



Heat Thaw Cure Dry

Operator Manual Central Heating Unit



Model 2100- Diesel Series

2100-0600

2100-0900

S.N. 22475 –

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1. Warranty Policies & Claim Procedures

DRYAIR MANUFACTURING CORP. (referred to within as DRYAIR) warrants 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

DRYAIR Manufacturing Corp.
410 Douglas Road, Box 264
Bradner, OH 43406
Ph. 1 (888) 750-1700

Canada

DRYAIR Manufacturing Corp.
400 Service Road, Box 126
St. Brieux, SK S0K 3V0
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.

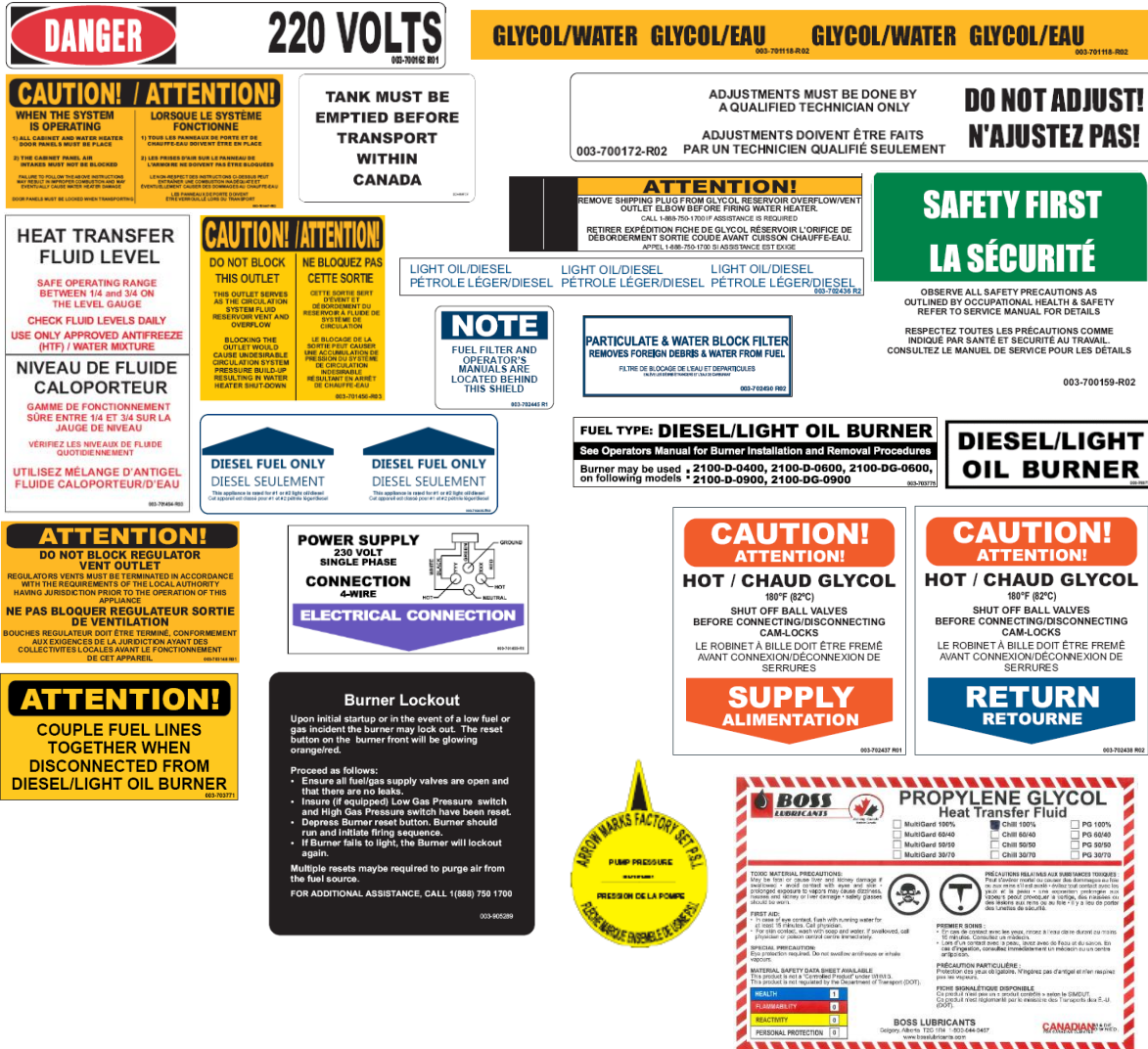


Figure 1 - Safety Decals

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.
- Patented Combustion Environmental Control System preheats the fuel and air used for combustion.



Figure 2 - Model 2100 Series Water Heater Module

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:

- **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.



Figure 3 - Extended Reservoir

Mixing/Booster Pump

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

- 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.



Figure 4 - Mixing/Booster Pump

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

Optional Remote Manifold

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

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



Figure 5 - Optional Remote 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.

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 6 - 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:



Figure 7 - Plate Heat Exchanger Unit

- 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).

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 8 - 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.

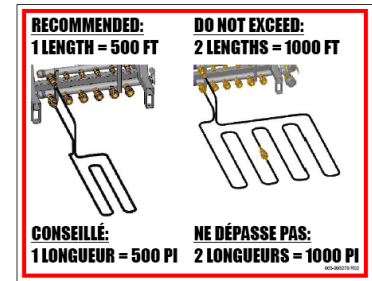


Figure 9 - Hose Loop Length

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 5/8” 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:

- 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.



Figure 10 - Hose Reel

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 11 - 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.

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.

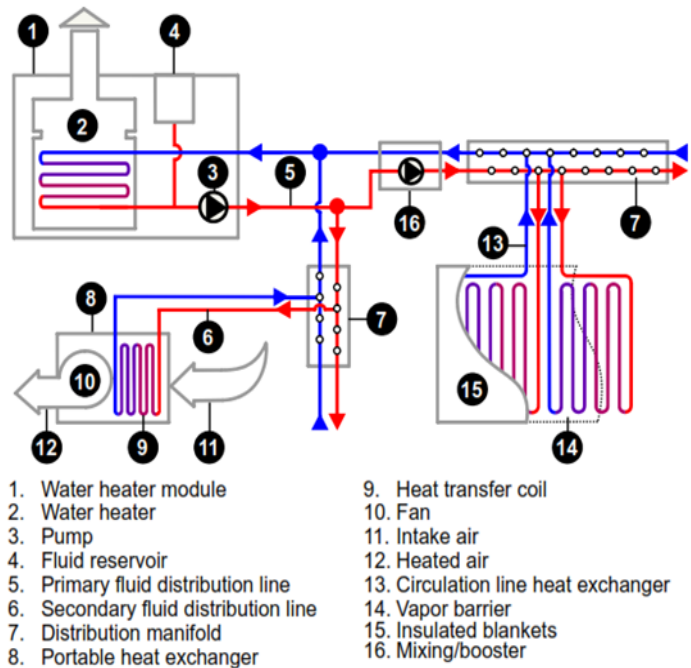


Figure 12 - How the System Works

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 codes and fire regulations when positioning the central heating module.

Required Safety Clearances

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

- Maintain 24” of clearance on all sides of the unit (Figure 13).
- Maintain 36” of clearance on all sides of the flue pipe and chimney cap (Figure 14).
- Confirm that the Water Heater module air intakes, on three sides of the Water Heater Module, are free of any obstructions.

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.

