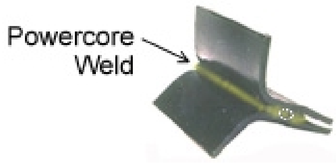
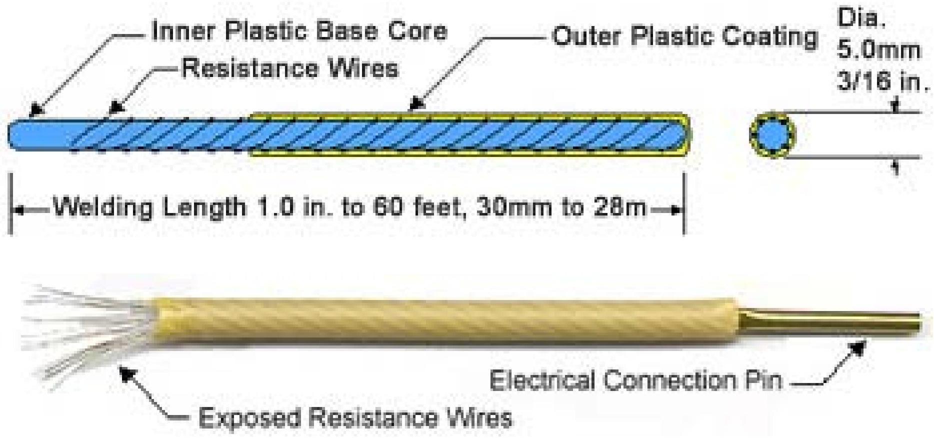
Introduction

What is Powercore?
Powercore Welding Rod is an " Electro-fusion System" used for joining all types of thermoplastic parts together.



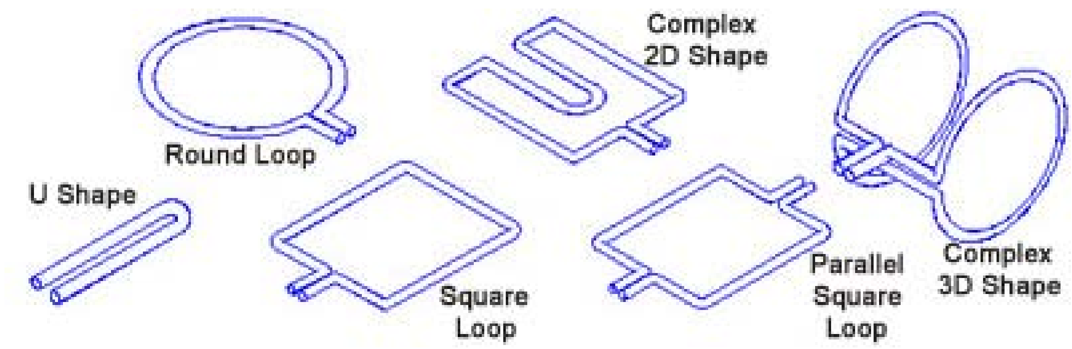
Powercore Welding Rod, is a flexible thermoplastic rod approximately 3/16" (5mm) in diameter with multiple super fine electrical resistance wires wound inside, and can be formed into virtually any shape. The same 3/16" welding rod can fuse thin sheet, thick plate, or any molded part from 1 inch to 60 feet (30mm / 28m) in length in a short period of time. The Powercore Welding Rod becomes an integral part of the weld. The super fine wires remaining in the weld area have been extensively tested, and have no negative effect on the strength or longevity of the weld.

Powercore Welding Rod Composition:



Note: The inner base core and the outer coating are made of the same plastic resin.

Examples of Powercore formed into different shapes:



How Does Powercore Work?
Order your Powercore Welding Rod made with the same plastic as the parts to be joined. Then cut to length and form (if applicable). A showen above, the ends of the rod are then stripped away to allow an electrical connection to be made.(see also Stripping Overview) The Powercore Welding Rod is positioned and attached to one of the plastic parts that are to be joined. There are many ways of positioning the rod including hot air gun, spot welding, machined or molded grooves, Thermo-Forming, and mechanical apparatus (see Positioning Powercore). The parts are then aligned and clamped. A variable AC or DC power supply is connected, and a current flows through the Powercore Welding Rod for a pre-determined length of time causing the entire rod to heat up and thermally fuse the parts together .(see Simple Weld)

Precise Welding Temperatures:
The amount of electrical current flowing in the Powercore Weld Rod can be adjusted to achieve precise welding temperatures for different plastics. This temperature can be maintained for a given length of time to allow heat to "soak" into the surrounding material for a perfect bond! (see Current Flow & Time)

Low Power Requirements:
Powercore can achieve most welding temperatures with approximately 6 Amps of current flow. This requires only 7.6 volts to induce 6 Amps in one foot, giving Powercore a very low power consumption of 45 watts/ ft. A standard 220 volt wall circuit can weld 29 ft (8.7 m) all at once!

Unique Features of Powercore:
One of the unique features of Powercore, is the ability to welding very large objects in the same time it would take to weld small objects. For example, if a one foot (0.30 m) sheet weld takes two minutes (as illustrated in Simple Weld). A 29 foot (8.7 m) sheet weld will also take 2 minutes. This is possible because the amount of electrical energy input is increased proportional to the length of the weld. A one foot weld uses 45 Watts. where a 29 foot weld uses 1305 Watts. Therefor the welding time remains the same. Think of it as 29 one foot welds in a row. This feature can save the user a tremendous amount of time.

Another unique feature of the Powercore Welding System is it welds itself. After constructing a customized clamping device for the particular parts to be welded, the operator clamps the Powerocre Welding Rod into position, flips a switch, and the Powercore fuses the parts together automatically.

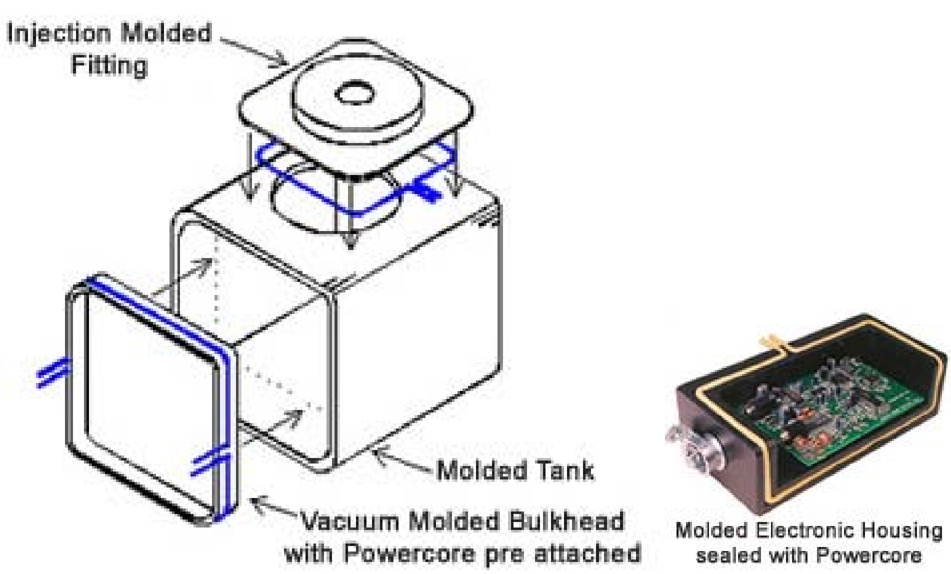
Applications

Piping Applications:

Powercore is used in all types of piping situations. Powercore can be used for Butt Fusion joints, fabrication of fusion collars, and the application of various types of fittings.

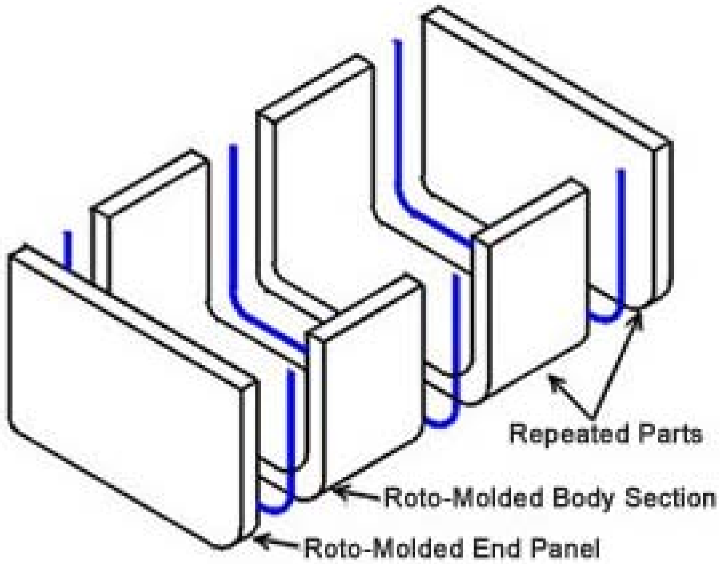
Molding Applications:

Vacuum molded and injection molded parts can be fused onto, or into, a variety of configurations. In the case of vacuum forming, the Powercore Welding Rod can be placed on the mold prior to forming. After the forming process, the Powercore Welding Rod will be pre-attached to the part in the optimum welding position. Injection molded parts can be made with a molded groove that the Powercore Welding Rod can snap into.



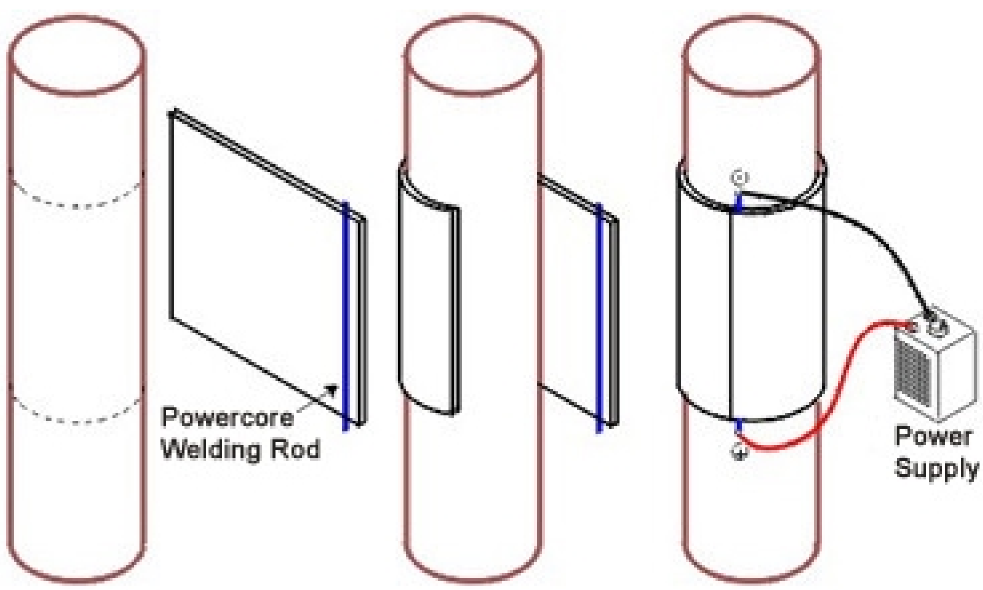
Roto-Molding Applications:

Roto-molders have used Powercore to fabricate multiple sized tanks with only two molds. By molding an end panel, and a body section, multiple sized tanks can be fused together with Powercore by adding body sections between end panels.



