

The **Button Furnace**™
Model 2701X
Electric Arc Remelt Button Furnace
by
Cianflone Scientific



Operation and Safety Manual



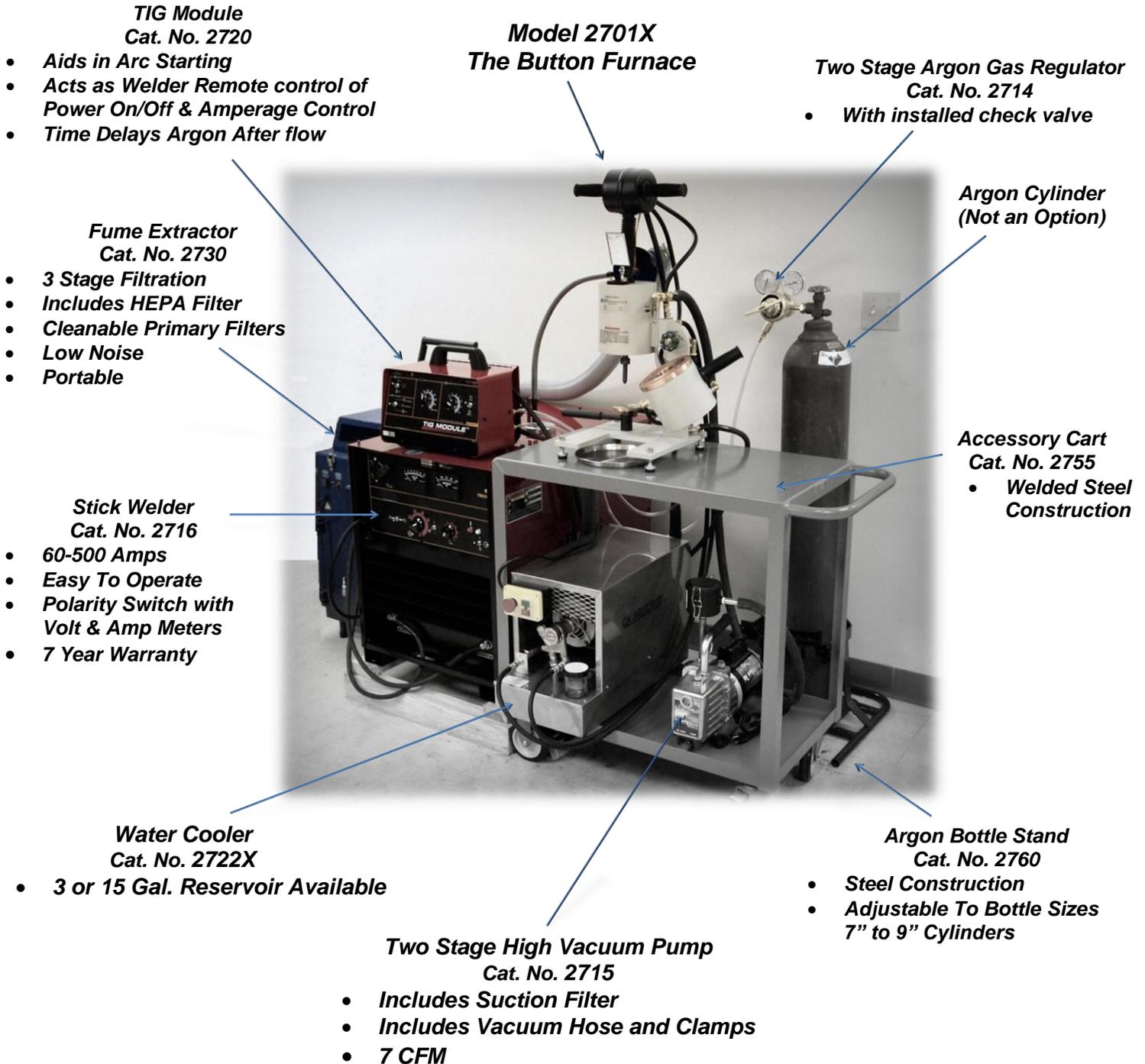
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The Button Furnace Model 2701X Major Component Callout



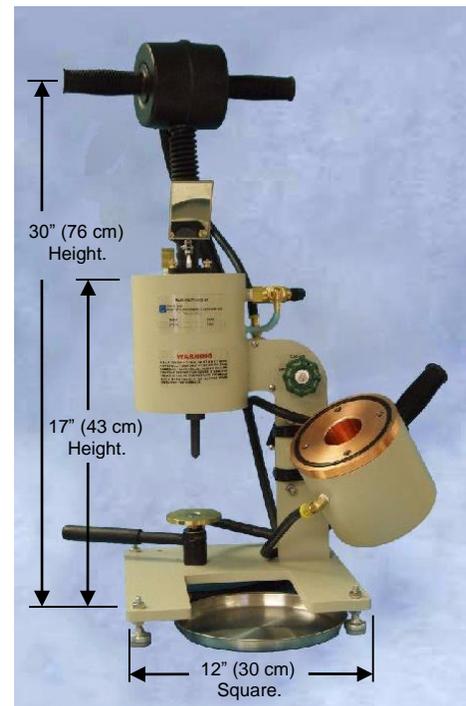
1. Description and Use

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 and cobalt alloys. It has been found that little volatilization occurs to metals whose boiling temperature is above the furnaces 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 purchased through Cianflone Scientific.
- b. A source of cooling water. Some customers use city water while others setup a several hundred gallon water reservoir and fill it with a dilution of 50% water and 50% ethylene or poly glycol.
- c. The source of water, whether a submergible pump or city water should be capable of delivering a minimum of 2 to 3 GPM, 7 ½ to 11 ½ LPM to the furnace.
- d. 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.



