Gravipull-4 Micropipette Puller

User Guide

For pulling standard and long-tapered multi or single-barrel micropipettes

Watch our video guide here:

https://www.youtube.com/watch?v=QezaiN1yhag&t=4s

Version: 2.1

Serial no.:

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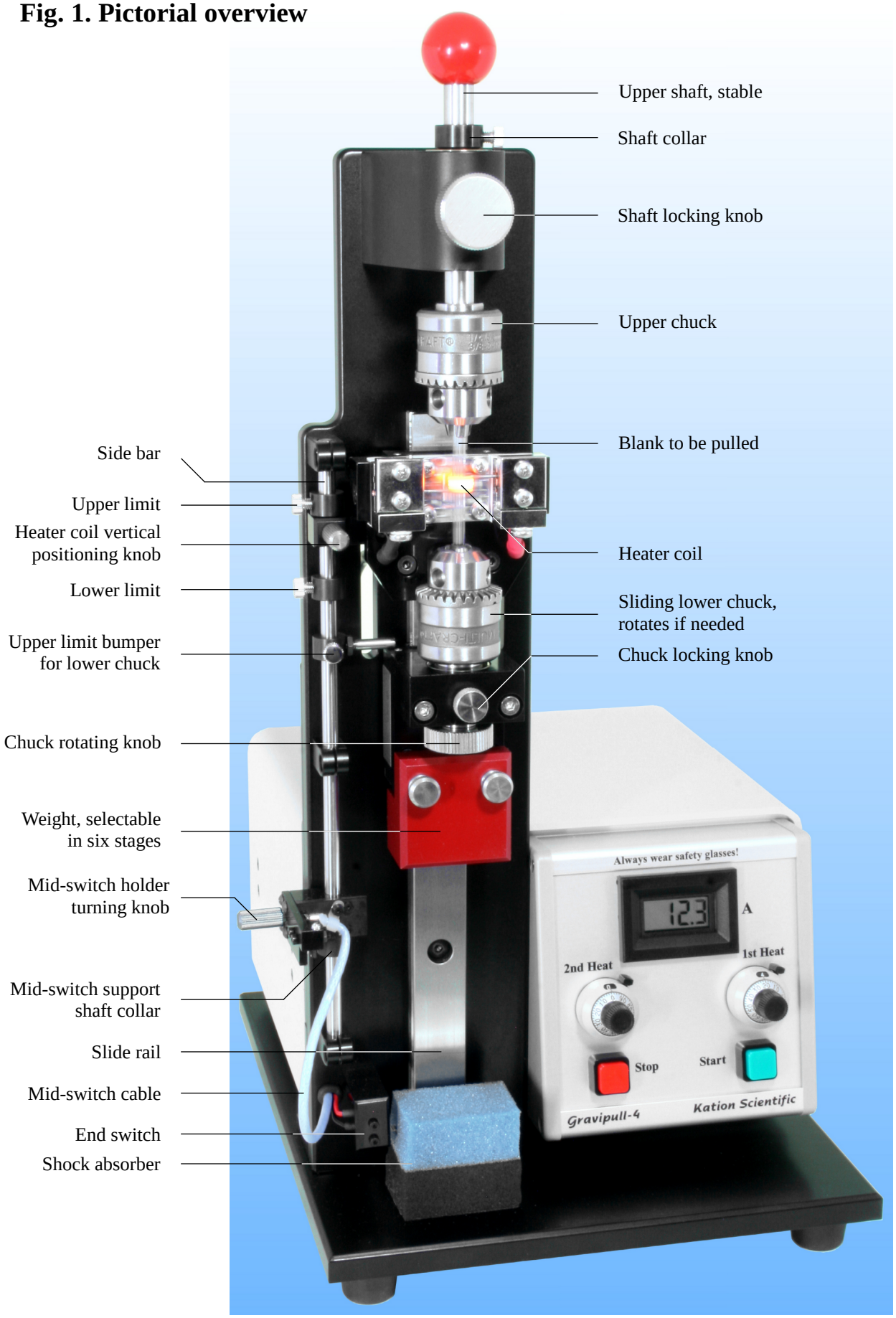
Fig. 1. Pictorial overview



