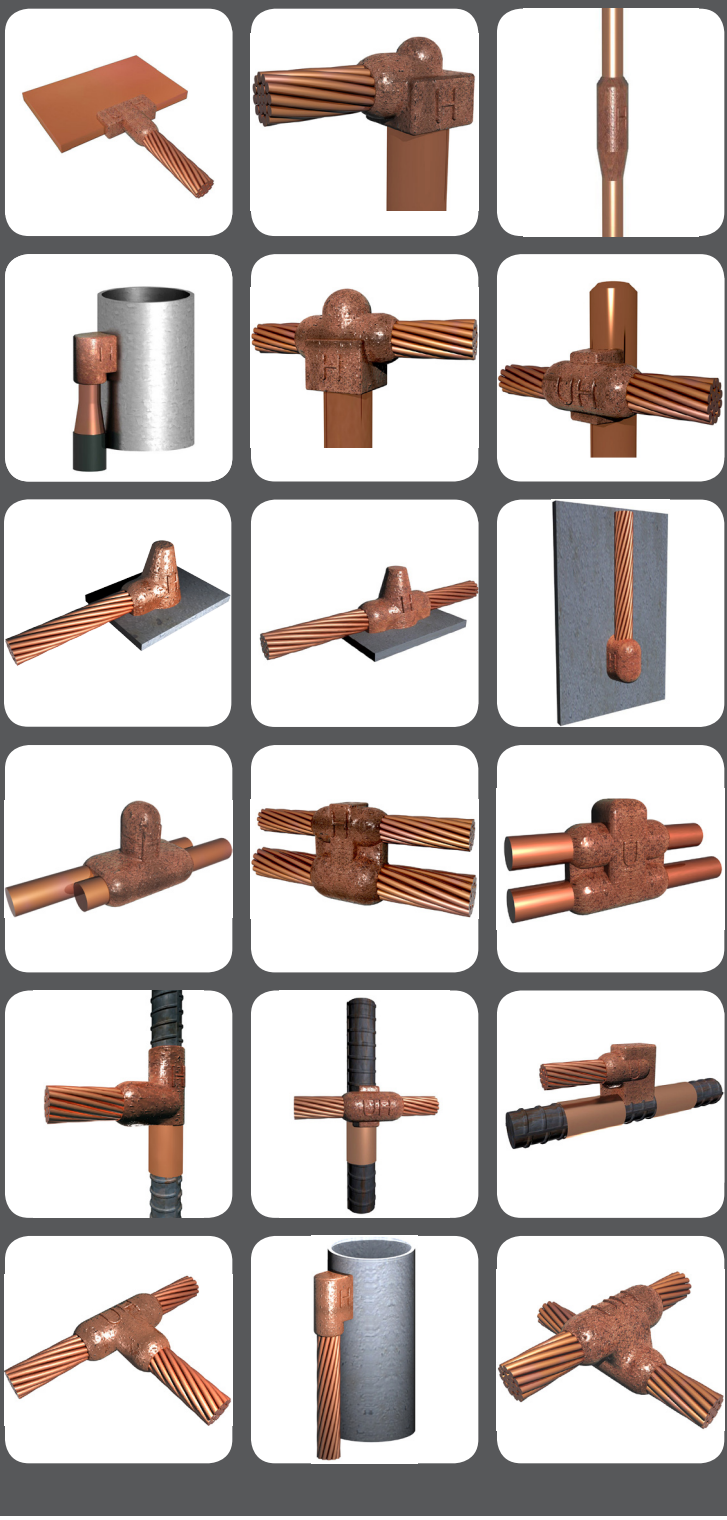


ULTRAWELD ULTRASHOT®

Installers and Inspectors Guide for making Exothermic Connections

- Grounding
- Lightning Protection
- Cathodic Protection
- Rail

HARGER®

This handbook was written to give installers and inspectors in the field a guide for making high quality Ultraweld connections.

