ACCUFREEZE OPERATING INSTRUCTIONS

1. Safety Precautions when working with liquid nitrogen (LN2).

    1.1. LN2 can cause asphyxiation. Work in a well ventilated area.

    1.2. Avoid Freeze burns. Wear protective gloves, and a face shield when tightening or opening LN2 connections.

    1.3. To maintain the freeze plug during maintenance, duration of the work must be considered before commencing. Consideration of additional LN2 tanks and methods to be used to change tanks during the freeze are required to be pre-planned.

2. General information

    2.1. Low pressure LN2 tanks are recommended for use. These are normally supplied as 22 psi tanks and 22 psi is the minimum LN2 tank pressure required for proper operation. The control solenoid valve is capable of operating with a maximum of 60 psi differential pressure.

    2.2. Some familiarity with the LN2 tank pressure builder system, relief system, and level indication system are required. Ask your gas supplier how these systems work on the tanks you are using and how to tell when the LN2 tank is nearing empty. These indications change with the tanks you are using.

    2.3. These tanks are normally configured with a Vent connection, and a Liquid connection. Ensure the LN2 tank connection to the freeze coil is made at the liquid connection.

Freeze times may vary due to actual working conditions. The pipe should be at ambient temperature. If ambient temperature is in excess of 90°F, add 15 minutes to the freeze time indicated in table 1 for every 4 degrees above 90°F for pipe size up to 6", add 15 minutes to the freeze time indicated in table 1 for every 2 degrees above 90°F for pipe size greater than 6". If the freeze is being performed in direct sunlight some method of providing shade over the freeze area is recommended.

3. System requirements to establish freeze seal

    3.1. Process fluid must be static.

    3.2. Pipe coating should be removed from area to be frozen.

3.3. Pipe should be free of dirt, oils, etc

4. Freeze seal setups.

4.1. Coil copper tubing around freeze location (see table 1 for freeze wrap recommendations). Copper tubing should be wrapped tightly with each successive wrap in contact with previous wrap. Coil wraps may be separated up to ¾ inches to allow for thermocouple placement (see 5.1 for direction on thermocouple placement).

4.2. Connect the Control Solenoid Valve Header to the liquid nitrogen (LN2) tank liquid supply and the LN2 supply flexible hose to the Control Solenoid Valve Header.

4.3. Check Control Solenoid Valve isolation valve closed.

4.4. Connect the flexible hose to inlet side of wrap tubing.

4.5. Direct vented side of wrap tubing away from equipment that may be damaged by Liquid Nitrogen emission. A catch bucket may be used.

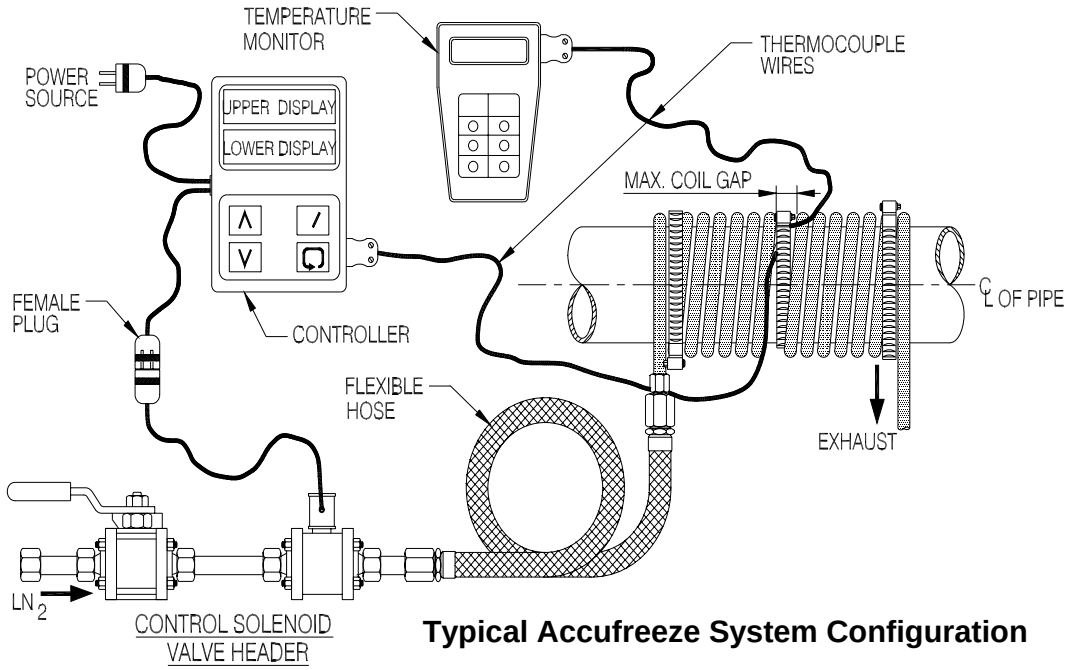
Note: If more than one Control Solenoid Valve Header and flexible supply hose is being used connect the system as described above and connect the supply hoses to a tee at the wrap inlet (see attachment 1).