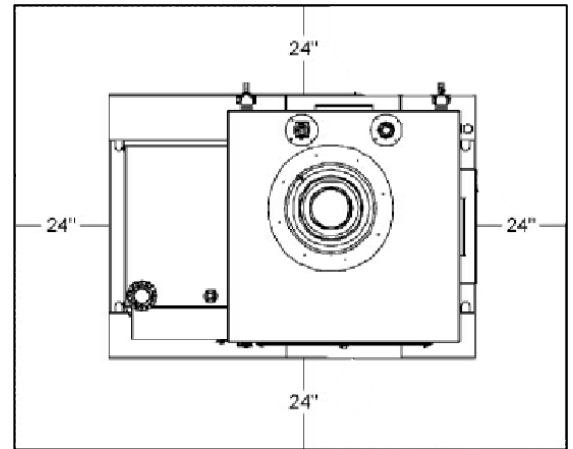


Figure 13 - Water Heater Module - Top View

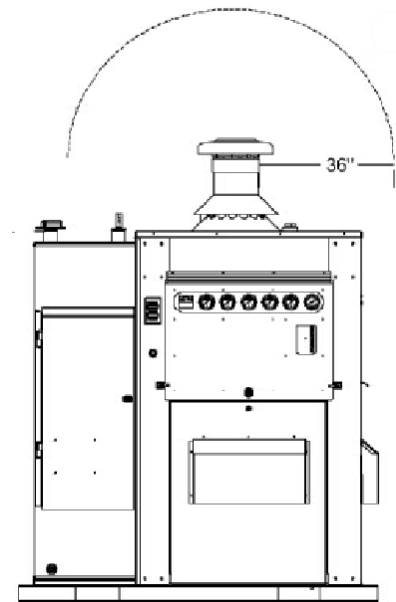


Figure 14 - Water Heater Module - Control Side View

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”.

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 15*).

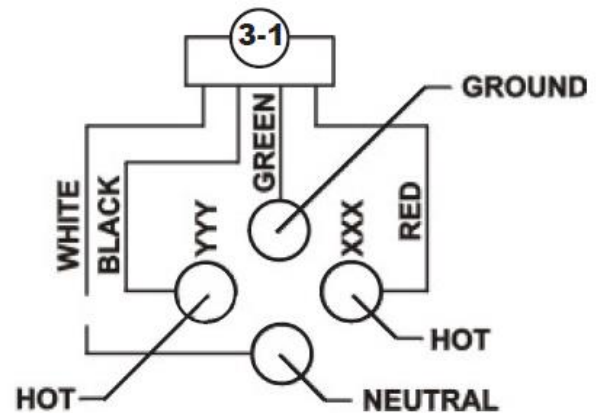


Figure 15 - Electrical Hookup (230V AC)

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 Propylene 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 16 - 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 17 - Primary Circulation Line Connections

Fuel/Gas

Diesel/Light Oil

- Only clean #1 or #2 diesel fuel or light heating oil is suitable for use in the system. *
- The “central heating module” comes equipped with its own tank, so there are no fuel line hookups required.
- The fuel system utilizes a two-pipe system to ensure efficient fuel supply to the burner.

* Contact your local fuel supplier to inform them of the requirements.

Burner Removal

To remove an existing **Riello Model 40-F20 Diesel/Light Oil Burner**, use the following sequence:

1. Make certain that the power supply to the water heater is disconnected.
2. Disconnect the electrical connection to the burner. This connection is on the interior of the water heater cabinet, at the base of the main control panel.
3. Disconnect the combustion air duct by loosening the gear clamp-band.
4. Disconnect the fuel supply hose and fuel return hose by uncoupling the quick connections on the side of the burner. The loose supply and return hose ends may be coupled together and pushed aside out of the way inside the cabinet. (Figure 18)
5. Remove 2 nuts from top of burner tube bracket. (**Error! Reference source not found.**)
6. Pull burner toward you and away from the mounting bracket. (**Error! Reference source not found.**)

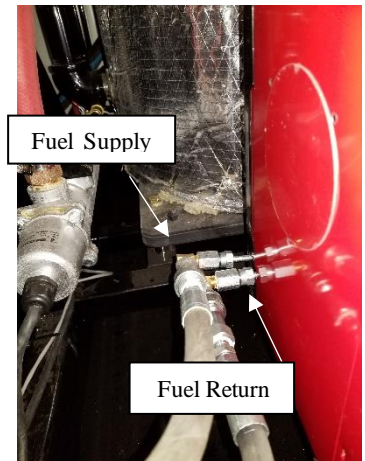


Figure 18 - Fuel Supply and Return Lines

Burner Installation

To install an alternate **Riello Model 40-F20 Diesel/Light Oil Burner**:

1. Insert burner into the mounting bracket.
2. Install 2 nuts at top of burner tube bracket. (**Error! Reference source not found.**)
3. Connect the fuel supply hose and fuel return hose by coupling them to the quick connections on the side of the burner. (Figure 18)
4. Connect the electrical connection to the burner, as per schematic.

5. Operation

Purging Air from the “HTF” Circulation System

- Verify that the primary circulation lines are connected to the “Supply” and “Return” isolation valves on the Water Heater Module.
- Verify that the primary circulation lines are connected to a distribution manifold.
- Complete the connection for one “heat exchanger loop” or Portable Heat Exchanger. This will close the heat exchanger loop and allow circulation.
- Verify that the “Supply” and “Return” isolation valves and the isolation valves at both ends of the primary circulation lines are in the “open” position.
- The automatic air vent valve cap should not need adjustment. The valve cap should be opened 1 ½ turns (counterclockwise) from fully closed to allow air escape from HTF system.
- Toggle the pump switch to the “ON” position and run the pump. This will release the air from the system.
- Monitor the process.
- Note that there may be a certain amount of air in the system. HTF levels may change as air is displaced from the system. Add HTF to maintain ¼ and ¾ level.
- When the air is eliminated, the “System Pressure” gauge will hold at a steady reading of between 15 to 40 PSI.



Figure 19 - Automatic Air Vent Valve Cap



Figure 20 - HTF Level Gauge and Vent

Before Firing the System

- Verify that the power supply is correct, and that the electrical hookup is as specified in “Setup”.
- Verify that the Water Heater is being supplied with the same fuel type as indicated on the Water Heater data plate (LIGHT OIL/DIESEL FUEL).
- Verify that the “Supply” and “Return” isolation valves are closed.
- Verify that the fuel line valves are in the positions as shown, to the right.
- Verify that the HTF level gauge shows approximately ¼ full.

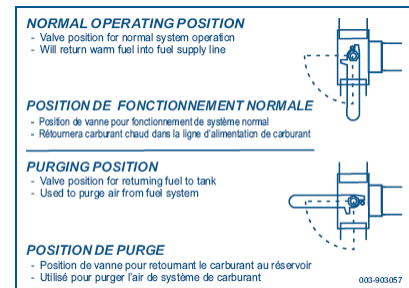


Figure 21 - Fuel Line Valve Positions

Cold Start Procedure

The system has a patented, built-in electric HTF pre-heater, which will heat the HTF in the heat exchanger without the burner being turned on. This device is unique to DRYAIR equipment. It is not always necessary to use this device, but it will make the unit start more smoothly and reduce maintenance costs associated with “cold starts”.

To utilize the HTF preheater, follow the procedure below:

- Plug in power supply.
- Confirm that the pump switch and Water Heater switch are in the “OFF” position.
- Position all four breakers to the “ON” position. This will automatically energize the “cold start” HTF pre-heater.
- Wait until the “Supply Temperature Gauge” reads between 80°F to 90°F (27°C to 32°C). The time required for the heat transfer fluid in the heat exchanger to reach this temperature will depend on the outdoor ambient air temperature.
- Toggle the pump switch located on the control panel to the “ON” position. Once the pump is turned on, the “cold start” HTF pre-heater is automatically shut off.
- With the pump on and the “Supply” and “Return” isolation valves on the exterior of the heat module in the closed position, the HTF will circulate through the heat module’s internal bypass system. This will supply warm HTF to the combustion air and fuel preheat systems, which tempers combustion air and fuel for smooth burner startup and operation.
- Continue circulating the HTF within the heat module’s distribution system until the “Combustion Air Gauge” and the “FUEL Temperature Gauge” reads approximately 60°F to 70°F (15°C to 21°C).
- The burner is now ready to be fired. Proceed with the “Temperate Start Procedure”.



