

Katanax[®]

K₁ PRIME

Automatic fluxer

Thank you for having chosen the K1 Prime fusion machine from Katanax. To enjoy years of reliable, efficient and safe use of this time-saving instrument, please read this manual thoroughly and keep it in a safe and handy place for future reference.

Should you have any question regarding the use, maintenance or repair of your instrument, kindly contact Katanax directly for assistance (see page 55 for contact details).

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Index

Index	2
Installation	4
Box contents	4
Location	4
Leveling	5
Connection	5
Compatibility with the older K1 model	5
Questions ?	5
Introduction	6
The fusion theory	6
Automatic fluxers	6
The K1 Prime fluxer	7
Main features of the Katanax K1 Prime	10
Precautions	12
High temperature	12
High voltage	12
Acid spills	12
Heavy instrument	12
Crucible locking	12
How the unit works	13
Heating	13
Agitation and pouring of the melt	13
Cooling	13
Solution agitation	13
Using the K1 Prime (basic)	15
The main running screen	15
During a fusion	17
The right ingredients	18
Care of the elements	21
Crucible installation	22
Mold installation	22
A general fusion	22
Making solutions	23
Description of the fusion steps	24
Programming the K1 Prime (advanced)	26
Viewing the fusion parameters	26
Unlocking the advanced mode	30
Managing fusion methods	31
Preparing a fusion program	31
Heating steps	32
Pouring step	33
Cooling steps	34

Solution programs	35
On-the-fly editing	35
Global parameters	36
Language	36
Automatic shut-off delay	36
Fusion counter	36
Fusion troubleshooting.....	37
Disk cracks.....	37
Disk crystallizes.....	37
Incomplete disk.....	38
Non-homogenous disk.....	38
Bubbles in disk	38
Periodic inspection	39
Warning	39
Inspection schedule table.....	39
Flux spillages.....	39
Visual integrity of heating elements.....	40
Element terminal connections	41
Thermocouple junction	41
Service operations	43
Warning	43
Crucible heating element replacement.....	43
Mold heating element replacement.....	47
Firmware and program transfers.....	50
Preset programs.....	50
Backup or restore by USB.....	51
Technical specifications.....	53
Electrical	53
Physical	53
Warranty	54
Contacting Katanax	55

Installation

Congratulations on your acquisition of the K1 Prime fluxer, from Katanax. Please read the following section for proper commissioning of your instrument. Do not hesitate to contact Katanax with any question you might have with this crucial step.

IMPORTANT: *It is advisable that at least two persons carry this instrument to avoid injuries. Do not drop instrument.*

Box contents

The instrument comes with its essential accessories. In addition to optional items you might have ordered, the box should contain:

- 1 fluxer (K1 Prime main unit)
- 1 mold heating/cooling unit
- 1 mold holder to fit your mold size
- 1 power cord
- 1 tool kit (hex keys, spare fuses...)
- 1 instruction manual (this booklet)
-

Additionally, if you have ordered a K1 Prime with solution-making capability, you will find:

- 1 solution agitation module
- 1 unbreakable Teflon beaker
- 1 magnetic stirring bars

Location

Vent hood

Molten flux, additives and some samples may produce vapors and gases that need to be extracted, but since this instrument does not produce post-combustion hot gases, only a small hood is required. A wide, funnel-ended, flexible suction duct may be the most practical and economical solution.

Table

The counter on which the instrument is to be used must be made of non-combustible material and must be able to withstand a weight of 30 kg (66 lbs). It is recommended to use the instrument from a standing position, and adjust table height accordingly.

It is advisable that at two persons carry the instrument to avoid back injuries.

Clearances

Because your new fluxer will produce heat, a minimal safety clearance must be provided to prevent surrounding material from heating and potentially catching fire. All around the instrument, a minimum distance of 30 cm (12") must be free

from combustible materials. Similarly, a clearance of at least 45 cm (18") must be provided above the top of the instrument.

Leveling

In order to obtain glass beads with a regular thickness, it is important that the mold be reasonably horizontal upon pouring. If in doubt, place a lightweight bubble spirit level on the mold and adjust instrument's feet to compensate for possible slant. (See page 22 for mold installation details.)

Connection

The K1 Prime works on 117-127 or 220-240 VAC, 50/60 Hz.

- When used at 117-127 VAC, the power line must be able to provide 12 A.
- When used at 220-240 VAC, the power line must be able to provide 10 A.

While it is technically workable to use the instrument in the lower range of voltages, heat-up times will be longer than in the recommended voltage range. It is possible that the instrument show heating errors due to this, because the microprocessor monitors temperature increase vs. time.

In areas where only 100 VAC is available, the use of a 1500 W step-up transformer is recommended.

Compatibility with the older K1 model

If you own an older-generation K1 unit, please note that the mold heating module and the solution agitation module, while being physically very similar to their new versions, are NOT compatible.

IMPORTANT: *Damage to the instrument will occur if an older module is connected to the K1 Prime.*

Questions ?

Should you have any question regarding the proper installation and start-up of your instrument, please contact Katanax directly (see information on page 55) for assistance.

Introduction

This section intends to introduce the reader to the fusion technique and to familiarize him or her to the K1 Prime.

The fusion theory

Fusion is a technique used to prepare inorganic samples, with a view to analyze them by x-ray fluorescence (XRF), inductively coupled plasma (ICP) atomic absorption (AA) or any traditional wet chemistry method. Typical samples include: cements, ores, slag, sediments, soils, rocks, ceramics, pigments, glasses and even metals.

A fusion can produce either a small, homogenous solid glass disk (or “bead”) for XRF, or an acid solution for other analytical methods.

The process of fusion as a sample preparation method exhibits many advantages over other methods, as it does not produce mineralogy, grain size or orientation effects and the result is perfectly homogenous.

In sample preparation by fusion, the sample never actually melts. It is merely dissolved into a solvent. This solvent, generally a lithium borate flux, is solid at room temperature and must be molten to dissolve anything. This is the only reason the process requires heat.

Therefore, the peak temperature of a sample preparation by fusion is determined only by the type of flux, not the type of sample.

A fusion temperature of 1100°C should be considered as a maximum.

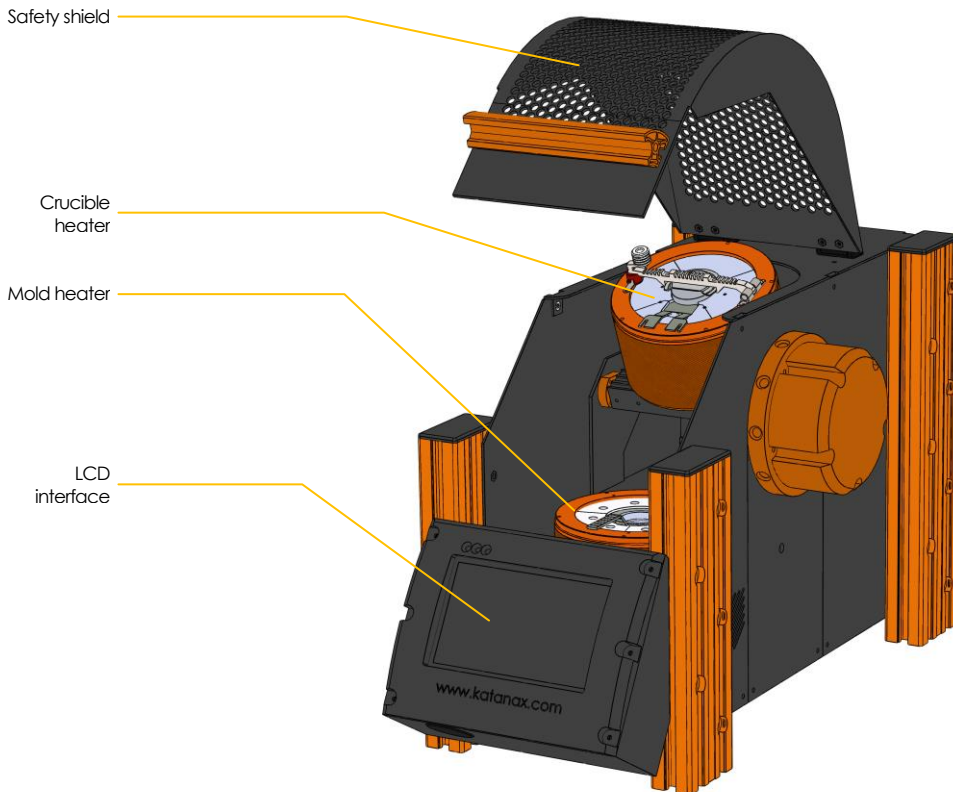
Heating above that temperature could cause flux evaporation that could bias the subsequent analysis.

Automatic fluxers

Because of the potential risk of manipulating red-hot samples and to increase repeatability of temperature, mixing and duration, the industry has now adopted the automated fusion machine as the standard equipment to prepare samples by fusion.

The K1 Prime fluxer

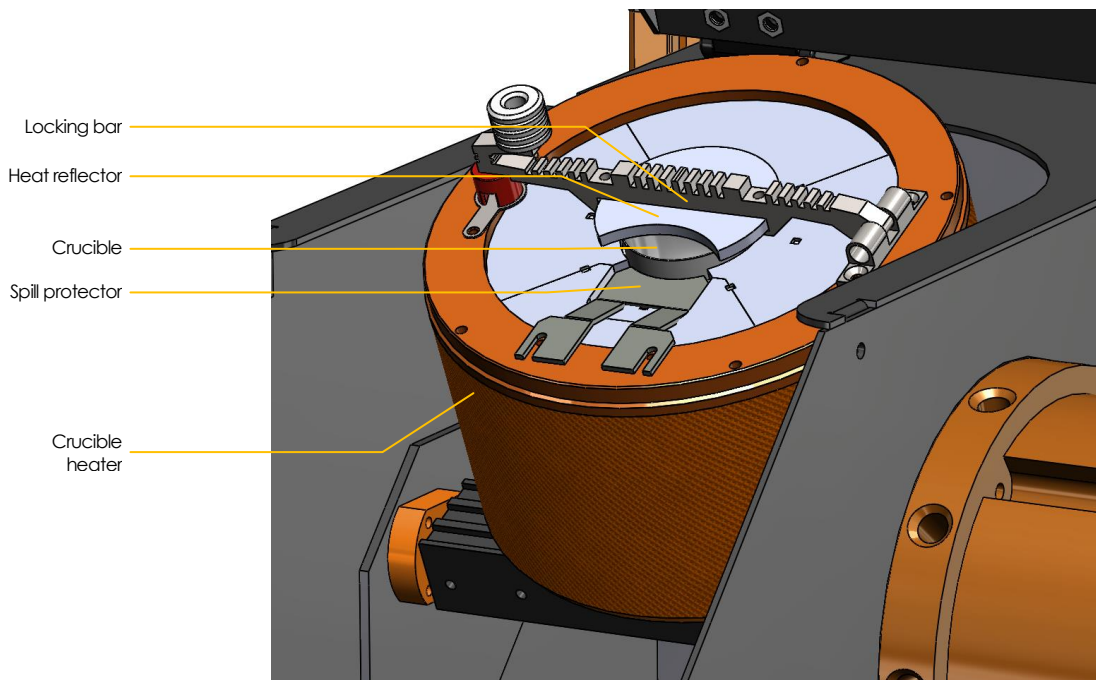
General view



Enter the K1 Prime, the fusion machine that is the evolution of the original K1, which was the first and only fully automated electric resistance fluxer. Based on this success, Katanax has updated the concept, making it sturdier and easier-to-use than ever.