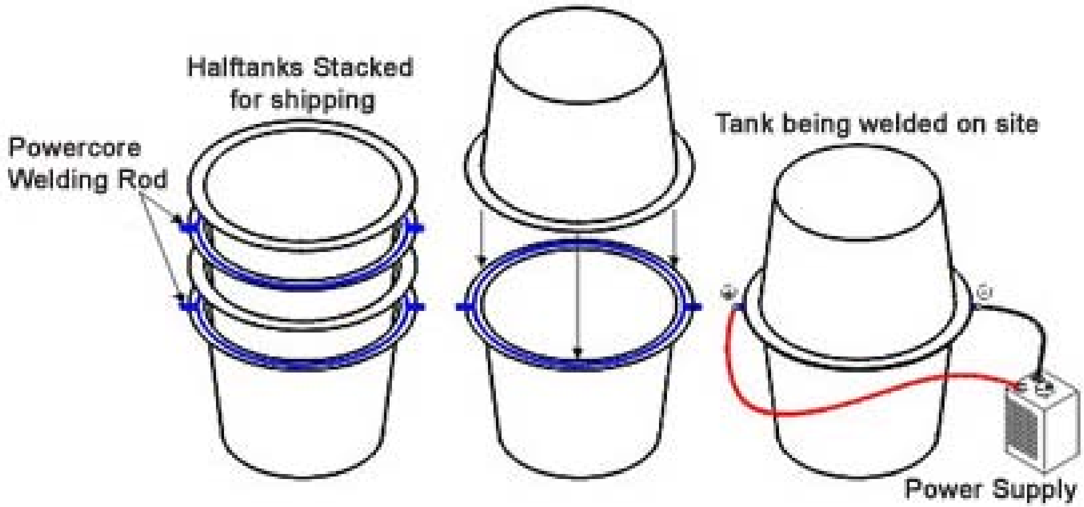
Thin Sheet Applications:

This example shows Powercore pre-attached to a thin plastic sheet, which is then used to create a protective wrap around Warf Piles.



Cost Saving Applications:

When large objects such as storage tanks need to be shipped great distances, the shipping cost can exceed the cost of the tank. By Rotomolding or Vacuum molding two half tanks that can be stacked inside another, many tanks can be shipped in the same amount of space it takes to ship one. The tank can be easily welded together once it reaches its final destination.

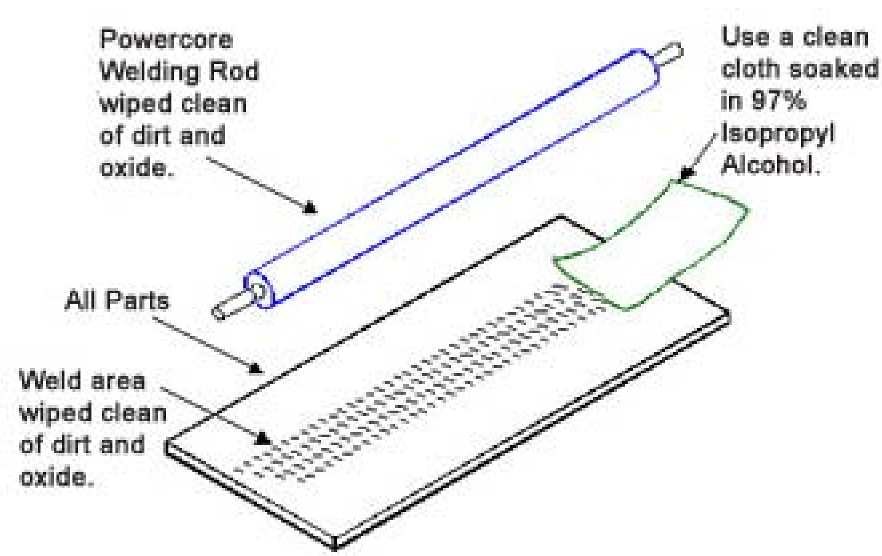


Simple Weld

Step 1:
After electrical connection pins are inserted (see Stripping Overview), the welding area and the Powercore Welding Rod must be wiped clean of any dirt and contaminants. We highly recommend 97% pure isopropyl alcohol, as it is a pure cleaner that leaves no residue. Acetone, Varsol, or other industrial cleaners are NOT recommended.

Remember; plastic can oxidize, as steel can rust. It is also recommended that the area be scuffed with a light sand paper or abrasive cloth to remove this oxidized layer. This will ensure a very strong bond.

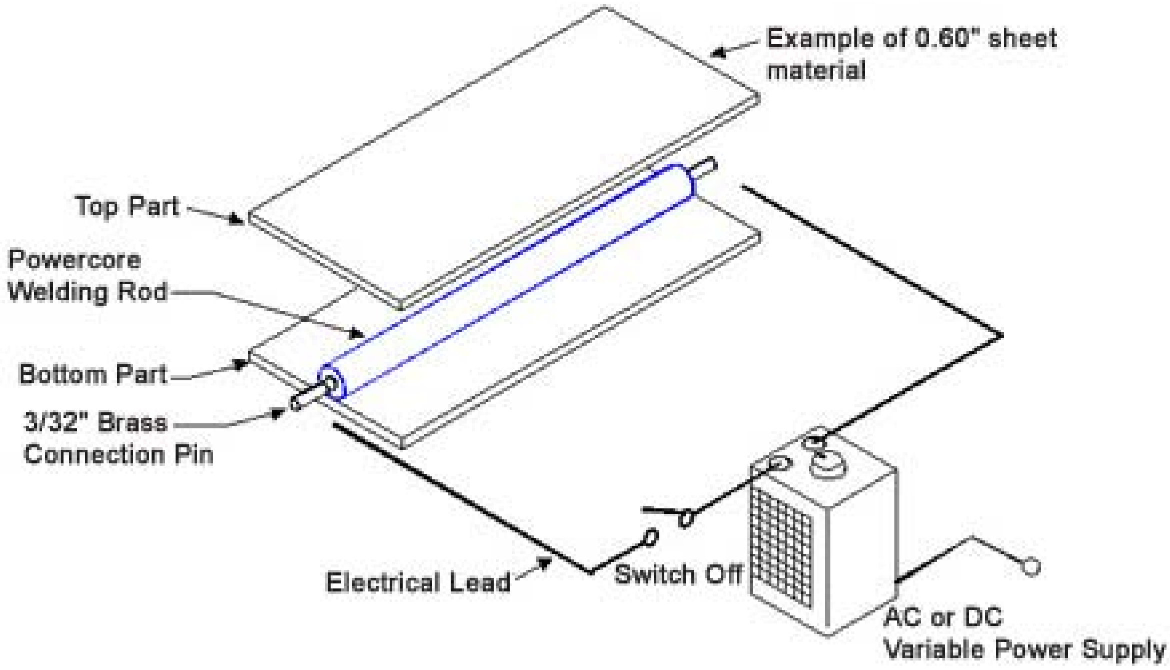
Note: Your hands have dirt and oils on them. Touching the Powercore, and weld area after they have been cleaned may re-contaminate.



Step 2:

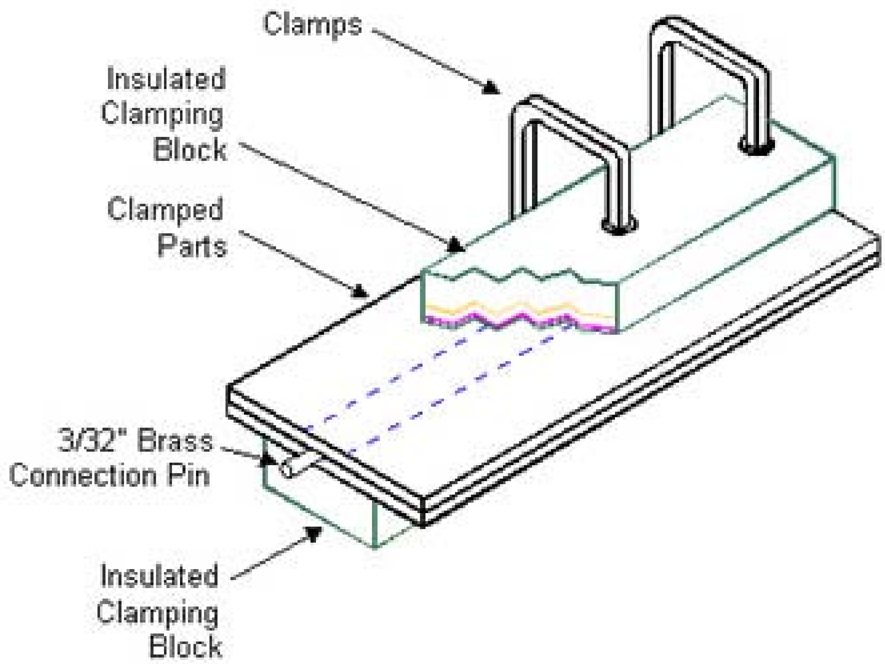
Powercore Welding Rod is positioned, and pre-attached to the bottom part.(see Positioning Powercore)

Note: Cleaning Powercore and weld area after it has been attached to part, is recommended and can save time.



Step 3:

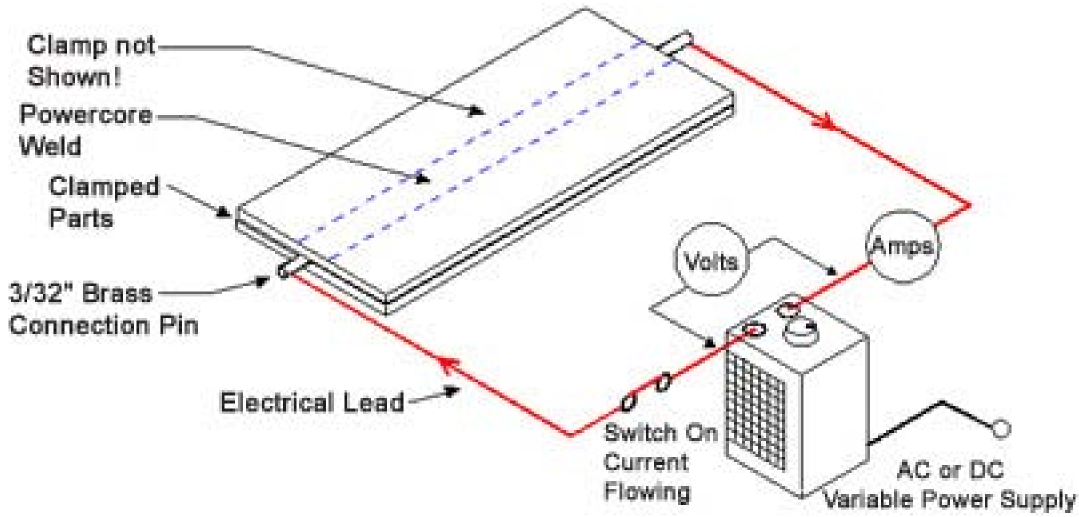
The parts are aligned and clamped together.(see Clamping Thin Plastics)



Step 4:

Once positioned and clamped, the electrical leads are connected, and the power supply is turned on for a pre-determined amount of time to allow parts to thermally fuse together.

Note: After the power supply is turned off, the parts should remain clamped together until weld area cools.(1 to 3 minutes depending on thickness).

