Operator Manual
Central Heating Unit

Model 2000-1200 CHU

S.N. 22396 –

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1.Warranty Policies & Claim Procedures

DRYAIR MANUFACTURING CORP. (referred to within as DRYAIR) warranties its new, unused equipment to be free of defects in material and workmanship at the time of delivery to the original retail purchaser.

Warranty Policies

Basic Warranty Policy

- DRYAIR will repair or replace, at its option, without charge, any defective part of the equipment for a period of twelve (12) months from delivery to the first retail purchaser, F.O.B St. Brieux, SK., Canada.
- Any parts that are covered by an extended warranty published by DRYAIR are an exception to the Basic Warranty policy and are to be warrantied as per the details of the Extended Warranty Policy.
- Labour is covered as per DRYAIR flat labour rate.
- The Warranty Policy, terms, and conditions may change from time to time without prior notice.
- Warranty terms and conditions are transferable in the event of the sale to a second owner.
- Replacement parts will be warrantied for 90 days from the repair date. Bill of sale must accompany the warranty claim.
- The terms of this Warranty Policy are subject to provincial and state legislation. DRYAIR reserves the right to make modifications in accordance with provincial and state legislation without prior notice or obligation.

Extended Warranty Policy

Heat Exchanger

- An extended warranty is available on the heat exchanger unit of the water heater assembly. The available warranty for a part, under the extended warranty policy, is prorated by 20% per year.
- Shipment date is the date to be used for the commencement of the warranty period.
- Coverage schedule

  Year 1 - 100%
  Year 2 - 80%
  Year 3 - 60%
  Year 4 - 40%
  Year 5 - 20%

Exceptions to the Warranty Policies

- Under no circumstance shall the owner be entitled to recover costs for incidental, special, or consequential damages such as, but not limited to loss of profit or revenue, other commercial losses, inconvenience and/or replacement equipment rental cost.
- Maintenance, repair, or service items not related to warrantable defects.
- Loss or damage during shipping.
- Failure resulting from lack of or improper maintenance.
- Damage caused by operator abuse, negligence, or improper operation.
- Damage resulting from improper voltage supply.
- Damage from improper installation. Installation done by other than the manufacturer.
- Non-defective items replaced at the request of the customer.
- Damage due to accidents.
- Damage resulting from improper fuel supply (i.e. pressure or contamination).
- Damage resulting from cracked or broken lines occurring during transport.
- Damage resulting from use of inadequate or improper fluids (i.e. Glycol or oil).
- Mileage is not covered.
- Glycol is considered a consumable and will not be covered under the warranty policy.
- Generators carry their own warranty coverage through their own manufacturers. Please refer generator issues to the OEM. Contact information may be found in the Service & Operators Manual under Optional Equipment.

Owner Obligations

- It is the responsibility of the owner, at the owner's expense, to transport the equipment to the service facility of an authorized DRYAIR distributor/dealer or alternately to reimburse the distributor/dealer, for any traveling expenses incurred in fulfilling this warranty.
- The terms of this Warranty Policy are subject to provincial and state legislation. DRYAIR reserves the right to make modifications in accordance with provincial and state legislation without prior notice or obligation.
- It is the responsibility of the owner to read, understand and implement the maintenance, safety and operational guidelines as laid out in the Operation and Maintenance Guide.
- All parts are to be tagged with warranty claim number and shipped prepaid to DRYAIR within 30 days.

Manufacturer Obligations

- DRYAIR reserves the right to continually improve the product’s parts or specifications at any time without notice or obligation.
- The terms of this Warranty Policy are subject to provincial and state legislation. DRYAIR reserves the right to make modifications in accordance with provincial and state legislation without prior notice or obligation.

Warranty Claim Procedure

- All warranty credits must be processed with the DRYAIR Warranty Claim Form.
- All warranty parts, unless otherwise specified, are to be returned to DRYAIR along with a completed Warranty Claim Form.

Note: *Prior to returning warranty parts, please call for an authorization number and shipping instructions from the Warranty department in Canada.*

Location of Warranty Depots:

USA	**Canada**
DRYAIR Manufacturing Corp.	DRYAIR Manufacturing Corp.
410 Douglas Road, Box 264	400 Service Road, Box 126
Bradner, OH 43406	St. Brieux, SK S0K 3V0
Ph. 1 (888) 750-1700	Ph. 1 (888) 750-1700

- Each warranty claim should only refer to one Serial or Production Schedule numbered unit.
- Warranty parts are to be tagged with warranty claim number.
- When claiming for warranty labour, the allowable warranty labour rate will be $85.00/hour. The factory reserves the right to adjust the number of hours claimed where deemed necessary.
- The factory may at times specify allowable labour for certain warranty procedures.
- Mileage and travel time to/from the customer are not eligible for warranty credit.
- Freight charges for warranty parts are not eligible for warranty credit.
- Labour flat rates for component changes:
- Electrical Components - 0.5hr
  - Relays
  - Switches
  - Thermostats
  - Breakers
- Plumbing Components - 1hr
  - Flow Reverser
  - Flow Switch
  - Valves
- Electric Motor Changes - 1hr
  - Hose Reel
- Glycol Pump Changes - 2hrs

Note: *Other labour charges will be at the discretion of DRYAIR.*

2. Safety Concerns

General Safety Guidelines

- Make certain that the operator reads and understands all the information in this manual.
- All unauthorized people must be kept away from the equipment while in operation.
- Maintain instructional and safety decals. Replace damaged decals *(Figure 1).*
- All guards must be in place when the equipment is in operation

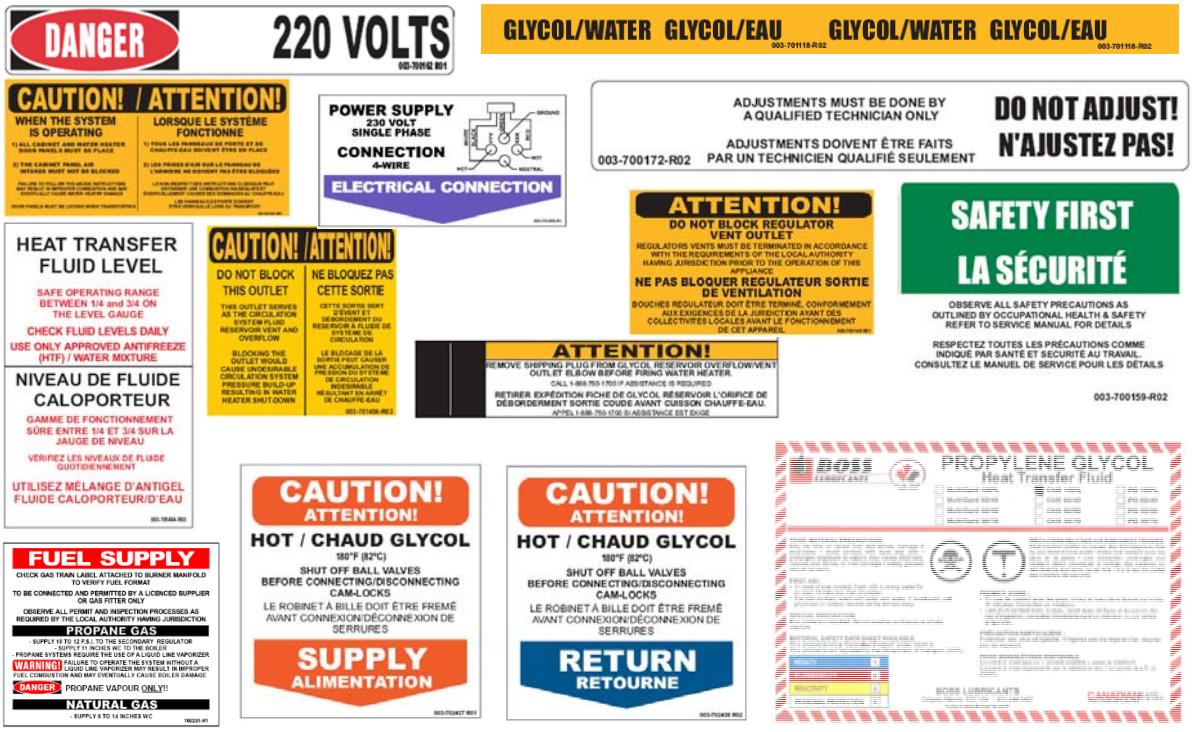


Figure 1 - Safety Decals

Water Heater Module

CAUTION! *The water heater is a heating appliance.*

- Observe all posted warnings and cautions when dealing with any heating appliance.
- Keep children and pets away from all piping and fuel accessories.
- While the system is operating the water heater housing panels must be kept closed - This prevents drafts from affecting water heater operation.

Heat Transfer Fluid

Follow the following precautions and measures when working with "heat transfer fluid" ("DOWFROST* HTF" & "BOSS CHILL PG").

Fluid Handling Precautions

- Ventilation ..... Good general ventilation should be sufficient for most conditions.
- Respiratory protection No respiratory protection should be needed.
- Skin protection ..... For brief contact, no precautions other than clean, body-covering clothing should be needed.
  ..... Use impervious gloves when prolonged or frequently repeated contact should occur.
- Eye protection ..... Use safety glasses.

First Aid Measures

- Eyes ..... Flush eyes with plenty of water.
- Skin ..... Wash off in flowing water or shower.
- Ingestion ..... Induce vomiting if large amounts are ingested.
  ..... Consult medical personnel.
- Inhalation ..... Remove to fresh air if effects occur.
  ..... Consult a physician.
- Note to Physician ..... No specific antidote.
  ..... Supportive care.
  ..... Treatment based on judgment of the physician in response to reactions of the patient.

For complete "heat transfer fluid" information, refer to the Material Safety Data Sheets for "Dowfrost HTF" & "Boss Chill PG" included with the manuals package.

3. Introduction

DRYAIR Components

Water Heater Module

- A compact and portable design. Forklift pockets on all four sides allow for easy positioning on the work site.
- Easy access from side doors.
- Automatic temperature control and fuel usage which responds to worksite demands.
- Low pressure, atmospherically vented circulation system. No special boiler certification is required to operate the system.
- Circulation system “automatic air vent” component for quick setup-and-go operation.
- A Water Heater Module Control Center which monitors and controls system operations.
- A multi-light system operation feature for easy system troubleshooting.
- Unit may be used as a construction heater, water heater, ground thaw, as well as a concrete curing unit.

Figure 2 - Model 2000-1200 Central Heating Unit

Accessories

Extension Reservoir Assembly

The Extended Reservoir Tank is required in scenarios when "portable heat exchangers" are higher than the top level of the glycol reservoir tank. If the Extended Reservoir tank is not used, the following can occur:

Figure 3 - Extended Reservoir

- **Insufficient Fluid in the System**
  Fluid can drain back to the heat transfer reservoir tank from the over-elevated fluid lines when the pump is shut off. The heat transfer reservoir tank will show adequate fluid, but when the pump is started extra fluid will be required to recharge the over-elevated fluid lines and portable heat exchangers and the system will then have insufficient fluid in the reservoir.
- **Fluid Overflow**
  If fluid is added to maintain proper fluid levels while the pump is running, overflow at the reservoir tank will occur when the pump is shut off. This would occur because of the drain back from the over-elevated fluid lines.

Mixing/Booster Pump

The multifunctional mixing/booster ensures maximum flexibility in the use of this system.

Figure 4 - Mixing/Booster Pump

- Tempering mode supplies lower temperature fluid for concrete cure and radiant floor heat applications, eliminating the need to reduce the water heater operating temperatures below safe operating ranges.
- When operating in booster mode the system can increase flow rates or function as a pumping station to increase pumping distances by over 300ft per station.
- The system also allows for dual-temperature control. High temperature fluid can be provided to portable heat exchangers, along with a lower temperature fluid for concrete cure and radiant floor heat applications.

Note: *Disengage Flow Reverser when using this accessory.*

Optional Remote Manifold

The multifunctional mixing/booster ensures maximum flexibility in the use of this system.

Figure 5 - Optional Remote Manifold

- Allows for additional distribution and/or separation between the central heating trailer and the manifold.

Insulated Line Jackets

Insulated circulation line jackets are also available. These insulated jackets will prevent exposed circulation line heat loss in extreme subzero conditions.

Figure 6 - Insulated Line Jackets

Portable Heat Exchangers

Portable heat exchangers are the ideal way to heat and/or dry enclosed structures. Their compact and mobile design allows them to be positioned where required on the job site. The efficient fan/coil design provides a high rate of heat transfer. High volume fans then deliver this heat evenly throughout a large area. The clean, low relative humidity heat delivery minimizes energy costs by eliminating the need to draw in fresh outside air. With this system, you just reheat warm internal air, rather than heating cold external air.

Figure 7 - Portable Heat Exchangers

Note: *Disengage Flow Reverser when using this accessory.*

Plate Heat Exchanger

The plate heat exchanger module uses a stacked parallel flat plate braised heat exchanger. This creates two separate and isolated fluid loops. In glycol-glycol situations it can extend the range of the HTF distribution. In other situations, it can be used to transmit heat energy from the glycol to another fluid. The plate heat exchangers combined with a central heating module can be used:

- To extend the effective range and lengths of the primary distribution lines.
- In a multi-story application to extend the vertical range of the primary distribution lines.
- In an HTF to liquid heating application, such as heating a swimming pool or other volume of water (or other low-viscosity non-corrosive liquid).

Figure 8 - Plate Heat Exchanger Unit

Note: *Disengage Flow Reverser when using this accessory*

Fluid Circulation Lines

Fluid circulation lines are designed to endure the toughest work site environments. Portable distribution manifolds connected to the primary circulation system redistribute the heat transfer fluid through secondary lines. All fluid circulation components come with isolation valves and quick couplers, ensuring quick set up, start up, and quick disassembly when the job is done. DRYAIR provides a full range of hoses, adapters, and manifolds for handling and distributing HTF.

Figure 9 - Circulation Lines

Circulation Line Heat Exchanger

The circulation line heat exchangers are the perfect solution for:

- Heating and/or thawing cold or frozen ground
- Frost prevention
- Concrete curing and heating in subzero environments
- Hose loops are typically 500ft in length with maximum of 1,000ft achieved by connecting two hoses together. Refer to the Components, Hose Reel section of the Operator Manual to verify hose length for your unit.

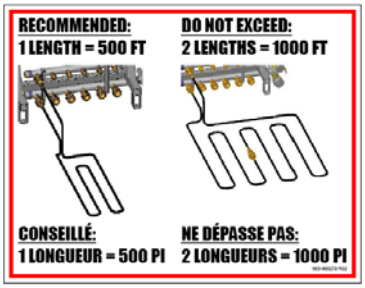


Figure 10 - Hose Loop Length

This system can be applied to all types of concrete applications. Circulation line heat exchangers can be secured directly against the surface of the concrete or concrete forms. Alternatively, an expendable circulation line can be incorporated into the concrete structure during the pour. Thus, the slab floor can continue being heated, to provide radiant floor heat during construction.

