CARE, MAINTENANCE, AND TESTING
OF
HOT LINE TOOLS

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HASTINGS
A WORLDWIDE SUPPLIER OF
Hot Line Tools & Equipment

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INTRODUCTION

Part of our continuing effort here at HASTINGS is to provide you, the customer, not only quality hot line tools but also with the same quality of customer service. It is for this reason that we would like to share our skills and expertise with you regarding the proper care and maintenance of your hot line tools.

As you, the end user, are well aware the technology and manufacturing processes to build hot line tools is constantly improving. We are aware of the fact that some wooden hot sticks are still being utilized. However, because of increased technology and updated regulations, the emphasis of these remarks will be directly related to the care and maintenance of fiber glass tools and not the older style wooden hot stick.

NEW TOOL TESTING

Each hot stick that leaves HASTINGS has passed a dielectric test with an electrical gradient of 100KV per foot in accordance with industry standards such as ASTM, OSHA and IEC. In our test facility the glass being tested is monitored by sensitive micro-ammeters during the test which will completely shut down the test equipment if there is either a flash over or if the leakage current exceeds the allowable levels.

An employee must manually remove any piece of fiberglass that fails the test. The failure is then reported to the department supervisor and our engineering department for analysis. The stick may or may not be destroyed during the analysis but it will be destroyed. No stick that fails the dielectric test is used for any reason. Once the manufacturing process has been completed and the hot stick has been packed and shipped, proper care and maintenance is turned over to you.

FIELD CARE OF TOOLS

In the daily use of your hot stick, precautions should be taken to prevent contamination or moisture build-up. Many of you can probably recall your first day on the line crew when you put a hot stick on the ground and heard – “Hey! Don’t lay that hot stick on the ground!” From that point on you knew that special precautions must be taken in the handling of hot sticks. It might have involved leaning the stick up against your line truck or maybe a nearby tree.

In the event your job involves several hot sticks, a tarp or a tool rack is recommended.

If your hot sticks are still reasonably clean and glossy, a daily inspection and a thorough wiping of the stick to remove dust and other contaminants is still recommended to maintain the dielectric strength of the tool.

FIELD CLEANING

A silicone treated wiping cloth will do the job of wiping down the stick. By doing this you are also adhering to OSHA Rule 1926.951:Sub-Part V: Tools & Protective Equipment. This rule states

“All live line tools shall be visually inspected before use each day. Tools to be used shall be wiped clean and, if any defects are indicated, such tools shall be removed from service.” This rule is also printed on the package that the silicone cloth is shipped in.

As this stick is being wiped down not only is the dust being wiped off but, by using a silicone treated cloth, a fine silicone film is being deposited on the surface of the stick. This will aid in repelling water and contamination helping to maintain the dielectric properties when the tool is used under wet or adverse conditions.

If the marks or contamination on your hot sticks are more than what can be removed by simply wiping down the stick, a hot stick cleaner wipe should be used. If the contaminants on your hot stick are more than the silicone cloth or cleaner wipe can handle, then we recommend using All Purpose Cleaner.

COMPLETE CLEANING

Our All Purpose Cleaner can be used on hot sticks, and it is also excellent for cleaning bucket and booms, rigid cover-up, and your rubber goods. This cleaner should be applied with a clean, soft cloth or a sponge. To avoid any waste or possible spillage, the cleaner can be poured into a hand dispenser and then applied. If the contaminants on your sticks cannot be removed with the cloth or sponge, then a non-metallic cleaning pad should be used. Once again, spray your stick with cleaner and, just as you used your cloth or sponge; repeat the cleaning procedure with the non-metallic pad. The All Purpose Cleaner is already pre-mixed for your use.

Based on your needs, it may be to your advantage to use this same All Purpose Cleaner in the concentrate form. The concentrate can be purchased by the gallon, 6-gallon case, or 5-gallon drum. A 6-pack of concentrate is also available. The mixture of the concentrate is 20 parts water to one (1) part concentrate. If your cleaning task is a large one, you can see that the All Purpose Cleaner Concentrate would certainly be to your advantage.