The tips for using NUWTube® and UltraShot® have been developed based on testing done by Harger as well as many years of experience in the field of exothermic welding.

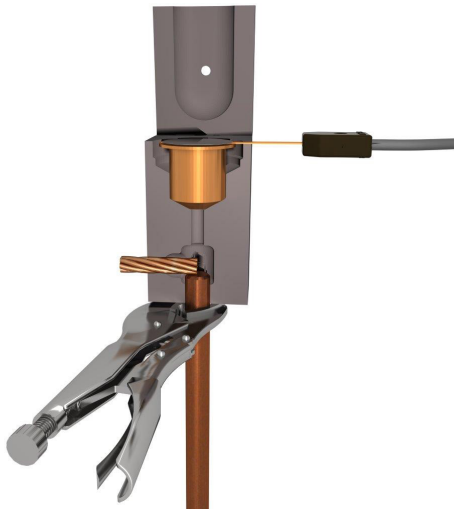
If you have any questions about this guide or any methods or tips described herein, please don't hesitate to contact either your Harger Representative or the experienced technical help personnel at the Harger main office, 800.842.7437 or www.harger.com.

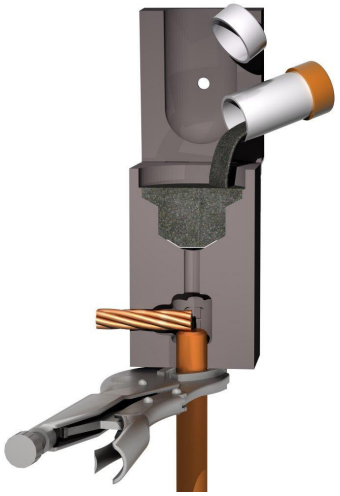
contents

What is Ultraweld

The Ultraweld processes (NUWTube and UltraShot) use the same, time proven way to connect conductors at the molecular level. This process involves the reduction of copper oxide by aluminum which creates Aluminum Oxide and enough heat to provide molten copper for the connection.

The reaction is encapsulated by a graphite mold that is designed for specific conductors. These molds provide a portable and economical way to make the best electrical connection.





The Ultraweld Connection

An Ultraweld connection produces an electrical connection superior in performance to any known mechanical or pressure type connection. These connections are made in several applications including; Grounding, Lightning Protection, Cathodic Protection, and Rail.

The molecular bond formed when making an Ultraweld between two or more conductors has the following advantages:

- Will not loosen
- Current carrying capacity greater than the conductors
- No increase in resistance over time
- Will last longer than the conductor being welded
- Made with materials that are inexpensive, portable, and require little training
- Easily inspected through non destructive means

Tips for Making Quality Connections

As with all products, there are tips to make the Ultraweld process easier and to insure a quality connection. Some of these tips are as follows:

- Read all instructions that accompany the mold. The type of mold can be found on the mold tag. This will indicate which drawing should be viewed to understand the placement of the conductors in the weld cavity.
- Dry the mold with a torch to remove any moisture in the mold. Mold should be heated above 220 degrees F.
- Clean and dry all conductors to be welded. All metal surfaces should be cleaned down to bright metal.
- Make sure mold can stay in the vertical position while making the weld as this process is a gravity fed system.
- Make sure handle closes mold tightly and handles lock properly.
- Check all conductor holes in the graphite to make sure they aren't worn or cracked.
- Make sure conductors fit snug in the mold to seal in the weld metal.
- Clean mold with a natural bristle brush. Do not use a metal or plastic brush on the mold.

