



Operating Manual

CG-900 Cryo-Blade™

Cryogenic Grinder

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1.0 Introduction

Thank you for choosing the CG-900 Cryo-Blade Cryogenic Grinder from Cole-Parmer. To ensure years of reliable, efficient, and safe use of this 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 Cole-Parmer directly for assistance (see page 36 for contact details).

This section intends to introduce the reader to basic grinding principles and to familiarize them with the Cryo-Blade.

1.1 The Cryo-Blade

General View



Working Principle

The Cryo-Blade is an automatic cryogenic knife mill. The Cryo-Blade uses a spinning blade to comminute samples that have been cryogenically frozen to produce a fine homogeneous powder. By working at cryogenic temperatures, the instrument embrittles the sample to improve grinding, even for materials that are difficult to reduce to powder otherwise.

The Cryo-Blade automatically dispenses the correct amount of liquid nitrogen each time. Avoiding the risks associated with handling liquid nitrogen for the user. Since the Cryo-Blade controls and monitors the input of liquid nitrogen, all grindings are highly repeatable, increasing the value of all data collected using its sample preparation method. Alternatively, it is also possible to use dry ice to prepare the sample.

The high-volume bowl of the Cryo-Blade can hold up to 5 liters of material. The high volume allows the user to process large sample amounts in a single run without the need to do multiple small batches.

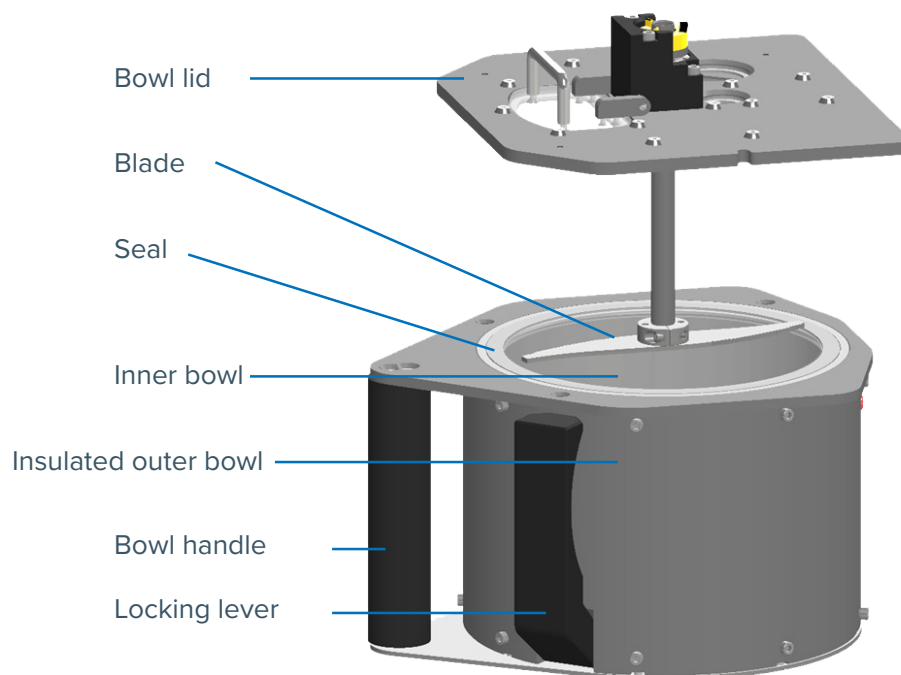
The bowl of the Cryo-Blade is composed of an outer insulated shell and an inner stainless steel bowl. The inner bowl can be removed for ease of cleaning and handling. A new inner bowl (order separately) can then be loaded in the outer shell to be ready to use. The insulated shell helps to keep the grinding chamber at cryogenic temperatures well after the grinding and helps reduce cryogen consumption.

The Cryo-Blade uses a load cell to measure the quantity of sample to be processed. The sensor is also used to adjust the quantity of liquid nitrogen during the freezing process. With its smart dispensing feature, the Cryo-Blade can help you consume less liquid nitrogen and optimize your workflow.

The Cryo-Blade bowl is equipped with a thermocouple placed directly between the bowl and the insulation to monitor the temperature of the sample. By monitoring the temperature of the bowl, the Cryo-Blade can make sure the sample remains at a temperature optimal for cryogenic grinding.

The Cryo-Blade operation is simple with the LCD touch screen to control the grinding process. Grinding can be adjusted to the user preference using the preset protocols as template or can be automatically controlled by the unit and adjusted based on the amount of sample loaded into the bowl. Using liquid nitrogen or dry ice produces a high volume of gas (N_2 , CO_2) as it evaporates. The Cryo-Blade is therefore equipped with an exhaust system to evacuate the gases produced. The exhaust can be directly connected to the building's main exhaust system or placed under a vent hood.

Bowl Assembly



1.2 Accessories

The Cryo-Blade requires the use of a specially designed bowl. This bowl is composed of the inner stainless steel bowl and an outer insulated bowl and lid. Additional inner bowls can be purchased separately to improve workflow and process multiple samples in a sequence and store them for subsequent analysis.

Cole-Parmer can also provide all the required equipment to handle liquid nitrogen like cryogenic Dewar, cryogenic hose, fitting, and cart. Please contact us for help with this setup.

1.3 Main Features

Accuracy

- Automated liquid nitrogen dispensing and grinding
- Use a load cell to measure the sample weight to control the required amount of liquid nitrogen or to monitor the dry ice remaining
- Temperature sensor (thermocouple type K) to monitor temperature of the bowl during cooling and grinding
- Electronically controlled, fully reproducible grinding methods

Safety

- User is never exposed to liquid nitrogen
- Detection of the correct insertion and the correct clamping of the bowl
- Automatic shutdown of the system in case of failure
- Insulated bowl (no dangerous cold surface exposed during the grinding)
- Emergency stop button
- Nitrogen gas exhaust

Versatility

- Stores up to 10 different grinding protocols
- Fully customizable grinding protocols
- USB connectivity
- Ethernet (wired network) port

Productivity

- Automated pre-cooling, cooling, evaporation (sublimation), and grinding
- Large 5-liter bowl
- Interchangeable inner bowl
- Dishwasher-safe bowl
- Remote troubleshooting

Durability

- Sturdy industrial grade modular electronics
- Robust IP65-rated industrial interface
- Dedicated PLC-based programming
- Low maintenance
- 3 year limited warranty

Simplicity

- Easy installation, easy use
- Single-phase power, no separate power supply
- Intuitive touchscreen color LCD graphics interface
- Easy icon navigation
- Multilingual interface
- Easy component access
- USB-upgradeable firmware

2.0 Precautions



High voltage

Disconnect power cord before attempting any cleaning, maintenance or repair operation. Be careful that no liquid infiltrates into the unit's casing.



Heavy instrument

It is advisable that at least two people move this instrument to avoid injuries. Do not drop instrument. Crated unit should only be moved with mechanical assistance (forklift or pallet jack).

Bowl is relatively heavy. The handle position creates an unbalanced load that requires two hands to manipulate it. One hand should grab the handle while the other one is used to lift the bowl from underneath. Never manipulate the bowl with the handle alone.



High noise levels

This device emits noise above 80 dB. Wear appropriate hearing protection.



Cold hazards

Liquid nitrogen boils at -195.8°C and can be dangerous if used improperly. Everything in contact will be cooled to extremely low temperature. Cryogenic gloves should be used to avoid frostbite.



Nitrogen

Although nitrogen composes 80% of the air we inhale. Liquid nitrogen releases a massive amount of gas when it evaporates. This nitrogen gas can displace oxygen and cause rapid suffocation. Adequate ventilation should always be used, and the oxygen concentration of the room should be periodically tested to ensure adequate working conditions.



Explosion hazard

When boiling, liquid nitrogen produces vapor by a factor of roughly 700 times its liquid volume. The safety relief valve must never be removed or blocked. Trapped liquid nitrogen could create dangerous pressure buildup that could expose the user to serious hazard or death.



General hazards

Never turn the unit on or run a grinding process with casing panels removed. Mechanical hazards due to high velocity and strong pinching motions.

3.0 Installation

Please read the following section for proper commissioning of your instrument. Do not hesitate to contact Cole-Parmer with any question you might have regarding this crucial step.



IMPORTANT: *The instrument can be carried by its bottom plate. It is advisable that two or more people carry this instrument to avoid injuries. Do not drop instrument.*

3.1 Location

Keep the shipping crate upright; it is advisable that two or more people lift the instrument to avoid back injuries. Crated unit should only be moved with mechanical assistance (forklift or pallet jack).

