CRYODRIVE 1.5 kW
CRYODRIVE 3.0 kW

INSTRUCTION MANUAL

	Name	Title	Date	Signature
Prepared By	Arie Shagie	Line Manager	15/12/2004	
Approved By	Givon Cohen-Ayal	Project Manager	16/04/2006	
Approved By	Gill Pasternak	Q/A Manager	20/04/2006	

עין חרוד איחוד, 18960, טלפון: 04-6530800, פקס: 04-6532424
En Harod Ihud 18960, Israel, Phone: 972-4-6530800, Fax 972-4-6532424
E-mail: info@ricor.com, Web site: www.ricor.com

DECLARATION OF CONFORMITY

We, Ricor Cryogenic & Vacuum Systems,
En Harod Ihud,
Israel, 18960.

Declare under our sole responsibility that the product

971B000A	1.5 Kw Cryodrive
976B000A	3.0 Kw Cryodrive

To which this declaration relates, is in conformity with the following standards, or other normative documents.

EN 1012-2	Compressors and vacuum pumps – Safety requirements - Part 2: Vacuum pumps.
EN / IEC 61010-1	Safety requirements for Electrical Equipment for Measurement Control and Laboratory Use
EN 61326	Electrical equipment for measurement, control and laboratory use. EMC requirements.

FOLLOWING THE PROVISIONS OF

73/23/EEC	Low voltage (electrical safety) Directive
89/336/EEC	Machinery Safety Directive

Gill Pasternak

Gill Pasternak Quality Manager Ricor.

9TH MAY 2002 EN HAROD ISRAEL

Date and Place

The product has been manufactured under a quality system registered to ISO 9001

TABLE OF CONTENTS

TABLE OF FIGURES

TABLE OF TABLES

1. INTRODUCTION

1.1. Scope of this manual

This manual provides installation, operation and maintenance instruction for the Ricor Cryodrive 1.5 and 3.0 microprocessor controlled cryogenic compressor system. Read this manual before you attempt to install and operate the Cryodrive.

This manual contains essential safety information that supplements the safety features of the Cryodrive 1.5 and 3.0. Safety procedures are highlighted as WARNING and CAUTION instructions. You must comply with these instructions. The use of WARNING and CAUTION is defined below.

WARNING

Warnings are given where failure to observe the instruction could result in injury or death to person.

CAUTION

Caution are given where failure to observe the instruction could result in damage to the equipment, associates equipment and process.

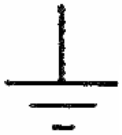
This units used throughout this manual conform to the SI international system of units of measurements.

In accordance with the recommendation of IEC1010, the following symbols appear on the Cryodrive:

Caution! Refer to accompanying documents.

Caution! Risk of electrical shock.

Protective conductor terminal



Earth (ground) terminal

1.2. General Description

The Cryodrive supplies compressed Helium gas, in a closed circuit, for between one and four Ricor coolstar cryopumps. Ricor coolstar cryopumps all contain a Ricor coldhead:

The coldhead is fitted with a stepper-motor. The rotational frequency of the stepper-motor controls the frequency of the coldhead displacer cycle, which in turn, controls the cooling power of the cryopump. The Cryodrive also controls the frequency of the stepper-motor in the coldhead.

The Cryodrive can be used to supply and control Ricor coldheads that are used as independent low-temperature refrigeration source.

The main components of the Cryodrive are the compressor system (described in section 1.5) and the Cryocontroller (described in section 1.6). The Cryodrive has two operation modes (normal and remote) which are described in summary in section 1.2.1 and 1.2.2 respectively.

The Cryodrive has one Helium inlet (from the Cryopump return), one Helium outlet (to the Cryopump supply) and two stepper-motor drive sockets. Up to four Cryopump (or coldheads) can be connected to these facilities with Ricor cables (supplied with the Cryopump), cable splitter and Helium line T-pieces and X-pieces as described in section 3.4.1. The Cryodrive is supplied fully charged with Helium.

1.2.1. Normal Operation

In normal operation, the Cryodrive is factory configured so that after it is switched on, it automatically controls the Cryopumps through a cool-down sequence and then into normal operation. In the cool-down sequence, the coldhead stepper-motor is driven at a higher than normal frequency for a specified time, after which it reverts to the normal frequency of operation. The default configuration is 90 rpm for 60 minute and then 60 rpm.

The parameters that control the stepper-motor frequency and the cool-down time are programmed into the Cryodrive. You may change the factory setup parameters through the PLCCOM.EXE program. See paragraph 4.6. To optimize the operation of your Cryopump installation, you must configure these parameters as described in section 3.3.

1.2.2. Remote Operation

The use of remote operation is optional. This facility is accessed through the PCSP (parallel command and status port) and through the RS232. Connection to these options and remote Operation of the cryodrive is described in section 4.6. In remote operation, you can:

Monitor all of the cryodrive signals.

Control the frequency of the stepper motor.

Control the length of the cooldown period.

Control the operation of the cryodrive (on and off).

When reducing the stepper motor speed this reduces the coldhead power but extends service life. On the other hand when increasing the stepper motor speed this provides extra cooling power at the coldhead when it is required for a high load.

1.3. Cryodrive Safety features

WARNING

Do not adjust Cryodrive pressure relief valve. If you do, you may cause a leak of high pressure Helium from the Cryodrive which could cause injury to people nearby.

The Cryodrive has a number of safety features that are provided to ensure the safe operation of the Cryodrive and Cryopumps connected to it. These safety features are summarized below. The compressor system and the Cryocontroller are described in more detail in section 1.4 and 1.5.

Differential pressure relief valve	Limits the pressure differential between the compressor supply and return to 13.5 bar (196 psig). It allows the Cryodrive to be run with Cryopump(s) disconnected.
Pressure relief valve	This is safety relief valve located on the manifold (see figure 7) which vents to the atmosphere if the Helium supply pressure rises above 30 bar (435.1 psig).
Pressure switch	Shuts down the Cryodrive if the Helium gas pressure at the Cryodrive Helium return falls below a set point.
Temperature monitoring device	Protects the Cryodrive from excessive temperature. Inhibits start (PTAT) up or shuts down the Cryodrive if the temperature exceeds the set points.
Cryodrive protection switch	Protects the compressor motor from excessive electrical supply current. It has an adjustable current limit potentiometer to accommodate allowable supply voltages. When activated, it isolates the Cryodrive from the electrical supply.

Table 1 – Cryodrive safety features summery

1.4. Identification of controls, indicators and connections

Figure 1 shows external front and rear views of the Cryodrive.

The function of the Cryodrive controls, indicators and connections are described below.

The numbered items in brackets are shown in figure 1.

High temperature LED (red) (1)	If the water return temperature is above 33 (±1C), this LED will flash. If the temperature is above 40ºC (±1C), the Cryodrive is shut-down and the LED is continuously lit
Low pressure LED (red) (2)	If the Helium return pressure is less than 6.0 ◊1 bar this LED will flash. If the pressure falls below 4.0 ◊1 bar, the Cryodrive is shut down and the LED is continuously lit.
Cryodrive on LED (green) (3)	After start up check when the Cryodrive is switched on (refer to section 3.9), the Cryodrive will start and this LED is continuously lit.
ON / OFF switch (4)	To use this switch to turn the Cryodrive on and off. In the event of a shut down due to high temperatures or low pressure, use this switch to reset the Cryodrive after you have corrected the fault.
Charge and vent port (5)	¼ inch Aeroquip self-sealing coupling to charge or vent the Cryodrive with Helium.
Elapsed hours counter (6)	Indicates total Cryodrive operating time in hours.
Helium return connection (green) (8)	½ inch Aeroquip self-sealing male coupling for connecting Helium return hose from Cryopump.
Helium supply connection (red) (9)	½ inch Aeroquip self-sealing male coupling for connecting Helium supply hose to Cryopump.
Cooling water inlet connection (12)	½ inch hose connection for cooling water inlet.
Cooling water outlet connection (13)	½ inch hose connection for cooling water outlet.
Pressure gauge (14)	Indicates the helium pressure in the compressor system.

Table 2 – Cryodrive elements description

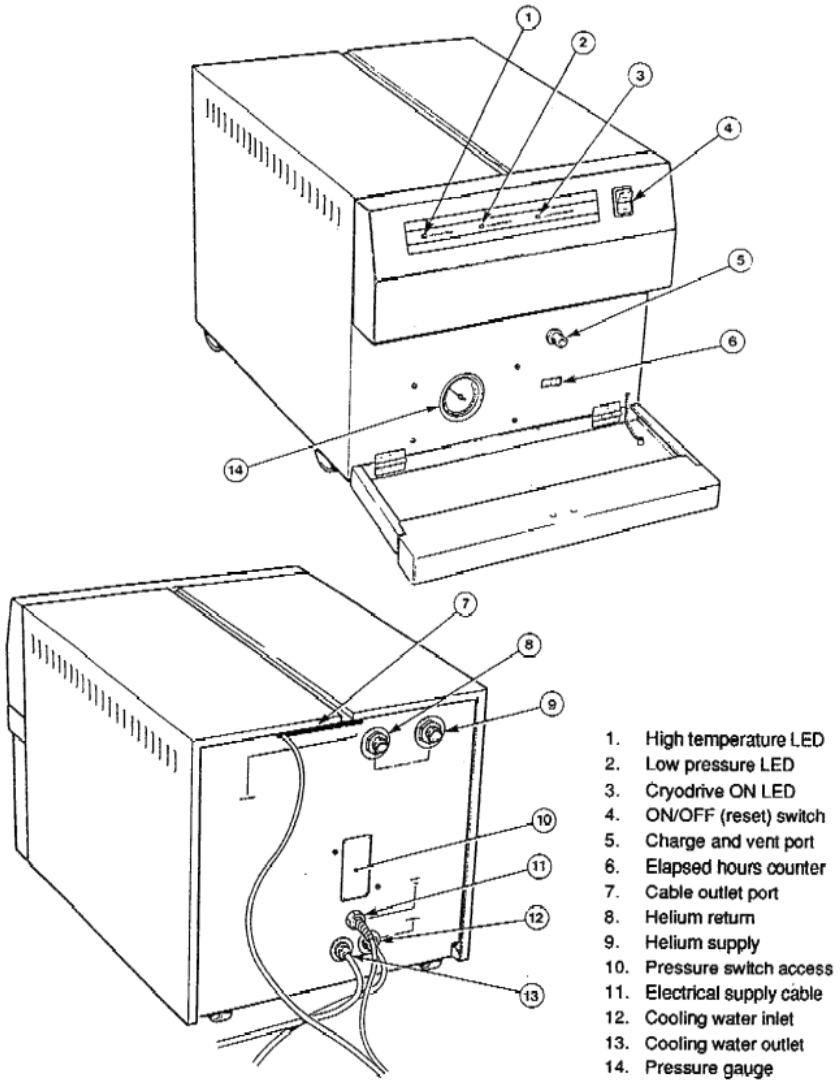


Figure 1 – External Views Of The Cryodrive

1.5. Compressor system:

The compressor system provides a constant supply of clean, compressed Helium to the Cryopump at the correct operating pressure. The gas flow through the compressor system is illustrated in figure 2.

Helium is returned from the Cryopump at low pressure to Helium return connection (17) and enters the oil-lubricated compressor (1). The Helium is compressed to 21 bar (301.3 psig) and then passes through a water- cooled heat exchanger (2) to remove the heat generated during the compression cycle.

Next, the pressurised Helium passes through the coalescer (3), where most of the oil is removed. This oil is periodically returned to the compressor sump through a solenoid valve (5), which is automatically open for 3 seconds every 3 hours, and also through a capillary (6) which is always open. On start up the solenoid valve (5) will stay open for 30 seconds allowing the compressor to warm up at low load. Then it closes and full load (22 bars) is applied.

