an uninsulated, grass-grown, wet fence.

With the voltage switch in the "NORM" position, peak current flow through a cow touching a well-insulated 5.4 and 16 km (3.3 and 10 mi) single wire fence varied from 2.4 to 1.8 A for a cow standing in water and from 0.59 to 0.30 A for a normally-grounded cow. The peak current delivered with the voltage switch in the "HI" position was about 50% greater than in the "NORM" position. The high peak current output indicated that the Smith-Roles EF-2 generated quite an intense shock on fairly long or poorly insulated fences.

The Smith-Roles EF-2 was 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 2200 V, 32% lower than its output at room temperature, when operating in the "HI" position, and about 1900 V, 19% lower than its output at room temperature, when in the "NORM" switch setting.

The Smith-Roles EF-2 did not have CSA approval. No durability problems occurred during testing.

## RECOMMENDATIONS

It is recommended that the manufacturer consider:

1. Modifications to prevent damage to the battery lead insulation where the leads enter the controller.
2. Submitting the controller to Canadian Standards Association for certification, to comply with regulations in the prairie provinces.
3. Providing additional instructions on safety, the use of insulators, and the types of fence arrangements suitable for livestock.

Chief Engineer -- E. O. Nyborg

Senior Engineer -- G. E. Frehlich

Project Technologist -- G. G. Burton

## THE MANUFACTURER STATES THAT

With regard to recommendation number:

1. Alternate lead wire insulations are being investigated.
2. The EF-2 has been discontinued in favour of a new model EF-4, which features improved output performance and battery life. The EF-4 does not include the AC adaptor feature and consequently does not require CSA certification. Smith-Roles Ltd. is making application for certification of a power line model EF-3.
3. Additional instructions will be considered and added where necessary.

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

## GENERAL DESCRIPTION

The Smith-Roles EF-2 electric fence controller is designed for 12 V battery operation. An AC adaptor is available to permit operation on 115 V power line outlets. The controller is meant to be mounted in a suitable weather-proof enclosure.

The Smith-Roles EF-2 contains solid-state electronics, with no moving parts. It may be used on short fences without insulators. It has a two position shock intensity switch and lights are provided to indicate controller and fence condition.

Detailed specifications are given in APPENDIX I.

## SCOPE OF TEST

The performance characteristics of the Smith-Roles EF-2 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 Smith-Roles EF-2 is equipped with wire leads and clips for connection to a 12 V automotive battery. The adaptor may be used to operate the controller in a standard 115 V AC receptacle. The controller is to be mounted indoors and may only be mounted outdoors in a weather-proof shelter.

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 states that the Smith-Roles EF-2 may be used on fences without insulators. The wire can be stapled directly to wooden posts, but should not be directly attached to live trees, green posts, salt-treated wooden posts or steel posts. 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.

For cattle fences, in areas with normal ground conditions, a single charged wire 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 Smith-Roles EF-2 is equipped with a two position shock intensity switch. The "HI" position increases the voltage output for control on long or poorly insulated fences or for feeding enclosures. The "NORM" position conserves battery life.

The controller is equipped with two lights that indicate if the controller is operating or the fence is properly charged. If the light does not flash, it indicates that insufficient charge is being placed on the fence, which may be the result of too long a fence or poor insulation.

Consistent with safety practice for power line operated fences, the controller was factory sealed. As a result, if the indicator light 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

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

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 k $\Omega$  for an uninsulated, grass-grown, wet fence to well above 500 k $\Omega$  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 k $\Omega$  for a cow standing in water and licking a charged wire to about 4 k $\Omega$  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 Smith-Roles EF-2 for a 5.4 and 16 km (3.3 and 10 mi) lengths of single wire fence over a range of insulation resistances. With the voltage switch in the "NORM" position, peak voltage output on a 5.4 km (3.3 mi) fence (FIGURE 1), varied from 2340 V for a well-insulated, grass-free, dry fence to 1250 V for an uninsulated, wet fence with considerable grass touching the charged wire. With the voltage switch in the "HI" position, peak voltage output varied from 3230 V for a well-insulated, grass-free, dry fence to 1880 V for an uninsulated, wet fence with considerable grass touching the charged wire. The voltage output for most fence conditions, was above the 2000 V minimum guard voltage needed for long-haired animals.