Hose Reel

The DRYAIR Hose Reel can hold over 6,000 feet of ⅝" I.D. circulation line heat exchanger hose. The reel can be transported by common carrier, or slings can be used for lifting. The hose reel is forklift accessible from all four sides.
The reel is ideal for on-site applications:

Figure 11 - Hose Reel

- A "unique" auto-feed system eliminates the need for a second person at the reel when laying out hose.
- The independent modular design lets you store the Hose Reel at a secure location on or off the job site when not in use. The independent modular hose reel also allows deployment of hose at more than one job site.
- The reel can be used to store or deploy other distribution lines used in DRYAIR portable heating applications.
- The reel can also be secured onto its own transport trailer. The trailer's "no-clog" opening directly under the Hose Reel prevent mud build-up. A "no-slip" working deck promotes safe, convenient, and dry hose reel operation.

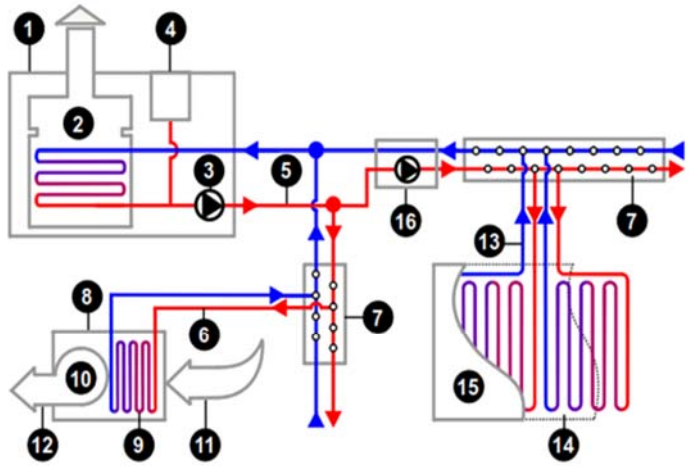
Trailers

Several different models are available upon request depending on the required applications. Single or tandem axle trailers are available depending on the size of Water Heater module and the accessories requiring transportation. Call DRYAIR for details.

Figure 12 - Trailers

How the System Works

The system uses a low-pressure, open-fluid loop distribution system with an atmospherically vented fluid reservoir. A hydronic Water Heater warms the heat transfer fluid. This heated fluid is pumped through heat exchangers in remote locations.



1. Water heater module
2. Water heater
3. Pump
4. Fluid reservoir
5. Primary fluid distribution line
6. Secondary fluid distribution line
7. Distribution manifold
8. Portable heat exchanger
9. Heat transfer coil
10. Fan
11. Intake air
12. Heated air
13. Circulation line heat exchanger
14. Vapor barrier
15. Insulated blankets
16. Mixing/booster

Figure 13 - How the System Works

Two types of exchangers are available: Portable Heat Exchangers and Circulation Line Heat Exchangers.

- Portable Heat Exchangers include a heat transfer coil, fan, and thermostatic temperature control. The heat transfer fluid flows through the transfer coil, where heat is transferred to the air being drawn through the coil by the fan. The coil is specially designed for optimum heat transfer, without adding any moisture or combustion by-products to the air.
- Circulation Line Heat Exchangers use flexible hose with hydraulic-style quick couplers for ease in hookup. Heat transfer occurs by direct contact heat transfer and radiant heat conduction.

The Mixing/Booster unit can be utilized to:

- Provide lower temperature fluid for concrete cure and radiant floor heat applications.
- Provide dual temperature control with a single fluid circulation system.
- Boost fluid flow and increase pumping distances.

4. Setup

The positioning of all the system components on the site will be influenced by several factors. Please read all the "Setup" section before beginning.

Be sure to observe all local electrical and gas codes, and fire regulations when positioning the central heating module.

Required Safety Clearances

The Central Heating Unit is a heating appliance, therefore safe heat and exhaust clearances must be observed.

- Maintain 24" of clearance on all sides of the unit *(Figure 14)*.
- Maintain 36" of clearance on all sides of the flue pipe and chimney cap *(Figure 15)*.
- Confirm that the Water Heater module air intakes, on three sides of the Water Heater Module, are free of any obstructions.

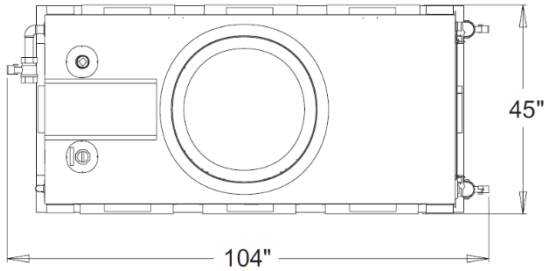


Figure 14 - Model 2000-1200 Dimensions (Top-View)

Water Heater Cabinet

Handling the Cabinet

- The cabinet can be moved with a forklift and is accessible from four sides.
- Be careful when lifting, moving, or placing our DRYAIR system for you can cause internal damage to your water heater.
- An optional module frame with four corner lifting eyelets is also available, call factory to inquire.
- When utilizing a cable or sling lift, it is important that all four lifting eyelets be used in conjunction.

Cabinet Positioning

- Cabinet must be leveled and not set on any type of combustible material.
- If the cabinet is mounted on a DRYAIR trailer, you can level the cabinet by using the four corner jacks located on the trailer.
- Make sure to consider down drafting which can be caused by tall buildings, high winds or when the top of the chimney is level with the

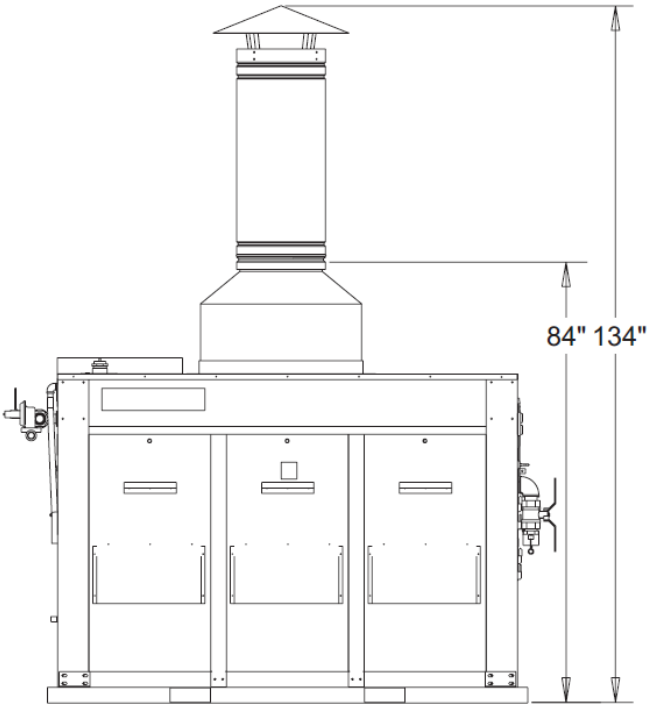


Figure 15 - Model 2000-1200 Dimensions (Side-View)

eve. Allow a 3-foot minimum clearance for all sides except the header connection side, which requires at least 6 feet.

- Do not install the water heater cabinet in a location that blocks or can block, fully or partially, the combustion air intakes which are located on the front and back of the system.
- Consider cabinet positioning in relation to Portable Heat Exchanger positioning.
- Mounting on trailer optional, call factory to inquire.

Elevation Concerns

Do not place any "portable heat exchangers" or "circulation line heat exchangers" higher than the top level of the heat transfer fluid fill tank without using a reservoir extension kit. If this is not observed, the following can occur:

- **Insufficient Fluid in the System**
  Fluid will drain back to the heat transfer fill tank from the over-elevated fluid lines when the pump is shut off. The heat transfer fill tank will show adequate fluid, but when the pump is started extra fluid will be required to recharge the over-elevated fluid lines and portable heat exchangers and the system will have insufficient fluid in the reservoir.
- **Fluid Overflow**
  If fluid is added to maintain proper fluid levels while the pump is running, overflow at the fill tank will occur when the pump is shut off. This would occur because of drain back from the over-elevated fluid lines.

Electrical Requirements & Connection

When determining the Water Heater location on site, consider setting up near the electrical power supply.

Note: *This applies mainly to systems not equipped with a dedicated generator.*

- The main feed wiring must be adequately sized to carry the minimum ampacity shown on the water heater cabinet's rating label. All electrical connections, connectors and wire must be CSA/UL compliant and installed according to local laws and codes.
- Before making any electrical connections, be sure that the electric power supply is "Off".

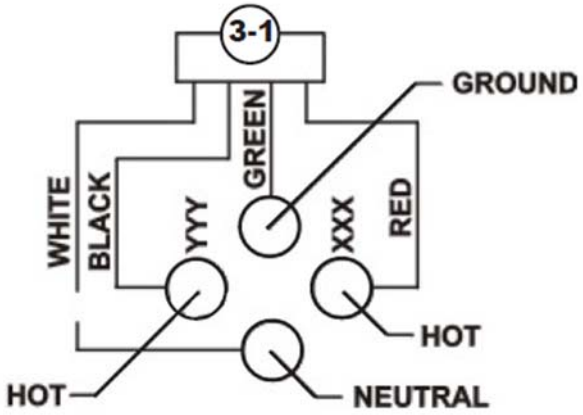


Figure 16 - Electrical Hookup (230V AC)

Electrical Connection

- The Water Heater Module requires 115/230V AC Power. The module is factory wired so that the only connection to be made is a 230V AC service outlet.

- The main feed wiring must be adequately sized to carry the minimum ampacity shown on the water heater cabinet's rating label.
- All electrical connections, connectors and wire must be CSA/UL approved, and installed according to local laws and codes.
- A 4-wire hookup is required for all systems to work properly. Warranty is void if the wiring hookup is not done correctly *(Figure 16)*.

Note: *Warranty is void if the wiring hookup is not done correctly.*

Heat Transfer Fluid "HTF"

CAUTION! *At no time should you use automobile antifreeze in your system. The use of automobile antifreeze will void your warranty.*

- The heat transfer fluid "HTF" level should show no more than ¼ on the gauge (cold fluid) at start-up. As the "HTF" warms to operating temperature, fluid expansion will raise the level to ½ or ¾ on the gauge (depending on the total volume of fluid in the circulation system).

Heat Transfer Fluid Specifications

- The system is shipped with pre-mixed "HTF", made up of 50% "Dowfrost ® HTF" or "Boss Chill PG" and 50% water*, by weight – freeze protection down to -28°F (-33°C).
- The "glycol/water mixture chart" below will provide you with more information on the proper mixture for your area.
- "Dowfrost ® HTF" or "Boss Chill PG" must be used. The pure "Dowfrost ® HTF" or "Boss Chill PG" heat transfer fluid used in the system is made of a blend of 95-97% Propylene glycol, <5% Dipotassium phosphate and deionized water (see Safety Concerns section – MSDS sheets) for additional information.
- Soft water with a pH level (#7) must be used.

Percent Propylyne Glycol		Freezing Point	
By Mass	By Volume	°F	°C
0.0	0.0	32.0	0.0
10.0	9.6	26.1	-3.2
20.0	19.4	17.9	-7.8
30.0	29.4	6.7	-14.0
40.0	39.6	-8.1	-22.3
50.0	49.9	-28.9	-33.8
60.0	60.0	-54.9	-48.3

Figure 17 - Glycol/Water Mixture Chart

CAUTION! *Whenever coupling or uncoupling quick couplers, make sure that the isolation valves are closed, and the pump is off. Failure to do so may put you at risk of injury from eye and/or skin exposure to hot glycol.*

Primary "HTF" Circulation Lines

- If possible, position the primary circulation lines out of high traffic areas.
- If primary "HTF" circulation lines are required, connect the primary circulation lines to manifold "supply" and "return" quick couplers at the back of the central mobile enclosure. Quick couplers are attached to both ends of the primary circulation lines to enable quick coupling. This also allows the isolation of the primary lines while retaining heat transfer fluid "HTF" in the lines. Plus, set up and dismantling of the circulation system is much quicker.

Figure 18 - Primary Circulation Line Connections

Fuel/Gas Setup

CAUTION! *Propane and Natural Gas DRYAIR systems are designed to be connected and permitted by a licensed supplier or gas fitter only. The system operates on Propane Vapor only! All systems require the use of a liquid line vaporizer. Improper hook-up can lead to an extreme fire or explosive situation!*

Setup - Natural Gas

Provide your local Natural Gas Utility Company with BTUH input and pressure requirements to ensure adequate volume of gas at the correct pressure range.

- A supply of "Natural Gas" should be connected to the manual gas train supply valve at a pressure of approximately 12-14" W.C.
- Be sure the gas service is adequate to feed the water heater cabinet.
- Refer to *Figure 19 - Inputs, Outputs & Temperature Ranges (page 4-13)* to determine water heater capacities.
- Refer to *Figure 20 - Gas Supply - Natural Gas and Figure 21 - Gas Supply - Propane (LP) Gas (page 4-13)* for gas requirements.
- Connect the gas main to the gas line connection on the DRYAIR water heater cabinet.
- In areas where permitted by code, flexible connection hose could be used with multiple access fittings on the gas main.

- The water heater cabinet can be moved to a location near the access port and connected with approved gas hose and connectors.

Setup - Propane Gas

Provide your local Propane supplier with BTUH input requirements to ensure an adequate volume of vaporized propane even in the coldest ambient conditions.

- A supply of "Propane Vapor" should be connected to the inlet of the secondary regulator at a pressure of 10 PSI MAX.
- The DRYAIR propane gas water heaters are equipped from the factory with external mounted, step down propane gas regulator valves adequate to reduce inlet pressures (tank to module) from 8 P.S.I. down to the water heater requirements of 11" WC. This is adequate for most regions. If your propane supply is not in the 8 P.S.I. range, contact DRYAIR for assistance, or your gas supplier for a correctly sized regulator valve.
- Be sure the gas service is adequate to feed the water heater cabinet you are installing.
- A "Propane Line Vaporizer" (available through your propane supply outlet) is required for the proper operation of this system.
- To use the DRYAIR system without a vaporizer will result in inadequate and inconsistent fuel delivery. DRYAIR will not be responsible for the system's operation if a vaporizer is not used.
- Connect the propane supply line to the inlet of the gas regulator located on the water heater cabinet. Open the fuel supply and check for leaks. Close off the fuel supply.
- Always check for gas leaks around fittings and connectors before proceeding to the electrical connections.