The Helium then passes through a charcoal adsorber (4), to remove any remaining oil vapor and contaminants. The Helium is then supplied to the Cryopump from the Helium supply connection (16).

A differential pressure-relief valve (7), pre-set to operate at 13.5 bar (196 psig), is connected across the compressor inlet and outlet. This valve limits the differential pressure across the compressor and so allows the Cryodrive to be operated safely with the supply and return hoses disconnected from the Cryopump.

The pressure gauge (13) measures the pressure of the Helium on the compressor supply side. The charge and vent port (8) is used to add helium to the compressor system.

1.6. Controller:

The Controller complex is comprised of four components, the PCB controller, PCB driver#1, PCB driver# 2, and PCB interface.

The microprocessor contains all of the necessary software to run the Cryodrive and the Cryopump(s) connected to it. The software has been configured to offer maximum control flexibility and protection to the equipment.

The software in the controller includes the possibility to reset the factory parameters setup. These parameters, which includes the stepper-motor frequency together with cool-down time have been set to optimize the performance of your equipment. In section 3.3, we describe how to select the correct setup for your equipment installation.

You have two options for remote control. For more information about the connection and how to use the remote control facility please refer to section 4.6. Use one of these options when you want to operate the Cryodrive compressor under remote control or if you want to monitor the Cryodrive signals.

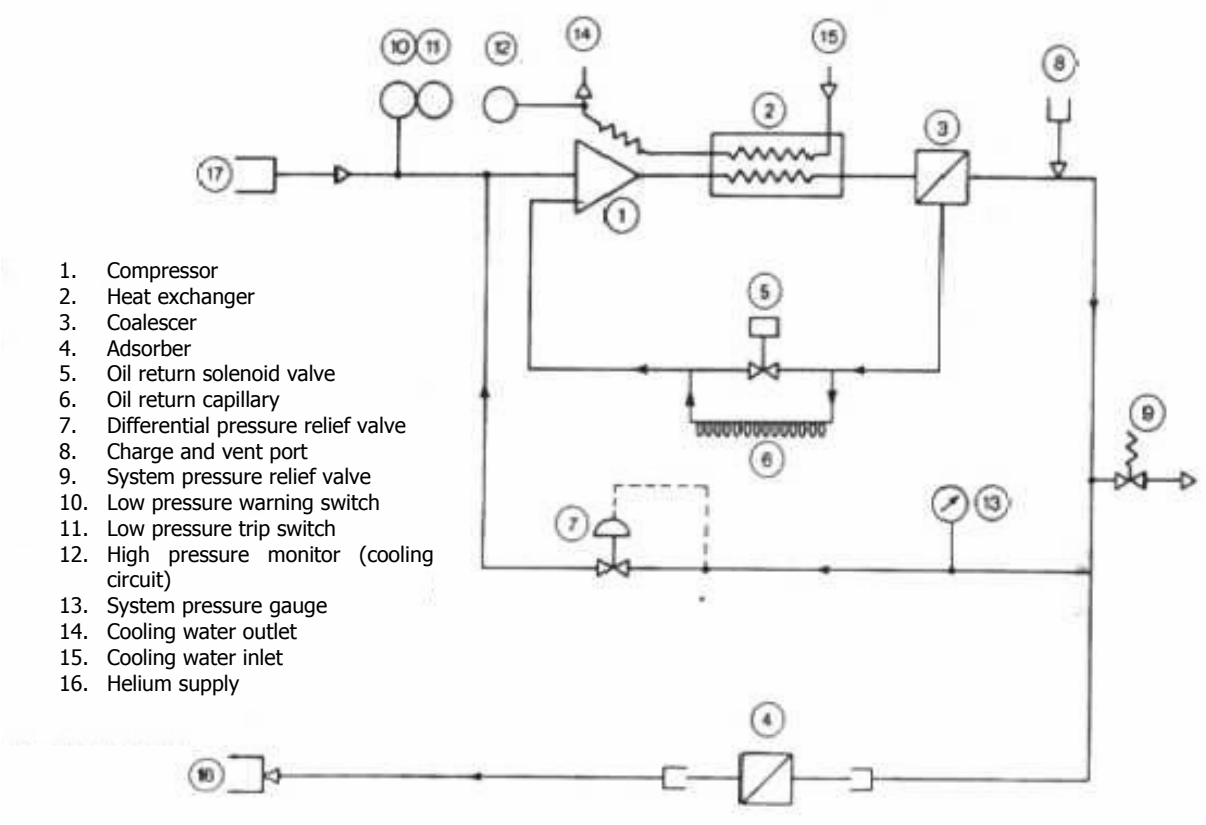


Figure 2 - Helium Flow Diagram

2. TECHNICAL DATA:

Note
The Cryodrive is designed for use indoors

2.1. Operating and storage conditions:

Maximum altitude (operation):	2000 m
Maximum humidity (operation):	80% RH up to 31C, decreasing linearly to 50% RH at 40˚C.
Ambient temperature range (operation):	+**4**ºC to 40ºC
Pollution category (IEC1010):	2

2.2. Performance:

Helium pressure (static):	16.5 +1.0 bar 239.3 + 14.5 psig
Sound pressure level at 1 meter:	less then 75 db A.

2.3. Mechanical Data:

Dimensions:	
Length:	460 mm.
Width:	425 mm.
Height:	375 mm.
Mass (approximate):	77.0 Kg.

2.4. Electrical Data:

Number of phases:	1.
Supply voltage:	200,220 or 240 V at 50 Hz.
(User configurable):	200,208 or 220 V at 60 Hz.
Supply voltage tolerance:	+10 %.
Full loud current:	see Table 1.
<u>Fuses:</u>	
Maximum supply fuse rating:	30A.
Recommended cryocontroller fuse type:	Slowblow.
Maximum cryocontroller fuse rating:	5A.
Over voltage category (IEC664):	2 (local level).

Supply frequency and	50 Hz	60 Hz

voltage		200 V	220 V	240 V	200 V	208 V	220 V
Cryodrive 1.5	Full load (A)	10.4	9.4	8.6	10.6	10.2	10.0
	Rating (KVA)	2.2	2.2	2.2	2.0	2.0	2.0
Cryodrive 3.0	Full load (A)	15.5	14.0	13.0	17.0	16.4	15.5
	Rating (KVA)	3.3	3.3	3.3	3.2	3.2	3.2

Table 3 – Full Load Current Data

2.5. Cooling water requirements:

Note: The required water quality is typical of a United Kingdom mains water supply.

Minimum flow rate:	1.5 l.*min^{-1}.
Maximum flow rate:	7.0 l.*min^{-1}.
Maximum water supply pressure:	101.5 psig.
Minimum water supply temperature (at start –up):	+**4**ºC.
Maximum water discharge temperature:	+33ºC.
Water quality pH range:	6.0 to 8.0.
Maximum calcium carbonate concentration:	75 parts in 10^6.

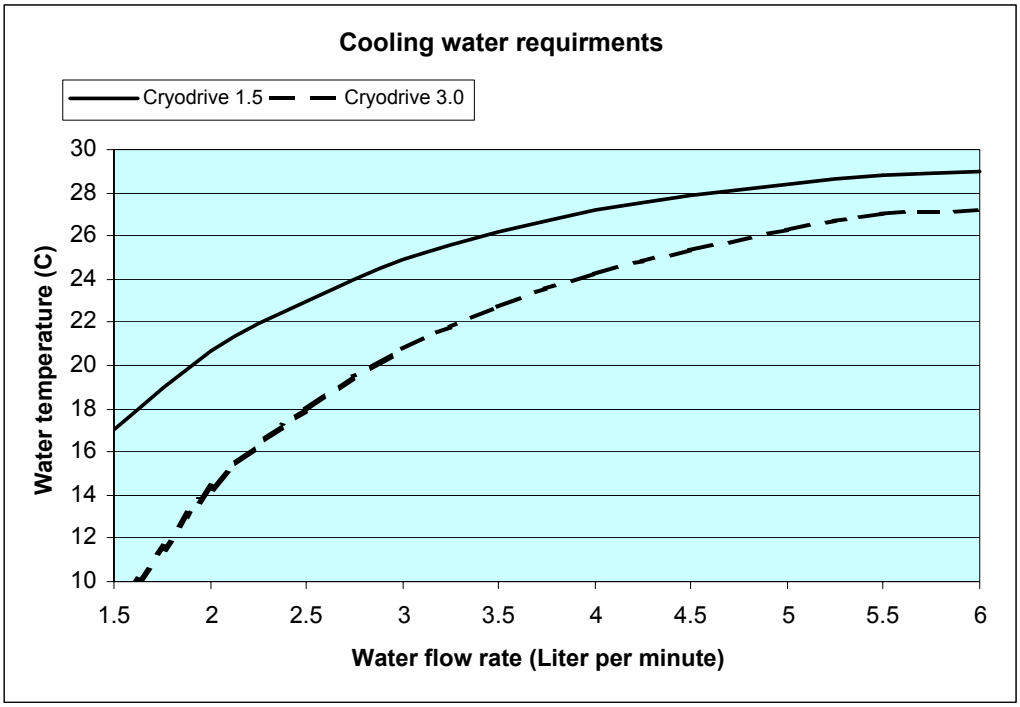


Figure 3a - Cooling Water Requirements

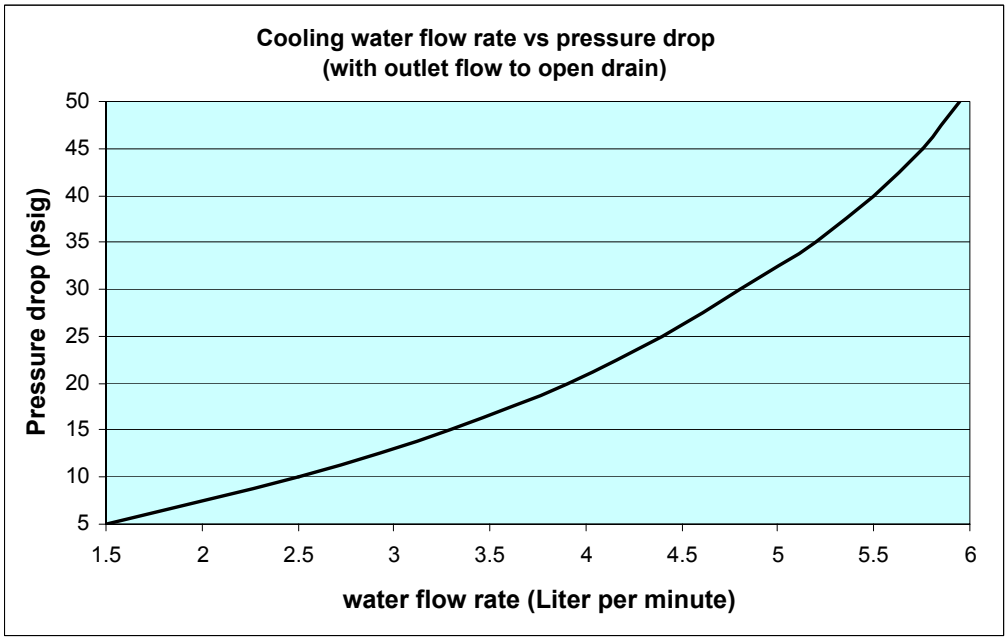


Figure 3b - Cooling Water Flow Rate vs. Pressure Drop (with outlet flow to open drain)

2.6. Construction details

2.6.1. Legislation and standards:

The Cryodrive has been designed in compliance with the following legislation and standards:

European low voltage directive 73/023/EEC.

IEC 61010-1 - Safety Requirements for Electrical Equipment for Measurement Control and Laboratory Use

European Electromagnetic Compatibility-Directive 89/336/EEC.

