



# *LN2-P4*

## *User's Manual*

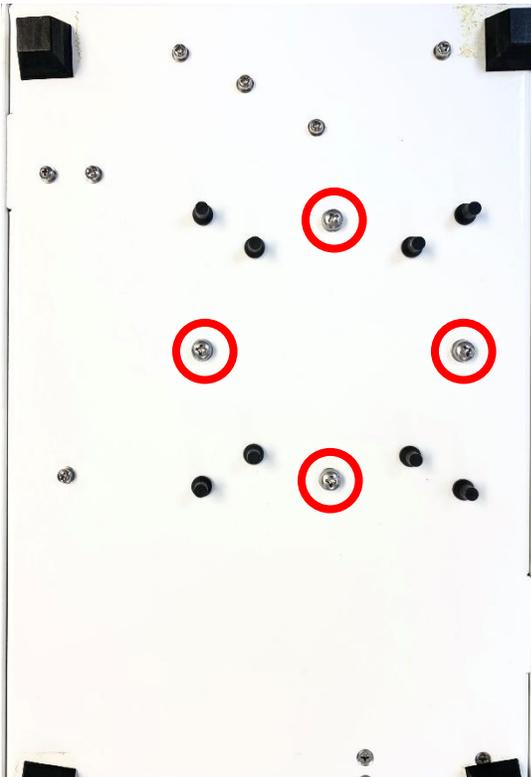
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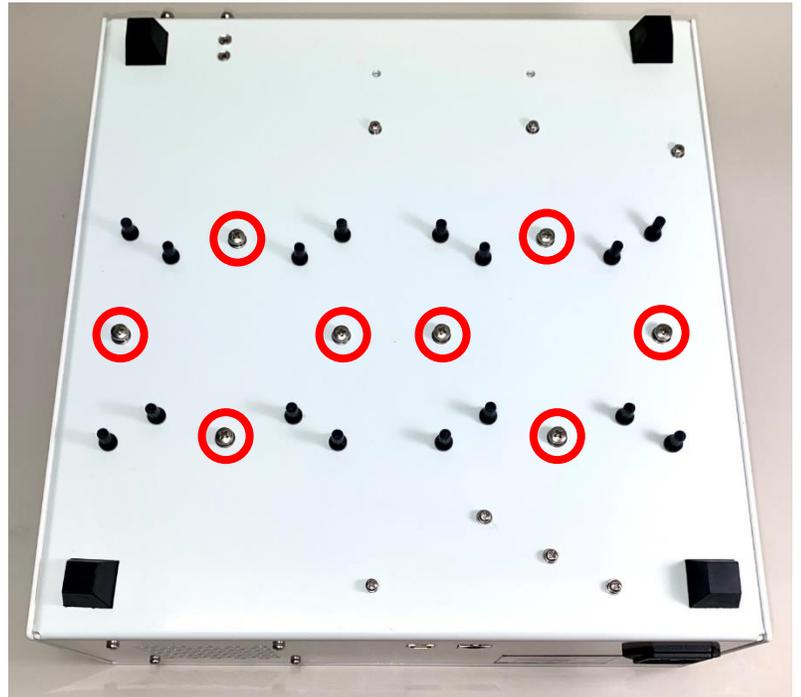
## WARNING!

### INTEC LN2-P SAFETY PLATE

The INTEC LN2-P pump comes with a safety plate attached to the bottom of the pump inside the chassis to prevent it from moving on its rubber mounts during shipping. ***This plate must be unfixe***d before using the pump. Simply remove the four or eight pan head screws indicated below, depending on which model you have. It will be easier to untighten each screw a little at a time – allowing the rubber pump mounts to decompress evenly.



LN2-P4C  
4 transport screws



LN2-P8C  
8 transport screws



## ***INTEC, Inc.*** **Warranty**

*INTEC, Inc.* warrants to the buyer that the products will conform to the specifications set forth in this manual, and will remain free of defects in workmanship and materials for a period of one year from the date of delivery. Should a product, in *INTEC's* opinion, malfunction during the warranty period because of a defect in workmanship or material, *INTEC* will repair or replace it at no charge to the buyer, provided the product has not been subject to accident, misuse, abuse, or unauthorized alteration, modification, and/or repair.

Examples of actions that will make this warranty null and void include, but are not limited to, the following:

- ◆ Storing or operating the device at any temperature outside the operating and storage temperature range.
- ◆ Performing or attempting to perform unauthorized service or repair
- ◆ Resale -- except through an authorized dealer.

Products requiring service under this WARRANTY should be returned to *INTEC, Inc.* *after approval and only with a valid RMA*. All portions of such systems, hardware and software, should be sent, along with proof of purchase if obtained from a dealer. Buyer must insure the product or assume risk of damage or loss in transit. If unable to repair or replace the product, *INTEC* will refund the purchase price paid by the original buyer.