Figure 22 - Fuel Line Valves and Filter



Figure 23 - Control Panel

Note: The time required for the combustion air and fuel to reach this temperature will again depend on the outdoor ambient air temperature.

Temperate Start Procedure

Start this procedure when:

- The ambient outdoor air temperature is above 50°F (10°C); or
- The recommended “cold start procedure” has been completed, if below freezing.

Control Settings

Low Flow Situation

Utilizing only one 80 or 200 portable heat exchangers or only one or two circulation line exchanger loops.

- Water heater heat exchanger temperature overrun can be expected, therefore, initially set the aquastat at 140°F (60°C) and the high limit switch at 200°F (93°C).

***Note:** A single line “heat exchanger loop” may not have enough flow to activate the system flow switch. If this occurs, consider adding another loop of hose to increase flow and reactivate the system.*

High Flow Situation

Utilizing two or more portable heat exchangers or three or more circulating line heat exchanger loops.

- Set the aquastat at 190°F (88°C) and the high limit switch between 200°F-210°F (93°C -99°C).

Initiate Firing

- Verify that the “Pump Switch” is in the “ON” position.
- Toggle the “Water Heater Switch” to the “ON” position.
- The burner will proceed through its firing sequence.
- Once the system pressure is steady (air has been eliminated from the system), monitor the “Supply Temperature” until it is within 10°F of the Aquastat temperature setting.
- Verify that only one “heat exchanger loop” or one Portable Heat Exchanger is connected to the primary line through the distribution manifold. This will close the loop and allow circulation from the “Supply” side to the “Return” side of the primary circulation line.
- Open fully the “Supply” isolation valves (*Figure 26 - 14-2*).
- Open fully the “Return” primary circulation line valve (*Figure 26 - 14-3*).
- Open the “Return” isolation valve (*Figure 26 - 14-4*) to the “half open” position. The “half open” position will ensure a slow introduction of cold HTF into the external circulation system and prevent a “cold shock” of the system.

Note: Do not close this valve more than the ½ closed position. The restricted flow may prevent the firing of the water heater.

- Incrementally open the “Return” isolation valve to a fully open position (*Figure 26 - 14-5*).
- Monitor the “Return Temperature Before Bypass” gauge. Before fully connecting more “heat exchanger loops” or “portable heat exchangers”, this gauge must show a noticeable rise in temperature indicating the HTF has made the full circuit. With “heat exchanger loops”, this may take approximately 10 minutes or more.
- Repeat the previous step until all “portable heat exchangers” or the “heat exchanger loops” are connected and circulating.



Figure 24 - Pump and Water Heater Switches



Figure 25 - Control Panel, Temperature Gauges

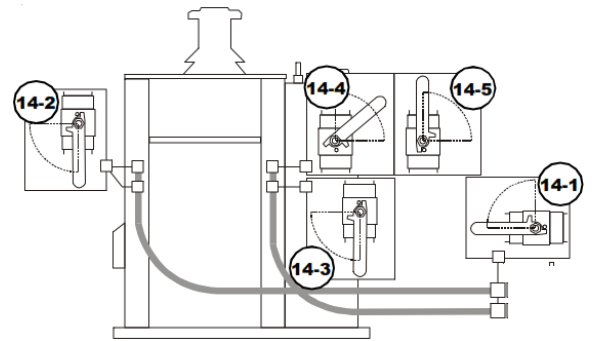


Figure 26 - Circulation Valve Positions

Purging Air from the Diesel/Light Oil Fuel System

If the burner does not fire, the fuel system may need to be purged of air.

- Confirm that there is an adequate fuel supply.
- (down) position.
- Open all full diversion to the tank. Set valve to the “Open” position.
- Confirm that the pump switch is in the “On” (up) position.
- Toggle the water heater switch to the “On” (up) position.
- Depress the reset button. This will activate the fuel pump & burner firing sequence.
- When the fuel system is primed, the fuel pressure gauge will show a steady reading and the water heater should attempt to ignite.
- Once the water heater has ignited and the fuel pressure has stabilized set the 3-way fuel bypass valve to the normal position (vertical position).

Note: The reset process can be tried up to six times, at the most. If the water heater does not fire, see the accompanying “Water Heater Module - Service Manual” or “Riello Burner Installation Manual” for information and/or contact DRYAIR Technical Support 1 (888) 750-1700.

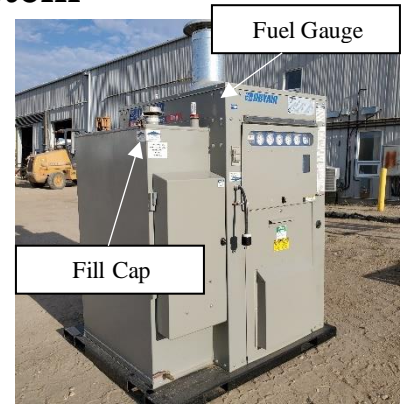


Figure 27 - Fuel Gauge and Fill Cap



Figure 28 - Fuel Line Valves and Filter

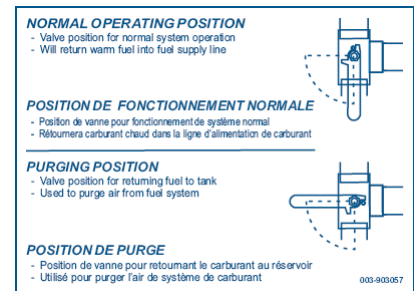


Figure 29 - Fuel Line Valve Positions

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.

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 30 - HTF Fill Cap and Gauge

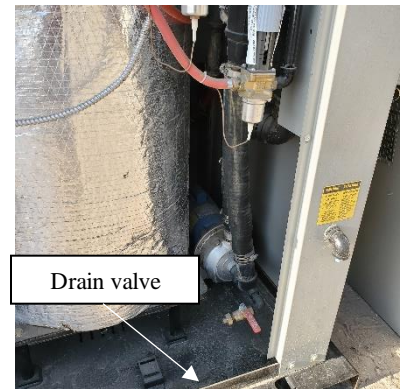


Figure 31 - Circulation Pump/Drain Valve

Startup for Diesel/Light Oil Burner:

Note: The following steps must be performed by “Qualified Personnel” only. Contact your local fuel supplier to inform them of requirements. Only clean, #1 or #2 diesel fuel or light heating oil is suitable for use in this system. These are factory settings, based on standard elevation. Adjustments must be made for high elevation.

1. Remove burner hood.
2. To remove the drawer assembly:
 - Loosen screw (Figure 32 - 3), then unplug control box (Figure 32 - 1), by carefully pulling it back and then up.
 - Remove the air tube cover plate (Figure 32 - 5) by loosening the two retaining screws (Figure 32 - 4).
 - Loosen screw (Figure 32 - 2) and the fuel supply line connection then slide the complete drawer assembly out of the combustion head as shown.
3. Remove the nozzle adapter (Figure 33 - 2) from the drawer assembly by loosening the screw (Figure 33 - 2).
4. Check the nozzle to ensure correct size and type. If wrong, replace the nozzle with one of the correct sizes and types listed below. Nozzles should be replaced after 5,000 hours of service due to gradual erosion of the orifice from high pressure flow.
 - Model 2100-DG-0600 nozzle = 3.50 x 60°B
 - Model 2100-DG-0900 nozzle = 5.00 x 60°B
5. Replace the nozzle adapter into the drawer assembly and re-source the retaining screw.
6. Check the position of the ignition electrodes. Refer to Figure 34 for correct alignment. Adjust if necessary. These dimensions must be observed and verified.

