

Canadian Distributors

Young Utility Equipment Inc.
39 Churchill Drive, Unit 3
Barrie, Ontario, Canada
L4N 8Z5
Tel: 705-722-3669
Fax: 705-722-8139

Landace Hydraulics
4376 Elgin Road
Mossley, Ontario, Canada
Tel: 519-269-3020
Fax: 519-269-3020

U.S. & International Distributors

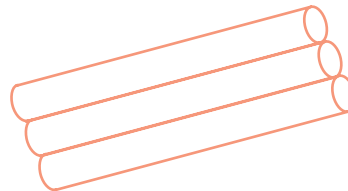
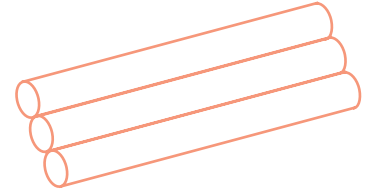
Lakeport Power Ltd.
169 Industrial Park Road
Colborne, Ontario, Canada
K0K 1S0
Tel: 905-355-3281
Fax: 905-355-3336

Manufacturer

SPIKE Tool Inc.
3 Mc bain Avenue,
North York, Ontario M4P 2S4
Canada

Direct line: 416-487-4380
E-mail: info@spiketool.com
<http://www.spiketool.com>

Don't Guess...SPIKE it!



SPIKE Tool Inc.
<http://www.spiketool.com>

The Story of the Spike

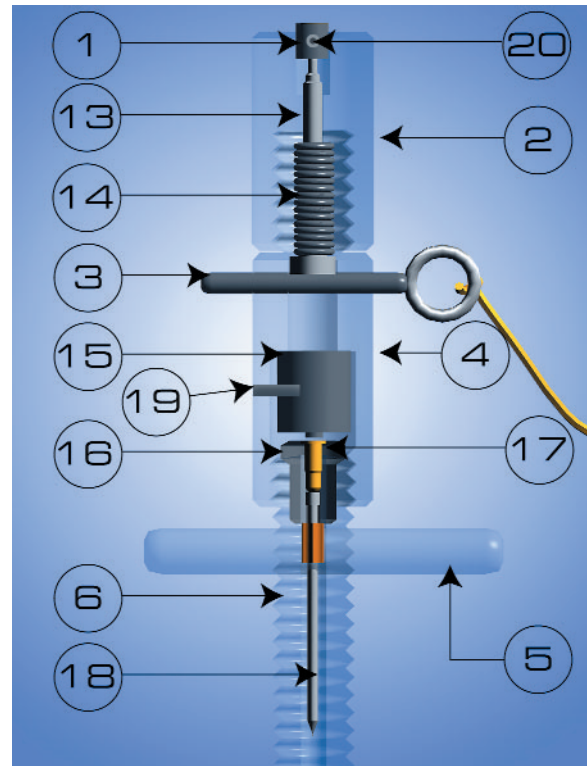
In 1975, Ron Mock, an enthusiastic, newly graduated University of Toronto engineer, joined Ontario Hydro. One of his first assignments was to observe field linemen repairing underground power electrical cables. This is what he observed. Electrical power was shut off at switch points to de-energise the cable at the repair site. A trench was dug to expose the cables requiring repair. A clip-on amp meter was used to confirm that power was shut off between termination points. An experienced guess was made to cut into one of the exposed cables with a hacksaw. Without positive assurance that the cable was de-energized, Ron was asked to cut the cable. The lineman handed Ron the hacksaw. Ron ended up cutting into the right cable. That night, he sat down with his father, Phillip R. Mock, a field supervisor with Ontario Hydro, and another fellow engineer, to design a safety device to positively ensure buried underground electrical cable was de-energised before cutting. The SPIKE Tool was born. Over 10 percent of SPIKE Tools have been returned since 1976; damaged beyond repair due to spiking an incorrectly identified cable. Loss of life or serious injury has been avoided using SPIKE. Don't guess...SPIKE it.

