Charge and Purge Procedure (commercial, multiple header pairs)

As per International Ground Source Heat Pump Association's Closed Loop Ground Source Heat Pump Systems, Installation Guide manual, Section 7, and International Ground Source Heat Pump Association's Closed Loop/Geothermal Heat Pump Systems – Design & Installation Standards 2000 manual, Section 1, Subsection 1E.

Prior to purging, the looping contractor should leave circuit and header piping filled with clean, potable water. The water source must be identified and approved by the person designing the ground loop.

Air may be removed from any piping system with sufficient flow velocity. IGSHPA has determined that the minimum flow velocity for air removal from any piping system is 2' of fluid flow per second. This minimum performance specification for air removal has been verified and repeated by various entities within the industry – it works. However, this minimum flow rate for air removal does not apply to solid contaminants, and is for pure water. Therefore, the ground loop and internal mechanical piping must remain clean and free of debris, and no antifreeze of any type should ever be added until after the system has been thoroughly flushed of air and charged with pure, potable water. In some cases where domestic water has a high total dissolved solids content, de-ionized or purified water may be necessary to charge the closed loop system.

There is no known minimum for purging of solid debris (dirt, gravel, etc.) from a ground heat exchanger as density, shape, texture, etc., cannot be determined (see page 13). For this reason proper pipe handling, care and installation procedures during loop installation must be strictly followed to eliminate any potential for contaminating a ground loop. From experience we have encountered gravel and other solid contaminants finding their way back to circulation pump systems 2 years *after* the system was installed; the result has been damaged circulation pumps and heat exchangers within the heat pumps. We have determined that fluid with sufficient viscosity, typical of systems with 20% to 25% propylene glycol, will eventually move solid contaminants that have not been permanently lodged in a ground loop circuit, back to the building mechanical system piping.

SEQUENCE OF PURGING

1. Loopfield Purging

- The purging process always begins with clean, potable water. **DO NOT** induce antifreeze until **AFTER** the entire loop, both the ground heat exchanger (GHX) and building loop, are purged of air. Antifreeze will entrain air, and viscosity will increase. This almost always requires a higher performance purge pump to meet the calculated

minimum flow rate and pressure drop per header pair, typically calculated for the longest header run-out. The basic procedure is described graphically on pages 4 through 8.

- The purge pump must be proven or rated as per manufacturer's specifications, or independently tested, to verify pump performance exceeds flow rate and pressure drop per each header pair to move water at **2' of fluid flow per second**. The ground loop designer must calculate a minimum flow rate and pressure drop for the longest header run-out to determine the minimum purge pump performance required.
- Connect temporary purge pump and charging barrel rated for calculated minimum purge pump performance to achieve **2' of fluid flow per second** to purge station adjacent to or located within internal mechanical room where the ground loop headers are manifolded. The purge station must be sited between GHX and internal building loop. **The purge port connections must be the same pipe inside diameter as that of the ground loop header pair.** See graphic description on pages 9 through 12.
- Isolate internal building piping and main circulation pump(s) from flow first.
- Isolate GHX subfields (if more then one), except for first header pair to be cleaned.
- Fill purge barrel with clean potable water, commence charging of subfield first.
- At this time, verify pressure drop across subfield is to minimum calculated for flow rate required. This can be done at P/T ports on subfield header pair, or P/T ports and/or calibrated flow meter on purge pump. **The flow meter should be on the return leg of the purge barrel; if the flow rate does not at least meet the calculated minimum flow rate for purging the system has insufficient power to clean out the system.**
- Commence purging of air and debris, reverse circulation and 'bump' as needed, until fluid is free of return bubbles or contaminants.
- Repeat with remaining subfield header pairs, isolating entire system from each effort until all header pairs are clean of debris and air, and charged with clean potable water.