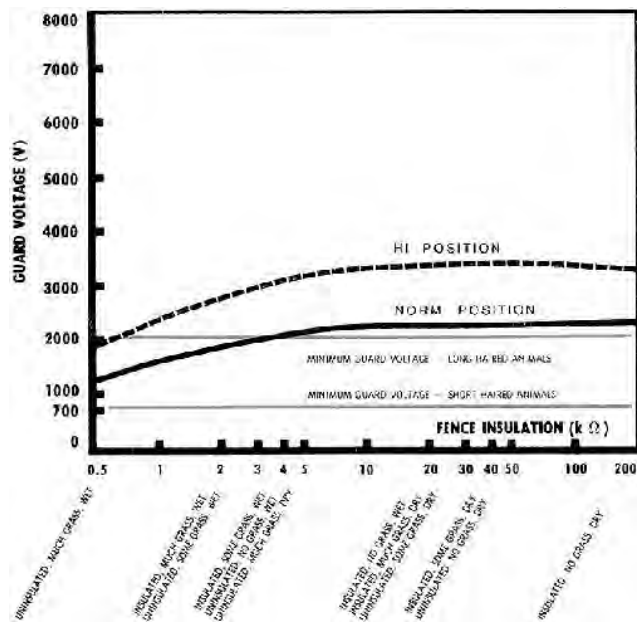


FIGURE 1. Guard Voltage Produced on a 5.4 km Single Wire Fence.

From FIGURE 1, it can be seen that the Smith-Roles EF-2 can be satisfactorily used on this length of fence without wire insulators. On a 16 km (10 mi) fence (FIGURE 2), peak voltage output ranged from 1170 V for a well-insulated, grass-free, dry fence to 820 V for an uninsulated, grass-grown, wet fence, with the voltage switch in the "NORM" position. In the "HI" switch position, peak output varied from 1690 V for a well-insulated, grass-free, dry fence to 1190 V for an uninsulated, grass-grown, wet fence. Voltage output was below the 2000 V minimum required for long-haired animals for all fence conditions, but was above the 700 V minimum guard voltage required for short-haired animals for all fence conditions.

As can be seen from both FIGURES 1 and 2, plant growth touching a fence did not appreciably affect controller performance. The Smith-Roles EF-2 can be expected to operate well over a wide

range of fence conditions.

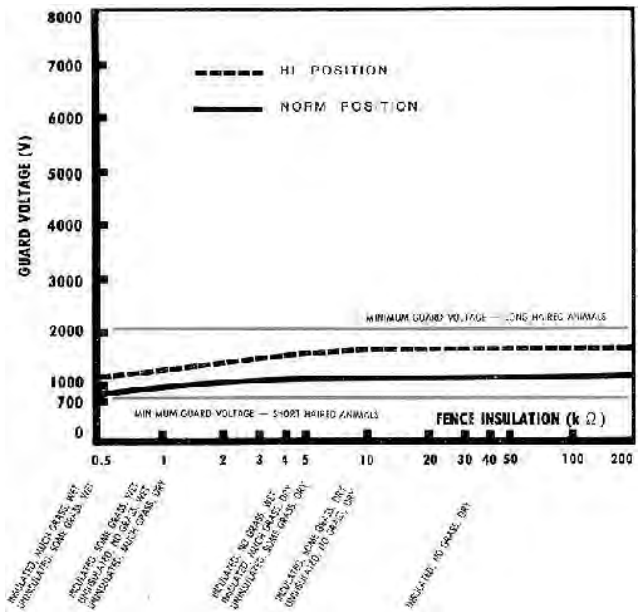


FIGURE 2. Guard Voltage Produced on a 16 km Single Wire Fence.