In Memory of

Phillip Robert Mock, September 1, 1928 - March 16, 1998.
An employee of Ontario Hydro from June 1, 1953 to June 30, 1989.

Thanks, Dad.
Ron Mock, PEng
President and CEO
SPIKE Tool Inc.

Figure 5



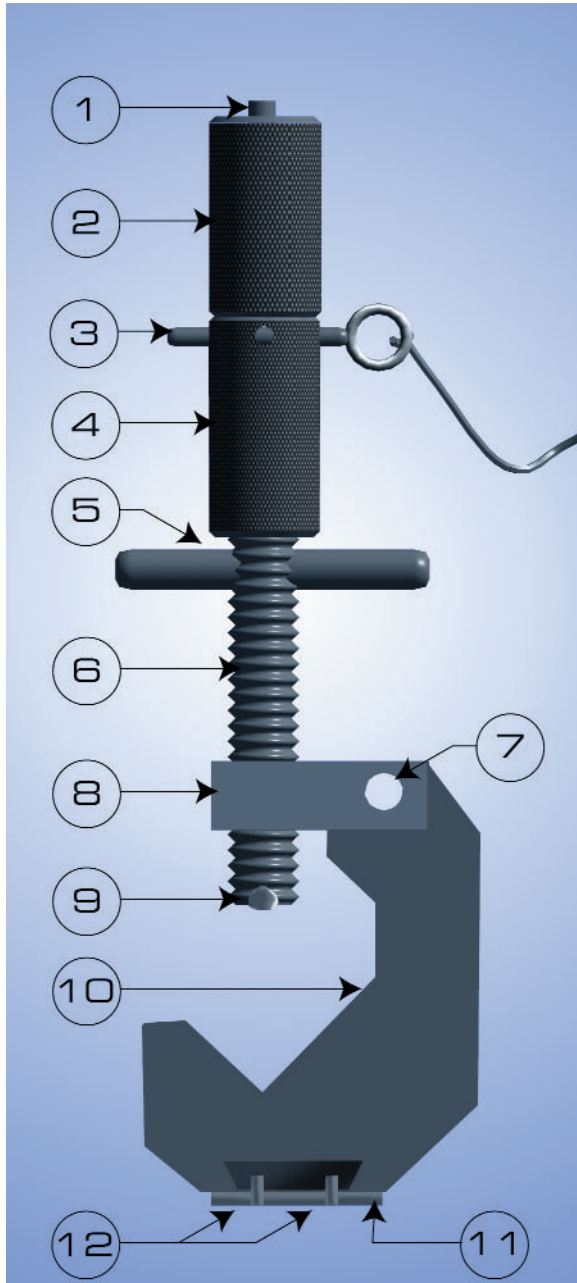
SPIKE PARTS DESCRIPTION

- | | |
|------------------------------------|----------------------------|
| 1) Hammer Cap | 12) 2 Allen Screws (5/32") |
| 2) Breech Cap | 13) Hammer |
| 3) Lanyard Pin and Lanyard | 14) Hammer Spring |
| 4) Breech Block | 15) Firing Pin Assembly |
| 5) Barrel 'T' Handle | 16) Cartridge Holder |
| 6) Barrel | 17) Cartridge |
| 7) Tapped Ground Lug Mounting Hole | 18) Spike |
| 8) Barrel Guide | 19) 1/8" Allen Screw |
| 9) Barrel Safety Stop | 20) 5/64" Allen Screw |
| 10) Cable Clamp | |
| 11) Safety Striker Plate (3/8") | |

<http://www.spiketool.com>

Parts Diagram

Figure 5



Spike

A lineman must be able to safely assure himself prior to cutting into an installed electric power cable that he is not cutting into an energised cable.

Responsible electric power system operation and maintenance procedures stipulate that, prior to cutting a buried underground electrical cable, the cable shall be spiked to ensure it is de-energised.