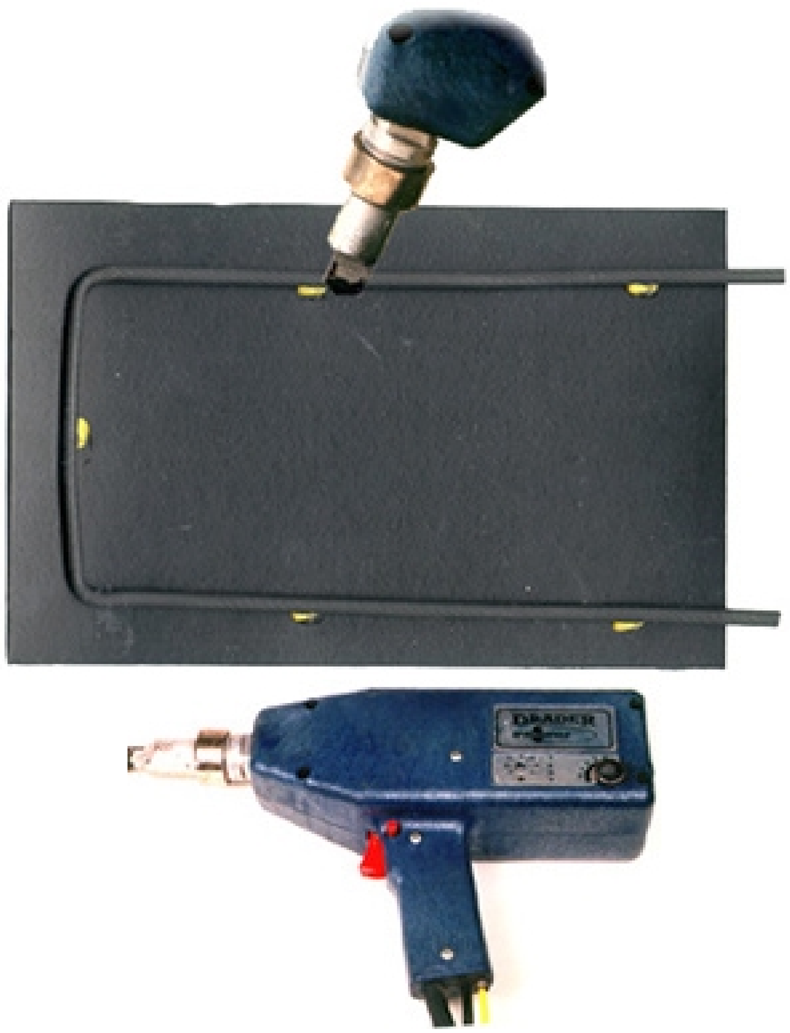


A section 0.060" (1.53mm) thick HDPE sheet material welded with Powercore Welding Rod.

Positioning Powercore

There are many ways of placing the Powercore Welding Rod on the parts to be welded. Including spot welding, hotair tacking, mechanical apparatus, and molded or machined grooves.

Spotwelding:

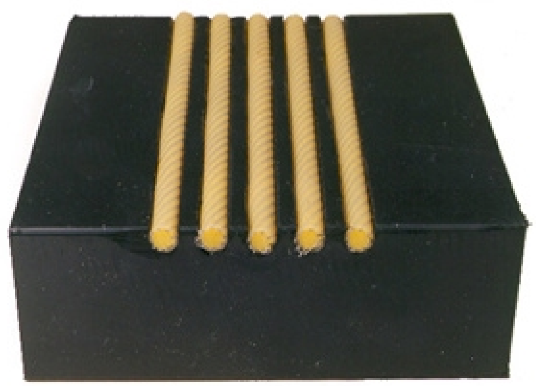


Powercore Welding Rod spotwelded (in yellow) on HDPE sheet material with a hand held extruder.

Hotair Tacking:

Powercore Welding Rod being " Tacked " onto thin sheet material with a hotair gun (use low heat setting).

Molded Grooves:



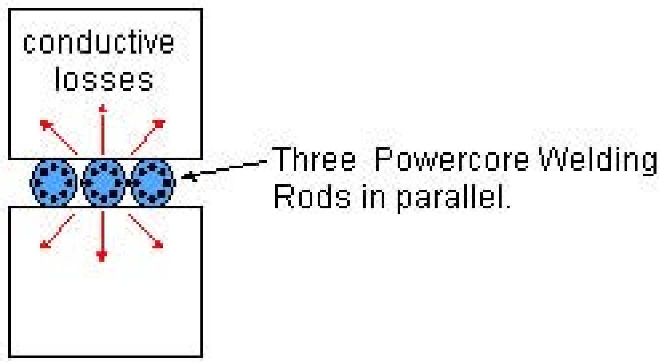
Powercore Welding Rod placed in grooves made in thick material.
(for more information see: Welding Thick Plastics)

Welding Thick Material

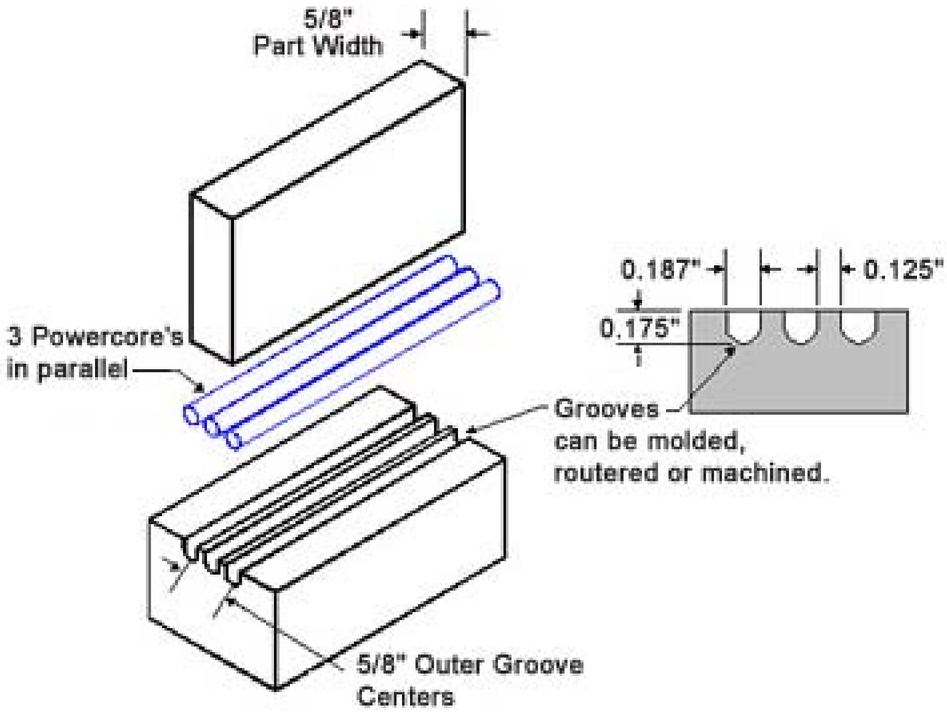
When welding thick material there are a number of factors to take into consideration:

Time to do the weld
Heat transfer
Applying the Powercore Welding Rod to the part
Strength of weld required

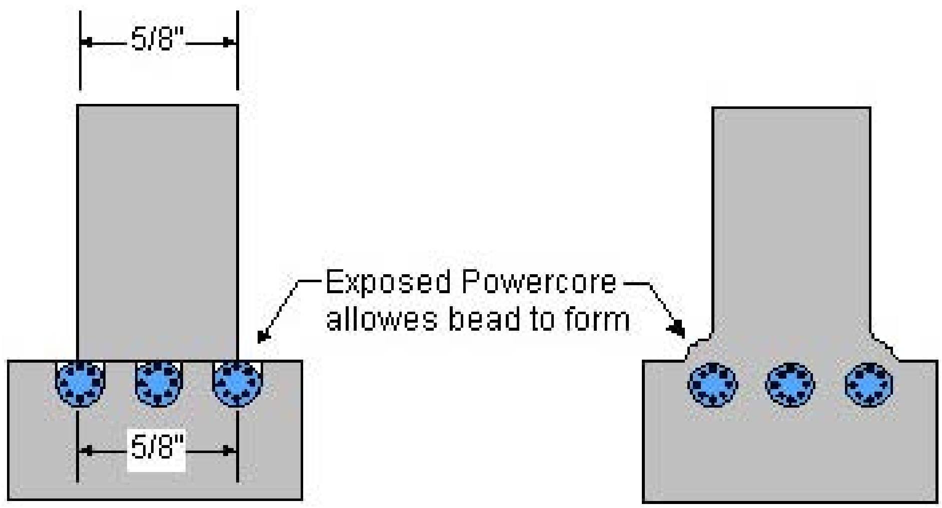
Due to the mass of material, heat energy is conducted away form the Powercore Welding Rod into the surrounding material. To compensate for conductive losses, two or more rods of Powercore can be used in parallel. Using Powercore in parallel creates greater heat input as well as a wider weld surface. To further compensate for conducive losses, the current flow in each welding rod can be increased. The amount of current flow and density of the Powercore Welding Rods in parallel can dramatically reduce the time it takes to weld. By placing the Powercore Welding Rod into a grove molded on the part can also decrease weld time as well as increase the strength of the welded joint. The following diagrams illustrate how Powercore can be used to weld thick material.



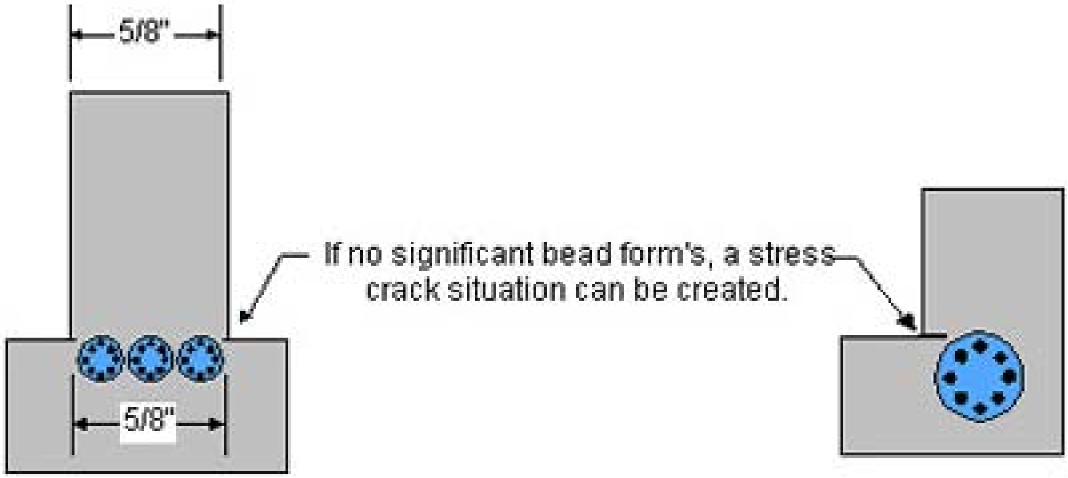
Powercore Welding Rods in parallel counteracts affect of conductive losses, and decreases weld time by inputting more heat energy into thick material.



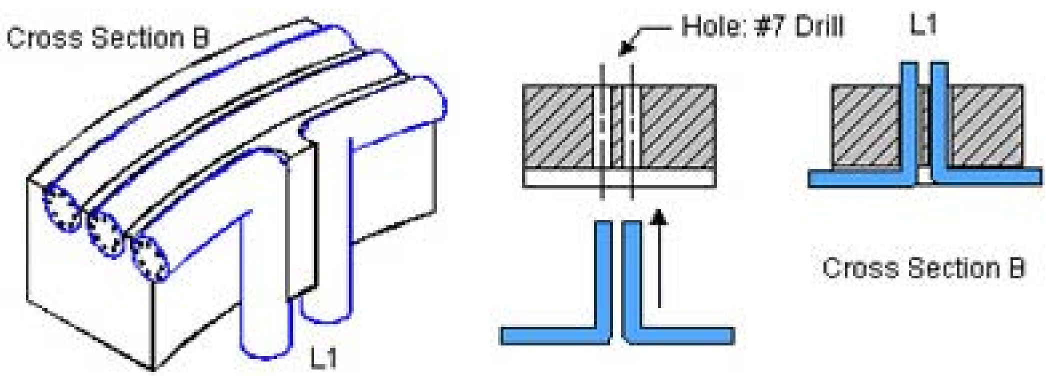
To increase eficency, Powercore can be placed in molded grooves. This also keeps the Powercore in the desired position for welding.