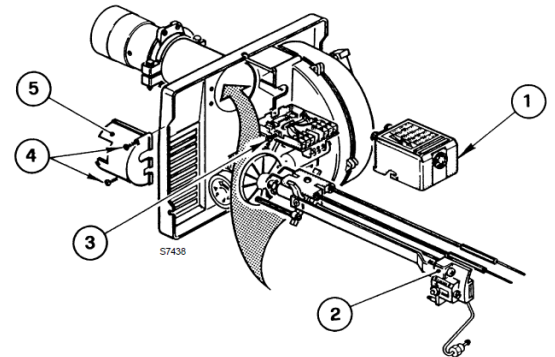


Figure 32 - Removing Burner Drawer Assembly

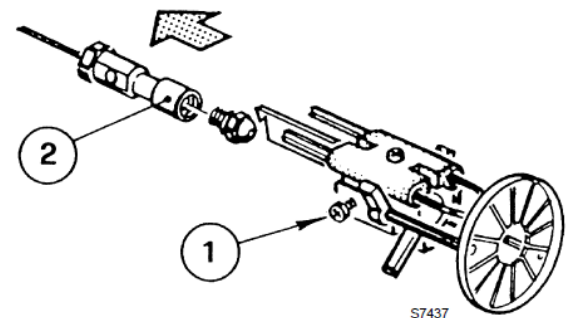


Figure 33 - Burner Nozzle

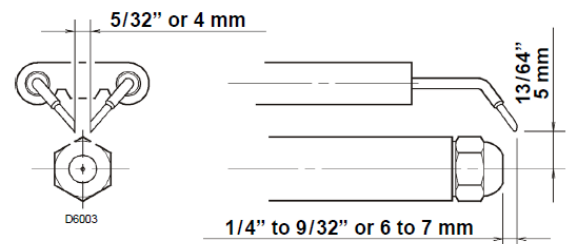


Figure 34 - Ignition Electrode Setting

7. To set the turbulator adjustment assembly:

- Loosen nut (Figure 35 – 1) and turn screw (Figure 35 – 2) until index marker is aligned with the correct index number. Re-tighten the retaining nut (Figure 35 – 1).

Note: Zero and five are scale indicators only. From left to right the first line is 5 and the last line 0.

- Correct turbulator settings are:
 - Model 2100-DG-0600 = 2.5
 - Model 2100-DG-0900 = 4.0

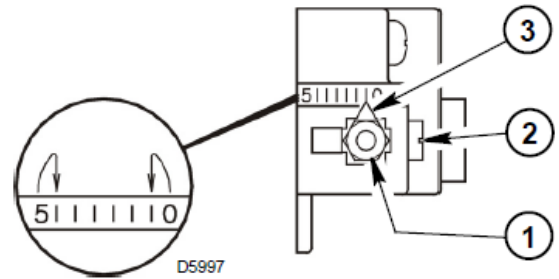


Figure 35 - Turbulator Setting

8. Insert the drawer assembly back into the burner tube. Replace the control box and cover plate by reversing procedure described in 2.
9. Connect power supply to the water heater and establish flow of heat-transfer-fluid by turning on the circulating pump's toggle switch, located on the control panel. Open supply and return isolation valves.
10. Initiate a try for ignition by turning on the water heater toggle switch located on the control panel. The burner will go through a pre-purge cycle before trying for ignition. Due to air in the fuel line, you may have to re-initiate the ignition cycle multiple times, by pressing and holding the burner reset button for at least 10 seconds. Once all air is eliminated, the burner should light. The burner will run on low for about ten seconds before shifting to high fire.

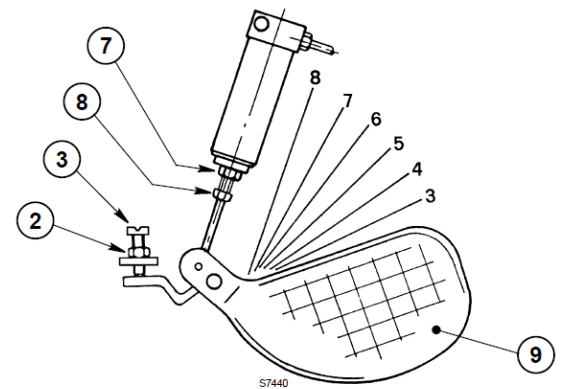


Figure 36 - Air Shutter

Note: If the diesel/light oil burner fails to ignite after several attempts, there may be air in the fuel system. To purge the air from the fuel system – see “Operation - Purging Air from the Diesel/Light Oil Fuel System” section of the Operator Manual.

11. To set the burner's air shutter and fuel pressure (Refer to Figure 36 and Figure 37).

- While the burner is firing on **low**, loosen retaining nut (2) and turn the adjusting screw (3) until the top of the air shutter (9) is correctly positioned.

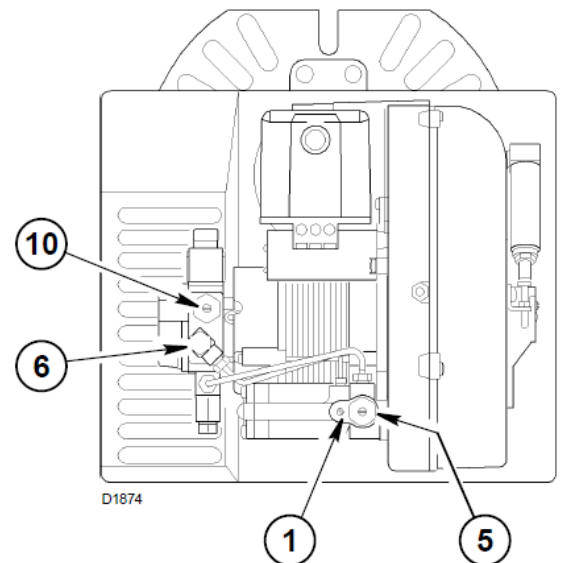


Figure 37 - Fuel Pressure Adjustment

Hold adjusting screw in position and secure by tightening the retaining nut. Preliminary settings for low fire are:

- Model 2100-DG-0600 = 2.8
- Model 2100-DG-0900 = 3.0
- Fuel pressure for **low fire** is factory set to 100 PSI for all models.
- While the burner is firing on **high**, set fuel pressure by turning the pressure regulator adjustment screw. Fuel pressure gauge is provided to monitor this adjustment. Fuel pressure settings for **high fire** are:
 - Model 2100-DG-0600 = 160 psi
 - Model 2100-DG-0900 = 145 psi
- While the burner is firing on **high**, loosen retaining nut and turn the bolt in a counterclockwise direction until about 3/4" of thread is visible. Position the air shutter so the top of the air shutter is aligned with the proper index line. Hold the shutter in the position and turn the adjusting bolt clockwise until a resistance is met. Preliminary air shutter setting for **high fire** are:
 - Model 2100-DG-0600 = 4.0
 - Model 2100-DG-0900 = 8.0

12. Using a good quality Smoke Spot Tester and Flue Gas Analyzer, take flue gas sample readings at the test port in the flue pipe above the cabinet. Fine tune the readings by adjusting the burner's air shutter, to achieve acceptable efficiency and emission levels. Final readings must be taken with the burner cover in place and the combustion air duct connected. **Note:** *This step is essential for clean, efficient combustion.*

Acceptable levels are:

2100-DG-0600		
	Summer Fuel	Winter Fuel
FT (Flue Temp)	Less than 650°F	Less than 635°F
O ₂	<u>3.2%</u> ± 0.5%	<u>4.3%</u> ± 0.5%
CO	Less than <u>50</u> ppm	Less than <u>50</u> ppm
EFF	Greater than <u>80%</u>	Greater than <u>80%</u>
CO ₂	<u>13%</u> ± 0.5%	<u>12.5%</u> ± 0.5%
EX/A	<u>15%</u> - <u>25%</u>	<u>20%</u> - <u>30%</u>

2100-DG-0900		
	Summer Fuel	Winter Fuel
FT (Flue Temp)	600°F to 650°F	575°F to 625°F
O ₂	<u>3.2%</u> ± 0.5%	<u>4.3%</u> ± 0.5%
CO	Less than <u>25</u> ppm	Less than <u>25</u> ppm
EFF	Greater than <u>80%</u>	Greater than <u>80%</u>
CO ₂	<u>13%</u> ± 0.5%	<u>12.5%</u> ± 0.5%
EX/A	<u>20%</u> ± 3%	<u>24%</u> ± 3%

6. Troubleshooting

- There are 8 troubleshooting/warning lights on the control panel. The upper 6 green troubleshooting lights indicate the status of a sequence of functions while the unit is running. The lower 2 red warning lights indicate low fluid 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 Aquastat and Burner lights will turn ON and OFF as the burner cycles.
- Troubleshoot power issues at the control panel terminal strip. Remove the control panel to expose terminal strip.
- Refer to “Appendix – Electrical Schematic” for terminal locations.



No Power at Outgoing Side of Water Heater Toggle Switch

Check for 120V power between letter N and #1 on the terminal strip. If there is no power check the following:

- a) Check that the water heater circuit breaker has not been switched off.
- b) Check that water heater toggle switch has not been turned off.
- c) Check for power in and out of breaker and toggle switch.
- d) Check that correct power supply has been connected to the unit. Investigate the power source and be certain that the power characteristics are correct (115/230V, 30 Amp, single phase, 4-conductor, 0'-100' – 10AWG, over 100' – 8 AWG).



No Power at Terminal #4 on Low Water Cut-off

Check for 120V power between letter N and #2 on the terminal strip. If there is no power check the following:

- a) Low water situation. Check fluid level in tank and add if necessary.
- b) Check fuse in Low Water Cut-off. Replace if required.

**LWCO- If LWCO is not working and the tank has fluid, call DRYAIR for further assistance.*



No Power at Flow Switch

Check for 120V power between letter N and #4 on the terminal strip. If there is no power, then check between N and #3 on the terminal strip. If power, check/remove filter screen if still used in unit. New units do not have this. If there is no power, check the following:

- a) Pump Not Running:
 - Check pump breaker and toggle switch on the control panel.
 - Check for 230V at pump motor. If correct power is confirmed at motor, but pump will not run, replace pump.
- b) Inadequate Flow:
 - Check that all valves are open in the Fluid Transfer loop. – Filter screen may be plugged. Use flush hose/valve attachment into a bucket, while pump is running, for a quick flush. Eventually the system may have to be drained and the filter

screen removed and cleaned by hand. – If fluid-receiving units are closed off, check that the pressure bypass valve is open.

- When performing “ground thaw” or “concrete cure” application, the use of only one “heat exchanger loop” may result in adequate flow. Utilizing at least two “heat exchanger loops” will provide adequate flow or a short bypass loop can also be incorporated to correct this situation.
- Air present in the circulation system. Air in the system can cause cavitation in the pump and pressure loss. Refer to “Operation, Purging Air from the System” for air purging instructions.
- Supply temperature overrun causing vaporization (steam) & pump pressure to be lost. Cavitation will occur in the “Water Heater Heat Exchanger” causing a noticeable bubbling, popping sound. Check the “Overflow Outlet” to confirm presence of fluid vapor. If vaporization is occurring, the Aquastat setting is set too high. Reset the Aquastat to a lower temperature (by 10°F increments) and allow cool-down. When the HTF cools down, the system will regain pump pressure. Allow the burner to cycle back on and observe to ensure that the vaporization situation does not reoccur. If it does reoccur, reset the Aquastat to a lower temperature until the problem is rectified.

Note: *This situation is more likely to occur in a “Low Flow” situation (refer to Operation, Temperate Start Procedure, Control Settings).*

c) Defective Flow Switch:

- If a) and b) check out good, the flow switch will need to be re-calibrated or replaced.



No Power at Outgoing Side of High Limit Switches.

Check for 120V power between letter N and #4 on the terminal strip. If there is no power check the following:

- a) Manual reset high limit – Check and reset if it has been tripped.
- b) Check switch settings. The automatic high limit should be set 10°F higher than the set point of the aquastat, and the manual reset high limit should be set 10°F higher than the automatic high limit switch.
- c) Determine which high limit switch is defective and replace.



No Power at Aquastat

Check for 120V power between letter N and #5 on terminal strip. If there is no power check the following:

- a) Check that the setting on aquastat is at desired operating temperature.
- b) Check well sensor (electric) and verify that it is intact and positioned properly in its well.
- c) If a) and b) check out good, replace both the aquastat and sensor.

Burner light and aquastat lights work in series. If burner does not start, press reset button on burner. Check for fuel pressure during pre-purge. If no pressure, switch 3-way valve (if equipped) to purge position. May need to reset burner a couple times to purge system. Call DRYAIR for further assistance.

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

7. 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 $\frac{1}{4}$ and $\frac{3}{4}$ 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 Supply Temperature Gauge

- Verify that the supply temperature gauge is within 10°F of the aquastat setting.

Seasonal Checklist

Fuel (Water Block/Particulate) Filter

- The water block/particulate filter should be changed every heating season, or as required.

Hoses

- Periodically check all hoses for damage due to aging, elevated temperatures, over-torqued hose clamps, abrasion, and weathering.
- Replace damaged hoses as required.
- Seasonally check hose clamp torque and adjust accordingly.

Water Heater Heat Exchanger

- Keep the flues in the water heater clean. Soot is a nonconductor of heat; a dirty water heater requires more oil to heat a structure than a clean one. Water heaters can corrode on the fireside. This results from corrosive substances in the fuel and can be difficult to control. Some fuel oils contain substances which cause fireside corrosion. Sulphur, vanadium, and sodium are among the materials that may contribute to this problem. The probability of trouble from this source depends to a large degree on the amount of Sulphur in the fuel and on the care used in cleaning the fireside heating surfaces. This is particularly true when preparing a boiler for a period of idleness. Preventing this problem also depends on keeping the boiler heating surfaces dry when a boiler is out of service.
- The person responsible for water heater maintenance should be certain that the fireside surfaces of the water heaters in his care are thoroughly cleaned at the end of the firing season. He should also observe the fireside surfaces during the firing season and if signs of corrosion are discovered, a reputable consultant should be contacted.
- The flue pipe and chimney cap should be taken off once a year and thoroughly cleaned of all soot.

Note: Check the gauge panel at regular intervals for any irregular gauge readings.

Heat Exchanger Cleaning Procedure

- Remove the burner from the water heater (*Figure 38*).
- Remove the plate from the bottom of the water heater (1-2).
- Remove the refractory board from the water heater by reaching into the burner hole and lightly tapping the board with your hand until it drops down (1-3).
- Remove the flue collar (1-4) to expose the burner tubes (1-5).
- Remove all flue baffles (1-6).
- Clean burner tubes with a steel round brush or rag on a piece of rod (1-5).
- Vacuum all debris.