5. Thermocouple installation.

5.1. Place thermocouples at desired locations in the Freeze Seal area. The control thermocouple should be placed near the wrap tubing linear center at least ¼" from nearest copper tubing. Each thermocouple should be placed at least ¼" from nearest copper tubing, if a thermocouple is in contact with the copper tubing the reading will be inaccurate.

5.2. Thermocouples may be held in place with hose clamps, Velcro straps, or other suitable devices such that the thermocouple is held firmly in contact with the pipe.

5.3. Connect the thermocouple wires to the AF 3000 controller and the temperature monitor. Ensure the control thermocouple is attached to the controller.



Typical Accufreeze System Configuration

6. AF 3000 Temperature Controller setup.

   6.1. Verify Power is on by presence of light indications on display.

   6.2. Verify controller is in auto (Manual indicator light below display readout on right labeled M is not illuminated). If in Manual, press upper right push button on controller to place in auto.

   6.3. Check Hysterisis setting by pressing lower right push button on controller until upper display indicates LVL1 and lower display indicates OPER. Then press up or down arrow until upper display indicates LVL2. Press lower right push button until Upper display indicates HYST. Press up or down arrows to set hysterisis to desired value (COB Industries, Inc. recommends 5 degrees). Press lower right push button until upper display indicates LVL2 and then press up or down arrow until display indicates LVL1/OPER. Press lower right push button once more to return to process and control temperature readout.

   6.4. Adjust AF 3000 temperature reading by following the above process <u>except</u> select LVL 3 and depress the lower right push button until the

readout displays O.AdJ. Use the up or down arrows to offset the display reading to correspond to the reading indicated on the temperature monitor (this sets the controller temperature at the surface temperature of the pipe as indicated on the temperature monitor at the start of the freeze). Press lower right push button once more to return to process and control temperature readout as described above.

6.5. Adjust control set point (lower display temperature readout) using the up/down arrow switches on the controller face to desired Freeze seal control set point. A control temperature of −30°F for Carbon Steel pipe and −80°F for Stainless Steel pipe is recommended. The control temperature may be set colder to compensate for high ambient conditions or high system heat conditions. If colder temperatures are used the controller should be returned to these recommended temperatures after the plug is established.

7. Initiate Freeze Seal.

7.1. Open LN2 tank liquid valve.

7.2. Open the control solenoid header isolation valve, observe LN2 Flow and freeze seal formation. LN2 flow is indicated by the sound of escaping nitrogen gas and observing condensation at the coil exhaust.

8. Perform desired maintenance.

8.1. The Accufreeze equipment should be monitored for proper and continuous operation while system repairs are being performed.

9. Terminate Freeze Seal.

9.1. The freeze seal can be thawed in a controlled manner if desired by raising the AF 3000 set point to allow for thermal soaking of the pipe.