The K1 Prime comes pre-loaded with various fusion methods that can be used as is, or can be customized. All fusion methods can be saved, renamed, deleted or copied, just like computer files. Only the preset methods are protected to avoid accidental overwriting.

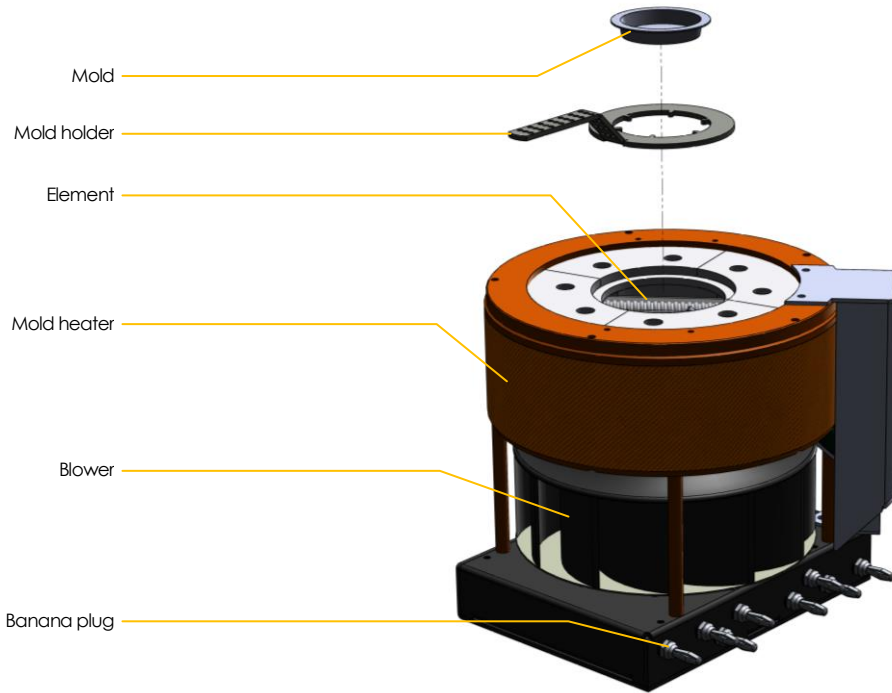
Crucible heater



A straight-walled platinum crucible is loaded with a few grams of powdered sample, an appropriate flux and often other agents. The crucible is inserted into the crucible heater, and locked by the locking bar's heat reflector.

A removable spill protector is provided, so that any pouring residue can easily be cleaned.

Mold heating/cooling unit



A platinum mold in a special holder is then installed in the removable mold heater. The mold is actually placed in a metal holder, which is available in various sizes to accommodate all typical mold diameters.

Should your instrument be fitted with a mold holder that is not suitable for your mold, please order as follows:

Part number	For mold with nominal diameter
KP0037A	30 mm
KP0038A	32 mm
KP0039A	35 mm
KP0040A	40 mm

A blower underneath will provide the necessary airflow to cool down the mold and glass bead at the end of the cycle. This is why this unit is sometimes referred to as the mold heating/cooling unit. For simplicity, we will simply refer to the "mold heater".

Fusion sequence

When the user instructs the K1 Prime to launch the actual fusion, all heating steps are automatically started in sequence. Temperature is constantly monitored and displayed.

Once the flux is molten (after a programmable time), a back-and-forth rocking of the crucible heater continuously mixes the flux with the sample.

The liquid flux starts dissolving the sample. When all sample is dissolved (after the programmed time), the crucible heater tilts forward and the crucible pours its contents into the mold.

If set so in the fusion program, it is possible for the now-full mold to be re-heated by its heater, before the final cooling. (This operation is called *annealing* and is needed in very special cases only.)

A blower located underneath cools the mold; when the mold is completely cooled, the user picks up a perfectly homogenous glass bead, ready for analysis by XRF.

For solution preparation, the hot melt is poured into an unbreakable beaker (instead of a mold), which contains a dilute acid that is automatically stirred by a magnetic system (optional).

Some fusion types, such as peroxide and pyrosulfate, do not even require pouring. The K1 Prime is also designed for such fusions, where the whole crucible is dipped into an acid, after the fusion, to prepare a solution by leaching.

Main features of the Katanax K1 Prime

Accuracy

- Entirely automated
- Fully reproducible fusion methods
- Real-time temperature display

Safety

- Integrated safety shield
- No gases used, so no post-combustion toxic products released
- Minimal heat dissipation; no need for a powerful vent hood

Versatility

- Makes glass disks for XRF, as well as peroxide or pyrosulfate fusions
- With optional solution agitation module, can also prepare solutions
- Ready to fuse with built-in methods for oxides, minerals, metals, alloys, sulfides, fluorides and more
- Can perform solid oxidations
- Can be used at both 120 and 240 VAC (voltage selection at the back of the instrument)
- Can be connected in any standard outlet (consumption is lower than 1300 W)
- Fully customizable fusion methods
- USB connectivity

Productivity

- Throughput of 5 to 7 samples/hour

Simplicity

- Simple, intelligent, high-performance heaters
- Easy installation
- Intuitive touch-screen color LCD graphics interface
- Easy icon and menu navigation
- Low maintenance; easy component access
- 1-year limited warranty

Precautions

High temperature

Although this instrument has been built to be very safe, it is still capable of reaching temperatures up to 1150°C. Care must be taken in order to avoid touching hot surfaces.

Even though the mold is supposed to be cool at the end of a fusion cycle, in order to avoid risks of burns, use appropriate gloves, laboratory tongs or some other adapted tool to manipulate the mold and glass disk. The crucible and its locking bar will remain hot at all times – use appropriate gear or tool.

User is advised that this instrument remains very hot for a long time, even after turning it off.

High voltage

This instrument is powered by 120/240 Volts AC. Although the elements are powered at voltages below 24 V, reasonable precautions must be taken.

Disconnect power cord before attempting any cleaning, maintenance or repair operation.

Be careful that no liquid infiltrate into the unit's casing.

Acid spills

When making solutions, user is strongly discouraged to use glass beakers, as acid spills in instruments are dangerous and not covered by warranty. Use only unbreakable Teflon beakers; otherwise, there is a risk of user injury, due to flying glass shards or acid splatter.

Heavy instrument

It is advisable that at least two persons carry this instrument to avoid injuries. Do not drop instrument.

Crucible locking

Installing the crucible requires that the crucible locking bar be secured by means of its magnet. To ensure safe operation, this needs to be checked by the user before each fusion. See page 22, *Crucible installation*, for detailed instructions.

How the unit works

Heating

Heating of both the mold and the crucible is achieved in separate heaters, using a state-of-the art alloy heating elements coiled around rigid ceramic rods. These rods run along a semi-soft, highly insulating material. These parts are then assembled into an aluminum container.

During heating, temperature is controlled by means of a platinum thermocouple.

To improve energy efficiency, a small cover is moved over the crucible. This reflector also doubles as a stopper that keeps the crucible in its heater during pouring.

In the case of the mold, a ring-shaped holder is placed around the mold to keep as much energy in the heater as possible.

Agitation and pouring of the melt

Homogenization of the sample into the flux is produced by the rotation of a geared stepper motor located at the far right of the instrument. This motor directly drives the crucible heater with a back-and-forth motion to agitate the melt.

At the moment of pouring, this tilting motor rotates the crucible heater further forward to an adjustable pouring angle, at an adjustable speed. The melt pours naturally into the mold, and the crucible heater is automatically brought back to the horizontal, ready for another fusion.

The pouring step can also be completely disabled, for procedures such as pyrosulfate or peroxide fusions, which do not need transferring the melt into another container.

Cooling

The mold heater is fastened right above a blower (centrifugal fan). When requested, this fan is powered and draws fresh air through the holes of the ceramic ring around the mold, then through the holes at the bottom of the mold heater ceramic shell. The mold heater thermocouple monitors the cooling process.

Solution agitation

Making solutions requires that the instrument be fitted with the optional solution agitation module.

When making solutions, the hot melt is poured directly into a beaker containing an acid. This beaker, along with the solution agitation module, is to be installed

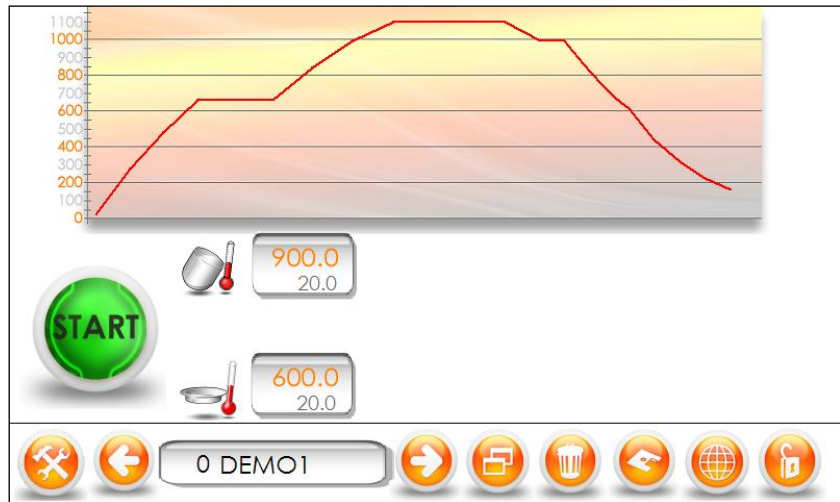
before the fusion is launched. The acid solution must be agitated to improve the dissolution speed of the crystallized flux and sample.

To do so, alternatively powered magnetic coils produce a rotating magnetic field under the beaker. By placing a laboratory-type magnetic stirring bar in the acid before fusion, the agitation will be automatically started and stopped.

Using the K1 Prime (basic)

The main running screen

After the booting screen, you will obtain a display similar to the following (not all buttons/icons will appear, depending on the instruments' settings):



Here is a short explanation of the various zones and buttons:



The graph zone shows the outline of the crucible temperature as a function of time.



The "Start" button, quite obviously, is used to launch the currently selected fusion program.



The crucible temperature icon is depicted with

- the actual measured temperature (in orange), and
- the target temperature, which the crucible heater is in the process of reaching (in gray)



Similarly, the mold temperature icon is shown with corresponding actual (orange) and target (gray) temperatures.



The “parameters” button is used to adjust the individual setting of each program step. More details are given at page 26, *Programming the K1 Prime (advanced)*.



This zone is used to select the current program. Click on the arrows to scroll among existing programs.