Vent hood

When boiling, liquid nitrogen produces vapor by a factor of roughly 700 times its liquid volume. Nitrogen vapor is odorless, colorless and can displace oxygen. This vapor is a serious asphyxiating hazard and should not be directly inhaled. Leak and safety valves also release nitrogen vapor and should be watched closely. We recommend monitoring oxygen level in the vicinity of the instrument. The room where the unit is installed should be well ventilated to ensure the oxygen level remains safe.

Dry ice also creates high amount of carbon dioxide. This gas should be taken very seriously to prevent asphyxiating hazard when dry ice is in use.

The instrument should be installed under a vent hood or directly connected to an exhaust system using the output connection on the instrument.

When using a vent hood, the lowest part of the funnel is recommended to sit 15 to 30 cm above the instrument. Fume hood air speed, measured at the top of the unit, should be around 1.0 m/s.

Motor and fan/impeller sizing information can unfortunately not be provided by Cole-Parmer, as those strongly depend on factors linked to each individual installation (pipe diameter, pipe distance to the outside, exhaust baffle type, etc.). Those will need to be calculated locally for each installation by HVAC engineers.



IMPORTANT: *The instrument should be installed under a vent hood or connected to an extraction system to remove the excess of nitrogen vapor (or fog). Oxygen level should be monitored to ensure adequate working conditions.*

Table

The counter on which the instrument is to be used must be sturdy and able to safely support a weight of 50 kg (110 lbs). It is recommended to use the instrument from a standing position and adjust table height accordingly.

The tabletop surface shall be horizontally flat, rigid, and stable.

It is advisable that several people lift the instrument onto the table to avoid back injuries.

Leveling

To improve precision of the instrument, it is important that the instrument be reasonably leveled. If in doubt, place a bubble spirit level on top of the instrument and adjust the instrument's back feet to compensate for possible slant.

Liquid nitrogen handling

Liquid nitrogen cylinder should be kept in a well-ventilated area. Leak and safety valve will release nitrogen vapor and can be a serious asphyxiating hazard.

When moving liquid nitrogen cylinders always use a specially designed cylinder cart and follow instructions of the cylinder manufacturer.

Inspection of the valve, fitting and cryogenic hose should always be done prior to instrument use.

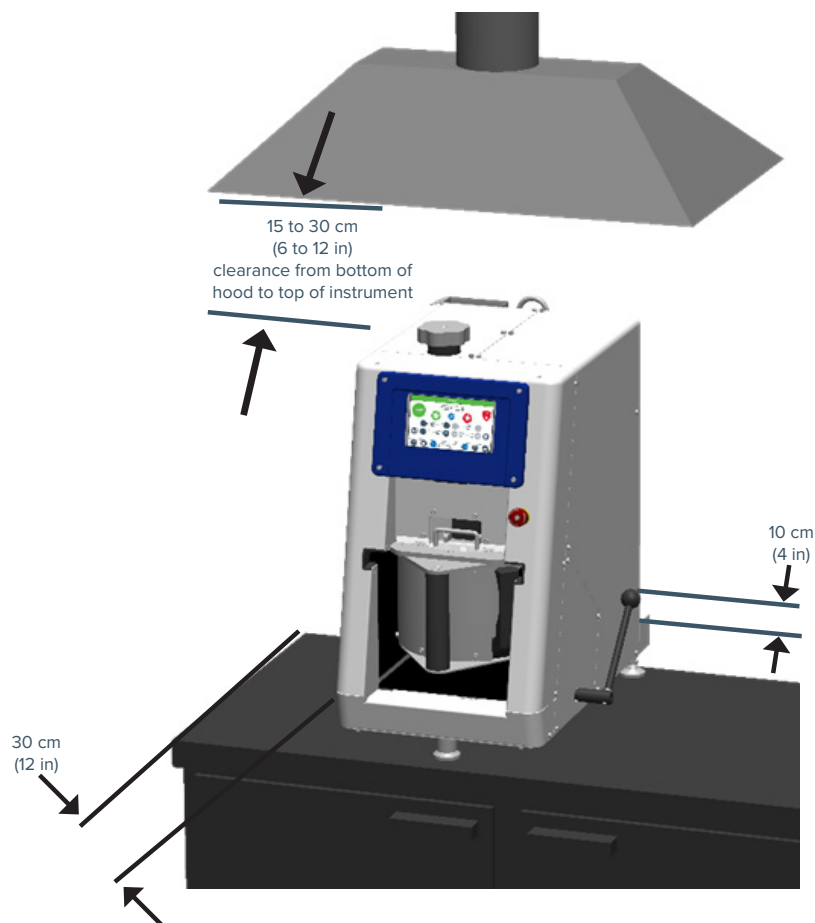
Always wear safety equipment when manipulating cylinders. Valves, hose, and fittings can become extremely cold when liquid nitrogen starts circulating.

Safety and working clearances

When this unit operates, it monitors weight with a load cell at the front of the unit. Liquid nitrogen hose and power cable must not exert force on the unit that would affect the weight measurement by the load cell.

Our minimum recommendations are:

- 30 cm (12 in) at the left side
- 30 cm (12 in) at the right side
- 10 cm (4 in) at the back



Keep clear access at the front of the unit for the operator to work the controls and load/unload the grinder.

3.2 Unpacking

The CG-900 Cryo-Blade mechanism and cabinet are shipped assembled, and carefully packed to avoid damage during shipping. Any visible damage to the shipping container should immediately be reported to the carrier. If there is no visible damage, remove all packing documents from the exterior of the box, and after completion of your inspection, file in your records.

Refer to separate unpacking instructions included with the unit for step-by-step details.

Retain the shipping crate in case there is ever a need to return the CG-900 Cryo-Blade for service.

Crate contents

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

- 1 CG-900 Cryo-Blade (main grinder unit)
- 1 Operating manual (this booklet)
- 1 USB memory stick
- 1 Insulated outer bowl
- 1 Bowl lid
- 1 Inner bowl
- 1 Insulation tube
- 1 Safety over-pressure relief valve and fittings
- 1 Exhaust collector container
- 1 Cleaning brush
- Tie-wraps to secure the hose to the back of the unit
- 1 Hex key metric set

3.3 Connection – Electrical

Plug the cabinet power cord into an approved electrical outlet.

Note that the CG-900 Cryo-Blade nominal voltage is either 115 VAC (60 Hz, 20 A) or 230 VAC (50/60 Hz, 12 A). These versions cannot be switched without hardware replacements.

NOTE: *If the included cable needs to be replaced to suit local electrical codes, the user should refer to the rating plate located on the back of the unit and consult with an electrician before attempting any electrical connection.*

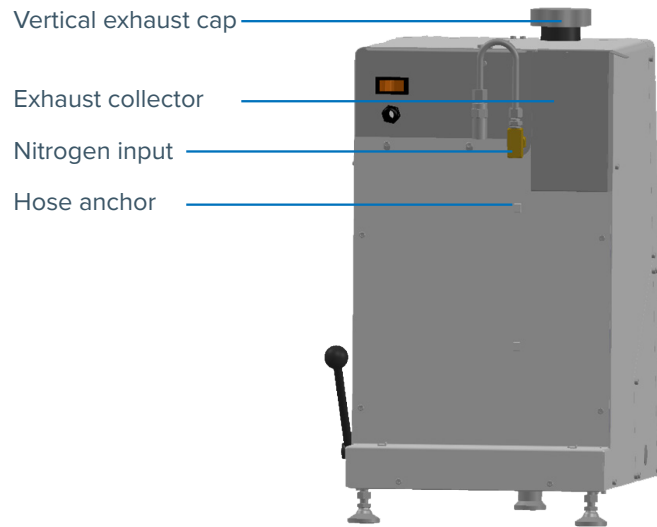
3.4 Connection – Exhaust

A standard 8.9 cm (3.5-in) outlet allows the unit to be connected to your exhaust system.

To connect it, we suggest using a standard rigid or flexible 8.9 cm (3.5-in) duct hose with worm-drive clamps to link the unit with user's air extraction system. The duct hose and the worm-drive clamp are not included with the unit.

Alternatively, if the duct hose is not used, the instrument comes with an exhaust collector container to collect potential material at the exit of the exhaust (see diagram on next page).

