OPERATING INSTRUCTIONS
for the
SQR-1 FILL SEQUENCER SYSTEM

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Safety:

Please use proper handling procedures when working with Liquid Nitrogen. It is an extremely cold refrigerant and can cause serious injury. Also, the liquefied gas can cause asphyxiation in a confined area so be sure that all confined areas have adequate ventilation. For detailed information on the handling of cryogenic liquids, refer to the publication: P12 “Safe Handling of Cryogenic Liquids” available from the Compressed Gas Association Inc., 1235 Jefferson Davis Highway, Arlington, VA 22202.

Introduction:

The Pacer Digital Systems SQR-1 was developed for and optimized to be used with the Taylor-Wharton Kryos Cryogenic Control System. This product provides the capability to sequentially fill 2-16 freezers. Sequential filling conserves LN_2 by directing all freezers to fill after 1 freezer has initiated the fill and the supply line has been cooled. This product also provides the capability to vent LN_2 vapor from the supply line allowing only LN_2 to enter the freezers. This reduces evaporation in each freezer again conserving LN_2.

Hardware Requirements:

- SQR-1 – The fill sequencer can handle from 2 to 16 Kryos controls.
- 2 Cables for each freezer to be connected to the SQR-1.
  - 1 cable from Kryos control to back panel of harness assembly
  - 1 cable from Kryos freezer to the sequencer.
- 24 VAC Wall Transformer for the SQR-1
- 24 VAC Solenoid Valve (for gas bypass)
- LN_2 detector (for gas bypass)
- Tank Switcher (for supply tank switching option)

Installation:

Each freezer that will plug into the SQR-1 requires two cables to be installed. The first cable connects the Kryos control to the wiring harness assembly and the second cable connects the freezer (through the wiring harness assembly) to the SQR-1 Fill Sequencer.

Procedure for internal mounted Kryos controls:

1. Remove the two screws holding the faceplate of the Kryos control to the cabinet.
2. Pull the Kryos faceplate out of the cabinet along with the main control board that is attached with a cable.
3. Remove the aluminum plate from the control to expose the circuit board
4. Observe where the cable enters the metalwork through the strain relief. You will notice that 4 wires connect to the circuit board through a 4-pin Molex connector, 1 wire is connected to a stud on the metalwork by a ring terminal and 3 wires terminate into a white connector that is not connected to anything. Plug the cable labeled “Internal SQR Cable” into this connector. Be sure to route this cable down through the back of the board and replace the aluminum plate.
5. Slide the control back down into its bracket and screw in the faceplate.

6. Run the cable around the tub of the freezer to the back where the electrical panel is located. This may require that the top of the cabinet be removed.
7. Remove the screws holding the electrical panel and pull out slightly so that you can perform the installation. Remove the red plug from the panel. Taking the cable routed from the front, remove the nut from the plug and push the plug through the hole where the red plug was located. Install the nut onto the plug and tighten.
8. Re-install the electrical panel. Also install the cabinet top if necessary.
9. Taking the cable labeled "External SQR-1 Cable" plug one end into the plug just installed on the wiring harness panel and plug the other end into the SQR-1 box into one of the jacks labeled 1 through 16.

Procedure for external mounted Kryos controls (packaged in blue anodized box):

1. Remove the blue plate from the back of the control to expose the circuit board
2. Observe where the cable enters the metalwork through the strain relief. You will notice that 4 wires connect to the circuit board through a 4-pin Molex connector and 3 wires terminate into a white connector that is not connected to anything. Plug the cable labeled "internal SQR" into this connector.
3. Using the supplied wire tie, attach this cable to the spacer used to secure the circuit board. Use the same spacer where the lid switch cable is already attached. Replace the blue anodized plate.
4. Taking the cable labeled "external SQR-1" plug one end into the plug just installed and plug the other end into the SQR-1 box into one of the jacks labeled 1 through 16.

SQR-1 General Operation:

The Pacer Digital SQR-1 was developed to work in coordination with the Kryos control. It manages the fill routines of multiple freezers but still allows each Kryos to retain full functionality and responsibility for the freezer being controlled. The SQR-1 can also manage a gas bypass operation and connects into a liquid supply cylinder switching system.

When multiple freezers are connected to a supply line, it saves LN_2 to fill all freezers in sequence. This efficiency occurs because the supply line only needs to be cooled one time. The SQR-1 fill sequencer manages this filling process by "telling" each freezer when its turn to fill has arrived.