Clicking on the program name itself will also allow you to rename it. More details on this are given at page 31, *Managing fusion methods*.



The Copy button is useful to duplicate an existing program, to create a derived program. More details are given at page 31, *Managing fusion methods*.



The Delete button is used to erase a program from memory. More details are given at page 31, *Managing fusion methods*.



The Save button is used to write the current program and its parameters into memory. More details are given at page 31, *Managing fusion methods*.



The Global Parameters button is used to access a screen where general configuration settings can be modified. More details are given at page 36, *Global parameters*.



The padlock icon/button shows the state of the fusion program parameters.

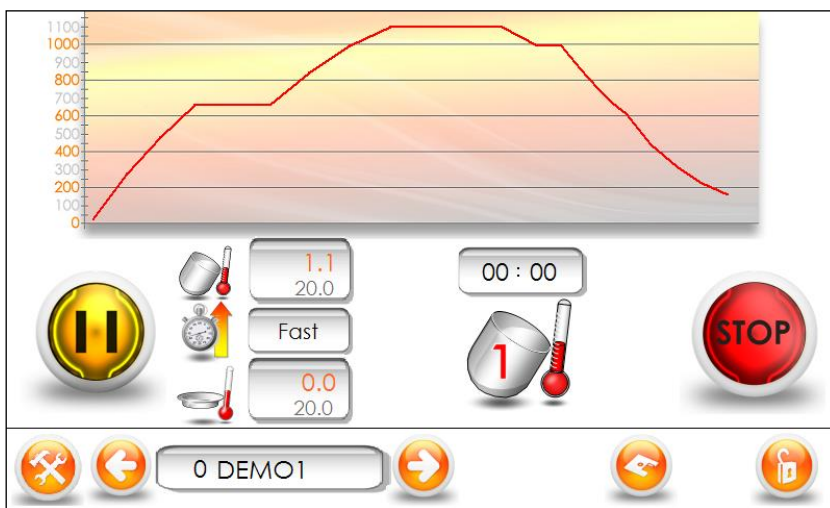
A closed padlock means that the parameters are locked, and a password is required to unlock parameter access. Conversely, an open padlock means that all parameters can now be freely changed.

More details are given at page 26, *Programming the K1 Prime (advanced)*.

Entering the password is also required to access the Global parameters screen.

During a fusion

While the instrument is running, the main screen will display additional information and buttons.



Here is the explanation of the new graphical elements. (Other icons were explained at page 15, in *The main running screen* section.)



The Pause button is used to temporarily “freeze” the ongoing fusion.

In pause mode, timers are suspended, and the current furnace temperature is maintained. Any ongoing motor motion will be continued or completed. This can be useful when some extra time is required to complete an oxidation or dissolution reaction, for example.

Press the Pause button again to resume normal operation.



Fast

This icon represents the ramping speed to reach the programmed crucible temperature. Default value is “Fast” (i.e. the crucible heats at full power), but it is possible to slowly ramp up the temperatures, at rates expressed in °C/minute.

00 : 45



This cluster represents the elapsed time (mm : ss) since the requested temperature is attained, as well as the currently-running step number (in red).

See page 24, *Description of the fusion steps*, for more information on this topic.



The Stop button, as the name implies, is used to halt an ongoing fusion process, stopping all motors.

This can be used when one realizes that the crucibles or molds are not properly prepared, or in case of emergency, for example.

- Pressing Stop again will cancel the ongoing program and reset the instrument.
- Pressing Start instead will resume the fusion program.

The right ingredients

From the preceding paragraphs, we already know how to launch a fusion program. There are, however, a few other things than one should know to obtain a perfect disk. These include:

1. properly preparing the sample for the fusion,
2. selecting the appropriate flux blend for the sample type,
3. determining the total mass in the crucible from the mold capacity,
4. estimating the flux-to-sample ratio,
5. using the appropriate additives, and
6. mixing the components together.

Sample preparation

Besides the traditional specifications of a sample to be representative, uncontaminated and dry, Katanax recommends that the sample be ground to <100µm. This is to ensure that the fusion be completed within a reasonable time.

Additionally, the sample must be fully oxidized before heating the crucible containing the sample.

IMPORTANT: Heating a sample containing metallic species at high temperatures will cause an alloying reaction, damaging the crucible, and possibly damaging the instrument.

Flux blend

Typical fusions use a mix of lithium metaborate (LiM) and lithium tetraborate (LiT). Lithium metaborate alone typically offers a better sample solubility, but generally leads to crystallization of the bead. Tetraborate stabilizes the melt, but limits solubility. Thus, to optimize solubility and obtain perfect glass disks, one must use the correct LiT/LiM flux ratio.

The mixing ratio is determined by the acidity of the sample. Acidic samples require a basic flux (more LiM), while alkaline samples need an acidic flux (more LiT) and neutral samples call for neutral flux (50% LiT + 50% LiM).

Here is a list of common oxides, along with the recommended flux.

Simple oxide	Recommended flux
K ₂ O, Na ₂ O, BaO, SrO, Li ₂ O, CaO, Ag ₂ O, MnO, MgO, PbO, CoO	Lithium tetraborate
Bi ₂ O ₃ , FeO, ZnO, CuO, NiO, BeO	67% Lithium tetraborate – 33% lithium metaborate
Al ₂ O ₃ , Fe ₂ O ₃ , Cu ₂ O, Sb ₂ O ₃ , ZrO ₂ , TiO ₂ , SiO ₂ , B ₂ O ₃ , SnO ₂ , V ₂ O ₅	50% Lithium tetraborate – 50% lithium metaborate
CrO ₃ , Mn ₂ O ₇ , SeO ₃	Lithium metaborate

Naturally, actual samples are generally composed of more than one oxide type, so a rough proportion must be calculated to determine the optimal flux type.

The only exception is when one makes solution. Since making a solution involves the complete dissolution of the melt into an acid, one does not care that the melt crystallizes when it cools; it is not only unavoidable, it is desirable. Therefore, when making a solution, one can pretty much always use lithium metaborate only, to increase sample solubility.

The choice of flux is also governed by the various chemicals that must be added. For example, many samples are initially un-oxidized, and thus need to be oxidized; since borate fluxes only dissolve oxides (metallic material ruins crucibles at high temperatures). Addition of strong acids or bases is often the easiest solution, but flux type must be adjusted accordingly.

Amount of flux and sample to use

Today's market has seen a proliferation of various mold diameters. Consequently, one must adapt the amount of flux and sample to obtain a full disk that will not overflow out of the mold.

Our recommendation is to measure the actual inner diameter on the bottom of the mold and apply the following formula, to obtain the total mass of sample and flux:

$$\text{Total mass [g]} = \frac{(\text{Mold diameter [mm]})^2}{150}$$

Thus, for a 32-mm inner diameter mold (recommended diameter), we obtain $32^2 / 150 = 6.827$ g, which we can round up to 7 g.

This being said, there are also molds on the market that are very shallow (despite the thickness of the metal they are made of). Those molds will require less flux to fill correctly, but leveling of the mold is more critical.

Flux-to-sample ratio

After the choice of the right flux, the flux-to-sample ratio is probably the second hardest question to answer. This section intends only to explain general concepts. For more specific information, the customer is invited to contact Katanax directly.

To obtain the best readability possible on the analytical instrument, one wishes to put as much sample as possible in the preparation. However, putting too much sample will over-saturate the flux, and leave undissolved sample particles in the disk.

The solubility of samples into the flux being rather hard to predict theoretically, it is recommended to work with the following method:

1. Determine the optimal flux type. If unsure, 67% LiT with 33% LiM is a good starting point.
2. Using the formula above, calculate the total amount of flux and sample required for your mold size.
3. From this mass: weigh 5% sample for 95% flux, directly in the crucible. Mix thoroughly.
4. Proceed with fusion, and observe the result.
5. If the bead is perfectly homogenous, it is possible to try increasing the amount of sample a little.
6. If the bead is milky or dusty (presents tiny particles of undissolved sample), try again with less sample, or change the flux type a little. It is also possible that the sample be not completely oxidized. Just after weighing the sample (before adding the flux), add a small amount of solid oxidizer, liquid acid or liquid base, depending on what reacts better with the sample at hand.

The optimal flux-to-sample ratio is found when all the sample is dissolved, and almost saturates the flux solvent.

Note that increasing fusion temperature does not allow the stable dissolution of more sample. It may quicken the dissolution speed, but when the disk will cool down, a precipitate will appear, or the disk will be prone to spontaneous bursting.

The non-wetting agent (NWA)

The non-wetting agent (NWA) acts as a surfactant that makes the melt less prone to sticking to platinumware. Non-wetting agents are halogen compounds (generally containing Iodine, Bromine or Fluorine) and typical formulations include KI, LiI, LiBr, NH_4I and NaI. Only a few milligrams are required. If in doubt, use about 30 mg of LiBr and observe the results.

We strongly recommend using such a non-wetting agent, to lengthen the mold's life expectancy, and to ensure all the melt is transferred into the mold upon pouring.

Katanax also sells flux blends that contain predetermined amounts of non-wetting agent. Please contact Katanax to obtain this time-saving product.

Oxidizing agents

As previously mentioned, it is of key importance that the sample be oxidized. While it is often safer and easier to oxidize the sample using a liquid acid or base before fusing, it is also possible to use powder reagents to oxidize the sample in a one-step operation.

Typical oxidizers are lithium carbonate (Li_2CO_3 , which reacts at around 700-800°C), and lithium nitrate (LiNO_3 , which reacts at around 500-600°C). Several minutes at the reaction temperature must be allowed before heating up further, and temperature ramping can be useful to avoid spills due to too fast a reaction (see page 26, *Programming the K1 Prime (advanced)* for details on ramping). The amount of selected reagent will depend on the sample contents and can be estimated stoichiometrically. An excess of oxidizer is recommended.

Manual mixing

Once all the components are selected and weighed into the crucible, some manual mixing is recommended, to improve contact between the various reagents.

In particular, very fine sample particles have been observed to agglomerate, and a manual mixing will help breaking the lumps that might have formed during and after weighing.

One exception to this general rule is when using powder oxidizers. In that special case, one wants to first lay some flux on the bottom of the crucible, then add the sample and oxidizer on top. Manual mixing would ideally just be done with those two top components, because one wants to have the most intimate contact between the sample and the oxidizer. Flux will merely act as a shield at first, protecting the crucible from alloying with the sample.

Care of the elements

In the K1 Prime, heating elements build a surface oxide layer, which protects them from degradation and lengthens their lifespan. However, this oxide is extremely sensitive to molten flux.

IMPORTANT: No flux must touch the elements. Element life would dramatically be reduced.

IMPORTANT: User must always remove the crucibles from the instrument before weighing powder components, and make sure that the crucible and mold external walls are clean before re-installing them in their heaters.

Crucible installation

Once the crucible is filled with the proper components, it can be installed in the crucible heater.

To install the crucible, rotate the locking bar upwards until it rests to the right. Gently insert the crucible into the heater cavity and re-close the locking bar.