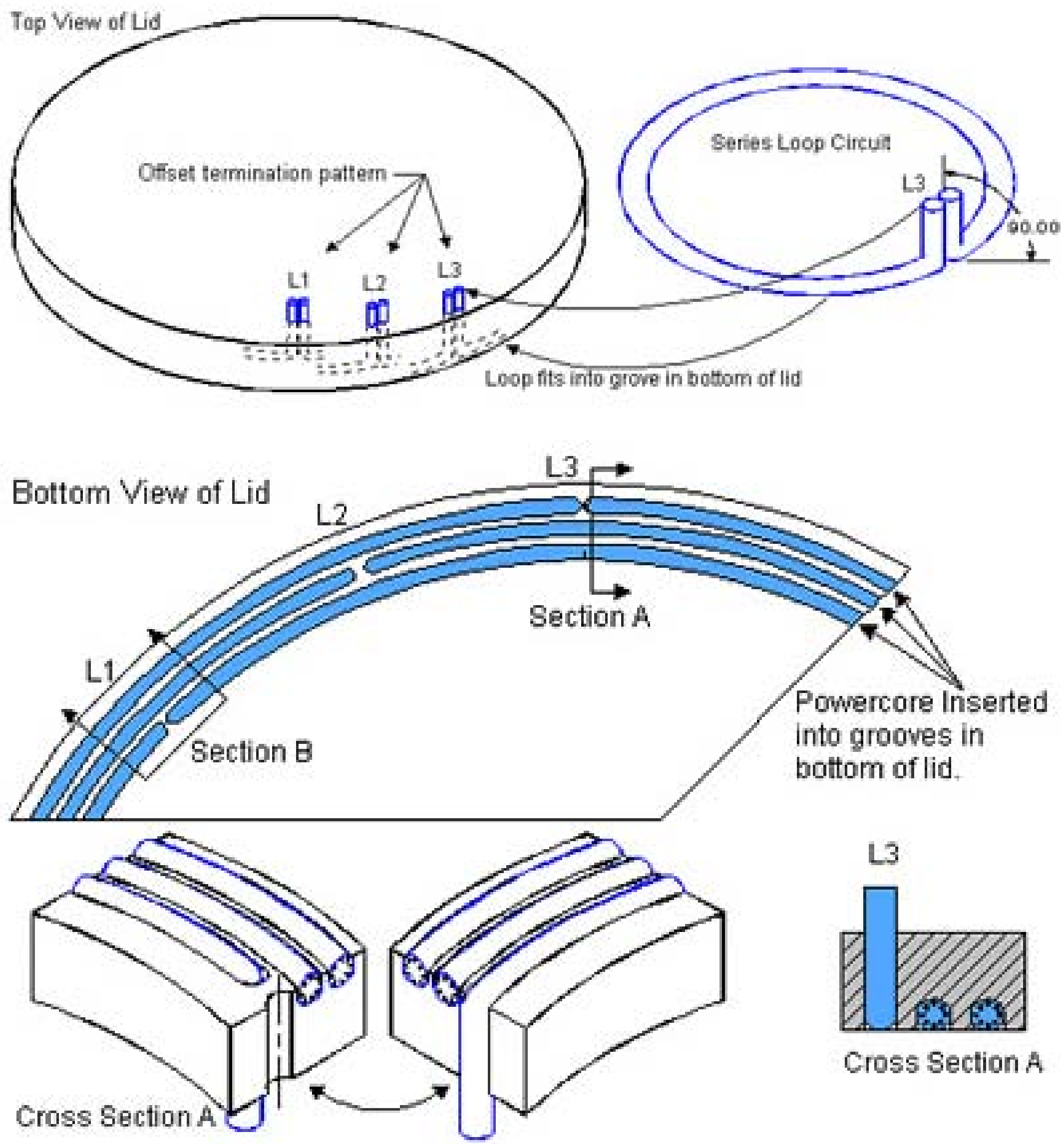
To ensure a stong joint, the groves for the Powercore Welding Rod should be slightly wider than the part to be weld to create a bead.



If the core centers are smaller than the part to be welded, no bead will form. A substandard joint may result even though the parts are fused together.

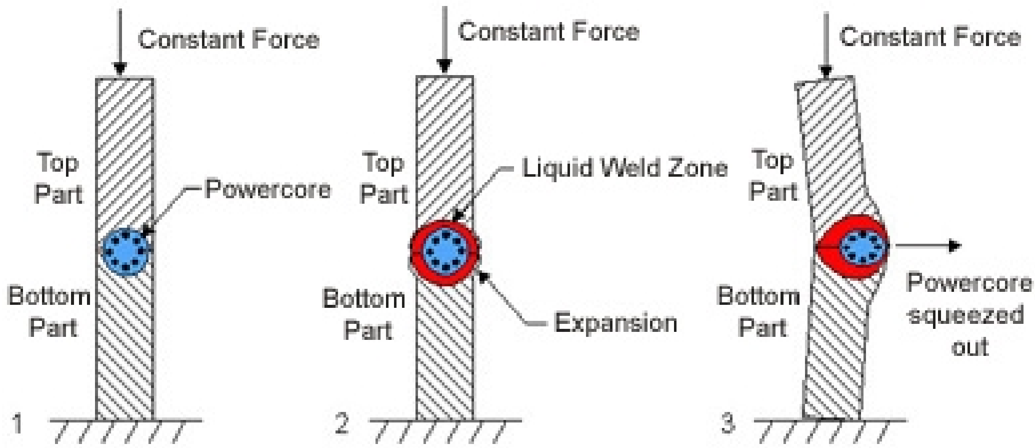


Creating a Lid With thick material

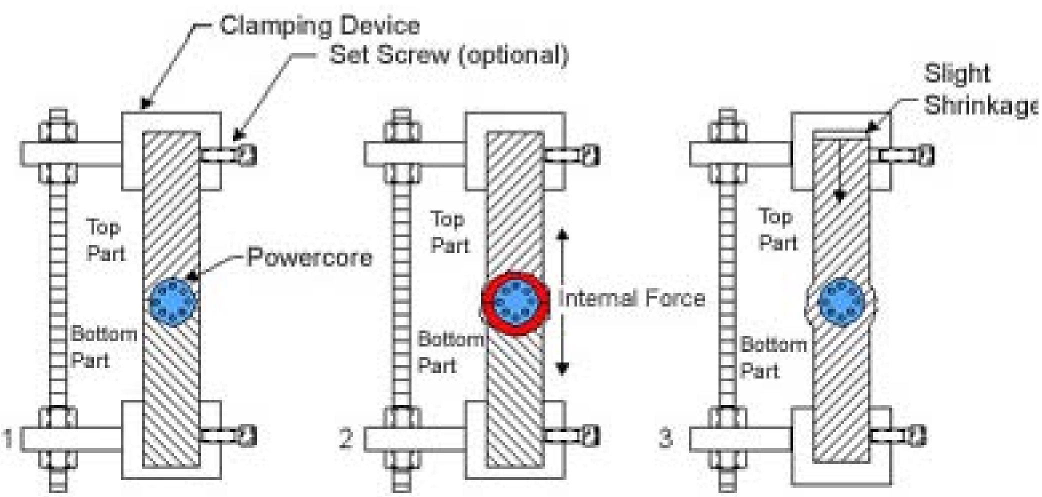


Clamping Thick Plastics

When plastic is at welding temperature it is essentially a liquid or it is molten. Therefore when the Powercore Welding Rod is at welding temperature, it is also molten. If too much external pressure is applied during the weld cycle the Powercore Welding Rod, and the molten weld zone can be squeezed out of the desired position. To properly weld with Powercore a small clamping pressure is all that is required. (less than 2 psi). More importantly the clamps should not allow the parts to move in any direction. This will allow the molten weld zone to stay in the same position, and the parts will stay aligned. The two illustrations below show the result of a constant force weld verses a static clamp weld for thick material.



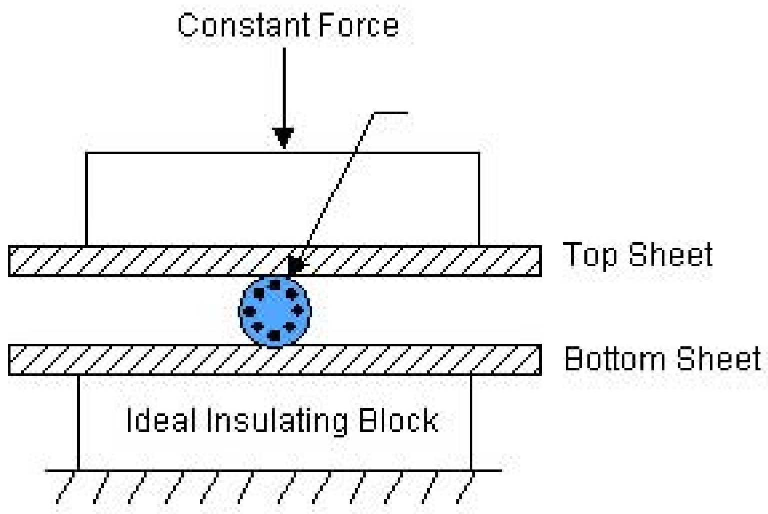
1) A constant force is applied.
2) As the weld zone and Powercore heats up, the entire weld zone will expand and become molten.
3) Powercore is squeezed out of weld zone. Parts are out of alignment.



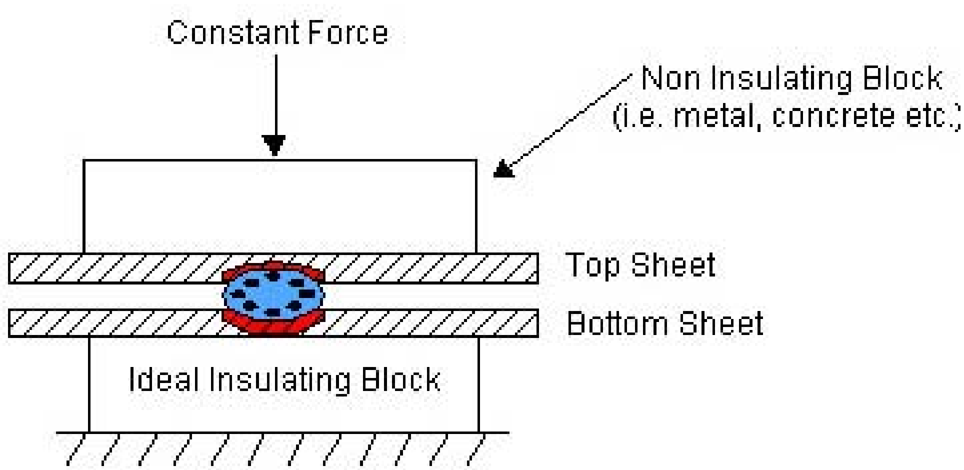
1) Clamping device holds parts in a static position
2) Weld zone will expand as it heats, causing internal pressure forcing parts into clamp.
3) As parts cool, a set screw is released to allow parts to shrink up slightly to prevent internal stress from forming.