SPIKE is designed to meet this need. It is a safety device.

The unique benefits provided by SPIKE are:

- SPIKE provides positive assurance that the lineman will not cut an energised cable
- SPIKE is operated remotely thereby removing the lineman from danger if a live cable is spiked
- SPIKE can be used on thermoplastic or thermosetting insulation as well as oil impregnated paper insulation
- SPIKE can be used on aluminum and lead sheathed cable and interlock armored cables
- SPIKE will accept single conductor cables ranging in diameter from 3/4" OD to 2-3/4" OD (a larger tool up to 3-1/2" OD is also available) at all voltages
- SPIKE is designed to ensure the spike pierces the cable directly through its centre core
- SPIKE creates minimal cable damage
- SPIKE is not cumbersome to use in the field. It weighs only 7 lbs.
- SPIKE is fast and easy to operate

WHY SPIKE A CABLE?

SPIKE is a safety tool designed for the sole purpose of providing a lineman with positive assurance that the cable is safe to cut.

Unlike overhead electric power distribution systems, underground cable systems cannot be visually traced back to an open point to ensure the cable is isolated. Once a cable enters the ground it is lost from sight.

If, for example, a new transformer must be cut into an existing feeder, a lineman positioning the new transformer between two termination points would be required to cut into a cable. Upon opening a trench, the lineman could see one or more cables identical in appearance. It is difficult to determine which one of the group has been isolated and de-energised at the termination points.

"As constructed" drawings are often used as a means of identifying cables between termination points but this does not constitute a positive identification. If a trench is dug between two termination points for maintenance purposes the lineman must be certain before cutting the cable that it is in fact de-energised.

As an initial procedure it is first recommended the cable be identified by the use of "as constructed" drawings and an electronic signal (to pulse the cable) placed on the cable at the termination point. The "pulsed" cable is identified at the trench location.

After the cable to be cut has been identified as closely as possible, the last step should be to spike the cable before it is cut. **If switching procedures were incorrectly followed or if "as constructed" drawings are in error, cutting a single cable in a trench can be lethal.**

- Place the new spring (part #14, Figure 5)) over the new hammer (part #13, Figure 5) and re-insert into the centre of the breech block.
- Holding the new firing pin assembly (part #15, Figure 5), align the indent on the side of the firing pin assembly with the 1/8" Allen screw opening and insert the new firing pin assembly back into the breech block. The indentation on the side of the firing pin assembly should be visible through the 1/8" Allen screw hole. The firing pin is the small end on the bottom of the firing pin assembly, which faces toward the bottom of the breech block (towards the barrel) when re-installed.
- While holding the firing pin assembly fully inserted in the breech block, tighten the 1/8" Allen screw securing the firing pin assembly and the hammer. **Do not over-tighten.**
- Temporarily replace the hammer cap on the hammer and pull the hammer cap to allow the lanyard pin to be re-inserted.
- With the hammer fully extracted and the lanyard pin holding the hammer up, remove the hammer cap.
- Place the breech cap back onto the breech block. Turn the breech cap all the way down to the breech block.
- Screw the hammer cap back onto the top of the hammer (turning only 5-6 turns). NOTE: If you turn the hammer cap too far the tool may not fire as the hammer will not fully strike the top of the firing pin. Secure the hammer cap to the hammer by tightening the 5/64" Allen screw (part #20, figure 5) to the "flat side" of the hammer shaft.
Do not over-tighten.
- Turn the breech cap counter clockwise and remove the lanyard pin.
- The installation is now complete.

SPIKE Tool Package

- Safety Striker Plate (with two Allen screws and 5/32" Allen key)
To install the SPIKE Maintenance Kit and restore your SPIKE safety tool to peak performance, follow the step by step procedures below. All part numbers refer to Figure 5 (pages 22-23) in this guide. Oil all parts during replacement, wiping off excess oil when completed.