EN 61326 - Electrical equipment for measurement, control and laboratory use EMC requirements. (1998)

European Machinery Directive 89/392/EEC.

EN 1012-2 - Compressors and vacuum pumps - Safety requirements - Part 2: Vacuum pumps.

2.6.2. Construction materials:

Steels, Copper, Glass fibre, Charcoal, Soft solder, Mineral oil lubricant and miscellaneous electrical components.

3. INSTALLATION:

3.1. Unpack and inspect:

Do not remove the cryodrive from the pallet until you are ready to start installation.

The fitting pack supplied with the cryodrive contains a vent adaptor, a pack of Aeroquip gasket seals and water fittings.

1. Remove all packing materials and inspect the exterior of the Cryodrive.
2. Open the drop –down front panel of the cryodrive and remove the fitting pack supplied.
3. Open the gull –wing doors. Check for any signs of damage.
4. Check that the pressure gauge behind the front panel reads 16.5(±) 1.0 bar (239±14.5 psig). If the pressure is less than 15.5 bar, contact your supplier to report this fact.
5. Close the front panel and the side doors.
6. If the cryodrive is damaged, notify your supplier and the carrier in writing within three days; state item number of your cryodrive together with your order number and your supplier's invoice number. Return all packing materials for inspection .Do not use the Cryodrive.
7. If the Cryodrive is not to be used immediately, replace the packing materials and store the cryodrive in suitable conditions as described in section 6.

3.2. Locate the cryodrive:

CAUTION
Do not pull on the door support rail at the top of the unit to lift the cryodrive. If you do, you may damage the cryodrive frame

The cryodrive can be located on the floor or on a bench, close to the cryopump(s) that it supplies. if you locate the cryodrive on a bench, you must push wedges under the castors to prevent the cryodrive from moving.

Lift the cryodrive from the pallet by hand or with a suitable hoist .if you lift the cryodrive by hand, support the weight from the base of the unit. If you use a hoist, follow the procedure below.

1. Remove the gull–wing doors and disconnect the earth braid from each door.
2. Pass the hoist slings under the base of the cryodrive and use 445-mm long spacers between the straps of the sling above the unit, to prevent damage to internal components.
3. Lift the cryodrive into place, remove the slings and replace the gull-wing doors.

3.3. Cryocontroller configuration:

You must configure the cryodrive to work with your particular system installation. If you change your system installation, you must re-setup your cryodrive for the new installation, you cannot run some combinations of Cryopumps with the cryodrive 1.5.

Use the PLCCOM program (refer to section 4.6) to reset the correct parameters for your system installation. Table 5 shows you which setup you may select. Some coldhead installations are also shown. The cryodrive will not be damaged if you do not select the correct setup but this will result in a less than optimum system performance.

Note: We recommend that you connect your cryopump to drive channel 1 and drive channel 2 as shown in Table 5. For example, if you have a CS400 and a CS800 cryopump, you should connect the CS400 to drive channel 1 and the CS800 to drive channel 2, and so forth.

For full instruction how to setup these parameters refer to section 4.6

Run With	System installation		SETUP PARAMETERS					
			Cooldown frequancy R.P.M.		Cooldown TIME Minute		Normal frequancy R.P.M.	
CRYODRIVE 1.5 or 3.0	DRIVER CHANNEL 1	DRIVER CHANNEL 2	Drive channel 1	2	Drive channel 1	2	Drive channel 1	2
	CS400 CS800		90	90	45	45	60	60
	CS2/9		90	90	25	25	60	60
	CS400 CS400 CS800	CS400 CS800 CS800	85	85	60	60	60	60
CRYODRIVE 3.0 ONLY	CS400+CS400 CS400+CS400 CS400 CS800+CS800	CS400 CS800 CS800+CS800 CS800	90	90	60	60	60	60
	CS400+CS400 CS400+CS400 CS400+CS400 CS400+CS800 CS800+CS800	CS400+CS400 CS800+CS800 CS800+CS800 CS800+CS800 CS800+CS800	90	90	90	90	60	60
	CS1500 CS3500		90	90	60	60	60	60
	CS1500 CS400 CS800	CS1500 CS1500 or CS3500 CS1500 or CS3500	85	85	60	60	60	60
	CS6/30		90	90	25	25	60	60

Table 4 – Parameters Setup recommendation Table

3.4. Connection of the cryopump:

Schematic illustrations of the stepper motor cable and helium hose configurations for connection of between one and four cryopump to the cryodrive are shown in Figure 5 and 6.

3.4.1. Cryopump stepper motor cable connection:

The cryodrive has two drive channel sockets for the connection of the stepper motor cable to your cryopump(s). These sockets are on the back of the controller and are labelled CRYOPUMP 1 and CRYOPUMP 2 (Figure 7, Item 6).

IF you connect more then one cryopump to either of these drive channels, you must use one or more cable splitters that are available as optional accessories from RICOR (see section 7). The cable splitters allow up to two stepper motor cables to be connected to one drive channel socket.

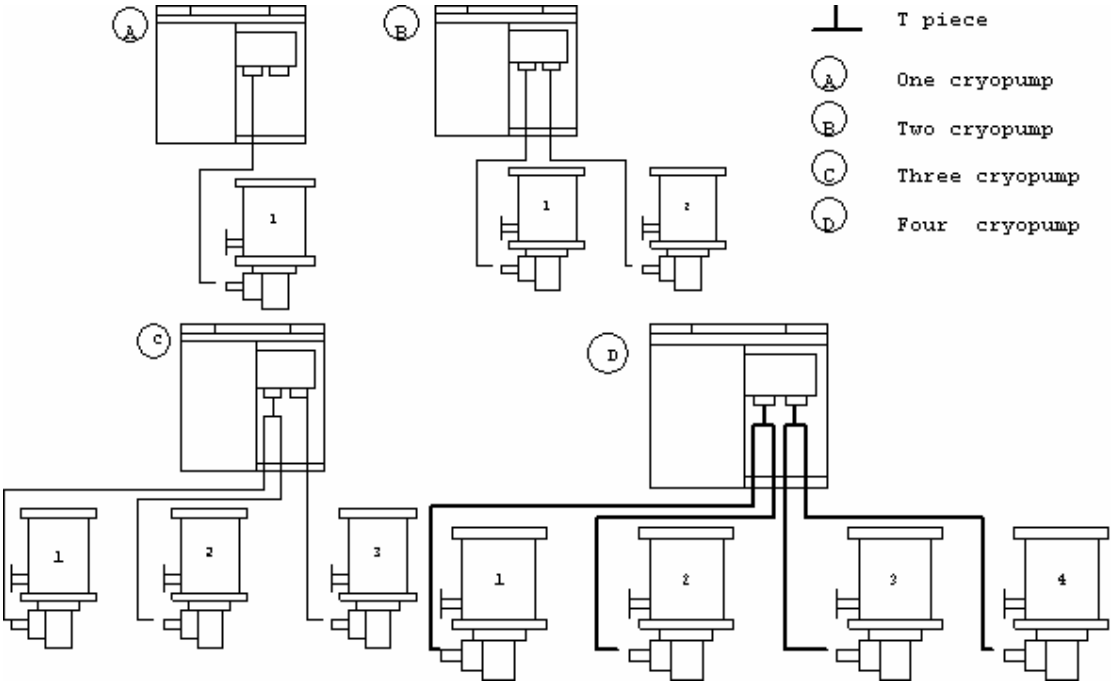


Figure 4 – motor connections to the drive channel sockets on the rear of the cryocontroller

Follow the Procedure Below:

With reference to Table 5, note which of your cryopump(s) must be connected to which of the two drive channels.

Locate the drive channels on the back of the cryocontroller (Figure 7,Item 6).

If necessary, fit cable splitter to socket CRYOPUMP 1.

Connect the correct stepper motor cable(s) to socket CRYOPUMP 1 or to the free ends of the cable splitter, as appropriate.

If necessary, fit cable splitter to socket CRYOPUMP 2.

Connect the correct stepper motor cable (s), to socket CRYOPUMP 2 or to the free ends of the cable splitter, as appropriate.

If you have used cable splitter(s), attach the cable splitter earth connector(s) to the earth stud between sockets CRYOPUMP 1 and CRYOPUMP 2.

For any stepper motor cable not connected through a cable splitter, attach the earth screen connector from the stepper motor cable(s) to the earth stud between sockets CRYOPUMP 1 and CRYOPUMP 2.

Pass the stepper motor cable through the cryodrive cabinet to exit as shown in figure 8. Fit suitable cable ties to the cable where they come out through the cryodrive cable outlet.

Finally, connect the stepper motor cable(s) to the connector on the cryopump(s).