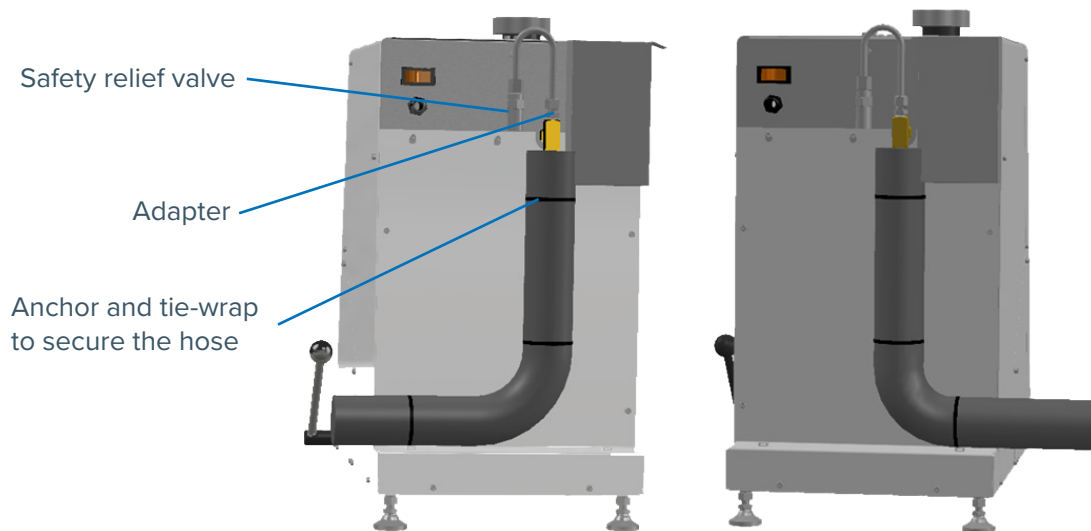
NOTE: Although this connection is optional, we recommend using it to remove nitrogen vapor (or fog) that could accumulate in the room.



Back View

3.5 Connection – Liquid Nitrogen

The liquid nitrogen should be connected to the unit using a hose (not included), safety valve and fitting with the unit as shown on the pictures below. We recommend inserting the hose in the insulation tube included. This will minimize the condensation and water spillages during operation. The input is located at the back of the unit. The safety relief valve and fittings are pre-installed on the back of the unit for your convenience. The hose should be secured as close as possible to the unit with tie-wraps on the anchors on the back of the unit. According to the location of the LN tank, the hose will exit the unit at left or right side. Liquid movement in the hose section can cause precision error when the unit dispenses liquid nitrogen. Proper installation of the hose, near the back wall and in line as much as possible with the rear leg will prevent future problems when using the unit. The hose should exit the unit and lay on the counter without pressure or tension exerted on it. We recommend keeping a short distance between the tank and the unit. This will minimize liquid nitrogen consumption. The tank pressure must be adjusted to 22 psi to ensure the necessary flow to cool the sample.



WARNING: The safety relief valve must never be removed. Trapped liquid nitrogen could create dangerous pressure buildup that could expose the user to serious hazard or death.

3.6 Leveling

The front foot of the unit is connected to a sensing device to monitor liquid nitrogen dispensed and measure sample weight. To have the best accuracy, it is important that the unit be reasonably leveled. If in doubt, place a bubble spirit level on top of the unit and adjust the instrument's back feet to compensate for possible slant.

3.7 Setting Up

After the initial unpacking and setup of the Cryo-Blade, you are ready to prepare the unit for use.

As you prepare the Cryo-Blade to grind samples, become familiar with the bowl and its components. The bowl is composed of an outer insulating shell, an inner stainless steel bowl, a seal, and the lid. Make sure all components are correctly in place. The seal should sit on top of the stainless steel bowl and press against the lid.

The sample is inserted in the bowl while the lid is in place using the opening in the lid to do so. Pre-chopping of the sample may be required. For large samples, chopping the sample into smaller chunks before loading it in the bowl will greatly improve the grinding. If the sample is too big to go through the lid opening it will be too big to be processed efficiently. The user should not try to bypass the lid opening.

A convenient locking lever to extract the inner bowl is located on the front right area of the bowl. Hold the bowl by its handle and pull that locking lever to move the inner bowl up to be extracted.

Before operating your new Cryo-Blade, make sure that you become familiar with its specific features. The section "How the Unit Works" on page 13 explains in detail how each part of the system operates.

While familiarizing yourself with the operation of the Cryo-Blade you may wish to run a test without sample.

3.8 Questions

Should you have any question regarding the proper installation and start-up of your instrument, please contact Cole-Parmer directly (see "Contacting Cole-Parmer" on page 36) for assistance.

4.0 Cryogenic Comminution

When analyzing aliment or material, good homogeneity of the material is critical to obtain a representative sample. Grinding and mixing is an effective way to obtain such a result. Unfortunately, some materials are difficult or impossible to process in a homogeneous way. Cryogenic grinding is a great solution for those materials.

Cryogenic grinding is a powerful method to grind and homogenize almost every material or food. The Cryo-Blade uses cryogen (liquid nitrogen or dry ice) to cool sample to cryogenic temperatures. At such temperatures almost everything becomes brittle. Samples can then be processed like rocks and grinded into a fine homogenous powder.

The instrument uses a specifically designed insulated bowl, keeping the sample frozen for longer and reducing the cryogen required to grind.

4.1 Safety and Handling

Even if the bowl is insulated it can still become very cold during and after the cryogenic grinding cycle. The casing of the Cryo-Blade can also become very cold after repeated use.

Cryogenic gloves should always be used to prevent frostbite.



WARNING: Always wear protective gloves when handling the bowl!

4.2 Cryogenic Basis

When cooled to cryogenic temperatures, almost all materials freeze and become hard and brittle. This property can be used to break them into a fine homogeneous powder. The powder can then be analyzed with the method of your choice.

With sample preparation, a good understanding of the method will enable you to obtain optimal results.

Sample preparation

When preparing your material to be processed you will need to cut or separate it into smaller pieces that will be loaded into the bowl. The Cryo-Blade bowl lid has an opening window to insert the sample into the bowl. To prevent loss of material all liquid and residues resulting from the cut can be inserted into the bowl to be processed.

The inner bowl has been designed to hold a maximum of 1 kg of material in a 5 L container. Overfilling the bowl or trying to load larger pieces that could not be inserted through the window opening will increase the grinding time and increase consumption of cryogen. It may also lead to grinding results that are not optimal. Ultimately, it could damage the instrument.

Contamination

The Cryo-Blade uses stainless steel for the component in contact with the sample to be processed. Users should be aware of the contact contamination from the material that could affect the sample analysis.

Cooling

The Cryo-Blade uses liquid nitrogen or dry ice to cool the sample to cryogenic temperature. During cooling, the sample will be agitated slowly to prevent the liquid contained in the sample from forming an ice structure which could prevent the rotation of the blades at the time of grinding. During the cooling, nitrogen vapor or carbon dioxide gases are created. These gases represent a serious asphyxiating hazard and proper ventilation is required. See “Installation instructions” on page 8 for more information.

5.0 How the Unit Works

5.1 Bowl Manipulation

Before installing the bowl on the unit, make sure the liquid nitrogen and exhaust ports of the instrument are not obstructed. The bowl and its components should be completely dry to prevent ice from quickly building up on the device.

Make sure the inner bowl is perfectly inserted in the outer bowl and the seal sits perfectly on the outer ring around the top edge of the sidewall of the inner bowl. The lid should be installed above the outer bowl with the opening window near the bowl handle. Make sure that the lid lays flat on the bowl (no gap remains) and the seal has not moved during the lid installation.

Always use two hands to manipulate the bowl. One hand is grabbing the handle, and the other hand is lifting the bowl from underneath.



WARNING: *The bowl is relatively heavy (5 kg). Use two hands to avoid injury or accidental spillages.*

Locking the bowl

When inserting the bowl in the Cryo-Blade, make sure the bowl is pushed completely to the back. If incorrectly inserted, it will be impossible to lock the bowl.

When the bowl is correctly inserted, the user can lock the bowl in place by moving the locking lever toward the back. With the locking motion, the bowl will rise and engage with the unit connections (blades, axle, liquid nitrogen port and exhaust port).

Unlocking and removing the bowl

When you want to remove the bowl, simply pull the locking lever towards you to lower the bowl and disengage with the unit connections (blades axle, liquid nitrogen and exhaust port). The bowl can then be slid out from the unit. Take note that the bowl and the lid will be very cold, and that personal protective equipment must be used when handling the bowl to prevent frostbite risk.



WARNING: Always wear protective gloves when handling the bowl!

