

Kulicke & Soffa 4700AD Instructions

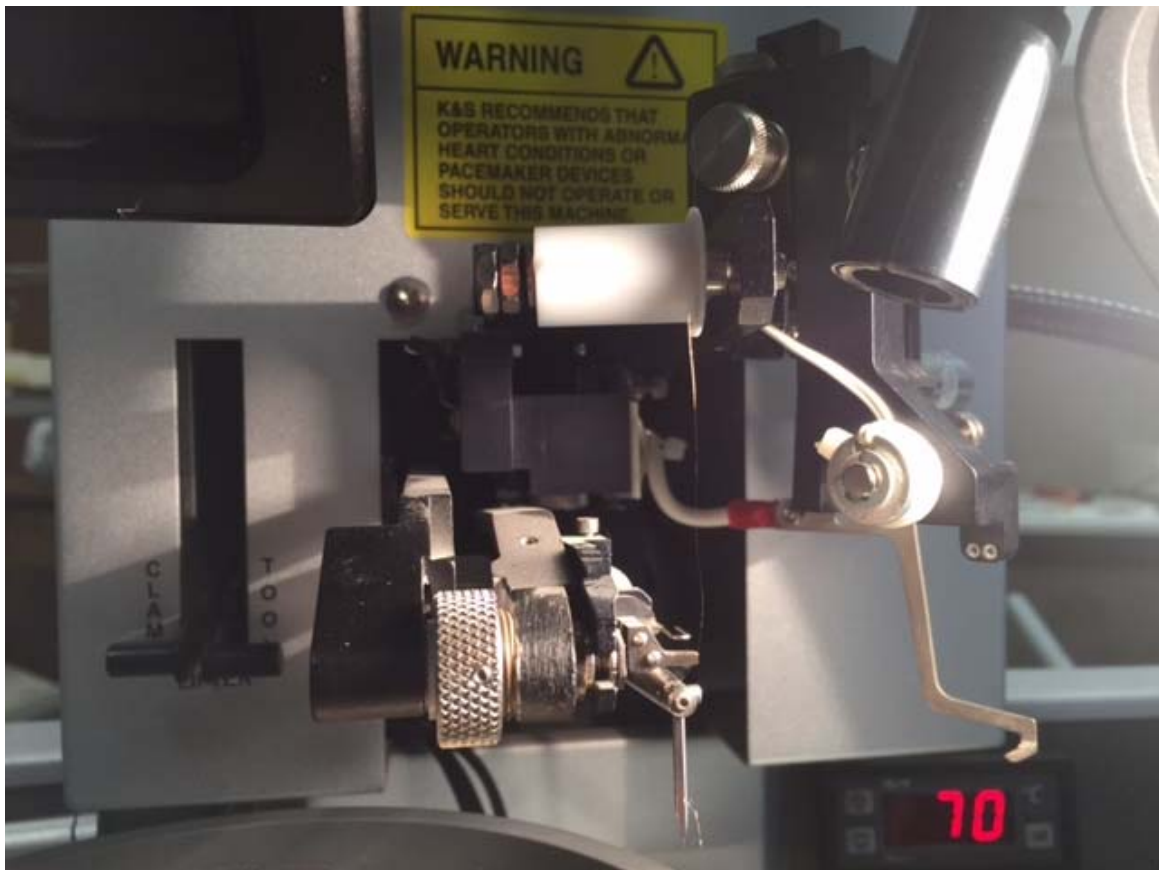
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4700AD model wire bonder can act like a wedge or ball-bonder. In the user manual refer to 4523AD for wedge bonding and 4524AD for ball-bonding.

Choosing Bond or Wedge bonding

For ball-bonding push the white teflon spool on the bonder head connected to the drag arm all the way left. In this case, wire bonder acts like 4524AD. Refer to 4524AD in the user manual. The gold wire should go through the drag clamp and the wire clamp.