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## SECTION 0. SAFETY INFORMATION



Within this manual, a set of symbols are used to call attention to Safety Warnings, Caution Notices, and Notes. The symbols are defined in Figure 1:

		
<p><b>Warning Symbol</b>          Indicates a safety guideline that should be followed at all times</p>	<p><b>Caution Symbol</b>          Indicates a caution notice that calls attention to a potential safety risk</p>	<p><b>Note Symbol</b>          Indicates an important notice which should be given careful consideration.</p>

*Figure 1: Symbol Legend*



**Documentation:** The LN2-P Liquid nitrogen Pump is just one component of your INTEC temperature control system. Be sure to carefully read, and follow the safety guidelines outlined for each component device in the system.



**Electrical Connections:** Always use the correct Input voltage and frequency according to the end-user's region. 110VAC 60Hz AC for North America, 220VAC 50Hz in Europe, etc. INTEC will configure each element of the INTEC temperature control system with the appropriate receptacle before delivery. NEVER use power plug adapters when using the LN2-P, or any other part of your INTEC System.



**Current Limiting Devices:** Most devices used in your INTEC System contain a replaceable fuse rated appropriately for each device. The fuse for the LN2-P is located within the AC power receptacle and can be accessed using a flathead screwdriver. **The fuse should only be accessed when the device is unplugged from the AC power supply.** Never replace the fuse with a fuse of a different current rating than what is indicated on the back panel of the pump.



**Extreme Temperatures:** While the LN2-P chassis should never greatly exceed ambient temperatures, special care should be taken with regards to the Stage/Plate/Chuck/ probe station being controlled, as well as the LN2 supply lines. Both the chassis, sample and supply line temperatures can exceed 60 C, or drop below -20 °C depending on the configuration. Always be aware of the operating temperature of your stage and avoid physical contact accordingly. Contact with extreme temperatures, hot or cold, may cause bodily harm.



**Liquid Nitrogen Handling:** It is strongly recommended that the user take the time needed to fully read and understand the Liquid Nitrogen safety warnings outlines in this section.

- ◆ Only use liquid nitrogen in areas with adequate ventilation. Liquid nitrogen boils at  $-196\text{ }^{\circ}\text{C}$ , changing state to nitrogen gas. Nitrogen gas (78% of the atmosphere) is colorless, odorless, nonflammable, and nontoxic. *However, it will not support life!* Nitrogen gas displaces ambient oxygen and could cause asphyxiation, possibly resulting in serious brain injury or death. Ambient air at STP typically contains 21% oxygen, and less than 19.5% oxygen is considered to be an oxygen deficient atmosphere. 1 cubic foot of liquid nitrogen will expand to 696 cubic feet of 100% nitrogen gas at 70°F. *Loss of consciousness from nitrogen asphyxiation can occur without any warning signs!* A victim will seldom recognize the signs of impending asphyxiation. Never fill liquid nitrogen containers in confined areas without adequate ventilation, and it is strongly advised to have another person present when conducting liquid nitrogen transfer operations.
- ◆ Cryogenic containers must always be stored in an upright position.
- ◆ Always wear appropriate safety equipment, including loose-fitting leather or cryogenic gloves and eye and face protection. Remove all metal jewelry such as rings, bracelets, and watches.
- ◆ Avoid rough handling of cryogenic containers. A cold exterior surface can indicate the loss of vacuum in the outer jacket. In this case contact the manufacturer or supplier immediately.
- ◆ Never attempt to change or remove any of the fittings on the cryogenic containers.
- ◆ Use only containers that are approved for use with liquid nitrogen, such as the containers supplied with *INTEC* liquid nitrogen pumps. Liquid nitrogen should never be handled in open pail type containers.
- ◆ Transfer of liquid nitrogen into warm lines or containers must be done slowly in order to prevent thermal shock and possible buildup of pressure.
- ◆ Liquid nitrogen transfer lines should extend to the mouth of the open container. Never allow a liquid nitrogen stream to fall a distance through the air to reach a container on the floor. Elevate the container on an appropriate stable platform, so that the liquid stream stays inside.
- ◆ When transporting the LN2 container from the cryogenic container to the work site, watch carefully for other people or obstacles. Never transport LN2 in a passenger elevator -- use the stairs instead.
- ◆ If liquid nitrogen is splashed in the eyes, flush with water for at least 15 minutes and seek immediate medical attention. For skin contact, soak the affected area in still ambient water and seek immediate medical attention.
- ◆ Be sure to use LN2-rated funnels when filling a low-pressure Dewar. Using a funnel not rated for LN2 can be dangerous!

#### Work Area:



- ◆ Place the pump in a space that provides adequate airflow for instrument cooling
- ◆ Keep the work area clean. Periodically remove and file or dispose of old samples.
- ◆ Do not store chemicals or solvents on shelving over the work area.
- ◆ Never use this equipment in an area with potentially flammable or explosive vapors present. It is not rated explosion proof!

#### Electrical Safety:



- ◆ Never perform unauthorized modifications or repairs. Such actions will void the warranty. Please consult with INTEC about modifications or repairs.
- ◆ Never perform maintenance or installation while the power is on.