9.2. If thermal soaking is not required close the control solenoid header isolation valve and the LN2 tank liquid valve.

9.3. The freeze seal can continue to be monitored using the temperature monitor until the seal has moved or the pipe has returned to baseline temperature (COB Industries, Inc. recommends continued monitoring until all thermocouples indicate it is safe to touch the freeze area with

bare hands and the freeze plug has thawed before restarting system equipment).

9.4. After the freeze has warmed sufficiently, disassemble the freeze wrap, and Accufreeze equipment.

10. Additional Information

10.1 The Accufreeze kit includes additional type T Thermocouple wire and connectors. Thermocouples can be made by cutting the wire to the desired length and connecting one end to a male or female connector (as appropriate). The copper colored thermocouple wire should be connected to the copper colored connector (also marked +) and the light colored wire connected to the light connector (marked –). The other end should be stripped bare, approximately 1" and the two wires twisted tightly together to form the thermocouple junction.

10.2 Connectors may be put on both ends of the thermocouple wire, observing connection polarity, to form thermocouple extensions if the monitoring and control equipment is placed away from the freeze area.

Accufreeze Operating Instruction

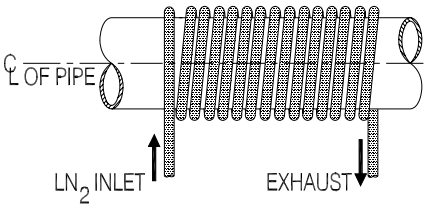
Table 1

Recommended Pipe Size Wrapping Table

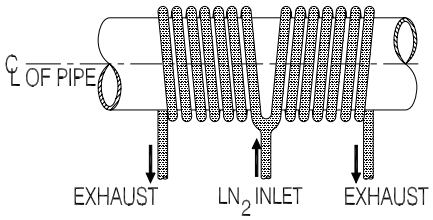
Pipe Size	Copper Tube Wrap Length	Time - Hrs./Mins.
1/4 through 3/4"	**3"**	**0:10**
1"	**6"**	**0:18**
1 1/2"	**6"**	**0:25**
2"	**8"**	**0:40**
3"	**8"**	**1:20**
4"	**12"**	**2:15**
6"	**18"**	**3:40**
8"	**24"**	**5:30***
10"	**36"**	**8:30***
12"	**36"**	**12:30**

*These are estimated times only, actual field tests have not been performed.

COB Industries, Inc. recommends 1/4" copper tubing for all freeze wraps up to and including wraps on 6" diameter pipe. 5/16" copper tubing should be used for all freeze wraps on 8" diameter pipe and larger and may be used for all freeze seal wraps.

