SPIKE Tool Manual

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Don’t guess…SPIKE it

Proudly manufactured and assembled in Canada

THE STORY OF THE SPIKE

In 1975, Ron Mock, an enthusiastic, newly graduated University of Toronto engineer, joined Ontario Hydro, now known as Hydro One. One of his first assignments was to observe field linemen repairing underground power electrical cables. This is what he saw. Electrical power to a specific cable was shut off at both termination points of the repair site. A trench was dug to expose the cables requiring repair. An Amp meter was used to identify that power was shut off between termination points. An experienced guess was made to cut into one of the exposed cables. Without positive assurance that the cable was de-energized, the lineman handed Ron the hacksaw and luckily Ron ended up cutting into the correct de-energized cable. That night he sat down with his father, Phillip, a field supervisor with Ontario Hydro, to design a safety device to further ensure the identified electric power cable was de-energized before cutting. The SPIKE Tool was born in 1976.

Over 10% of SPIKE Tools have been returned since then, damaged beyond repair due to spiking an incorrectly identified energized cable. Loss of life or serious injury has been avoided because of SPIKE.

In Memory of

Phillip Robert Mock
September 1, 1928 - March 16, 1998
Employed at Ontario Hydro June 1, 1953 - June 30, 1989
Thanks Dad!

Ron Mock, PEng, President, SPIKE Tool Inc.

Ron Mock worked at Ontario Hydro (Toronto, Canada) from 1975 to 1986. For the first five years Ron worked in the Underground Distribution (0-44kV) and Underground Transmission (115-230kV) Departments. This included field work, design, construction and research.

Ron then worked in the Electrical Engineering Department designing control, shutdown, and power systems (up to 15kV)for Pickering and Darlington Generating Stations. When Ron left Ontario Hydro he was in charge of Nuclear Safety for Pickering Generating Station.

THE SPIKE TOOL

Cable maintenance personnel must positively ensure an underground electric power cable is de-energized prior to cutting. SPIKE Tool plays an important role in this process.

Responsible electric power system operating and maintenance procedures stipulate that prior to cutting underground or buried electric power cable, the cable should be spiked to ensure it is de-energized.

SPIKE Tool is designed as a safety device for maintenance linemen to prevent injury or loss of life. SPIKE Tool is designed for single conductor cable.

SPIKE Tool is a portable, low velocity, charge actuated device which pushes a 2” spike into a single conductor cable to help line and cable personnel verify it is de-energized prior to cutting. SPIKE Tool is designed to be operated remotely at a distance of approximately 35 feet to prevent potential injury.

The unique benefits provided by SPIKE are:

- SPIKE plays a critical role in providing assurance that cable is not energized in the field, prior to cutting.
- SPIKE is operated remotely, thereby removing cable maintenance personnel from danger, if an energized cable is spiked.
- SPIKE can be used on thermoplastic or thermosetting insulation.
- SPIKE can be used on aluminum and lead sheathed cable and armored cables.
- SPIKE is designed to ensure the spike pierces the cable directly through its center core.
- SPIKE creates minimal cable damage in de-energized cable.
- SPIKE is not cumbersome to use in the field. It weighs only 7 lbs.
- SPIKE is fast and easy to operate.
- SPIKE is proudly made and assembled in Canada.
- A larger SPIKE accommodates cable sizes up to 3-1/2” OD.

WHAT DOES SPIKE DO?

SPIKE is a safety tool designed for the purpose of piercing a cable's neutral or sheath and its insulation through to the main conductor. By breaking down the cable insulation, an arcing fault is created, if the cable is energized prior to cutting. If the cable is de-energized, there is no fault and there is minimal damage to the cable.

WHY SPIKE A CABLE?

Unlike overhead electric power distribution systems, underground or hidden power cable systems cannot be visually traced back to a termination point to ensure the cable is isolated. 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 several cables identical in appearance. It is difficult to determine which one within the group has been isolated 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 the cable is de-energized before cutting the cable.