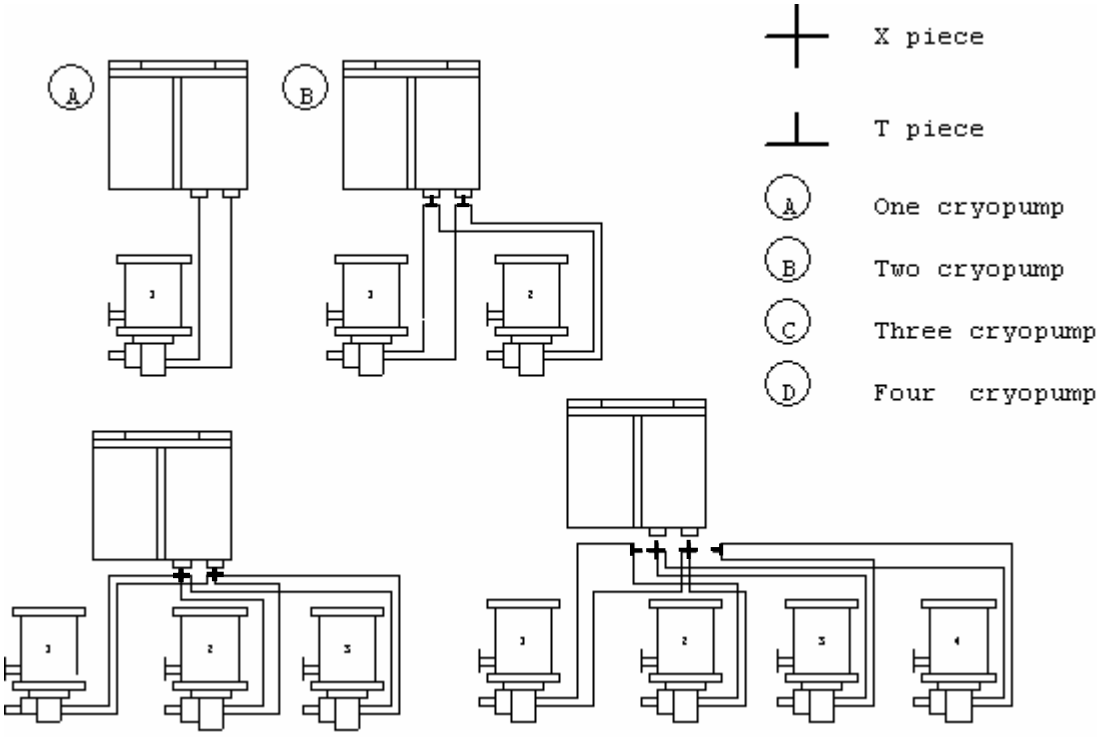
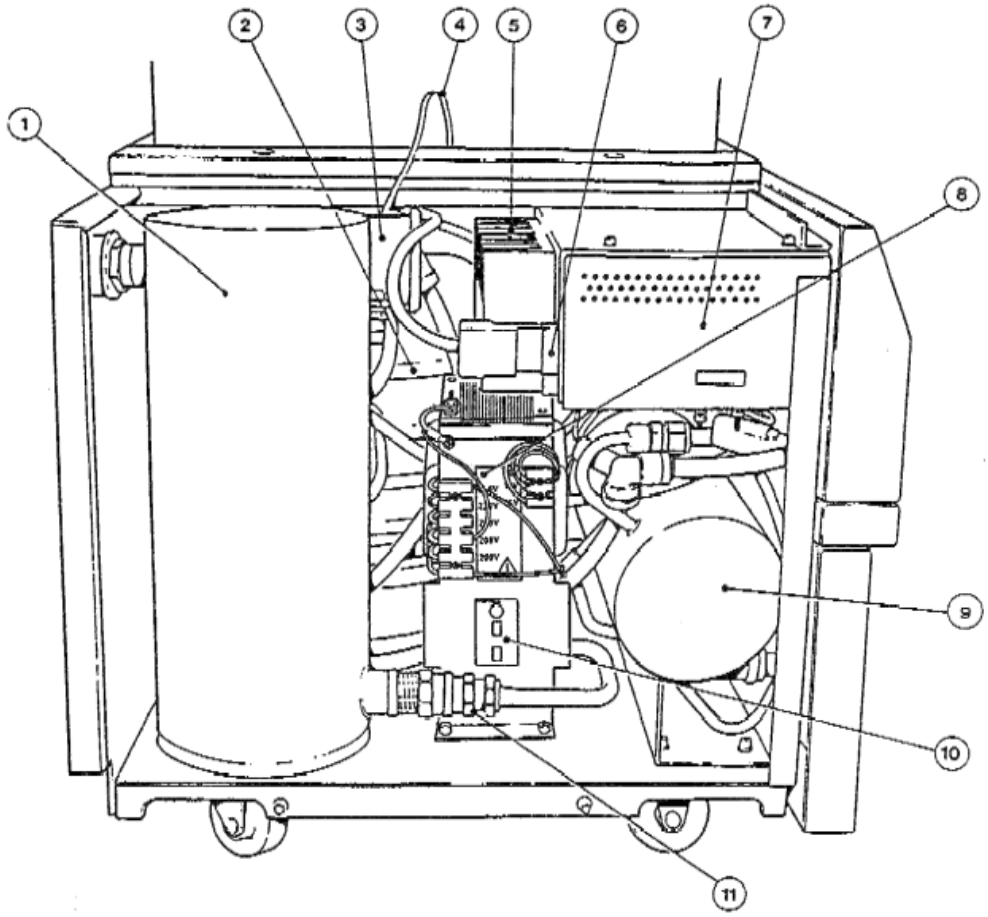
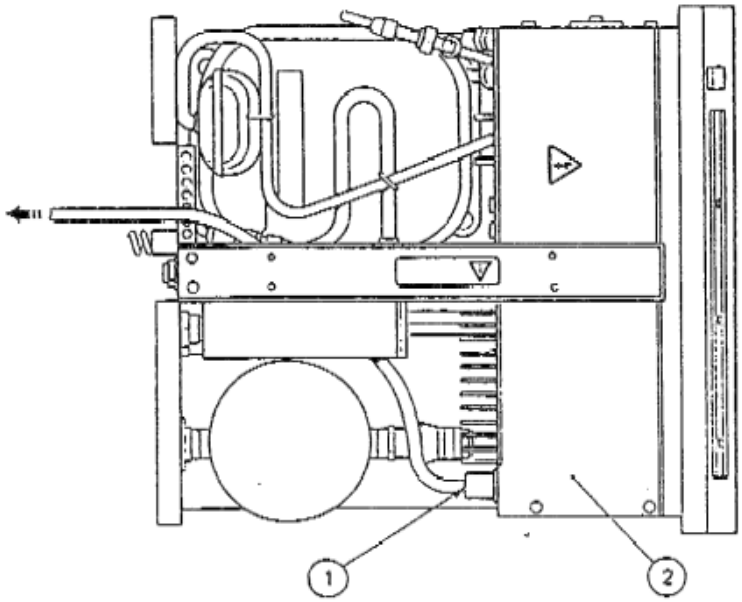


Figure 5 – Helium supply and return hose connections to the rear of the cryodrive



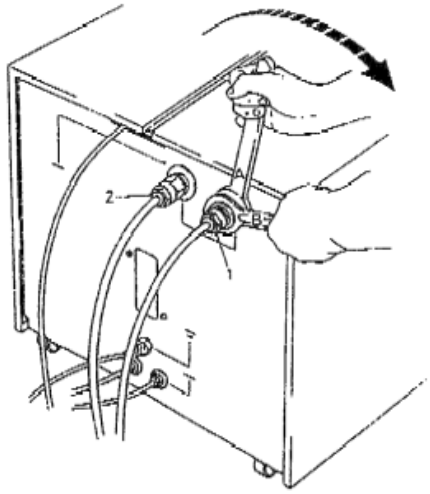
1. Charcoal absorber.
2. Compressor.
3. Manifold.
4. Gull wing door earth strap.
5. Stepper driver heatsink.
6. Drive channel socket (one of two).
7. Cryocontroller.
8. Cryodrive transformer (shown with transformer cover removed).
9. Coalescer.
10. Cryodrive protection switch.
11. Absorber internal Aeroquip connection.

Figure 6 - Internal View of the Cryodrive, With the Transformer Cover Removed



1. Cable plug.
2. Cryocontroller

Figure 7 - stepper Motor Cable Installation



1. Helium supply (red)
2. Helium return (green).

Figure 8 - Connection Of helium Supply and Return Hoses To Cryodrive Using Two Spanners

3.4.2. Helium hose connection:

The cryodrive has one helium supply outlet and one helium return inlet, as shown in figure 9.if you want to connect more then one cryopump to the cryodrive, you must use one or more T –piece and X- piece optional accessories to accept the additional helium house required. The accessories are available from Ricor (refer to figure 6 and section 7).

Figure 6 shows the recommended configuration of the helium hoses and T – and X -pieces, with the T –and X –pieces connected directly to the cryodrive. If necessary, you may fit the T and X –pieces at the cryopump end of the helium hoses: but note that the resulting pressure drop along the helium hoses may result in reduction in cooling power at the cryopump.

Appendix 2 shows the details of the self –sealing couplings and the recommended procedures for connecting and disconnecting the couplings .To prevent damage to the couplings and leakage of the helium, you must use two spanners as described. Complete the fitting as quickly as possible to prevent leakage of the helium from the couplings.

Note that helium hoses and T –and X- pieces are pressurized with helium. When you fit these components, you must follow the safety advice and instructions given in the instruction manual supplied with them. Do not over bend or twist the helium hoses; do not allow damage to occur to the braid on the outside of the hoses.

First, fit any T –and X – pieces that are required to both the helium supply and the helium return connectors, (figure 8):

Check that the connecting surfaces of the couplings are clean

Check that the sealing 'O' ring (figure 17, item 6) is in place.

Connect the coupling halves by hand until you feel resistance.

Refer to figure 9. Rotate spanner A as shown to fully tighten the coupling.

When the connection if fully made, rotate spanner A in the opposite direction for one complete turn to ensure that the sealing 'O' ring is not over compressed .If you over compress the sealing 'O' ring the service life of the fittings will be reduced.

Repeat steps 1 to 4 until all of the necessary T-and X pieces have been connected to the cryodrive.

Next, fit the cryopump helium hoses as described below, use the technique described above to make the connections.

Connect the hose marked with the red band to the helium supply connector (figure 9, Item 1): connect the hose directly to the helium supply connector or to one of the free ends of a T-or X –piece, as appropriate. Connect the other end of the hose to the helium supply connector (marked with a red band) on the cryopump.

Connect the hose marked with the green band to the helium return connector (see figure 9, Item 1): connect the hose directly to the helium return connector or to one of the free ends of a T – or X – piece, as appropriate. Connect the other end of the hose to the helium return connector (marked with a green band) on the cryopump.

Repeat the above procedure to install additional pairs of hoses, as required for your cryopump installation.

3.5. Cooling water connection:

1. Use hose clips to secure suitable water hoses (1/2-inch nominal internal diameter) to the water connection nozzles (supplied in the fitting pack).
2. Connect the supply and return hoses to the cooling water inlet and outlet connectors as marked on the rear of the cryodrive (figure 1, items 12 and 13).
3. Connect the water supply hose to cooling water supply with an adequate flow rate and temperature (see section 2.5).
4. Connect the water return hose to a suitable drain.
5. Turn on the cooling water supply and check that there are no water leaks.

3.6. Electrical supply connection:

We recommend that you use a suitably fused isolator at your electrical supply outlet. Locate the isolator switch close to the electrical outlet. We also recommend that you install back –up fuses at electrical supply outlet: details of suitable fuses are given in section 2.

You must configure the cryodrive to suit your electrical supply. The cryodrive is dispatched configured for use with 240 V and 50 Hz electrical supply (as shown in figure 9) .Use the procedure below to change this configuration.

1. Look at Table 6: find your electrical supply in the left –hand column, look along this row to find the connections you must make for wire 30(W30) and wire 31(W31).
2. Lift the left-hand gull –wing door and locate the transformer (see figure 7. item 8).
3. Undo the M5 screw on the transformer cover and pull the transformer cover forwards to expose the terminals.
4. With reference to Table 6, change the position of wire 30 (W30) and wire 31 (w31) so that they are in the correct position for your electrical supply. Ensure the connections are fully tightened.
5. Replace and secure the transformer cover.
6. Locate the protection switch current –limit potentiometer, which is on the front panel of the protecting switch (figure 7, item 10).
7. Look at Table 7: find your cryodrive type and electrical supply frequency in the left –hand column, look along this row to find the recommended limit for the protection switch current.
8. Use a small screwdriver to adjust the current –limit potentiometer to the recommended value.
9. To identify the new electrical configuration, put the two plastic pegs into the appropriate positions in the transformer cover.
10. Close the gull-door.
11. **Make sure that the cryodrive ON/OFF switch is in the OFF position and connect the cryodrive to your electrical supply**

Electrical supply	Primary tap connection					
	N	200V	208V	220V	230V	240V
50Hz , 200 V	W32	W31	W30	-	-	-
50Hz ,220V	W32	-	W30	W31	-	-
50Hz, 240V	W32	-	W30	-	-	W31
60Hz, 200V	W32	W31	-	-	W30	-
60Hz, 208V	W32	-	W31	-	W30	-
60Hz , 220V	W32	-	-	W31	W30	-
60Hz , 240V	W32				W30	W31

Table 5 – Wire connections to primary tap connections

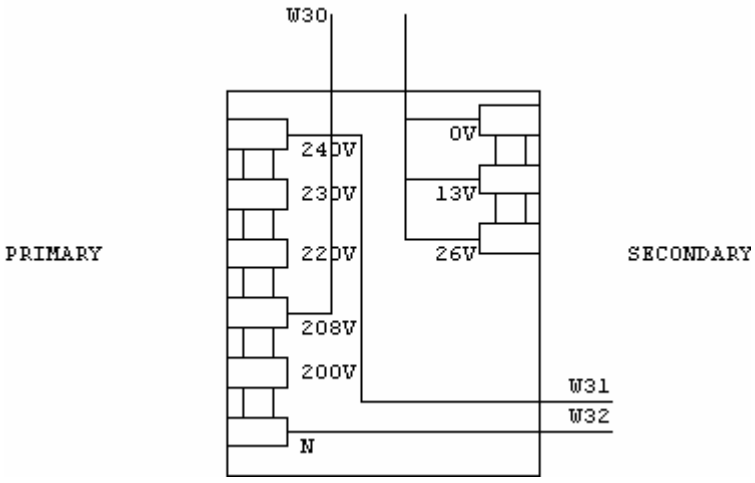


Figure 9 – Transformer Tap Settings (shown configured for 50 Hz, 240V electrical supply)

Cryodrive modol	Electrical supply voltage			
	200V	208V	220V	240V
Cryodrive 1.5,50Hz supply	11A	-	10A	10A
Cryodrive 1.5,60Hz supply	11A	11A	11A	-
Cryodrive 3.0,50 Hz supply	16A	-	16A	16A
Cryodrive 3.0,60 Hz supply	18A	17A	16A	-

Table 6 – Recommended Protection Switch Current Limit Setting

3.7. Installation check-list:

Check that, as minimum, you have completed the following installation procedures. If you have not, you may damage your cryodrive when it is switched on.