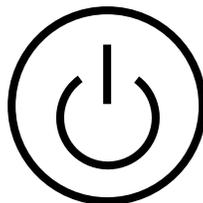
#### Instrument safety considerations:



- ◆ Never operate an instrument outside of its rated temperature range.
- ◆ *INTEC* recommends the use of instrument frame cooling accessories (e.g. water pumps & circulators), where possible when operating instruments at temperatures in excess of 100°C.
- ◆ When using a water circulator to rapidly cool from temperatures higher than 100°C, *INTEC* requires that the water pump tubing be secured to the cooling tubes with locking cable ties or clamps (included with water circulator). **If not properly secured, the tubes may be forced off and the water will continue to run. This is especially dangerous if water gets into the electronics of the hot stage or mK2000 controller.**
- ◆ When cooling from high temperatures, keep your hands and other body parts away from the steam that may come out of the return tube – a burn could result!



**Power Button:** Power is supplied or interrupted on the LN2-P via an illuminated push-button switch located on the front panel. This button can be identified by the power symbol below in **Figure 2**.



*Figure 2. Primary power switch indicator*

**Thank you for taking the time to read the safety section, from all of us at *INTEC*!**



## Section 1. INTRODUCTION

### 1.1 Product Overview

The LN2-P Liquid Nitrogen Cooling System provides fast and accurate sample cooling for INTEC hot and cold stages, plates and chucks down to  $-196^{\circ}\text{C}$ . While the majority of stages/plates/chucks can reach  $-196^{\circ}\text{C}$  without issues, some may struggle based on the system components and configuration. Refer to the included stage/plate/chuck User's Manual (technical specifications section) for model-specific temperature limits. Furthermore, it is highly recommended to read this manual, and all other system component manuals in their entirety to get the most out of your temperature control system.

The LN2-P System consists of a liquid nitrogen source (typically an insulated Dewar full of ambient pressure LN<sub>2</sub>), an LN2-P liquid nitrogen pump, and the associated tubing. The pump can be manually operated a knob of the front panel, however a temperature controller such as the INTEC mK2000 is required to provide precision temperature control. The LN<sub>2</sub> pump can be configured for analog voltage/current input to allow for compatibility with other controller options.

When activated, the LN2-P pump draws LN<sub>2</sub> from the Dewar and through the stage/plate/chuck sample area to cool the sample. During this process, the liquid nitrogen quickly transitions into a gas state, meaning no liquid reaches the pump itself. Instead of wasting the "spent" LN<sub>2</sub>, this gas is warmed and expelled via the "Out" port for window defrosting, or use as purge gas. Dry purge gas can prevent condensation from forming on the sample when pumped in the gas-purge ports on gas-tight stages/plates/chucks. When the LN2-P is used in conjunction with the mK2000 temperature controller, bi-directional sample temperature control is possible, wherein both heating and cooling can be used to maintain the target temperature. This is useful to prevent temperature overshoot, reducing experiment downtime, or for thermal cycling applications.