Clamping Thin Plastics

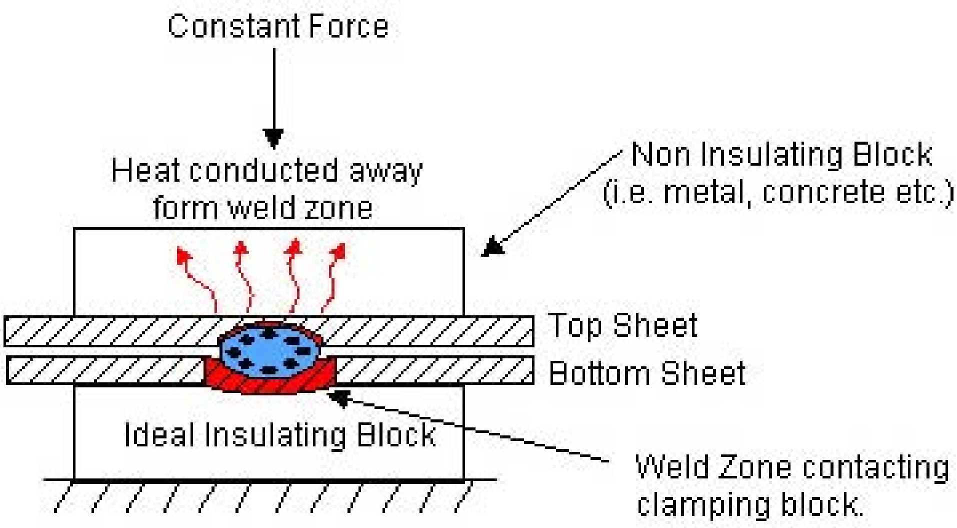
When welding thin material, the size of the molten weld zone compared to the size or thickness of the material must be taken into consideration. The molten weld zone can penetrated up to 3/16" (5mm) around the Powercore Welding Rod into the plastic material. As in the case of thick material the parts must be held in a static postion during the entire weld cycle. However; with thin material, the molten weld zone will come in contact with the clamping device. The clamping device must be constructed so that it will not stick to the weld zone after it cools, and does not conduct the heat away from the weld zone during the weld cycle. The diagrams below illestrates the formation of the molten weld zone between a insulating, and non insulating clamping locks.



The Powercore Welding Rod is positioned and clamped between the top and bottom sheet. (see Simple Weld)



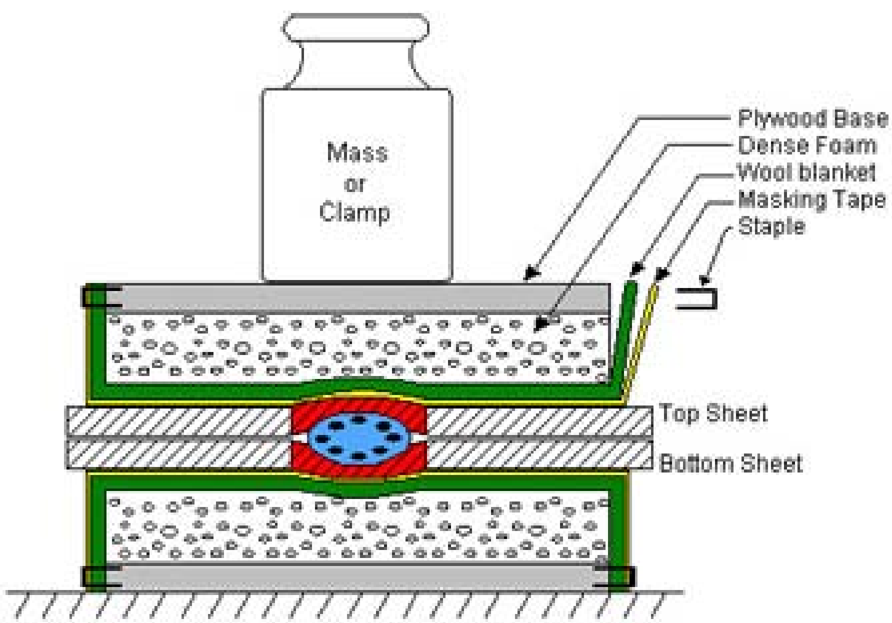
When the weld cycle begins, the Powercore Welding Rod becomes molten and it will begin to flatten.



If a non insulating material is used, heat will be conducted away from the weld zone, and a poor bond may result.

The Ideal Clamping Block:

The ideal clamping block for thin sheet is made out of some surprisingly common materials. To prevent the block form sticking to the weld zone, masking tape is and excellent material. It has high heat resistance , its inexpensive , and easily removed. Wool Blanket (genuine wool) is an incredible insulating material. It can withstand very high heat, and it is plyable and durable. A dense form is used so the block will conform to the weld zone during the weld cycle. The block is constructed with a ridged base of plywood. In this case a constant force can be applied will a mass (or a clamp) that will give a average weight of .25 psi over the entire clamping block surface. Materials such as rubber or silicone can also be used as an insulator, but these materials can conduct heat away if they are too thick.



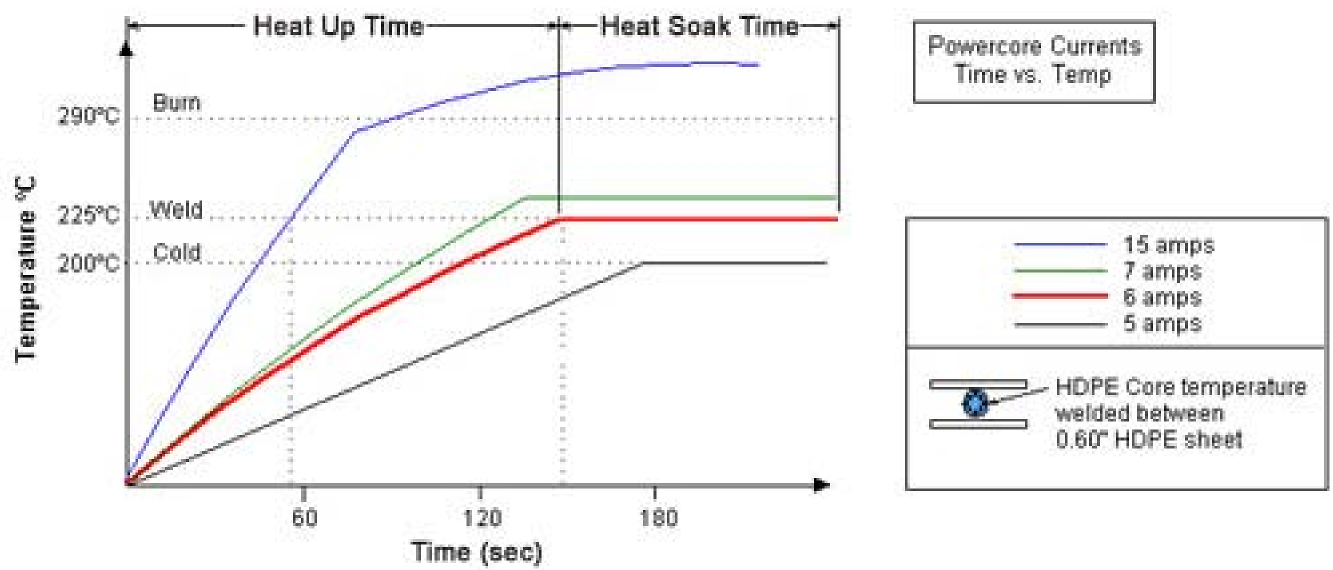
The Ideal Clamping Block

Current Flow and Time

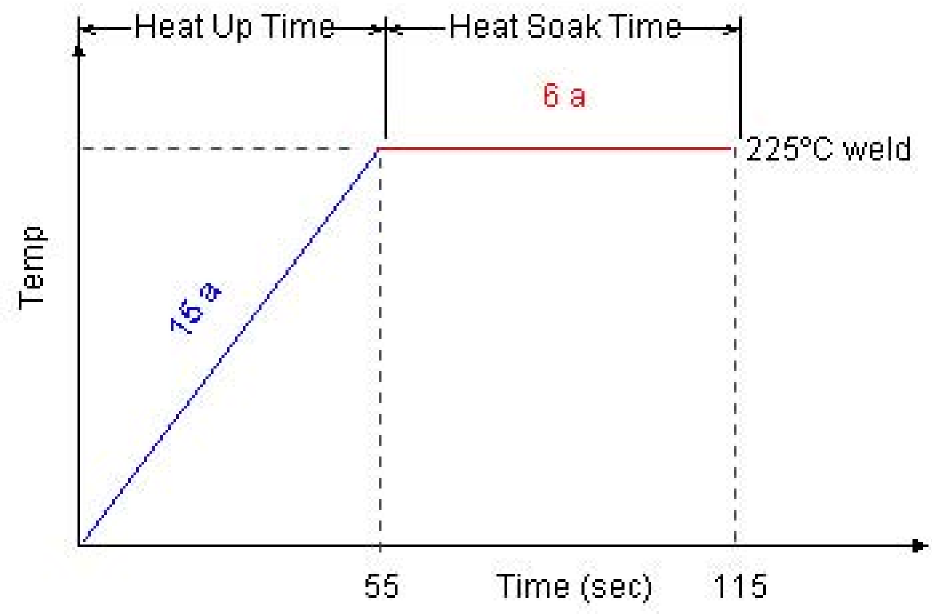
Current flow measured in Amps is the factor that determines the temperature of the weld.

When the Powercore Welding Rod is placed between two pieces of plastic, it requires a minimum of 6 amps of current to reach a stable welding temperature. Higher current can be used when a faster welding time is needed, or a material thicker than 1/2" is to be welded.

Powercore can surpass the welding temperature of a given plastic if the current flow remains too high for too long. When 6 amps of current is induced in a single piece of HDPE Powercore in air, the temperature will reach 290 ºC. Smoke will result, but it will not catch fire. The graph below illustrates maximum weld temperature reached for different current flows in a 0.060" (1.53mm) sheet weld configuration (see Simple Weld), after a period of time. Notice that the core temperature is quite stable during the Heat Soak Time.



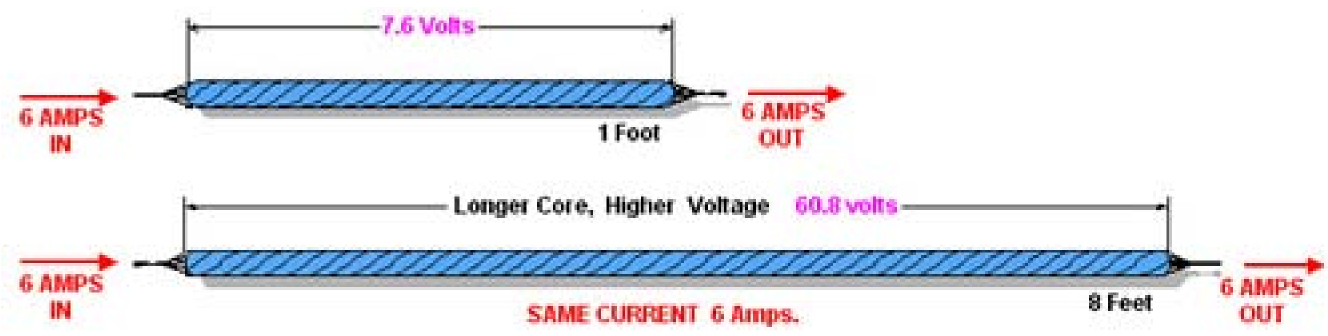
Decreasing Weld Time:
To decrease heat-up time, a two step current flow may be used. For example 0.060" (1.53mm) sheet can be welded at 15 amps for 55 seconds, then 6 amps for 60 seconds. Extreme caution must be used, if current is left at 15 amps for too long a fire may result!