Making an UltraShot Connection (drop-in steps)

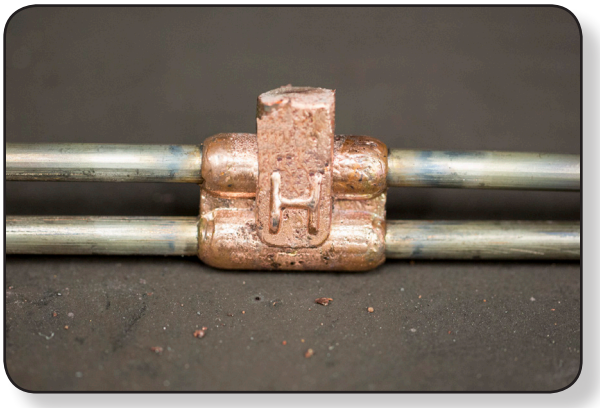
step **1**
Dry and Clean the mold and conductor.

step **2**
Place conductors and UltraShot® cartridge into mold.

step **3**
Close the lid and attach DRONE cord to the UltraShot® igniter.

step **4**
Push and hold both igniter buttons at the same time.

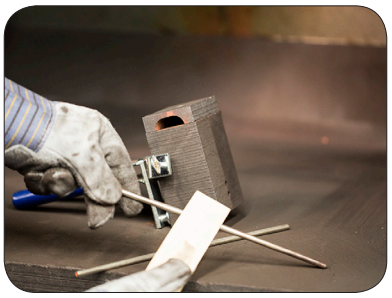
step **5**
Open mold and remove connection, remove slag and clean mold before making the next connection.



A Completed UltraShot® connection

Making a NUWTube Connection (pour-in steps)

Step 1:
Torch dry the mold before making the first connection.



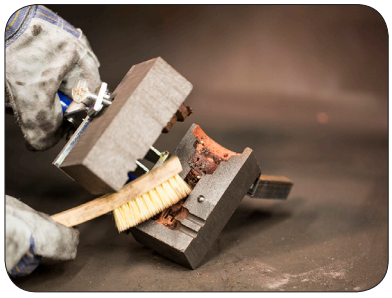
Step 2:
Clean and dry conductors, insert conductor into mold, close handle clamp and lock mold.

Step 3:
Insert disk into mold.

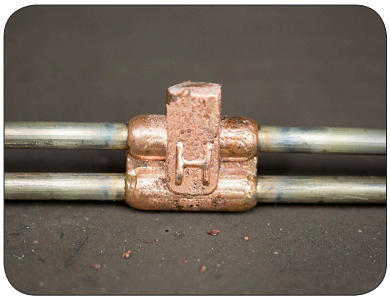
Step 4:
Remove Clear plastic cap from NUWTube, pour weld metal into mold.

Step 5:
Close lid, remove Orange cap from starting powder chamber and sprinkle next to ignition hole.

Step 6:
Ignite material located on top of the lid using a flint igniter (FLTIG).

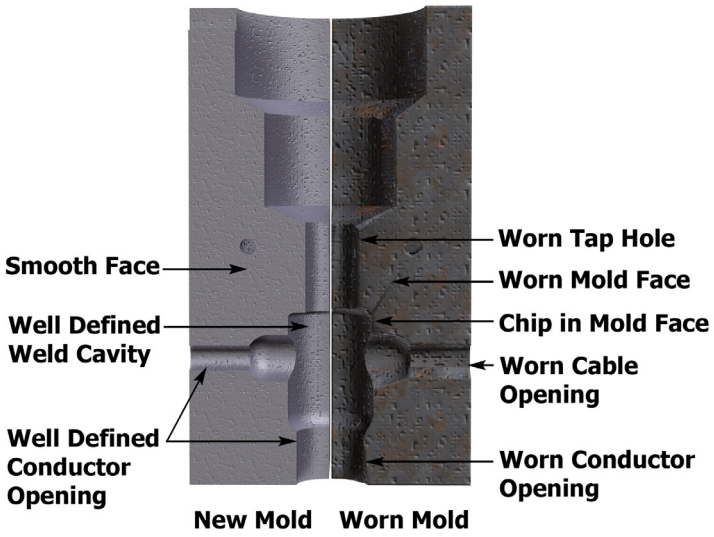


Step 7:
After the connection is complete, open the mold and remove the connection, remove slag and clean mold before making the next connection.