As an overall procedure, it is first recommended the cable to be cut be identified by the use of "as constructed" drawings. Next an electronic signal or other electronic means, such as a clip-on Amp meter, should be used according to local procedures to further identify the cable to be cut. This process should substantially reduce the probability of cutting a live cable. To provide further assurance the cable to be cut has been correctly identified, 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 energized cable in a trench can be lethal. Detailed instructions of SPIKE Tool operation follow. Please read carefully in conjunction with the Lab Test link found on the website **www.spiketool.com**.

NOTE: The SPIKE Tool is designed to pierce a cable's insulation and if the cable is energized, create a cable fault. The tool should be bonded to an acceptable grounding arrangement to ensure fault current can readily flow to trigger system fault protection.

SPIKE TOOL BONDING

SPIKE Tool is designed to pierce a cable's insulation and create a cable fault if the cable is energized. Bonding SPIKE Tool to a solid system ground is important to provide a path for fault current to operate system protection, should an energized cable be spiked.

SPIKE Tool should be bonded to ground by using the 25mm ball stud provided or the split bolt connector supplied prior to July 2018. Using 1/0 AWG copper for the split bolt connector should be limited to system fault currents not exceeding 10k Amps. The 25mm ball stud is able to handle fault currents up to 20k Amps. Please see Lab Test link on the website www.spiketool.com. This Lab Test report constitutes part of the operating instructions below and should be read carefully before the field use of SPIKE Tool.

SPIKE TOOL PACKAGE

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 40’ lanyard
- Ramrod
- 3 Allen wrenches for maintenance (5/64”, 5/32”, 1/8”)
- 25mm ball stud for bonding to ground
- Operations manual

PRINCIPLE OF OPERATION

SPIKE is a charge-actuated device which pushes a spike approximately 2” in length into a cable to cause dielectric breakdown and create an arcing fault if the cable is energized 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. Cartridges used in SPIKE have been selected to ensure the spike penetrates the cable at least to the center so that the cable would have been faulted if it had been 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 prevent the tool from accidentally firing while loading.

NOTE: It is critical to ensure the hammer cap in Figure 5 #1 and the hammer cap Allen screw in Figure 5 #20 be secure and tight at all times when the SPIKE Tool is in use. A loose hammer cap can lead to spurious firing of the tool. This must be checked each time before each tool use.

SPIKE is designed to be operated remotely. The means of remote operation is a rope or lanyard. The lineman, at a distance of 35 feet, pulls the lanyard, removing the lanyard pin from SPIKE. The hammer is released, impacting the firing pin, and the 2” 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.

WHY REMOTE OPERATION?

When a de-energized cable is spiked, the damage to the cable is minimal. If however an energized cable is cut or spiked, the energy released in the open trench is of concern. On distribution systems with fault currents in the order of 5k Amps or higher, the fault energy released creates an explosion in the open trench. See Lab Test link on the website **www.spiketool.com** and videos.

The trench acts as an escape for the melted metal of the cable, the vaporized 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 help determine if any power cable that must be cut is safely de-energized. The operating procedure for SPIKE is outlined below.

Figures 5 show the SPIKE parts list. Note that there is a specific sequence of steps to be followed when using SPIKE. It is mandatory to follow this sequence 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 center of the cable. In the event the cable is incorrectly identified and is energized, the spike creates a cable short circuit. Line protection should operate, isolating the faulted cable.

PRECAUTIONARY NOTES

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

1. Before each use, the tool must 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
iv. the hammer cap on Figure 5 #1 and the hammer cap Allen screw on Figure 5 #20 are tight

2. If the tool is defective, it will not be used, will be marked "defective" and returned your distributor.

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
v. all personnel are 35-40 feet away when SPIKE is being fired (see Lab Test Link)

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 an energized 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

Please follow the operating procedure below when using SPIKE**:**

Figure 5 shows the complete **SPIKE parts list**.