Fuel Specification Charts

	Raypak 1223 - Natural Gas		Raypak 1223 - Propane	
Gas Input & Output Capacities – Million BTU's / hour				
	Input	Output	Input	Output
Elevation 0 – 2000 ft.	1222.5	1014.7	1124.7	933.5
Elevation 2000 ft.- 4500 ft	1100.25	913.23	1012.2	840.1
Water Heater Temperature Range	54°C – 82°C (130°F – 180°F)		54°C – 82°C (130°F – 180°F)	
Note: Input & output capacities are as shown utilizing normal fuel calorific values:	1,000 BTU's/cu. ft.		24,197 BTU's/Liter	

Figure 19 - Inputs, Outputs & Temperature Ranges

- This system is calibrated to run efficiently with the gas settings shown in the chart above, and burning fuel with the following calorific values:
  - Propane – 24,197 BTU/Liter
  - Natural Gas – 1,000 BTU/ft^3
- If calorific values are other than shown above, adjustments to the water heater gas pressure could be required. Contact a factory representative for instructions.

The tables at right show the ranges for which the Manifold, Supply and Regulator pressures should be set

	Raypak 1223
Natural Gas	
Supply Gas Pressure – Max.	14" W.C.
Supply Gas Pressure – Min.	6"W.C.
Manifold Gas Pressure – Max.	4"W.C.
Manifold Gas Pressure – Min.	3.5"W.C.
Connection	1 ½"

Figure 20 - Gas Supply - Natural Gas

	Raypak 1223
Propane (LP)Gas	
Primary Regulator Pressure	8 PSI
Secondary Regulator Pressure	11"W.C.
Manifold Gas Pressure – Max.	11"W.C.
Manifold Gas Pressure – Min.	10"W.C.
Connection	Min. ¾"

Figure 21 - Gas Supply - Propane (LP) Gas

Gas Connection (Licensed Gas Tradesman)

- Natural Gas to Propane conversion – propane gas regulator valve mounts at location.
- For gas requirements refer to *Figure 20 - Gas Supply - Natural Gas and Figure 21 - Gas Supply - Propane (LP) Gas (page 4-13).*

Note: *Any work on Natural gas and Propane fuel lines must be performed by a licensed gas tradesman and must conform to all local gas codes for water heater appliance installations.*

Removing and Re-Installing Burner Tray

- Check that all conversion kits components are accounted for:
  - Natural Gas to Propane Kit
    - One storage box
    - One propane burner tray – check data plate to confirm burner tray specs.
    - One step-down, external mounted, propane gas regulator (tank to module) from 8 P.S.I. down to the water heater requirement of 11" W.C.

Figure 22- Conversion Kit (Propane CSD-1 Model Shown)

  - Propane to Natural Gas Kit
    - One storage box
    - One natural gas burner tray – check data plate (Figure 8-1, item 9) to confirm burner tray specs.
- The burner/gas train will be removed as a complete assembly.
  - It includes manufacturer's data decal, manifold, orifices, burners, pilot burner assembly, 2-stage natural or propane valve, diaphragm firing valve on propane units only, shut off "A" valve and pilot "B" valve.
  - The alternate burner/gas train will be installed as a similar complete assembly.
- The following components must be removed to access the burner/gas train.
  - Three (3) exterior doors on the front side of the cabinet (Remove shipping screws).
  - Two (2) interior door (Remove shipping screws).
  - Two (2) divider posts between exterior doors. Two (2) bolts at the top and two bolts at the bottom will need to be removed.
  - One (1) divider post between exterior doors. Exert upward pressure and this post will pop out.

Figure 23 - Model 2000-1200 CHU Ready for Conversion

- Make sure that the power supply to the system is disconnected.

- The following wire connectors can now be unhooked: make note of the location to which each terminal is connected.
    - The orange ignition cable and green ground wire which lead down to the pilot assembly.
    - The three (3) clip-on connectors that connect wires to the main 2-stage gas valve.
    - The two (2) clip-on connectors that connect wires to the diaphragm valve. This valve will be present if the gas train is for propane. If it is a natural gas train, these two wires will not be connected to anything.
    - The two (2) clip-on connectors that connect wires to the pilot valve.
- Make sure that the gas supply to the system is disconnected.
- The following gas pipe/tube connections can now be unhooked (be certain to use a back-up wrench when loosening or re-tightening fittings).
    - The 1 ¼" steel union which connects the main gas supply.
    - The ¼" tubing which is connected to the outlet port on the under-side of the 2-stage gas valve. You will have to remove the angle compression fitting for use on the alternate gas train. Make note of the port in which this fitting was installed.
    - The ¼" tube which is connected to the ventilation port of the diaphragm valve. This diaphragm valve will be present only if the existing gas train is propane. If the existing gas train is natural gas, this ¼" tube will not be connected to anything, but you will need to connect it when you install the propane gas train.
- There is one (1) bolt at each end of the burner tray frame that must be removed.
- The entire burner/gas train can now be easily slid out. Store in a safe, dry place.
- The alternate burner/gas train can now be installed by reversing the above procedures.
- Observe the following details as well:
    - Be certain the burner/gas train you are about to install is the correct format for the gas type you intend to use.
    - Use an approval grade of thread sealant when installing gas fittings. Soap-test all connections for leaks.
    - Test-run the system to confirm the proper function of all operating and safety controls.

Observe all permit and inspection processes as required by the local authority having jurisdiction.

Fluid Circulation System

Positioning Specifications

- Keep 2” hose out of high traffic areas.

Hose Length Limitations

- 2” hose ……..No more than 300 feet one way *(Figure 24)*
  No more than 200 feet two ways *(Figure 25)*
- ¾”, 1”, 1 ¼” hose…....No more than 100 feet to the Portable Heat Exchangers *(Figure 26)*

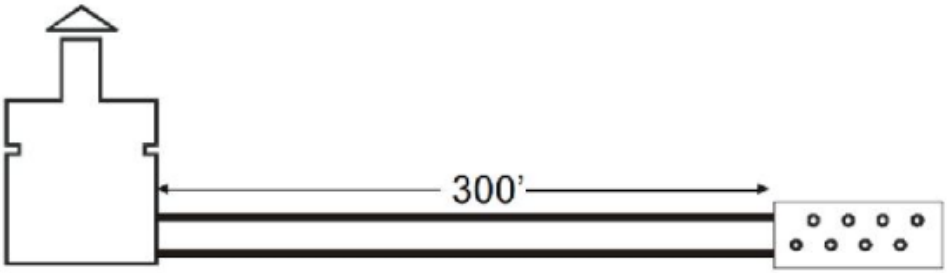


Figure 24 - One Way

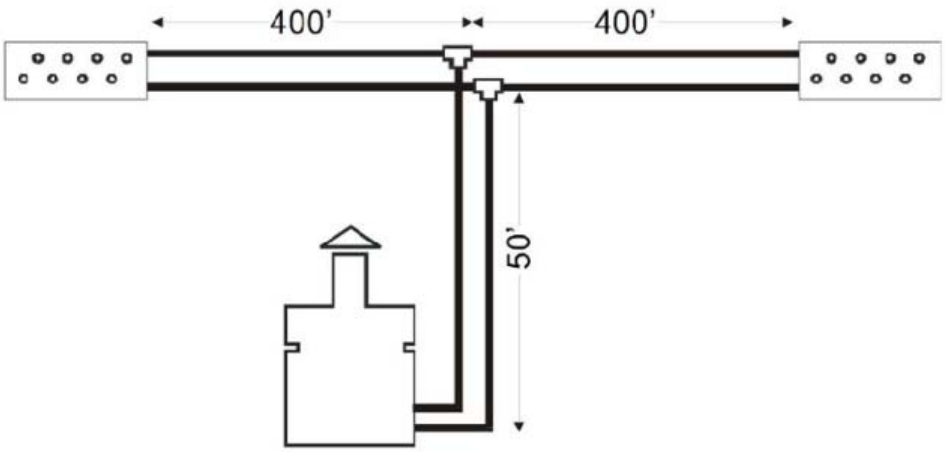


Figure 25 - Two Way

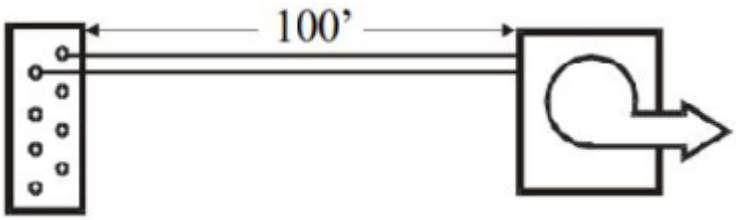


Figure 26 - Manifold to Portable Heat Exchanger

Circulation Line Connections

Figure 27 - 2” Connection to Water Heater Cabinet

- Connection of the 2” circulation line involves attaching the 2” circulation lines to the camlock fitting on the water heater cabinet and circulation manifolds. Isolation valves and camlock quick couplers are attached to both ends of the 2” circulation lines to enable quick coupling. This allows the isolation of the 2” lines and retaining of the HTF fluid in the lines. Set-up and dismantling of the circulation system is much quicker.
- Make sure that the pump is turned off and the isolation valves are closed before uncoupling the camlocks. Failure to do so may put you at risk of injury from eye or skin exposure to hot glycol.
- Multiple circulation manifolds can be positioned at choice locations along the 2” circulation system.
- Attach the ¾”, 1” or 1 ¼” secondary circulation lines to the circulation manifold. Quick couplers similar to those used with hydraulic systems are used. The coupling and uncoupling of ¾”, 1”, and/or 1 ¼” circulation lines can be accomplished with the system under pressure.
- If outside lines must be insulated, use insulated line jackets *(Figure 6; page 3-5)*.

5. Initial Start-Up

Note: *It is very important that the following steps be observed when starting the system for the first time.*

Before Proceeding

Before Proceeding with the *Initial Start-Up* procedures:

- Confirm that the *Cabinet Positioning* procedures on *page 4-8* have been completed.
- Confirm that the *Fuel/Gas* procedures on *page 4-11* have been completed.
- Confirm that the *Electrical Requirements & Connection* procedures on *page 4-9* have been completed.
- Confirm that the chimney has been removed from chimney holder and placed into position and secured by screws.

Electrical Check & Power-Up

- Make sure the gas supply is closed off and all electrical switches are off.
- Supply power to the system.
- Turn on all breakers.

Fluid Circulation System Start-Up

- The DRYAIR water heater cabinets, portable heat exchangers and ¾", 1", 1 ¼" or 2" circulation line are shipped pre-charged with HTF.

Purging Air from System

Primary Circulation Line – 2" Lines

- Confirm that all valves are open in the fluid transfer system and the fluid tank is filled to a proper operating level. (¼ to ¾ filled).
- Make sure no ¾", 1" or 1 ¼" circulation lines are hooked up to manifolds.
- Connect a circulation loop (1" circulation line) into the last circulation manifold in the circulation system.
- Make sure the 2" supply and return lines are hooked up to the cabinet.
- Open the air elimination valve in the open position. This will release the air from the system.
- Turn the supply and return valves in the open position and start the pump.
- Make sure the reservoir stays at least ½ full at all times.

Figure 28 - Primary Circulation Line Connections

- Circulate until there is no air left in the system. To determine that all your air is out of the system, the system pressure gauge will maintain a steady P.S.I. reading.
- Check for leaks or improperly attached 2” camlocks.
- Remove circulation loop.

Secondary Circulation Lines – ¾”, 1”, 1 ¼” Lines

- Hook up all the secondary circulation lines to the Portable Heat Exchangers and circulation manifold.
- Allow the fluid to circulate for 10 minutes or more while connected to a Portable Heat Exchanger. This will purge any air remaining in the circuit.
- Close elimination valve so only 10% of flow is passing though the loop.
- When the circulation and purging process is complete, top up the reservoir (¼ to ¾ full) with HTF.
- Check for leaks or improperly attached quick couplers.

Before Firing the System

Note: *See Figure 29 for item references from this section.*

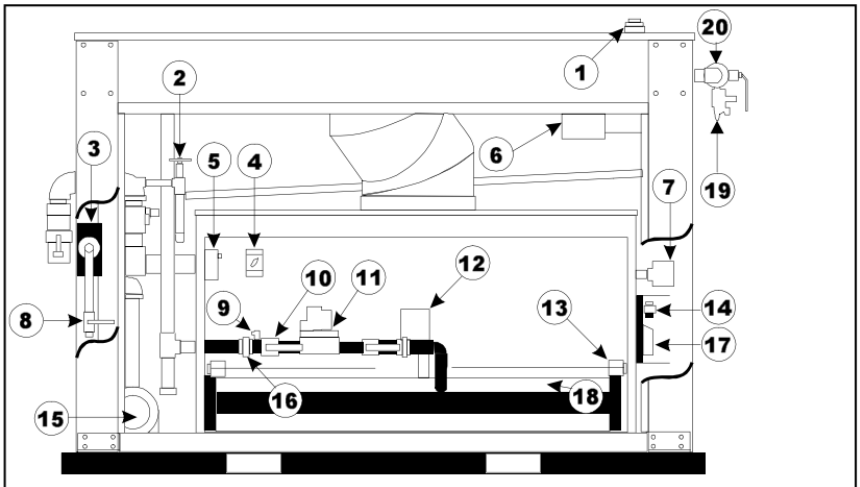


Figure 29 - Water Heater Cabinet Diagram

1. Bleed Gas Line:
    - With door panels removed from the front of the cabinet and the heating unit, loosen the gas line union (item 16) and open exterior gas line valve (item 20) only enough to purge air from gas line.

- Tighten union again and allow 15 minutes for possible gas accumulations to ventilate from the enclosure.

CAUTION! *Propane gas is heavier than air. In the event of a leak, or odor of gas is noticed, immediately turn off all power switches and the main gas supply to the water heater cabinet. Ventilate the water heater cabinet. Find and correct the leak before turning on any power or trying to re-light the water heater.*

2. Open the exterior gas line valve completely. Soap-test the union for leaks.
3. Open the firing valve (item 10) and pilot "B" valve (item 9) on the gas train.
4. Turn on all the breaker switches on the control panel.
5. Turn on the pump.
    - Flip the pump toggle switch on and run the pump to confirm that there is no air left in the fluid transfer system.
    - The "System Pressure" gauge should hold at a steady reading of between 25 to 35 P.S.I.
6. Check the setting of the aquastat (item 5). Confirm that the setting is between 140°F and 190°F (60°C and 88°C).
7. Check that the setting of the high limit switch (item 4). Confirm that the setting is between 200°F and 210°F (93°C and 99°C).
8. Confirm that there are no Portable Heat Exchanger fans in operation.
9. The Water Heater is now ready to be fired, proceed with *Initiate Firing*.