IMPORTANT: Installing the crucible requires that the locking bar be fully closed. Checking this before each fusion is required to ensure safe operation.

Mold installation

After the crucible has been installed, one must place a mold to receive the molten material.

IMPORTANT: Forgetting to install the mold will cause the crucibles to pour the hot molten glass onto the instrument, possibly damaging it.

A general fusion

Here are the steps required to perform a fusion on the K1 Prime fluxer.

1. Turn the instrument on by flipping the rocker switch at the back of the instrument. The main screen appears when booting is complete.
2. Check crucible and mold heaters for possible flux spills from a previous fusion. (See page 39, *Flux spillages*, for details.) If heaters' interiors look vitreous and dirty, clean them immediately; do not start a fusion process with dirty holders, as this could damage the instrument.
3. Select the desired fusion program, by clicking on the left and right arrows that flank the current program name.
4. In the platinum crucible, weigh the required amount of flux.
5. Add the sample by weighing it directly into the crucible on top of the flux. Mix if no solid oxidizer is to be used.
6. Prepare solid oxidation, if required.
 - 6.1 Add a suitable solid oxidizer (generally, a nitrate or carbonate) in the crucibles.
 - 6.2 Mix thoroughly with the sample. (Try to leave the bottom layer of flux untouched.)

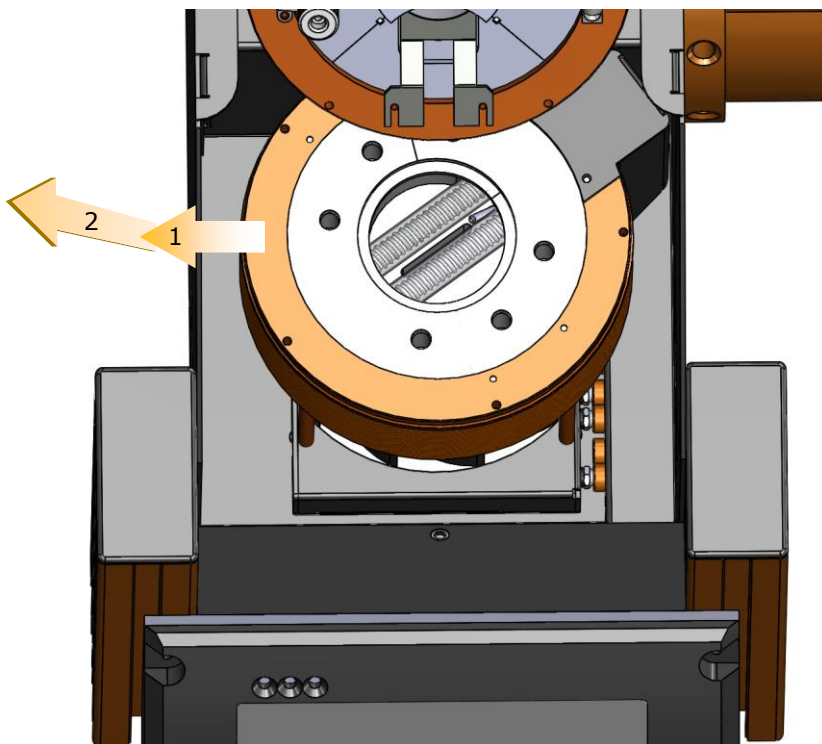
7. Add the non-wetting agent if it is not already integrated within the flux.
8. Place crucible in its heater. **Important:** make sure that it is properly locked in place. See page 22, *Crucible installation*, for details.
9. Place mold on its holder, using appropriate mold holder ring. **Important:** do not forget to install the mold! See page 22, *Mold installation*, for details.
10. Touch Start to launch the fusion.
11. Upon heating, the sample reacts if an oxidizer is present. Then, the flux melts and dissolves the sample. The mold is heated at the same time. At the end, the crucible is tilted to pour into the mold. A blower cools the disk.
12. At the end of the cycle, carefully pick up the glass disk. **Important:** It may still be very hot, depending on the mold weight and program parameters.

Making solutions

When making a solution, the process is quite similar, but a solution-specific program must be selected, and the mold installation changes for the following:

9. Place beaker in instrument.
 - 9.1 Fill a Teflon beaker with about 100 ml suitable dilute acid. (Nitric acid is the most commonly used.)
 - 9.2 Add a magnetic stirring bar.

- 9.3 Remove the mold heater by first wiggling it to the left, and then pulling it upwards after it is disconnected.



- 9.4 Install the magnetic solution stirrer in place of the mold heater. First lay the agitation module on the bottom of the cavity (the connector pointing to the right), and then slide it rightwards, to connect it fully.

- 9.5 Put the beaker on the agitator.

In the last steps of the fusion program, the magnetic stirrer will automatically start, just before the crucible pours the melt into the acid.

Description of the fusion steps

All fusion programs in the K1 Prime are built the same way, and have seven (7) steps. Here is the list of those steps, along with the corresponding icon:



Heating 1

Typically used to pre-heat the sample, with little or no agitation.



Heating 2

Typically used to oxidize the sample, with little or no agitation.



Heating 3

Typically used to melt the flux.



Heating 4

Typically used to dissolve the sample in the flux.



Pouring

Used to transfer the crucible contents into a mold or beaker.

Not used for some preparations, with peroxide fluxes for example.



Cooling 1

Used for natural-cooling of the mold, or stirring of the solution



Cooling 2

Used for blower-cooling of the mold

Each step is launched when the preceding one is completed. It is also possible for a step to have a null duration (i.e. zero seconds), useful when one wants to increase crucible temperature with no rocking (the rocking parameter must be set to 0). Most fusion programs will not use all heating steps.

Note that all heating steps (1 to 4) are identically structured and could be used interchangeably.

Also, some of the steps have built-in on/off switches that allow extra actions to be executed, or sometimes to turn off the fusion step itself.

Manual edition of step parameters is the subject of the next chapter.

Programming the K1 Prime (advanced)

Viewing the fusion parameters

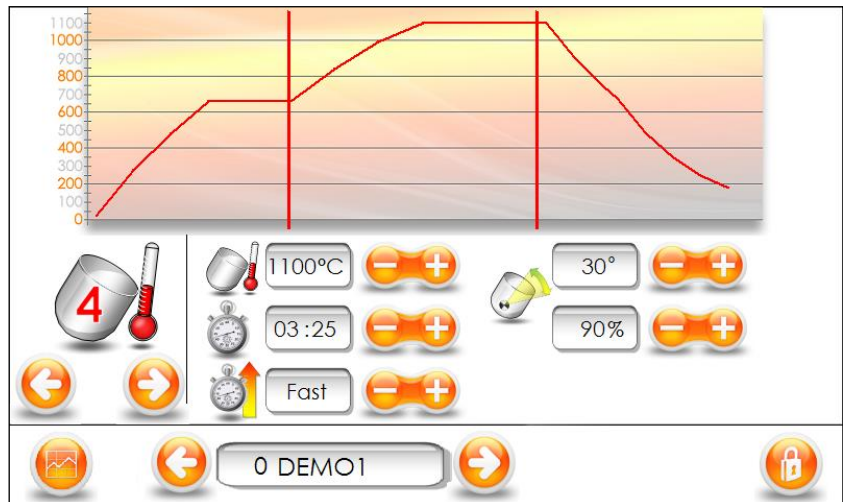
When specific sample types do not seem to be easily processed by a preset fusion method, it is necessary to manually modify the parameters of critical fusion steps.

Without risking to change a parameter, any user can check the current values and settings of the current program, step-by-step. This is done by pressing the "Settings" icon, in the lower left corner of the main running screen.

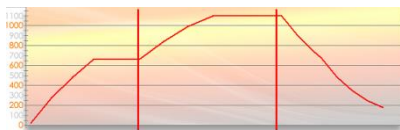


The Settings icon allows to toggle to a screen where the parameters for a given fusion step are displayed. Nothing can be changed unless the advanced mode is unlocked (see page 30, *Unlocking the advanced mode*).

The screen will now look something like this:



Let us now understand the meaning of each symbol.



We are now familiar with the graph zone, which shows the outline of the crucible temperature as a function of time.

The fusion step being edited is represented as the portion of curve between the two vertical red lines.

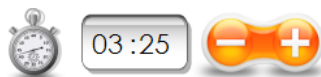


The large crucible with red thermometer represents a heating step, and the numeral "4" indicates that we are now viewing the parameters of step "Heating 4".

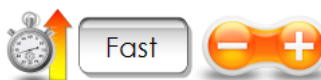
The Left and Right arrows are used to scroll among the steps of the current program.



The small crucible with red thermometer icon is placed just besides a cell where the target crucible temperature is displayed. (The Minus and Plus buttons will be used to change the parameter.)

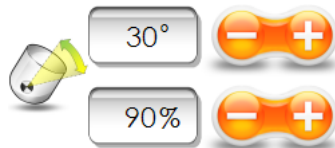


The stopwatch icon is placed just besides a cell where the step duration is displayed. Note that step durations are calculated *after* the required temperature is reached.



The stopwatch with arrow icon is placed just besides a cell that indicates how fast the target temperature will be reached.

Most fusion applications can use the "Fast" setting, but oxidation steps often call for a slower heat-up rate. This is called "ramping", and its speed is expressed in °C/minute.



The crucible with angle symbol is used to refer to two rocking parameters.

The top one is the amplitude of the rocking.

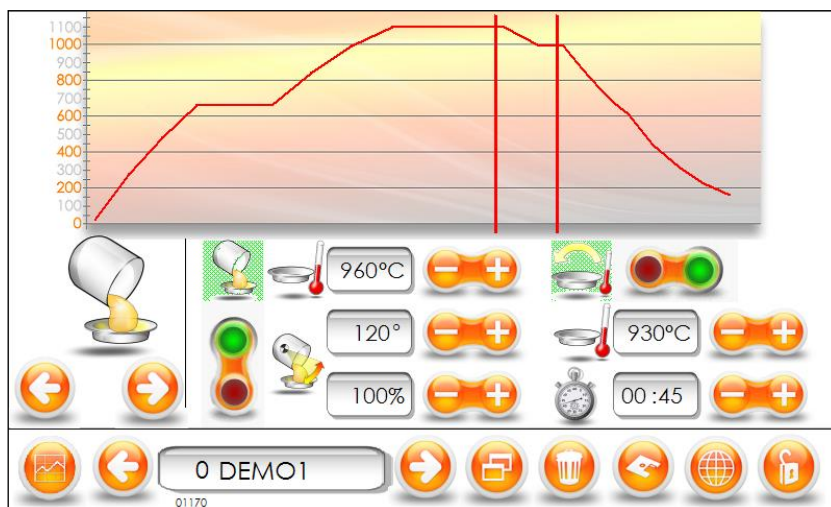
The bottom one is the rocking speed.



The icon in the lower left corner has now switched to a graph icon.

Pressing this button will bring you back to the main running screen.