## 1.2 System Operation Flowchart

**Step 1:**  
 mK2000 reads sample temperature, modulates LN2-P suction power



**Step 2:**  
 Suction pressure draws liquid nitrogen from low-pressure Dewar and through the thermal block



**Step 3:**  
 LN2-P expels warmed N2 gas for defrosting or gas purge

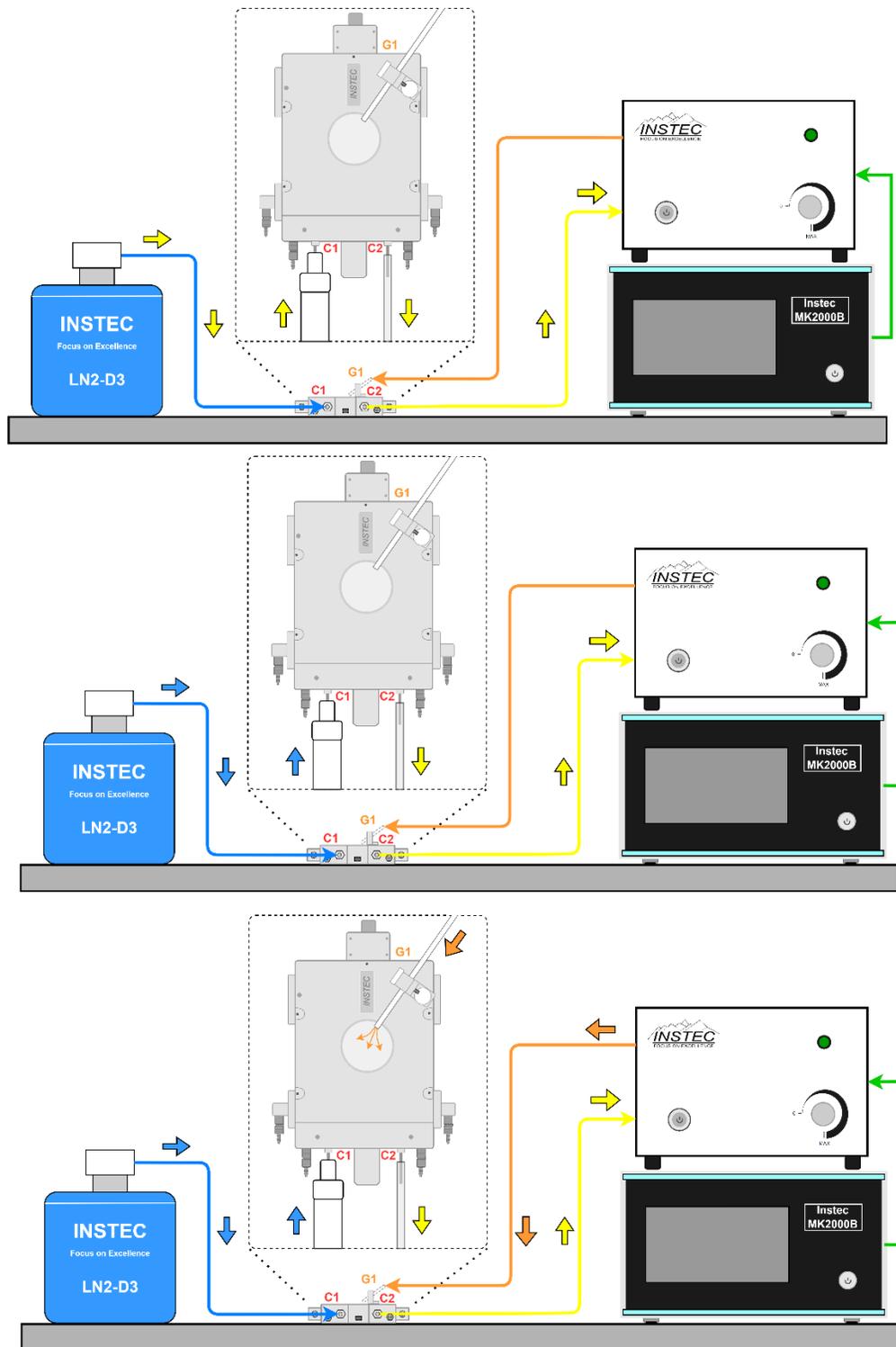


Figure 3: Operational diagram for the LN2-P cooling system used with mK2000 temperature controller



### 1.3 Features

- ◆ Two control modes; Open loop control via knob, Closed loop control via mK2000 link. (Analog Input control options available upon request)
- ◆ Sample cooling down to -196 °C (stage/plate/chuck model dependent)
- ◆ High-output LN2-P8 version available

### 1.4 Specifications

General Specifications	
Specification	Value
Sample Temperature range	-196°C to RT (stage/plate/chuck model dependent)
Inlet Gas Temperature Range	-196° to 200°C
Environmental requirments	Ambient Temperature 0~50°C, humidity < 85%RH, with minimal electromagnetic interference.
Maximum Suction Pressure	-0.24 Bar
Maximum Gas-flow rate	32 L/min (P4C), 50L/min (P8C)
Chassis Dimensions	LN2-P4C Model 140mm wide x 350mm long x 130mm tall LN2-P8C Model 315mm wide x 350mm long x 130mm tall
Inlet/ Outlet port dimensions	¼ inch barbed fittings
Peak Noise Level	<60 dB
Power Requirments	150W max – Universal Input Voltage

## Section 2. SYSTEM INSTALLATION AND USE

### 2.1 Equipment list for the LN2-SYS

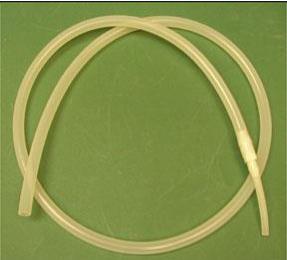
Inspect the shipping carton for any obvious signs of damage that may have occurred during shipment. It is highly recommended to retain the shipping carton for the duration of the product warranty in case the product needs to be returned for repair. Carefully open the shipping carton and remove and inspect the contents for any damage that may have occurred during shipment. Please report any evidence of shipping damage to *INSTECH* immediately



**Shipping Carton:** It is highly recommended to retain the shipping carton for the duration of the 1-year factory warranty. Using the original packaging for manufacturer-approved return shipping greatly reduces instances of shipping damage.

*Table 1: LN2 System Parts List*

<p>One (1) LN2 Pump, which will be one of the following:</p> <ul style="list-style-type: none"> <li>• LN2-P4C</li> <li>• LN2-P8C</li> </ul>		
<p>One (1) AC Power cord ( Region appropriate)</p>		
<p>One (1) control cable: LN2-P to mK2000</p>		