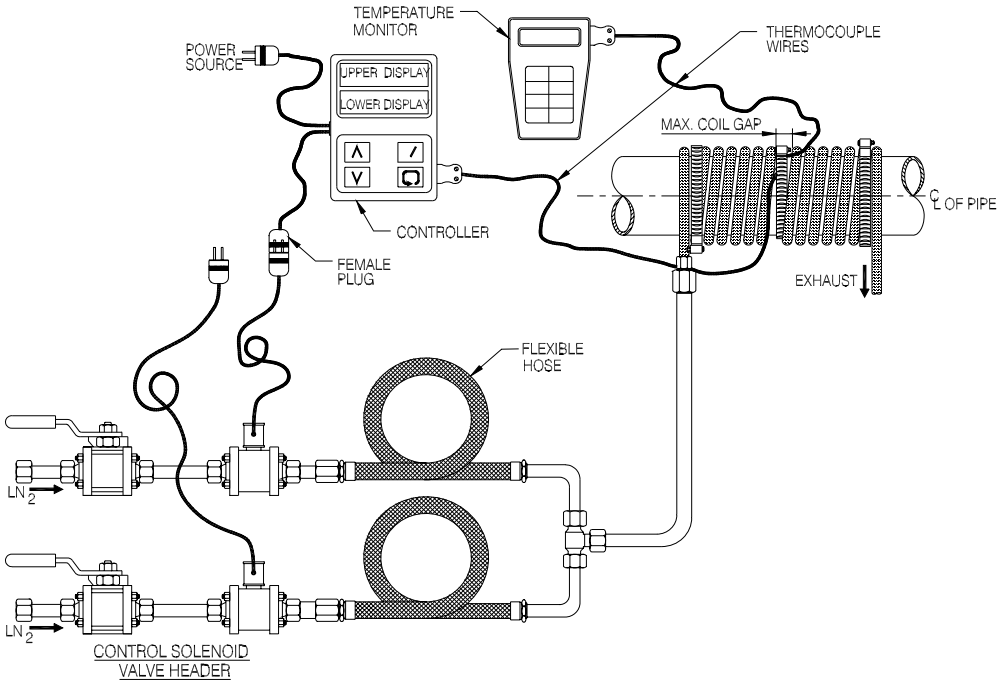


This coil configuration should be used on 6 inch diameter pipe and smaller. See step 4.1 for coil placement.



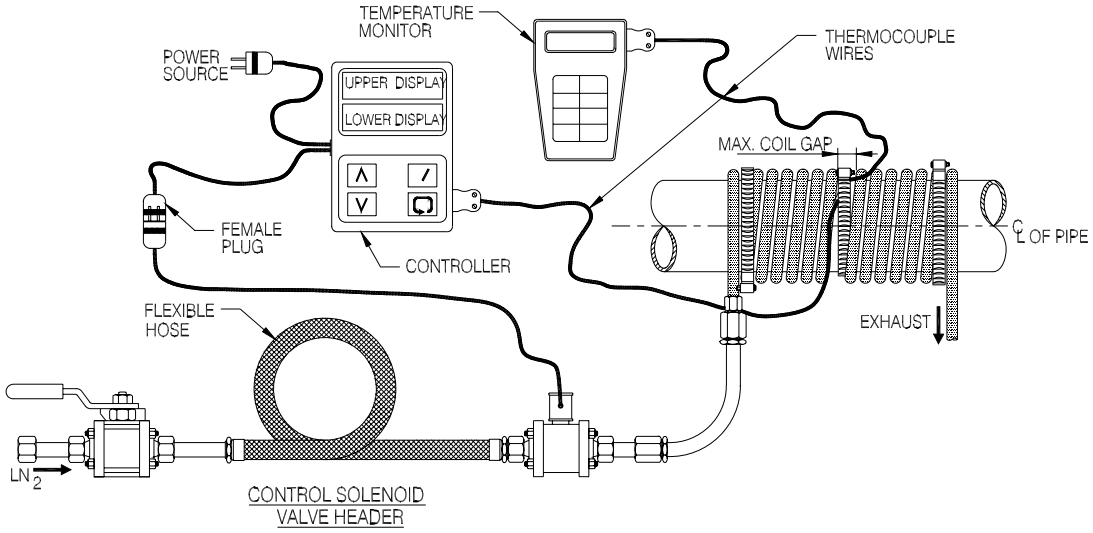
This coil configuration should be used on 6 inch diameter pipe and larger. See step 4.1 for coil placement. When this configuration is used care should be taken to assure equal length of the coils from the tee to exhaust to allow balanced LN2 flow in both legs of the coil.