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**.

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, bond the tool using the ball stud to the concentric neutral. If the cable does not have a grounded concentric neutral, bond the tool to ground (i.e. cable tray, ground conductor, driven ground rod, or preferably system ground) using the ball stud supplied. See **Figure 5, #7**: Tapped mounting hole.

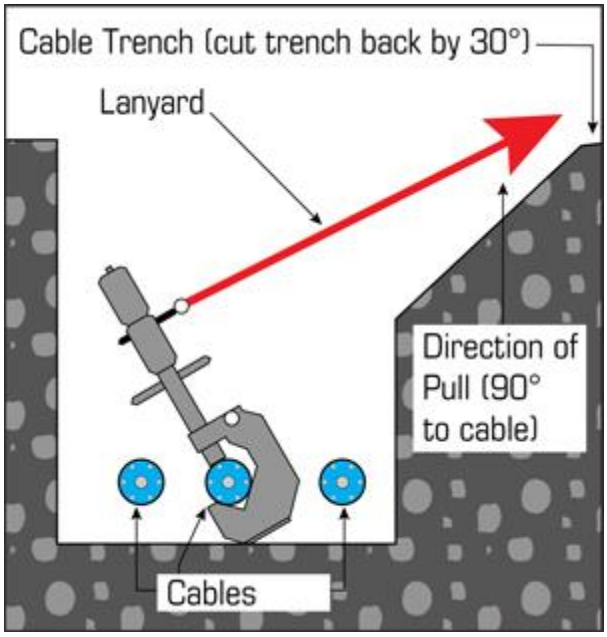


Figure 1

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**.

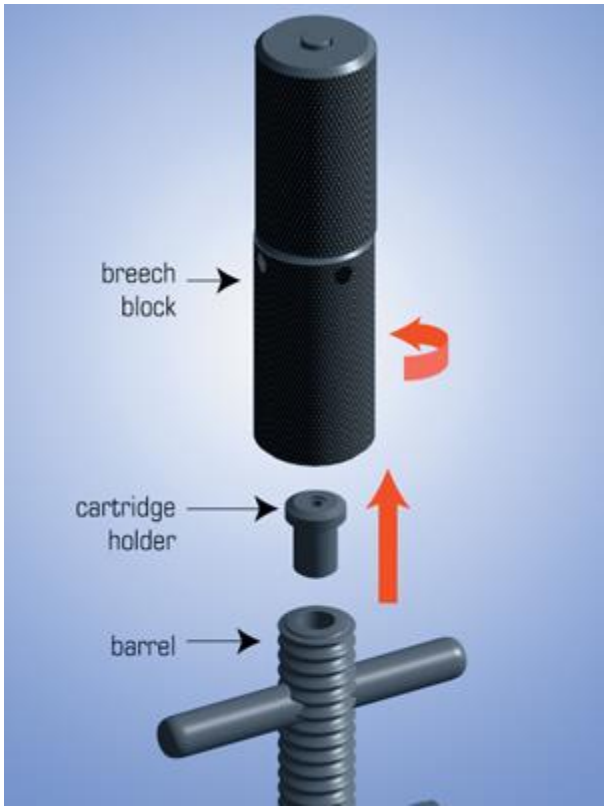


Figure 2

RECOMMENDED CARTRIDGE SELECTION

CONDUCTOR RANGE	INSULATION	CABLE VOLTAGE CLASS	CARTRIDGE SELECTION COPPER / ALUMINUM	
#2-4/0	XLPE	5 KV to 46 KV	Brown	Brown
250 MCM-750MCM	XLPE	5 KV to 46 KV	Green	Green
1000 MCM-1500 MCM	XLPE	5 KV to 46 KV	Yellow*	Yellow
#2-4/0	Lead or	15 KV to 46 KV	Green	
250 MCM-500 MCM	Aluminum	15 KV to 46 KV	Green	
750 MCM-1250 MCM	Sheath or	15 KV to 46 KV	Yellow	
1500 MCM-2000 MCM	Armored	15 KV to 46 KV	Yellow*	

*SPIKE may not completely penetrate the conductor and project out the opposite side.
ATTENTION: Cartridge misfires may occur when the cartridge shelf life exceeds 6 months.
Table updated July 2018 as recommended by Kinetrics.