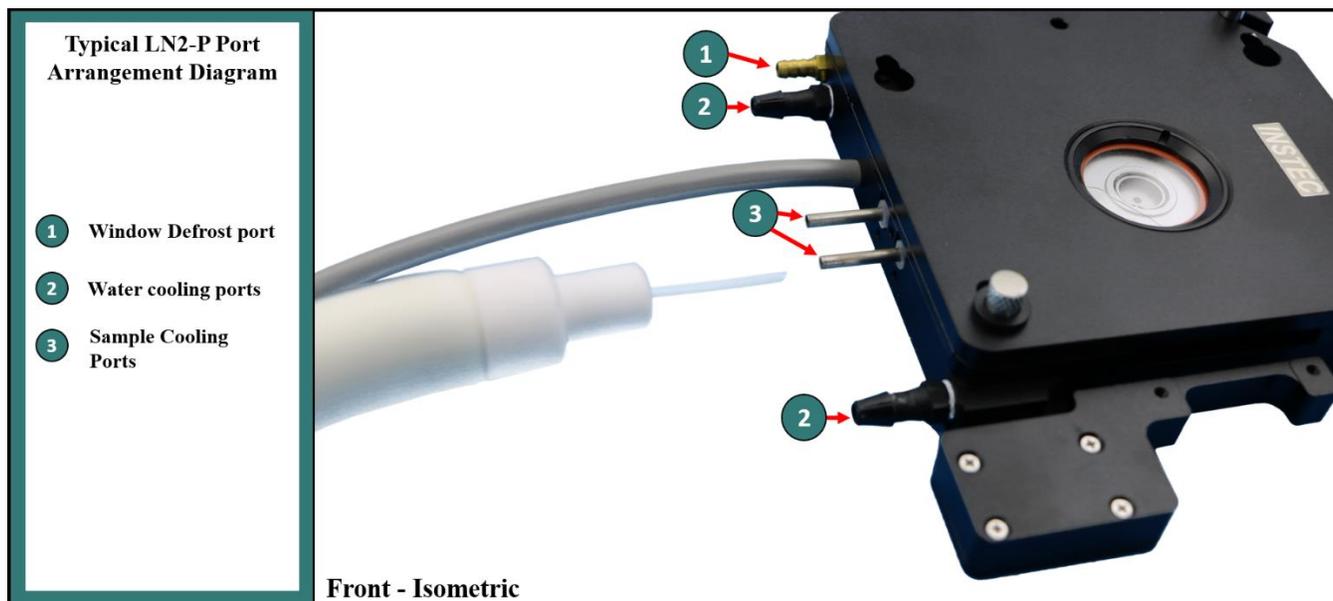
<p>Up to Two (2) LN2 transfer lines</p>	
<p>Optional: One (1) Liquid Nitrogen Dewar:</p> <ul style="list-style-type: none"> <li>• LN2-D3 (3 liters)</li> <li>• LN2-D10 (10 liters) (shown)</li> <li>• LN2-D30 (30 liters)</li> </ul>	
<p>Dewar Option:</p> <p>One (1) Refillable Dewar Lid and Teflon Dewar Straw.</p>	
<p>Refillable Dewar Lid Accessories:</p> <p>One (1) Rubber Stopper</p>	

## 2.2 Connecting the LN2-SYS Liquid Nitrogen Cooling System



**Be sure to read the Preceding section on safety before using the LN2-P system!**

The procedure for connecting the LN2-SYS Liquid Nitrogen Cooling System for sample cooling is described below. For reference, and example of the typical connections on a stage are shown in **Figure 4**.



*Figure 4: Port labelling diagram for typical INTEC LN2-P compatible Heating and Cooling Stage*



### Transportation screws:

To protect the internal components, every LN2-P pump is shipped with removable packing screws. **These screws must be removed BEFORE the system is used.** Failure to remove the screws will cause the LN2-P to vibrate and emit a loud rattling noise. Prolonged use with these screws installed will lead to premature failure of the LN2-P, and is NOT COVERED by the manufacturer warranty. Please retain these screws for future use, as they must be reinstalled before the pump can be shipped again for repair or maintenance.

1. It is important to place the stage or chuck into the desired viewing position and orientation before turning on the LN2 cooling pump, in case the transfer lines freeze. **Once the LN2 lines freeze they become inflexible and the stage cannot be moved. Any movement of the equipment may cause the tubing to break!**
2. Remove the shipping lid from the Dewar and replace it with the INTEC refillable Dewar lid. Place the Dewar in a location that is close to the stage and has convenient access to the

stage. For the larger Dewars; it will not be necessary to move the Dewar again to refill. It is best practice to place the Dewar at the same or higher elevation as the stage/plate/chuck.

3. Place the LN2 pump in a convenient location. It should have access to AC power and adequate ventilation. A typical location is either under or on top of the mK2000.
4. Connect the LN2 pump to AC power via the included AC Power cable.
5. Connect the LN2 control cable from the “Cooling I/O” port on the LN2-P to the “Cooling I/O” port on the back of the mK2000 temperature controller.
6. Remove the protective cover from the Dewar head supply line, and connect the LN2 supply line to one of the sample cooling ports on the stage/plate/chuck. There is no preferred inlet or outlet, so the LN2 supply line can be connected to either of the two silver sample cooling ports (item 3 in **Figure 4**). The supply line end fitting should fit snugly around the metal cooling tube, forming a loose seal. It is normal for some of the metal sample cooling tube to remain visible even once the supply line is fully installed.
7. Connect the sample cooling line between the stage/plate/chuck and the LN2 pump. The sample cooling line has a reducer at one end, which is the end that should connect with the stage. Connect the other end of the sample cooling line to the Input port of the LN2 Pump. When all connections are correctly made, external fasteners should not be required to make a secure connection.
8. (Optional) If the stage/plate/chuck has windows, your system will most likely contain a Gas Purge line or window defrosting port. This line can be connected from the LN2-P Outlet to the gas purge port/ window defrosting port on the stage/plate/chuck. Some Intec products have fully integrated window defrosting ports, while others rely on external defrosting fixtures. Consult your stage/plate/chuck manual for specific guidance on how to use the window defrosting features.
9. Turn on the power to the LN2-P via the push-button switch located on the front panel; you are ready to begin cooling the stage via the manual control knob, or the connected mK2000 temperature controller.