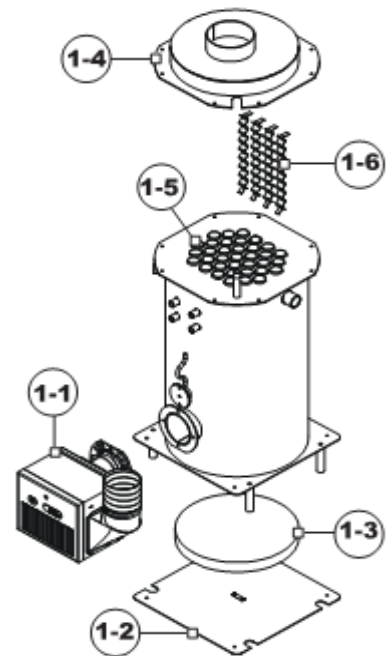


Figure 38 - Heat Exchanger Breakdown

Heat Transfer Fluid “HTF”

- A clean and properly maintained hot water system should not be drained unless there is a possibility of freezing, the boiler has accumulated a considerable amount of sludge or dirt on the water side, or draining is necessary to perform repairs. Very little sludge should accumulate in a water heater where little make-up water is added and where an appropriate water heater water treatment is maintained at proper strength.
- The “HTF” should be tested from year to year for freeze protection and should be strong enough for your area. The “HTF” should be checked with a refractometer. Check the glycol/water mixture chart (see “Setup, Heat Transfer Fluid) for the mixing ratios.
- The “pH level” of the “HTF” requires an annual check to see if the pH level is neutral. The pH level should be at #7. This should be checked with a pH instrument.

Burner

- For burner seasonal maintenance see the “Service Manual”.

8. 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.

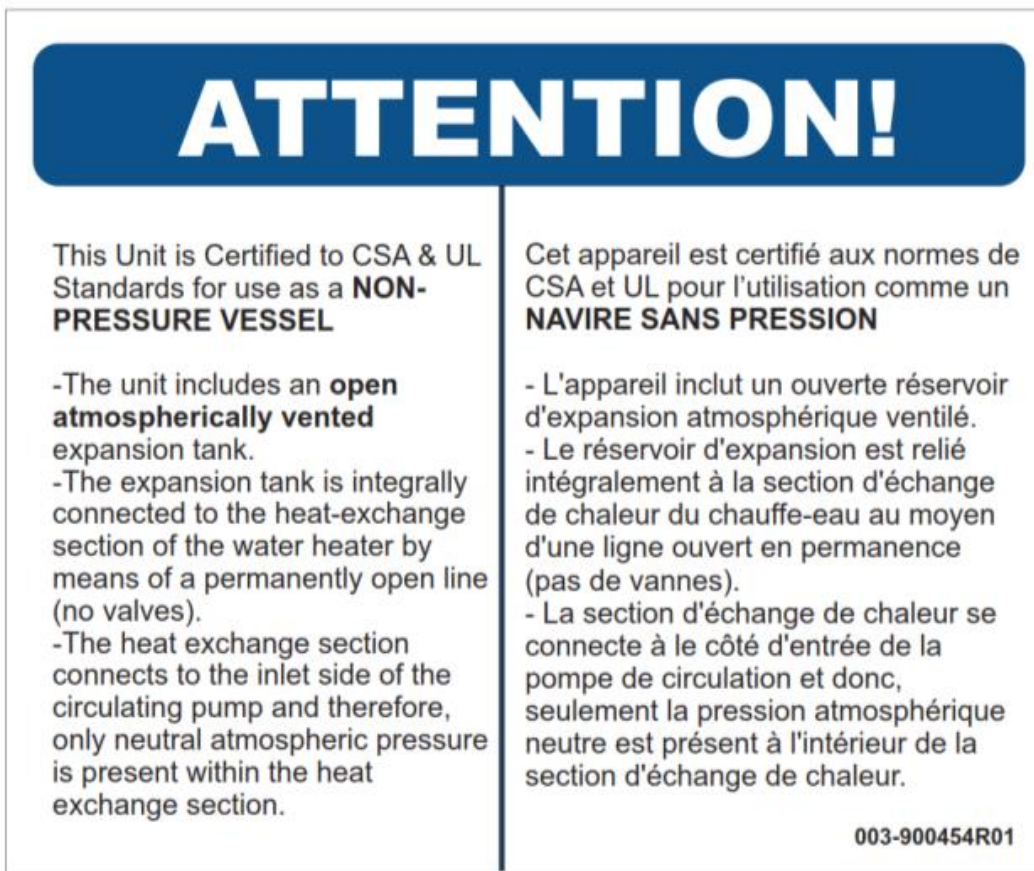


Figure 39 - Non-Pressure Vessel Decal

Certification & Heater Specifications




		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		Oil Burner		
Volts:		Model:	Riello 40-F20	
Phase:	1	Fuel:	#2 Heating Oil	#1 Heating Oil
HZ:	60 HZ	Calorific Value:	140,000 BTU / US Gal.	136,000 BTU / US Gal.
Max. Ampacity	30A	Output:	BTUH	BTUH
Control Voltage		Fuel Input:	US GPH	
Min. Circuit Ampacity	A	Pump Pressure:	P.S.I.	
Max. Overcurrent Protection	A			
 C US		Clearances:		
		Sides	24" (61cm) minimum	
		Flue Pipe	36" (91cm) minimum	
		Floor	0" (0cm) non-combustible	
		003-903519 R01		

