

Model 2701X
Electric Arc Remelt Button Furnace
by
Cianflone Scientific



Operation and Safety Manual



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Electric Arc Remelt Button Furnace Model 2701X Major Component Callout



IMPORTANT NOTE
Third-Party Items may vary by Manufacturer.
Cianflone Scientific reserves the right to substitute.

1. Description and Use

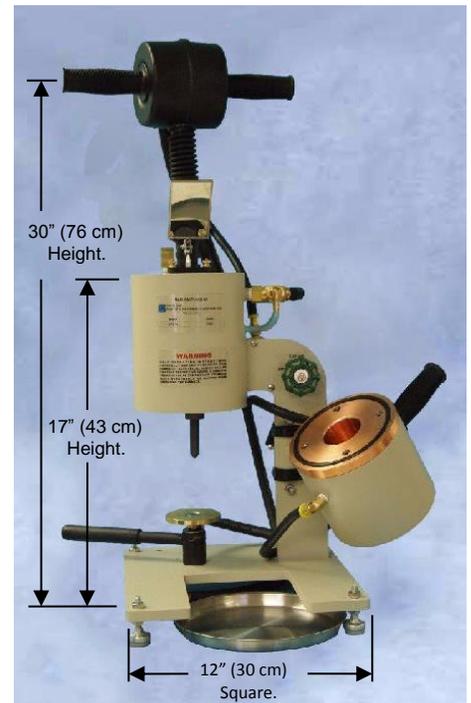
The Model 2701X Electric Arc Remelt Button Furnace produces metallic buttons 1 ¼" (32 mm) diameter by approximately ¼" (6.5 mm) thick for further analysis using x-ray fluorescence or optical emission spectroscopy. Its primary function is to melt irregular shaped metals such as drillings, fillings, lathe turnings, slugs, powders, grindings etc. into a button form. The violence of the arc during the melting process creates agitation or mixing of the molten metal to produce a homogeneous sample. It is especially useful in alloy research of steel, stainless steel, tool steel, as well as nickel, titanium and cobalt alloys. It has been found that little volatilization occurs to metals whose boiling temperature is above the furnace's 3600° F (2000 °C) maximum. A DC electric welder with a capacity of 400 to 600 Amps is recommended for use and can be purchased from Cianflone Scientific.

2. Site Preparation

Remelting metal into buttons is oftentimes a dirty operation and may not be suitable to a laboratory environment. Use this and the following recommendations to select a site.

- a. Properly sized electrical disconnects and wiring for the welder will be necessary. Contact us for proper sizing information for the welder if you purchased one through Cianflone Scientific.
- b. A source of cooling water. We offer a 30,000 BTU water recirculator that is suitable for constant operation. The recommended coolant should be purchased separately. Some customers elect to use city water when their furnace use is intermittent.
- c. A water shut off valve should be placed before the furnace and in an accessible location for the operator. With this configuration, the furnace will remain unpressurized while not in operation.

Note: *The brass globe valve shown has now been replaced with a ball valve to control the water flow through the furnace.*



Model 2701X Dimensions

- d. Argon Supply. Generally, welding purity grade argon would be sufficient. To be on the safe side when melting Ti sponge, opt for a higher purity with a lesser moisture content.
- e. Button Furnace stand/table/cart, height and material considerations. The image above displays the furnace height to the centerline of the furnace handles. The operator should be able to reach the handles comfortably while observing the melt by either through the adjustable mirror or looking directly down through the site glass. The furnace stand/table/cart should be constructed from metal as opposed to wood, fiber board or any type of laminate or composite. If a table is already in place and made from material other than metal, a sheet metal cover should be fabricated to cover the working area around the Button Furnace. An

Accessory Cart can be purchased through Cianflone Scientific as seen and described on page 3.

- f. A ducted ventilation hood over the furnace is recommended unless other forms of ventilation are available. A hood would eliminate the fumes created during a melt, dust created when cleaning the copper crucible between melts, as well as the exhaust fumes from the vacuum pump. Cianflone Scientific offers a ductless, portable welding fume extractor that features 3 stage air filtration. The first two primary filters can be cleaned with a water hose, with the third stage being a replaceable HEPA filter.
- g. AC receptacles must be provided and sized to accommodate the Vacuum Pump, Water Circulator and Portable Fume Extractor, in addition to an electric drill that may be used for cleaning the copper crucible after each melt. Below are the power requirements for the different products that Cianflone offers. All offerings listed are single phase 60hz. *NOTE: The Fume Extractor is not available in 50hz.*

	Voltage	Amps
Cat. No. Vacuum Pump	115	7
	230	3.5
Cat. No. 2722X-15 Water Circulator	115	8.2
	230	4.1
Cat. No. 2730 Fume Extractor	115	15

3. Unpacking the Button Furnace

The Button Furnace is typically shipped in a cardboard carton and placed on to a plastic pallet. Standard and optional accessories, depending on what was ordered, will be in a second carton and placed on the same pallet. Both cartons are banded together and to the pallet. The Welder and Fume Extractor ships mounted onto separate pallets.