One final note to mention is that the HASTINGS All Purpose Cleaner is: bio-degradable, non-toxic, non-alkali, non-acid, non-flammable, and gentle to the skin. Ventilation is not required with this cleaner. Also, we can provide, upon your request, a Material Safety and Data Sheet (MSDS) for any of the cleaning agents we supply.

WAX

After thorough cleaning with the non-abrasive cleaning pad, fiber glass wax should be used to restore and retain the surface gloss on your stick. A glossy surface is required on all hot line tools in the event they are used under wet or rain conditions. A glossy surface makes moisture “bead up” and eliminates a potential blanket effect on the surface.

Once you have used the non-abrasive cleaning pad, we recommend two (2) coats of Hot Stick, Boom, and Bucket Wax be applied. This high grade Carnuba wax will slow down the buildup of contaminants not only on your hot sticks but also on your fiber glass booms and fiber glass buckets. Precautions should be taken, however, to avoid any wax build-up. Waxing should only be done on a clean stick in good conditions.

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REFINISHING

After extended periods of use and because of nicks, scratches, scrapes, and exposure to the elements, general wiping off and cleaning may not improve the outward appearance of your hot sticks. Unless the tool is mechanically damaged, this is not a reason to discard it for a new one.

The use of a refinishing kit can restore the finish to new condition with little effort. Because it takes a minimum drying time of 24 hours when using the refinishing kit, downtime on rainy days or inclement weather would be excellent opportunities for refinishing your hot sticks. The HASTINGS Epoxy Refinishing Kit is a two-part system (parts A and B) that is mixed in two equal parts. It is available in "clear" for hot line tools and "white" for refinishing buckets and booms that are also white. The kit comes complete with sand-paper, the two-part mixture, and thinner (to use if necessary for thinning and to clean your brush when finished.)

For the best results when refinishing your sticks it may be necessary to disassemble them. When removing disconnect heads, hooks, and etc., first drive out any roll pins that may be in the head. More than likely it will be necessary to apply a moderate amount of heat to the end of the stick and fitting. This can be done with a heat gun or portable hair dryer. Once you are able to twist the fitting, pull it straight off. Do not pry or bend so that no damage is done to the stick itself.

Once you have your sticks disassembled, sand-paper is used to remove the old finish along with those surface nicks and scratches. Either dry sanding or wet sanding is acceptable.

After sanding the stick thoroughly to remove all dents, scratches, and nicks, clean and dry the stick to remove any dust or other contaminants using a lint-free cloth. A final wiping with a lint-free cloth and a spray cleaning solvent will remove any potential residue.

Once all of your sanding and cleaning has been completed, you are ready to mix parts A and B to begin refinishing:

1. Measure out and mix equal parts of both A and B.
2. Be sure this mixture is thoroughly stirred and directions are followed accordingly.
3. Once mixed, the epoxy finish should be used within a few hours or the hardener in the epoxy will start to setup. (The shelf life of the epoxy kit is indefinite before mixed, as long as the lids are kept on tightly.)
4. A coat of epoxy is now applied to the full length of the tool being refinished. After each coat the tool is then allowed to dry for 24 hours.
5. If desired, additional coats may be applied for a long lasting finish, but they can only be applied after each "24 hour drying period."
6. This epoxy coating leaves few or no brush marks and provides a hard, tough, moisture-resistant high gloss finish of high dielectric strength and is easily cleaned.

As previously mentioned, this refinishing kit works equally well with aerial devices; such as, buckets and fiber glass booms. Your safety rules, along with the condition of these units will dictate how often this refinishing should be done. Your hot sticks, booms, and buckets are your means of protection – the same as your rubber gloves and sleeves. They should be maintained in first class condition.

Once your epoxy refinishing process has been completed, we again recommend that you apply two (2) coats of Hot Stick, Boom, and Bucket Wax. This slows down the build-up of contaminants, makes them easier to clean and maintain, and will prolong the life of the fiber glass. Never wax without a thorough cleaning.

An additional product we offer at HASTINGS if our Epoxy Patch Kit. This can be used on those small nicks and scratches that sanding did not eliminate.