Accufreeze Operating Instruction Attachment 1



Typical Accufreeze System Configuration Using Two Control Solenoid Valve Headers

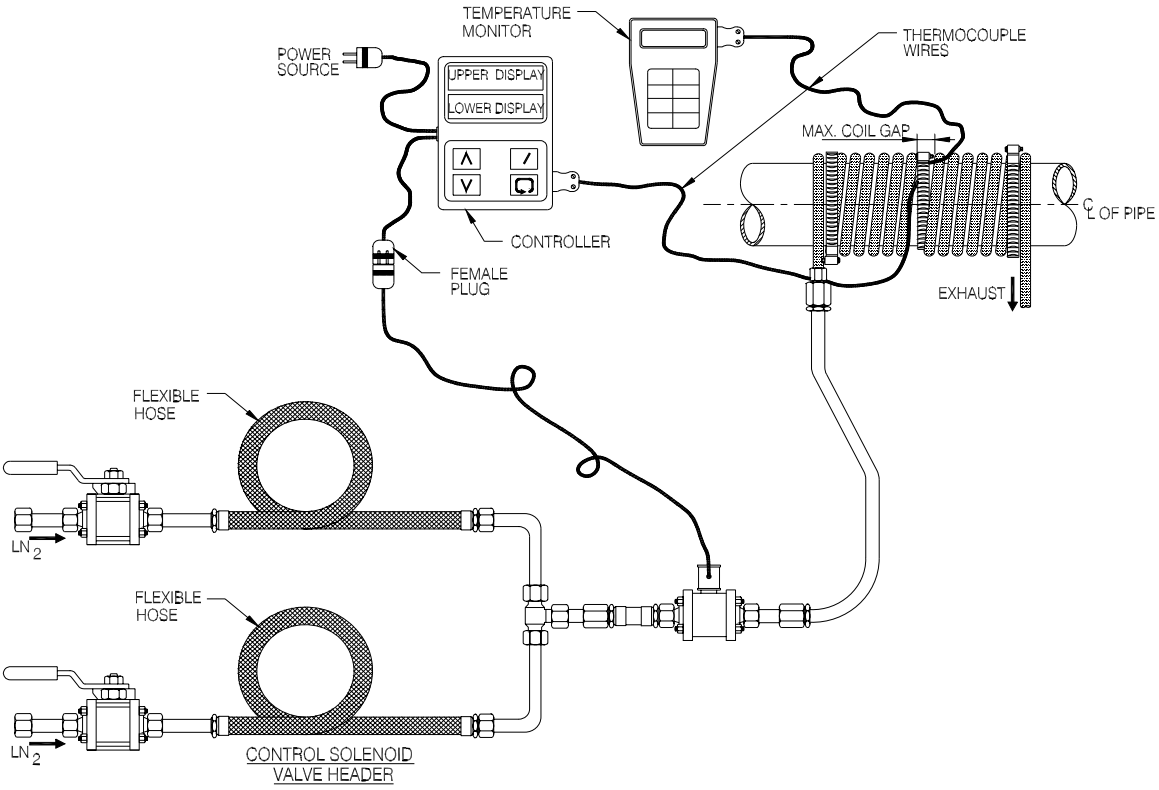
Accufreeze Operating Instruction
Attachment 2



Typical Accufreeze System Configuration When Using Flexible Hose Lengths Greater Than 30 Feet.

Note: The solenoid valve should be attached to the copper coil in a near upright position

Accufreeze Operating Instruction
Attachment 3



Typical Accufreeze System Configuration When Using Flexible Hose Lengths Greater Than 30 Feet And Two Manual Isolation Valves

Note: The solenoid valve should be attached to the copper coil in a near upright position

ACCU-FREEZE OPERATING INSTRUCTIONS
ATTACHEMENT 4

Accufreeze Operating Instruction

Table 2

LN2 Operating Pressure Recommendations

Single freezes up to 4 inch diameter pipe	22 psi
Single freezes >4 inch to 8 inch diameter pipe	35 psi
Single freezes >8 inch diameter pipe	35 psi
Double freezes 3 inch to 6 inch diameter	35 psi
Double freezes > 6 inch diameter pipe	35 psi
Freezes where distance from LN2 source to freeze wrap is >20 feet and ≤ 50 feet	35 psi
Freezes > 50 feet and ≤ 100 feet	35 psi
Freezes > 100 feet from LN2 source to freeze wrap are not recommended with supplied system. Additional equipment is recommended.	Contact Vendor