For wedge-bonding push the white teflon spool on the drag arm all the way right as shown in the picture below. In this case, the drag clamp will not be used. The gold wire goes above the white Teflon spool and through the wire clamp. Refer to 4523AD in the user manual.



Bonder in wedge bonding mode

Turning the bonder ON

Turn the power switch of the bonder ON. Wait about 1 minute for initialization.

Choose Password Enable by the left hand keyboard arrows and Enter.

Choose the Engineer mode and Enter. (There is no going back, if you chose the operator mode, you need to shut down power first to go to engineer mode later) In the operator mode, the user is able to load the previously stored parameters, and vary some operational parameters (like Search Height, Loop height, etc.). On the other hand, engineer mode can change all parameters and engineer is able to store the parameters.

Engineer mode needs a password: Enter the password: 3519 (Using +, – and arrow buttons) Enter (The buttons are somewhat unfriendly, be patient.)

Change Password: Choose No Enter (do not change the password)

Choosing the Bonding mode

Ball-bonding:

In the mode screen there are three options: Standard, Ball bumping, Single Point Tab

Standard mode is the typical use: Two pads are connected to each other with a wire bond.

Ball bumping is used to place gold balls on the pads without the wires. The gold balls can then be used for flip-chip bonding.

Single point tab is used to connect two pads using a single ball.

Semi-Automatic/Manual/Automatic bond modes are selectable (Manual mode is selected by pressing the Manual button on the keyboard, Semi-automatic is selected by setting Auto: Off. Automatic is selected by setting Auto: On)

Automatic mode is used if the distance between two bonding pads in y-direction is constant. The operator only adjusts the position of the first bond in x-direction, the second bond is automatically performed)

In the manual mode the movement of the bonding head is controlled by the black button on the left.

Time: Long or Short

Wedge bonding:

In the mode screen there are three options: Standard, Lange Coupler, Table Tear. Lange coupler mode is for fabricating a Lange coupler (special application). Table Tear mode is useful for controlled termination of the bond.

Semi-Automatic/Manual/Automatic bond modes are selectable (Manual mode is selected by pressing the Manual button on the keyboard, Semi-automatic is selected by setting Auto: Off, Automatic is selected by setting Auto: On)

Time: Long or Short

Adjusting bonding parameters

In the mode screen

1. bond (black cursor over 1)

Search: 3.52 (Adjust using Search + or – buttons) (This is z-position the capillary descends to just before making the first bond) It should be set about 100µm above the bond site.

Power: 1.48 (Adjust using + or – buttons) This number defines the ultrasonic power applied during the first bond. Ball-bonds require less ultrasonic power compared to wedge bonds. If the wire breaks after the first bond, the power may be too high. If the gold ball does not bond well, the power can be increased.

Time: 2.5 (Adjust using + or – buttons) (This is the time spent for the first bond)

Force: 1.5 (Adjust using + or – buttons) (This is the force applied for the first bond) If the wire breaks after the first bond, the force may be too high. If the gold ball does not bond well, the force is too low.

Use down arrow key to move to the next screen

Step: 3.0 This is the distance the stage travels in y-direction towards the operator after the first bond to get ready for the 2. Bond. In the automatic mode the step is the distance the stage travels before making the second mode. It is a relative measure.

Kink: 1.5 (this is the z-distance capillary travels before the stage travels in reverse direction to create a kink in the wire). It is a relative distance.

Reverse: 1.5 (this is the y-distance stage travels away from the operator after the kink height). It is a relative distance.

Yspeed: 1.0 (this is the speed of the bond head movement in y-direction)

Loop: 4.0 (Adjust using Loop + or – buttons) (this is the z-distance capillary tip moves, after finishing the first bond) If the bonding locations are far apart, a higher loop value should be used, If the bonding locations are close to each other, use a smaller loop value. Note that Loop value is not a relative value, it is an absolute value. Therefore, you should set the Loop parameter larger than the Search parameter. If the Loop value is very high, the bond wire will make a big loop. If the Loop value is very small, the bond wire will be very close to the surface.