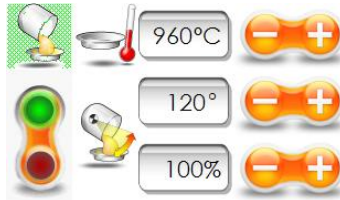
If we scrolled fusion steps towards the right, until we reach the pouring step, we would obtain a screen similar to the following:



Icons and symbols have the following meaning:

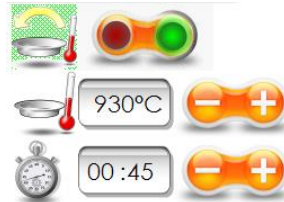


The large crucible pouring into a mold shows that we are now viewing the Pouring step parameters.



This block of icons shows that the pouring is On (thus the "green light").

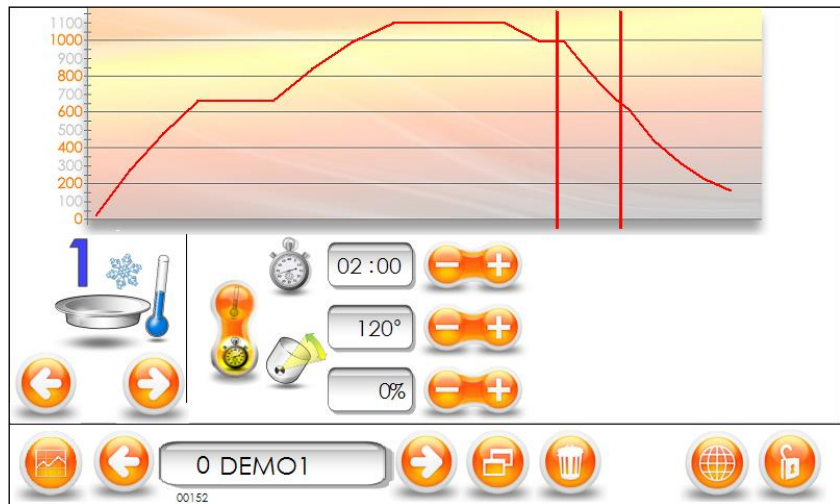
The parameters to the right show the mold temperature upon pouring, the crucible angle (in degrees), as well as the pouring motion speed (in percent).



This block of icons shows that the annealing is activated (thus the "green light").

Annealing is very rarely used, but in the most specific applications. It reheats the mold at the given temperature, *after* pouring, for the given duration.

Again, scrolling to the next step will show us the available parameters for a cooling step.



And we now recognize the duration parameter, as well as the crucible tilting angle and motion speed.

However, there is also a new switch depicting a thermometer and a stopwatch. The active state is bright yellow, and applies to both "Cooling 1" and "Cooling 2" steps.



When the switch is in "stopwatch" mode, the cooling step will end when the set timer expires. Hence, the corresponding parameter is a duration.



When the switch is in "thermometer" mode, the cooling step will end when the mold reaches a given temperature. Hence, the corresponding parameter is a target temperature.

The two crucible-related parameters are used to control the straightening up of the crucible heater (there is no continuous rocking motion here).

Typically, the tilting angle of "Cooling 1" will be the same as the pouring, and the tilting angle of "Cooling 2" will be zero degree (0°). This will give some time for the flux to pour completely out of the mold during "Cooling 1", while straightening the crucibles when the blower starts at the beginning of "Cooling 2".

Unlocking the advanced mode



Before being allowed to manage fusion program and edit parameters, one must enter the correct password. To do so, click on the padlock icon/button.



After touching the padlock button, a numeric keypad will pop up, ready for password entry.

Type the password, which is 2014.

If you make a mistake while typing, press CR to clear.

If you summoned the numeric keypad by error, you can close it by pressing ES ("escape").

Once the password is correctly typed, press ENT ("enter") to confirm. The numeric keypad will close, and the padlock icon will now be displayed as unlocked.



This icon informs you that you can now modify the fusion program parameters, but also manage the fusion methods (i.e. copy, delete and save). You are now in “advanced mode”.

To close the advanced mode (i.e. “re-lock” the padlock), simply click the icon and enter an incorrect password on the numeric keypad.

Managing fusion methods

Fusion methods can be managed just like files on a computer. In the main screen, you can press the icon corresponding to Copy, Delete and Save. Note, however, that the “advanced mode” must first be accessed in order to perform any of the following actions.

Copying



The Copy button is useful to duplicate an existing program, to create a derived program. Hence, begin with a preset program that is close to the sample type you want to process, and then you will be able to fine-tune the parameters to suite your specific sample. After clicking on the icon, a window will ask for a confirmation. Click “Yes” to proceed, or “No” to cancel.

Renaming

Once a method is copied, you will be automatically brought into that copied program, named “Untitled”. We suggest that you immediately rename this with some name that is relevant to your application. To rename the program, click on its name (in this case, “Untitled”), and a full keyboard will pop up. (Note that renaming a preset program is not allowed.)

Deleting



The Delete button is used to erase a program from memory. Once a program is erased, it frees the corresponding memory slot, and it cannot be recovered. Furthermore, preset programs cannot be deleted.

Saving



The Save button is used to write the current program and its parameters into memory. This icon will appear automatically when the user changes a parameter value or a setting in a program. Otherwise, the icon is not shown.

Preparing a fusion program

To build your first fusion program, you must first select a preset program template that will be used as a starting point to design your own program. In most cases, the Oxide program is a good all-around program. Copy it under your desired name, as described above.

Once this “editable” program exists, you can adjust parameters to suit your sample.

Heating steps

Heating steps all have the same structure. Hence, if you need only two temperature plateaus, you could use Heating 1 and Heating 2, or Heating 1 and Heating 3, and so on, without affecting anything. For standardization purposes, Katanax tends to use the last heating steps, and leave the first ones empty when not needed.

Temperature



Crucible temperature can be adjusted by pressing on the plus and minus buttons besides the crucible temperature icon.

Note that the K1 Prime firmware prevents the user to create a decreasing temperature before pouring. The instrument will prevent a heating step from having a temperature that is lower than an earlier step. Also, the instrument will automatically increase temperatures of subsequent steps to match the step being edited.

Examples:

Suppose that we have a program with Heating 2 at 500°C and Heating 3 at 700°C. You will not be allowed to decrease Heating 3 below the temperature of Heating 2, i.e. 500°C.

Now suppose that the program has Heating 1 at 900°C and Heating 2 also at 900°C. If you increase temperature of Heating 1, the temperature of Heating 2 will be automatically increased by the same amount.

User is advised that too high temperatures will affect the life expectancy of the heating elements, but can also lead to analytical problems, due to evaporation of the flux.

IMPORTANT: No fusion should require temperatures in excess of 1100°C. Please contact Katanax if you feel your sample type needs higher temperatures.

Duration



Step duration (mm : ss) is also adjusted by pressing on the plus and minus buttons. The actual step timer will start once the heater has reached the temperature set for this step. Hence, the length of a step is actually the sum of the time required by the furnace to increase up to the step temperature, plus the duration parameter. For each step, the duration parameter is limited to 19 minutes and 55 seconds, except if ramping is in use (see below).

Ramping

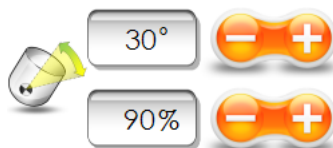


The ramping parameter determines how fast the crucible heater will increase its temperature to reach the one set in the current step. In most application, we want the

furnace to heat up as fast as possible, but it is also possible to set this parameter (by pressing on the plus and minus buttons) to limit the heat-up rate. The other ramping values (besides Fast) are given in °C/minute.

Slow heat-up rates are particularly useful with a solid oxidizer, when we want it to react slowly over a temperature range of about 100°C.

Crucible rocking speed and amplitude



The crucible content is mixed by a back-and-forth rocking motion, whose amplitude (in degrees) and speed (in % of the max) can be controlled by means of the plus and minus buttons.

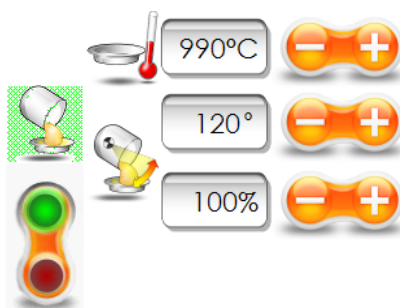
Typically, initial heating steps call for no rocking at all. This allows for the oxidizer to react, and for flux to melt without risking overflowing from the crucible (molten flux takes up less volume than powder flux).

When pouring approaches, speed and amplitude can be used more generously. One exception would be with samples containing gases. Those samples cause bubbles in the melt and de-gassing the melt is sometimes better achieved with very slow speeds before pouring.

Pouring step

The pouring step is when the crucible is tilted forward quickly, to empty its contents either into a mold or a beaker containing acid. However, pouring can be turned off altogether, for those fusion types where pouring is not desired: fusions in sodium peroxide or potassium pyrosulfate.

Basic pouring parameters



Pouring can be completely turned off and on by pressing the red and green vertical switch.

The mold temperature can also be adjusted here. Note that entering a mold temperature of 20°C switches to "solution" mode.

If pouring is on, the crucible tilting angle and speed can be controlled with the plus and minus buttons.

Generally, a pouring angle of 120° with a speed of more than 30% works well. Adjustment is sometimes required to adapt to melt viscosity and mold size.

Annealing feature



Annealing is very rarely used, except in very specific applications, with highly unstable glass disks (i.e. disks that always crack or crystallize). When activated (by means of the horizontal red and green switch), the instrument will reheat the mold at the given temperature, for the given duration (adjustable with the plus and minus buttons).

Generally, however, cracking and crystallizing disk problems can be cured by proper control of the cooling (see below).

Cooling steps

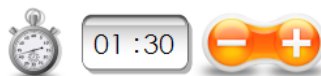
The cooling process is normally divided into two distinct steps. The first cooling stage (Cooling 1) is a natural-convection cooling, that is, without any forced-air cooling. This allows for the melt to completely fill the molds while the molds are as hot as possible, and is of key importance in the stabilizing of the melt.

Indeed, in most cases, if we were to start the forced air circulation immediately after pouring, the bead would not cool down uniformly, and residual thermal stresses would remain in the solid disk. This can cause hazardous bursting of the produced disk, in the next minutes, hours or even days.

On the other hand, and again there are exceptions, if the blowers were to start too late (Cooling 2), a crystallization reaction could occur if the molecules have enough time to arrange in an orderly fashion. Crystallization reaction cause the transparent melt to become milky-opaque, typically from the edges towards the center of the mold, pushing the still-liquid melt to the center and upwards as crystallization progresses, thus creating a volcano-like structure. Therefore the solution resides in finding the correct time for still-air cooling (Cooling 1), and then the blower can start and work until the molds are comfortably cool to the touch. Hence, the chosen parameter is very important, especially for "Cooling 1".

There are two distinct ways to globally control the cooling process: by duration or by temperature. The method is selected by the "thermometer / stopwatch" switch (see page 30 for more information).