OSHA TESTING REQUIREMENTS

On January 31, 1994 OSHA published the Final Rule on 29 CFR Part 1910 which contains the paragraph (269 paragraph j) that mandated not only design requirements for Hot Line Tools but also the condition in which they shall be maintained. The enforcement of this rule was stayed until November 1, 1994.

OSHA regulations are available online at www.osha.gov . The 1910.269 (j)(2) states:

1910.269(j)(2)
"Condition of tools."
1910.269(j)(2)(i)
Each live-line tool shall be wiped clean and visually inspected for defects before use each day.
1910.269(j)(2)(ii)
If any defect or contamination that could adversely affect the insulating qualities or mechanical integrity of the live-line tool is present after wiping, the tool shall be removed from service and examined and tested according to paragraph (j)(2)(iii) of this section before being returned to service.
The first two sentences of this section (1910.269 paragraph (j)(2)) on the "condition of tools" are straight forward. The tool shall be wiped clean and inspected prior to use each day, and if any defect is present the tools shall be removed from service. This takes a good common sense practice and makes it the law.

1910.269(j)(2)(iii)
Live-line tools used for primary employee protection shall be removed from service every 2 years and whenever required under paragraph (j)(2)(ii) of this section for examination, cleaning, repair, and testing as follows:

The third section of "condition of tools" is much more controversial. This is the section that contains the language that requires testing on two-year intervals. The controversy is the result of the language in three specific areas. First is the definition of what is a live line tool vs. what is auxiliary equipment. In a conversation with OSHA Washington, we were informed that ladders, auxiliary arms, platform boards and the like are auxiliary equipment and not live line tools. Therefore they are not covered by this rule. If you intend to omit some fiberglass equipment from testing, there will be gray areas that should be worked out between the utilities and the local OSHA compliance officer. Wire tongs would be a good example of a device that could be considered either a tool or auxiliary equipment depending on how it is used.

This raises the second area of controversy, which is the definition of "primary employee protection". In an effort to prevent the need to test tools, some people are taking the stand that their rubber gloves are their primary protection and that the live-line tools are a secondary means of protection, therefore relieving them from the requirements of this section. After reviewing this with the OSHA compliance officers in Washington, we learned that OSHA does not concur with this position. The issue of the live-line tool touching the worker in areas other than his hands cannot be ignored. Nor can the possibility that other persons such as a contractor may use the same tool be ignored. If it is a live-line tool it can be used for primary employee protection and therefore falls under these test requirements.

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The third controversy revolves around the statement that the tools shall be tested "…..unless the tool is made of FRP rod or foam-filled FRP tube and the employer can demonstrate that the tool has no defects that could cause it to fail in use." Again in an effort to eliminate or minimize testing, some people are hanging their hats on this statement and interpret it to say that the tool only needs to be tested if defects are found during examination. This position doesn't address the need to "demonstrate that the tool has no defects". However, there are variations in how the OSHA regulations are enforced. The local compliance officer appears to be the first line of interpretation of the rules which results in the possibility of variations from one utility to another.

A clarification letter addressing these issues will be re-printed following the remainder of 1910.269(j)(2)

1910.269(j)(2)(iii)(A)
Each tool shall be thoroughly examined for defects.
1910.269(j)(2)(iii)(B)
If a defect or contamination that could adversely affect the insulating qualities or mechanical integrity of the live-line tool is found, the tool shall be repaired and refinished or shall be permanently removed from service. If no such defect or contamination is found, the tool shall be cleaned and waxed.
1910.269(j)(2)(iii)(C)
The tool shall be tested in accordance with paragraphs (j)(2)(iii)(D) and (j)(2)(iii)(E) of this section under the following conditions:
1910.269(j)(2)(iii)(C)(1)
After the tool has been repaired or refinished; and
1910.269(j)(2)(iii)(C)(2)
After the examination if repair or refinishing is not performed, unless the tool is made of FRP rod or foam-filled FRP tube and the employer can demonstrate that the tool has no defects that could cause it to fail in use.
1910.269(j)(2)(iii)(D)
The test method used shall be designed to verify the tool's integrity along its entire working length and, if the tool is made of fiberglass-reinforced plastic, its integrity under wet conditions.
1910.269(j)(2)(iii)(E)
The voltage applied during the tests shall be as follows:
1910.269(j)(2)(iii)(E)(1)
75,000 volts per foot (2461 volts per centimeter) of length for 1 minute if the tool is made of fiberglass, or
1910.269(j)(2)(iii)(E)(2)
50,000 volts per foot (1640 volts per centimeter) of length for 1 minute if the tool is made of wood, or
1910.269(j)(2)(iii)(E)(3)
Other tests that the employer can demonstrate are equivalent.