Installation check	Reference	Tick box
Check that cryodrive is not damage	3.1	
Check that cryodrive pressure is between 15.5 and 17.5 bar	3.1	
Configure the cryodrive for your electrical supply	3.6	
Set the protection switch current –adjustment	3.6	
Connect your helium hoses and stepper motor cables	3.4.1 & 3.4.2	
Set the controller parameters according to your system installation.	3.3 & 4.6	
Connect the cooling water supply	3.5	

Table 7 – Installation checklist

3.8. Installation test:

Follow the procedure below to test the cryodrive:

1. Take note of the pressure shown by the pressure gauge (Figure 1, item 14) behind the Front drop down door.
2. Switch on electrical supply and put the cryodrive ON/OFF switch to the ON position. Check that the front panel LEDs light in the sequence shown below. The cryodrive is switched on (sequence 8) after the ON has flashed for 3 second (sequence 7).

LED illumination sequence	Hige Temp LED red	Low pressure LED red	Cryodrive ON LED green
1	OFF	OFF	ON
2	ON	OFF	ON
3	ON	ON	ON
4	ON	ON	OFF
5	OFF	ON	OFF
6	OFF	OFF	OFF
7	OFF	OFF	FLASE
8	OFF	OFF	ON

Table 8 – LEDs sequence table

3. After a few seconds, check that the pressure gauge shows about 21 bar.
4. Push the ON/OFF switch to the OFF position. Wait until the pressure gauge shows the pressure noted in step 1.
5. Repeat step 2 and 3 when you are about to start operation.

4. OPERATION:

4.1. Start-up procedure:

Note: When you start the cryodrive, if the water supply temperature is lower then **4**

°C the lubricating oil in the compressor will be very viscous. This may cause the compressor motor current to rise above the protection switch current –limit (see section 3.6) and the protection switch will trip. Re-set the protection switch and re-start the cryodrive as describe in section 4.3 and ensure that the cooling water supply temperature is above **8**°C before you attempt to re –start.

1. Switch on the cooling water supply.
2. Switch the front panel ON /OFF rocker switch to ON.
3. Check that the front panel LEDs illuminate in the sequence described in section 3.8

4.2. Automatic re-start:

1. On initial start–up or, following an interruption of the electrical supply, the compressor will automatically restart with the cryopump(s) in the cooldown sequence, this allows the cryopump(s) to run at high cooling power which gives the best chance of recovery.
2. Due to over heating the Cryodrive will stop it's operating. It will automatically re-start when the temperature has decreased to the normal limits.

4.3. Re-start after the protection switch has tripped:

Follow the procedure below to re- start the cryodrive after the protection switch has tripped.

1. Switch the front panel ON/OFF switch to OFF.
2. Lift the left-hand gull wing door and locate the protection switch (figure 7, Item10).
3. Refer to section 3.7 and Table 7 and check that the protection switch current limit is set correct. Adjust the current limit if necessary.
4. Press the button marked 'I' on the protection switch.
5. Replace the gull wing door.
6. Switch the front panel ON/OFF switch to ON

4.4. Manual shut-down:

To manually close – down the cryodrive, follow the procedure below.

1. Switch the front panel ON /OFF switch to OFF.
2. Turn OFF the cooling water supply.

4.5. *Automatic shut-down:*

If the current drawn by the compressor motor rises above the current –limit of the protection switch, the protection switch will trip and the cryodrive will be closed–down.you must manually re-set the protection switch before you can re-start the cryodrive: follow the procedure in section 4.3.

4.6. *Remote operation:*

The use of remote operation is possible. You have two options for remote operation. One is directly through your PC by using the Cryodrive operation software (Plccom.exe & Plccom.ini). The other option is accessed through the PCSP (Parallel Command and Status Port).

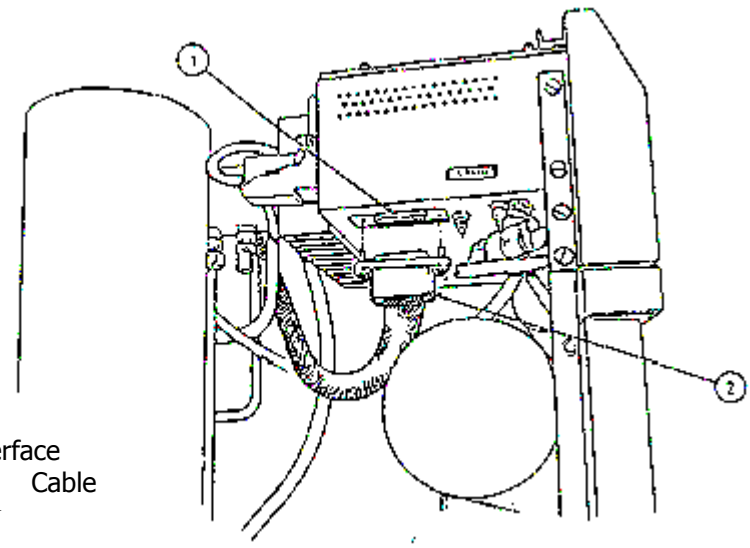
4.6.1. Remote operation using Plccom.exe program:

The required files (Plccom.exe & Plccom.ini) for this option can be obtained from Ricor under the part No. (SFW00012).

4.6.1.1. RS232 Connection:

The RS232 interface is located on the underside of the cryodrive, see figure 10. The RS232 cable should be configured with D9 type connectors as follows:

Cable Configuration		
Cryodrive Side (MALE)	P.C side (FEMALE)	
5	2	Transmit
2	3	Receive
1	5	Earth (ground)



1. PCSP Interface
2. PCSP Cable connector

Figure 10 – RS232 and PCSP Interface

4.6.1.2. Operation:

After connecting your PC to the cryodrive by RS232 cable, start the cryodrive as described in section 4.1. While the cryodrive is running start the Plccom.exe program on your computer. You need to have the PLCComm.exe, PLCComm.ini, WinIo.dll and WinIo.sys files. A window as described in figure 11 would be displayed.

The first time you operate the system you may need to configure it accordance with the port you are using. Normally COM=1 suit laptops and COM=2 suit desktops. To configure the COM port click on the configure button and set the COM number according your connection and click OK.

Activating the program while the cryodrive is at off mode would bring a window without any parameters and a note about NO COMUNICATION would appear. The same note would appear if your COM port configuration is wrong or if you have any communication problem between the controller and your PC.

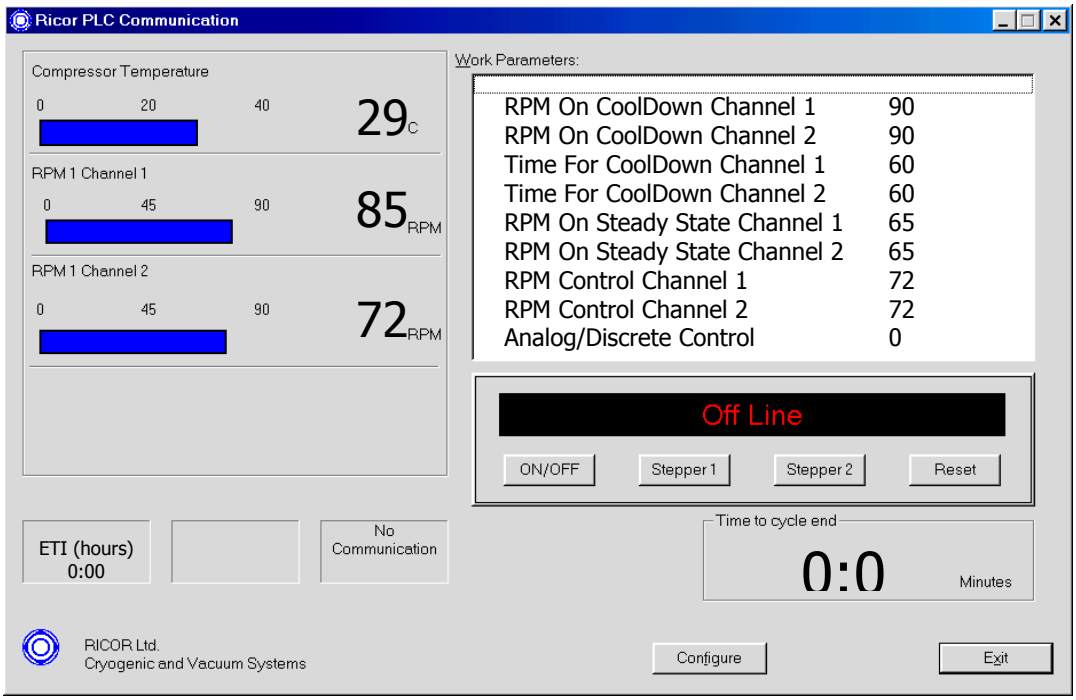


Figure 11 - Plccom program display

[windows E.T.I /Time to cycle end not in use in use application]

Once the program is running and the communication is correct you will be able to monitor the current status of the Cryodrive and to control it.

You may turn the cryodrive on and off as you wish by the On\Off button. Also you may turn on and off each coldhead channel driver. (Buttons Stepper 1 and Stepper 2)

You are able to monitor the cryodrive temperature and Coldhead speed.

You may change the next 9 parameters between the Min\Max as described below.

To change any of these parameters double clicks on the row you desire and enter the

requested number in the window that would display.

1. RPM on cooldown cannel 1. (min 72/max 90).
2. RPM on cooldown cannel 2. (min 72/max 90).
3. Time for cooldown channel 1. (min 01/max 90).
4. Time for cooldown channel 2. (min 01/max 90).
5. RPM on steady state channel 1 (min 40/max 72).
6. RPM on steady state channel 2 (min 40/max 72).
7. RPM Control Channel 1 (min 40/max 90).
8. RPM Control Channel 2 (min 40/max 90).
9. Analog/Discrete Control (1 for Analog 0 for Discrete).

Parameters 1 to 6 define the operating program. If you press the "Reset' button after new set up of these parameters the program will restart with the new parameters.
In order to preserve from now on your new setup as the default operation profile you should tick the "Save this as default" box.

With parameters 7 and 8 you may change the channels speed at real-time.
The new parameter will take place immediately once it has changed.

Parameter 9 defines the PCSP mode of operation. For discrete mode insert "0".
For analog mode insert "1" and tick "Save this as default" box. The new set up will take place only after switching the Cryodrive Off and On.

Now you may disconnect your computer and the RS232 cable. The cryodrive will operate according to the new set up unless you will change it again.

4.6.2. Remote operation with PCSP (Parallel Command and Status Port):

This facility is accessed through the D15 Type port which is located on the underside of the cryodrive, see figure 10. This option provides you the capability to control the system by designing your own device. Technical data and interface are given below.
Two control modes are possible (only one at a time), discrete mode and analog mode.
For discrete mode insert "0" on parameter 9 at the PLCcom software display.
For analog mode insert "1". After each change between discrete and analog the Cryodrive must be turn off and on by the rocker switch.
Choosing analog mode will eliminate the boost and stand by commands. When operating on analog mode stand by switches (If located) should be at Open position.

4.6.2.1. Connection:

The functions of the PSCP pins are shown in table 10. Note that Pin No. 6 is 0 V common for logic and analog input and pin No. 7 is 5 V for analog signal.

Switching both CH1 and CH2 to "Close" position activates Cryodrive Off.
Switching any channel to "Open" (CH1 or CH2 - Pins 4 or 8), activates Cryodrive On.