Color of parts may vary

General description

The Gravipull-4 is designed to pull multi-barrel glass micropipette assemblies, but it is also capable of pulling single-barrel ones. It is intended to soften and pull borosilicate or aluminosilicate glass capillary tubing assemblies or glass tubes (blanks) up to 0.25" (6.4mm) in diameter and 6" (152mm) long. The blank is fixed in the upper and lower chucks of the puller, while the upper one is held in place by a locking screw. The “Start” button on the front panel begins the pulling cycle. The pull is fed by gravity using a 6-stage weight system. When a multi-barrel assembly made of individual glass tubes is to be pulled into a single tip, the lower chuck should be rotated once the glass begins to soften. The rotation and pulling cause the lengths of tubing to fuse together. The combination of currents supplied to the heating coil and the degree and timing of the pull may be varied to produce pipettes of different lengths and diameters. A shock absorber in the bottom of the puller arrests the lower glass holder gently so as not to damage the lower piece of glass. The heater automatically switches off at the end of each cycle.

A truly unique feature of the Gravipull-4 is the capability of pulling micropipettes in two stages using a mid-switch holder, stopping the sliding chuck at the end of the first pulling stage. For greater flexibility, the heater coil and the mid-switch system can be moved on a side bar allowing vertical adjustments. Altogether, this system permits producing taper lengths up to about 100mm.

Setting up the puller

Unpack your puller with great care. Set up your pulling station in a room with still air, having a temperature of about 25°C. Keep in mind that room temperature, humidity, and air convection can greatly influence the quality of pulling. Place the puller on a horizontal surface. This puller is equipped with a universal, worldwide power supply with automatic self-adjustment.

Fig. 2

Front panel controls

Four-digit LC display:
Displays the actual current flowing through the heater coil.

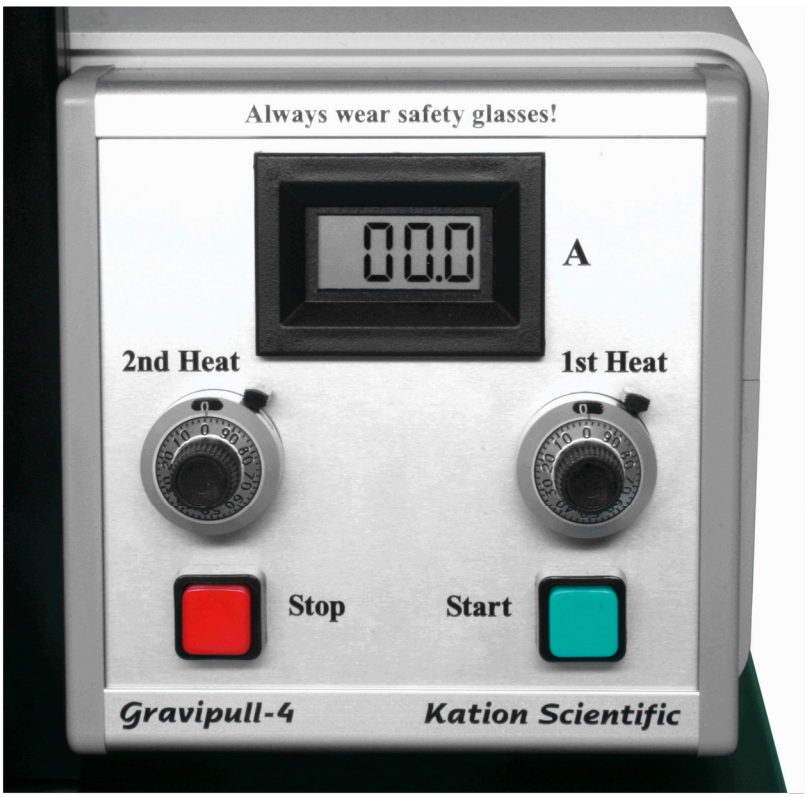
1st Heat:
Sets the current for the heater coil up to 20A.