Safety Striker Plate Replacement

- Using the 5/32" Allen key, remove the two 5/32" Allen screws (part #12, Figure 5) from the bottom of the cable clamp (part #10, Figure 5).
- Remove the worn striker plate and install the new plate. Secure the striker plate with the two 5/32" Allen screws provided with your maintenance kit.

Hammer, Hammer Cap, Spring, and Firing Pin Assembly

- Turn the breech cap (part #2, Figure 5) counter clockwise fully, and insert the lanyard pin (part #3 Figure 5) through the hole in the breech block (part #4, Figure 5).
- Turn the breech cap clockwise fully until the hammer cap (part #1, Figure 5) protrudes from the top of the breech cap.
- Using the 5/64" Allen key, loosen (do not remove) the 5/64" Allen screw (part #20, Figure 5). Turn the hammer cap (part #1, Figure 5) counter clockwise and remove from the top of the hammer (part #13, Figure 5).
- Turn the breech cap counter clockwise and remove it from the SPIKE Tool.
- While holding the exposed hammer in one hand, remove the lanyard pin and slowly lower the hammer.
- Unscrew the breech block (with hammer assembly) and separate from the SPIKE Tool.
- Using the 1/8" Allen key, loosen the 1/8" Allen screw (part #19, Figure 5) on the side of the breech block. The spring (part #14, Figure 5), the hammer (part #13, Figure 5), and the firing pin assembly (part #15, Figure 5) will fall out for replacement.

The SPIKE cable spiking tool is shipped fully equipped for 30 spiking operations. Designed for lightweight portability for transport and use in field maintenance, the SPIKE Tool components are:

- SPIKE Tool carrying case
- The SPIKE Tool
- 30 cable spikes
- 40 cartridges in three power load strengths (B 10 / G 20 / Y 10)
- lanyard pin attached to a 30' lanyard
- ramrod
- 3 Allen wrenches for maintenance (5/64", 5/32", 1/8")
- ground lug
- operations manual

SPIKE Operating Procedure

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Principle of Operation

SPIKE is a charge-actuated device, which pushes a 2-5/8" spike into a cable to verify the cable is de-energised prior to cutting.

A charge-actuated device was chosen to provide enough stored energy to drive the spike through cables as large as 2000 MCM. Shells used in SPIKE have been chosen to ensure the spike penetrates the cable at least to the centre. This should ensure the cable would have been faulted if it were energized.

The spike enters the cable and is safely stopped by a "safety plate" positioned at the bottom of SPIKE's cable clamp.

SPIKE is easily loaded and the firing mechanism has been carefully designed to ensure the tool cannot be accidentally fired while loading.

SPIKE is designed to be operated remotely. The means of remote operation is a rope or lanyard. The lineman, at a distance of 30 feet, pulls the lanyard, removing the lanyard pin from SPIKE. The hammer is released, impacting the firing pin, and the 2-5/8" spike is driven into the cable.

Although SPIKE could have been designed for remote operation using radio signals, this form of operation was avoided to prevent spurious operation of the tool due to unwanted electromagnetic interference. There is no contact with SPIKE during firing.

Parts List and Ordering Information

Additional cartridges, cable spikes, lanyard pin and lanyard for the SPIKE Tool are available for purchase. Contact:

SPIKE Tool Inc.
3 McBain Avenue
North York, Ontario Canada M4P 2S4
Direct Line: 416-487-4380
Order online: <http://www.spiketool.com>
E-mail: info@spiketool.com

SPIKE Maintenance Kit Installation

The internal parts of the SPIKE will wear with continued use (spring compression, misfires due to a worn firing pin or hammer, etc.). To ensure SPIKE operates at an optimal level, SPIKE Tool Inc. offers a complete parts Maintenance Kit:

SPIKE Peak Performance Maintenance Kit

To ensure 100 percent operating efficiency from your SPIKE Tool the manufacturer recommends replacement of operating parts every two years.