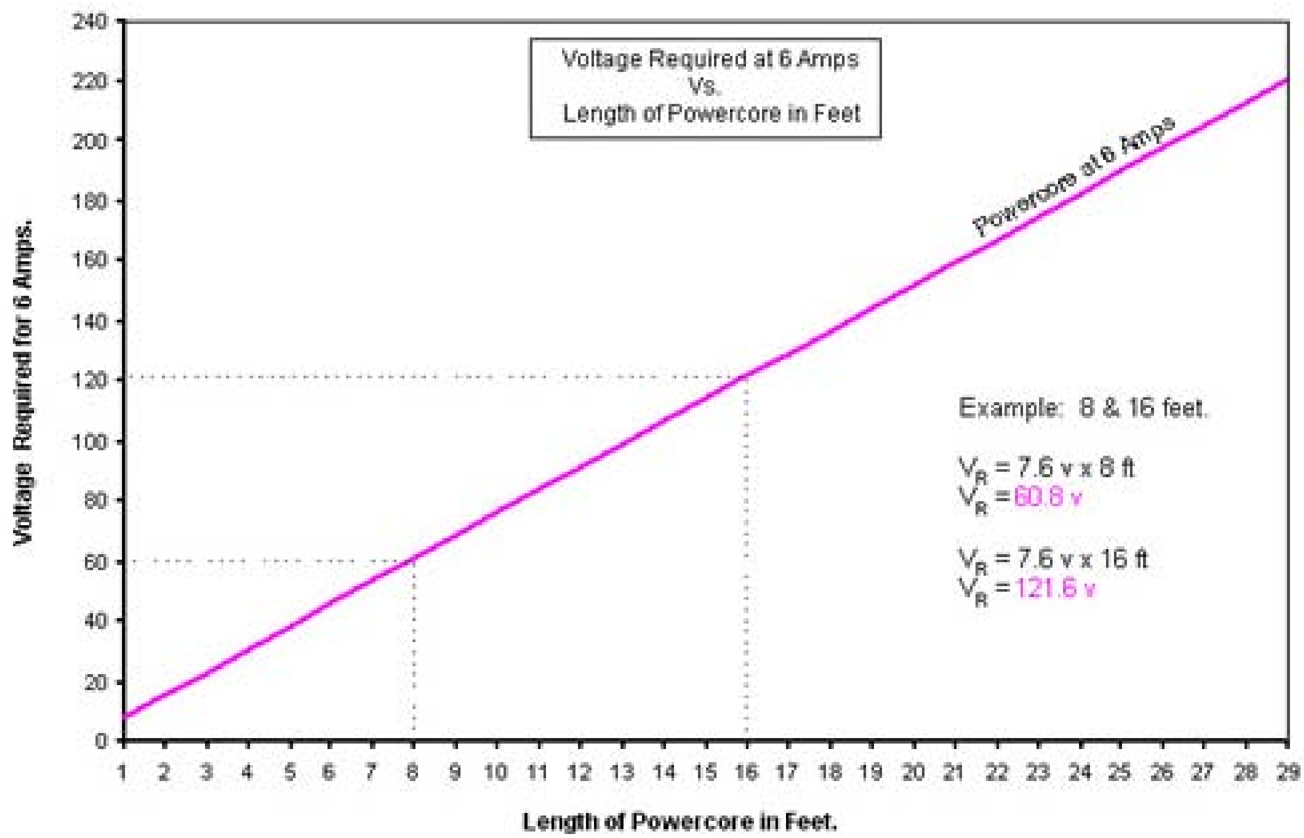


Voltage

Voltage is the dependent factor with Powercore. Knowing that 6 amps is the minimum current required, the voltage is adjusted to acquire 6 amps of current flow. The two main factors determining voltage are the amount current flow, and the length of Powercore. Higher current flow will require higher voltage. Longer lengths of Powercore will also require a higher voltage. Both an AC or DC power supply can be used, and the voltage and current requirements will remain the same. The graph below illustrates the voltage required to induce current flow from 1-foot (0.30 m) to 29 feet (8.7 m) of Powercore.

Example: Voltage Difference 1 & 8 Feet of Powercore





Series and Parallel Circuits

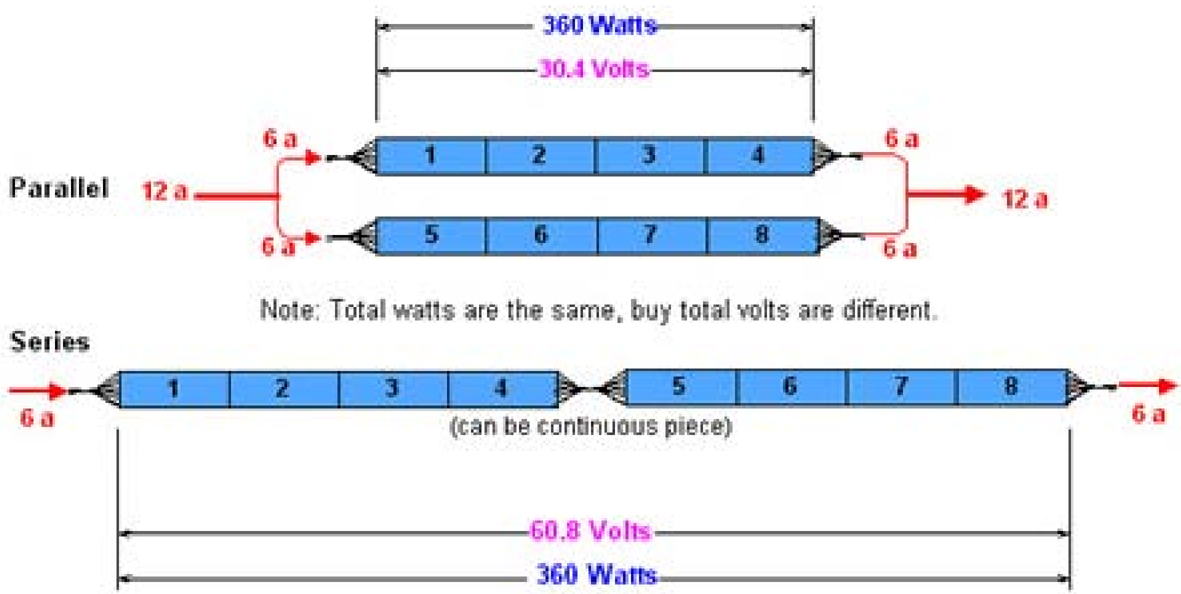
There are two main differences between series and parallel circuits; total voltage, and total current. Series circuits have higher voltage lower current, and parallel circuits have higher current with lower voltage.

Parallel Circuits:
Voltage is dependent on the longest length of Powercore NOT the total number of feet of Powercore.

Total volts = (Volts/foot) x (maximum length in feet)

Current is the current per core, multiplied by the total number of Powercores to be welded.

Total Current = 6 a x (Total No. of Powercores)



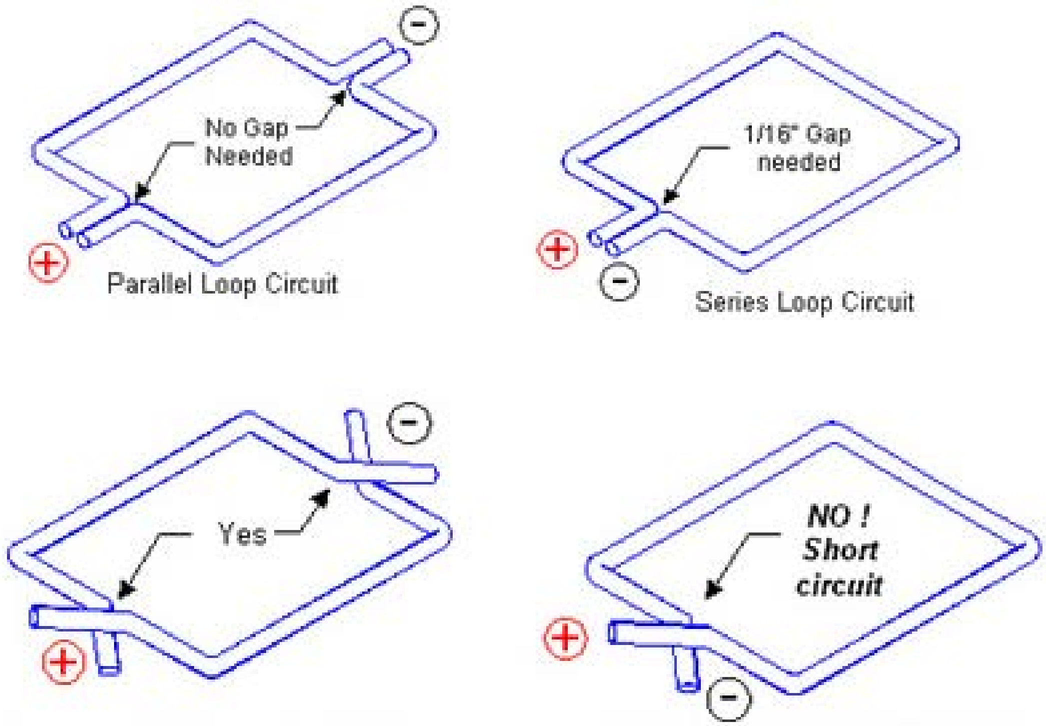
Series Circuits:
Voltage is dependent on the longest length of Powercore (the total number of feet in this case).

Total volts = (Volts/foot) x (total number of feet)

Current is the minimum current required (6 amps).

Welding Parallel & Series Loop Circuits:
When making a parallel loop circuit, the Powercore welding rod can actually touch without shorting out. The Powercore will not short out because there is an equal potential difference between the wires at the same point along their length.

In a series loop circuit, the ends of the Powercore must be placed 1/16" (2mm) apart to prevent shorting. During the welding process the plastic around the wires will migrate together to form an air tight joint, but the wires will remain in the same location.



In a parallel loop circuit the wires can be crossed to create a air-tight seal. This will not short out.

In a series loop circuit the wires CANNOT be crossed, this will be a short circuit.

Power Supplies

There are many different types of power supplies that can be used to induce an electric current flow in the Powercore Welding rod. Both AC (alternating current) and DC (direct current) devises can be used at the same voltage and current flow with no change in weld temperature. The type of power supply depends on the type of weld, and the environment to be welded in.

AC Variable Transformers
For factory environments, variable AC transformers can be used. Variable AC transformers are available in many different voltages, and current ratings. Variable AC transformers can have high voltages, allowing them to do very long welds with a single length of Powercore. High voltage can be dangerous, that is why they are more suited for controlled factory conditions.

Variable AC Transformer, many different sizes available (500 - 7000 watts.)

DC Arcwelding Power Supplies
For field welding environments, a DC Arcwelding power supply should be used. Arcwelding power supplies have lower voltages with higher current flow. The lower voltage is safer in wet conditions but limits the length of Powercore that can be welded at one time. To compensate for the shorter length, multiple Powercore Welding Rod's can be welded in parallel because of the high current available. Another advantage for Arcwelding power supplies is they are approved field devices with ground fault protection which are easily accepted on job sites with strict safety regulations.

DC Arcwelding Power Pack 0 - 90 amps, 0 - 60 volts, with ground fault protection.