Figure 30 - Control Panel

Initiate Firing

1. Flip the water heater's toggle switch on.
2. All the indicator lights should be on once burner is firing, low fire light will not come on until pilot light is lit.
3. The spark igniter will immediately begin its attempt to light the pilot. It will continue this for 15 seconds or until the pilot lights.
4. After 15 seconds the spark igniter will lock out if the pilot flame has not yet been established (this could happen due to air in the pilot line).
5. If the pilot flame has not been established, turn the water heater's toggle switch off and back on again to re-initiate the lighting sequence.
6. As soon as a pilot flame is established, the main gas valve will open, and the burners will light. The burners will continue on High Fire until the fluid in the system reaches the set temperature. The flame will now extinguish. When the fluid cools a few degrees below the set point, the burners will ignite on Low Fire. If the set point temperature cannot be achieved and maintained with Low Fire, the aquastat will call for High Fire until the set temperature is achieved. It will then switch back to Low Fire and the cycle will repeat. If the Low Fire mode

is capable of achieving and maintaining the set temperature, the aquastat will not switch up to High Fire, but will instead cycle the burners between Low Fire and Off.

7. Confirm Gas Pressure
    - Check the gauge on the control panel labeled "Gas Manifold"
        - Propane
            - High Fire – 11" W.C.
            - Low Fire – 2.75" W.C.
        - Natural Gas
            - High Fire – 4" W.C.
            - Low Fire – 1.2" W.C.

CAUTION! *A minimum return temperature of 130°F (54°C) must be maintained. Operating the water heater with a return temperature below 130°F for an extended period of time will cause condensation in the water heater heat exchanger which will lead to sooting in the heat exchanger and eventual system shut-down. Condensation of the water heater heat exchanger will eventually lead to corrosion damage and eventual failure.*

Raising HTF Fluid to Set Temperature

- First, make sure that none of the Portable Heat Exchanger fans are in operation. The Portable Heat Exchanger fans must be turned on in succession.

Cold Structure

- Plug in the first Portable Heat Exchanger fan and verify that the fan is running.
- With the first Portable Heat Exchanger fan running, monitor the "Return Temperature" gauge at the control panel.
- When the "Return Temperature" rises above 130°F (54°C), plug in another Portable Heat Exchanger fan.
- Repeat the first three steps with another Portable Heat Exchanger until the return temperature does not rise above 130°F. At this point, the water heater will be operating at full capacity and will be unable to maintain the minimum temperature of 130°F.
- Disconnect the last Portable Heat Exchanger fan and the return temperature will again rise to above 130°F.

As the Structure Warms Up

- More Portable Heat Exchangers may be added at a later time as the temperature in the structure rises.
- If more Portable Heat Exchangers are added, repeat the step in the previous "Cold Structure" section.

6. Operation

Be sure to entirely read and understand this section before trying to start and run your new DRYAIR system. It is important that you follow the Start-Up and procedures for your system very carefully. If these procedures are not followed the system will not perform to its fullest and system failure may eventually result.

Water Heater Cabinet

Controls

The DRYAIR system has one manually set control required for normal operation. There are also several controls that are factory set, and normally do not require adjustment. Any adjustments that you make will require some patience before the system has fully settled.

Aquastat

- Temperature control is provided by the Aquastat.
- This thermostat controls the maximum supply water temperature (factory adjusted to 180°F (82°C)).
- The Aquastat sensor is located on the water heater outlet piping.
- The Aquastat is used as a primary high temperature limit control.

Note: *It is essential to the proper operation of your system that the Aquastat setting is lower than the High Limit Thermostat setting. The DRYAIR circulation system cannot withstand fluid temperatures in excess of 200°F (93°C) for extended periods of time. Do not adjust the Aquastat to a higher temperature than 200°F.*

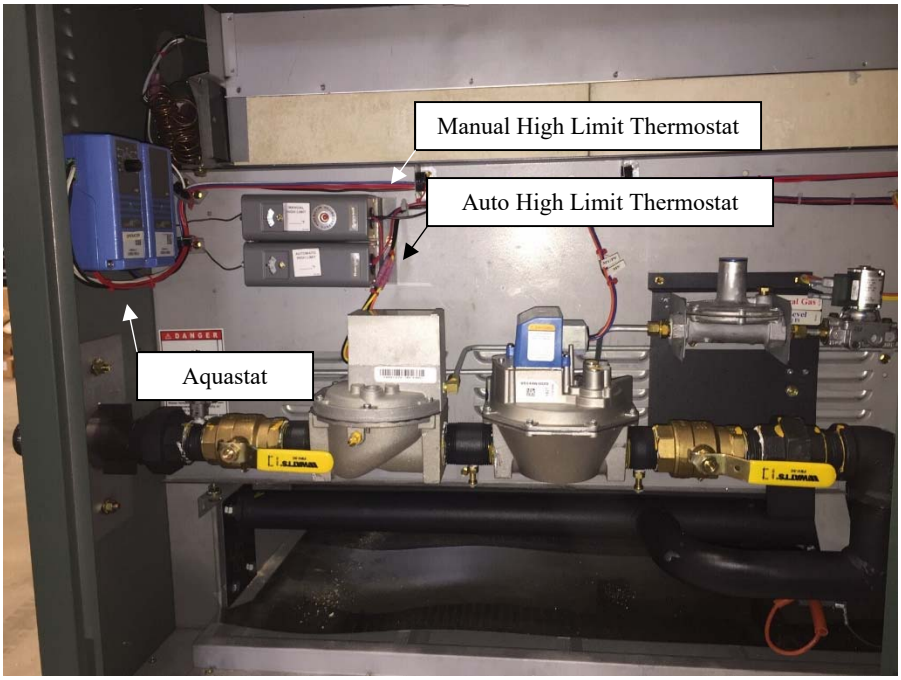


Figure 31 - Water Heater Cabinet

High Limit Thermostat

- A second level of control is provided by the High Limit Thermostat.
- This control will override all other temperature controls if its set point (factory set to 200°F) is exceeded.
- The high limit temperature cut out is a CSA required safety switch set to shut down the water heater if the fluid temperature exceeds the set point.
- Canadian models will automatically reset once the fluid temperature cools to below its set point.
- U.S. models need to be reset by pushing the reset button.
- It is essential to the proper operation of your system that the High Limit Thermostat setting is higher than the Aquastat setting.

Pump On/Off Toggle Switch

- The Pump On/Off Toggle Switch is located on the electrical panel and used to operate the pump.
- Turn this switch on first, before turning on the water heater.

Water Heater On/Off Toggle Switch

- The Water Heater On/Off Toggle Switch turns on the water heater's control system.
- It is located on the electrical panel.
- When the water heater electronics are turned on and the water heater fires all the indicator lights will be on.
- The high fire light will go out if the water heater is operating on Low Fire. The Low Fire, High Fire, Pilot Valve, and Operator lights will go out if the burners are not operating.

Figure 32 - Indicator Lights & Toggle Switch

Flame Roll-Out Switch

- The Flame Roll-Out Switch is a safety control which has a 48" capillary tube strung across the front of the water heater. There is one located on either end of the water heater.
- Should the water heater experience a flame roll-out or abnormal rise in cabinet temperature, the switch will cause the water heater to shut down.
- This switch must be manually reset.
- Should a flame/heat roll-out situation occur, reset the Flame Roll-Out Switch, turn off the ON/OFF Switch and wait for 5 minutes. Turn the ON/OFF Switch back on.
- If the problem persists, initiate *Troubleshooting* procedures on *page 7-1*.

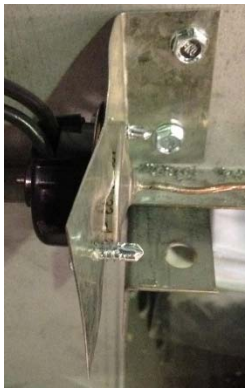


Figure 33 - Flame Roll-Out Switch

Low Water Cut-Off Switch

- The Low Water Cut-Off Switch is a safety control located at the bottom of the HTF reservoir.
- Should the fluid level in the reservoir be allowed to drop below the Low Water Cut-Off Switch, the water heater pump will shut down.
- The switch will automatically reset and will allow the water heater to operate normally when the fluid reservoir is tipped up.

Figure 34 - Low Water Cut-Off Switch

HTF Flow Switch

- The HTF Flow Switch is mounted to the water heater manifold.
- Should the pump become unable to provide the required minimum fluid flow rate, the HTF Flow Switch will shut down the water heater.
- The water heater will operate normally once fluid flow has been re-established.

Figure 35 - HTF Flow Switch

Thermostatic Control Valve

- Tempering valve (factory adjusted).
- The Thermostatic Control Valve tempers the fluid entering the water heater to help maintain a fluid temperature to 130°F (54°C).
- The water heater cannot operate for extended periods of time with fluid entering below 130°F. Corrosive condensation can form on the combustion side of the heat exchanger and may result in perforation.

Note: *If you notice a fluid temperature on the water heater Return Gauge lower than 130°F, adjustments may be necessary. Contact your dealer for instructions.*

Figure 36 - Thermostatic Control Valve

Pressure Bypass Valve

- The Pressure Relief Valve maintains a minimum fluid flow through the water heater as outside circuits are closed off.
- It also ensures that fluid flow through the external circuits is optimum for the number of Portable Heat Exchangers operating.
- This valve is factory set and does not need adjustment under normal operation.
- In the event that fluid flow is not adequate to close the flow switch, but the pump is operating and at least one external circuit is open (Portable Heat Exchanger connected and operating), this valve may be adjusted.
- Open slowly until enough flow is present to operate the water heater and there is a difference in temperature from the Return Header Temperature gauge and the Supply Fluid Temperature gauge of 30°F (-1°C) or less.

Figure 37 - Pressure Bypass Valve

Safety Relief Valve

- The Safety Relief Valve opens when the circuit pressures exceed 60 P.S.I. (AMSE standard).
- Although this valve is required, it has no function with the DRYAIR system. The DRYAIR system is an open fluid loop with an atmospherically vented fluid tank.

Figure 38 - Safety Relief Valve

Drain Valve

- Use the Drain Valve any time you need to remove fluid from the system for service work.
- Isolate your system by closing off the 2” ball valves which are located on the outside of the cabinet.
- Connect a garden hose to the fitting and drain the HTF into a clean plastic container.
- By keeping the fluid clean, you can re-use it once the service work has been completed.

Figure 39 - Drain Valve

Gauges

The DRYAIR Raypak water heater and system is equipped with the following gauges:

System Pressure

- Measures the pressure of the HTF fluid within the water heater and HTF fluid circulation loop.

Manifold Gas Pressure

- Measures the pressure of the gas at the burner manifold location.
- This pressure must be within the ranges specified on the manufacturer's "Data Plate" *(Figure 29, item 12 on page 5-2).*

Figure 40 - Control Panel

Supply Temperature

- Measure the temperature of the HTF fluid at the supply side of the water heater.
- The temperature must be maintained between 130°F and 180°F (54°C and 82°C).
- This temperature is adjustable utilizing the Aquastat.

Return Temperature

- This gauge reads the temperature of the HTF at the return side of the water heater.
- This temperature must not drop below 130°F (49°C).

Note: *If you notice a fluid temperature on the Return Temperature gauge lower than 130°F, adjustments may be necessary. Contact your Dealer for instructions.*

Adding “HTF” to System

Verify that the power supply is correct, and the electrical hookup is as specified in “Setup.”

- Ensure all breakers are in the “On” position.
- Add premixed “HTF” to the 2” bung on top of the glycol tank (see “Setup” for heat transfer fluid specification).
- While watching the glycol level gauge, continue to fill the system until the glycol level gauge shows ½ full.

Figure 41 - HTF Fill Cap and Gauge

Note: *Caution must be taken when approaching the ½ full mark as it could take 2-3 seconds to register the actual level.*

In the case of overfull situations, do the following:

- Attach a drain hose to the drain valve.
- Insert drain hose into a barrel, pail, or jug with sufficient room for the “HTF”.
- Open drain valve to release “HTF”.
- Once the desired amount of “HTF” has been attained and the glycol level gauge is showing ½ full, turn the drain ball valve to the “Closed” position and continue with the following procedures.

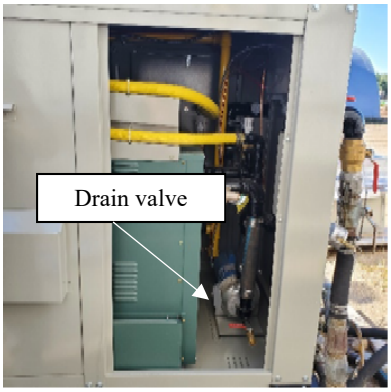


Figure 42 - Circulation Pump/Drain Valve

7. Troubleshooting

- There are 11 troubleshooting/warning lights on the control panel. The 10 green lights indicate the status of a sequence of functions while the unit is running. There is also one red warning light, which indicates low HTF levels.
- When the burner is on, all green lights should be on. Any light that is not illuminated while the burner is on should be considered burnt out.
- The Operator light (item 7) and Burner lights (items 9 and 10) will turn ON and OFF as the burner cycles.
- Refer to *Appendix - Electrical Schematic* for terminal locations.