Use down arrow key to move to the next screen

2. bond (Black cursor over 2)

Search: 3.52 (Adjust using Search + or – buttons) (This is the z-position the capillary descends to just before making the second bond)

Power: 2.5 (Adjust using + or – buttons) (Adjust using + or – buttons) (This number defines the ultrasonic power applied during the second bond. Second bond is a wedge-bond which requires more ultrasonic power.)

Time: 5 (Adjust using + or – buttons) (This is the time spent for the second bond)

Force: 5.0 (Adjust using + or – buttons) (This is the force applied for the second bond)

Use arrow key to move the next screen.

Tail: 4.5 (defines the length of the wire hanging from the capillary after the second bond is completed)

Tear: 2.5 This is the distance y-table travels towards the operator to tear the wire after the second bond is completed. This parameter is useful in the Table Tear mode in wedge bonding.

Ball: 3.5 (defines the size of the ball) (for a larger ball a higher voltage is applied to NEFO.)

Mode: Standard

Time: Short

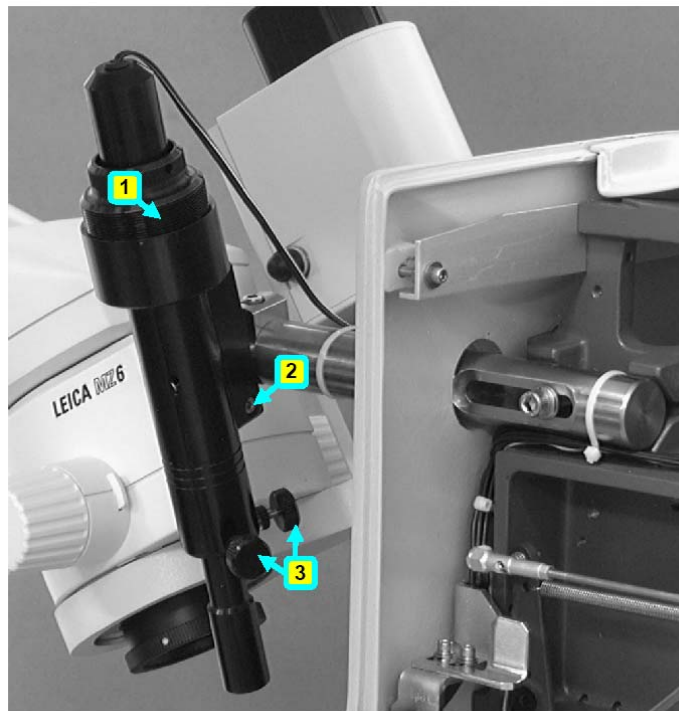
Auto: Off

Microscope adjustment:

Set the Loop parameter to 0.0. Press and release the Left mouse button. The bonding head lowers to the smallest distance. Adjust the microscope so that the tip is in the lower center of the field of view. You may need to use an Allen wrench for this purpose. It is a good idea to be able to see the capillary tip in rest position through the microscope in the smallest magnification. This is useful to see if the ball is formed correctly.

Laser pointer adjustment:

Set the bonding machine to Ball Bumping mode. Set the Step parameter to zero. Make one bond. Adjust the two knobs (3) of the laser pointer to center on the ball-bond. Adjust the focusing ring at top of the laser pointer (1) to focus on the ball-bond.