Duration



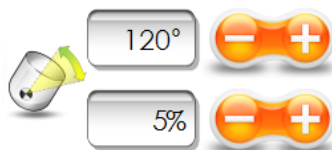
Step duration (mm : ss) is adjusted by pressing on the plus and minus buttons. Generally speaking, a "Cooling 1" duration of one to two minutes is a very good starting point. Thereafter, "Cooling 2" can be set for as many minutes as needed, and this parameter will be roughly proportional with the melt and mold combined weight.

Temperature



When in temperature mode, the parameter is adjusted by pressing on the plus and minus buttons. Normally, the "Cooling 1" temperature should be quite high, whereas the "Cooling 2" setting would be close to room temperature, for a safe manipulation of the glass disk.

Crucible position after pouring



As explained earlier, in a cooling step, the two crucible-related parameters are not used to control the crucible rocking motion, but rather to control the straightening up of the crucible heater, after the pouring.

Typically, the tilting angle of "Cooling 1" will be the same as the pouring (typically 120°), and the tilting angle of "Cooling 2" will be zero degree (0°). This will give some time for the flux to pour completely out of the mold during "Cooling 1", while straightening the crucibles when the blower starts at the beginning of "Cooling 2".

Solution programs

To create a fusion dedicated to making solutions, the best is to either directly use the "Solutions" program, or create a copy of it if parameter edition is required.

Alternatively, it is possible to simply set the pouring step's mold temperature to 20°C, to activate the solution mode.

On-the-fly editing

During a fusion, it is also possible to edit parameters on the fly, that is, while the fusion program is running.

To do so, simply edit parameters as explained in the previous paragraphs (from page 26 onwards).

Note, however, that there are logical limitations, and the firmware will automatically limit the accepted parameter range to prevent nonsensical or error-causing combinations.

Global parameters

In addition to program-specific parameters, your fluxer provides extra versatility through flexible parameters that will apply to all fusion programs.



To access the global parameters screen, first unlock the advanced mode (see page 30, *Unlocking the advanced mode*), then touch the Global Parameters icon that is now available on the main display screen.

Language

In the global parameters page, you can change the instrument's interface language by selecting your preferred language in the list.

Automatic shut-off delay

When the instrument is idle for a certain period of time, the heating will be automatically turned of, to save energy.

This delay can be changed by the user, depending on the context of use of the instrument. Enter the global parameters screen, and slide the "Automatic shut-off delay" slider to the value of your choice.

Fusion counter

In the global parameters screen, there is a read-only parameter that displays the number of fusions since the instrument was built, not unlike the odometer on a car.

Fusion

troubleshooting

This section presents the most common fusion-related problems. For specific assistance, please do not hesitate to contact us (see page 55, *Contacting Katanax*).

Disk cracks

Disk cracking occurs when there are internal stresses within the glass bead. The specific causes can vary as follows:

Glass disk sticks to the mold

If disk top surface is concave (disk adheres to the mold walls), add non-wetting agent at the beginning or during the fusion. Katanax recommends lithium bromide.

Glass disk contains undissolved particles

Some sample may not be completely dissolved. Make sure that sample is fully oxidized or decrease amount of sample.

Glass disk is improperly cooled

Generally, cooling a disk too fast can cause its cracking. Allow more time for the still-air cooling (i.e. before starting the cooling blower).

Disk crystallizes

Crystallization reaction cause the transparent melt in the mold to become milky-opaque during cooling, typically from the edges towards the center, pushing the still-liquid melt to the center and upwards as crystallization progresses, thus creating a volcano-like structure.

Inappropriate flux

Crystallization will occur if too alkaline a flux is used (i.e. too much lithium metaborate). Increase the proportion of tetraborate to compensate.

Improper cooling

Natural convection (still air) cooling is too long or too short. Edit convection cooling duration parameter manually.

Generally, crystallization occurs when the natural convention cooling is too long.

External contamination

In some circumstances, dirt, dust or other small debris can be sucked into the blower and land onto the glass bead. This type of crystallization will develop from

this single point on the surface and radiate outwards. Cleaning the instrument's base and surroundings will correct the problem.

Incomplete disk

This symptom causes disks that have the shape of a moon crescent, i.e. a circle with a missing section.

It is caused by the mold not containing enough flux, or by the mold not being leveled. Level instrument/mold holder or add flux accordingly.

Non- homogenous disk

When holding the glass disk in front of a light source, if you can observe powdery residues, then some sample may not have dissolved. This can sometimes be mistaken for micro-bubbles in the disk, which has an entirely different origin.

Sample is not fully oxidized

As we know, un-oxidized sample cannot be dissolved in flux, and will also cause damage to platinumware. Make sure to use the proper type and amount of oxidizer.

Oversaturation

A fusion being a dissolution reaction, it is perfectly possible to obtain an oversaturated bead. Simply reducing the amount of sample will correct the problem.

Improper grinding

If the sample is too coarse, or if it lumps together easily, then the time allotted by the fusion program might not be long enough.

One can either extend the fusion duration, or grind the sample to a finer granulometry. We recommend smaller than 100 μm . Also, a manual mixing of the sample with the flux can often prevent the lumping issues.

Sometimes, the small "dust" is actually gas (see below).

Bubbles in disk

Typical with carbonate samples, this phenomenon exhibits gaseous bubbles that remain imprisoned within the glass disk.

To correct the problem, simply set the pouring step with an extra minute or two, and use a very slow speed.

Periodic inspection

This instrument requires some regular checking, which is very important to keep your instrument up and running.

Katanax knows that a broken instrument in a laboratory setting causes sample back-up and unnecessary costs. That is why this manual comprises not only a *Periodic inspection* section, but also a *Service operations* chapter (see page 43), which guides the user in a step-by-step fashion through operations that sometimes need to be performed on-site.

If unsure, do not hesitate to get in touch with a Katanax technician (see page 55, *Contacting Katanax*).

Note that no modifications of the instrument, except those explicitly described and permitted in this manual, are allowed. Any undue modification automatically cancels the warranty and could endanger the user's life.

Warning

IMPORTANT: *Some of the procedures described in the following pages imply a risk of death by electrocution; those procedures shall be executed only by trained personnel.*

Inspection schedule table

Frequency	Checkpoint	Description	Action (if problem found)	Page
Every fusion	Flux spillages	Check for flux deposits	Cleaning	39
1 month or 100 cycles	Visual integrity of heating elements	Check elements integrity, section and pitch regularity	Replace	40
	Element terminal connections	Check for correct tightening and oxidation	Re-tighten or replace	41
3 months or 300 cycles	Thermocouple junction	Check junction	Replace	41

Flux spillages

This procedure describes an easy, yet crucial, step to be completed before each fusion cycle. Flux spillages (residues), if left un-cleaned, can lead to a rapid deterioration of key components of the fluxer.

1. This visual inspection should be done every fusion cycle.
 - 1.1 Look for vitrified, darker or colored spots on the ceramics or metal parts that make up the mold and the crucible heaters.
 - 1.2 In the case that a spillage has occurred on one or more parts of the heaters, clean or replace immediately. Ceramic and metallic parts of the

holders are slowly dissolved by the flux when it is molten, but will quickly degrade when cooling, as the ceramic parts could break.

- 1.3 The metal part that acts as a lid for the crucible may get dirty over time. You can disassemble the lid by removing its two screws, and then soak the lid in an ultrasonic bath filled with mild citric acid solution.
- 1.4 Similarly, the front of the crucible is fitted with a metallic part called the spill protector, which can be removed and cleaned. Upon re-installing the spill protector: first install a crucible in the heater, then prepare the installation of the spill protector; slide the spill protector gently against the crucible, then slide it back, to leave a gap of 0.5 to 1 mm between the spill protector and the crucible. Then, tighten the spill protector screws.
2. If parts are found to be contaminated with flux deposits, Katanax recommends to carefully disassemble the parts in question, and soak them for a few hours in a citric acid ultrasonic bath. This does not apply to fibrous ceramic parts, which cannot be cleaned easily, and must be scraped clean, or replaced.

Visual integrity of heating elements

IMPORTANT: Always disconnect the instrument from the power outlet when working with panels removed. Risk of electrocution!

In the K1 Prime, heating elements build a surface oxide layer over the metallic coil, which protects it from degradation and lengthens its lifespan. However, this oxide is extremely sensitive to molten flux.

It is extremely important that no flux ever touch the element. Element life would dramatically be reduced. This is why elements are protected by a clear or semi-clear tube.

Always remove the crucibles from the instrument to weigh components, and make sure that crucible external walls are clean before re-installing the crucibles in their holder.

1. Flux spills on elements
 - 1.1 Visually verify that no flux (powdered or molten) is found on or near the elements. Check both the crucible and the mold heaters.
 - 1.2 If necessary, the clear tubes can be replaced independently from the whole element assemblies.
2. Wire diameter
 - 2.1 Visually verify that diameter of wire is the same throughout the whole length of the element. If a section of a heating element exhibits reduced diameter, replace this element without delay.

If an element is found to be in a dubious state, it should be replaced as soon as possible to prevent any failure of the instrument during a production peak.

Element terminal connections

IMPORTANT: Always disconnect the instrument from the power outlet when working with panels removed. Risk of electrocution!

1. To check the integrity of the element ceramic connectors and terminals, do the following:
 - 1.1 Unplug instrument (Caution – risk of death by electrocution) and let the heaters cool down completely.
 - 1.2 Tilt the crucible heater towards the front (i.e. in pouring position). The crucible heater element connectors are underneath the heater cell itself.
 - 1.3 Visually inspect and verify that both terminal connectors are not overly oxidized. If a faulty connector is found, replace this ceramic connector immediately.
 - 1.4 Tilt the crucible heater back to the upright position.
 - 1.5 Now, check the mold heater element terminals, by first removing the mold heating unit from the instrument. (Pull left, then gently upwards.)
 - 1.6 Remove the thermocouple cover.
 - 1.7 Locate the mold heater connector, on the side of the round mold heater (under the thermocouple cover).
 - 1.8 Visually inspect and verify that both terminal connectors are not overly oxidized. If a faulty connector is found, replace this ceramic connector immediately.
 - 1.9 Using an appropriate tool, verify that all wire terminals of ceramic connectors are well tightened, both on the element side and the wire side. Do not over-torque the screws. Simply verify that they are not loosened.

Thermocouple junction

IMPORTANT: Always disconnect the instrument from the power outlet when working with panels removed. Risk of electrocution!

IMPORTANT: Do not touch the small metal tip of the thermocouple.

To run this inspection, instrument must be turned OFF, unplugged and completely back to room temperature.

The thermocouple used in this instrument is made of platinum-platinum/rhodium (type R) and is normally very durable. In particular, it is impervious to oxidation or damage by heat; only a mechanical incident could damage the junction (i.e. the tip) of the thermocouple.