Fill Sequencing:

The freezers are plugged into the SQR-1 in the sequence in which they will be filled (#1 filling first and #16 filling last). Normally the freezer on the end of the line will be filled first while the freezer closest to the LN_2 supply will be filled last. When the freezer is plugged into the SQR-1, the SQR-1 automatically detects this connection and starts monitoring the freezer. As long as the liquid levels on all freezers are within the specified ranges the SQR-1 just monitors the situation. When any one of the freezers calls for a fill, it notifies the SQR-1 that it needs LN_2. The SQR-1 then tells the freezer connected to #1 to begin its fill operation and it tells all other freezers to keep monitoring their levels. While the fill is occurring the SQR-1 indicates this fact by illuminating a green light – "Fill in Progress." A green light is also illuminated directly below the freezer currently being filled. While freezer #1 is filling all buttons on its Kryos control panel are disabled. When freezer #1 is done filling it notifies the SQR-1.

The SQR-1 then unlocks the control panel on freezer #1, locks the Kryos control panel on freezer #2 and then tells it to fill. This occurs until all freezers are filled.

Low level alarms detected by the Kryos always take precedence. If during the filling process, any of the freezers go into a low level alarm, the Kryos on that freezer automatically takes control and initiates a fill.

Once a fill sequence starts, the SQR-1 attempts to fill all freezers beginning with 1 and progressing to 16. If the SQR-1 does not detect a freezer connected to a particular jack it automatically skips the jacks that do not have a connection (i.e. if freezer 4, 5 and 6 have been unplugged from the SQR-1, the fill sequence will go from 3 to 7 automatically.)

A manual fill can be initiated from the SQR-1 by pressing the manual fill button and holding for 10 seconds. This may be used when none of the Kryos are calling for a fill but the user wants to "top off" the freezers.

If the SQR-1 detects a problem a red fault light illuminates and the remote alarm relay is activated. The SQR-1 can detect two problems, a Gas Bypass Sensor problem and a Low LN2 Supply problem (both LN2 Liquid Cylinders are empty). All error conditions that can occur in the freezers are monitored and indicated by the Kryos controls installed on the freezers.

Gas Bypass:

When LN_2 is not flowing in a fill line it will evaporate causing the nitrogen to change state from liquid to gas. When a freezer then calls for a fill, its solenoid is opened allowing this gas to enter the freezer causing greater evaporation and loss of LN_2. To help conserve LN_2, the gas can be purged from the system before the fill operation begins.

The SQR-1 has the capability to manage a gas bypass operation. This operation requires that a fitting with a thermistor (LN_2 detector) be installed at the end of the fill line along with a cryogenic solenoid valve. When one of the freezers calls for a fill, the SQR-1 first looks at the LN_2 detector at the end of the fill line. If it detects gas the solenoid at the end of the fill line will be opened allowing the gas to escape. While this is happening the green light on the panel of the SQR-1 will illuminate showing that "Gas Bypass" is occurring. When the LN_2 detector detects that liquid has reached the end of the fill line the solenoid at the end of the line is closed and then control is sent back to the SQR-1 which proceeds with its fill sequencing.

Note: It is important that the solenoid valve used in the Gas Bypass operation be properly vented. See safety instructions at the beginning of this operations manual for details.

Tank Switcher:

The SQR-1 has the capability to display information provided by the tank switcher. The tank switcher can manage multiple supply cylinders or banks of cylinders. (We suggest

using Taylor-Wharton XL-240 Supply Cylinders with pressure builders). If the primary liquid supply cylinder or bank of cylinders is being used, the green light indicating, "supply tank" will illuminate. If the tank switcher has changed to the backup supply cylinder or bank of cylinders, the green light indicating the "backup tank" will illuminate. A flashing green light, will indicate if the Tank Switcher has determined that the primary or the backup supply is empty. Please see the Tank Switcher Owners Manual for information on resetting the Tank Switcher after changing supply cylinders and for managing multiple supply cylinders and banks of cylinders.

Frequently Asked Questions:

Q: I would like to change the order that the freezers fill, is this possible?
A: Yes, simply make your changes at the SQR-1 panel. The SQR-1 fills the freezers beginning with 1 and progressing to 16.