2nd Heat:
Sets the current for the heater coil up to 20A when two-stage pulls are implemented by turning the mid-switch on.

Start pushbutton:
Initiates the pulling cycle, provided that the sliding chuck is in its upper position and the end switch is deactivated**.**

Stop pushbutton:
Functions as an emergency stop, interrupting pulling cycles and halting all operations at any point in time.

Fig. 3



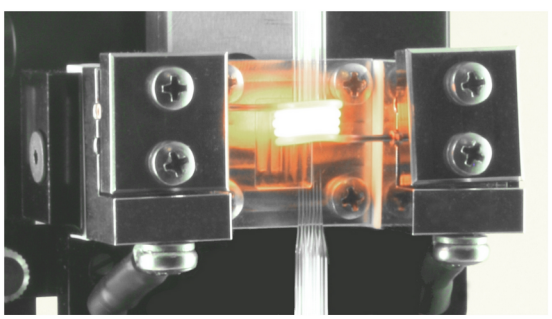
Making and positioning heater coils

Heater coils are supplied by the manufacturer (Part no. GP4101). If you decide to make your own, follow these steps:
1. Take Kanthal AF, AWG 18, or a similar heater wire and wrap it around a cylindrical object with a diameter of 0.25" (6.3 mm), such as the shank of a drill bit, for four turns or as needed.
2. Form horizontal radial ends of the wire that will be mounted in their holder.
3. Crimp 2mm x 16mm (diameter x length) copper tubes onto the two ends of the wire, as shown in Figure 4.
4. Position the coil in the holder so that it is coaxial with the pulling shafts. Note that heater wires can be easily shaped when they are hot. Therefore, heat up the coil, press the Stop button, and then reshape the coil as needed.
5. Additionally, a metal rod fixed in the lower chuck, movable up and down, can be useful for adjusting the coils. Use a scalpel blade if the loops are too close to one another and form a short circuit.

Fig. 4

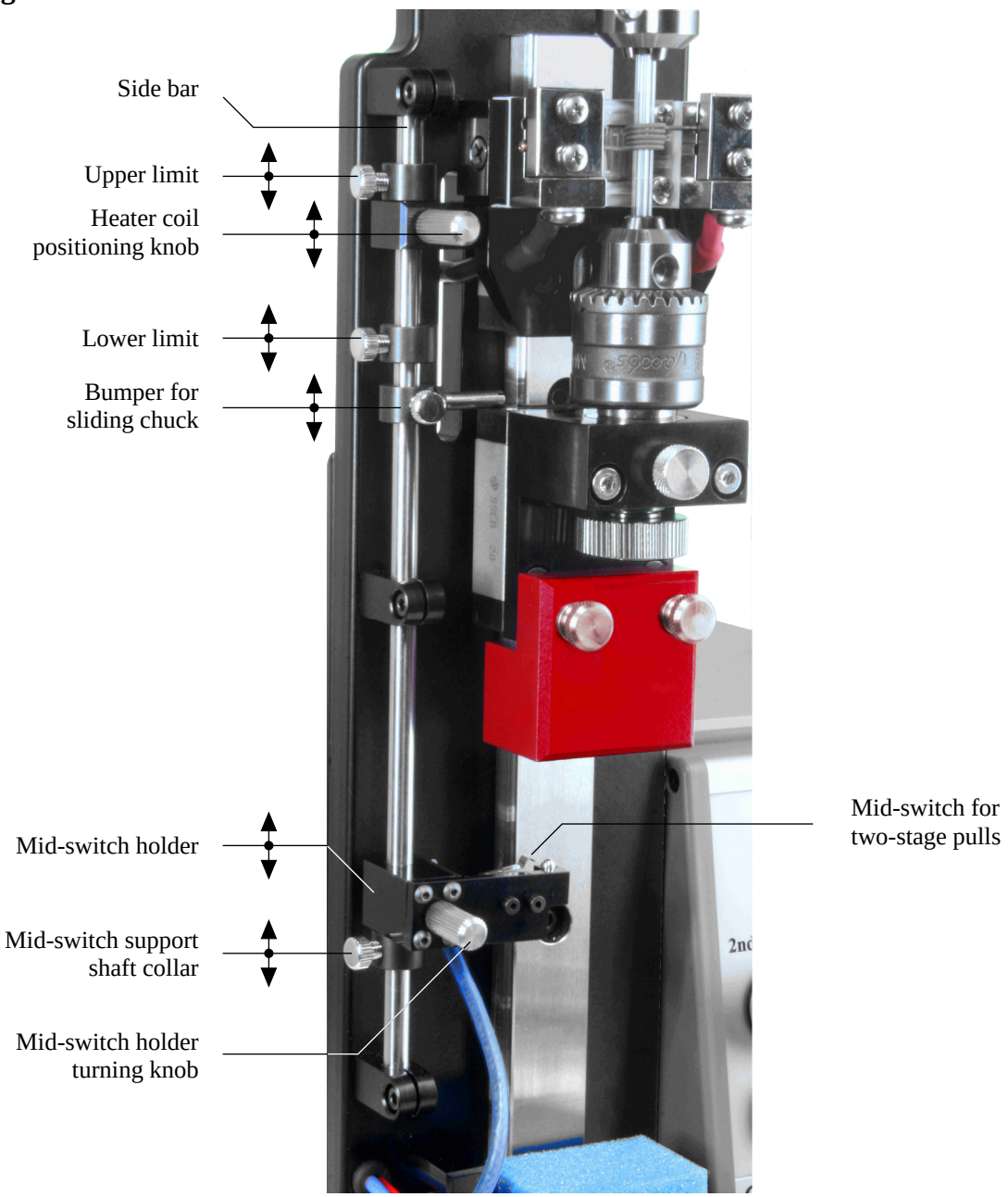
Caution!
Heater coils can become extremely hot (about 1500°C). Only qualified personnel should perform this task.