Note: Guidelines for the examination, cleaning, repairing, and in-service testing of live-line tools are contained in the Institute of Electrical and Electronics Engineers Guide for In-Service Maintenance and Electrical Testing of Live-Line Tools, IEEE Std. 978-198

Following is a clarification letter (also available online) from OSHA addressing the issues of recurrent testing.

February 2, 1995

Dear Mr. Peach:

This is in further response to your December 6 letter, requesting clarification of the Electric Power Generation, Transmission, and Distribution Standard, 29 CFR 1910.269. Specifically, you requested clarification of testing required by section 1910.269(j)(2)-Condition of tools.

Paragraph 1910.269(j)(2)(iii) requires that a live-line tool be removed from service and examined and tested according to paragraph 1910.269(j)(2)(iii) when any defect or contamination is present that could adversely affect its insulating qualities or mechanical integrity. Also, paragraph 1910.269(j)(2)(iii) requires (as categorized in the fourth paragraph of the letter) the thorough examination, cleaning, repair, and testing of live-line tools used for primary employee protection on a two year cycle. The performance-oriented Electric Power Generation Standard does not specify under whose direction, that is, the employer, a contracted testing facility or others, the 1910.269(j)(2) activities including examination, cleaning, waxing, repair, refinishing and testing of live-line tools are performed; however, the employer is held responsible for compliance under the Occupational Safety and Health Act. Safety reference sources applicable to these activities include national consensus standards (See Appendix E to Section 1910.269), manufacturer recommendations and other recognized safe working practices of the industry.

The employer must be able to demonstrate to the Occupational Safety and Health Administration, that is, the Compliance Safety and Health Officer (CSHO) during an inspection of the work site, that the aforementioned activities meet 1910.269(j)(2) requirements. The CSHO would determine compliance by inspecting live-line tools at the work site, by looking at available documentation and by interviewing employees who are assigned work involving live-line tools.

By paragraph 1910.269(j)(2)(iii)(C), a test must be performed after the aforementioned two year cycle examination when:

The live-line tool has been repaired or refinished regardless of its composition;

The live-line tool is made of wood or hollow fiberglass reinforced plastic (FRP);

The live-line tool is made of solid or foam-filled FRP tube, unless the employer can demonstrate that the examination has revealed all defects that could cause the live-line tool to fail in use. The employer has to be prepared to demonstrate that integrity has not been compromised, for example, by a contamination that could conduct harmful electrical energy, along the foam-filled portion of a live-line tool.

The test method used must be designed to verify the integrity of the live-line tool along its full working length. Full working length means the entire length of a single piece and the extended length of an adjustable, including telescoping, live-line tool. Live-line tools made of FRP include, singularly or in combination, solid, hollow or foam-filled configurations.

In consideration of the performance-oriented requirement of 1910.269(j)(2)(iii)(D), OSHA intends that an effective testing method be used. The testing method, whether wet or dry, must be designed to verify the tool's integrity under wet conditions. Guidelines for the examination and testing of live-line tools are contained in the Institute of Electrical and Electronic Engineers (IEEE) "Guide of In-Service Maintenance and Electrical Testing of Live-Line Tools," IEEE Std. 978-1984, which is mentioned in the note following paragraph 1910.269(j)(2)(iii)(E)(3) and is listed in Appendix E of the Electric Power Generation Standard.