- 1 Focus Ring
- 2 Spotlight Clamping Screw
- 3 Knurled Screws

Figure 5-11: Spotlight Adjustment

Workholder height adjustment:

Do this step before threading the wire. Load the device to be bonded in the workholder using spring clamps. Note that the device should be placed firmly on the workholder stage and it should be in a thermal contact with the workholder. For example, for a DIP-40 package, add a metallic support block under the device between the pins of the package. Adjust the Loop parameter to 1.0. Press and release the Left mouse button. Hold the top of the workholder and adjust the base of the workholder clockwise to raise the workholder until the capillary just touches the lowest bonding level. Set the Loop parameter to 5.0. Press and release the Left mouse button to return the bonding head to the reset position. At this capillary position, the highest position of the device should just touch the

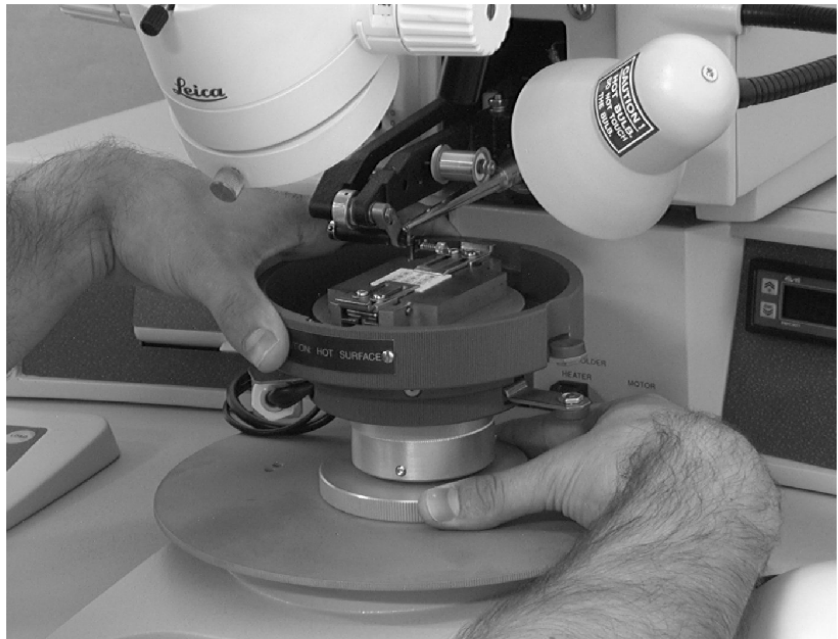


Figure 5-5: Adjusting Workholder Height

capillary. This adjustment provides the maximum working distance of the capillary.

Note that if the laser pointer is focused properly earlier, then this can be used as a guide to adjust the workholder height as well. The workholder height should be such that the laser pointer is focused on the bonding layer of the device.

Make sure that the heater cable of the workholder does not block the free movement of the bonding head. Bonding head moves with a very small force: Even a small impediment will stop its movement.

Search height adjustment:

Make sure that the Search value is sufficiently high before adjusting. Press the left-mouse button, but do not release it. Press the Search + or – keys on the keypad to reduce the distance between the capillary tip and the bonding location. This is the Search height for the first bonding level. Release the left-mouse button. The capillary makes the first bond and then raises to the Loop height. Press the left-mouse button, but do not release it. Press the Search + or – keys on the keypad to adjust the distance. This is the Search height for the second bonding level. Save the settings in one of the saving locations by pressing the Save key on the keypad.

Threading the wire:

1. Press Clamp Open button at the right. Its LED should turn ON. The clamp has three minutes timeout. You should not keep the LED turned on for longer, otherwise the clamp is released automatically (possibly to prevent the overheating in the clamp coil) and it no longer responds to clamp button. You need to press the Reset button to correct the state.
2. Pass the gold wire through the Drag clamp. If this took a long time, turn the Clamp Open button OFF and ON to restart the timer.
3. Use flat head tweezers to hold the gold wire. (If the tweezers tips are too sharp, the gold wire breaks.) Use fingers in gloves to hold the end of the gold wire, while holding the gold wire with tweezers at about 2.5 cm distance. Pull and break the wire to create straight and sharp-tipped gold wire. The straight portion should be about 2cm. If the straight portion is too short, try again.
4. Use the tweezers to direct the straight portion of the gold wire through the capillary. If the capillary is clean and not blocked, the wire should show up at the tip of the capillary. If the gold wire resists going through, press the Test button at the right to apply ultrasonic vibrations to the capillary tip.
5. If you took a long time, turn the Clamp Open button OFF and ON to restart the timer.
6. When the gold wire shows up at the tip of the capillary, use the wide-tip tweezers to pull the wire further about 1cm.
7. Use the wide-tip tweezers to pass the gold wire through the wire clamp. Note that while you are manipulating the gold wire the Clamp should be open, otherwise the gold wire may break.
8. If the wire slips back into the capillary, you may be able to push the wire from the top of the capillary using flat-head tweezers. If the wire resists, you may press the Test button to apply ultrasonic vibrations. If you are not successful, pull the wire out completely to check that the tip of the wire is not blocking it. If there is a blockage, such as a small size ball, tear the wire to create a sharp tip. You may have to go to step 3.