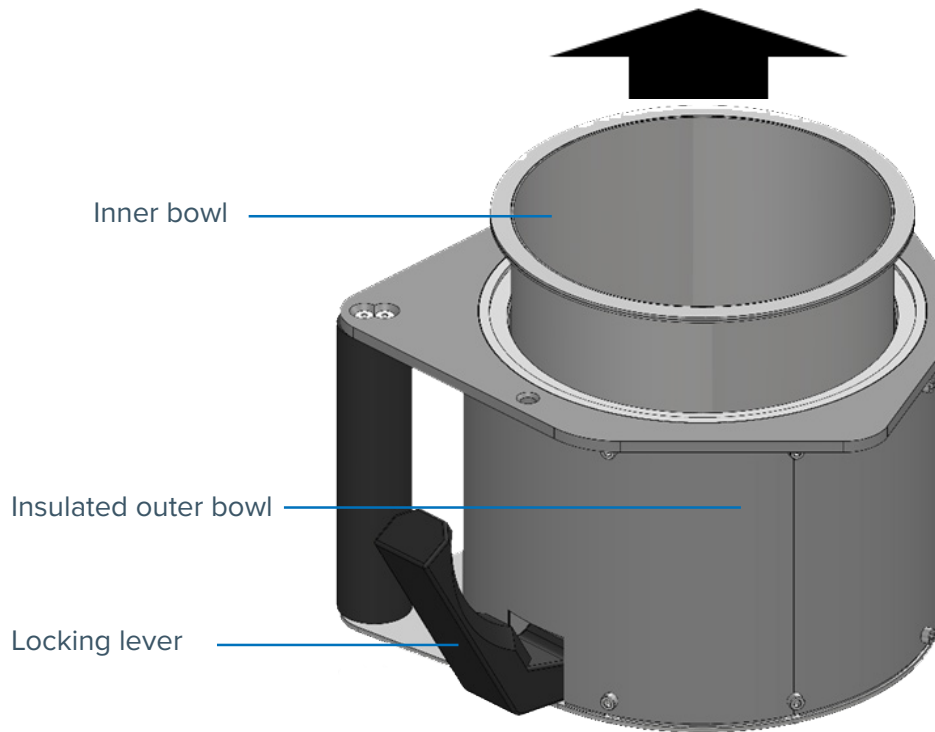
Separating the inner bowl from the insulation

The Cryo-Blade bowl has been designed to reduce liquid nitrogen consumption and keep the ground sample frozen. The bowl consists of the following:

1. A lid with the blades attached to it.
2. The outer insulated frame with handle and the inner bowl locking lever.
3. An inner stainless steel bowl.
4. The seal that sits on the top ring of the inner bowl.
5. The plastic rim that supports, insulates, and centers the inner bowl.

Using the slightly larger surface of the lid in all corners, grab the lid with one hand, hold the external bowl with your other hand. Pull the lid in an upward direction to separate it from the external bowl. While the blade is still in the inner bowl, shake the lid a bit to remove the accumulated ground material that remains on the blades. Then, remove the lid entirely to be cleaned for the next run.

Using the inner bowl locking lever, the inner and the outer bowl can be easily separated from each other. As shown in the figure below, grab the outer bowl handle with one hand and the locking lever with the other hand. Pull on the lever to lift the inner bowl. Then, grab the inner bowl with your protective gloves and remove it entirely from the outer bowl. This makes the sample removal, the cleaning, and the storage easier. Using multiple inner bowls, you could exchange the bowl full of ground sample with a new empty one to prepare a new sample immediately.



WARNING: Wear protective gloves to remove or when handling the inner bowl to prevent frostbite risk.

Bowl and lid cleaning

Even though the bowl is insulated, ice can form on or around its components due to the extremely cold temperature involved in the process. We recommend using soapy water to clean the inner bowl and lid. If an accidental spillage occurs on the outer bowl, we recommend using a wet soft cloth to remove the spillage and immediately wipe the wet surface with a dry cloth. Make sure all parts are perfectly cleaned to prevent any contamination between your samples.

Before using the bowl for a new cycle, make sure that all its components are completely dry to avoid the formation of ice which could damage or prevent the Cryo-Blade from running properly. The inner bowl may get wet with the sample (e.g., a juicy sample like watermelon). The outer surface of the bowl, the seal and the joint surface between the lid and the bowl must remain dry for the correct operation of the device.

5.2 Grinding Methods

The Cryo-Blade comes pre-loaded with basic grinding protocols that can be used as is or can be customized. All grinding protocols can be saved, renamed, deleted, or copied, just like computer files. Only the presets protocols are protected to avoid accidental overwriting.

Cryogenic protocols consist of 4 steps: preconditioning, sample cooling, evaporation and sample grinding. See “Using the Cryo-Blade” section on page 17 for the information on how to program each step. Cryogenic protocols can be executed in two modes: liquid nitrogen or dry ice. The execution will be adapted according to the mode selected.

Preconditioning

The first step executed by the unit is dispensing the liquid nitrogen to cool down the sample and the vessel used to grind it. If dry ice protocol is used, the dry ice is added by the user manually and the liquid nitrogen will not be used. The preconditioning step is completed when the preconditioning temperature and the quantity of liquid nitrogen are reached within the maximum allowed time. For dry ice operation, only the temperature will be monitored to complete the preconditioning step. The volume of liquid nitrogen is measured by weight.



WARNING: *Instrument is using a load cell to monitor the liquid nitrogen volume and measure the sample weight! Avoid touching the unit during the cycle execution!*

The temperature of the sample and bowl must be cold enough to prevent the vaporization of the liquid nitrogen added. At cryogenic temperatures, the liquid nitrogen will remain in its liquid state that can be weighed. The nitrogen gas produced is liberated through the exhaust. This vaporization helps to cool down the sidewall of the bowl, the blades axle, and the inner surface of the lid. During this step, the motor moves the blades in a back-and-forth motion at low speed. The speed used in this step is the same as the one used in the cooling step. The motor rotates 1.5 seconds in a forward direction before the direction is reversed for another 1.5 seconds.

Cooling

The cooling step is immediately launched when the pre-conditioning parameters are reached. A timer is used to control the cooling time required to completely freeze the sample. Even if the cryogenic temperature is measured by the thermocouple, the sample may not show a uniform temperature yet. It is critical to expose the sample for an extended period to allow the uniformization of the temperature. A load of 300 g will require less time than a load of 1 kg. The slow agitation used in the preconditioning step is continued during this step. The use of liquid nitrogen will require less cooling time than the dry ice because of the lower temperature generated. During the cooling step, liquid nitrogen will be dispensed to keep the level to the desired amount.

Evaporation/sublimation

At the end of the cooling step, the remaining liquid nitrogen or dry ice must be evaporated to prevent sudden pressure buildup in the bowl at the start of the grinding. Pressure could cause fine particles to be projected through the exhaust during the grinding. The unit will wait for the liquid nitrogen to evaporate or the dry ice to sublime for a predetermined time that can be adjusted by the user. The back-and-forth agitation continues but the speed is accelerated to increase the evaporation or sublimation rate.

Grinding

The grinding step is immediately launched after the evaporation step is completed. The grinding timer is started, and the motor is accelerating to the grinding speed in the forward direction. Blades rotate clockwise to expose the sample to the teeth of the blades. When the timer has elapsed, the motor will stop. The bowl can be removed to recover the ground sample.

5.3 Liquid Nitrogen Dispensing

The Cryo-Blade automatically dispenses the liquid nitrogen used to cool the sample prior to grinding, reducing the risk generated by the manipulation of this substance.

A cryogenic solenoid valve is used to control the dispensing of the liquid nitrogen. A temperature sensor (thermocouple type K) is located underneath the inner bowl and connected to the unit by inserting the bowl in the instrument to monitor the temperature inside the bowl. A load cell located under the instrument (front foot) is used to measure the weight variation. This information is then used to measure the weight of the sample and to control the volume of liquid nitrogen added during the process.

When the cryogenic valve is activated, a large flow of nitrogen gas circulates and creates a high pressure in the bowl. To prevent this pressure from creating a gas leak, an exhaust is connected to the bowl to remove the excess pressure.

5.4 Dry Ice Operation

When using the dry ice mode, the appropriate quantity of dry ice should be added first in the empty bowl through the opening of the lid. The quantity of dry ice required is inversely proportional to the mass of sample being treated. A dry ice/sample mass ratio of 1.5 to 1 will be used for a sample mass from 250 to 1000 grams. The lower the mass of the sample being used, the higher the ratio of dry ice mass is required to reach the necessary cooling temperature. After the dry ice is added and well spread over the bottom surface, the bowl can be placed in the instrument to capture the weight of the dry ice used. This step is optional but allows the user to follow the sublimation process more accurately during the cycle. Otherwise, the user can simply enter an estimated amount of dry ice used. Then, the bowl can be removed to add the sample over the spread dry ice. The bowl should immediately be inserted in the unit and the cycle started to prevent the formation of strong ice bridge that would prevent the blade from moving.