We appreciate your interest in employee safety and health. If we can be of further assistance, please contact Mr. Ronald Davies of my staff, telephone 202-219-8031, extension 110.

Sincerely,

Joseph A Dear Assistant Secretary

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STICK FAILURES

TYPES OF FAILURES

There are several mechanisms that will cause a fiberglass tool to “fail”. By fail, we mean to have an increased leakage current or to flash-over when subjected to test conditions. The track record for fiberglass tools used in this industry has been outstanding. In talking about failures today we are not stating that the tools would have failed in field use, only that it has or would have failed a specified electrical test.

The required OSHA re-test for live line tools is primarily a test of the surface condition of the tool. Because the surface of the live line tools receives the most abuse from daily work, it makes sense to inspect and test it on a regular basis. The surface will be the first to be scratched, to lose its gloss, to be contaminated by dirt, oil, creosote and moisture. Most but not all of these defects can be detected visually. The majority of sticks that will fail the OSHA test will fail due to the lack of gloss on the surface. Moisture will collect on the surface with “sheeting action” the same as on an un-waxed stick and will provide a direct path for leakage current to follow from one electrode to another. Here we see a “glossy” tool. A tool in this condition will usually pass the OSHA test as water will “bead up” on the surface. However, a visual inspection will not always reveal all defects. The opposite end of the same stick “while appearing glossy” does not pass the electrical test. Water does not bead on the surface as it did on the other end. A stick that fails this type of test can be waxed or refinished, depending on its surface condition, to produce a surface finish that will then pass. Obviously, any conductive material on the surface must also be removed to pass the test.

It is possible to have a live line tool that has been over stressed mechanically to the point that it has cracks in the wall of the fiberglass. These cracks will, according to Murphy, fill themselves with whatever will most adversely affect their intended function. In this case it is moisture from the air. This will increase the leakage of a tool prior to the application of water for the OSHA wet test.

It is also possible to have voids in the foam core due to over stressing, poor repair procedures or even manufacturing defects. We prefer to believe that the latter, while theoretically possible, is the most remote of these possibilities. In the manufacture of foam filled fiberglass tools, a great deal of time and effort is spent in making sure the internal core is properly manufactured, as after it is produced, visual inspections and/or repairs are not possible. In this case, there is a puncture in the center of the stick that has been filled with what appears to be an RTV type of sealant. The internal damage is not readily apparent. Any void internal to the tool, regardless of how it got there, tends to fill with moisture and becomes detectable with a sensitive test. While not required by OSHA, a dry test can be utilized first to detect these types of defects. The magnitude of leakage currents during a dry test must be lower than that of a wet test due to the more subtle nature of the defect. Once detected the tool can then be further inspected, repaired or retired. Waxing or refinishing the outside of a tool such as this would be a waste of time. Trying to determine whether the defect is internal or external with only a wet test would be very difficult.

TYPES OF TESTS

OSHA requires a 75,000 volt test under wet conditions for fiberglass. The details of how to perform the test and the pass/fail criteria are not contained in the OSHA wording but must be taken from the IEEE 978 guide. This guide gives the requirements for the conductivity of the water, how it is to be applied, and a recommended acceptance criteria of a steady or decreasing leakage current.

In order to develop a portable tester that operated at a voltage and distance other than the OSHA recommended 75,000 per foot, we had to determine how the stick would actually fail under the OSHA setup. The two possibilities were if the tool flashed over prior to 1 minute or if the leakage reading were increasing. After reviewing test data collected over many years of full scale testing, it was observed that flashovers were nearly always preceded by unstable leakage readings, and that these readings occurred with regularity at levels above 200 micro amperes. It is conceivable that problems would result at, or slightly below, 200 micro amperes, however we feel that 200 micro amperes is as close to an exact match for the OSHA requirement (based on leakage current) as one could choose. Since the possibility for error does exist a safety factor should be used, as such we currently recommend that 75 micro amperes be used as the cutoff point for wet test acceptance. This was taken into account in our design and can be seen on the upper scale labeled “wet test” where the red range starts.