Fig. 5



Side bar mechanical controls

Fig. 6



The heater coil can be vertically positioned using its positioning knob, as shown. Its upper and lower positions can be pre-set using the respective limiting shaft collars. This feature is useful for repetitive two-stage pulls, where the heater coil needs to be positioned and re-positioned during each pull.

Another adjustable shaft collar with a steel stud acts as an upper bumper for the sliding (lower) chuck, ensuring that it consistently stops in the same upper position.

The mid-switch is used to initiate a two-stage pull when its holder is turned in the path of the descending lower chuck. It can be vertically positioned using its turning knob. A movable shaft collar provides additional support and helps keep the holder in position.

The role of the mid-switch

A.

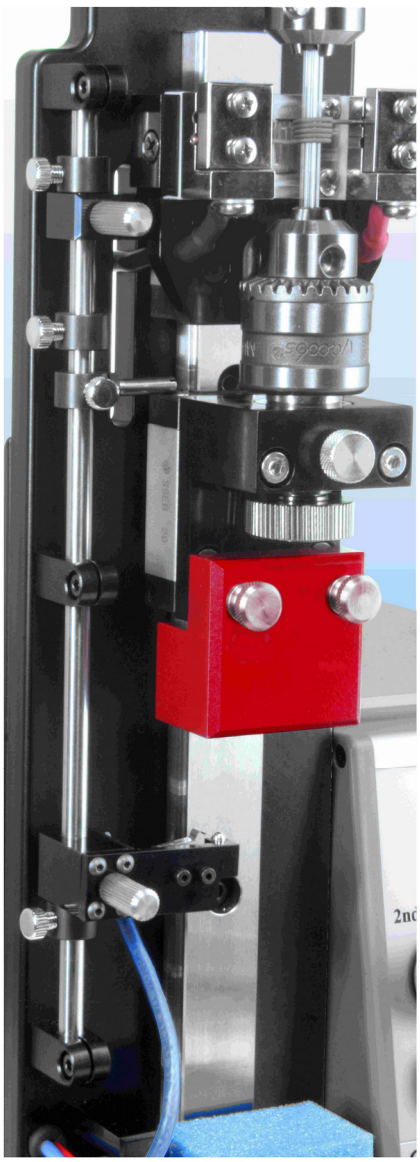
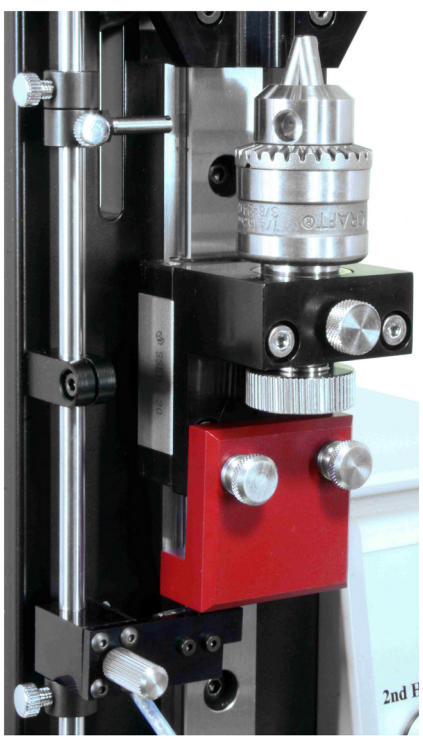