The SPIKE Tool maintenance kit can be ordered through your distributor or direct from SPIKE Tool Inc., or return your SPIKE Tool to the manufacturer, SPIKE Tool Inc., for a Maintenance Kit installation and performance testing.

- Hammer Assembly (Hammer, Hammer Cap with Allen screw, Spring, 5/64" Allen key)
- Firing Pin Assembly (with 1/8" Allen key)
- Cartridge Holder
- Safety Striker Plate (with two Allen screws and 5/32"

IMPORTANT NOTE

Only cartridges and spikes as specified in section 3.0 shall be used in this tool. Cartridge selection is of vital importance. Too light a cartridge will not properly spike the cable, while too heavy a cartridge may damage the cable clamp. The manufacturer will not be responsible for any damage to the tool, equipment or personnel resulting from incorrect cartridge and spike selection.

This tool has been engineered for simplicity, durability and safety. With reasonable care and maintenance SPIKE will provide many years of trouble free service.



During the first year after purchase all parts of SPIKE which we find are defective in material or workmanship will be replaced by SPIKE Tool Inc. free of charge, including labour and costs of shipping and handling.

No further warranty, express or implied, in connection with SPIKE is given and our sole liability consists in replacing or repairing parts under warranty.

This warranty is null and void if incorrect selection of cartridges or spikes result in equipment damage. Cartridges and spikes must be selected in accordance with the owner's manual.

WHY REMOTE OPERATION?

When a de-energised cable is spiked or cut, the damage suffered by the cable is minimal.

If, however, an energised cable is cut or spiked the energy released in the open trench is of concern. On distribution systems with fault currents of the order of 5,000 amperes, the fault energy released creates an explosion in the open trench.

The trench acts as an escape for the melted metal of the cable, the vaporised gases and the trench sand. The debris is sprayed upwards from the cable to the trench opening. Therefore stand well clear of the trench. A lineman standing near the trench would be directly in the line of fire of the escaping debris.

Furthermore although most fault current would return along the sheath or concentric neutral, the possibility of fault current entering the earth and creating local step potentials must not be discounted.

It is for these two very important reasons that SPIKE employs a remote operation feature.

Cable Spiking Tool Operating Procedure

INTRODUCTION

The SPIKE cable spiking tool is used by a lineman to ensure any power cable that must be cut is safely de-energised. The operating procedure for SPIKE is outlined below. Figure 5 shows the SPIKE parts list (on pages 22-23). Note there is a specific sequence of steps to be followed when using SPIKE. It is mandatory this sequence is rigidly followed in order to ensure maximum safety.

The cable to be cut must be reasonably identified in the trench by means of an electronic signal, operating diagrams, etc. prior to using SPIKE. Once the cable has been identified the cable should now be spiked as the last step prior to cutting.

SPIKE is fired by a remote release of SPIKE's hammer, thereby firing a spike into the centre of the cable. In the event the cable is incorrectly identified and is energised the spike creates a cable short circuit. Line protection will operate isolating the faulted cable.

PRECAUTIONARY NOTES

The following precautionary notes are presented and should be adhered to at all times.

1. Before use the tool shall be inspected by the operator to ensure that:
 - i. there is no obstruction in the barrel
 - ii. all moving parts operate freely
 - iii. the tool is in a safe, clean working condition
2. If the tool is defective it shall not be used but shall be marked "Defective" and returned to SPIKE Tool Inc. or your distributor.

The spikes used have a special plastic guide tip on the end. This plastic tip must be on any spike which is inserted into the barrel.

If spikes with the above dimensions are not available they may be ordered from SPIKE Tool Inc.