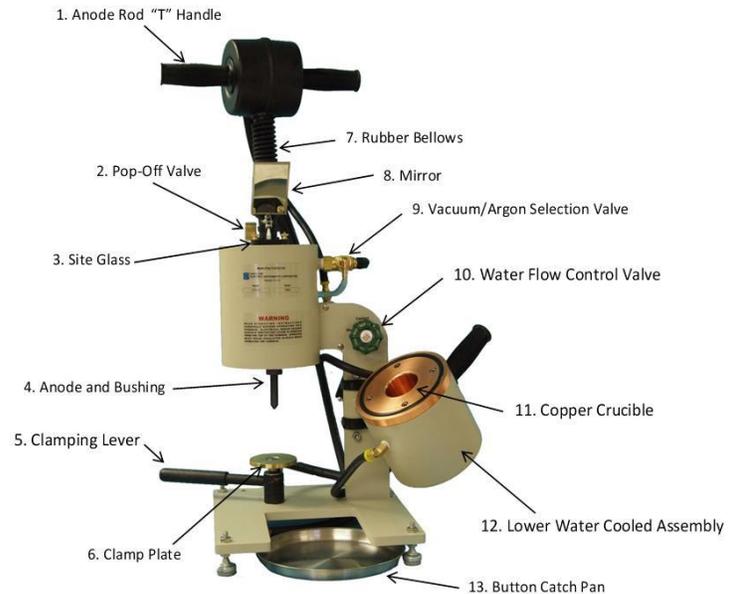
- a. Unpack and inspect the shipment to make sure no damage (*noticeable or concealed*) has occurred during shipment. If so, communicate with the carrier to register a claim.
- b. Use the packing list as a check list to ensure that all standard and optional accessories are included.

4. Identifying the Major Components

Use the following image to identify the major components of The Button Furnace.

1. Anode Rod "T" Handle. Connects to negative terminal of the welder and can be manipulated by lowering, raising and rotating during a melt to assure that all material in the #12 Copper Crucible becomes molten. It has the #4 Anode and Bushing attached.
2. Pop-Off Valve. Acts as a relief valve to release pressure buildup during a melt. It is rated to release pressure over 4 to 5 psi.
3. Site Glass. The Dark Site Glass is a made from #11 shaded plastic welding lens. Confined under the Site Glass Holder is the Clear Site Glass that seals pressure and vacuum in the furnace chamber.
4. The welder current discharges through the Anode. It is made from carbon graphite or tungsten. The Anode is retained by the carbon graphite Bushing or retaining nut.

5. Clamping Lever. Rotates 160° to lift the #12 Lower Water Cooled Assembly and seal it to the furnace Upper Chamber.
6. Clamp Plate. Mates to the bottom of the #12 Lower Water Cooled Assembly to provide a path to ground for the welder.
7. Rubber Bellows. The Rubber Bellows allows the #1 Anode Rod to have freedom of movement as well as holding vacuum and pressure.
8. Mirror. The mirror provides different viewing angles for the operator to observe the melt. It can be used or removed for direct viewing through the #3 Site Glass.
9. Vacuum/Argon Selection Valve. This valve has three positions, Argon, Off or Vacuum. An additional valve can be added for purging the chamber with other inert gasses like Helium.
10. Water Control Valve. The brass globe valve has been replaced with a ball valve to adjust water out of the furnace.
11. Copper Crucible. Holds the material to be melted.
12. Lower Water Cooled Assembly. Held in place by the Universal "T" which allows Lower Water Cooled Assembly to be rotated under the furnace upper chamber for melting and rotated upside down to drop the finished button out of the Copper Crucible.
13. Button Catch Pan. Catches the hot finished button.



The Button Furnace Component Call Out

5. Connecting and Setting Up

To ensure optimal operation, use the following steps for proper water, argon, vacuum and welder connections.