Fig. 7

The mid-switch is used when creating long-tapered micropipettes with a two-stage pull. During the first pull, use the finger brake to control the process. With skill and practice, it is possible to form tapers as long as 4" (101mm). Watch our video guide here:

https://www.youtube.com/watch?v=QezaiN1yhag&t=4s

B.



C.

When performing a two-stage pull, turn the mid-switch holder in the direction of the descending lower chuck or weight, as shown in Figure 6 or Figure 7A. The length of the first pull is determined by the vertical position of the mid-switch holder. The chuck assembly rests on the holder (Figure 7B), activating the built-in micro switch and ending the first stage of the pull. The second stage will commence after a 20-second automatic pause. Reposition the heater coil once it stops glowing, and lock the lower chuck using the corresponding knob. Just before the second heat begins, as depicted in Figure 7C, move the mid-switch holder out of the way.

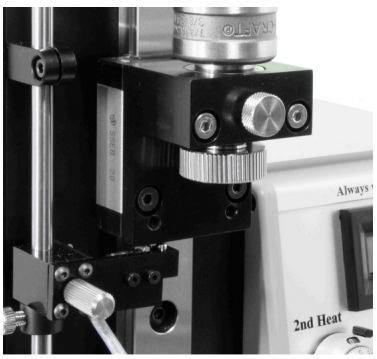
The second heat will complete the second pull through free gravitational force, and the activated end switch will halt the pulling cycle (Figure 7C).

If only one-stage pulls are needed, simply move the mid-switch holder out of the way, as shown in Figure 1 or Figure 7C.

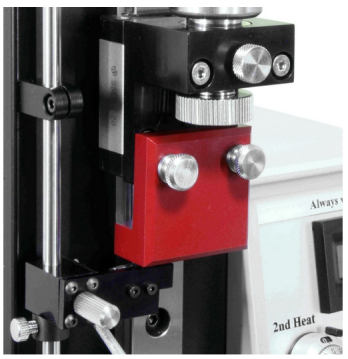
The weight system

The pulling force can be adjusted by selecting various weights in six stages. These weights, driven by gravity, provide potential energy that moves the lower (sliding) chuck downward. The potential weight combinations are illustrated in Figure 8. The pulling force should be determined through trial and error during test pulls.