Spike Maintenance Procedures

1. After each use take SPIKE to a clean maintenance area and disassemble the tool into the two main sections. Clean and oil all moving parts.
2. Clean the barrel section of the cable clamp and ensure it is clear of all foreign material. Push a wedge of cloth 1" square soaked in light machine oil through the barrel with the ramrod.
3. Wipe clean all moving parts with a lightly oiled cloth using only light machine oil.
4. Re-assemble the SPIKE Tool and place it back in the carrying case. Make sure the firing mechanism is in the unloaded position.
5. The nylon rope or lanyard was carefully chosen for its dielectric strength. Care must be exercised to ensure it is kept clean and dry.
6. Neglecting to properly clean and oil SPIKE after use will lead to premature corrosion of the tool.

STEP 11

Remove SPIKE from the cable while wearing **rubber gloves**.

STEP 12

Before replacing SPIKE in its case make sure the barrel is clear and the fired cartridge is removed from the cartridge holder.



CARTRIDGES

All cartridges used in the SPIKE are the same as those employed in other commercially available charge-actuated tools. Only cartridges used for low velocity tools shall be substituted for the cartridges that initially come with the SPIKE. If cartridges cannot be purchased locally they are available through:

SPIKE Tool Inc.
3 McBain Avenue
North York, Ontario Canada M4P 2S4
Direct Line: 416-487-4380
Order online: <http://www.spiketool.com>
E-mail: info@spiketool.com

SPIKES

The SPIKE uses hardened spikes, which are 2 5/8" in length and 1/4" head diameter. No other diameter of spike should be substituted. **DO NOT USE LENGTHS SHORTER THAN 2".**

3. The operator of the tool shall ensure that:

- i. The tool is not pointed at any person at any time, whether loaded or not
- ii. The tool is used in accordance with the instructions contained in the manual
- iii. The tool is not loaded until it is secured on a cable
- iv. The tool is not used where flammable or explosive substances, gases or dust are present

4. If the SPIKE is being used in a manhole or similar enclosed location do not stand inside the enclosed area when operating SPIKE. Operate SPIKE from outside the enclosed area. When SPIKE is operated in enclosed areas or indoors ear protection must be worn in the event a live cable is spiked.

5. The SPIKE barrel shall not be removed from SPIKE's "cable clamp". "Barrel safety stops" have been put in place to ensure the barrel cannot be removed.

OPERATING PROCEDURE

The following operating procedure shall be followed when using SPIKE. Figure 5 shows the complete operating parts list for SPIKE (on pages 22-23).

STEP 1

Provide clearance for the lanyard, which will activate the SPIKE, by sloping one side of the trench on approximately a 30-degree angle. (See Figure 1)

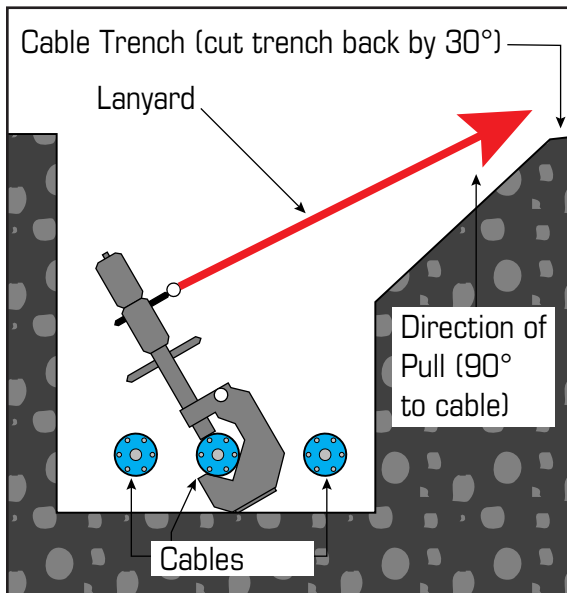


Figure 1

STEP 2

Remove SPIKE from its case and tighten it on the cable. SPIKE is secured to the cable by turning the "barrel T-handle" clockwise thereby lowering the barrel onto the cable. **DO NOT LOAD THE TOOL WITH A CARTRIDGE AT THE SAME TIME.** Lean SPIKE on a 30 to 45 degree angle from the vertical. The tool should be angled away from the direction in which the lanyard will be pulled. (See Figure 1)

NOTE: If the cable being spiked has a grounded concentric neutral or the concentric neutral is connected to ground through low voltage lightning arresters then proceed to STEP 3.