Pins 1 and 9 are for stand by operation at discrete mode.
At analog mode these pins change their functionality to analog input.

Canceling the Cooldown sequence is achieved by activating boost switch of any channel twice (Open and Close) or by opening stand by switch. This is possible only at discrete mode.

PCSP Pin. No. (D15 Connector.)	FUNCTION
1	Channel 2 stand by/analog
2	Channel 1 boost on/off
3	Channel 2 boost on/off
4	Channel 2 on/off (Cryodrive on/off)
5	12 V Signal
6	0 V Common
7	5 V Signal
8	Channel 1 on/off (Cryodrive on/off)
9	Channel 1 stand by/analog
10	Channel 2 boost Led signal
11	Not in use.
12	Low pressure warning/trip Led signal
13	Cryodrive On/Off LED signal
14	Channel 1 boost Led signal
15	High Temperature warning/trip Led signal

Table 9 – PCSP interface pin function.

4.6.2.2. Recommended remote operation circuit:

Figure 12 shows a suitable circuit to monitor the Cryodrive status.

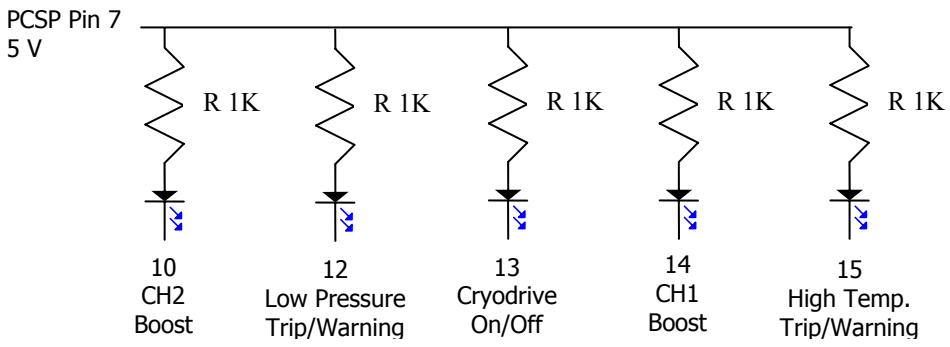


Figure 12 - PCSP monitoring function LED indicators.

Figure 13 shows a suitable circuit to access the logic inputs. The figure shoes the required set up for normal start up. The functions shown in the figure are activated when the corresponding switch is open. For example, if you open the switch between pins 3 and 6 this will activate the boost speed (90-RPM) of channel 2. If you close this switch channel 2 speed will return to the default setup.

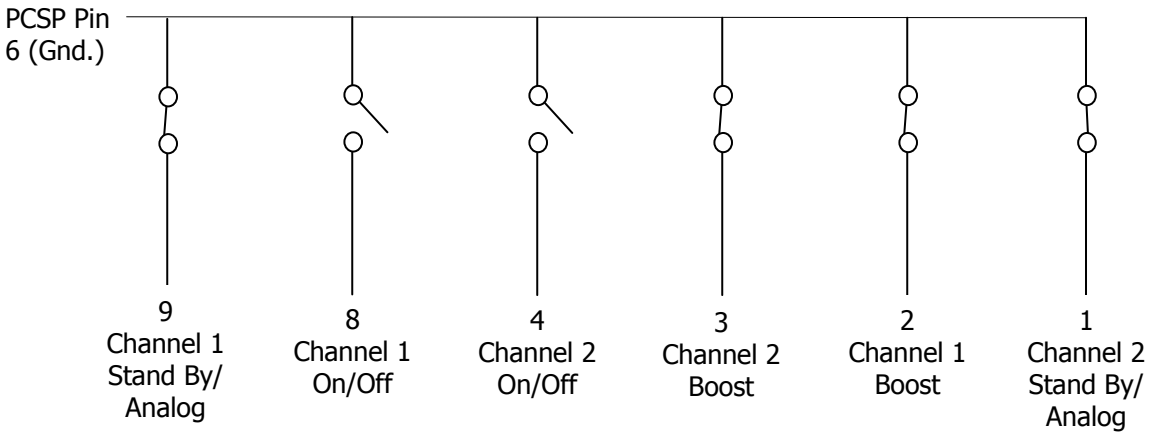


Figure 13 - PCSP Control function switches.

Figure 13.1 shows a suitable circuit to access the analog inputs. Use these inputs if you want to control the stepper motor frequency signal to the drive channels.
The stepper motor frequency varies linearly with input voltage. 0 V DC equivalent to 40 rpm and 2.5 V DC equivalent to 90 rpm.
Do not operate your Cryopump at above 72 rpm for longer you need, because you will increase the wear on the seals in the coldhead, which will reduce the service life of the cryopump.

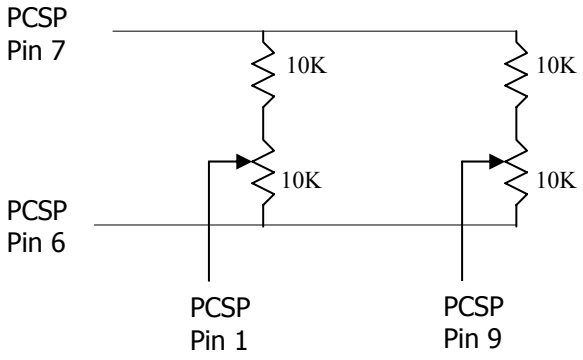


Figure 13.1 - PCSP Variable speed control potentiometers.

MAINTENANCE:

To maintain the cryodrive in normal use, you must replace the adsorber after the adsorber has been used for 15000 hours; this operation is described in section 5.2.you do not have to clean the cryodrive to maintain system performance or safety. Section 5.3 describes the procedure you must follow to re-charge the cryodrive with helium. Section 5.4 describes tests that you can perform on the cryodrive if a fault occurs. A fault-finding guide is given in section 5.5.

4.7. Precautions:

WARNING

Obey the safety instructions given below and take note of appropriate precautions. If you do not, you can cause injury to persons and damage to equipment

1. A suitably trained and supervised technician must perform maintenance work.
2. Wear the appropriate safety – clothing.
3. Check that all the required parts are available and of the correct type before starting work.
4. Isolate the cryodrive from the electrical supply so that it cannot be operated accidentally; if possible, remove the fuse from your electrical supply current and lock the isolator switches to the OFF position.
5. Leak-test the system after maintenance works are complete; seal any leaks found.

4.8. Replace the adsorber:

WARNING

Do not bend over the internal pipework when you fit and remove the adsorber. After removal, the old adsorber must be safely depressurized before disposal the replacement adsorber will be charged with helium 16.5 bar. Always vent gas safely, directed away from personnel

When the cryodrive has been operated for 15000 hours, you must replace the adsorber with a new adsorber which you can buy from your supplier or from Ricor company. The new adsorber is supplied pressurised with helium, so you should not have to re-charge the cryodrive with helium after you fit the new adsorber. A depressurization adapter is supplied with the new adsorber.

When necessary, refer to Appendix 2 for details of how to connect and disconnect the self-Sealing Aeroquip coupling used for the adsorber in the cryodrive.

1. Switch the cryodrive ON/OFF switch to OFF, isolate the cryodrive from the electrical supply.
2. Looking from the front of the cryodrive, unclip the left –hand gull –wing door by pulling the door away from the cryodrive to clear the location pins and lift the door clear of the cryodrive. Lay the door on the remaining right –hand door to avoid straining the earth strap.
3. Disconnect the helium supply hose (colored red), at the cryodrive rear panel.
4. Disconnect the Aeroquip coupling from the adsorber inlet.
5. Unscrew and remove the adsorber rear panel locking nut and washer. Remove the single screw retaining the adsorber inlet connection clamp plate. Lift the adsorber out of its locating hole and remove the adsorber. Remove the locking nut and clamp plate from the adsorber inlet connection. Retain the clamp plate and screw, locking nut, washer and star washer.
6. Depressurise the old adsorber by connecting the depressurisation adaptor to the adsorber helium inlet and outlet coupling and tighten slowly by hand.
7. Remove the dust from the inlet and discharge self –sealing couplings of the new adsorber. Fit the adsorber clamp plate and locking nut to the adsorber Aeroquip inlet connection.
8. Install the new adsorber in position in the compressor unit and ensure that the locating pin is correctly engaged. Secure the new adsorber in place using the nut and washers, and adsorber clamp plate screw retained in step 5.
9. Re-connect the helium supply hose. Re –connect the internal Aeroquip on the adsorber inlet.
10. Refit the gull wing door.
11. Check that the pressure gauge reads 16.5☛1.0 bar (239.31☛14.5 psig). If the gauge reads below 15.5 bar, add helium gas following the procedure detailed in section 5.3.
12. Note the data the new adsorber is fitted and record in the operating log. Also record the hours run from the compressor hours counter.

4.9. Re-charging the cryodrive with Helium

CAUTION
Ensure that the interconnecting pipework is capable of safely withstanding the maximum regulator delivery pressure

WARNING

When you vent helium from the charge and vent adapter during the purging procedure, ensure that the vented gas is directed safely away from personnel

CAUTION

You must re-charge the cryodrive with 99.999% Helium. If you do not, you will contaminate the cryopump with impurities that will reduce its efficiency

Recharge the cryodrive with helium if the helium presser (indicated on the pressure gauge) falls to below 15.5 static.

If you need to recharge the cryodrive frequently (for example, every 6 months or more often), there is probably a leak in your installation, use a helium leak detector or other suitable method to find the leaks.

For convenience, use the Ricor adapter (see section 7) to re-charge the cryodrive. Alternatively, you must have a valved manifold that can be used to purge the charging hose of air and which terminates in ¼ inch Aeroquip female coupling.

1. Pressure regulator
2. Compressor unit
3. Charge and vent adapter
4. Charge and vent port
5. Charging house
6. Helium cylinder (99.995% purity)

V1. Depressurization valve
V2. Evacuation valve
V3. Helium charge valve

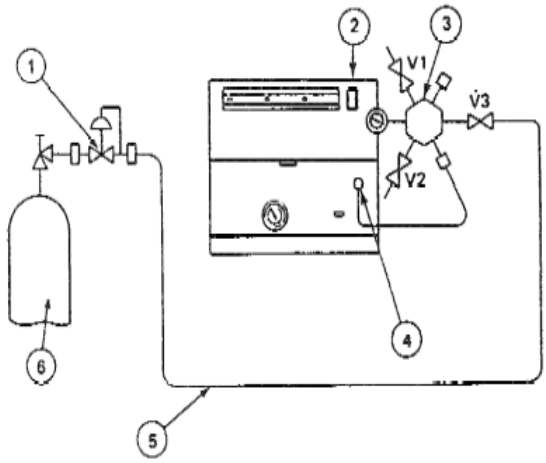


Figure 14 - Adding Helium Gas (schematic)

Figure 14 illustrates the method of adding.gas. Follow the procedure below:

1. Switch off the cryodrive.
2. Connect a regulator capable of providing 17 bar minimum delivery pressure to a helium-supply cylinder. Do not allow the maximum supply pressure of the regulator to exceed 37 bar (537 psig).
3. Connect suitable charging house from the regulator outlet the 7/16 inch UNF 20TPI male flare fitting V3 of the charge and vent adapter.
4. Ensure that all valves V1V2 and V3 on the charge and vent adapter are shut.