Moving the wire:

It is possible to move the wire at the tip of the capillary up or down using the wire clamp arm:

To move the wire up, move the wire clamp arm while the wire clamp is closed. Then press the clamp open button and move the clamp arm down. Repeat if necessary. If the wire is stuck to the faces of the wire clamp, you may try pressing the Test button to release the wire.

To move the wire down, move the wire clamp arm while the wire clamp is open. Then close the clamp and move the clamp arm down. Repeat if necessary.

If this does not work, you may have to use the tweezers above the wire clamp to push the wire.

Creating the ball manually

- Make sure that NEFO is ON.
- Press the clamp open button to release the wire clamp.
- Pull 4-5mm wire from the capillary tip.
- Close the wire clamp
- Push and hold the NEFO solenoid, moving the NEFO wand to a position under the wire. Make sure that the wand does not touch the wire.
- Press black Manual Spark button on the left panel.
- If the wire is too far, OPEN LED turns on. You should pull the wire a bit more. Press the NEFO button twice to turn off the OPEN LED.

Temperature Controller Adjustment

The temperature controller has the following controls and indicators:

SET Pushbutton to enable setting of the workholder temperature.

UP Pushbutton for increasing the set point 1 value during temperature setting.

DOWN Pushbutton for decreasing the set point 1 value during temperature setting.

LED I Status light which blinks when set point 1 is displayed or changed.

LED II Status light is not used by the bonder.

TC Display Three-digit display that shows the temperature (°C) of the workholder.

When the SET pushbutton is pressed, the set-point temperature appears in the TC display.

Bonding:

1. Place the device to be bonded in the workholder.
2. For good bonding set the temperature to 100 to 120 degrees.
3. Wait 5 minutes to make sure that the device reached the workholder temperature.
4. Make sure that the device is firmly connected to the workholder and that it cannot move.
5. Adjust the workholder height.
6. Make sure that both Search parameters are sufficiently large so that the capillary does not hit the device (start with Search parameters like 6.0)
7. Make sure that the Loop parameter is larger than both Search parameters.
8. Press the left mouse button, but do not release it yet.
9. Reduce the first Search parameter. Observe that the capillary is approaching the device. When the capillary tip is very close to the bond pad, you can aim the target. Make sure that nothing is restricting the movement of the bonding head (like the cables of the workholder.)
10. When the capillary tip is right on top of the bonding location, release the left mouse button. Do not touch the y-stage or the workholder during the bond operation. It should be free during the bonding. You should only be touching the mouse.
11. The first bond will be made. The capillary rises by Kink amount, the y-stage moves away from the operator by Reverse amount to generate a kink in the wire and then the capillary rises to Loop height and y-stage moves by Step amount towards the operator.
12. If the y-position is not correct, change the Step parameter to correct the y-position. Note that Loop parameter should be and Step parameter are related. We have approximately: $\text{Step} = \text{Loop} - \text{Search}$
13. Press the left mouse button. Capillary should come down to the second Search height. If it is too high, reduce the second Search parameter. Aim the second bond pad location. Make sure that y-stage is free and nothing is restricting the movement of the bonding head. Release the button to complete the second bond.
14. The capillary rises to the Reset position.
15. A ball will be formed automatically by the NEFO wand.
16. Save the parameters into a saving location. You are ready for the next bond.