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**.

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

STEP 6

Screw the breech block of SPIKE back onto the barrel.

Before placing the breech block back onto SPIKE, check that parts **#1 and #20** are firmly in place and tight. Then turn the breech cap counter clockwise a few times and check that the firing pin is able to move freely, namely not seized. Do not screw the breech block onto the barrel if the firing pin is seized, only if it moves freely. This is a critical step in mitigating premature firing.

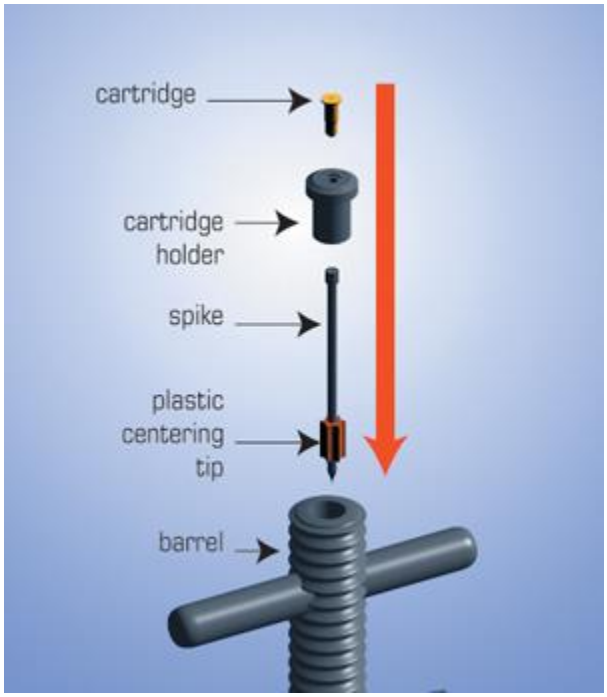


Figure 3

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**.

STEP 8

Turn the breech cap and the breech block of the tool clockwise until tightened down. If done correctly, the hammer cap in **Figure 5**, #1 will be protruding from the breech cap. Ensure the breech cap is well-tightened onto the breech block. **The tool will not fire otherwise. SPIKE IS NOW IN FIRING POSITION**

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

STEP 9

Carefully leave the trench, being sure not to accidentally pull the rope with your feet. Proceed to the end of the rope keeping a minimum distance of 35 feet from SPIKE. Wrap the end of the lanyard around your hand once or twice. It is mandatory that the appropriate class of rubber gloves and safety goggles be 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 5 minutes before handling SPIKE. While wearing the appropriate class of rubber gloves and safety goggles, remove the SPIKE Tool from the cable.

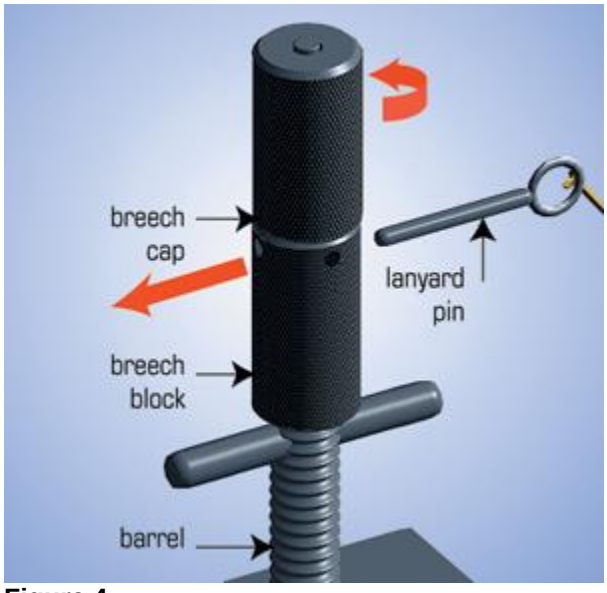


Figure 4

Remove the breech block from the barrel and remove the cartridge holder. Check to see that 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 should increase cartridge strength by one level.