1. This inspection consists in verifying the junction of thermocouple for visible damage.
 - 1.1 Unplug K1 (Caution – risk of death by electrocution).
 - 1.2 Look inside the crucible heater, where the crucible would normally sit. The thermocouple is the cylindrical prong, with a tiny metallic wire running through its top end.
 - 1.3 Visually inspect the thermocouple junction. Verify that no mechanical shock has occurred, which could have damaged the thermocouple junction.
 - 1.4 Now look inside the mold heater, where the mold would normally sit. The thermocouple protrudes diagonally from the bottom of the mold heater.
 - 1.5 Visually inspect the thermocouple junction. Verify that no mechanical shock has occurred, which could have damaged the thermocouple junction.
 - 1.6 If any junction is damaged, a new thermocouple should be ordered and installed.

Service operations

This section describes tasks that are not performed on a regular basis, but are rather performed to adjust or repair a malfunctioning system of the instrument.

Should you have any question, or need further assistance, please do not hesitate to contact us (see page 55, *Contacting Katanax*).

Warning

IMPORTANT: *Some of the procedures described in the following pages imply a risk of death by electrocution; those procedures shall be executed only by trained personnel.*

Crucible heating element replacement

IMPORTANT: *Always disconnect the instrument from the power outlet when working with panels removed. Risk of electrocution!*

The crucible heating element comprises a single wire, wound in a spiral into ceramic insulators plates. The resulting assembly is inserted into a soft thermal insulation shell.

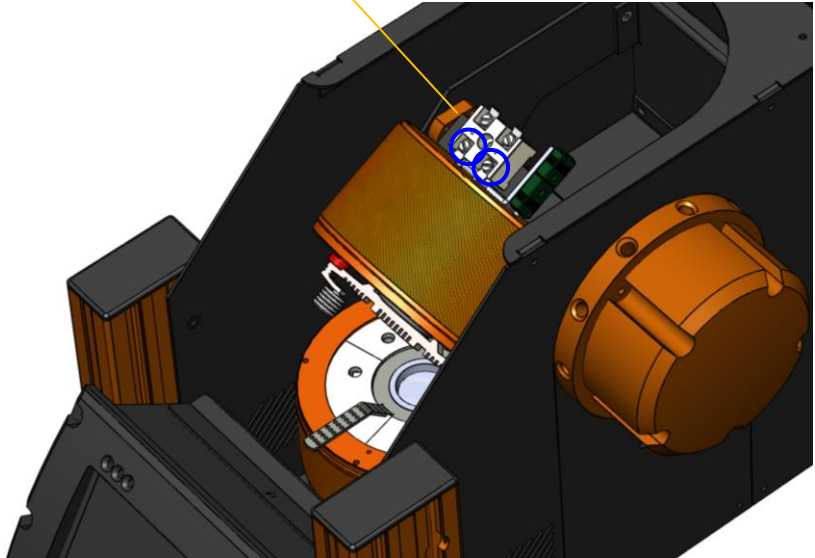
Then, a clear tube is inserted to protect the element from flux spills and halogen gases released by non-wetting agents. This tube can be removed from the heating element, in order to replace independently either the element or the tube.

Heating element removal

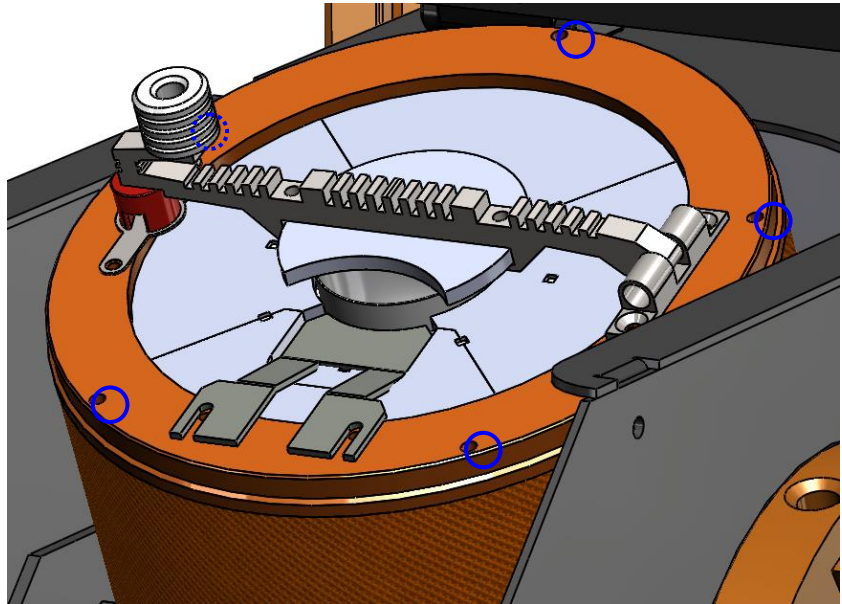
1. Disconnect the instrument from the wall outlet and wait for the heaters to cool down completely.
2. Wear surgical-style gloves. They will protect you from the insulation fibers, and will protect the heating element's clear tubes from your skin oil.
3. Remove the crucible from the heater, if applicable.
4. Loosen the element leads connection.
 - 4.1 Manually tilt the crucible heater in the pouring position.

- 4.2 Remove the terminal screws (circled below), their lock washer and their contact brackets. You should have in your hand two screws, two washers and two small contact brackets.

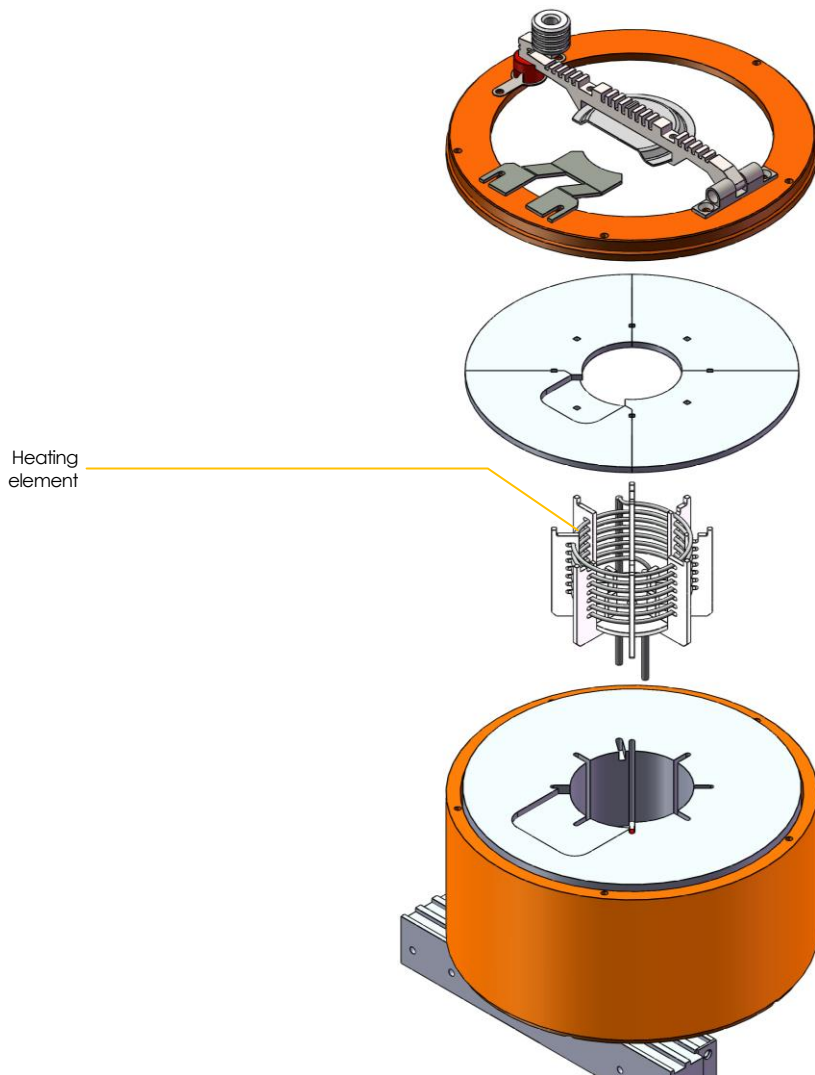
Terminal screws



- 4.3 Manually tilt the crucible heater back to the upright position.
5. With the crucible in the upright position, remove the five (5) screws of the outer ring.



6. Now remove the top ring, and the five ceramic top plates (see picture below).



7. Carefully remove the inner sapphire tube that protects the element.
8. Gently pull the element upwards.

Heating element installation

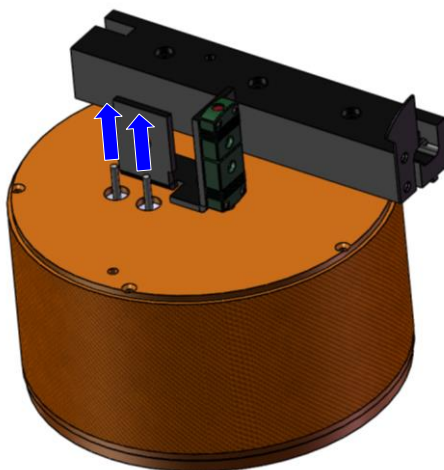
From the instructions above, the crucible heater is in a partially disassembled state. You are ready to install the new heating element.

1. Make sure the instrument is still disconnected from its power outlet.

2. Wear surgical-style gloves. They will protect you from the insulation fibers, and will protect the heating element's clear tubes from your skin oil.
3. Inspect the heater cavity, and look for molten flux spills. If molten flux is found, scrape the insulation clean, or replace the soft insulation completely.

IMPORTANT: Remember that molten flux on the soft insulation could transfer onto the new element and ruin it rapidly. Ensure that the heater's cavity is completely clean before installing a new element.

4. Carefully insert the new element through the opening on the top of the heater's soft insulation. Be extra cautious to not crush the thermocouple tip.
5. The two element's leads should run through the matching holes in the bottom of the heater.
6. While holding the element in the heater, gently tilt the heater forward, in the pouring position.
7. Using thin pliers, gently pull on the two element leads. No need to pull hard; the idea is to just relieve any compression stress, which could cause premature failure of the element. (Note that the ceramic connector is not show on the picture, for clarity.)



8. Re-install the terminal screws and washers onto the connector (see step 4.2 at page 44).
9. Tighten firmly, to ensure a good electrical contact.
10. Straighten the crucible heater back to the upright position.
11. Re-install the clear sapphire tube inside the element coil.
12. Re-install the five ceramic plates.
13. Re-install the top ring, and fasten its five (5) screws.

Mold heating element replacement

IMPORTANT: Always disconnect the instrument from the power outlet when working with panels removed. Risk of electrocution!