5.5 Grinding

When the desired temperature is reached and the sample is thoroughly frozen, the instrument starts the grinding cycle. The time required to grind the material to the desired granulometry will depend on the nature of the material and its quantity.

During the grinding, the cryogenic valve is turned off. This allows the finely ground material to stay in the bowl and not be sent out through the exhaust.

A grinding protocol alone can also be executed. The preconditioning, the cooling and the evaporation can be turned off. So, the only step remaining to execute is the grinding. This can be useful when the already ground sample needs more grinding, or if the user must interrupt a complete cycle and restart it with only the grinding remaining to execute.

6.0 Using the Cryo-Blade

6.1 Loading the Bowl in the Unit

As mentioned previously, the Cryo-Blade is equipped with a manual safety lock and sensors that informs the unit if the bowl is installed and locked correctly in the unit before operation. When correctly inserted and locked, the bowl cannot be removed without releasing the locking lever.



WARNING: Pinch point; keep hands clear of the lid of the bowl when locking it in place.

6.2 Safety Features

To run, the bowl needs to be inserted and locked in the unit using the locking lever. Unlocking the bowl while the unit is running will disengage the bowl from the unit and stop the grinding process.

When the bowl is correctly locked in the unit, the ready status in the upper area of the main screen will show that the unit can be started (see picture below). This very same area will always inform about the bowl status; “No bowl”, “bowl is not locked”, or “ready” message will be displayed according to the physical status of the bowl.



WARNING: Vent hood should be turned on while the Cryo-Blade is in use (or running).

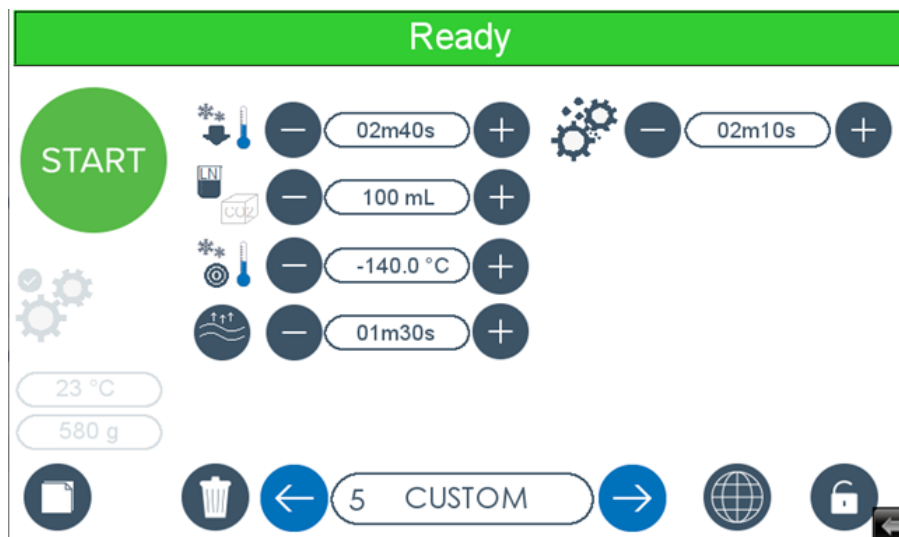
6.3 Taring the Load Cell

The unit is equipped with a load cell to measure the weight of the sample and to control the quantity of liquid nitrogen added during the process.

It is important to make sure that recorded reference weight value for the unit with an empty bowl loaded is accurate. This is particularly important in automatic mode while the unit is measuring the weight of the sample to determine the duration parameters to apply during the cycle. It is advised to verify periodically that this parameter is accurately adjusted. A variation of more than 100 g should be corrected. See section “Special Parameters” page 28 for more information.

6.4 The Main Screen

After the booting screen, you will obtain a display like the following one (not all buttons/icons will appear, depending on the unit’s settings):



Here is a description of the various zones and buttons:



The “Start” button is used to launch the currently selected grinding program.

This button only appears when the bowl is properly installed. (The screen also shows a green “Ready” line at the top.)



This icon indicates the cooling step. When pressed (grayed), it deactivates the cryogenic steps (preconditioning, cooling and evaporation).



When activated, the cooling duration can be adjusted using the decrease and increase buttons.



This icon is used to select the mode of operation (liquid nitrogen or dry ice). In liquid nitrogen mode, it identifies the quantity of liquid nitrogen to dispense and maintain during the preconditioning and cooling steps.



In dry ice mode, it identifies the mass of dry ice used. The green button confirms the mass of dry ice read by the load cell. See page 17, “Dry Ice Operation”.



This icon is used to identify the temperature to be reached to complete the preconditioning step.



This icon is used to identify the duration used to evaporate the liquid nitrogen or to sublimate the dry ice in the evaporation step.



This icon is used to identify and adjust the duration of the grinding step.



This icon allows to toggle between protocol mode and automatic mode. When the icon is grayed, the protocol mode is activated. Parameters to control the grinding process can be adjusted and saved. When the icon is ignited, the automatic mode is activated and parameters are automatically set by the weight of the sample measured at the beginning of the process. The way the parameters are automatically adjusted can be controlled from the global parameter window. See page 26, “Global Parameters” for details.



These icons show the current temperature in the bowl and the current sample weight measured by the system.

The weight information icon is also used as a button to access and modify the reference weight (Tare). See page 28, “Special Parameters” for details.



This button is used to copy (duplicate) the current grinding program.

See page 25, “Managing Grinding Methods” for details.



The Delete button is used to erase a program from memory. See page 25, “Managing Grinding Methods” for details.



The Save button is used to log the current program and its parameters into memory. See page 25, “Managing Grinding Methods” for details.



This button is used to access Global parameters.

See page 26, “Global Parameters” for details.



This zone is used to select the current active grinding method.

See page 20, “Loading a Protocol” for details.



The padlock icon/button shows the state of the grinding recipe 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.

Entering the password is also required to modify the parameters of the Global parameters screen.

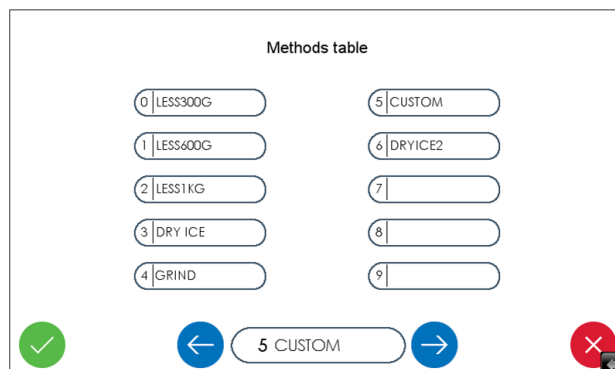
See page 24, “Programming the Cryo-Blade (advanced)” for details.

6.5 Loading a Protocol

Changing the current protocol can be done in several ways.



- Touching the protocol number (“1” in the example above) will call the protocol selection screen.
- Touching the left or right arrows on either side of the protocol name will also call the protocol selection screen but will also decrease/increase the protocol number.
- In the protocol selection screen, you can use the left or right arrows to scroll among the proposed protocols, or you can directly select the desired protocol by touching its name or number.



Touch the green button to confirm, or red to cancel.

6.6 During a Cycle

While the instrument is running, the main screen will display additional information and buttons, as well as the number of the step being currently executed and a countdown showing the total time remaining to the grinding protocol.



The icon in the middle of the arrows wheel is used to indicate the step that is being executed. The current one shown in the middle of the arrows wheel shows the preconditioning step. The subsequent icons shown on the second line are used to indicate the cooling, the evaporation, and the grinding step respectively.



06m20s

This icon shows the remaining time for the protocol being executed. The red square indicates that preconditioning parameters are not reached; the timer is frozen, and the step being executed is the pre-conditioning one. A green square indicates that pre-conditioning parameters are reached, and timer is counting down.



00 mL

This first icon is used to show the approximate level of liquid nitrogen during the process when liquid nitrogen mode is selected.



210 g

The second icon shows the approximate quantity of dry ice remaining when dry ice mode is selected.



23 °C

This icon shows the temperature of the inner bowl. The temperature sensor is located underneath the bowl and allows the system to measure a temperature down to -160 °C. When the bowl is not inserted or the temperature is below -160 °C, the system indicates a temperature of -160 °C.



770 g

This icon in the running windows is used to show the approximate measured weight of the sample at the beginning of the process when stability of the mass cell is obtained. The green square indicates stable condition while the red indicates the instability of the mass cell.



-152RPM

This icon shows the current speed of the blade in RPM.



The Stop button, as the name implies, is used to halt an ongoing grinding process, stopping all motors and resetting the system.