2. Internal Loop and Heat Pump Purging

- Isolate GHX, isolate heat pumps internally, bypass main circulation pump(s) if appicable, and clean internal supply/return piping mains in building until clean of air and debris (solder, flux, etc.).
- Starting with furthest heat pump from purge station, clean and charge each individual heat pump feeder pair with jumper pipe or hose kit (short-circuit flow), maintaining isolation of each heat pump, before charging heat exchanger of each heat pump with clean potable water.
- Repeat for all heat pumps throughout building.
- Place internal and external piping in communication, circulate again to verify system is clean and free of air

3. Inducement of Antifreeze

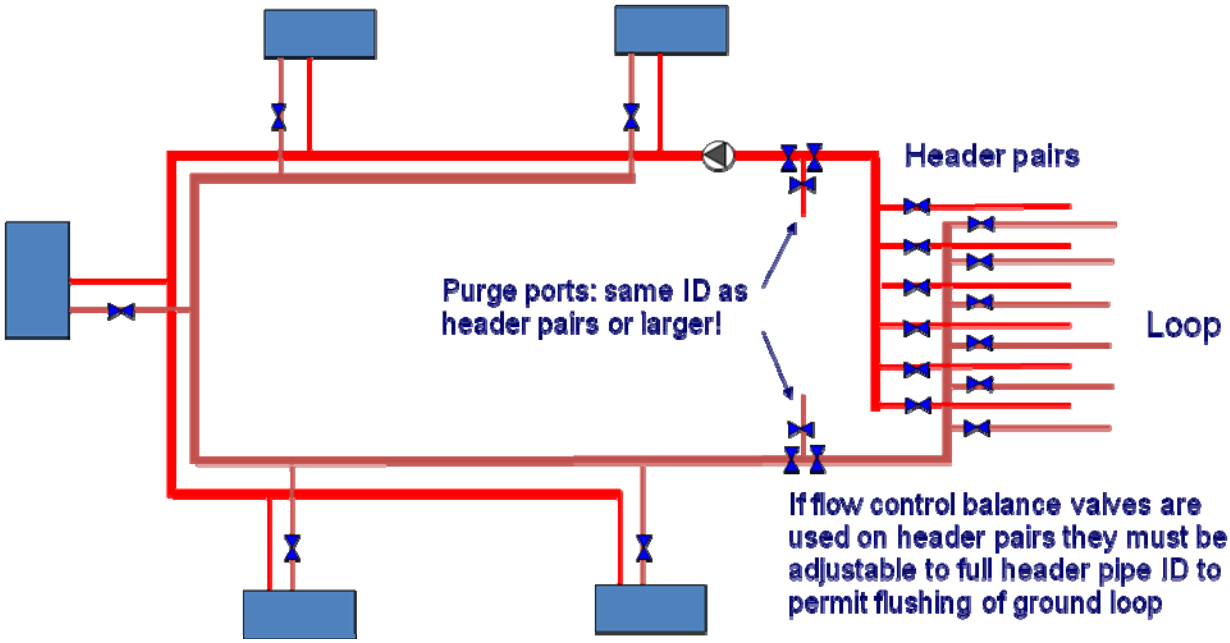
- Isolate to GHX **only** from purge station, leaving all header pairs and all circuits open.
- Add prescribed amount of antifreeze to purge barrel, calculated from total fluid capacity of system, while removing equal amount of water simultaneously from return line of ground heat exchanger to purge barrel, **stop** immediately when antifreeze inducement is complete.

- Circulate GHX with antifreeze fluid mixture for 30 minutes, or longer as calculated for preliminary mixing.
- Open entire piping system to full communication and circulate until mixing is complete.
- Closed return valve at purge station to charging unit to build pressure, close inlet valve of opposite purge station to lock in static pressure to at least 30 to35 psi, minimum starting recommendation to avoid potential negative pressure on the suction-side of the circulation pump(s), and/or cavitation due to remnant entrained air within the system.
- Add additional static pressure if necessary through P/T ports on header manifold using a hydraulic inducer, domestic water pressure or larger purge pump. If properly purged, even a large commercial loopfield will only require a small amount of water, usually less then a pound, to raise static pressure substantially and will not make a significant impact on the antifreeze capacity.

RECOMMENDATIONS FOR INTERNAL PURGE PORT DESIGN/FABRICATION

Purging of commercial GSHP systems requires a centralized purge port configuration. Locating the purge stations on the main supply and return piping between the building and ground loop allows the contractor to isolate specific portions of the system and methodically purge air from the system with minimum purge pump power, allows for faster more efficient installation of antifreeze or inhibitors, and easier pressurization of the system. For the most effective configuration:

1. Purge ports must be the same inside diameter or larger as the header pipes servicing the ground loop circuits.
2. If uneven header pair lengths force the use of balancing valves on the header pairs, select flow control balancing valves that are fully adjustable to the same inside diameter of the header piping for purging before operating the system and adjusting for flow balance.