**LN2-P Outlet:** The OUTLET on the LN2 pump is heated to prevent Liquid Nitrogen from being expelled from the LN2 pump, thus after long periods of operation it is normal to feel warm to the touch.

### 2.3 LN2-P Operation

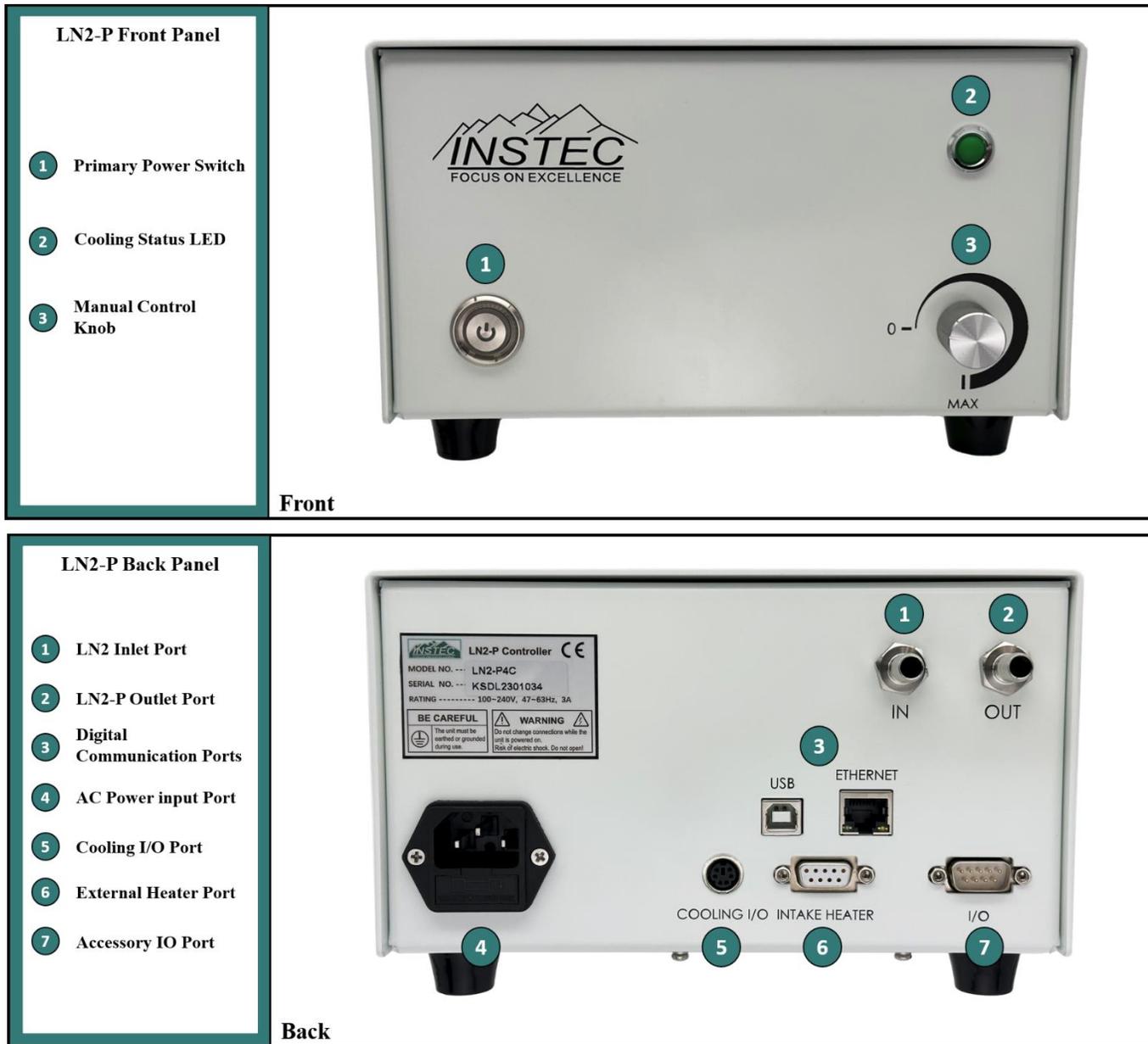


Figure 5: LN2-P front and back panel diagrams

When used with only the mK2000 precision temperature controller, LN2-P operation is very simple: there is no need for the user to do anything other than setup the system, connect it to the mK2000, and power the system on. The mK2000 will measure the sample temperature and set the LN2-P power to provide the necessary amount of LN2 flow.