Possible problems:

Ball is so small that the capillary hole cannot stop the ball going through it. Either NEFO wand is incorrectly positioned or the ball size is too small. If NEFO wand is too far, the ball may be small. NEFO wand should be 0.5mm away from the capillary tip in the reset position. If the ball is too small, make the Ball parameter larger or bring the NEFO wand closer to the tip.

Wire breaks after the first bond. Possible problems:

1. The drag force is too much.
Drag clamp is too tight.
Loosen the drag clamp by using the drag force adjusting nut (13).
2. The Power parameter for the first bond is too high. Reduce the power parameter.

The first bond is overly squashed:

1. Reduce the Force parameter of the first bond.

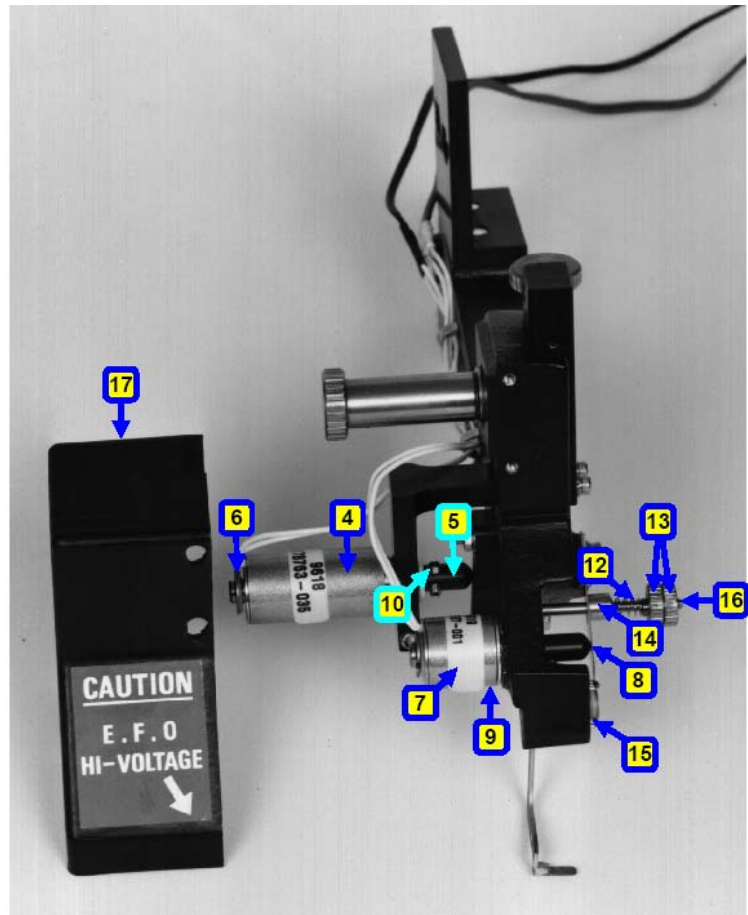
Missing ball detector:

Short LED turns on after the NEFO wand tries to make a ball.

1. NEFO wand is too close to the capillary.

Open LED turns on after the NEFO wand tries to make a ball.

2. NEFO wand is too far from the capillary.



Pressing right mouse button while in reset position displays the bond cycle mode.