If the cable does not have a grounded concentric neutral, connect a flexible #2 copper conductor between the "ground lug" on SPIKE and a local ground (i.e. cable tray, ground conductor, driven ground rod, or preferably system ground). (see Figure 5, part #7: Tapped Ground Lug Mounting Hole)

Note: It is the responsibility of the SPIKE operator to make sure all personnel are clear of the area before firing the tool.

STEP 9

Carefully leave the trench being sure not to accidentally pull the rope with your feet. Proceed to the end of the rope. Wrap the end of the lanyard around your hand once or twice. It is mandatory that the appropriate class of rubber gloves is worn for this step.

Fire the SPIKE by pulling on the lanyard with a **snapping action**. Do not use a steady pull.

STEP 10

Proceed to the trench and visually check to see if the spike is projecting from the bottom of the cable before removing SPIKE from the cable.

If the spike is projecting from the cable (except as noted in Table 1) proceed to Step 11.

If the spike is not projecting from the bottom of the cable wait five minutes before handling SPIKE.

While wearing the appropriate class of rubber gloves remove the SPIKE Tool from the cable.

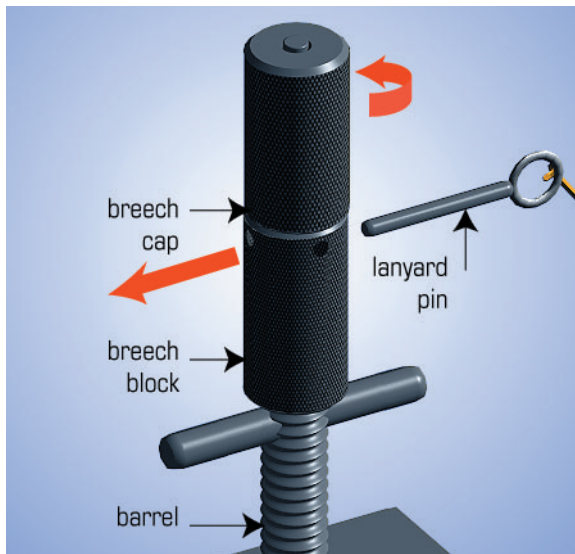
Remove the breech block from the barrel and remove the cartridge holder. Check to see the barrel is clear. If it is not then clear it with the metal ramrod provided.

After the barrel is cleared and the old cartridge is discarded place SPIKE back on the cable and repeat steps 4 through 10. You may increase cartridge strength by one level.

STEP 7

Prepare the tool for firing by turning the breech cap of the tool counter-clockwise until the "lanyard pin" can be inserted. Insert the lanyard pin into the appropriate pinhole located in the breech block of the tool. (see Figure 4)

Figure 4



STEP 8

Turn the breech cap and the breech block of the tool clockwise until tightened down. If done correctly, the hammer cap (figure 5, part #1) will be protruding from the breech cap. Ensure the breech cap is well tightened. **The tool will not fire otherwise.**

SPIKE IS NOW IN THE FIRING POSITION

STEP 3

Remove the lanyard pin and lanyard from SPIKE's case. Place the end of the rope with the lanyard pin attached in the trench near SPIKE. Unravel the rope and stretch it out on the ground at right angles to the trench in the direction of the pull (see Figure 1).

STEP 4

Holding the barrel of SPIKE in one hand unscrew the breech block of SPIKE with the other hand and set it aside. Remove the cartridge holder (see Figure 2).