**Electrical Charge:** FIGURES 3 to 6 show the current output of the Smith-Roles EF-2 in the "NORM" switch position 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 k $\Omega$ , which represent the 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 k $\Omega$ , 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.

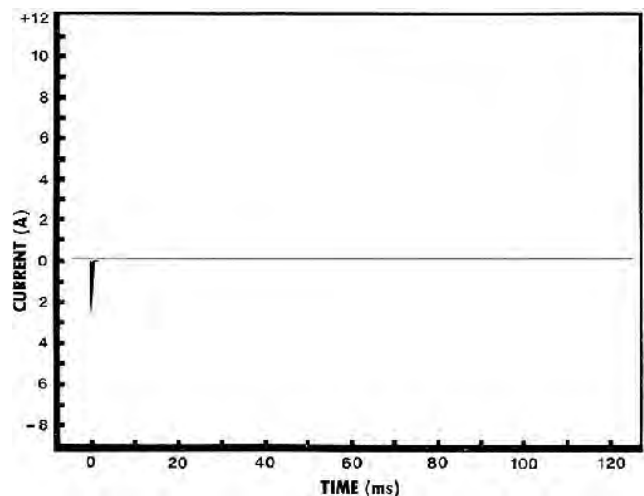


FIGURE 3. Current Delivered to a Well-Grounded Cow Touching a 5.4 km Well-Insulated Fence

The peak current delivered by the Smith-Roles EF-2, with the voltage switch in the "NORM" position, varied from 2.4 A for a well-grounded cow touching the 5.4 km (3.3 mi) fence to 0.30 A for a normally-grounded cow touching the 16 km (10 mi) fence.

The peak current delivered with the voltage switch in the "HI" position was about 50% greater than in the "NORM" position. The Smith-Roles EF-2 gave quite an intense shock on fairly long fences or poorly insulated fences.

About 28 charge pulses per minute were delivered in the "NORM" position, and about 44 in the "HI" position. The number of pulses did not vary with fencer load, however, the on-time was affected by load. On-time varied from about 0.13 to 3.0 ms.

**Low Temperature Operation:** The Smith-Roles EF-2 could effectively be used to energize cattle feeding wires during low winter temperatures. The peak voltage output of the controller at -35° C

on a 5.4 km (3.3 mi) single wire fence with the voltage switch in the "HI" position was about 2200 V, 32% lower than its output at room temperature. With the voltage switch in the "NORM" position, peak voltage output was about 1900 V. Since the peak voltage output was above the 2000 V minimum required to overcome the insulation resistance of long-haired animals, with the voltage switch in the "HI" position, the Smith-Roles EF-2 was suitable for feeding enclosures. Since battery voltage is severely reduced at low temperatures, it may be 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.

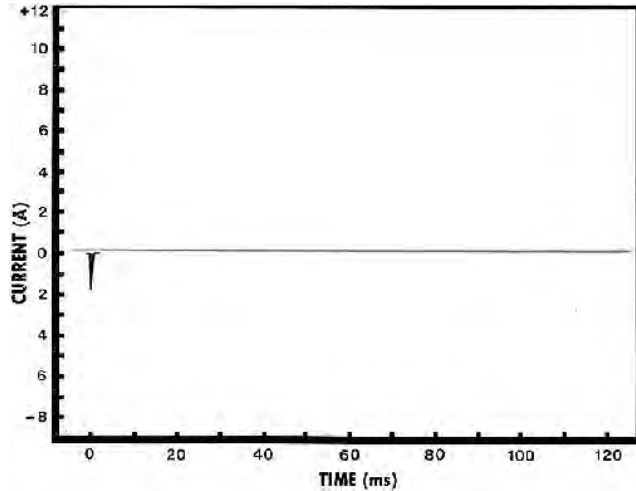


FIGURE 4. Current Delivered to a Well-Grounded Cow Touching a 16 km Well-Insulated Fence.