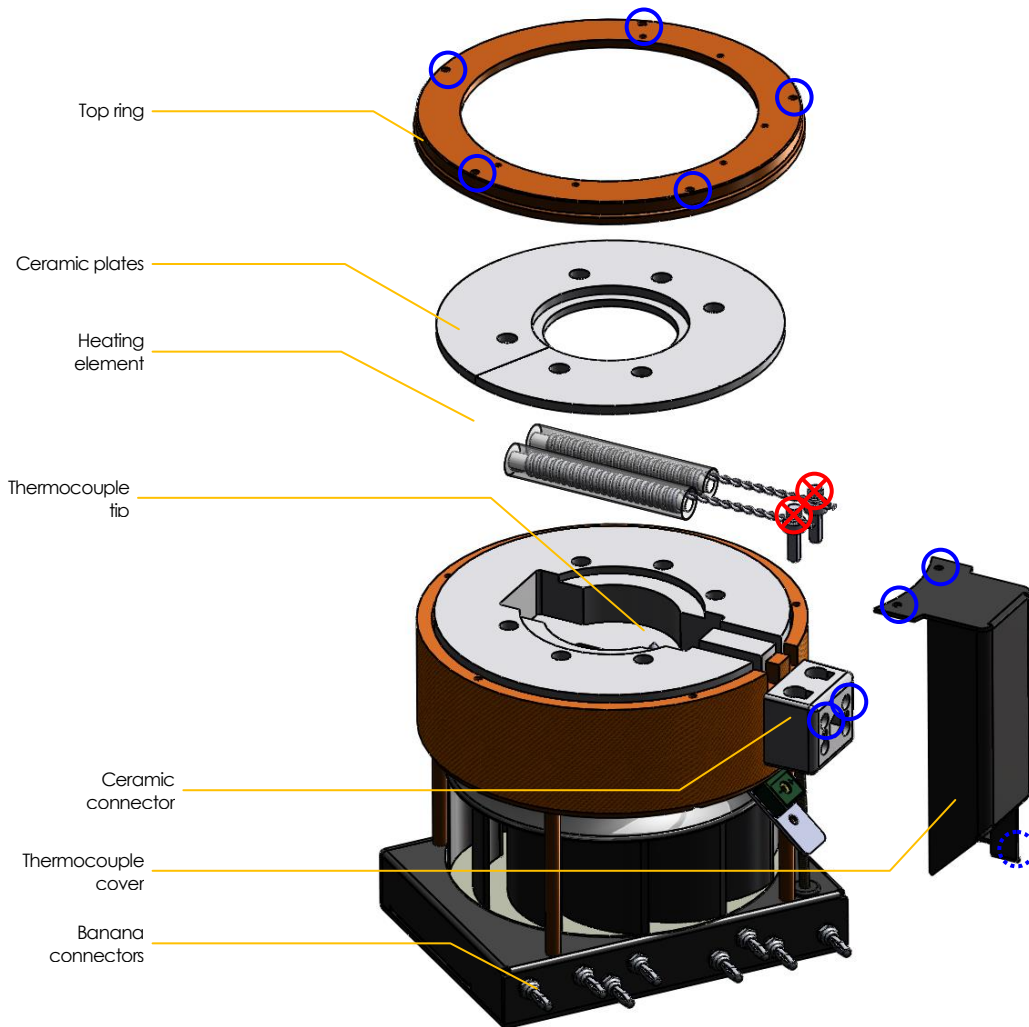
The mold heating element comprises a single wire, wound in a spiral around two ceramic screws. The resulting assembly is inserted into a soft thermal insulation shell.

Then, clear tubes are inserted to protect the element from flux spills. These tubes can be removed from the heating element, in order to replace independently either the element or the tubes.

A general picture for the next steps is provided on page 48.

Heating element removal

1. Disconnect the instrument from the wall outlet and wait for the heaters to cool down completely.
2. Wear surgical-style gloves. They will protect you from the insulation fibers, and will protect the heating element's clear tubes from your skin oil.
3. Remove the mold and mold holder, if needed.
4. Remove the mold heater unit from the instrument.
 - 4.1 Open the safety shield completely.
 - 4.2 Slide the mold heating unit to the left, so that its orange plugs disconnect from the main casing. This may require some force.
 - 4.3 The heating unit is now free, and you are now able to remove it from the instrument.
5. Remove the screws that fasten the thermocouple cover, and set this cover aside.
6. Remove the five (5) screws of the top ring.
7. Now remove the top ring, and the five ceramic top plates.
8. Loosen the screws on the ceramic connector (*NOT the screws at the ends of the heating element itself*).
9. You are now able to slide the heating element upwards, out of the ceramic connector.



10. To remove the clear tubes from the heating element (if they are clean and you intend on re-using them), you will need to remove the screw at the ends of the heating element.

Heating element installation

From the instructions above, the mold heater is in a partially disassembled state. You are ready to install the new heating element.

1. Make sure the instrument is still disconnected from its power outlet.
2. Wear surgical-style gloves. They will protect you from the insulation fibers, and will protect the heating element's clear tubes from your skin oil.

3. Inspect the heater cavity, and look for molten flux spills. If molten flux is found, scrape the insulation clean, or replace the soft insulation completely.

IMPORTANT: Remember that molten flux on the soft insulation could transfer onto the new element and ruin it rapidly. Ensure that the heater's cavity is completely clean before installing a new element.

4. Carefully insert the new element into the connector, and into the opening on the top of the heater's soft insulation. Be extra cautious to not crush the thermocouple tip.
5. Tighten the element connection screws ; tighten firmly, to ensure a good electrical contact.
6. Re-install the five ceramic plates.
7. Re-install the top ring, and fasten its five (5) screws.
8. Re-install the thermocouple cover.

Firmware and program transfers

Preset programs

This section lists the methods that are factory programmed into the K1 Prime. It is not possible for the user to alter or delete them.

Note that Katanax cannot be held responsible for any damage to platinumware or fluxer incurred by the use of those methods. Especially, samples containing un-oxidized material should be fused with extreme care. If unsure, please contact Katanax. We will be glad to prepare an adapted method for your specific sample.

Name	Applicable to...	Description
Oxide	Cement, glass, ceramics, petrochemical catalysts, most geochemistry samples and general oxides	Most common fusion method. Must only be applied to fully oxidized material.
Metal	Samples containing un-oxidized material	Applicable to metals that can be attacked by acids or bases. This method has a low-temperature oxidation period, in which the solid oxidizer attacks the sample. Fusion is then completed like an oxide.
Solution	Oxidized material to be analyzed by wet method.	Is normally used with lithium metaborate.
Peroxide	Samples containing metals, often precious, which are attacked in peroxide or peroxide fluxes	Low-temperature fusion that does not pour. Crucible is removed with tongs at the end, cooled a little on a metallic surface, then immersed into acid. Platinum crucibles are normally not used with this method, as the flux would damage the crucible.
Anneal	Particularly unstable samples that burst or crack	Provides the user with a template to re-heat the mold after casting, and relieve thermal stresses.

Name	Applicable to...	Description
Ramping	Samples that require slow heat-up slope	Example of the ramping feature. (See page 32, <i>Ramping</i> for details on how to use this feature in your custom-designed programs.)

Backup or restore by USB

Once your favorite methods are developed and optimized, you might want to store them on a USB flash drive, especially before upgrading the firmware of your instrument. This can also be useful to transfer fusion programs among several fusion instruments.

Alternately, you might have received from Katanax a firmware upgrade that you want to install on your instrument.

Backup fluxer to USB drive

1. To start the process, simply insert a USB flash drive into the USB port of the fusion machine. A dialog will automatically pop up, after a few seconds.
2. Touch "Upload".
3. A dialog will appear, requesting a password and what data to upload. The password is "111111" (six times the digit one). You may have to drag the dialog window to the left, to show the keyboard and then type the password.
4. Select "Upload Project Files" if you want to backup the firmware (i.e. the instrument's operating system).
5. Select "Upload History Files" if you want to backup the fusion programs' parameters.
6. Touch "OK".
7. Now, choose where you want the data to be written. Double-click on "USBDISK", then click on its sub-directory, named "disk_a_1".
8. Click "OK" to start the transfer to the USB drive. The screen will black out, and the fluxer will re-boot.
9. The firmware or the programs are now saved, and you can remove the USB drive.

Restore programs, firmware or upgrade firmware

1. If you want to restore a backup that you have made yourself, simply insert the USB drive that contains you backup files, into the USB port of the fluxer.
2. If you have obtained a new firmware by email, copy the directory structure and files you have received onto a blank USB drive. Then, insert the USB drive into the instrument's USB port.
3. A dialog will automatically pop up, after a few seconds.

4. Touch "Download".
5. A dialog will appear, requesting a password and what data to download. The password is "111111" (six times the digit one). You may have to drag the dialog window to the left, to show the keyboard and then type the password.
6. Select "Download Project Files" if you want to restore or upgrade the firmware (i.e. the instrument's operating system).
7. Select "Download History Files" if you want to restore the fusion programs' parameters. Note that this will erase ALL fusion programs currently stored on your fluxer.
8. Touch "OK".
9. Now, choose where you want the data to be fetched. By default, you will have to double-click on "USBDISK", then click on its sub-directory, named "disk_a_1". If the data was created in another (sub-)directory, you will need to browse to reach it. In particular, firmwares obtained from Katanax (via Web or email) are located in a sub-directory named "Firmware K1P..." ; you must select (highlight) this folder at this step.
10. Click "OK" to start the transfer to the USB drive. The screen will black out, and the fluxer will re-boot.
11. The new firmware or programs are loaded, and you can remove the USB drive.

Technical specifications

Electrical

Voltage..... 117-127 VAC or 220-240 VAC
Frequency 50-60 Hz
Electric power 1300 W (max consumption)
Main fuse.....@ 115 VAC : 12 A
.....@ 230 VAC : 10 A

Physical

Weight 30 kg (66 lbs)
Height 40 cm (16 in)
Width 28 cm (11 in)
Depth..... 61 cm (24 in)

Warranty

All Katanax instruments have been carefully inspected and tested before shipping and are warranted to be free from defects in workmanship and material for a period of one (1) year from date of shipment. Ceramic parts may exhibit small cracks developed under heat, and will not be considered defective unless this situation impairs functionality of the instrument. Heating elements, crucible heater assemblies and mold holders are warranted for a period of six (6) months.

During the warranty period, Katanax guarantees the product against defective workmanship and material, provided the equipment has been installed according to the manufacturer's instructions. This warranty does not apply to any product which has been altered, damaged, tampered with, or subjected to misuse or abuse including substituting parts or accessories of other manufacturers without the written consent of Katanax. Minor adjustments are not covered by warranty.

Katanax disclaims any responsibility for misuse, misapplication, negligence or improper installation and maintenance of equipment. Katanax makes no warranty or representation regarding the fitness for use or the application of its products by the purchaser.

Katanax is not liable for costs incurred in installation, removal or unauthorized repair of the product or for damage of any type, including incidental or consequential damage.

At its option, Katanax will repair or replace any defects that are exhibited under proper and normal use. All customs- and freight-related charges are customer's responsibility: items returned to Katanax for any reason shall be via freight prepaid, while parts sent to customer will be either sent collect, or shipping charges will be invoiced.

Katanax reserves the right to make changes in the design or to make additions or improvements with respect to its product without incurring any obligation to modify or install same on previously manufactured products.

Contacting Katanax

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Web: www.katanax.com

When contacting us, kindly have the serial number of the instrument at hand.

Customers are invited to visit our web site regularly, since useful information is periodically added.