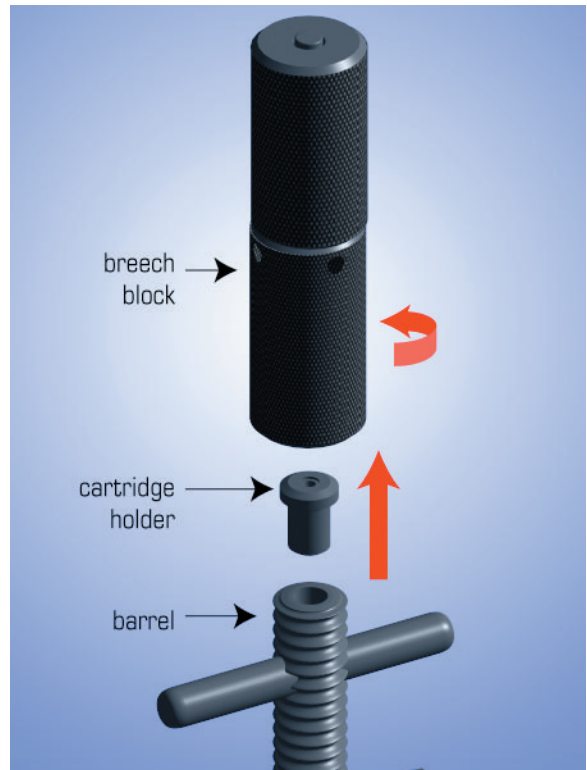


Figure 2

TABLE 1 --- RECOMMENDED CARTRIDGE SELECTION

CONDUCTOR RANGE	INSULATION	CABLE VOLTAGE CLASS	CARTRIDGE SELECTION
#2 - 750 MCM 750 MCM - 1250 MCM 1500 MCM - 2000 MCM	XLPE - EPR	5 KV to 46 KV	Brown Green Yellow*
#2 - 4/0 250 MCM - 500 MCM 750 MCM - 1250 MCM 1500 MCM - 2000 MCM	Oil Impregnated Paper (Lead or Aluminum Sheath)	15 KV to 230 KV	Brown Green Yellow Yellow*

* Spike may not completely penetrate the conductor and project out opposite side.
ATTENTION: Cartridge misfires may occur when the cartridge shelf life exceeds six months.

STEP 5

Push a spike into the barrel. Make sure the spike has a plastic centering tip on its pointed end. Re-insert the cartridge holder. Insert a cartridge of the size specified in Table 1 into the cartridge holder (see Figure 3).

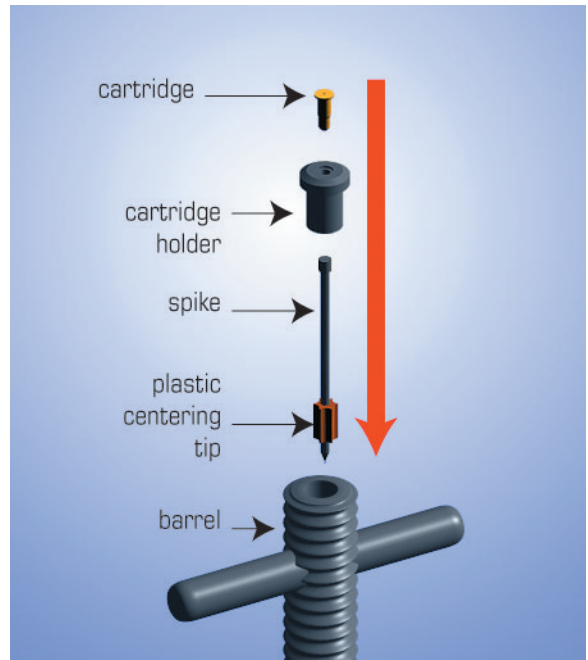


Figure 3

Note: Cartridge selection is of vital importance. SPIKE Tool Inc. will not be held responsible for damage to equipment or personnel due to incorrect cartridge selection.

STEP 6

Screw the breech block of SPIKE back onto the barrel.