6.7 General Comminution Using Liquid Nitrogen

Steps required to perform a grinding on the CG-900 Cryo-Blade using liquid nitrogen mode:

The following sequence is typical. It supposes familiarity with the chief features of the CG-900 Cryo-Blade, as described earlier.

1. Switch the power on. The display will light up and the unit will perform a self-initialization.
2. Open liquid nitrogen container valve.
3. Load the bowl with sample in the Cryo-Blade making sure it is slid all the way to the back.
4. Using the locking lever, lock the bowl in place. The locking will connect the bowl with the driving mechanism and the nitrogen input and output.
5. Select the grinding protocol of your choice (e.g., “Less600g”) on the LCD screen. Or, alternatively use the automatic mode and let the instrument determine the optimal grinding parameters according to the weight of the sample measured just after the start. Make sure the protocol is set for liquid nitrogen mode.
6. Press the “Start” button to launch a grinding cycle.
7. The unit will automatically pre-cool the sample and the bowl in preparation for the cooling phase. During this phase the blade will move slowly to prevent formation of ice structure that could block the blades. The extraction system will also be engaged to remove the excess of nitrogen gas.
8. The Cryo-Blade will dispense the required amount of liquid nitrogen to reach cryogenic condition.

9. The Cryo-Blade motor then starts and reaches the speed set for the grinding and maintains it for the set time.
10. Once the timer has elapsed, the motor slows to a stop, the screen will return to main screen to inform the user that the cycle has been completed.
11. Using appropriate protective equipment, unlock the bowl and remove the bowl from the unit.
12. Slowly pull off the lid. Rinse under cold water in a sink and then clean the entire lid. Make sure to dry it perfectly for the next run.
13. Using the locking lever, remove the inner bowl from the outer one. Store the inner bowl in a freezer for later analysis or transfer the sample to an appropriate container.
14. Rinse the inner bowl under cold water and clean thoroughly. Make sure to dry it perfectly for the next run.
15. Remove the exhaust cap on the top of the unit, put an exhaust connector container under the vertical section of the exhaust and clean the vertical section of the exhaust with the provided brush. Re-install the cap for the next run.



WARNING: Cold hazards; use protective gloves to avoid frostbite.

6.8 General Comminution Using Dry Ice

Steps required to perform a grinding on the CG-900 Cryo-Blade using dry ice mode:

The following sequence is typical. It supposes familiarity with the chief features of the CG-900 Cryo-Blade, as described earlier.

1. Switch the power on. The display will light up and the unit will perform a self-initialization.
2. Add the appropriate quantity of dry ice to cool the sample and make sure to uniformly cover the bottom surface of the bowl. See page 17, “Dry Ice Operation” for details.
3. Load the bowl on the unit and press the green button beside the mass of dry ice to record the read mass or alternatively adjust roughly the value to the estimated one (if not already done in the protocol).
4. If the bowl has been inserted to measure the dry ice weight, remove it. Add the sample to the bowl (above the dry ice).
5. Load the bowl with dry ice and sample in the Cryo-Blade making sure it is slid all the way to the back.
6. Using the locking lever, lock the bowl in place. The locking will connect the bowl with the driving mechanism and the nitrogen input and output.
7. Select the grinding protocol of your choice (e.g., “Dry Ice”) on the LCD screen. Or, alternatively use the automatic mode and let the instrument determine the optimal grinding parameters according to the weight of the sample measured just after the start. Make sure the protocol is set for dry ice mode.
8. Press the “Start” button to launch a grinding cycle.
9. The unit will automatically pre-cool the sample and the bowl in preparation for the cooling phase. During this phase, the blade will move slowly to prevent formation of ice structure that could block the blades. The extraction system will also be engaged to remove the excess of carbon dioxide gas.

10. The Cryo-Blade motor then starts and reaches the speed set for the grinding and maintains it for the set time.
11. Once the timer has elapsed, the motor slows to a stop, the screen will return to main screen to inform the user that the cycle has been completed.
12. Using appropriate protective equipment, unlock the bowl and remove the bowl from the unit.
13. Slowly pull off the lid. Rinse under cold water in a sink and then clean the entire lid. Make sure to dry it perfectly for the next run.
14. Using the locking lever, remove the inner bowl from the outer one. Store the inner bowl in a freezer for later analysis or transfer the sample to an appropriate container.
15. Rinse the inner bowl under cold water and clean thoroughly. Make sure to dry it perfectly for the next run.
16. Remove the exhaust cap on the top of the unit. Put an exhaust collector container under the vertical section of the exhaust and clean the vertical section of the exhaust with the provided brush. Dump and clean the exhaust collector container. Re-install the cap for the next run.



WARNING: Cold hazards; use protective gloves to avoid frostbite.

7.0 Programming the Cryo-Blade (Advanced)

When specific sample types do not seem to be easily processed by a preset grinding method, it is necessary to manually modify its parameters.

7.1 Unlocking the Advanced Mode



Before being allowed to manage grinding programs 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 the backspace button to clear your entry.

If you summoned the numeric keypad by error, you can close it by pressing the locking padlock icon.

Once the password is correctly typed, press on the unlocking padlock icon to confirm. The numeric keypad will close, and the padlock icon will now be displayed as unlocked.



This icon indicates that you can now modify the grinding protocol parameters and manage the grinding methods (i.e. copy, delete and save). You are now in “advanced mode”.

NOTE: *It is not possible to modify the parameters in the preset program, and so even entering the correct password will not “unlock” the padlock icon. However, the instrument remains in “advanced mode”, and so switching to a custom grinding program will “unlock” the padlock and allow parameter edition.*

To close the advanced mode (i.e., “re-lock” the padlock), simply click the padlock icon and then press on the “locking padlock” icon on the keypad.

NOTE: *If you prefer to always keep the unit in “advanced mode”, it is possible to do so, in the Global Parameters (refer to page 26).*

7.2 Managing Grinding Methods

Grinding 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 activated in order to perform any of the following actions.



Copying

The Copy button is useful to duplicate an existing program, to create a derived recipe. 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 suit 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 enter 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.



Transferring

The Transfer button is used to enter the current parameters into the current selected protocol. This icon will appear automatically when the icon padlock is opened (unlocked) in the automatic mode.

7.3 Preparing a Grinding Program

To build your first grinding protocol, you must first select the preset protocol template or any existing protocol (refer to “Loading Protocol” on page 20) that will be used as a starting point to design your own protocol. Copy it under your desired name, as described above.

Alternatively, you can select a desired protocol or create one by copying an existing one.

Then from the automatic mode, use the transfer button to copy the shown values in the selected protocol. Then save the transferred parameters by pressing the save icon.

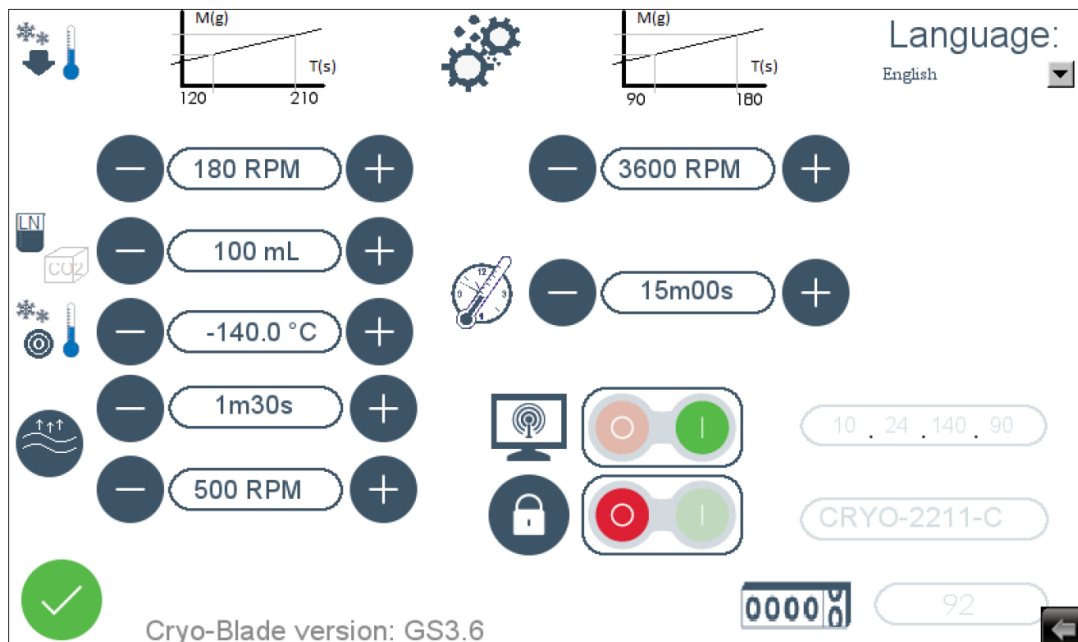
Once this “editable” protocol exists, you can adjust parameters to suit your sample.