The LN2-P system output power is determined by two independent sources: one is the manual control knob located on the front panel, and the other is the control signal from the mK2000 temperature controller. The larger of these two source signals determines the output power. For example, if the knob is set to 50% power and the controller outputs a 30% power signal, then the LN2-P will output at 50%. If the Knob is set to 50% power and the controller outputs a 75% power signal, then the LN2-P will output at 75% power. The green status LED on the front of the LN2-P will flash with a duty cycle corresponding to the current output power %, meaning at full power it will be solid green, and at 50% power will flash on and off evenly.

While it is generally recommended to set the manual control knob to 0% power and let the temperature controller fully regulate the LN2-P output, there are a few situations in which the user may want to utilize the manual control knob:

### **Manual Control Knob Use-Cases**

#### **1. Setup/Troubleshooting**

During Setup or troubleshooting, it is often useful to apply a manual 50% power signal to the LN2-P. Doing so will allow the user to verify that the LN2 lines are correctly routed and that there is sufficient LN2 in the supply Dewar to cool the stage/plate/chuck. This can also be helpful when troubleshooting controller issues since the manual control knob can bypass the controller signal. If you try to cool the stage with the controller, but the temperature does not change and the pump doesn't audibly turn on, try using the manual control knob to independently verify that the pump is powered and operational.

#### **2. Unregulated cooling**

There may be times when precision temperature control is not required, and the target stage/plate/chuck just needs to be cooled as fast as possible and kept as cool as possible. In such cases, the manual control knob can be used for open-loop control of the sample temperature.

#### **3. Window defrosting/ Gas-purging**

When optical access is required for a sub-zero temperature experiment, window defrosting must be considered. The LN2-P can be used to provide a constant flow of warm nitrogen gas by routing the LN2-P outlet gas onto the stage/plate/chuck window. In these situations, the stable operating point of the LN2-P may not be high enough to provide sufficient N<sub>2</sub> gas for window defrosting or gas-purging. In such cases, the manual control knob can be used to provide a constant power bias, ensuring a minimum gas flow is achieved. If a constant power bias is applied via the manual control knob, the mK2000 temperature controller will regulate the target sample temperature not by modulating the flow of LN<sub>2</sub>, but by the heater embedded in the temperature-controlled stage/plate/chuck. This will be less efficient in terms of LN<sub>2</sub> consumption but may provide better optical clarity for a given experiment. Try experimenting with different knob settings if window frosting is an issue.

## 2.4 Advanced Features

### 2.4.1 Digital I/O

The LN2-P has two digital communication ports which are used for quality control testing and field debugging. These ports are not utilized during operation in either a standalone configuration or in conjunction with the mK2000 precision temperature controller and may be ignored during normal operation. If new LN2-P firmware is released, Instec may provide instructions to utilize these digital communications ports to perform the update using the InstecApp Software.

### 2.4.2 External Heater Port

The External Heater port on the Gen 11 LN2-P is used to supply heating power to LN2-P accessories, such as the LN2-EXH outlet gas heater. For the standard LN2-P, these ports are not used and can be ignored. If purchased, a supplementary user's manual will be included with these accessories which describe their functionality.

### 2.4.3 General Purpose I/O

The General Purpose I/O port on the Gen 11 LN2-P is used to interface with specialized accessories for the LN2-P system, including the LN2-ARF (automatic refill system). For the standard LN2-P, these ports are not used and can be ignored. If purchased, a supplementary user's manual will be included with these accessories which describe their functionality.

## 2.5 Cooling Tips and Tricks



**Frozen transfer lines:** After completing a low-temperature experiment, please wait until the transfer lines have thawed before disconnecting them from the stage/plate/chuck. Trying to remove frozen transfer lines is very difficult, and could lead to broken tubes.



**Minimizing transfer line length:** To increase cooling response, try shortening the silicone rubber LN2 transfer lines by simply cutting the rubber tubes with a pair of scissors. The shorter the distance the Liquid Nitrogen has to travel, the greater the cooling response will be for the stage/plate/chuck. The transfer lines shipped are intentionally long to allow the greatest flexibility in user setup. Once you get your system installed and functioning, check to see if you can shorten the transfer lines to maximize system performance.



**Dewar positioning:** To increase cooling performance try keeping the Dewar elevated, relative to the stage, as much as possible. The flow of N<sub>2</sub> is Open-loop, meaning the less distance the pump has to lift the N<sub>2</sub>, the more effectively it will operate



**Fill Level:** Due to the effects of gravity, the LN2-P system functions more efficiently and with higher stability when the LN2 Dewar is filled with more LN2. Specifically, the higher the fill level of the Dewar, the better the performance. Consider this during experiments where maximum performance is required, and fill your Dewar often for the best results.