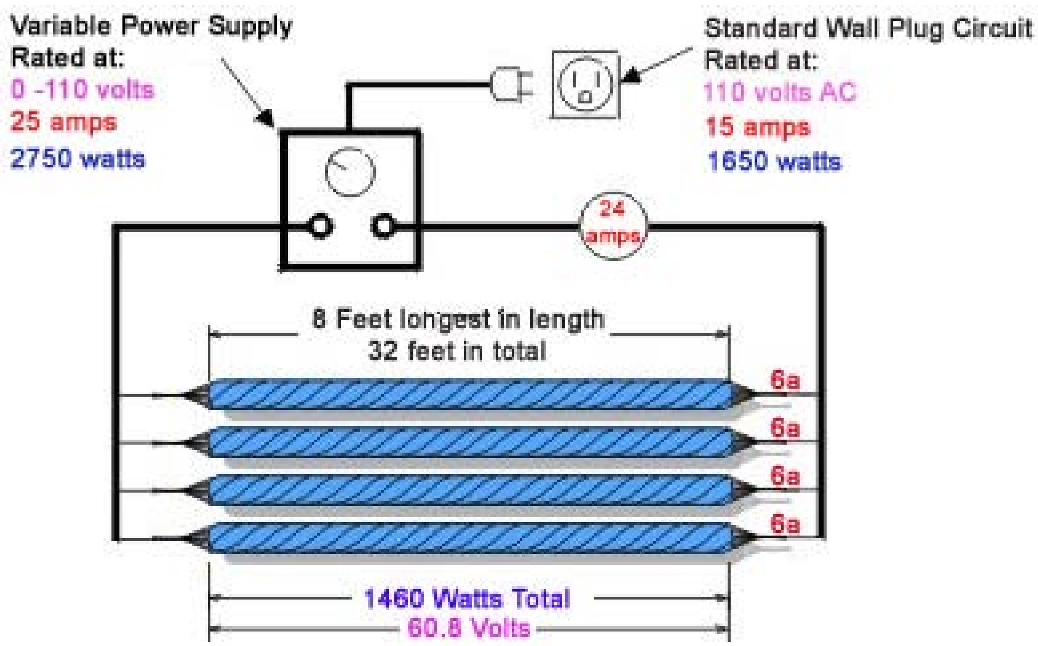
Other Power Supplies

There are many other electrical devises that can be used to supply an electric current. Powercore can be energized with any solid-state controller, or even a battery. Each type of power supply has its advantages and disadvantages depending on the situation, limitations and cost.

Sylvania Solid State Voltage Controller.(must be placed in electrical box) dimension (4x4x3 inches 100x100x75 mm) 0 - 220 VAC, 0 - 25 amps. See: Wiring Schematic

A power supply needs to be able to supply the power required for an extended period of time. Electrical devices are not perfect, they do have internal inefficiencies and tend to loose power when running its maximum for an extended period of time. It is always better to get a power supply that is capable of supplying at least 10 % more power (measured in watts) than is required to the weld.

For example four - 8 foot lengths of Powercore were to be welded in parallel:



Voltage Required = 8ft x 7.6v/ft
Voltage Required = 60.8v

Current Required = 6a x 4powercores
Current Required = 24a

Watts Required = 32ft x45.6w/ft
Watts Required = 1460w

or Watts Required = 60.8v x 24a
Watts Required = 1460w

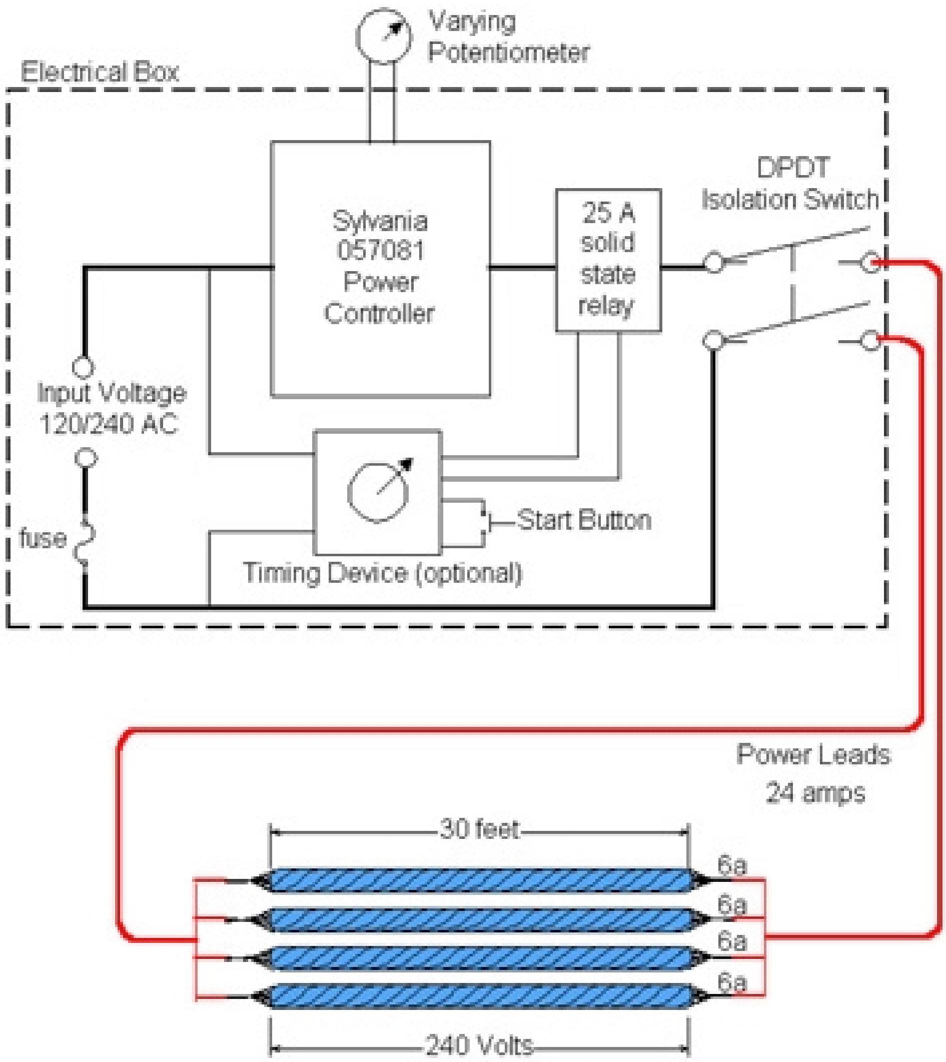
A standard North American wall circuit is 15a x 110 v = 1650 watts, this is 10.7% greater than 1460-w circuit shown. The power supply must be able to run 24 amps at 60.8 volts (1460 watts) continuously. A 15amp 110-volt 1650-watt wall plug is adequate to power such a device.

Note: The power supplies can produce a higher current on the welding circuit than on the wall plug circuit. It can do this because only 60.8 volts is required on the weld circuit (far less than 110v) . This wall circuit would not be able to supply 24 amps at 110 volts this surpasses the total wattage of the wall plug (24a x 110v = 2750 watts). The power supply would have to be plugged in to a 30 amp 110 v wall plug to run at its full rating continuously.

Schematic

Wiring diagram for Sylvania 057081 Power Controller

Note: Due to the fact that the welding circuit is wired directly to input voltage source, a DPDT isolation switch must be used to ensure safety.

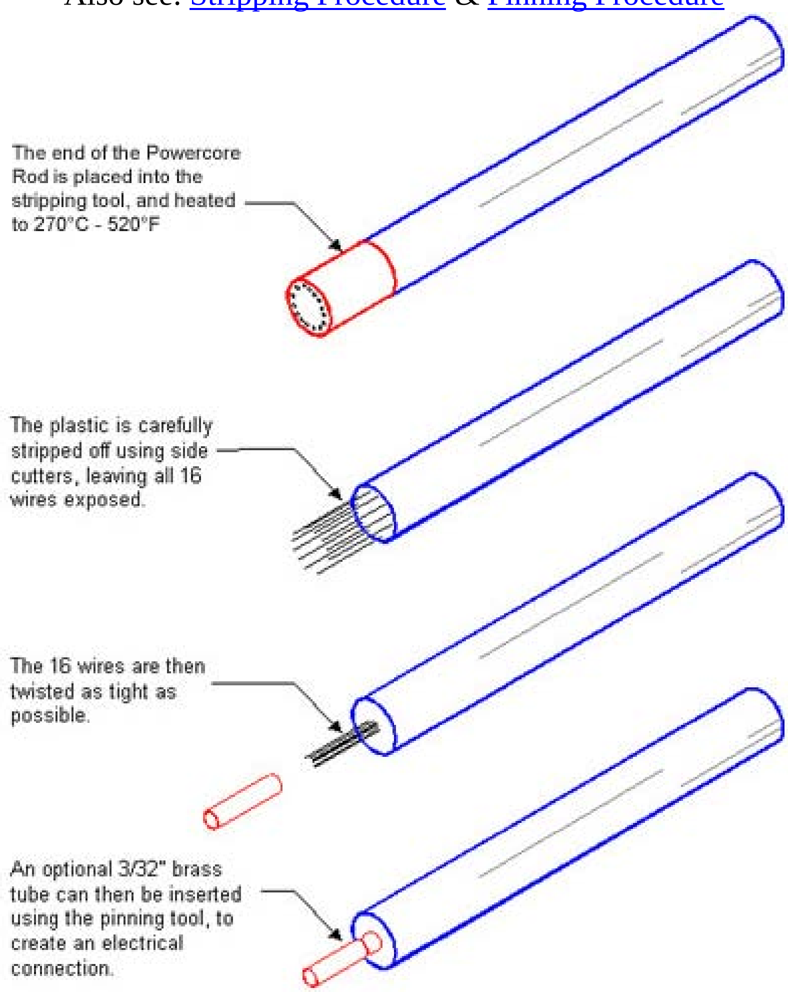


Powercore Welding Circuit.

[Back to Power Supplies]

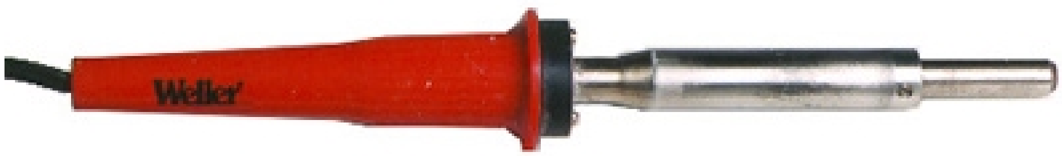
Stripping Overview

Stripping Tools made with Weller soldering pencils.
Also see: Stripping Procedure & Pinning Procedure

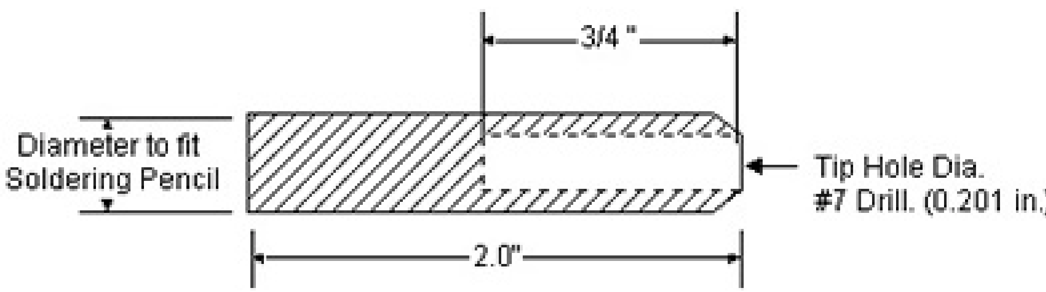


Stripping Procedure

End View of Stripping Tool.

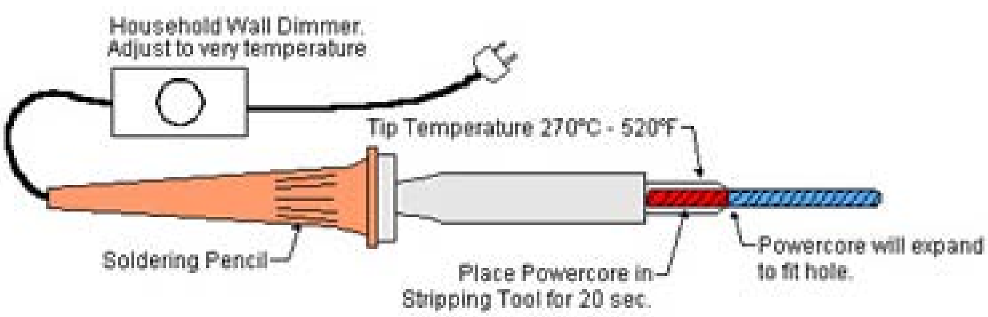


Stripping Tool inserted in soldering pencil.