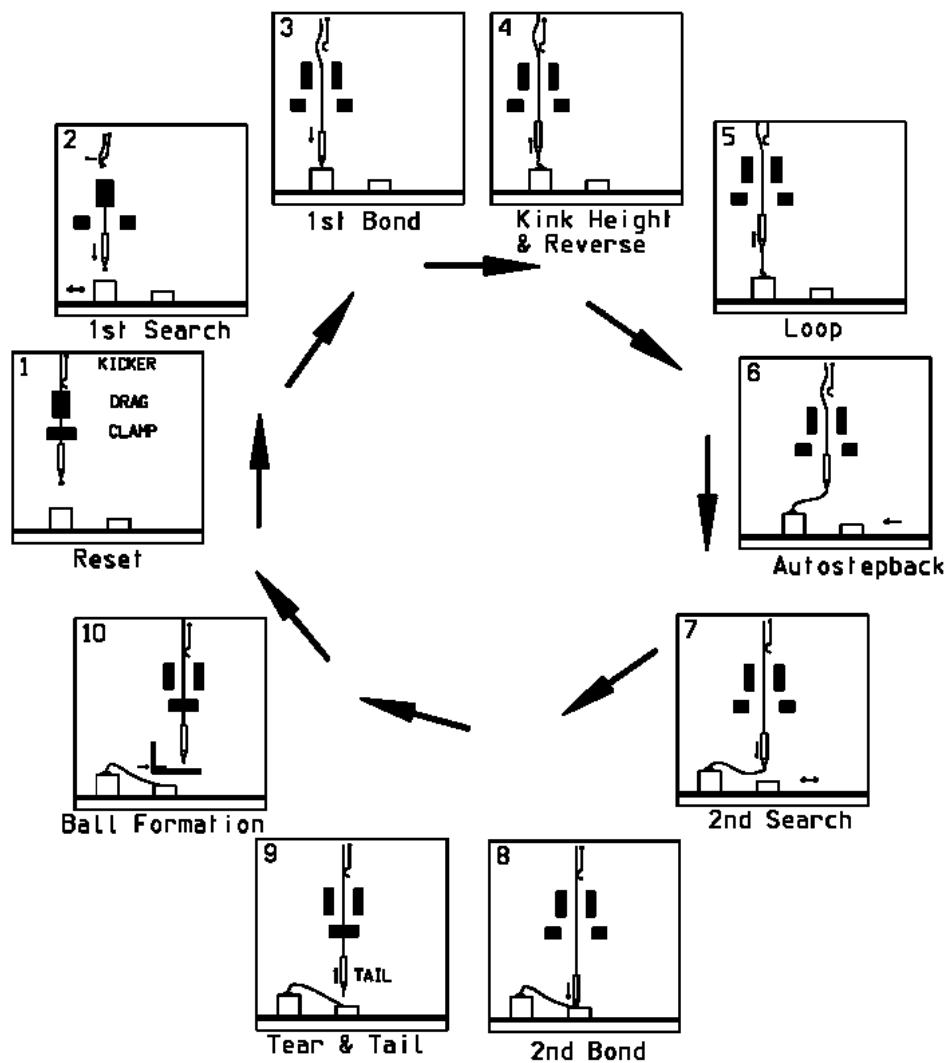


Figure 6-14 Ball Bonding Cycle in Semi Automatic Setting (Model 4524AD)