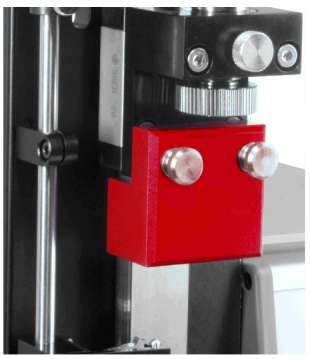
Fig. 8



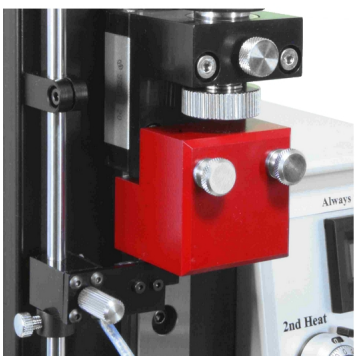
Weight 0



Weight 1



Weight 2



Weight 3

Weight 4

Weight 5

Pulling multi-barrel micropipettes

Always wear eye protection when the coils are heated! A pair of dark sunglasses will suffice.

Mounting blanks for pulling:
Securely mount your blank in the chucks with the heater coil in the middle. Ensure that the glass is positioned in the center of the coil. Adjust the grip of the chucks to hold the blank firmly without cracking it. In most cases, tightening the chucks by hand will suffice. It is often helpful to place an unsymmetrical blank upside down (working end) in the chucks and use the multi-barrel pipette that remains in the lower chuck.

General procedures:
The pulling cycle is initiated by pressing the green Start push button, provided that the sliding shaft is in its upper position and the end switch is deactivated. The pulling cycle can be interrupted at any time by pressing the red Stop push button switch. The current flowing through the heater is displayed on the top in a 4-digit reflective display.

When the glass begins to soften, gently rotate the lower chuck about 2/3 of a full turn, then release the chuck. Meanwhile, the lower chuck will start descending. The rotation and pulling will cause the lengths of tubing to fuse together. **This may require some practice!**

In the case of a one-stage pull, turn out the mid-switch holder and allow the weight system to complete the pull by free-falling onto the shock absorber. It is important to set the suitable sliding distance to the shock absorber by using the right positions of the upper shaft, the heater coil, and the lower chuck to avoid unnecessary shocks in the system.

When pulling long-tapered micropipettes, finger braking is often an effective way to slow down the speed of the descending lower chuck assembly. In this case, place your right index finger against the slide rail and the lower edge of the lower chuck assembly to slow down the descent and achieve a less attenuating taper. **This technique requires practice!**

For one-stage pulls:
Move the mid-switch holder out of the way (Fig. 7C). The glass is softened by the heater coil, which is supplied with a pre-selected current. Adjust the heater current using the 10-turn 1st Heat dial. Determining the appropriate current may require trial pulls.
To initiate the pulling cycle, press the Start button. The cycle will end when the end switch is activated or when the Stop button is pressed.

For two-stage pulls:
The first pulling phase is typically accomplished as a one-stage pull. However, instead of allowing the sliding chuck assembly to hit the end switch, it rests on the vertically positioned and turned-in mid-switch holder. This activates the built-in micro switch and concludes the first stage of the pull. The second stage will begin after a 20-second pause. Once the heater coil stops glowing, reposition it as needed. Lock the lower chuck using the corresponding knob. Just before the second heat begins, move the mid-switch holder out of the way, as shown in Fig. 7C.
The second heat, generated by a pre-selected current using the 2nd Heat dial, will complete the second pull through free gravitational force. The activated end switch will stop the pulling cycle. Pressing the Stop button will interrupt all operations at any moment during the pulling cycle.
The length of the taper is greatly influenced by the applied current and the weight's mass. It is important to note that even a small change in the heater current can lead to a significant change in the shape of the tip formed by the second pull. **Therefore, practice and perseverance are highly recommended.**

Pulling single-barrel micropipettes

When pulling single-barrel micropipettes, the pulling procedure is similar to what has been described above for multi-barrel pipettes, with a few differences. The main difference is that there is no need to rotate the sliding chuck during the pulling process. Therefore, tighten the chuck locking knob (Fig. 1) to ensure a secure grip on the glass.