Complete NUWTUBE connection

Inspecting an Ultraweld Mold



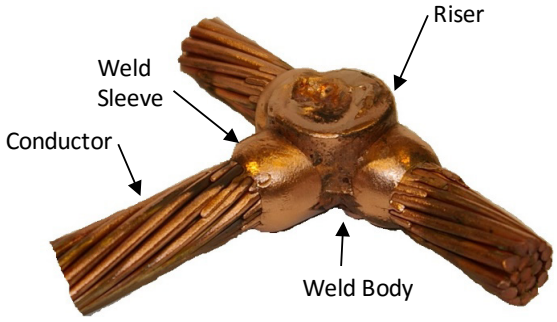
An Ultraweld graphite mold is designed to last an average of at least 50 shots but can last longer with proper care and cleaning. Using the UltraShot system has proven to more than double the life of the mold.

Inspect the mold regularly for the following items:

1. ***Conductor Openings*** – The conductors should fit tight to keep the mold from leaking when fired.
2. ***Weld Cavity*** – The weld cavity should be well defined without large chips or cracks that may effect the weld.
3. ***Tap Hole*** – Should be well defined without major chips.
4. ***Disk Seat*** – Should be well defined and capable of sealing the weld metal in the crucible area while the reaction is taking place.
5. ***Mold Parting Surface*** – Needs to be without major chips or cracks and capable of sealing the reaction in the mold.
6. ***Crucible*** – Should be able to safely hold the reaction.

Inspecting Ultraweld Welds

In order to properly inspect an Ultraweld connection, you must first familiarize yourself with the terms used for the different parts of the mold and the different parts of the weld. The mold was described in the previous section. The weld is detailed below.



Weld Sleeve – The area of the weld that comes out from the weld body and helps give mechanical strength to the area where the molecular bond is made.

Conductor – The metal materials that are to be welded together.

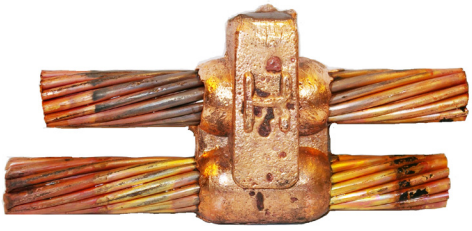
Riser – The area on top of the weld that is used for excess weld material and slag.

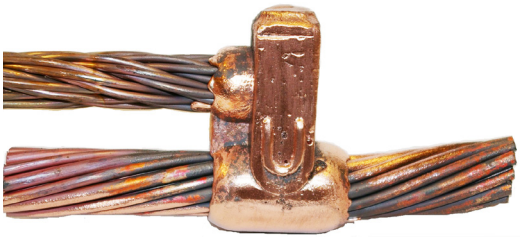
Weld Body – The area under the tap where the conductors are welded or melted together at the molecular level.

An exothermic weld can conduct more current than a mechanical connection because the cross section of weld body is greater than the cross section of the conductor being welded.

To have a quality weld you must have a solid weld body with a cross section greater than the conductors, the sleeves must be complete, there should be limited slag in the weld, and there should be limited signs of contamination in the riser. The riser should be higher than the level of the highest conductor.