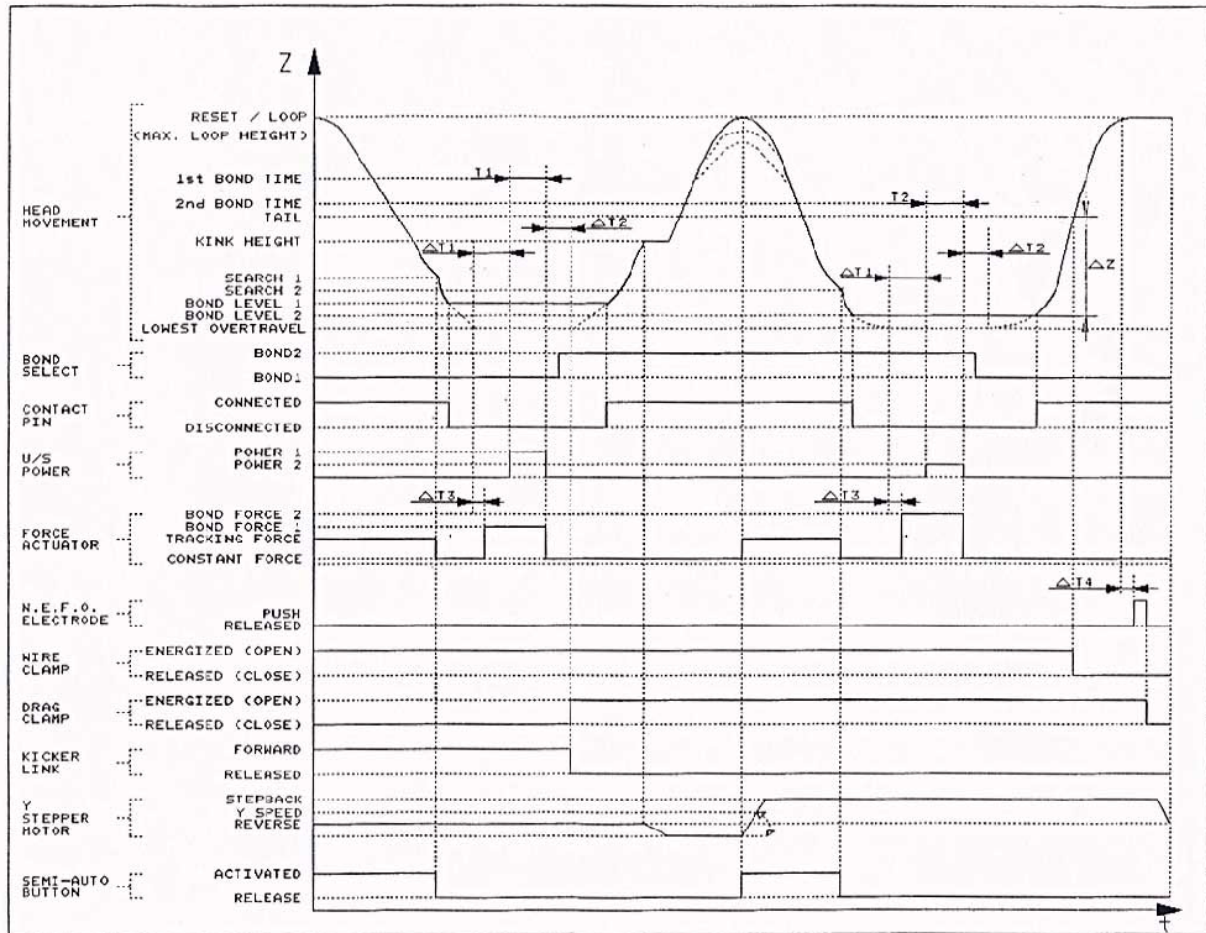
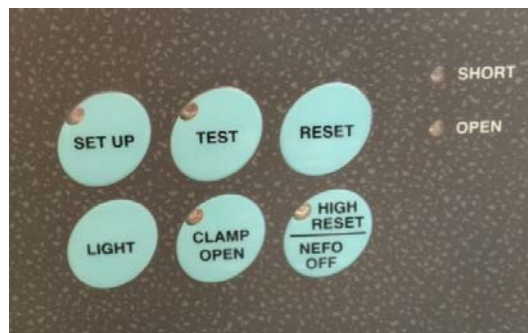


Figure 10-11: Model 4524AD Semi/Auto Bonding Cycle

As the graph indicates, the tail length determines the distance above the device surface the wire clamp closes after the second bond. If the force of second bond is too high, the wire may break before the wire clamp closes. In such a case, no tail will remain in the capillary. You need to thread the wire again. Reduce the bonding settings of the second bond not to break the wire after the second bond.

The gold wires have a lifetime. User manual writes: "If the wire is over 6 months old, replace it". Old wires become brittle, and making bonds with them is more difficult. It is possible to use the wires that are couple of years old, but the bond parameters (like force, power, time) will be more critical. Many trials must be carried out in test samples, before using an old wire with a real sample.



Buttons at the right hand side.