Once the acceptance value, based on leakage current, has been established, all that was left to do was to design a tester that will measure leakage current at a reduced voltage and then amplify the current reading to correlate with the full scale voltage values. In other words, the reading the operator receives will be representative of the reading he would have received at 75,000 volts per foot. To provide the capability of a dry test, to check for defects not measurable with the wet test, the tester was equipped with a more sensitive scale, which is selectable from the front panel. While the dry scale appears to be five times more sensitive from the fact that the full scale reading if 40 micro amperes instead of 200 micro amperes, it is actually more than six times more sensitive. This is because the dry readings on the dry scale are referenced to 100KV per foot instead of 75KV per foot. This is the most typical voltage used for dry stick testing by OSHA, ASTM, and IEC to name a few.

One factor that does make portable testers more critical than a full scale test is that the electrode spacing is usually less than one foot. This will enable the tester to detect a smaller defect as it will be a larger portion of the stick being tested. Here we have a 3 inch defect on a 4 foot tool. If we space our electrodes at 12 inches, we will have 9 inches of good pole insulating the 3 inch defect. If we reduce the electrode spacing, the defect becomes a larger percentage of the tool being tested resulting in an increased leakage reading and a more sensitive test. Internal defects can also be detected as they are capacitively coupled with the electrodes. This enables the tester to “see inside” the tool. While some have a hard time accepting that current will flow through good dielectric material to detect the internal defect, it is really no different than what happens on the outside of the tool. There will almost always be sections of good fiberglass surrounding the defects. The capacitive coupling allows these defects to be detected.

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While the path of the capacitive current is slightly longer than the straight line surface leakage path, the defect is still readily detectable. As the diameter of the tool increases the current path may also increase. If the diameter gets larger, or the defect gets further from the outside, the change in the length of the leakage path can become excessive when compared to the length of the straight line leakage path across the surface. For this reason, it is desirable for the distance between the electrodes to be at least twice the diameter of the tool being tested. Since most hot line tools are 3 inch diameter or smaller, we designed our tester to have an electrode spacing of 6 inches. The electrode spacing may not be apparent if you only examine the outside of a portable tester.

While a full scale test is always an option, there are several disadvantages associated with it. As we mentioned earlier, the resolution with electrodes spaced one foot apart is less than the resolution with closer spaced electrodes. But larger problems are associated with the elevated voltage levels. Metering is more of a problem as the higher voltage also results in more energy being available should the tool flash over. Since the current is being monitored, the flash over will take its toll on the meter. There are various schemes to protect the meter and all I will say about that is that some of them will work some of the time. Even if you don't blow your meter, you will most certainly be putting the tool at risk.

We have heard from several customers who have ruined tools by flashing them over due to poor surface finishes. These tools could have been waxed or refinished to make them serviceable again but because of the power unleashed at the instance of flash over, the tool was burned and/or small fiberglass slivers were blown out in the vicinity of the electrodes, making a major repair or retirement of the tool necessary. One customer now uses a portable tester to screen his tools prior to full scale testing.

Operator safety, convenience, and the time to complete the test are also more of a problem with full sale testing.

When talking about full scale testing, we believe that the choice of A.C. or D.C. is more of an operator preference. Both have advantages and disadvantages. When a reduced voltage is used, we feel it is necessary for the applied voltage to be A.C.. To produce a leakage current when there is not a solid conductive path between the electrodes, we need the capacitive effect offered by A.C. to get the most critical test results. This also allows us to "see" inside the fiberglass and to detect problems that are insulated from the electrodes by good fiberglass. D.C. will not allow this. As I mentioned earlier it is important to keep the electrode spacing as close together as possible for maximum surface sensitivity. For maximum internal sensitivity it is important not to reduce the spacing below twice the diameter of the tool being tested.

If you want additional information on the tester that was designed not only to meet the OSHA rules but to give you additional information about the quality of the tools being tested, please contact us.

Our purpose at HASTINGS is to serve you, the customer, in the best manner possible and to provide for your needs. Please do not hesitate to contact our factory representative in your area or the factory for any of your needs. Our research and development talents and manufacturing capabilities are available to you from concept to the finished product.

Thank You.