Q: Some Slave system products "fool" the control to initiate a fill. Does the SQR-1 "fool" the Kryos?
A: No. Because the SQR-1 was developed to work with the Kryos, the integrity of the control system is maintained. There is no need to "cut" into sensors or valves on individual freezers. The Kryos control still monitors the liquid level and the temperature, provides complete control functionality maintains the data logs.

Q: Some Slave system products fill all freezers at the same time. What is the advantage to filling freezers one at a time?
A: The advantage to filling freezers one at a time is that the pressure is maintained meaning faster fills for each freezer. Faster fills conserve LN_2.

Q: Does the SQR-1 work with any other control systems?
A: The SQR-1 works only with the Kryos Control System and the Cryosafe Protector Plus Control System. Because it was designed with these control systems in mind, complete integrity of the control system is maintained.

Q: What happens if the Kryos has temperature control enabled when plugged into the SQR-1?
A: The SQR-1 disables the temperature control function when the control is connected. The reason is that a freezer running with temperature control has a different purpose than that of the SQR-1. Where the SQR-1 is trying to save LN_2, temperature control requires that more LN_2 be used to maintain a temperature profile. If a freezer is running temperature control, it is desirable to connect it to the fill line to utilize the vapor in the line for cooling purposes in the freezer. We suggest these units not be connected to the SQR-1.

Q: How do I start a fill on an individual freezer?
A: When the Kryos control is plugged into the Fill Sequencer, the Fill button is disabled on the faceplate of the Kryos control panel. To fill only that freezer, disconnect the freezer temporarily from the SQR-1 where it plugs into the SQR-1. After a few seconds, the Fill button will appear on the Kryos front panel. Press the Fill button and a fill will start (only on that freezer with no gas bypass). After the fill operation, connect the freezer back into the SQR-1.

Quick Reference Guide:

- ⇒ Instructions are printed on the panel of the SQR-1
- ⇒ A green LED illuminates to indicate which freezer is filling.
- ⇒ A green LED illuminates to indicate if the Gas By-pass valve is open.
- ⇒ A red LED illuminates to indicate if a sensor fault has occurred.
- ⇒ A green LED illuminates to indicate that a fill is in progress.
- ⇒ A green LED illuminates to indicate which supply tank is being used.
  - ⇒ A flashing green LED indicates an empty supply cylinder.
- ⇒ The SQR-1 automatically detects the devices which are connected (freezers, gas by-pass, tank switcher)
- ⇒ Designed and tested to operate with the Kryos controller. Complete functionality of the control system is maintained.

Specifications:

Power Source:
- 24 VAC

Control System Compatibility:
- Taylor-Wharton Kryos Control (No external interface needed)
- Cryosafe Protector Plus Control (No external interface needed)
- Other controls (upon request) through interface box

Alarms:
- Red Fault Light
- Remote Alarm Relay (SPDT, 2 amp)

Dimensions:
- 10” wide x 8” deep x 3.75” high

Weight:
- 2.25 lbs.

Maximum Number of freezers per SQR-1:
- 16 freezers

Fill Trigger:
- Automatic - triggered by a fill from a freezer.
- Manual - triggered by user pressing and holding manual fill button

Options:
- Tank Switcher
- Gas Bypass

Warranty

Pacer Digital Systems, Inc.

Pacer Digital Systems, Inc. warrants that each of its electronic control products will be free from defects in material and workmanship, in the normal service for which the product was manufactured, for a period of two years from the date of purchase. Pacer Digital Systems, Inc. at its option will either repair or replace any item covered under this warranty.

This warranty is void if the product is used for any other purpose than that for which it was designed, including but not limited to connection with third party systems. This warranty is also void if the product is in any way altered or repaired by others. Pacer Digital Systems, Inc. shall not be liable under this warranty, or otherwise, for defects caused by negligence, abuse or misuse of this product, corrosion, fire or the effects of normal wear.

The remedies set forth herein are exclusive. Pacer Digital Systems, Inc. shall not be liable for any indirect or consequential damages including, without limitation, damages relating to lost profits or loss of products, resulting from the delivery, use or failure of the product or for any other cause. By accepting delivery of the product, the purchaser acknowledges that this limitation of remedies is reasonable and enforceable. In no case shall Pacer Digital Systems, Inc.'s liability exceed the purchase price for the product.

Diagram of SQR-1 Fill Sequencer