5. With the regulator adjusted for zero pressure, open the cylinder valve.
6. Adjust the regulator for 2 or 3 bar delivery pressure.
7. Open the charge and vent adapter valves V1 and V3 briefly to purge the charging hose of air, then close V1.
8. Increase the regulator delivery pressure until the adaptor pressure gauge reads 16.5 bar.
9. Close the charge valve V3 and slowly open the depressurisation valve V1 vent the adapter pressure to 2 bar minimum. Close V1.
10. Open the charge valve V3 until the adapter pressure gauge read 16.5 bar.
11. Repeat steps 8 and 9 a further five times to fully purge the charge and vent adapter.
12. Close V3 and connect the adapter to the compressor charge and vent port located behind the drop down front panel of the compressor.
13. Slowly open the charge valve V3 until the compressor system pressure gauge indicates 16.5◊ 1.0 bar (240◊ 14.5 psig) if necessary, re-adjust the pressure regulator to achieve this. Close V3.
14. Finally, remove the adapter from the compressor charge and vent port, set the regulator delivery pressure to zero and close the cylinder valve. Slowly open valve V1 to vent the charge and vent adapter.

4.10. Cryodrive fault-finding schedule:

Symptom	Possible	Action
Cryodrive fails to start when switch on. Cryodrive on LED dose not flash or light. Or Cryodrive starts when switched on but stops after several minutes operation. ` Cryodrive on ` LED goes out.	Cryodrive protection switch is tripping on over load. Returns to OFF position. Electrical supply fuses or circuit breakers in electrical supply outlet are tripping.	Isolate electrical supply to cryodrive. Check transformer tap connection, see Table 6. Check protection switch overload setting and reset protection see Table 7. Check cooling water is not too cold .increase water temperature to above **4**◊C (40◊F) Check electrical supply voltage. Overload devices in supply outlet should be as detailed in section 3.6.
Cryodrive fails to start when switched on. 'cryodrive on' LED flashes and then is continuously lit.	A Cryodrive fuse has blown.	Isolate electrical supply. Check and replace fuse 5A. Check electrical supply voltage, adjust cryocontroller transformer taps to match electrical supply voltage, as described in section 3.6.

Cryodrive fails on start when switch on. 'Cryodrive on ' LED flashes then goes out. or Cryodrive start when switch on but stops after several minutes operation. 'Cryodrive on ' LED goes out.	Compressor has over – heated. High temperature LED is lit. Cryodrive low on helium .low pressure LED is lit. Compressor is below **4**☜C. high temperature LED is lit.	Turn off cryodrive using ON/OFF. Check cooling waters and allow cryodrive time to cool. Re-start cryodrive. Turn off cryodrive using ON/OFF check helium pressure is 16.5 ☟1.0 bar. Re-fill if necessary. Restart cryodrive. Ensure that cooling water colder then **4**☜C is not circulated while the cryodrive is shout down .if this occurs, shut off water and allow the cryodrive to warm up to ambient temperature, restart cryodrive then turn on cooling water supply immediately.
Cryopump not operational	A cryocontroller fuse has blown. Cryopump cables not connected. Cryopump motor is defective	Isolate electrical supply, check and replace fuse with 5A. Check cables are correctly connected. Activate cryodrive from Plccom Check motor pin resistances. Should be : A-B nominally C-D nominally If the motor is defective, connected your or supplier.

Table 10- Cryodrive Fault –Finding Schedule

5. STORAGE AND DISPOSAL:

5.1. Storage:

Follow the procedure below to store the cryodrive.

1. Shut – down the cryodrive as described in section 4 and disconnect all services and connection to cryopump.
2. Ensure the cooling water circuit is completely drained of water. Residual water can be blown out using a compressed air line into either the supply or return connection at the rear of the cryodrive.
3. Store the cryodrive in cool, dry conditions until required for use. When required, prepare and install the cryodrive as described in section 3.

5.2. Disposal:

The cryodrive, adsorber and helium gas are at high pressure. The cryodrive must be de-pressurised before disposal.

To de-pressurize, you must use the charge and vent adapter (see section 7) or the depressurisation adapter supplied with replacement adsorber to vent the helium gas. When you vent helium ensure that the vented gas is directed safely away from personnel.

The cryodrive is constructed steels, copper, glass fiber, charcoal, soft solder, mineral oil lubricant and miscellaneous electrical components.

Dispose of the cryodrive and any components in a safe manner in accordance with all local and national safety and environmental requirements.

6. ELECTRICAL CIRCUIT DIAGRAMS:

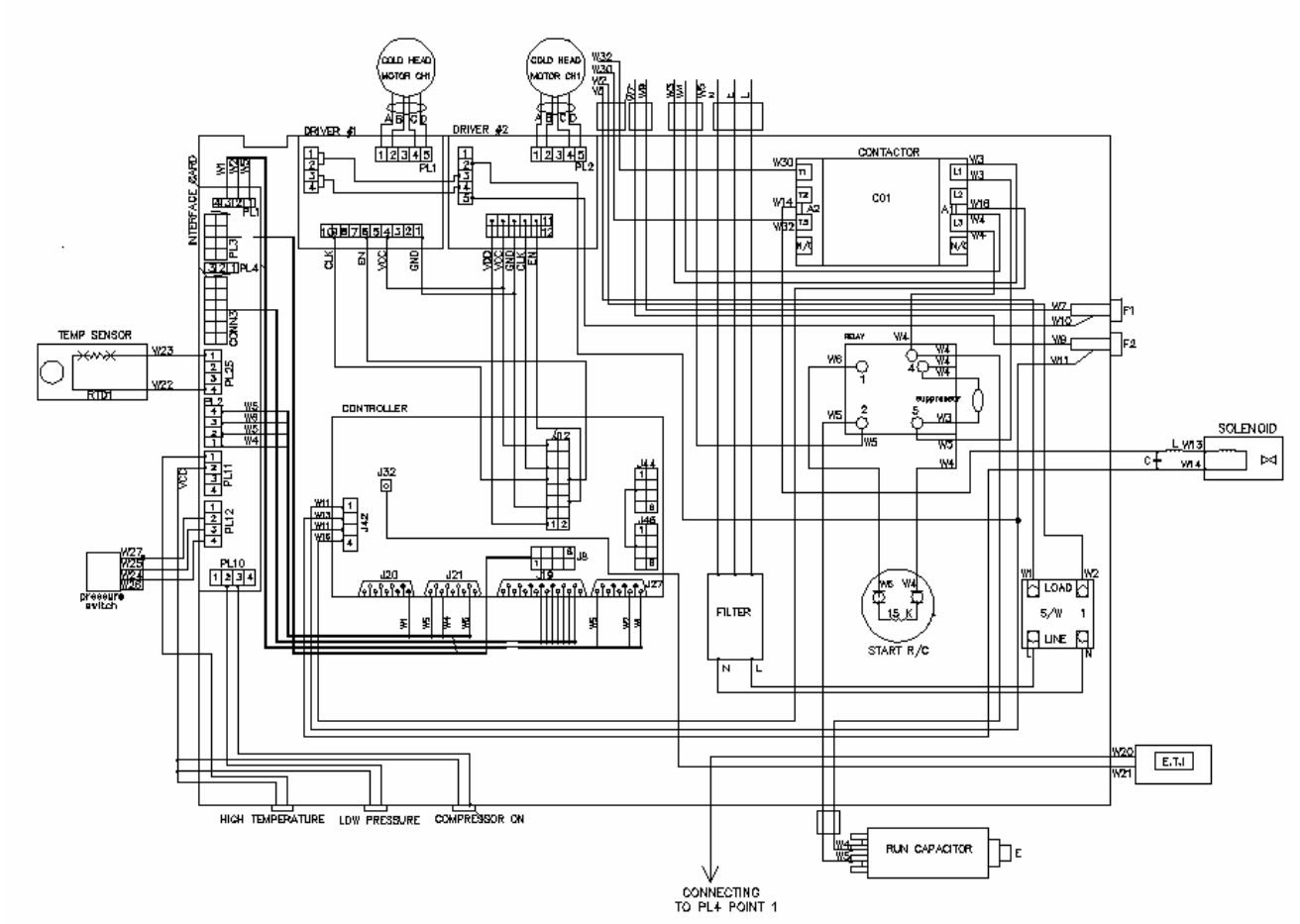


Figure 15 - Cryocontroller PCB block diagram

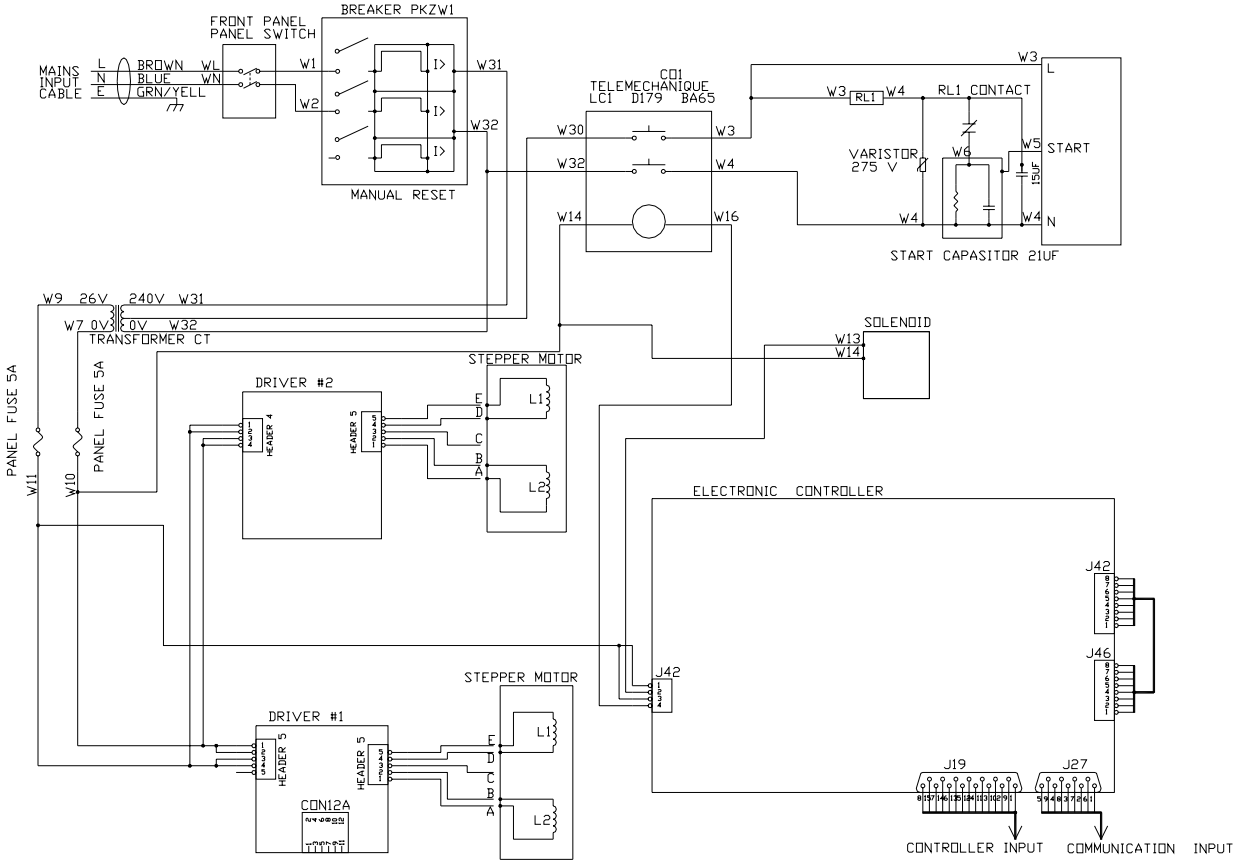


Figure 16 - Cryocontroller electrical control circuit.

7. APPENDIX 1: CRYOPUMP CONFIGURATION EXAMPLES:

The following examples show you how to configure the Cryocontroller for some examples of Cryopump installation.

7.1. Example 1: Cryodrive 1.5 with Coolstar 800 Cryopump:

Refer to table 5 in section 3.3; It is better to select setup parameters 90, 45 & 60 for this combination of equipment.

Connect your PC to the RS232 as described in section 4.6.1.

Run the Plccom program.