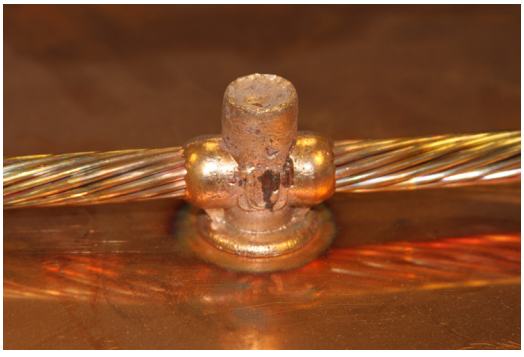
Good Welds





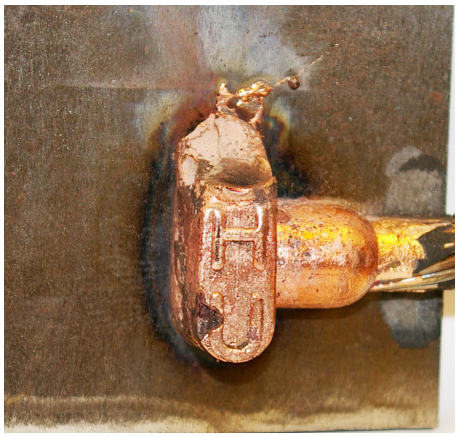
Inspecting Ultraweld Welds

Good Welds continued



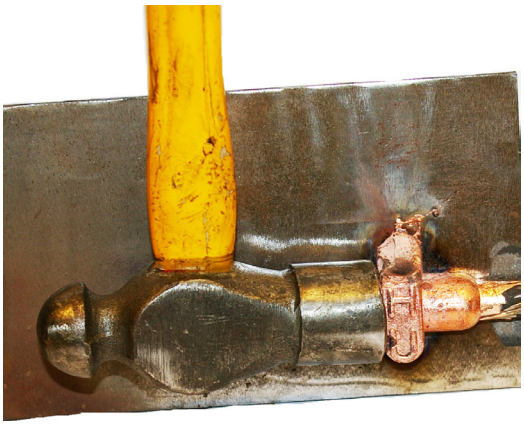
Inspecting Ultraweld Welds

Inspecting welds to steel, cast iron, galvanized steel and copper bar.



1. Make sure the surface is ground down to bright metal with all coatings and oxide removed.

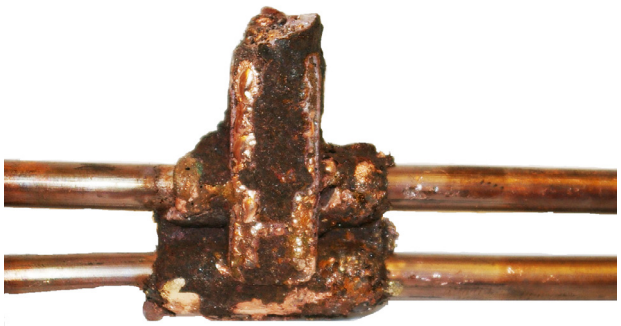
2. In most cases, you will be able to see a discoloration of the metal surface around the weld.



3. Tap weld with a 12 to 16 oz. ball peen hammer at 90 degrees to weld and in such a way that you do not damage the conductor or hard enough that you deform the weld. A bad weld will pop off if not made properly.

Inspecting Ultraweld Welds

Bad Welds



Weld has too much slag in the weld that may compromise the resistance of the connection. Sleeves not filled out which may affect the strength of the weld. Disk not properly placed or a leak in the mold are possible causes.

Bad weld due to under filling. Body of weld is too low, it is lower than the top of the conductors. Sleeves are not filled out. It could compromise the resistance. Wrong weld metal used or there was a leak in the mold.

Bad weld due to gas in the weld. This is usually apparent by the color of the weld which will be lighter in color, the riser will be high with a mushroom top, and there will be pin holes apparent in top of the riser.

Inspecting Ultraweld Welds

Bad Welds

The above weld cut in half reveals the amount of voids in the weld. These can be caused by contaminates in the mold, conductor or weld metal.
Note: A small number pin holes are acceptable, up to 20%.

Weld was not closed properly or it was worn out and leaked significantly. Also there is too much slag in the weld. Replace mold if needed.