STEP 11

Remove SPIKE from the cable while wearing **rubber gloves and safety goggles**.

STEP 12

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

CARTRIDGE & SPIKE SPECIFICATIONS

CARTRIDGES

All cartridges used in the SPIKE are low velocity and are similar to those employed in other commercially available charge-actuated tools. Only cartridges used for low velocity tools should be substituted for the cartridges that initially come with the SPIKE. If cartridges cannot be purchased locally, they are available through the **SPIKE Tool distributors** listed at the end of this manual.

SPIKES

The SPIKE uses hardened spikes which are approximately 2" in length and ¼" head diameter. No other diameter of spike should be substituted. The spikes used have a plastic guide tip on the end. This plastic tip must be on any spike which is inserted into the barrel. Spikes for the SPIKE Tool may be ordered from SPIKE distributors.

SPIKE MAINTENANCE

1. After each use, take SPIKE to a clean maintenance area and disassemble the tool into its 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. Make sure it is kept clean and dry.
6. Neglecting to properly clean and oil SPIKE after use will lead to premature corrosion or may render the tool non-operational.

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 SPIKE Tool. The manufacturer will not be responsible for any damage to the tool, equipment or injury of 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 use.

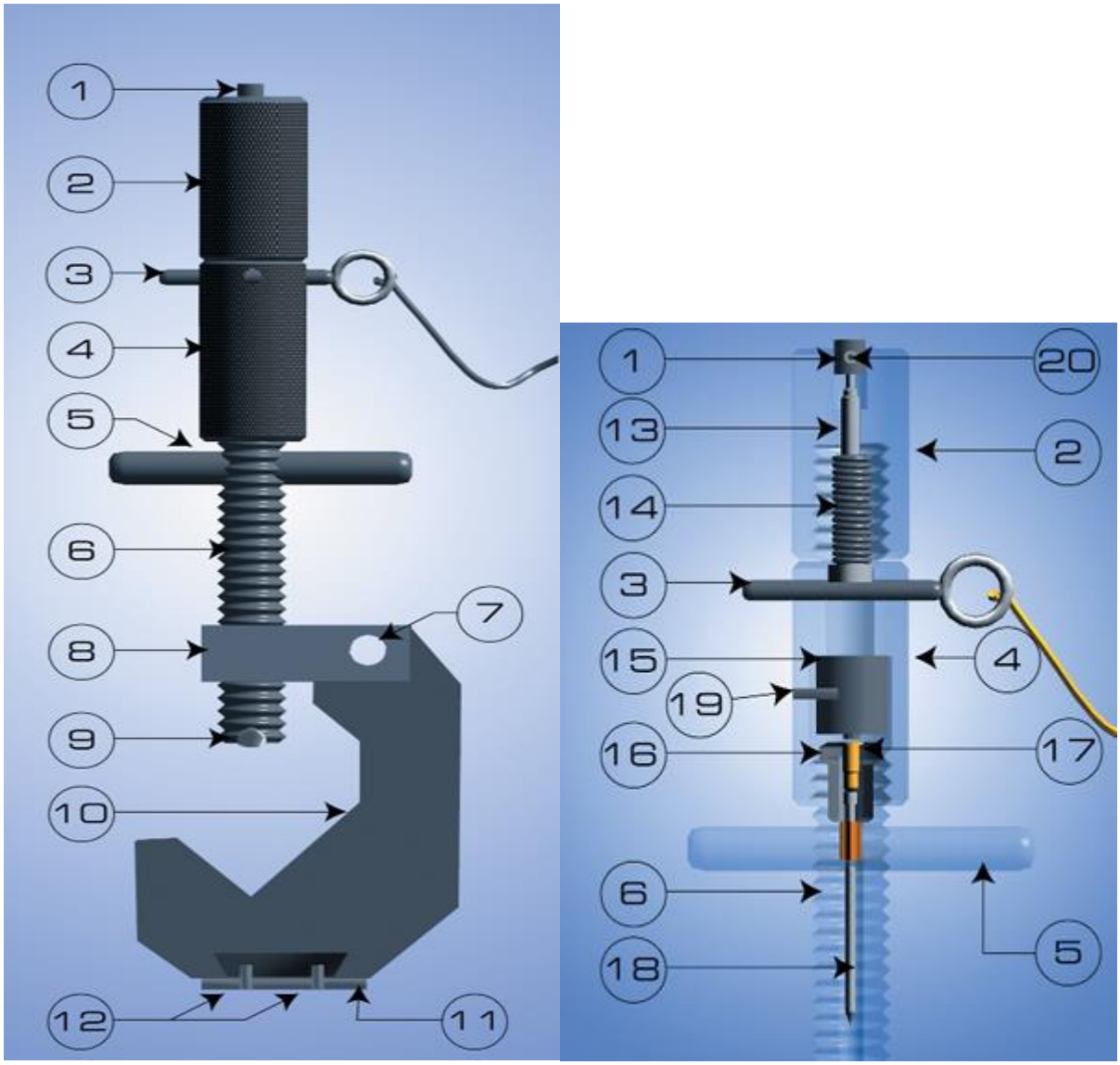
WARRANTY

During the first year after purchase, all SPIKE Tool parts that the company finds defective in material or workmanship will be replaced by SPIKE Tool Inc. free of charge, including labor, shipping and handling.