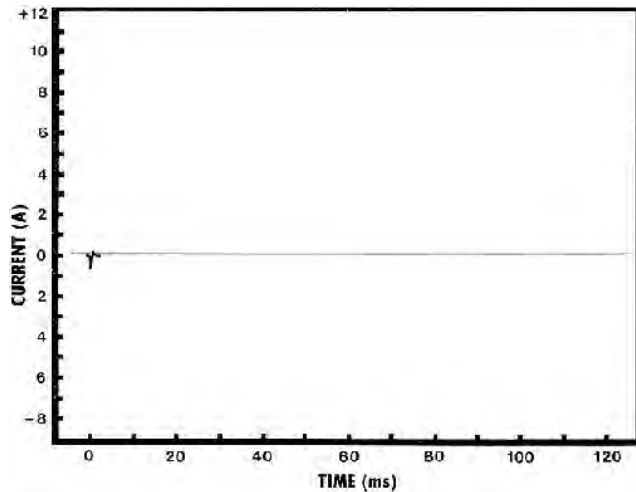


FIGURE 5. Current Delivered to a Normally-Grounded Cow Touching a 5.4 km Well-Insulated Fence.

**Battery Consumption:** A 12 V, 70 amp-hour battery will operate the Smith-Roles EF-2 from ten to 24 days, depending upon the naturally occurring discharge rate. The consumption rate did not increase as the load on the controller increased. The battery should be regularly checked to ensure effective controller performance.

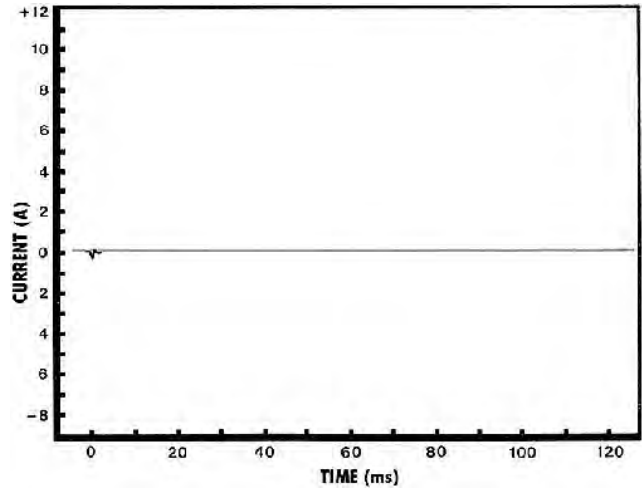


FIGURE 6. Current Delivered to a Normally-Grounded Cow Touching a 16 km Well-Insulated Fence.

### SAFETY

No safety problems were evident during testing.

The Smith-Roles EF-2 did not have Canadian Standards Association certification. CSA certification of power line operated fence controllers is a requirement in the prairie provinces. The Smith-Roles EF-2 is a power line-operated fence controller since it may be operated off a 115 V AC circuit using the adaptor. It is therefore recommended that the manufacturer submit the controller for certification.

### INSTRUCTION MANUAL

The instruction manual provided very brief installation and operating instructions. It is recommended that additional instructions be provided on safety, use of insulators and the fence arrangements suitable for 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:	Smith-Roles Electric Fence Controller
MODEL:	EF-2
SERIAL NUMBER:	80A 143
TYPE:	Solid State Electronic
POWER REQUIREMENTS:	12 V DC (110 V AC adaptor)
WEIGHT:	1.7 kg (with AC adaptor)
OVERALL DIMENSIONS:	
-- length	192 mm
-- width	184 mm
-- height	116 mm
NUMBER OF INDICATOR LIGHTS:	2 (operation indicator, shock intensity)
TYPE OF ENCLOSURE:	for indoor use
OPTION:	AC adaptor

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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