8.0 Global Parameters

In addition to recipe-specific parameters, the Cryo-Blade provides extra versatility through flexible parameters that will apply to set automatic mode parameters. This screen also provides general parameters to control the operation of the unit.



To modify the global parameters, first unlock the advanced mode (see page 24, “Unlocking the Advanced Mode”), then touch the Global Parameters icon that is now available on the main display screen.

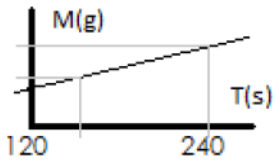


8.1 Options

Language:

English 

This section allows you to pick from a selection of available interface languages.



The duration parameters are used to determine the relation between the sample mass and the duration to execute during the cooling and grinding step in automatic mode. The default setting is 90 and 180 seconds for the grinding step. These parameters are similar for liquid nitrogen or dry ice mode. The cooling step has different parameters according to the mode used. Pressing the liquid nitrogen/dry ice mode button allows to toggle between the parameters for each mode. The default parameters for the cooling step in liquid nitrogen mode are 120 and 210 seconds. The default parameters for the cooling step in dry ice mode are 240 and 480 seconds.



This icon is used to set motor speed for the various steps. Speed parameters are common to all protocols. Adjusting them will affect all protocols. They will also be used in the automatic mode.



The top left icon is used to toggle between liquid nitrogen and dry ice mode parameters setting to be used in automatic mode. The default values for liquid nitrogen mode are 100 mL, -140 °C, 1m30s and 500 rpm. The default values for dry ice mode are 1000 g, -55 °C, 10m00s and 500 rpm. Note that evaporation speed is common to both modes.



This is the maximum time allowed to reach the set temperature. This parameter is common to both modes, all protocols and used in automatic mode.



Turning on this switch allows for the remote control and diagnostics of the Cryo-Blade over a wired network.



This box shows the IP address of the Cryo-Blade, when successfully connected to a wired LAN network.



Turning off this switch will initialize the unit in Advanced mode at boot up, so that password entry is not needed anymore. If the password is changed or deleted with the padlock icon/button, the Advanced mode will be disabled until next boot up or until it is manually entered again.

CRYO-2211-B

This box shows the serial number of the Cryo-Blade unit.

0000

15

The number to the right of the “odometer” icon shows the total number of grinding cycles that the Cryo-Blade unit has performed.

9.0 Special Parameters

This section presents an advanced interface window that can be used to adjust the special parameters on the Cryo-Blade.

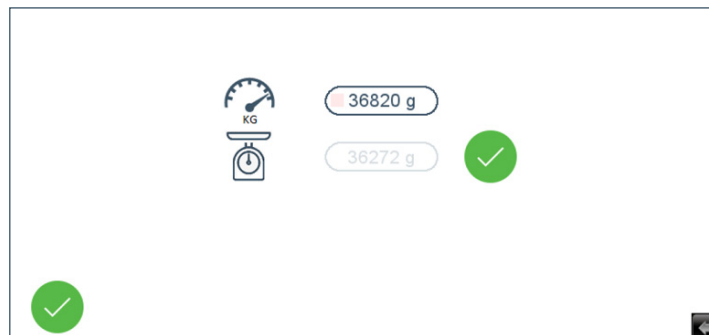
9.1 Accessing the Special Parameters

530 g

To display the Special parameters window, press on the “Sample weight” icon shown here, in the bottom left of the main screen.

(The padlock icon must be in unlocked position to see the “Special Parameter” icon that will allow user to reach this screen. See “Unlocking the Advanced Mode” on page 24 for details.)

The following window appears:



9.2 Special Parameter Descriptions



36815 g

These icons are used to show the total mass of the unit. The small colored square in it is used to show the stability or instability of the mass read (red is unstable state, green is stable state).



36272 g



This parameter allows the user to set the weight of the unit with an empty bowl. This value will be used as a reference to measure the weight of the sample at the beginning of the grinding cycle. Pressing the green icon beside the value will record the value shown in the mass reading cell above when the load cell becomes stable (green square, see above).

10.0 Grinding Troubleshooting

This section presents the most common grinding-related problems. For specific assistance, please do not hesitate to contact us (see page 36, “Contacting Cole-Parmer”).

Problem	Possible Cause	Possible Solution
Unit does not turn on	No power at all	Make sure the power cord is plugged into outlet. Check outlet for power and correct voltage as required.
	Power switch not turned on	Press power switch to ON position.
Unit does not run	Locking and insertion sensors	Make sure the bowl is locked correctly when installed in the unit. Make sure the top of the lid is free of ice that could prevent proper operation of the locking sensor. “Ready” message should appear on the top of the screen when proper conditions are met.
Liquid nitrogen does not flow	Make sure the valve is opened, and the container is not empty.	Make sure the liquid nitrogen container is correctly connected to the unit.
Sample is not frozen when grinding is finished	Grinding generates heat. If the grinding is unnecessarily long, the sample will start to heat up. Reduce the grinding time to reduce heat generated.	Increase quantity of liquid nitrogen or cooling step duration to make sure all the sample is properly frozen.
Cooling takes too long	—	Make sure your liquid nitrogen tank (or line) is set at 22 psi. A lower pressure will reduce the flow of liquid nitrogen and will increase the time required to reach the desired quantity in the bowl.

11.0 Periodic Inspection

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

Cole-Parmer knows that a broken instrument in a laboratory setting causes sample backup and unnecessary costs. That is why this manual comprises not only a Periodic Inspection section, but also a Service Operations section (see page 31), 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 Cole-Parmer specialist (see page 36, “Contacting Cole-Parmer”). Assistance by phone or email is always free of charge.

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

11.1 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.

11.2 Inspection Schedule Table

Frequency	Checkpoint	Description	Action (if problem found)
Each run	Clean bowl and lid	Clean bowl and lid with soap and water and dry completely before the next run.	—
	Clean vertical exhaust	Remove the top cap, use the provided brush and an exhaust collector container under the chimney (no bowl installed) to remove any material that could have found its way out in the vertical section of the exhaust.	—
Daily	Taring the load cell	Verify that recorded reference weight values for the unit with an empty bowl loaded and the unit alone without the bowl are accurate.	—
1 month or 300 cycles	Clean bowl loading area	Use a soft wet cloth to clean loading area and bowl connections. Clean the liquid nitrogen outlet port.	—
	Visual inspection of bowl and bowl loading area	Monitor wear on the moving parts.	Replace parts as needed.
	Clean horizontal section of the exhaust and dump the material found in the exhaust collector container	Remove any material that could have found its way out in the horizontal exhaust section. Empty the back container and clean it in soapy water.	—
6 months or 2000 cycles	Complete cleanup	General cleaning of various surfaces.	—
	Motor and belt inspection	Remove right side panel and inspect the belt and pulleys; looking for wear.	Replace belt or pulleys when necessary.

12.0 Service Operations

This section describes tasks that are performed on a regular basis and are performed to adjust or repair a malfunctioning system of the instrument.

Some sections also describe initial operations, which need to be performed before first using the unit.

Should you have any question, or need further assistance, please do not hesitate to contact us (see page 36, “Contacting Cole-Parmer”).

12.1 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. 240 Volts inside!

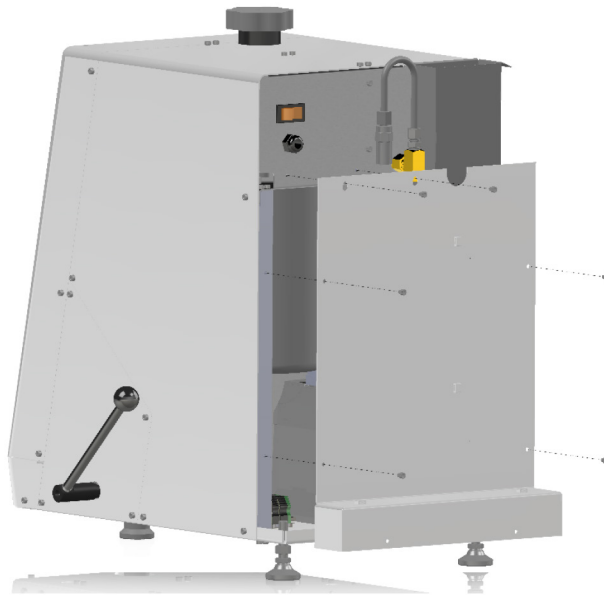
12.2 Back Panel Removal

In order to gain access to most electronic components, it is necessary to remove the back panel.