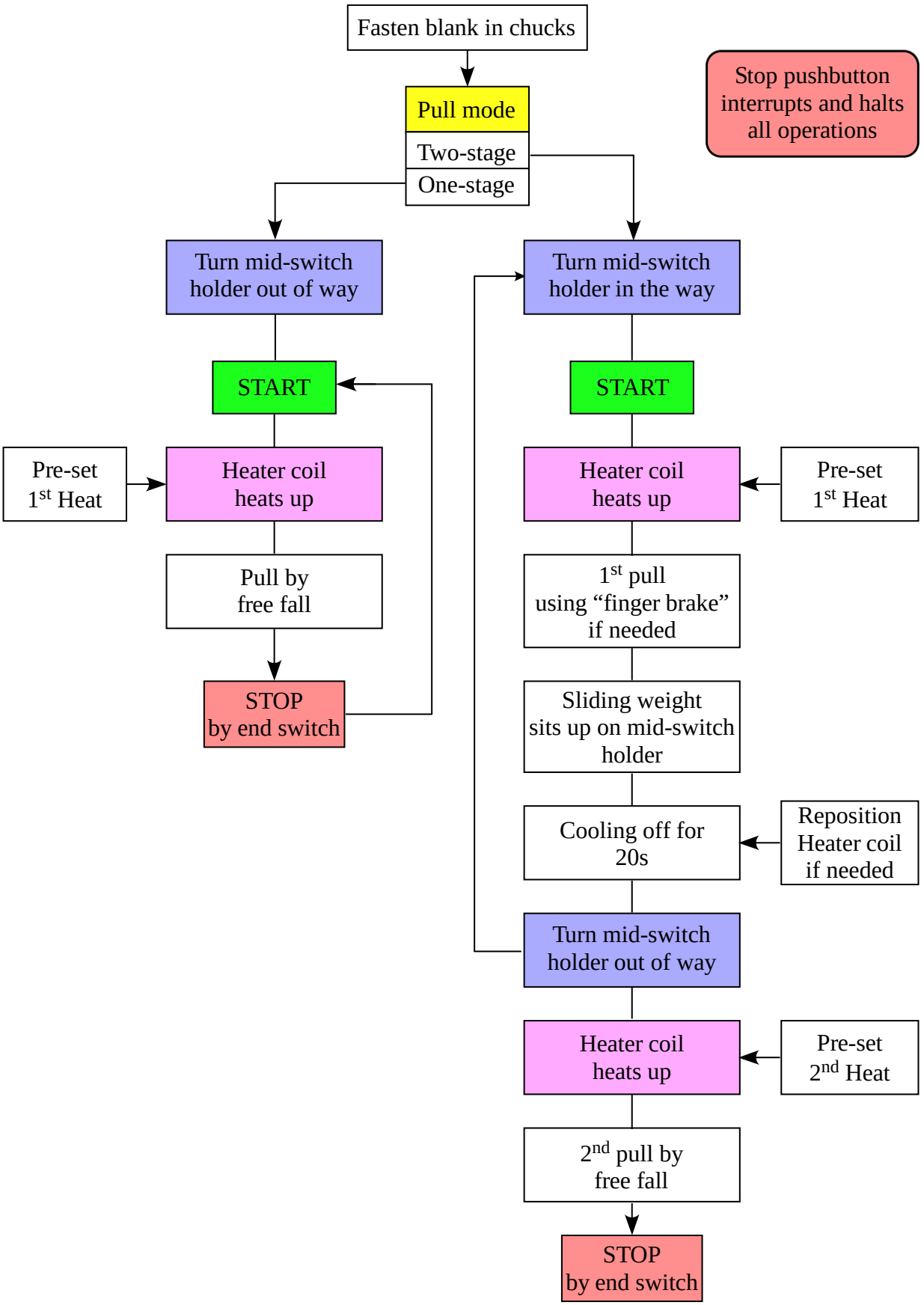
It is important to exercise extra care when working with fine-walled glass tubing. To prevent cracking, it is often a good idea to use sections of heat-shrinkable plastic tubing at both ends of the glass that will be pulled. When pulling fine-walled tubing, it is advisable to use lighter weights for pulling force.

The overall pulling procedure for single-barrel micropipettes remains the same, with the exception of omitting the rotation of the sliding chuck. By following these steps and taking the necessary precautions, you can successfully pull single-barrel micropipettes.