Note: *Service Technicians – For more troubleshooting on the water heater, refer to the Raypak Manual, which you will find included with this manual package.*

Water Heater & Circulation System

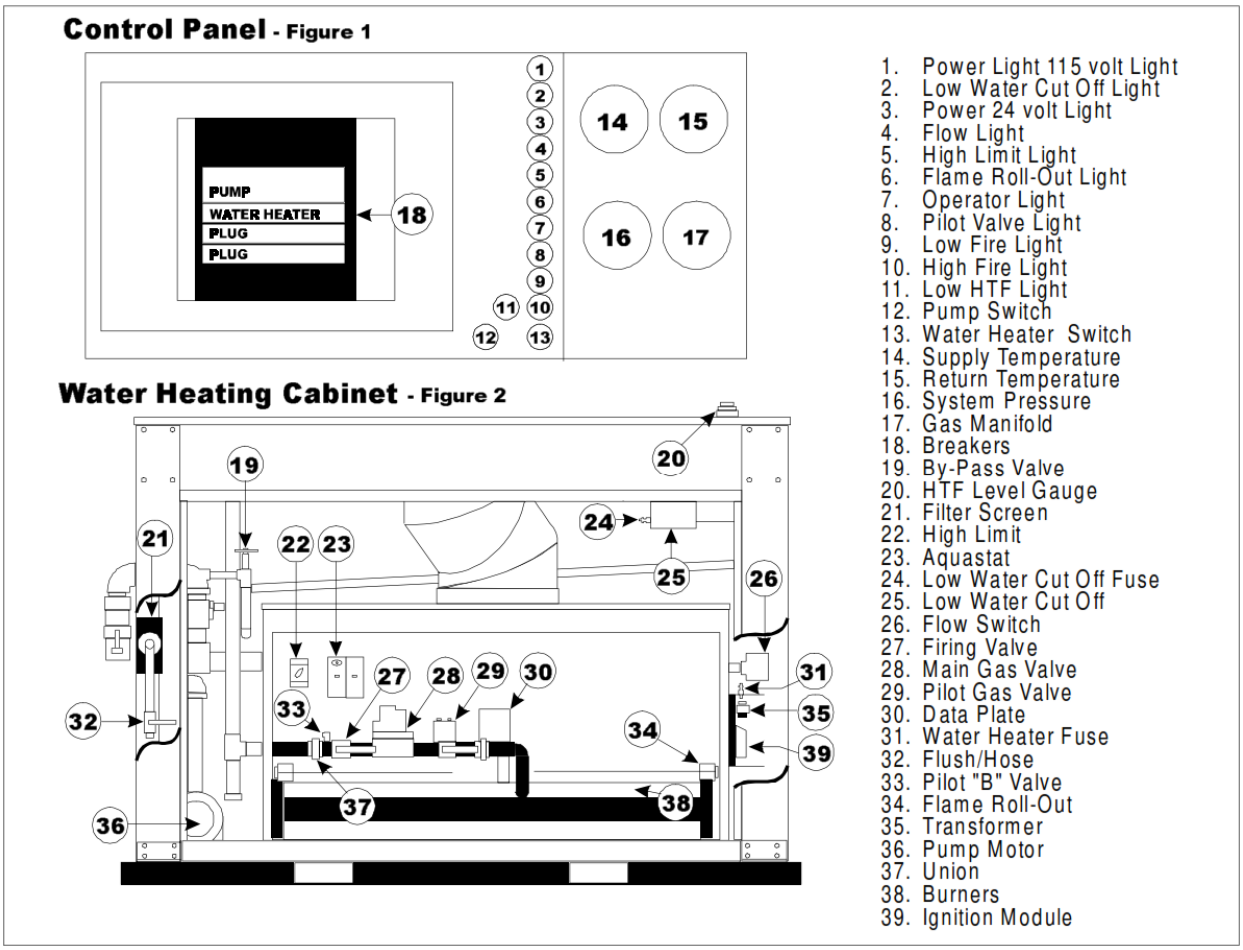


Figure 43 - Control Panel & Water Heater Cabinet Layout

System Operating Properly but One or More Lights Are Off

- One or more lights are disconnected or burnt out
  - Check lights and change if necessary

No Power at Outgoing Side of Water Heater Toggle Switch

a) Check for 120V power on bottom of water heater breaker, if no power ensure breaker is on.
b) If no power, check power supply to unit.
   - Investigate power source and be certain that the power characteristics are correct. (115-230V, 30A, single phase, 4-conductor, 0'-100' – 10 AWG, over 100' – 8 AWG)
c) If power coming out of breaker, check the 120V power coming off water heater toggle switch. If no power, change the toggle switch. If power, check light bulb for burn out.

No Power at Terminal #4 on Low Water Cut-Off (item 25)

a) Lower water situation.
   - Check fluid level (20) in tank and add if necessary.
b) Defective lower water cut-off (25).
   - Check by grounding out white wire going to sensor to the screw that holds the cover on the LWCO. If light comes on, replace the LWCO sensor before continuing. If the light does not come on, check that the bulb is not burned out. If bulb is good, replace LWCO.
c) No power at low water cut-off.
   - Check fuse (24) located on low water cut-off.

No Power at 24V Side of Transformer (item 35)

a) Defective 24V Transformer.
   - Check for 120V power at the transformer in back control panel on water heater. If power check for 24V power coming out of the transformer. If no power, replace the transformer. If power, check that 3A breaker on side of back control panel has not tripped. Reset as needed. If power going through, check light bulb.

No Power at Outgoing Side of Flow Switch (item 26)

a) Pump Not Running
   - Check pump breaker (item 18) and toggle switch (item 12) on control panel.
   - Check for 230V at pump motor (item 36). If correct power is confirmed at motor, but pump won't run, replace pump.
b) Inadequate Flow
   - Check that all valves are open in the fluid-transfer loop.

- Filter screen (item 21) may be plugged. Use flush hose/valve (item 32) attachment into a bucket, while pump running, for a quick flush. Eventually the system may have to be drained and the filter screen removed and cleaned by hand.
- Check that the pressure by-pass valve (item 19) is open, if fluid receiving units are closed off.

c) Defective Flow Switch (item 26)
- If a) and b) check out good, the flow switch will need to be re-calibrated, or replaced.

d) If power, check light bulb.

No Power at Outgoing Side of High-Limit Switch (item 22)

a) High-Limit Switch (item 22) is set too low.
- Check setting of switch. Auto High-Limit should be set at 200°F and the manual set at 215°F. Check that supply temp is not higher than set point of the High-Limit

b) Defective High-limit switch.
- Check for 24V going in and out of switch. If there is power in, but not out and the switch setting is found to be correct, replace switch.

c) If power is going through, check if light bulb is burned out.

No Power at Outgoing Side of Flame Roll-Out Switch (item 34)

a) Flame has contacted the copper capillary tubes.
- Check the manual reset buttons on the two switches and reset. If they are tripped, restart system and watch for a flame roll-out from the bottom of the heat exchanger. If flame is rolling out the bottom of the heat exchanger, shut down immediately and check for blockages.
- Check for blockage in the heat exchanger in the form of foreign debris or soot build up. See Operator's Manual for proper cleaning procedure.
- Check the entire vent system for possible blockage or restriction and correct any problems.

No Power at the Outgoing Side of the Aquastat (item 23)

a) No call for heat.
- Temperature of fluid may be at or above set-point temperature when unit is working correctly. When the heat transfer fluid cools below the set point of the aquastat (23), the switch will close and call for heat again.
- Set point of aquastat may be set too low.

b) Defective Aquastat.
- Verify that the scenario above is not the case.
- Check for 24V power on COM (power in) and 24V out on N/O on left aquastat. If no power, check temp sensor (CALL DRYAIR FOR ASSISTANCE). If no power out of N/O on aquastat and sensor checks out, replace aquastat. This aquastat is calling for low fire heat only. If power out, check bulb.

No Power at Pilot Valve (item 29)

a) Defective Ignition Module (item 39).
   - Light should come on and try to spark, if light does not come on, check for power at PV on ignition module. If no power, check for power at 24 input. If power, check that pilot is not still lit. There could be a small flame causing the ignition sequence to fail. If the pilot is lit with the pilot valve light off, replace the pilot solenoid. If light comes on and unit begins to spark but pilot does not light, check that the unit fuel supply has been bled properly. If pilot will not light check that the pilot orifice is not plugged. Replace orifice if necessary. If pilot lights but continues to spark for the 90 sec. trial period, replace the pilot assembly. If pilot does not spark replace the ignition module.

No Power at Main Gas Valve (item 28).

a) Defective Ignition Module (item 39).
   - If pilot is light and light #9 does not come on but #10 is on, unit is calling for high fire heat but burner is not lighting. Check that the fresh air vent is not plugged. May need to take vent line off right at redundant valve and remove the 90deg compression fitting elbow on the valve. If this fixes issue, blow out vent line with air. Reconnect once blown out. If this does not repair the issue, check that redundant valve is opening. Check for 24V power in and out of the valve. If there is no power coming out replace the redundant valve. If power is coming out, check for power at PV on the two stage gas valve. If power in and still no burner, replace two stage gas valve (valve must fire on low fire to get high fire but can run on low fire with faulty high fire). Insure proper gas supply. Low gas pressure can also cause burner to not light even though the pilot is lit. Natural gas 14" WC supply, propane 10psi from tank to unit, regulator on unit converts gas supply to inches.

No Power at MV on Gas Valve (item 28).
Burner Should Be Operating on Low Fire.

a) If #10 light off check that aquastat set temp is within 10F of supply temp. If temp range is greater, check that the red light located on the right side of the aquastat (hi fire) is coming on. If light is off, check the differential and offset dials inside the two aquastats (CALL DRYAIR FOR CORRECT SETTINGS). If light is on check for 24V power on N/O on right side aquastat. If not power replace aquastat.
b) If power, check for 24V power on MV wire on two stage gas valve. If no power, check wire between aquastat and gas valve. If power there, replace gas valve.

All Lights On
The aquastat (item 23) is calling for heat but the burners are not operating.

a) Replace main gas valve (28) or redundant valve (on propane only; located to the left of the main gas valve).

Light 11 Blinking Red
Low HTF

a) Add glycol to half a tank if needed. Light will only come on when 24V power light is on.

FOR ADDITIONAL ASSISTANCE CALL DRYAIR TECHNICAL SUPPORT 1 (888) 750-1700

8. Maintenance

The DRYAIR system is designed to be a low maintenance system. All system equipment is assembled using extensively tested and certified components. Following these maintenance procedures will ensure the maximum benefit and minimal downtime for the system. The daily maintenance schedule is designed to be a quick system check and ensures a low risk of operating interruptions. Additional supplemental information provided by component manufactures such as the hose reel and is included with each unit. Use the supplemental information for maintenance procedures and frequency as directed.

Daily Checklist

A daily inspection of the water heater cabinet should be performed with attention paid to the following:

Check for Strong Odor of Fuel

- If a leak or the odor of fuel is noticed immediately turn off all power switches and the main fuel supply to the water heater cabinet.
- Ventilate the water heater cabinet.
- Find and correct the leak before turning on any power or trying to relight the water heater.

Check Heat Transfer Fluid "HTF" Level Everyday

- Maintain between ¼ and ¾ on the heat transfer level gauge when fluid is hot.
- Top up, as necessary.
- For "HTF" specifications, see "Setup, Heat Transfer Fluid, "HTF", Fluid Specifications.
- For "HTF" handling precautions, refer to "Safety Concerns, Material Safety Data Sheet".
- If loss of fluid is excessive check for leaks at all the fittings and connections in the water heater cabinet, as well as the fluid circulation system.

Check the Operation of the Pilot and Gas Burner

- For intermittent electric pilot models, verify the pilot cycles on and off normally once per day.
- On propane versions, the pilot should be on constantly.
- For natural gas models, the pilot will light only when the water heater is required to fire the burner.

Check the Light Panel for Indication of System Failure or Bulbs That Are Burned Out

Seasonal Checklist

Water Heater Cabinet

- Water heaters operated continuously should be inspected every 6 months.
- Seasonal or intermittently operated water heaters should be inspected at the end of each operating season.
- Water heaters that have not run for more than 60 days should have a complete inspection and must be started up as if they were new.

Heat Exchanger

- Water Side
  - Disconnect the circulation system and remove the header casting, exposing the ends of the tubes.
  - Make sure they are clear of scale on the inside and there are no restrictions to fluid flow. If scale is apparent, use a stiff wire brush or mild muriatic acid solution to clean to bare metal. To prevent scale re-occurrence, check for proper water flow, and correct HTF type and blend.
- Fire Side
  - Remove and support the chimney, then remove the draft hood and inspect the copper fins for carbon build-up.
  - If cleaning is required, remove the water heater top, inner flue cover, and burner drawer. Clean with a high-pressure air gun and a **soft, non-metallic** brush. Carbon particles are explosive, and a spark could ignite them.
  - While the water heater is open, check for cracks or deterioration of the fire brick. Replace if required.
  - If the tubes show signs of warping or deterioration, contact the Service Department. Tube warping or deterioration may be cause by low water flow or chemical corrosion (impure or non-specified HTF).

Burner and Pilot

- Turn off the gas main.
- Disconnect the pilot tubing and the thermocouple or flame sensing wire.
- Break the main gas union and pull out the burner drawer. If any parts of the burners or their retainers are damaged or worn, replace them.
- For water heaters out of service for more than 60 days, disassemble and clean the pilot with a soft brush. Make sure it is clear of any obstruction.
- For electric ignition pilots, check the spark gap (see the Raypak operator's manual) and flame sensor.
- Check the pilot porcelain for cracks or damage.
- Check the pilot ignition and sensor wires for deterioration and replace, as necessary.
- Re-assemble the water heater and follow start-up instructions.

Circulation Pump

- The pump requires no special maintenance other than the specified manufacturer's pump manual information provided as part of the literature package with each DRYAIR system.

Figure 44 - Circulation Pump

Aquastat

- Verify the operation of the Aquastat by checking the temperature of HTF leaving the water heater when the burner is off.
- Turn the Aquastat set-point down to the temperature noted.
- If the burner does not turn on continue reducing the Aquastat set-point until the burner turns off or a "click" is heard at the Aquastat housing. Note the setting of the Aquastat.
- Read the temperature of the HTF once the burner turns off. If the difference between the set-point and the actual temperature is more than 10°F, replace the Aquastat.
- If a click is heard but, the burner does not turn on, check the wiring from the Aquastat to the control box, then have the Main Gas Valve tested.

HTF Flow Switch

- Test by turning off the pump while the burner is on. The burner should immediately turn off.

Figure 45 - HTF Flow Switch

Flame Roll-Out Switch

- Test by exposing it to heat by holding a match or lighter below the capillary tube while the system is running. This should cause the system to shut down.

Storage

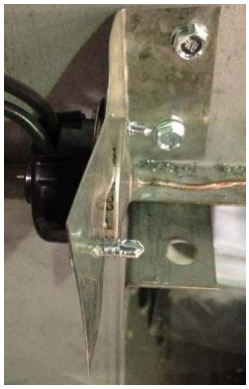


Figure 46 - Flame Roll-Out Switch

Hardware

- Exercise reasonable care when handling.
- Water heater cabinet can be stored outdoors.
- Portable Heat Exchangers should be stored out of the elements.

Hose & Poly

- To extend the life of the rubber and poly components of the system (hoses and air tubes), it is recommended that they be stored out of the sun when not in use.

Heat Transfer Fluid

- Exercise reasonable care then handling.
- Be careful not to spill on hot fibrous insulation. Combustion may occur.