Model 2701X Dimensions

Note: A brass globe valve is used to control the water flow through the furnace. A slot is cut in the globe that allows a constant minimum water flow rate through the furnace. This is done to aid in preventing overheat damage to the furnace. The flow rate with the valve in the off position is approximately 16 oz. or 1/2 L per minute

- e. 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.
- f. Button Furnace stand/table height and material. The image above displays 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 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.

- g. A 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. A Portable Fume Extractor can be purchased through Cianflone Scientific.
- h. An AC receptacle must be provided and sized to accommodate the Vacuum Pump as well as for an electric drill used for cleaning the copper crucible after each melt. Below are the images of the power plugs associate with the different models we supply.

Vacuum pump power
plug for the 230 VAC
60 HZ model.
3.5 Amp Draw



115/230 VAC
Single Phase
NEMA 6-15



115 VAC Single Phase

Vacuum pump power
plug for the 115 VAC
60 HZ model.
7 Amp Draw

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 will be in a second carton and placed on the same pallet. Both cartons are banded together and to the pallet. The welder ships mounted to a second separate pallet.

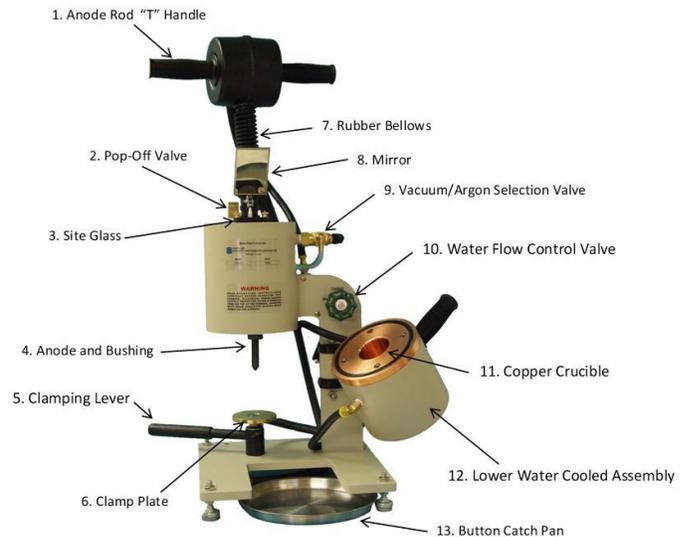
- a. Unpack and inspect the shipment to make sure no damage (*noticeable or concealed*) has occurred during shipment. If so, communicate with the carrier to register a claim.
- b. Use the packing list as a check list to ensure that all standard and optional accessories are included.

4. Identifying the Major Components

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

- a. 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.
- b. 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.
- c. 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.
- d. 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.
- e. Clamping Lever. Rotates 90° to lift the #12 Lower Water Cooled Assembly and seal it to the furnace Upper Chamber.

- f. Clamp Plate. Mates to the bottom of the #12 Lower Water Cooled Assembly to provide a path to ground for the welder.
- g. Rubber Bellows. The Rubber Bellows allows the #1 Anode Rod to have freedom of movement as well as holding vacuum and pressure.
- h. 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.
- i. Vacuum/Argon Selection Valve. This valve has three positions, Argon, Off or Vacuum.
- j. Water Control Valve. Brass globe valve used to adjust water out of the furnace.
- k. Copper Crucible. Holds the material to be melted.
- l. 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.
- m. 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.
- c. 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 relive pressure. This should occur when argon pressure is approximately 4 to 6 psi. Tighten the locknut on the valve stem to hold this position.
- d. 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.

- e. 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.
- f. 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 connector. 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.*

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 crucible clamping device.
- 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.

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 by unscrewing body of valve. Wash spring and plunger in solvent, dry and lubricate with light oil.
- 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. Welder must be off when replacing anodes or bushings.
- b. Always use approved eye and ear protection.
- c. The operator should always wear gloves that would insulate the operator against electrical shock. The welder sold by Cianflone Scientific has a maximum 67 OCV (Open Circuit Voltage) across the terminals when the welder is on and a melt is not being made.
- d. Never operate the furnace without the Dark Site Glass, made from #11 shaded plastic welding lens.
- e. Keep the operator area clean and obstruction free.
- f. Have the welder shutoff within easy reaching distance to the operator.

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 60 or 80 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.