## Section 3. MAINTENANCE AND TROUBLESHOOTING

### 3.1 Regular Maintenance

*Table 2: Periodic Maintenance summary*

Every 3-5 full Dewars	Every 2-3 months	Every 3-5 years
<ul style="list-style-type: none"> <li>• Basic Dewar cleaning</li> <li>• Stage/Plate/Chuck bakeout</li> </ul>	<ul style="list-style-type: none"> <li>• Complete Dewar Cleaning</li> </ul>	<ul style="list-style-type: none"> <li>• LN2 transfer Line Replacement</li> </ul>

#### 3.1.1 Basic Dewar Cleaning

For best results preventing ice formation inside the system, the LN2 Dewar should be cleaned between each use, with a minimum cleaning frequency of every 3-5 experiments. To clean the Dewar, simply wipe the inside surface of the Dewar using a dry microfiber cloth to remove any water or small amounts of dirt. Doing so will keep the system water-free, which will greatly reduce instances of clogging and maximize performance.

#### 3.1.2 Stage/Plate/Chuck Bakeout

Similar to the Dewar, the Stage/Plate/Chuck should receive a “Bakeout” every 3-5 uses with the LN2-P system to achieve the most consistent cooling results. To complete a bakeout, disconnect the LN2 supply line at the stage/plate/chuck cooling port. Then, set the sample temperature above 150 °C, and set the LN2-P power to 100% using the manual control knob on the front panel. The heating of the sample area will free water molecules trapped inside the stage/plate/chuck cooling channels, while the vacuum force from the LN2-P removes the released moisture from the system. Let the system bake out in this manner for about 10 minutes, then stop the controller and pump, and reconnect the LN2 supply line. The system should now be ready for another 3-5 experiments, or another 3-5 Dewars worth of LN2.

#### 3.1.3 Complete Dewar Cleaning

If the Dewar or LN2 has been in use for more than 2-3 months or has been contaminated by another substance dust or dirt, the Dewar should be fully cleaned. To fully clean the Dewar, safely empty it of all remaining liquid nitrogen, rinse the Dewar with warm tap water and quickly the water into a sink to remove any debris that has accumulated inside. Invert over a small empty sink or towel can to collect any leftover water or debris. Once finished, be sure to wipe out the inside of the Dewar using a clean and dry microfiber cloth, and let the Dewar dry for at about 24 hours.



### 3.1.4 LN2 Transfer line replacement

The LN2 transfer lines should be replaced every 3-5 years; more often in systems that are under heavy usage. The line will become stiff and brittle over time, leading to an increased chance of failure. These Silicon rubber transfer lines can be ordered from INTEC, or procured from another manufacturer directly.

## 3.2 Troubleshooting

Symptom	Possible Cause	Potential Solution
LN2-P does not power on (Power switch does not illuminate)	Unit is not powered	Verify power cable is fully inserted and AC outlet is active
	Input fuse is blown	Replace with the included backup fuse
	Internal components have failed	Contact <a href="mailto:Support@INTEC.com">Support@INTEC.com</a> for assistance
Control signal is applied (manual or Remote), but pumps cannot be heard	Poor connection to mK2000	Verify PS2 accessory cable is fully inserted, gently manipulate the cable to check for defective socket or wire insulation
	LN2-P firmware is improperly configured	Contact <a href="mailto:Support@INTEC.com">Support@INTEC.com</a> for assistance
	Internal components have failed	
LN2-P runs, but sample temperature does not decrease	LN2 lines are improperly routed	Double-check LN2 line setup against the setup instructions in section 2.2 of this manual
	LN2 lines are kinked	Straighten all LN2 lines and ensure no bends greater than 90 degrees are present.
	Blockage in LN2 lines restricts flow	Abort the experiment then follow Dewar cleaning and stage/plate/chuck bakeout instructions in section 3.1 of this manual
	LN2-Dewar has insufficient LN2	Refill Dewar using LN2 rated funnel if needed
	Temperature measurement is incorrect	Verify mK2000 controller is correctly configured, and verify sample temperature visually or by touch (Saftey first!)

If you are noticing a drop in sample cooling performance, the most likely cause is a blocked LN2 line.

Tips to clear the blockage in transfer lines:

- Remove the LN2 transfer line from the LN2 inlet port. If the pitch of the pump motor drops then you most likely have a clogged transfer line.
- Remove the Dewar head from the Dewar and place it on a nearby work surface. Connect the transfer line to the Outlet port for a few minutes. This will force warm gas into the



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Web: <http://www.INSTECH.com>

E-mail: [sales@INSTECH.com](mailto:sales@INSTECH.com) // [support@INSTECH.com](mailto:support@INSTECH.com)

transfer line from the pump to the stage/plate/chuck to break up any blockage. Be careful when doing this as any blockage may be discharged from the line rapidly.

- Remove the Dewar lid from the Dewar and check the straw's filter for blockage. Using your fingernail or a flat screwdriver gently scrape the surface of the filter to remove any blockages.
- If the system keeps intermittently developing blockages, there may be condensation inside the Dewar itself. If blockages recur, follow the Dewar cleaning/ bakeout procedures described in section 3.1.