IMPORTANT: Always disconnect the instrument from the power outlet when working with panels removed. 240 Volts inside! Risk of electrocution!

1. Disconnect the instrument from the wall outlet.
2. Disconnect the liquid nitrogen hose.
3. Remove the screws as shown on the picture below.



12.3 Left Panel Removal

In order to gain access to the exhaust system, it is necessary to remove the left panel.



IMPORTANT: Always disconnect the instrument from the power outlet when working with panels removed. 240 Volts inside! Risk of electrocution!

1. Disconnect the instrument from the wall outlet.
2. Remove the screws as shown on the picture below.



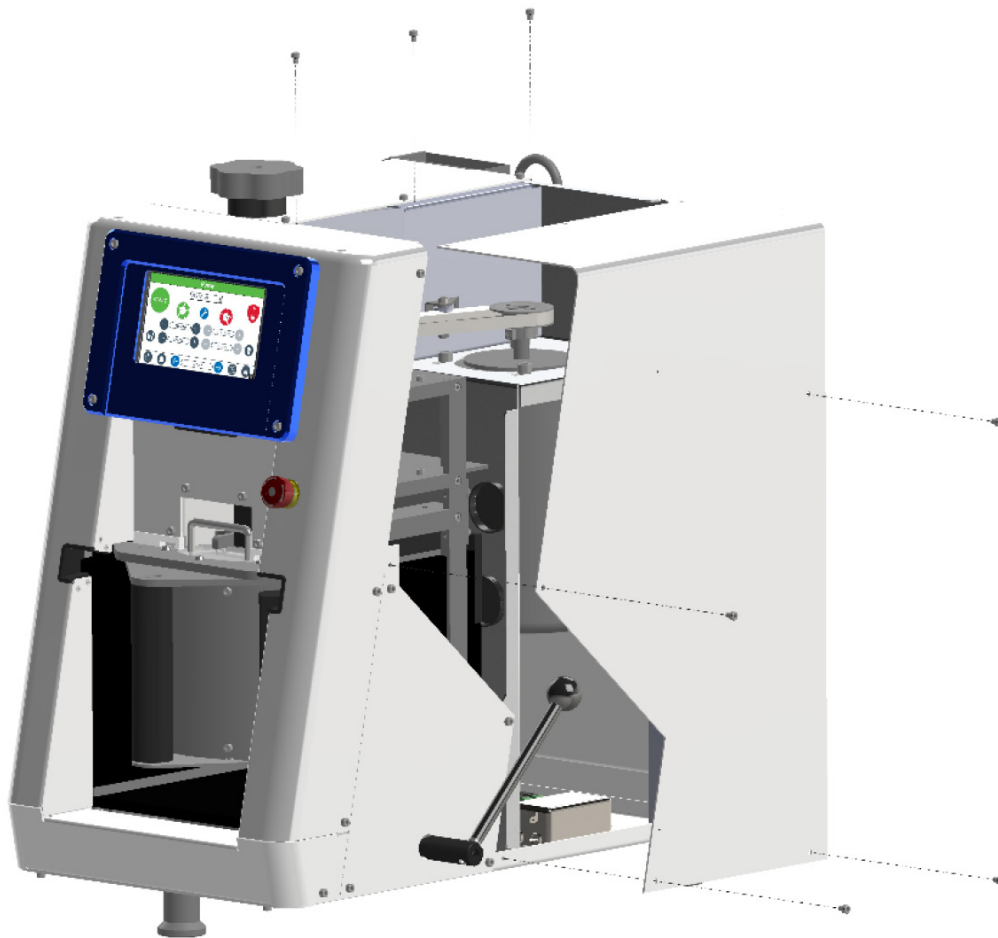
12.4 Right Panel Removal

In order to gain access to motor and belt, it is necessary to remove the right panel.



IMPORTANT: Always disconnect the instrument from the power outlet when working with panels removed. 240 Volts inside! Risk of electrocution!

1. Disconnect the instrument from the wall outlet.
2. Remove the screws as shown on the picture below.



13.0 Firmware and Program Transfers

13.1 Preset Protocols

This section lists the methods that are factory programmed into the CG-900 Cryo-Blade. It is not possible for the user to alter or delete them.

Note that Cole-Parmer cannot be held responsible for any damage to unit and the bowl incurred by the use of those methods. If unsure, please contact Cole-Parmer. We will be glad to prepare an adapted method for your specific sample.

Number	Name	Description
0	Less300g	Template protocol for liquid nitrogen operation using sample quantity under 300 g
1	Less600g	Template protocol for liquid nitrogen operation using sample quantity under 600 g
2	Less1Kg	Template protocol for liquid nitrogen operation using sample quantity under 1 kg
3	Dry Ice	Template protocol for dry ice operation using sample quantity under 1 kg
4	Grind	Template protocol for grinding without cooling

13.2 Backup or Restore by USB

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

Alternatively, you might have received from Cole-Parmer a firmware upgrade that you want to install on your instrument.

Backup Cryo-Blade to USB drive

1. To start the process, simply insert a USB flash drive into the USB port of the unit. A dialog will automatically pop up on the screen in 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 back up the firmware (i.e. the instrument's operating system).
5. Select "Upload History Files" if you want to back up the grinding programs' parameters.
6. Touch "OK".
7. Now, choose where you want the data to be stored. 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 unit 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 your backup files into the USB port of the unit.
2. If you have obtained a new firmware by email, extract the directory structure and files you have received in the root directory of 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 grinding programs' parameters. *Note that this will erase ALL grinding programs currently stored on your instrument.*
8. Touch "OK".
9. Now, choose where you want the data to be stored. 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.
10. Click "OK" to start the transfer to the USB drive. The screen will black out, and the unit will re-boot.
11. The new firmware or programs are loaded, and you can remove the USB drive.

14.0 Technical Specifications

Type of Mill	Cryogenic grinder
Grinding Mechanism	Grinding containers with rotating blade
Weight (without grinding container)	50 kg (110 lbs)
Dimensions (W x D x H)	45 x 63 x 70 cm (17.7 x 24.8 x 27.5 in)
Electrical	115 V/60 Hz/20A built-in breaker or 230 V/50~60 Hz/15A built-in breaker
Motor	1 HP, 3600 RPM
Operating Conditions	Indoors, in ambient air
Ambient Temperature	4~35 °C (40~90 °F)
Humidity	0~95%

NOTE: Operator is responsible for supplying proper line cord/plug if required. Contact a licensed electrician if unsure.

15.0 Warranty

Cole-Parmer guarantees its products and new equipment against defects in materials or workmanship for three (3) years from the date of original shipment. Repairs, replacements, or parts are guaranteed for 30 days or for the remaining original warranty period (whichever is greater) for the item that was repaired or replaced. Items not produced by Cole-Parmer carry the manufacturer's warranty only. Some parts are considered wear parts and are not covered by warranty; these include drive belts and gas cylinders. Cole-Parmer reserves the right to judge whether a malfunction or breakage is due to defects in materials and workmanship, or to wear, negligence, or misuse.

15.1 Product Changes

Every effort has been made to provide complete and accurate product operation and information in this manual. However, since specifications are subject to change without notice, changes may be made from time to time to improve the performance, reliability, and function of the product. Therefore, slight changes that are not reflected in the current illustrations should be considered minor and inconsequential for the purposes of this operating manual.

15.2 Return Shipments

We want you to be happy with whatever you purchase from Cole-Parmer. Please bring any problem to our attention, but please DO NOT RETURN any item before contacting us for a Return Authorization Number and instructions. Unauthorized returns will be refused. Cost for all return transportation is the responsibility of the customer. Credit for returned unused merchandise will be issued only after goods have been received and inspected. Returned goods are subject to a 25% restocking charge.

16.0 Contacting Cole-Parmer

Web: coleparmer.com

USA:	Canada: +1.800.363.5900	India: +1.800.266.1244
+1.800.323.4340	China: +86.21.5109.9909	Italy: +39 (0) 1313 89513
+1.847.549.7600	France: +33 (0) 1486 37800	UK: +44 (0) 1480 272279
	Germany: +49 (0) 9377 92030	All other countries: +1.847.549.7600

coleparmer.com

USA:	Canada: +1.800.363.5900	India: +1.800.266.1244
+1.800.323.4340	China: +86.21.5109.9909	Italy: +39 (0) 1313 89513
+1.847.549.7600	France: +33 (0) 1486 37800	UK: +44 (0) 1480.272279
	Germany: +49 (0) 9377 92030	All other countries: +1.847.549.7600

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