Figure 40 - Water Heater Data & Serial Plate

Electrical Schematic

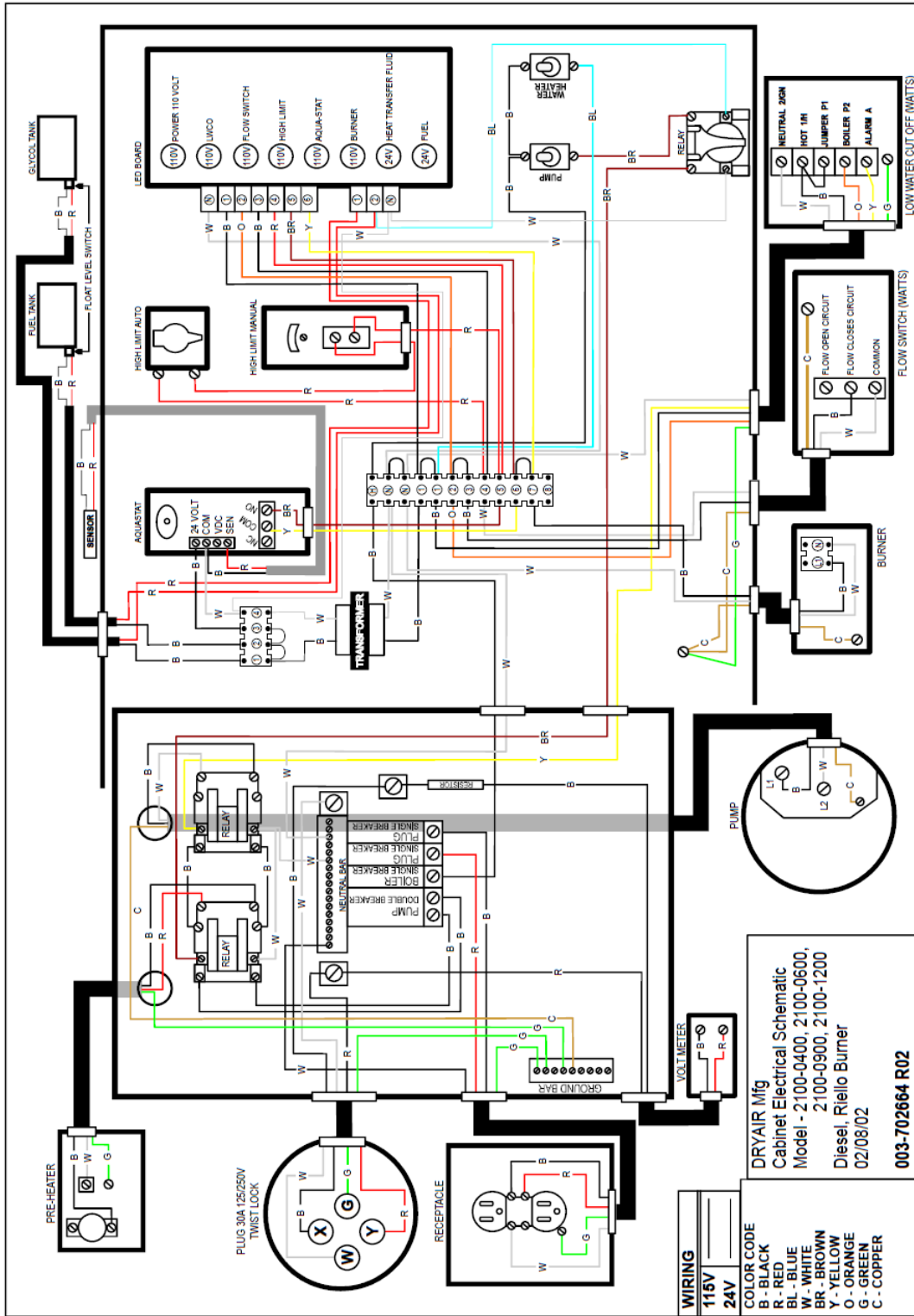


Figure 41 - 2100- Diesel Series CHU Electrical Schematic

Heat Transfer Fluid Preheater Information

Function

- The design intention for the HTF preheater is to ensure a smooth start in cold environments. The preheater heats the glycol in the heat exchanger which in turn sends heated glycol to DRYAIR'S patented air and fuel preheater to provide a controlled constant air and fuel temperature thus providing smooth start operations in cold weather.
- While using the HTF preheater it is recommended to have a supply temperature to be between 140°F and 150°F (60°C to 65°C) before turning on the pump and burner switch. The estimated time before these temperatures can be achieved will depend on the ambient temperature outside. Basically, the colder environment outside the longer it will take to achieve the recommended supply temperature.

DRYAIR's Patented HTF Preheater

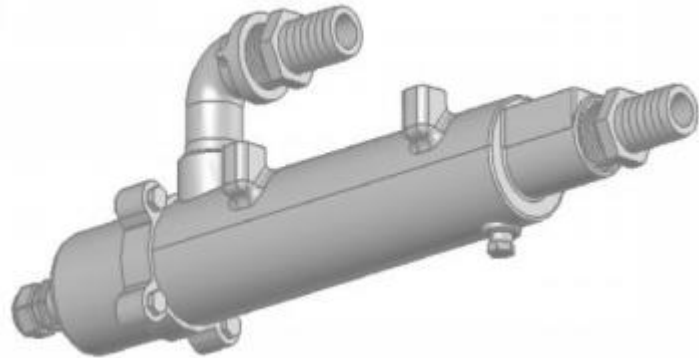


Figure 42 - HTF Preheater

Pros of Using HTF Preheater:

- Using the HTF preheater according to recommendations will ensure a smooth start in all weather conditions, thus providing a superior product to all users.
- Allows the machine to operate in even the coldest environments with fewer combustion issues.
- Less down time and reduced fuel costs as units will start and run at maximum efficiency.
- Having warm glycol reduces initial load to the glycol circulating pump at start up.
- Increase heat exchanger longevity and efficiency.
- Decreases maintenance costs due to the reduced stress on all components during cold startups.

Cons of Not Using HTF Preheater:

- Burner may not fire, which in turn will create down time on job locations. For competitor's units that do not have a preheater option, this typically means bringing the unit off site to a heated shop to allow the unit to thaw out before it will fire. Again, it will depend on the ambient temperature inside the shop as to how long this will take but in any event, it will take much longer compared to using the preheater on the DRYAIR unit.

- If the unit does start in cold temperatures, there is potential for the heat exchanger to accumulate soot due to not having a controlled environment of air and fuel going into the burner. Sooting will stop after the unit warms up if the settings on the burner are correct. Every 1 mm of soot accumulated on the heat exchanger results in a 5% loss of efficiency compared to a clean exchanger. Running the preheater on the DRYAIR unit eliminates the need to adjust burner settings in reaction to changing weather conditions.
- Decreases heat exchanger service life.
- Increases maintenance costs due to added stress on all components during cold startups.

In Conclusion

Using the preheater as instructed in the manual will allow you to operate DRYAIR units in colder climates without sacrificing efficiency or long-term reliability of the unit.

DRYAIR recommends planning ahead and starting the preheater to allow it to run while the unit is in transit to the jobsite (running on generator power) and while operators are reeling out and placing hose on the site. This will still make for productive use of the time while allowing the unit to benefit from the patented preheater feature.

If the operator decides they do not want to wait for the preheater to work, the DRYAIR unit will perform just like any of our competitor's units that do not have a preheater option.



Material Safety Data Sheets

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



Test Certificate

Bolt-on Lifting Frame Assembly for DRYAIR 2100-0900 System

Certificate No.: 661 **Project No.:** T21029P

Manufacturer: DRYAIR Mfg. Corp. **Test Location:** PAMI **Test Date:** July 9, 2021
St. Brieux, SK Humboldt, SK

Identification of Test Object: Lift Frame Assembly (DRYAIR Dwg No. 018-905894) for DRYAIR 2100-0900 (**Figure 1**).

- Corner posts (quantity of four) consisting of:
 - HSS steel tube, 2 in x 2 in x 0.250 in wall thickness
 - lifting bracket, 3/8 in. thick steel plate formed and with 1-3/4 in. diameter hole for clevis pin or hook; welded to end of HSS steel tube
- Side and end upper rails (quantity of two each) constructed from:
 - structural steel channel, 4 in. x 1.58 in. x 0.180 in. web thickness (C4 x 5.4)
- Side and end upper rails bolted to corner post lifting bracket with 1/2 in. Gr. 8 fasteners (quantity of two at each end of rail)
- Corner posts bolted to system base mount bracket with 5/8 in. Gr. 8 fasteners (quantity of two for each corner post)

Regulations Tested To: Current Province of Saskatchewan “The Occupational Health and Safety Regulations, 2020” Chapter S-15.1 Reg 10 – Part 13, sections 13-5 and 13-8; Part 14, sections 14-4 and 14-5.

Test Description: An applied force of at least 21,000 lb_f (93.4 kN), or five times the maximum 4,200 lb (1,905 kg) weight of the 2100-0900 system, will be applied simultaneously and evenly distributed to the four corner-post lifting brackets. Four individual chain slings will be used to simulate the engineered quad-leg polyester web sling that is available for lifting the 2100-0900 system.

Tests Result Required: The lifting frame assembly must withstand a total applied load of at least five times the maximum weight of the 2100-0900 system without failing. The maximum load applied divided by five will define the load rating of the lifting frame assembly.

Test Equipment:	Description	Date Calibrated	Calibration Due Date
	Load Cell – Serial No. 13479 (Figure 6)	October 9, 2017	October 9, 2021
	Indicator – Serial No. 17168961	Verified with load cell - July 6, 2021	

Test Results: A maximum force of 22,152 lb_f (98.5 kN) was applied to the lifting frame assembly by means of the four lifting chain slings and shackles attached to each of the corner post lifting brackets. No failure of any lifting frame components occurred during the test; however, deformation occurred in one corner of the system base near the lifting frame corner post mount bracket (**Figure 5**). This result allows the lifting frame assembly, when used on the 2100-0900 system, to have a maximum load rating of 4,430 lb (2,009 kg).