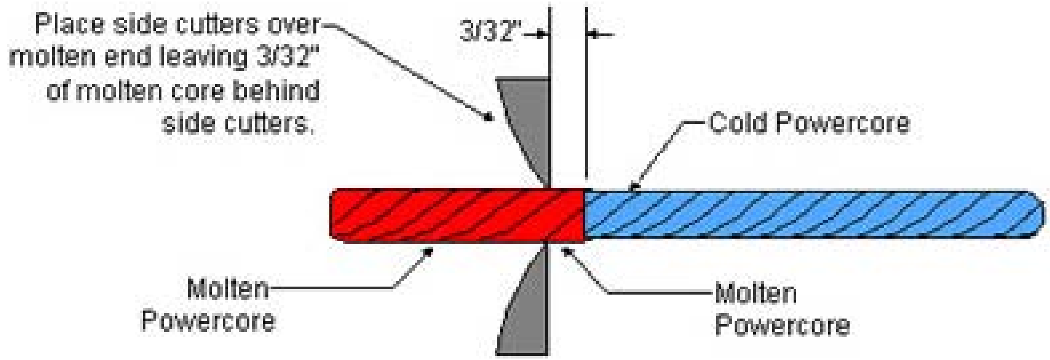


Stripping Tool Dimensions, machined out of brass rod.

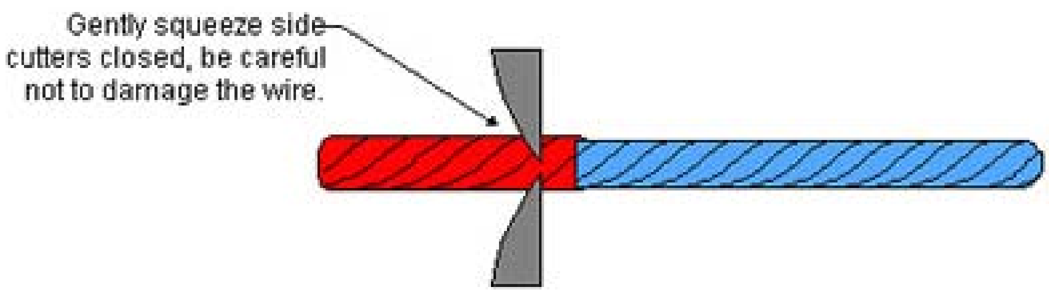
Step 1:



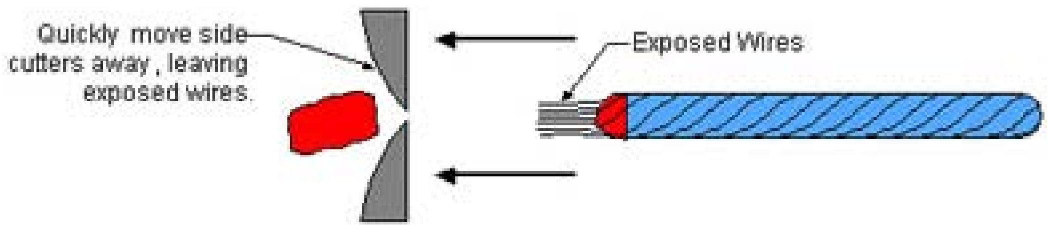
Step 2:


Place side cutters over
molten end leaving 3/32"
of molten core behind
side cutters.
3/32"
Cold Powercore
Molten
Powercore
Molten
Powercore

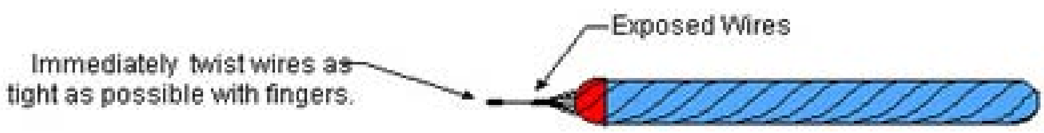
Step 3:

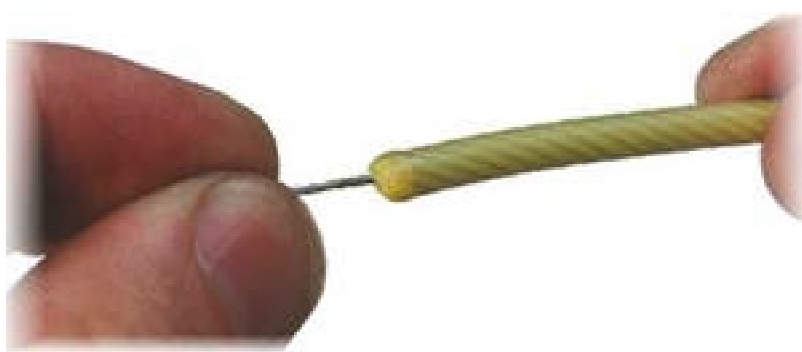

Gently squeeze side
cutters closed, be careful
not to damage the wire.

Step 4:


Quickly move side cutters away, leaving exposed wires.
Exposed Wires

Step 5:

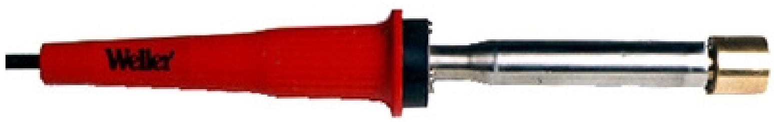

Exposed Wires
Immediately twist wires as tight as possible with fingers.



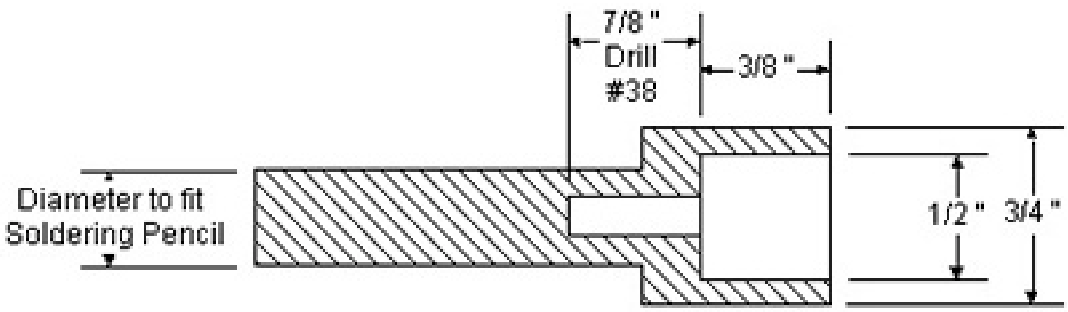
Pinning Procedure

Pinning Tool:

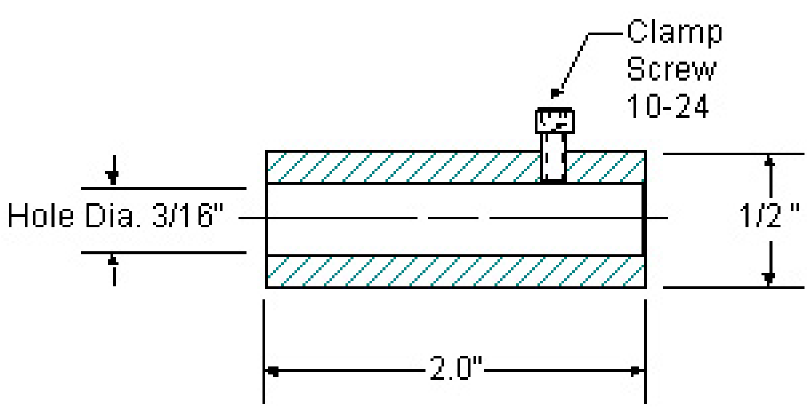
End View of Pinning Tool & Brass Connector Pin.



Pinning Tool inserted in soldering pencil.



Pinning Tool Dimensions, machined out of 3/4" brass rod.

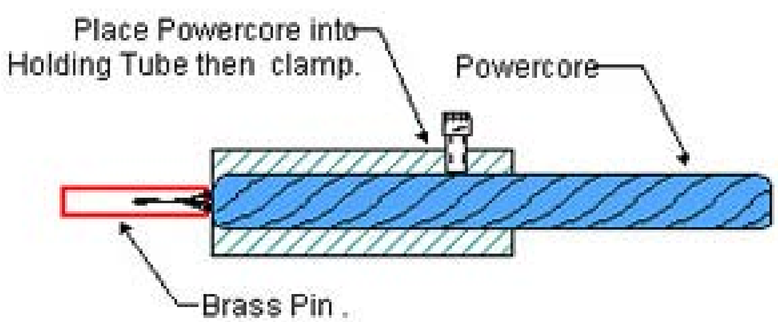


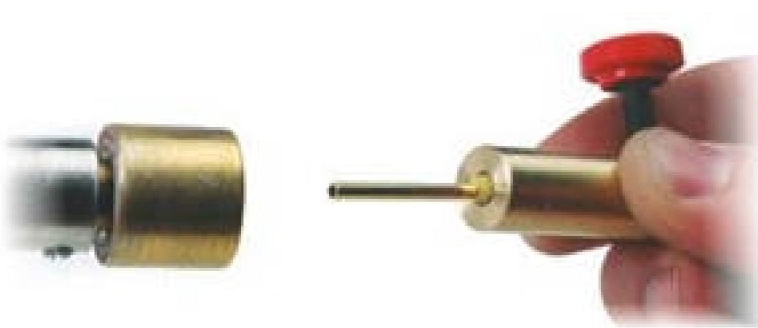
Welding Rod Holding Tube machined from 1/2" brass rod.

Pinning Procedure:

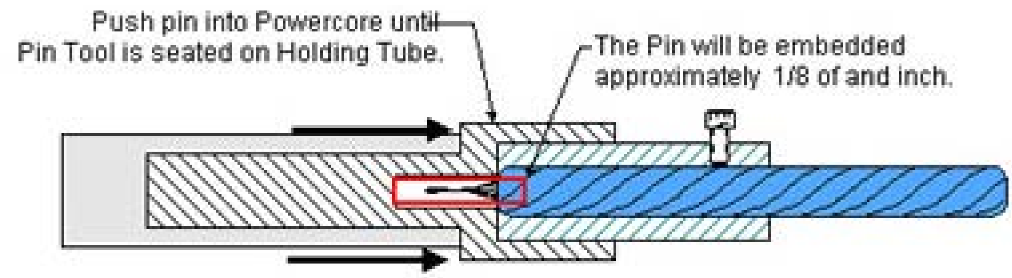
Step 1:

Step 2:

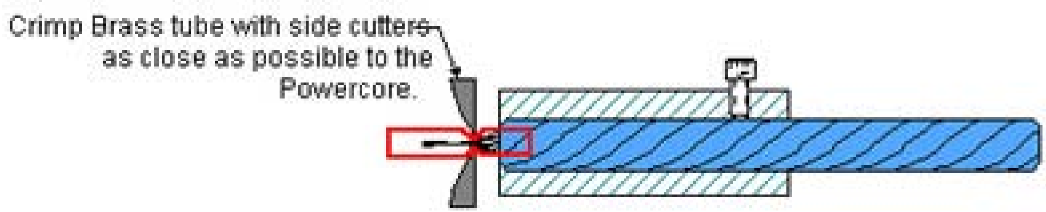




Step 3:


Push pin into Powercore until
Pin Tool is seated on Holding Tube.
The Pin will be embedded
approximately 1/8 of and inch.

Step 4:


Crimp Brass tube with side cutters
as close as possible to the
Powercore.