- a. Water Connections. Two ¼ FPT ports are provided for water in and out. The water ports are located where the water flow control valve connects to the manifold with the water inlet on top and the outlet on the bottom.
- b. Argon Connections. A quality two stage argon gas regulator is a must. The regulator sold by Cianflone Scientific has a built in check valve that will not allow gasses and debris produced by the melt to blow back into the regulator thus preventing damage. The regulator comes ready to connect to a standard argon bottle with tubing fitting attached. The Button Furnace assembler need only mount the regulator on the argon bottle and make the hose connections from the regulator to the furnace with the ¼" vinyl tubing that is supplied.
- a. Argon Regulator Pressure Adjustment. Rotate the Lower Water Cooled Assembly to the closed position and rotate the Clamping Lever from left to right, sealing the Lower Water Cooled Assembly to the Upper Furnace Chamber. Start increasing the regulator pressure until the Pop-Off opens and starts to

relieve pressure. This should occur when argon pressure is approximately 4 to 6 psi. Tighten the locknut on the valve stem to hold this position.

- c. Vacuum Connections. The Vacuum Pump, if purchased through Cianflone Scientific, comes with a flared suction fitting attached. If purchased, the vacuum hose that comes with the furnace will have a compatible fitting attached to the hose. The Button Furnace assembler need only make the connection from the pump to the furnace.
- d. Welder Connections. This job must be done with a qualified electrician. Consideration must be given as to the distance the welder will be placed from the disconnect and the distance from the welder to the Button Furnace. Both distances could affect wire size. If the welder is purchased from Cianflone Scientific, the power requirements will be provided upon request.
- e. Welder Settings. Initially, use the minimum setting for “arc force” and make small upward adjustments experimentally as necessary.

Note: *Welder Connections to The Button Furnace. Connect the (-) negative cable from the welder to the provided in-line cable connection. The negative cable must continue to the top of the furnace. The (+) positive cable from the welder will connect to the base of the furnace. (Newer Models may have the (+) positive cable connected to the Jack Plate)*

6. Sample Preparation

- a. For best results, it is advisable to load the furnace with clean oil free metal. Alcohol would be a good choice as a cleaning solvent, as it has low toxicity and dries fast.
- b. When melting grindings that contain a high amount of nonconductive material, add a measured amount of, for example, pure iron powder to the top of the load to aid in striking an arc to start the melt. When analyzing the content, the pure iron can be proportioned out.
- c. Another method for initiating an arc in a nonconductive load would be to lay a metal foil over the load. Again this foil could be proportioned out of the analysis. Aluminum is oftentimes used with this method.
- d. Try to load the crucible evenly. Cut the larger pieces to be melted into smaller, more uniform size pieces. These smaller pieces will collapse in on one another when they melt making for a faster melt.
- e. Crucible load requirements. Weights are based upon steel, other materials may require more or less.

Copper Crucible Size	Load In Grams
1 1/4	50
1 1/2	72
1 5/8	86
1 3/4	100

- f. Powder samples should be poured in the crucible, leveled and compacted if possible. Start the melt with the welder set to a low amperage setting, around 50 amps. This low setting will not be enough current to completely melt the sample but will form a crust on the sample so that when you re-adjust the current higher, the arc force will not blow the powder away.
- g. Machine turnings should be placed in the crucible and compacted, being careful not to damage the crucible.

7. Operating the Button Furnace

The following is the recommended sequence of operation. Keep in mind that this is totally a manual operation and the operator will have to practice to become proficient at making quality buttons. We recommend melting clean mild steel using a carbon graphite anode for practice. Experiment with higher or lower amperage settings to determine the best setting for a specific material being melted.

Note: *We recommend that the operator wear gloves that would insulate the operator against electrical shock. The welder sold by Cianflone Scientific has a maximum 67V OCV (Open Circuit Voltage) across the terminals when the welder is on and a melt is not being made.*