9. Appendix

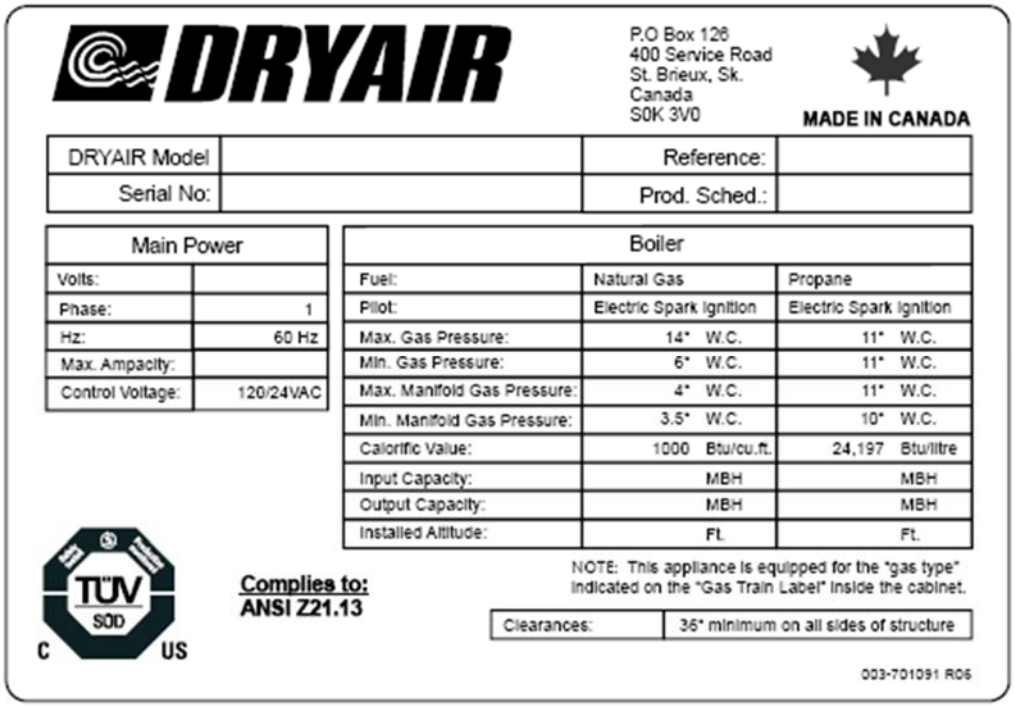
Important Certification & Operational Information

Non-Pressure Vessel

- The unit includes an open atmospherically vented expansion tank
- The expansion tank is integrally connected to the heat-exchanger section of the water heater by means of a permanently open line (no valves).
- The heat exchange section connects to the inlet side of the circulating pump and therefore, only neutral atmospheric pressure is present within the heat exchange section.

Figure 47 - Non-Pressure Vessel Decal

Certification & Heater Specifications



DRYAIR

P.O Box 126
400 Service Road
St. Brieux, Sk.
Canada
S0K 3V0

MADE IN CANADA

DRYAIR Model		Reference:	
Serial No:		Prod. Sched.:	

Main Power	
Volts:	
Phase:	1
Hz:	60 Hz
Max. Ampacity:	
Control Voltage:	120/24VAC

Boiler		
Fuel:	Natural Gas	Propane
Pilot:	Electric Spark Ignition	Electric Spark Ignition
Max. Gas Pressure:	14" W.C.	11" W.C.
Min. Gas Pressure:	6" W.C.	11" W.C.
Max. Manifold Gas Pressure:	4" W.C.	11" W.C.
Min. Manifold Gas Pressure:	3.5" W.C.	10" W.C.
Calorific Value:	1000 Btu/cu.ft.	24,197 Btu/litre
Input Capacity:	MBH	MBH
Output Capacity:	MBH	MBH
Installed Altitude:	Ft.	Ft.

TÜV SÜD C US

Complies to:
ANSI Z21.13

NOTE: This appliance is equipped for the "gas type" indicated on the "Gas Train Label" inside the cabinet.

Clearances:	36" minimum on all sides of structure

003-701091 R06

Figure 48 - Water Heater Data & Serial Plate

Electrical Schematic

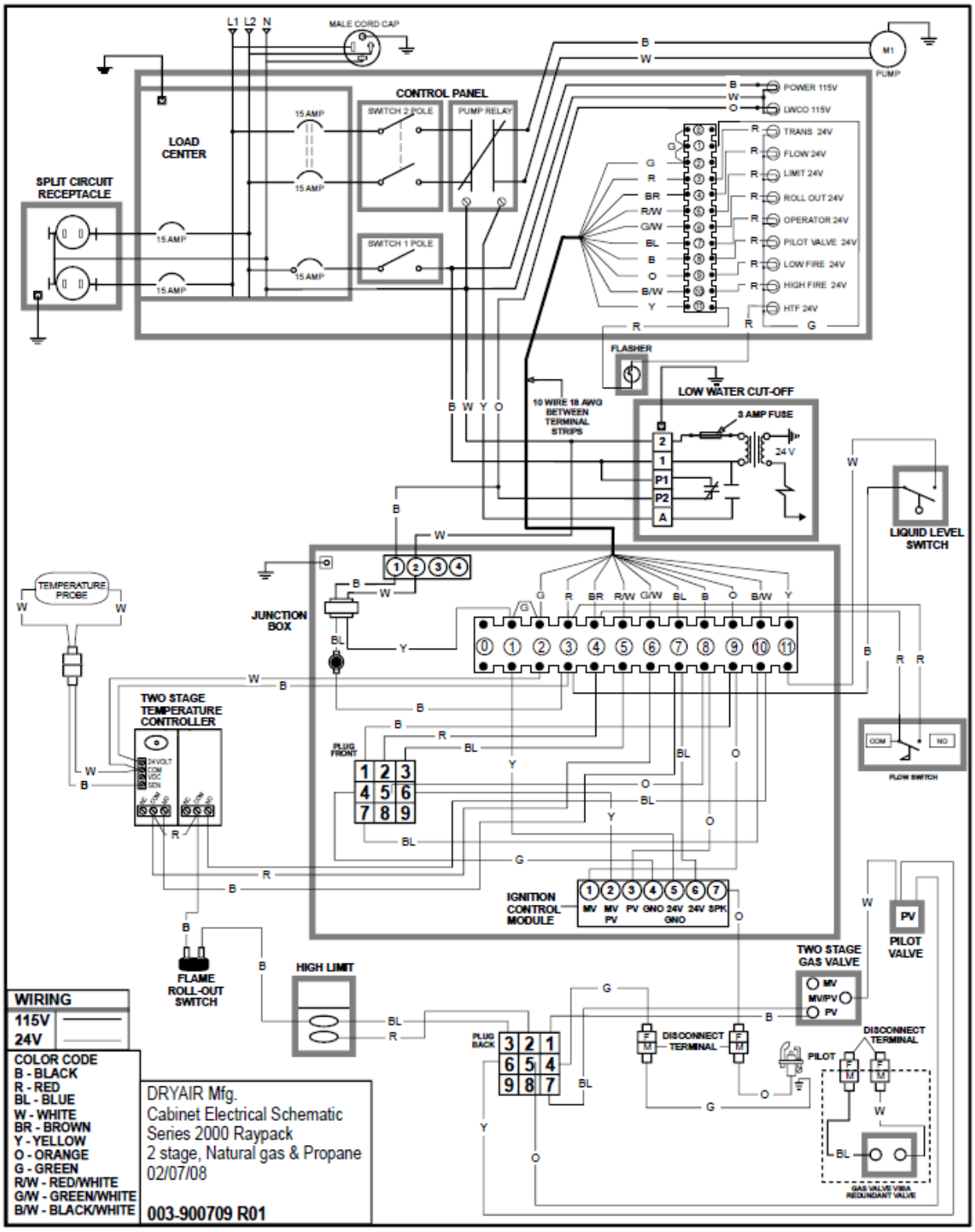


Figure 49 - Model 2000-1200 CHU Electrical Schematic

Material Safety Data Sheets

The Material Safety Data Sheets (MSDS) included with this manual have been provided by DRYAIR's suppliers.

SAFETY DATA SHEET

Issuing Date 03-Jun-2019 **Revision date** 03-Jun-2019 **Revision Number** 1

1. Identification

Product identifier

Product Name BOSS Chill Propylene Glycol

Other means of identification

Product Code(s) GHSRBS-041

UN/ID no. UN 3082

Synonyms None

Recommended use of the chemical and restrictions on use

Recommended use Heat transfer medium

Restrictions on use No information available

Details of the supplier of the safety data sheet

Initial supplier identifier
BOSS Lubricants

Manufacturer Address
6303 30 ST SE Calgary, AB T2C 1R4

Emergency telephone number

Initial supplier phone number (800) 844-9457
Emergency Telephone Chemtrec 1-800-424-9300

2. Hazard(s) identification

Classification

Not a hazardous substance or mixture according to the Globally Harmonized System (GHS) and Canada's Hazardous Products Regulations

Label elements

Hazard statements

Not a hazardous substance or mixture according to the Globally Harmonized System (GHS) and Canada's Hazardous Products Regulations.

Precautionary Statements - Disposal
Dispose of contents/container in accordance with local, regional, national, and international regulations as applicable

Other information

3. Composition/information on ingredients

Substance

Chemical name	CAS No.	Weight-%	Hazardous Material Information Review Act registry number (HMIRA registry #)	Date HMIRA filed and date exemption granted (if applicable)
Water	7732-18-5	0.1 - 1	-	
Propylene glycol	57-55-6	80 - 100	-	
PROPRIETARY ADDITIVES	PROPRIETARY	1 - 5	-	

If CAS number is "proprietary", the specific chemical identity and percentage of composition has been withheld as a trade secret.

4. First-aid measures

Description of first aid measures

Inhalation Remove to fresh air. If not breathing, give artificial respiration. IF exposed or concerned: Get medical advice/attention.

Eye contact IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. Get medical attention if irritation develops and persists.

Skin contact Wash off immediately with soap and plenty of water while removing all contaminated clothes and shoes. Get medical attention if symptoms occur.

Ingestion Do NOT induce vomiting. Call a physician or poison control center immediately. If vomiting occurs spontaneously, keep head below hips to prevent aspiration. Never give anything by mouth to an unconscious person.

Most important symptoms and effects, both acute and delayed

Symptoms Prolonged contact may cause redness and irritation.

Indication of any immediate medical attention and special treatment needed

Note to physicians Treat symptomatically.

5. Fire-fighting measures

Suitable Extinguishing Media Carbon dioxide (CO2). Foam. Dry chemical. Water spray or fog. Alcohol resistant foam.

Unsuitable extinguishing media Do not scatter spilled material with high pressure water streams.

Specific hazards arising from the chemical Use water spray to cool fire-exposed containers and structures. Isolate and restrict area access. Violent steam generation or eruption may occur upon application of direct water stream to hot liquids. Container may rupture from gas generation in a fire situation. Fight fire from a safe distance and from a protected location. Do not direct a solid stream of water or foam into hot, burning pools; this may cause frothing and increase fire intensity. Consider use of unmanned hose holder or monitor nozzles.

Explosion data

Sensitivity to mechanical impact None.

Sensitivity to static discharge None.

Special protective equipment for fire-fighters Firefighters should wear self-contained breathing apparatus and full firefighting turnout gear. Use personal protection equipment.

6. Accidental release measures

Personal precautions, protective equipment and emergency procedures

Personal precautions Use personal protective equipment as required. See section 8 for more information. Ensure adequate ventilation.

Methods and material for containment and cleaning up

Methods for containment Stop leak if you can do it without risk. Keep out of drains, sewers, ditches and waterways. Ventilate the area. Avoid breathing vapors or mists.

Methods for cleaning up Cover liquid spill with sand, earth or other noncombustible absorbent material. Prevent product from entering drains.

7. Handling and storage

Precautions for safe handling

Advice on safe handling Avoid breathing dust/fume/gas/mist/vapors/spray. Avoid contact with skin, eyes or clothing. Use only with adequate ventilation. Handle in accordance with good industrial hygiene and safety practice. Do not eat, drink or smoke when using this product. Do not ingest. If swallowed then seek immediate medical assistance. For industrial use only.

Conditions for safe storage, including any incompatibilities

Storage Conditions Keep container tightly closed in a dry and well-ventilated place. Keep away from heat, sparks, flame and other sources of ignition (i.e., pilot lights, electric motors and static electricity). Do not contaminate food or feed stuffs. Store only in containers resistant to alkaline solutions with a pH of 9.0 to 12.0.

8. Exposure controls/personal protection

Control parameters

Exposure Limits This product, as supplied, does not contain any hazardous materials with occupational exposure limits established by the region specific regulatory bodies.

Appropriate engineering controls

Engineering controls Ensure adequate ventilation, especially in confined areas.

Individual protection measures, such as personal protective equipment

Eye/face protection Wear safety glasses with side shields (or goggles). If splashes are likely to occur, wear safety glasses with side-shields. Avoid contact with eyes.

Hand protection Wear suitable gloves.

Skin and body protection Wear suitable protective clothing.

Respiratory protection No protective equipment is needed under normal use conditions. If exposure limits are exceeded or irritation is experienced, ventilation and evacuation may be required.

General hygiene considerations Handle in accordance with good industrial hygiene and safety practice.

9. Physical and chemical properties

Information on basic physical and chemical properties

Physical state	Liquid
Appearance	No information available
Color	purple
Odor	Odorless
Odor threshold	No information available

Property	**Values**	**Remarks • Method**
pH	9.0– 10.5	
Melting point / freezing point	No data available	None known
Boiling point / boiling range	188 °C / 317 °F	ASTM D7213
Flash point	116 °C / 240 °F	ASTM D93
Evaporation rate	No data available	None known
Flammability (solid, gas)	No data available	None known
Flammability Limit in Air		None known
Upper flammability or explosive limits	No data available	
Lower flammability or explosive limits	No data available	
Vapor pressure	No data available	None known
Vapor density	No data available	None known
Relative density	No data available	None known
Water solubility	completely soluble	
Solubility in other solvents	No data available	None known

Partition coefficient	No data available	None known
Autoignition temperature	No data available	None known
Decomposition temperature	No data available	None known
Kinematic viscosity	No data available	None known
Dynamic viscosity	No data available	None known

Other information

Explosive properties	No information available.
Oxidizing properties	No information available.
Softening point	No information available
Molecular weight	No information available
VOC Content (%)	No information available
Liquid Density	No information available
Bulk density	No information available

10. Stability and reactivity

Reactivity No information available.

Chemical stability Stable under normal conditions.

Possibility of hazardous reactions None under normal processing.

Conditions to avoid Heat, flames and sparks.

Incompatible materials Strong oxidizing agents. Strong acids.

Hazardous decomposition products Thermal decomposition can lead to release of irritating and toxic gases and vapors.

11. Toxicological information

Information on likely routes of exposure

Product Information

Inhalation No known effects under normal use conditions.

Eye contact Irritating to eyes.

Skin contact Avoid contact with skin and clothing.

Ingestion Harmful if swallowed. Ingestion of larger amounts may cause defects to the central nervous system (e.g. dizziness, headache). Ingestion may cause gastrointestinal irritation, nausea, vomiting and diarrhea. May cause adverse kidney effects.

Symptoms related to the physical, chemical and toxicological characteristics

Symptoms No information available.

Acute toxicity

Numerical measures of toxicity
No information available

Unknown acute toxicity No information available

Product Information

Chemical name	Oral LD50	Dermal LD50	Inhalation LC50
Propylene glycol 57-55-6	= 20 g/kg (Rat)	= 20800 mg/kg (Rabbit)	Not available

Delayed and immediate effects as well as chronic effects from short and long-term exposure

Skin corrosion/irritation Based on available data, the classification criteria are not met.