Double click on line number 3 (Time for cooldown channel 1) and change the time into 45 minutes.

Tick the box for save as default and click OK.

You may disconnect your PC from the cryodrive.

From now on once your cryodrive would start the stepper motor on channel 1 would run on 90 RPM for 45 minutes and then it would turn to 60 RPM.

7.2. Example 2: Cryodrive 3.0 with Coolstar 400 and a Coolstar 1500:

Refer to table 5 in section 3.3. It is better to select setup parameters 85, 60 & 60 for this combination of equipment.

Connect your PC to the RS232 as described in section 4.6.1.

Run the Plccom program.

On line number 1 (RPM on steady state channel 1) set the RPM into 60 minutes.
On line number 2 (RPM on steady state channel 2) set the RPM into 60 minutes.
On line number 3 (Time for cooldown channel 1) set the time into 60 minutes.
On line number 4 (Time for cooldown channel 2) set the time into 60 minutes.
On line number 5 (RPM on cooldown channel 1) set the RPM into 85 minutes.
On line number 6 (RPM on cooldown channel 2) set the RPM into 85 minutes.

Tick the box for save as default and click OK.

You may disconnect your PC from the cryodrive.

From now on once your cryodrive would start the stepper motor on channel 1 and 2 would run on 85 RPM for 60 minutes and then it would turn to 60 RPM.

8. HOW TO CONNECT AND DISCONNECT A SELF-SEALING COUPLING:

You must use two spanners for this operation to avoid leakage and damage to the coupling and pipework. A small amount of gas may leak from the coupling whilst it is being disconnected; complete the procedure quickly to prevent excessive gas loss.

8.1. Disconnect:

1. Take the two spanners and place them on the female self-sealing coupling as shown in figure 16.
2. Hold spanner 'B' (25.4 mm, 1 inch AF) stationary and turn spanner 'A' (30 mm, 13/16-inch AF) to unscrew the two halves on the coupling. Whilst disconnecting ensure male ensure that the mating coupling male half does not rotate. If rotation occurs, stop immediately and tighten the male half of the coupling before proceeding; if you do not, serious Helium gas loss may occur

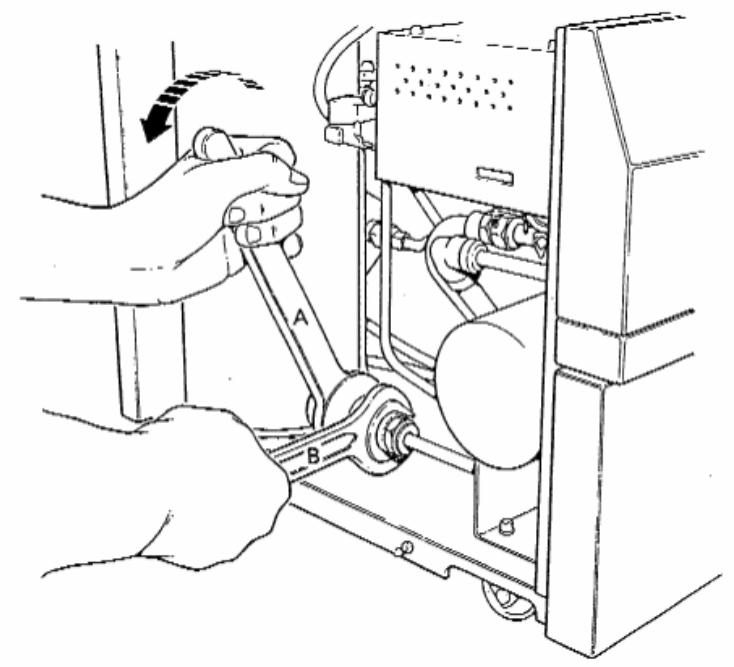


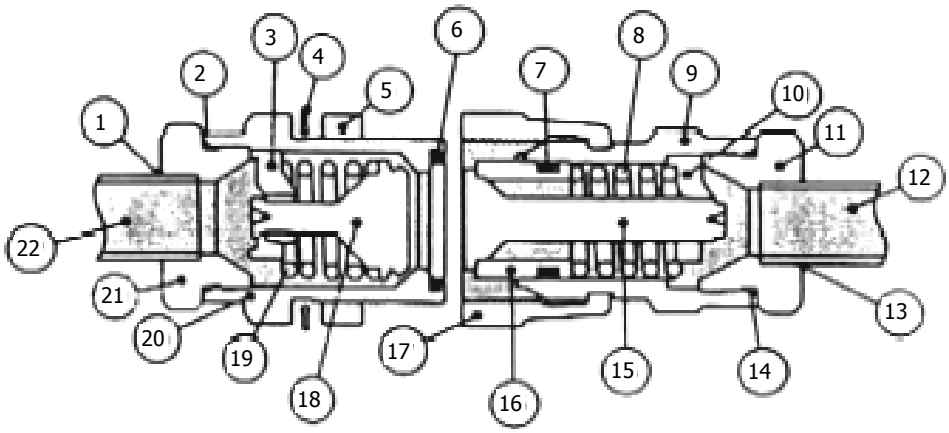
Figure 17 – Disconnecting a Self –Sealing Coupling

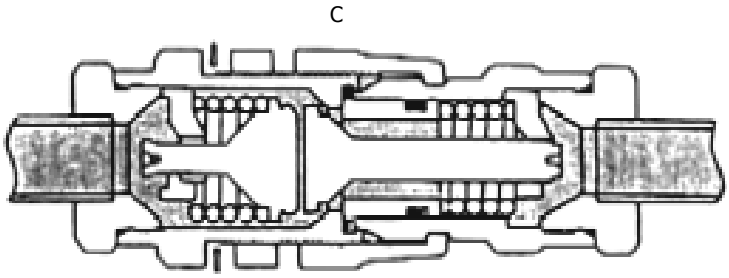
8.2. Connect:

Check that the internal surfaces of two halves of the coupling are clean and that the Rubber gasket is in place, refer to Figure 17 for details of the coupling.

1. Connect the coupling halves by hand until resistance is felt.
2. Follow the procedure given for disconnection (see section 9.1) but rotate A in The opposite direction to connect fitting.
3. Tighten coupling fully and then uncouple one turn to ensure sealing 'O' ring (6) is Not over compressed or the service life of the fittings will be reduced.

1. Brazed joints
2. 'O' ring seal
3. Retainer
4. Lock washer
5. Lock nut
6. Sealing 'O' ring
7. Packing ring
8. Spring
9. Body
10. Retainer
11. Adapter
12. Tubing
13. Brazed joints
14. 'O' ring seal
15. Stem valve
16. Bonded sleeve
17. Union nut
18. Poppet valve
19. Spring
20. Body
21. Adapter
22. Tubing





1st. Male coupling half
2nd. Female coupling half
3rd Coupling halves

Figure 18 - Cut-away of a self-sealing coupling (Aeroquip)

9. RICOR EQUIPMENT RETURN PROCEDURE:

Return of Ricor Equipment – Procedure.

Introduction

Before you return your equipment you must warn your supplier if the substances you used (and produced) in the equipment can be dangerous. You must do this to comply with health and safety at work laws.

You must complete the Declaration (FRM00130) on the next page and send it to your supplier before you dispatch the equipment. If you do not, your supplier will assume that the equipment is dangerous and he will refuse to accept it. If the Declaration is not completed correctly, there may be a delay in processing your equipment.

Guidelines

Take note of the following guidelines:

1. Your equipment is **'uncontaminated'** if it has not been used or if it has only been used with substances that are not dangerous. Your equipment is **'contaminated'** if it has been used with any dangerous substances.
2. If your equipment has been used with radioactive substances, you must decontaminate it before you return it to your supplier. You must send independent proof of decontamination (for example a certificate of analysis) to your supplier with the Declaration (**FRM00130**). Phone your supplier for advice.
3. We recommend that contaminated equipment be transported in vehicles where the driver does not share the same air space as the equipment.

PROCEDURE

Use the following procedure:

1. Contact your supplier and obtain a Return Authorization Number for your equipment.
2. Turn to the next page(s), photocopy and then complete the Declaration **(FRM00130)**
3. Remove all traces of dangerous gases: pass an inert gas through the equipment and any accessories that will be returned to your supplier. Drain all fluids and lubricants from the equipment and its accessories.
4. Disconnect all accessories from the equipment. Safely dispose of the filter elements from any oil mist filters.
5. Seal up all of the equipment's inlets and outlets (including those where accessories were attached). You may seal the inlets and outlets with blanking flanges or heavy gauge PVC tape.
6. Seal contaminated equipment in a thick polythene bag. If you do not have a polythene bag large enough to contain the equipment, you can use a thick polythene sheet.
7. If the equipment is large, strap the equipment and its accessories to a wooden pallet. Preferably, the pallet should be no larger than 510mm x 915mm (20"x 35"); contact your supplier if you cannot meet this requirement.
8. If the equipment is too small to be strapped to a pallet, pack it in a suitable strong box.
9. If the equipment is contaminated, label the pallet (or box) in accordance with laws covering the transport of dangerous substances.
10. Fax or post a copy of the Declaration (FRM00130) to your supplier. The Declaration must arrive before the equipment.
11. Give a copy of the Declaration to the carrier. You must tell the carrier if the equipment is contaminated.
12. Seal the original Declaration in a suitable envelope; attach the envelope securely to the outside of the equipment package. **WRITE YOUR RETURN AUTHORISATION NUMBER CLEARLY ON THE OUTSIDE OF THE ENVELOPE OR ON THE OUTSIDE OF THE EQUIPMENT PACKAGE.**

(Form FRM00129/A0)

Return of Ricor Equipment –Declaration

	Return Authorization Number:

You must:
Know about all of the substances which have been used and produced in the equipment before you complete this Declaration

- Read the Procedure (FRM00129) on the previous page before you attempt to complete this Declaration
- Contact your supplier to obtain a Return Authorization Number and to obtain advice if you have any questions
- Send this form to your supplier before you return your equipment

SECTION 1: EQUIPMENT

Equipment model: _____ Serial Number: _____ Has the equipment been used, tested or operated? yes ☐ Go to Section 2 no ☐ Go to Section 4	FOR SEMICONDUCTOR APPLICATIONS ONLY : Tool Reference Number: _____ Process: _____ Failure Date: _____ Serial Number of Replacement Equipment:

SECTION 2: SUBSTANCES IN CONTACT WITH THE EQUIPMENT

Are any of the substances used or produced in the equipment • Radioactive yes ☐ no ☐ • Biologically active yes ☐ no ☐ • Dangerous to human health and safety? yes ☐ no ☐ If you have answered 'no' to all of these questions, go to Section 4.	Your supplier will not accept delivery of any equipment that is contaminated with radioactive substances, unless you: • Decontaminate the equipment • Provide proof of decontamination **YOU MUST CONTACT YOUR SUPPLIER FOR ADVICE BEFORE YOU RETURN SUCH EQUIPMENT**

SECTION 3: LIST OF SUBSTANCES IN CONTACT WITH THE EQUIPMENT

Substance name	Chemical symbol	Precautions required (for example, use protective gloves, etc.)	Action required after spillage or human contact
1			
2			
3			
4			
5			
6			

SECTION 4: RETURN INFORMATION

Reason for return and symptoms of malfunction: _____
_____
If you have a warranty claim:

- Who did you buy the equipment from? _____
- give the supplier's invoice number: _____

SECTION 5: DECLERATION

Print your name: _____ Print your job title: _____
Print your organization: _____
Print your address: _____
Telephone number: _____ Date of equipment delivery: _____

I have made reasonable inquiry and I have supplied accurate information in this Declaration. I have not withheld any information. I have followed the Return of Ricor Equipment Procedure (FRM00129) on the previous page.

Signed: _____ Date: _____

(Form FRM00130/A0)