UltraShot Troubleshooting Tips

Problem	Possible Cause	Suggested Corrections
UltraShot did not fire	Battery not charged	Charge battery and retry.
		Try different battery pack if available.
	Igniter not properly connected to plug	Push igniter all the way into plug.
NUWTube Starting Powder would not ignite	Old flint gun	Replace flint gun.
	Starting powder being used improperly	Sprinkle starting powder on the side of the lid's ignition pocket.
Weld cavity under fills	Wrong size cartridge for mold	Check ID plate on mold for proper size weld material to be used.
	Mold leaked too much molten copper to make proper weld	Worn mold. Opening in mold is too large to seal the mold properly. Replace mold.
		Wrong mold used for the conductors being welded. Buy correct mold.
		Mold did not close completely. Adjust handle clamps as needed to get mold closed completely.
	Wrong mold being used	Buy correct mold.

UltraShot Troubleshooting Tips

Problem	Possible Cause	Suggested Corrections
Weld not sticking to steel or cast iron surface	Surface not prepared properly	Clean surface down to bright metal by either grinding or using tools suggested in the instructions.
	Cable not placed in mold according to instructions	Be sure to follow the mold instruction on the placement of the conductors in the mold to make sure sufficient heat is transferred to the steel surface to make the weld.
	Not using cast iron powder when welding to cast iron surface	Order cast iron powder.
Problems welding to ground rod	Surface not prepared properly	Clean and prepare surfaces according to instructions.
	Mold not supported during welding	Place vice grips or clamp under mold to support it during welding process.
	Cable not placed in mold according to instructions	Be sure to follow the mold instructions on the placement of the conductors in the mold to make sure sufficient heat is transferred to the ground rod to make the weld.
Mold does not close all the way or handle clamps won't lock	Handle clamp is not adjusted properly	Follow instructions on adjusting handle clamp to adjust them properly.
	Dirt, slag or other material stuck in the parting line or on the dowel pins	Clean off all material to get a good seal.
	Bent or out of round conductors	Straighten conductors or cut out bad sections and retry.
Mold gets stuck on weld	Mold left on weld too long	Remove mold from weld within about 30 seconds to weld being made, especially on welds to steel.

UltraShot Troubleshooting Tips

Problem	Possible Cause	Suggested Corrections
Excessively high weld or excessive gas in weld	Moisture or foreign substance on the mold or conducturs	Preheat molds and conductors with a torch to a temperature that will burn off any water or organic material. Use steel brush to remove any residual material from conductors. Do not use steel brush on graphite mold.
	Wrong size cartridge used	Double check the mold ID plate to make sure the proper weld cartridge is being used.
	Moisture in weld metal	Replace with new weld metal.
	Duct seal in weld cavity	Duct seal is to be used on the outside portion of the mold only as a last resort. If it has to be used do not let it migrate into the weld cavity.
Conductors pull out of mold during process	Conductors are under tension	Remove tension from conductors or use wire clamp GRCC to remove tension from conductors.
Mold wearing out too fast	Improper cleaning of molds	Only use soft bristle brush or cotton rag to clean out the mold. Use of metal brushes, screw driver, or other metal objects will scratch the mold. Also, do not use plastic on the mold as it will melt and cause gassy welds.
	Bent, burred, or out of round conductors	Closing the mold on conductors that are bent, burred, or out of round will crack and chip the molds. Try removing the damaged sections if possible.
	Inserting conductors after mold is closed	Try to close the mold with the conductors already inserted. This will reduce the wear on the conductor openings.

Ultraweld® Exothermic Welding Certification Training by Harger

This training is hands-on and provides your team with understanding of Harger's Ultraweld exothermic welding process.

The tools required to make a connection as well as the inspection process, safety and troubleshooting are also discussed.

Attendees become certified!

How Do You Get Started?

- Work with your Harger Sales Representative to pick a date and time that works best for you and your team.
- Harger will provide the training materials and train your team at your designated location, ex; jobsite or at your office.
- Attendees must sign-in and pass a test prior to certification.
- Individual certification cards will be sent for distribution after successful class completion.
- Depending on class size, training typically takes 1 to 3 hours.

Harger Lightning & Grounding
301 Ziegler Drive • Grayslake, IL • 60030
800.842.7437 • 847.548.8700
www.harger.com