Serious eye damage/eye irritation Based on available data, the classification criteria are not met.

Respiratory or skin sensitization Based on available data, the classification criteria are not met.

Germ cell mutagenicity Based on available data, the classification criteria are not met.

Carcinogenicity Based on available data, the classification criteria are not met.

Reproductive toxicity Based on available data, the classification criteria are not met.

STOT - single exposure Based on available data, the classification criteria are not met.

STOT - repeated exposure Based on available data, the classification criteria are not met.

Aspiration hazard No information available.

12. Ecological information

Ecotoxicity Harmful to aquatic life.

Persistence and degradability No information available.

Bioaccumulation No information available.

Other adverse effects No information available.

13. Disposal considerations

Waste treatment methods

Waste from residues/unused products Dispose of waste in accordance with environmental legislation.

Contaminated packaging Do not reuse empty containers.

14. Transport information

Transport Canada Not regulated

TDG Not regulated

DOT Not regulated unless shipping container holds at least 5,000 pounds.
- **UN/ID no.** UN 3082
- **Hazard class** 9
- **Packing group** III

MEX Not regulated

ICAO (air) no data available

IATA no data available

IMDG no data available

RID no data available

ADR no data available

ADN no data available

15. Regulatory information

Safety, health and environmental regulations/legislation specific for the substance or mixture

International Regulations

The Montreal Protocol on Substances that Deplete the Ozone Layer Not applicable

The Stockholm Convention on Persistent Organic Pollutants Not applicable

The Rotterdam Convention Not applicable

International Inventories

TSCA	Complies.
DSL/NDSL	Complies.
EINECS/ELINCS	Contact supplier for inventory compliance status.
ENCS	Contact supplier for inventory compliance status.
IECSC	Contact supplier for inventory compliance status.
KECL	Contact supplier for inventory compliance status.
PICCS	Contact supplier for inventory compliance status.
AICS	Contact supplier for inventory compliance status.

Legend:
TSCA - United States Toxic Substances Control Act Section 8(b) Inventory
DSL/NDSL - Canadian Domestic Substances List/Non-Domestic Substances List
EINECS/ELINCS - European Inventory of Existing Chemical Substances/European List of Notified Chemical Substances
ENCS - Japan Existing and New Chemical Substances
IECSC - China Inventory of Existing Chemical Substances
KECL - Korean Existing and Evaluated Chemical Substances
PICCS - Philippines Inventory of Chemicals and Chemical Substances

AICS - Australian Inventory of Chemical Substances

16. Other information

NFPA	**Health hazards** 2	**Flammability** 1	**Instability** 0	**Physical and chemical properties** -
HMIS	**Health hazards** 2	**Flammability** 1	**Physical hazards** 0	**Personal protection** X

Key or legend to abbreviations and acronyms used in the safety data sheet

Legend **Section 8: EXPOSURE CONTROLS/PERSONAL PROTECTION**

TWA	TWA (time-weighted average)	STEL	STEL (Short Term Exposure Limit)
Ceiling	Maximum limit value	*	Skin designation

Key literature references and sources for data used to compile the SDS

Agency for Toxic Substances and Disease Registry (ATSDR)
U.S. Environmental Protection Agency ChemView Database
European Food Safety Authority (EFSA)
EPA (Environmental Protection Agency)
Acute Exposure Guideline Level(s) (AEGL(s))
U.S. Environmental Protection Agency Federal Insecticide, Fungicide, and Rodenticide Act
U.S. Environmental Protection Agency High Production Volume Chemicals
Food Research Journal
Hazardous Substance Database
International Uniform Chemical Information Database (IUCLID)
Japan GHS Classification
Australia National Industrial Chemicals Notification and Assessment Scheme (NICNAS)
NIOSH (National Institute for Occupational Safety and Health)
National Library of Medicine's ChemID Plus (NLM CIP)
National Library of Medicine's PubMed database (NLM PUBMED)
National Toxicology Program (NTP)
New Zealand's Chemical Classification and Information Database (CCID)
Organization for Economic Co-operation and Development Environment, Health, and Safety Publications
Organization for Economic Co-operation and Development High Production Volume Chemicals Program
Organization for Economic Co-operation and Development Screening Information Data Set
RTECS (Registry of Toxic Effects of Chemical Substances)
World Health Organization

Issuing Date 03-Jun-2019

Revision date 04-Jun-2019

Revision Note No information available.

Disclaimer

The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text.

End of Safety Data Sheet

Data for Regulatory Rules

Region	Template name	Revision Note
Canada	HGHS	2.0

GHS Product Information

pH	9.0– 10.5
Physical state	Liquid
Flash point °C	116
Boiling point / boiling range °C	188

Component Information

Canada

GHS Classification

Not Hazardous	Not a hazardous substance or mixture according to the Globally Harmonized System (GHS) and Canada's Hazardous Products Regulations
Precautionary Statements - Disposal	Dispose of contents/container in accordance with local, regional, national, and international regulations as applicable

SAFETY DATA SHEET

DOW CHEMICAL CANADA ULC

Product name: DOWFROST™ Heat Transfer Fluid

Issue Date: 12/16/2019
Print Date: 12/17/2019

DOW CHEMICAL CANADA ULC encourages and expects you to read and understand the entire (M)SDS, as there is important information throughout the document. We expect you to follow the precautions identified in this document unless your use conditions would necessitate other appropriate methods or actions.

1. IDENTIFICATION

Product name: DOWFROST™ Heat Transfer Fluid

Recommended use of the chemical and restrictions on use
Identified uses: Intended as a heat transfer fluid for closed-loop systems. This product is acceptable for use where there is possibility of incidental food contact and as a product for use in the immersion or spray freezing of wrapped meat and packaged poultry products. We recommend that you use this product in a manner consistent with the listed use. If your intended use is not consistent with the stated use, please contact your sales or technical service representative.

COMPANY IDENTIFICATION
DOW CHEMICAL CANADA ULC
#2400, 215 - 2ND STREET S.W.
CALGARY AB T2P 1M4
CANADA

Customer Information Number: 800-258-2436
SDSQuestion@dow.com

EMERGENCY TELEPHONE NUMBER
24-Hour Emergency Contact (transportation emergencies only): 1-800-424-9300
Local Emergency Contact (transportation emergencies only): 1-800-424-9300
24-Hour Emergency Contact: 1-989-636-4400

2. HAZARDS IDENTIFICATION

Hazard classification
This product is not hazardous under the criteria of the Hazardous Products Regulation (HPR) as implemented under the Workplace Hazardous Materials Information System (WHMIS 2015).

Other hazards
No data available

3. COMPOSITION/INFORMATION ON INGREDIENTS

This product is a mixture.

Component	CASRN	Concentration (w/w)
Propylene glycol	57-55-6	> 95.0 %
Inorganic corrosion inhibitor	not hazardous	< 3.0 %
Water	7732-18-5	< 3.0 %

4. FIRST AID MEASURES

Description of first aid measures
General advice:
If potential for exposure exists refer to Section 8 for specific personal protective equipment.

Inhalation: Move person to fresh air; if effects occur, consult a physician.

Skin contact: Wash off with plenty of water.

Eye contact: Flush eyes thoroughly with water for several minutes. Remove contact lenses after the initial 1-2 minutes and continue flushing for several additional minutes. If effects occur, consult a physician, preferably an ophthalmologist.

Ingestion: Rinse mouth with water. No emergency medical treatment necessary.

Most important symptoms and effects, both acute and delayed:
Aside from the information found under Description of first aid measures (above) and Indication of immediate medical attention and special treatment needed (below), any additional important symptoms and effects are described in Section 11: Toxicology Information.

Indication of any immediate medical attention and special treatment needed
Notes to physician: No specific antidote. Treatment of exposure should be directed at the control of symptoms and the clinical condition of the patient.

5. FIREFIGHTING MEASURES

Extinguishing media

Suitable extinguishing media: Water fog or fine spray.. Dry chemical fire extinguishers.. Carbon dioxide fire extinguishers.. Foam.. Alcohol resistant foams (ATC type) are preferred. General purpose synthetic foams (including AFFF) or protein foams may function, but will be less effective..

Unsuitable extinguishing media: Do not use direct water stream.. May spread fire..

Special hazards arising from the substance or mixture

Hazardous combustion products: During a fire, smoke may contain the original material in addition to combustion products of varying composition which may be toxic and/or irritating.. Combustion products may include and are not limited to:. Carbon monoxide.. Carbon dioxide..

Unusual Fire and Explosion Hazards: Container may rupture from gas generation in a fire situation.. Violent steam generation or eruption may occur upon application of direct water stream to hot liquids..

Advice for firefighters

Fire Fighting Procedures: Keep people away. Isolate fire and deny unnecessary entry.. Use water spray to cool fire exposed containers and fire affected zone until fire is out and danger of reignition has passed.. Fight fire from protected location or safe distance. Consider the use of unmanned hose holders or monitor nozzles.. Immediately withdraw all personnel from the area in case of rising sound from venting safety device or discoloration of the container.. Burning liquids may be extinguished by dilution with water.. Do not use direct water stream. May spread fire.. Move container from fire area if this is possible without hazard.. Burning liquids may be moved by flushing with water to protect personnel and minimize property damage..

Special protective equipment for firefighters: Wear positive-pressure self-contained breathing apparatus (SCBA) and protective fire fighting clothing (includes fire fighting helmet, coat, trousers, boots, and gloves).. If protective equipment is not available or not used, fight fire from a protected location or safe distance..

6. ACCIDENTAL RELEASE MEASURES

Personal precautions, protective equipment and emergency procedures: Use appropriate safety equipment. For additional information, refer to Section 8, Exposure Controls and Personal Protection.

Environmental precautions: Prevent from entering into soil, ditches, sewers, waterways and/or groundwater. See Section 12, Ecological Information.

Methods and materials for containment and cleaning up: Small spills: Absorb with materials such as: Cat litter. Sawdust. Vermiculite. Zorb-all®. Collect in suitable and properly labeled containers. Large spills: Dike area to contain spill. Recover spilled material if possible. See Section 13, Disposal Considerations, for additional information.

7. HANDLING AND STORAGE

Precautions for safe handling: No special precautions required. Keep container closed. See Section 8, EXPOSURE CONTROLS AND PERSONAL PROTECTION.
Spills of these organic materials on hot fibrous insulations may lead to lowering of the autoignition temperatures possibly resulting in spontaneous combustion.

Conditions for safe storage: Do not store in: Galvanized steel. Opened or unlabeled containers. Store in original unopened container. See Section 10 for more specific information. Additional storage

and handling information on this product may be obtained by calling your sales or customer service contact.

Storage stability
Shelf life: Use within 60 Month

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Control parameters
If exposure limits exist, they are listed below. If no exposure limits are displayed, then no values are applicable.

Consult local authorities for recommended exposure limits.

Component	Regulation	Type of listing	Value
Propylene glycol	US WEEL	TWA	10 mg/m3
	CA ON OEL	TWAEV Total	155 mg/m3 50 ppm
	CA ON OEL	TWAEV	10 mg/m3
	Further information: C: For assessing the visibility in a work environment where 1,2-propylene glycol aerosol is present.		
	CA ON OEL	TWA	155 mg/m3 50 ppm
	CA ON OEL	TWA	10 mg/m3
	Further information: (c): For assessing the visibility in a work environment where 1,2-propylene glycol aerosol is present		
	CA ON OEL	TWA Vapour and aerosols	155 mg/m3 50 ppm
	CA ON OEL	TWA aerosol	10 mg/m3
	Further information: (c): For assessing the visibility in a work environment where 1,2-propylene glycol aerosol is present		

Exposure controls
Engineering controls: Use local exhaust ventilation, or other engineering controls to maintain airborne levels below exposure limit requirements or guidelines. If there are no applicable exposure limit requirements or guidelines, general ventilation should be sufficient for most operations. Local exhaust ventilation may be necessary for some operations.

Individual protection measures

Eye/face protection: Use safety glasses (with side shields).

Skin protection

Hand protection: Use gloves chemically resistant to this material when prolonged or frequently repeated contact could occur. Examples of preferred glove barrier materials include: Butyl rubber. Natural rubber ("latex"). Neoprene. Nitrile/butadiene rubber ("nitrile" or "NBR"). Polyethylene. Ethyl vinyl alcohol laminate ("EVAL"). Polyvinyl chloride ("PVC" or "vinyl"). Avoid gloves made of: Polyvinyl alcohol ("PVA"). NOTICE: The selection of a specific glove for a particular application and duration of use in a workplace should also take into account all relevant workplace factors such as, but not limited to: Other chemicals which may be handled, physical requirements (cut/puncture protection, dexterity, thermal protection), potential body reactions to glove materials, as well as the instructions/specifications provided by the glove supplier.

Other protection: Wear clean, body-covering clothing.

Respiratory protection: Respiratory protection should be worn when there is a potential to exceed the exposure limit requirements or guidelines. If there are no applicable exposure limit

requirements or guidelines, wear respiratory protection when adverse effects, such as respiratory irritation or discomfort have been experienced, or where indicated by your risk assessment process. In misty atmospheres, use an approved particulate respirator. The following should be effective types of air-purifying respirators: Organic vapor cartridge with a particulate pre-filter.

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance	
Physical state	Liquid.
Color	Colorless
Odor	Characteristic
Odor Threshold	No test data available
pH	10.0 50% *Literature*
Melting point/range	Not applicable to liquids
Freezing point	supercools
Boiling point (760 mmHg)	152 °C *Literature*
Flash point	**closed cup** 104 °C *Pensky-Martens Closed Cup ASTM D 93* (based on major component), Propylene glycol. **open cup** *Cleveland Open Cup ASTM D92* None
Evaporation Rate (Butyl Acetate = 1)	<0.5 *Estimated.*
Flammability (solid, gas)	Not applicable to liquids
Flammability (liquids)	Not expected to be a static-accumulating flammable liquid.
Lower explosion limit	2.6 % vol *Literature* Propylene glycol.
Upper explosion limit	12.5 % vol *Literature* Propylene glycol.
Vapor Pressure	2.2 mmHg *Literature*
Relative Vapor Density (air = 1)	>1.0 *Literature*
Relative Density (water = 1)	1.05 at 20 °C / 20 °C *Literature*
Water solubility	*Literature* completely soluble
Partition coefficient: n-octanol/water	No data available
Auto-ignition temperature	371 °C *Literature* Propylene glycol.
Decomposition temperature	No test data available
Kinematic Viscosity	43.4 cSt at 20 °C *Literature*
Explosive properties	No data available
Oxidizing properties	No data available
Molecular weight	76.9 g/mol *Literature*

NOTE: The physical data presented above are typical values and should not be construed as a specification.

10. STABILITY AND REACTIVITY

Reactivity: No data available

Chemical stability: Stable under recommended storage conditions. See Storage, Section 7. Hygroscopic

Possibility of hazardous reactions: Polymerization will not occur.