No further warranty, expressed or implied, in connection with SPIKE is given and the company's sole liability consists of 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 SPIKE Tool package list shown in this manual.

The maintenance program is highly recommended. Every 2 years, SPIKE Tool Inc. can set up a full maintenance program for your SPIKE Tool. Please contact your distributor.



SPIKE Parts Diagram FIGURE 5

SPIKE PARTS LIST

1. Hammer cap
2. Breech cap
3. Lanyard pin and lanyard
4. Breech block
5. Barrel ‘T’ handle
6. Barrel

7. Tapped mounting hole for 25mm ball stud (limit 20kA) or split bolt connector 1/0 AWG copper (limit 10KA) for bonding to ground
8. Barrel guide
9. Barrel safety stop
10. Cable clamp
11. Safety striker plate 3/8”
12. 2 Allen screws 5/32”
13. Hammer
14. Hammer spring
15. Firing pin assembly
16. Cartridge holder
17. Power load
18. Spike
19. Allen screw 1/8”
20. Allen screw 5/64”

ORDER THE SPIKE TOOL AND PARTS

Order the SPIKE Tool directly from one of the listed authorized SPIKE Tool distributors below:

Global Distributor (Including Canada)

Lakeport Power
169 Industrial Park Road
Colborne, ON, Canada
K0K 1S0
U.S. & Canada toll free: 800-293-1909
Tel: 905-355-3281
Fax: 905-355-3336
E-mail: **gbh@lakeportpower.com**
website: **www.lakeportpower.com**

Manufacturer

SPIKE Tool Inc.
2301-25 Broadway Avenue
Toronto, ON, Canada
M4P1T7
E-mail: **info@spiketool.com**
website: **www.spiketool.com**

Distributors Canada Only

Landace Hydraulics
4376 Elgin Road
Mossley, ON, Canada
N0L 1V0
Tel: 519-269-3020
Fax: 519-269-9902
E-mail:**landace@sympatico.ca**