Factors affecting the length and shapes of micropipette tapers and tips

- Temperature, humidity, and air convection in the room
- Current applied to the heater coil.
- Pulling force determined by the weights.
- Speed of the descending motion of the lower chuck.
- Wall thickness or mass of the glass blanks.
- Skills, dedication, and perseverance of the operator.

Flow-chart of the two pull modes



Safety features

The internal low voltage circuitry and the power supply for the heater coil are designed with safety in mind. They are isolated from the AC input power using a certified switch mode power supply. The specific power supply model used is MeanWell RPS-500-12, which is certified as a medical safety-approved device.

This power supply meets various safety standards, including IEC60601-1, TUV EN60601-1, UL ANSI/AAMI ES60601-1 (3.1 version), EAC TP TC 020, and CAN/CSA-C22.2 No. 60601-1:14 - Edition 3. These certifications ensure that the power supply adheres to strict safety regulations and guidelines.

To prioritize your safety, it is strongly recommended to always wear eye protection when performing micropipette pulling. Even a pair of dark sunglasses can provide adequate protection for your eyes during the process.

Care and maintenance

To maintain your Gravipull-4 and ensure its optimal performance, it is important to follow proper care and maintenance guidelines:

Cleaning: Use a mild detergent and a soft cloth or sponge to clean your Gravipull-4. Avoid using aggressive organic solvents such as acetone, as they can damage the surfaces of the instrument.

Lubrication: The stationary and sliding shafts of the Gravipull-4 do not require any lubrication. It is advised not to apply any fluid lubricant, such as oil or grease, as they can attract dust and debris, leading to potential issues with the instrument's operation. Use some WD-40 on the rail guide if the blocks are not gliding smoothly.

Storage: Keep your Gravipull-4 in a dry environment, away from moisture and corrosive fumes. Store it in a clean and dust-free area to prevent any accumulation of debris.

By following these care and maintenance instructions, you can prolong the lifespan of your Gravipull-4 and ensure its reliable performance over time.

Specifications of the Gravipull-4 instrument are as follows:

Blank dimension:	0.25" diameter x 6" length, maximum (6.4 mm x 152 mm)
Slider's travel:	4.4" (112 mm), vertical
Taper length:	100 mm, maximum
Pulling force:	Gravity-fed, set by weights
Weights:	1, 2, and 3-unit masses
Heater power:	12 VDC, maximum 20 A, controlled by pulse width modulation
Heater wire:	Kanthal AF, AWG 18
Display:	Four-digit LCD showing heater currents in Amperes (A)
Mains power input:	Worldwide automatic, self-adjusting, ranging from 80 to 264 VAC, maximum 400 W
Mains frequency:	47 Hz to 63 Hz
Dimensions:	8.3" x 9.7" x 17.3" (Width x Depth x Height) or 21.0 cm x 24.5 cm x 44.0 cm
Net weight:	16 lbs (7.3 kg)
Shipping weight:	20 lbs (9.0 kg)

These specifications provide information about the size, power requirements, weight, and other relevant details of the Gravipull-4 instrument.

Certification:
Kation Scientific certifies that the Gravipull-4 instrument has undergone comprehensive testing and inspection to ensure that it meets all published specifications prior to being shipped from the factory. This certification assures customers that the instrument has been thoroughly evaluated for quality and performance.

Warranty:
The Gravipull-4 instrument is covered by a warranty against defects in materials and workmanship for a period of one year from the date of shipment, under the condition that it has been used in a normal and proper manner. If any defects arise during the warranty period, Kation Scientific will repair or replace the product free of charge, provided that it is returned to the factory. The warranty does not cover damages resulting from improper use or unauthorized modifications.

After the warranty period, Kation Scientific offers servicing and calibration for a reasonable service charge. Customers are responsible for shipping the instrument to the factory, with postage prepaid.

This warranty provides customers with assurance that Kation Scientific stands behind the quality and reliability of the Gravipull-4 instrument, offering support and assistance in the event of any issues that may arise.