Conditions to avoid: Exposure to elevated temperatures can cause product to decompose. Generation of gas during decomposition can cause pressure in closed systems. Avoid direct sunlight or ultraviolet sources.

Incompatible materials: Avoid contact with: Strong acids. Strong bases. Strong oxidizers.

Hazardous decomposition products: Decomposition products depend upon temperature, air supply and the presence of other materials.. Decomposition products can include and are not limited to:. Aldehydes.. Alcohols.. Ethers.. Organic acids..

11. TOXICOLOGICAL INFORMATION

Toxicological information appears in this section when such data is available.

Information on likely routes of exposure
Ingestion, Inhalation, Skin contact, Eye contact.

Acute toxicity (represents short term exposures with immediate effects - no chronic/delayed effects known unless otherwise noted)

Acute oral toxicity
Very low toxicity if swallowed. Harmful effects not anticipated from swallowing small amounts.

For the major component(s): Propylene glycol.
LD50, Rat, > 20,000 mg/kg

Information for components:

Propylene glycol
LD50, Rat, > 20,000 mg/kg

Inorganic corrosion inhibitor
LD50, Rat, female, > 2,000 mg/kg No deaths occurred at this concentration.

Acute dermal toxicity
Prolonged skin contact is unlikely to result in absorption of harmful amounts.

For the major component(s): Propylene glycol.
LD50, Rabbit, > 20,000 mg/kg

Information for components:

Propylene glycol
LD50, Rabbit, > 2,000 mg/kg No deaths occurred at this concentration.

Inorganic corrosion inhibitor
LD50, Rabbit, > 5,000 mg/kg

Acute inhalation toxicity
At room temperature, exposure to vapor is minimal due to low volatility. Mist may cause irritation of upper respiratory tract (nose and throat).

For the major component(s):
LC50, Rat, 4 Hour, vapour, 6.15 mg/l No deaths occurred following exposure to a saturated atmosphere.
Information for components:

Propylene glycol
LC50, Rabbit, 2 Hour, dust/mist, 317.042 mg/l No deaths occurred at this concentration.

Inorganic corrosion inhibitor
Based on information for a similar material: Maximum attainable concentration. LC50, Rat, male and female, 4 Hour, dust/mist, > 0.83 mg/l No deaths occurred at this concentration.

Skin corrosion/irritation
Based on information for component(s):
Prolonged contact is essentially nonirritating to skin.
Repeated contact may cause flaking and softening of skin.

Information for components:

Propylene glycol
Prolonged contact is essentially nonirritating to skin.
Repeated contact may cause flaking and softening of skin.

Inorganic corrosion inhibitor
Prolonged contact may cause slight skin irritation with local redness.

Serious eye damage/eye irritation
Based on information for component(s):
May cause slight temporary eye irritation.
Corneal injury is unlikely.

Information for components:

Propylene glycol
May cause slight temporary eye irritation.
Corneal injury is unlikely.
Mist may cause eye irritation.

Inorganic corrosion inhibitor
May cause slight eye irritation.
May cause slight temporary corneal injury.

Dust may irritate eyes.
Mist may cause eye irritation.

Sensitization
For the major component(s):
Did not cause allergic skin reactions when tested in humans.

For respiratory sensitization:
No relevant data found.

Information for components:

Propylene glycol
Did not cause allergic skin reactions when tested in humans.

For respiratory sensitization:
No relevant data found.

Inorganic corrosion inhibitor
For similar material(s):
Did not demonstrate the potential for contact allergy in mice.

For respiratory sensitization:
No relevant data found.

Specific Target Organ Systemic Toxicity (Single Exposure)
Evaluation of available data suggests that this material is not an STOT-SE toxicant.

Information for components:

Propylene glycol
Evaluation of available data suggests that this material is not an STOT-SE toxicant.

Aspiration Hazard
Based on physical properties, not likely to be an aspiration hazard.

Information for components:

Propylene glycol
Based on physical properties, not likely to be an aspiration hazard.

Chronic toxicity (represents longer term exposures with repeated dose resulting in chronic/delayed effects - no immediate effects known unless otherwise noted)

Specific Target Organ Systemic Toxicity (Repeated Exposure)
In rare cases, repeated excessive exposure to propylene glycol may cause central nervous system effects.

Information for components:

Propylene glycol
In rare cases, repeated excessive exposure to propylene glycol may cause central nervous system effects.

Inorganic corrosion inhibitor
Based on available data, repeated exposures are not anticipated to cause significant adverse effects.

Carcinogenicity
Similar formulations did not cause cancer in laboratory animals.

Information for components:

Propylene glycol
Did not cause cancer in laboratory animals.

Inorganic corrosion inhibitor
No relevant data found.

Teratogenicity
For the major component(s): Did not cause birth defects or any other fetal effects in laboratory animals.

Information for components:

Propylene glycol
Did not cause birth defects or any other fetal effects in laboratory animals.

Inorganic corrosion inhibitor
For similar material(s): Did not cause birth defects or any other fetal effects in laboratory animals.

Reproductive toxicity
For the major component(s): In animal studies, did not interfere with reproduction. In animal studies, did not interfere with fertility.

Information for components:

Propylene glycol
In animal studies, did not interfere with reproduction. In animal studies, did not interfere with fertility.

Inorganic corrosion inhibitor
For similar material(s): In animal studies, did not interfere with reproduction.

Mutagenicity
In vitro genetic toxicity studies were negative. For the major component(s): Animal genetic toxicity studies were negative.

Information for components:

Propylene glycol
In vitro genetic toxicity studies were negative. Animal genetic toxicity studies were negative.

Inorganic corrosion inhibitor
In vitro genetic toxicity studies were negative.

12. ECOLOGICAL INFORMATION

Ecotoxicological information appears in this section when such data is available.

Toxicity

Propylene glycol

Acute toxicity to fish
Material is practically non-toxic to aquatic organisms on an acute basis (LC50/EC50/EL50/LL50 >100 mg/L in the most sensitive species tested).
LC50, Oncorhynchus mykiss (rainbow trout), static test, 96 Hour, 40,613 mg/l, OECD Test Guideline 203

Acute toxicity to aquatic invertebrates
LC50, Ceriodaphnia dubia (water flea), static test, 48 Hour, 18,340 mg/l, OECD Test Guideline 202

Acute toxicity to algae/aquatic plants
ErC50, Pseudokirchneriella subcapitata (green algae), 96 Hour, Growth rate inhibition, 19,000 mg/l, OECD Test Guideline 201

Toxicity to bacteria
NOEC, Pseudomonas putida, 18 Hour, > 20,000 mg/l

Chronic toxicity to aquatic invertebrates
NOEC, Ceriodaphnia dubia (water flea), semi-static test, 7 d, number of offspring, 13,020 mg/l

Inorganic corrosion inhibitor

Acute toxicity to fish
Material is practically non-toxic to aquatic organisms on an acute basis (LC50/EC50/EL50/LL50 >100 mg/L in the most sensitive species tested).
LC50, Leuciscus idus (Golden orfe), static test, 48 Hour, > 900 mg/l, Method Not Specified.

Persistence and degradability

Propylene glycol

Biodegradability: Material is readily biodegradable. Passes OECD test(s) for ready biodegradability. Biodegradation may occur under anaerobic conditions (in the absence of oxygen).
10-day Window: Pass
Biodegradation: 81 %
Exposure time: 28 d
Method: OECD Test Guideline 301F or Equivalent
10-day Window: Not applicable
Biodegradation: 96 %
Exposure time: 64 d
Method: OECD Test Guideline 306 or Equivalent

Theoretical Oxygen Demand: 1.68 mg/mg

Chemical Oxygen Demand: 1.53 mg/mg

Biological oxygen demand (BOD)

Incubation Time	BOD
5 d	69.000 %
10 d	70.000 %
20 d	86.000 %

Photodegradation
Atmospheric half-life: 10 Hour
Method: Estimated.

Inorganic corrosion inhibitor
Biodegradability: Biodegradation is not applicable.

Bioaccumulative potential

Propylene glycol
Bioaccumulation: Bioconcentration potential is low (BCF < 100 or Log Pow < 3).
Partition coefficient: n-octanol/water(log Pow): -1.07 Measured
Bioconcentration factor (BCF): 0.09 Estimated.

Inorganic corrosion inhibitor
Bioaccumulation: No bioconcentration is expected because of the relatively high water solubility.

Mobility in soil

Propylene glycol
Given its very low Henry's constant, volatilization from natural bodies of water or moist soil is not expected to be an important fate process.
Potential for mobility in soil is very high (Koc between 0 and 50).
Partition coefficient (Koc): < 1 Estimated.

Inorganic corrosion inhibitor
No relevant data found.

13. DISPOSAL CONSIDERATIONS

Disposal methods: DO NOT DUMP INTO ANY SEWERS, ON THE GROUND, OR INTO ANY BODY OF WATER. All disposal practices must be in compliance with all Federal, State/Provincial and local laws and regulations. Regulations may vary in different locations. Waste characterizations and compliance with applicable laws are the responsibility solely of the waste generator. AS YOUR SUPPLIER, WE HAVE NO CONTROL OVER THE MANAGEMENT PRACTICES OR MANUFACTURING PROCESSES OF PARTIES HANDLING OR USING THIS MATERIAL. THE INFORMATION PRESENTED HERE PERTAINS ONLY TO THE PRODUCT AS SHIPPED IN ITS INTENDED CONDITION AS DESCRIBED IN MSDS SECTION: Composition Information. FOR

UNUSED & UNCONTAMINATED PRODUCT, the preferred options include sending to a licensed, permitted: Recycler. Reclaimer. Incinerator or other thermal destruction device.

14. TRANSPORT INFORMATION

TDG

Not regulated for transport

Classification for SEA transport (IMO-IMDG):

Not regulated for transport

Transport in bulk according to Annex I or II of MARPOL 73/78 and the IBC or IGC Code

Consult IMO regulations before transporting ocean bulk

Classification for AIR transport (IATA/ICAO):

Not regulated for transport

This information is not intended to convey all specific regulatory or operational requirements/information relating to this product. Transportation classifications may vary by container volume and may be influenced by regional or country variations in regulations. Additional transportation system information can be obtained through an authorized sales or customer service representative. It is the responsibility of the transporting organization to follow all applicable laws, regulations and rules relating to the transportation of the material.

15. REGULATORY INFORMATION

Canadian Domestic Substances List (DSL)
All substances contained in this product are listed on the Canadian Domestic Substances List (DSL) or are not required to be listed.

16. OTHER INFORMATION

Hazard Rating System
NFPA

Health	Flammability	Instability
0	1	0

Revision
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Most recent revision(s) are noted by the bold, double bars in left-hand margin throughout this document.

Legend

CA ON OEL	Canada. Ontario OELs
TWA	8-hr TWA
TWAEV	time-weighted average exposure value
US WEEL	USA. Workplace Environmental Exposure Levels (WEEL)

Full text of other abbreviations

AICS - Australian Inventory of Chemical Substances; ASTM - American Society for the Testing of Materials; bw - Body weight; CERCLA - Comprehensive Environmental Response, Compensation, and Liability Act; CMR - Carcinogen, Mutagen or Reproductive Toxicant; DIN - Standard of the German Institute for Standardisation; DOT - Department of Transportation; DSL - Domestic Substances List (Canada); ECx - Concentration associated with x% response; EHS - Extremely Hazardous Substance; ELx - Loading rate associated with x% response; EmS - Emergency Schedule; ENCS - Existing and New Chemical Substances (Japan); ErCx - Concentration associated with x% growth rate response; ERG - Emergency Response Guide; GHS - Globally Harmonized System; GLP - Good Laboratory Practice; HMIS - Hazardous Materials Identification System; IARC - International Agency for Research on Cancer; IATA - International Air Transport Association; IBC - International Code for the Construction and Equipment of Ships carrying Dangerous Chemicals in Bulk; IC50 - Half maximal inhibitory concentration; ICAO - International Civil Aviation Organization; IECSC - Inventory of Existing Chemical Substances in China; IMDG - International Maritime Dangerous Goods; IMO - International Maritime Organization; ISHL - Industrial Safety and Health Law (Japan); ISO - International Organisation for Standardization; KECI - Korea Existing Chemicals Inventory; LC50 - Lethal Concentration to 50 % of a test population; LD50 - Lethal Dose to 50% of a test population (Median Lethal Dose); MARPOL - International Convention for the Prevention of Pollution from Ships; MSHA - Mine Safety and Health Administration; n.o.s. - Not Otherwise Specified; NFPA - National Fire Protection Association; NO(A)EC - No Observed (Adverse) Effect Concentration; NO(A)EL - No Observed (Adverse) Effect Level; NOELR - No Observable Effect Loading Rate; NTP - National Toxicology Program; NZIoC - New Zealand Inventory of Chemicals; OECD - Organization for Economic Co-operation and Development; OPPTS - Office of Chemical Safety and Pollution Prevention; PBT - Persistent, Bioaccumulative and Toxic substance; PICCS - Philippines Inventory of Chemicals and Chemical Substances; (Q)SAR - (Quantitative) Structure Activity Relationship; RCRA - Resource Conservation and Recovery Act; REACH - Regulation (EC) No 1907/2006 of the European Parliament and of the Council concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals; RQ - Reportable Quantity; SADT - Self-Accelerating Decomposition Temperature; SARA - Superfund Amendments and Reauthorization Act; SDS - Safety Data Sheet; TCSI - Taiwan Chemical Substance Inventory; TSCA - Toxic Substances Control Act (United States); UN - United Nations; UNRTDG - United Nations Recommendations on the Transport of Dangerous Goods; vPvB - Very Persistent and Very Bioaccumulative

Information Source and References

This SDS is prepared by Product Regulatory Services and Hazard Communications Groups from information supplied by internal references within our company.

DOW CHEMICAL CANADA ULC urges each customer or recipient of this (M)SDS to study it carefully and consult appropriate expertise, as necessary or appropriate, to become aware of and understand the data contained in this (M)SDS and any hazards associated with the product. The information herein is provided in good faith and believed to be accurate as of the effective date shown above. However, no warranty, express or implied, is given. Regulatory requirements are subject to change and may differ between various locations. It is the buyer's/user's responsibility to ensure that his

activities comply with all federal, state, provincial or local laws. The information presented here pertains only to the product as shipped. Since conditions for use of the product are not under the control of the manufacturer, it is the buyer's/user's duty to determine the conditions necessary for the safe use of this product. Due to the proliferation of sources for information such as manufacturer-specific (M)SDSs, we are not and cannot be responsible for (M)SDSs obtained from any source other than ourselves. If you have obtained an (M)SDS from another source or if you are not sure that the (M)SDS you have is current, please contact us for the most current version.
CA