***I hereby certify these results meet or exceed the requirements of the performance regulations.
This certificate is based on results obtained by testing the equipment as indicated herein.
This Test Certificate shall not be reproduced except in full, without written approval of PAMI.***

Certified by: Mark Marianchuk, P.Eng.
Project Leader

Date: August 18, 2021

Test Procedure

1. A sample system base frame of the 2100-0900 assembly with the lifting frame installed (**Figure 1**) was placed on a rigid test bed and secured with steel beams and chains to allow the application of a vertical force perpendicular to the mounting surface.
2. The 2100-0900 product is intended to be lifted from a single point using an engineered quad-leg polyester web sling with 7-ft legs (**Figure 2**). To ensure the maximum force could be applied to the lifting frame assembly for the purpose of the test, the quad-leg sling was substituted with four individual chain slings load rated in excess of the maximum force to be applied (**Figure 3**).
3. A forklift with a fabricated lifting attachment secured to the forks was used to apply the load.
4. The applied force was measured using a load cell installed between the lifting attachment and a shackle that the four individual chain slings were attached to.
5. An indicator connected to the load cell provided an instantaneous readout of applied load (**Figure 4**).
6. The force application was video recorded.
7. The applied force was gradually increased from zero to approximately 21,000 lb_r. This target force was based on applying at least five times the maximum weight of the fully assembled 2100-1200 product, indicated by the Client to be approximately 4,200lb.
8. Once the target force was reached and exceeded, the applied force was held for at least ten seconds and then removed. The peak force applied was retrieved from the indicator (**Figure 4**) and used to calculate a load rating for the lifting frame as follows (imperial units):

Peak force applied = 22,152 lb_r

Allowable maximum rating for the lifting frame assembly system using a five-times design factor, or working load limit, = 22,152 lb ÷ 5 = 4,430 lb

This is the maximum allowable total weight of the final 2100-0900 assembly that can be lifted with the lifting frame, as tested, installed. The Client indicated the maximum weight of the complete product would be approximately 4,200 lb. Therefore, the 4,430 lb rating is adequate.

PAMI recommends the above rating be conspicuously marked on the lifting frame, along with any other additional information required in accordance with OH & S regulations for jurisdictions where the lifting frame may be used.



Figure 1. 2100-0900 system base frame and installed lifting frame assembly secured to test bed.



Figure 3. Test set-up for application of force to test bed.



Figure 2. Polyester web sling intended to be used to lift the 2100-0900 at four corner post lifting bracket locations.



Figure 4. Peak force applied during the lifting frame test.



Figure 5. Deformation of the system base near the lifting frame corner post mount bracket.



LOAD CELL CALIBRATION CERTIFICATION

CUSTOMER : PAMI PRAIRIE
ADDRESS : CANADA
CONDITION: AS FOUND & FINAL S.O. #: 170810 P.O. #: 23848
MODEL: 1220AF-50K-B SERIAL: 13479 BRIDGE: A CAPACITY: 50 Klb
PROCEDURE: C-1257 Mounting Per Interface Installation Instruction 15-5
ZERO BALANCE: 0.326 %RO

TEST CONDITIONS

TEMPERATURE: 73 °F HUMIDITY: 27% EXCITATION: 10 VDC

TRACEABILITY

FORCE STANDARD: STD-10 NIST#: STD-10C3116 DUE: 15-MAR-2018
STANDARD INDICATOR: BRD108 NIST#: 050898
TEST INDICATOR: BRD330 NIST#: 050898

SHUNT CALIBRATION

	Shunt (+/- .01%)	Output	Straight Line Conversion	Connections*
TENSION	30.0 KOhm	2.90648 mV/V	35.653 Klb	-Out to -Exc
COMPRESSION	30.0 KOhm	-2.90713 mV/V	35.646 Klb	-Out to +Exc

Shunt calibration resistor connections for tension and compression respectively are (-Exc to -Out) and (+Exc to -Out) for connector models; (-Sense to -Out Shuntcal) and (+Sense to -Out Shuntcal) for 7 wire models.

PERFORMANCE

	Rated Output	SEB Output	Nonlinearity	Hysteresis	SEB
TENSION	4.07552 mV/V	4.07606 mV/V	0.016 %FS	0.009 %FS	± 0.013 %FS
COMPRESSION	-4.07772 mV/V	-4.07777 mV/V	-0.021 %FS	0.043 %FS	± 0.021 %FS

STATIC ERROR BAND (SEB) The band of maximum deviations of the ascending and descending calibration points from a best fit straight line through zero OUTPUT. It includes the effects of NONLINEARITY, HYSTERESIS, and nonreturn to MINIMUM LOAD.

TEST LOAD APPLIED (Klb)	RECORDED READINGS (mV/V)	
	Tension	Compression
0	.00000	.00000
10	.81502	- .81489
20	1.63060	-1.63024
30	2.44594	-2.44595
40	3.26108	-3.26174
50	4.07552	-4.07772
20	1.63097	-1.63198
0	- .00018	.00008

Interface Inc. certifies that force measurements are traceable to primary standards at NIST. Calibration performed per Interface QA program and the requirements of ISO/IEC 17025, MIL-STD-45662A & ANSI/NCSL Z540-1994. Estimated measurement uncertainty is 0.040% RDG. expressed as the expanded uncertainty at 95% confidence level using a coverage factor of k=2. Results relate to load cell serial 13479 only. DO NOT REPRODUCE THIS REPORT except in full or with Interface Inc. written approval.

TECHNICIAN : Joseph Pezzi

CALIBRATION DATE : 09-OCT-2017

APPROVED : Josh Smith - Repair Supervision

Interface Inc.
7401 East Butherus Drive- Scottsdale, Arizona 85260 U.S.A
Telephone (480)-948-5555 - FAX (480)-948-1924

Figure 5. Calibration certificate for load cell SN 13479.



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 (CO ₂). 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

<u>Property</u>	<u>Values</u>	<u>Remarks • Method</u>
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.
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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

<u>Transport Canada</u>	Not regulated
<u>TDG</u>	Not regulated
<u>DOT</u>	Not regulated unless shipping container holds at least 5,000 pounds.
UN/ID no.	UN 3082
Hazard class	9
Packing group	III
<u>MEX</u>	Not regulated
<u>ICAO (air)</u>	no data available
<u>IATA</u>	no data available
<u>IMDG</u>	no data available
<u>RID</u>	no data available
<u>ADR</u>	no data available
<u>ADN</u>	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% <i>Literature</i>
Melting point/range	Not applicable to liquids
Freezing point	supercools
Boiling point (760 mmHg)	152 °C <i>Literature</i>
Flash point	closed cup 104 °C <i>Pensky-Martens Closed Cup ASTM D 93</i> (based on major component), Propylene glycol. open cup <i>Cleveland Open Cup ASTM D92</i> None
Evaporation Rate (Butyl Acetate = 1)	<0.5 <i>Estimated.</i>
Flammability (solid, gas)	Not applicable to liquids
Flammability (liquids)	Not expected to be a static-accumulating flammable liquid.
Lower explosion limit	2.6 % vol <i>Literature</i> Propylene glycol.
Upper explosion limit	12.5 % vol <i>Literature</i> Propylene glycol.
Vapor Pressure	2.2 mmHg <i>Literature</i>
Relative Vapor Density (air = 1)	>1.0 <i>Literature</i>
Relative Density (water = 1)	1.05 at 20 °C / 20 °C <i>Literature</i>
Water solubility	<i>Literature</i> completely soluble
Partition coefficient: n-octanol/water	No data available
Auto-ignition temperature	371 °C <i>Literature</i> Propylene glycol.
Decomposition temperature	No test data available
Kinematic Viscosity	43.4 cSt at 20 °C <i>Literature</i>
Explosive properties	No data available
Oxidizing properties	No data available
Molecular weight	76.9 g/mol <i>Literature</i>

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

Identification Number: 11045208 / A208 / Issue Date: 12/16/2019 / Version: 8.0

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