- a. Load crucible with material to be melted using the table shown on Page 7.
- b. Rotate the Lower Water Cooled Assembly into position and close it with the Clamping Lever.
- c. Open the Water Control Valve to a point where approximately 1 quart/1 L per minute is passing through the furnace. Adjustments will have to be made to the flow rate depending upon water temperature and the length of time it takes to produce a button.
- d. Rotate the Argon/Vacuum selection valve to the vacuum position.
- e. Start the Vacuum Pump and allow it to become quiet.
- f. Rotate the Argon/Vacuum selection valve to the Argon position.
- g. If your material is porous or in a powder or grindings form, you may want to repeat steps c, d and e to eliminate all air from the chamber.
- h. Turn the Welder on.
- i. Lower the Anode Rod slowly until you strike an arc and immediately pull back slightly (1/2") so as not to bottom out the anode in the crucible. Making direct contact with the material being melted is not advisable. The hottest arc is produced when there is approximately 1/2" of space between the material and the anode.
- j. If the crucible is nearly full of bulky material, such as drillings, you will see it start to melt and fall down into the bottom of the crucible. Raise and lower the anode to melt any particles that stick to the sides of the crucible.
- k. Experiment by raising and lowering the anode while moving it from side to side to make sure that all material is in the bath, and to establish the hottest spark.
- l. It should take approximately 30 to 40 seconds to melt the steel.
- m. The Lower Water Cooled Assembly can become quite warm during the melt (100° to 120° F / 38° to 50° C) without doing harm to the furnace. Adjust the Water Control Valve to allow for such a temperature.
- n. When the melt is completed, turn the welder off before raising the anode.
- o. Let the finished button cool down in the argon gas atmosphere. When sufficiently cooled, turn the Argon/Vacuum Control Valve to the center "Off" position. Rotate the Clamp Lever to the left and rotate the Lower Water Cooled Assembly out and to the inverted position. If the sample does not drop out, tap the button with a metal rod to dislodge it.

Note: Before the next melt:

- p. Inspect the carbon graphite anode and bushing for wear. Ensure that they have not been contaminated by the previous melt.
- q. Inspect and clean the Copper Crucible. Use the wire brush to remove soot and grit that may have accumulated in the crucible and a metal scraper to dislodge metal splatter clinging to the sides of the crucible.

8. Maintenance

- a. Clean Pop-Off Valve regularly after opening with an alcohol wetted cotton swab. If clogged, unscrew the valve body from the base and wash the internal parts in solvent and let dry.
- b. Clean the Clear Site Glass regularly by removing the Site Glass Holder.
- c. Clean the brass Clamp Plate and bottom of Lower Water Cooled Assembly to maintain good electrical contact.
- d. Clean and replace O-rings regularly.

9. Operational Safety

- a. The welder should be turned OFF when not in use.
- b. **Caution!!!** An OCV (Open Circuit Voltage) is present on most welders when the welder is on and an electrical shock hazard exists. The welder must be OFF when replacing anodes or bushings.
- c. The operator should always wear gloves that would insulate the operator against electrical shock. Some welders sold by Cianflone Scientific have a maximum 67 OCV (Open Circuit Voltage) across the terminals when the welder is on and a melt is not being made.
- d. Have the welder shutoff switch within easy reaching distance to the operator.
- e. Always use approved eye and ear protection.
- f. Never operate the furnace without the Dark Site Glass in place. It is made from #11 shaded plastic welding lens.
- g. Keep the operator area clean and obstruction free.

10. Other Notes

- a. Cianflone Scientific does not recommend melting alloys made of Zinc (Zn), including Brass, as well as materials that contain Lead (Pb), Cadmium (Cd), Mercury (Hg), Antimony (Sb), Magnesium (Mg) and Selenium (Se).
- b. When melting Ferro Alloys, try to dilute it with pure Fe (50% + Alloy) to mitigate cracking.
- c. The melting of Aluminum Alloys requires a special crucible which has an 11° taper in the melting area. The standard crucible has a 7° taper.
- d. For quicker cleaning of the crucible between melts, cut off the "T" end of the wire brush to allow insertion in a standard variable speed drill.
- e. Clean the bottom of the Lower Water Cooled Assembly and Clamp Base with 80 or 100 grit sandpaper too ensure a good electrical connection.

Should you have any questions, please contact Cianflone Scientific or if purchased through an International Distributor, contact the International Distributor directly.

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WARRANTY – SAMPLE PREPARATION

The manufacturer warrants the equipment manufactured by it to be free from defects in material or workmanship for a period of one (1) year from the date of shipment to buyer by manufacturer or the manufacturer's authorized distributor. If the equipment or any part thereof becomes defective within one (1) year from such date, the defective equipment or part will be replaced or credit allowed therefore at the sole option of manufacturer, but without any credit or payment for any labor cost or expense.

The foregoing is the exclusive remedy for any buyer of manufacturer's equipment. The maximum damage liability of manufacturer is the cost of replacement of the equipment or part.

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IMPORTANT NOTE:

Third-Party items may vary from manufacturer and Cianflone Scientific LLC reserves the right to substitute.

Cianflone Scientific LLC does not warrant any equipment, part, material, component or accessory manufactured by others and sold or supplied in connection with the sale of manufacturer's products.