Flushing Larger Systems

4" headers to building system

Valves on supply & return lines

2" supply & return lines to loop flushed & purged individually

31

Flushing & Purging the Loop

Flushing Larger Systems

150+ gpm unit

32

Flushing & Purging the Loop

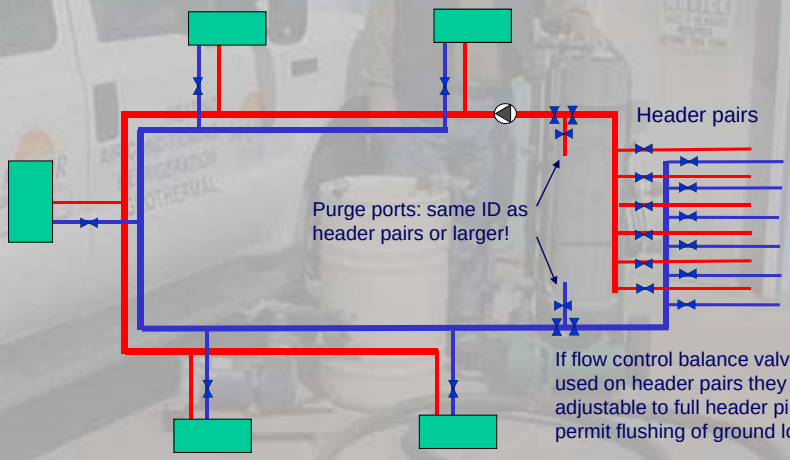
Importance of Strainer

VERY IMPORTANT to strain debris from loop fluid to prevent damage to pump lower pump performance.

If debris clogs heat exchanger, performance of heat pump will be adversely affected.

Pipes left exposed during construction should ALWAYS be protected from vandalism with sealed ends.

Purging Large Loops



If flow control balance valves are used on header pairs they must be adjustable to full header pipe ID to permit flushing of ground loop

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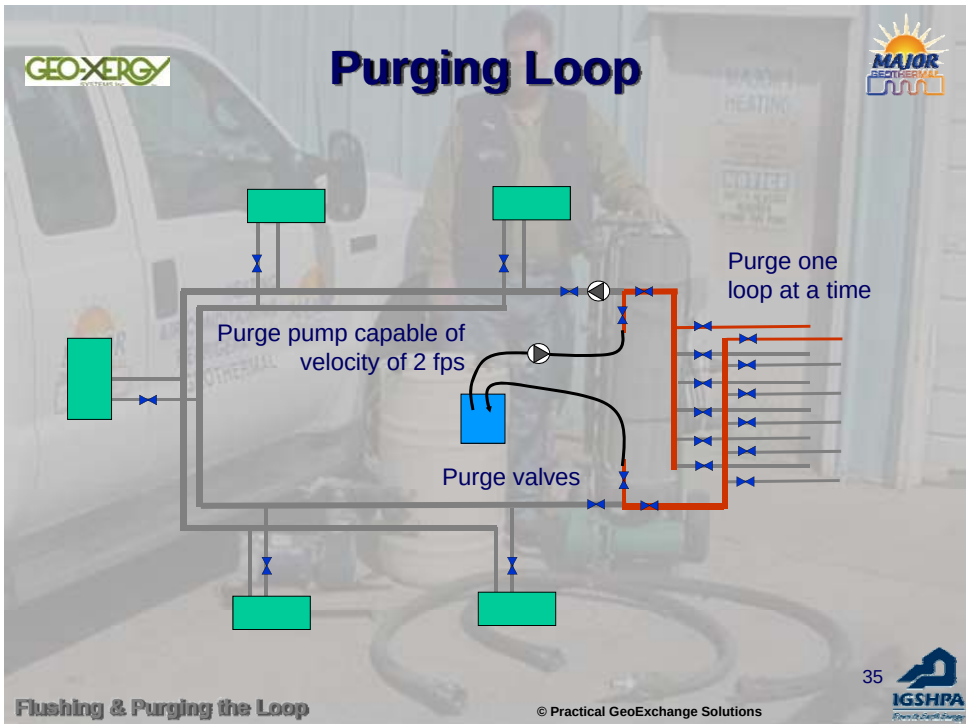

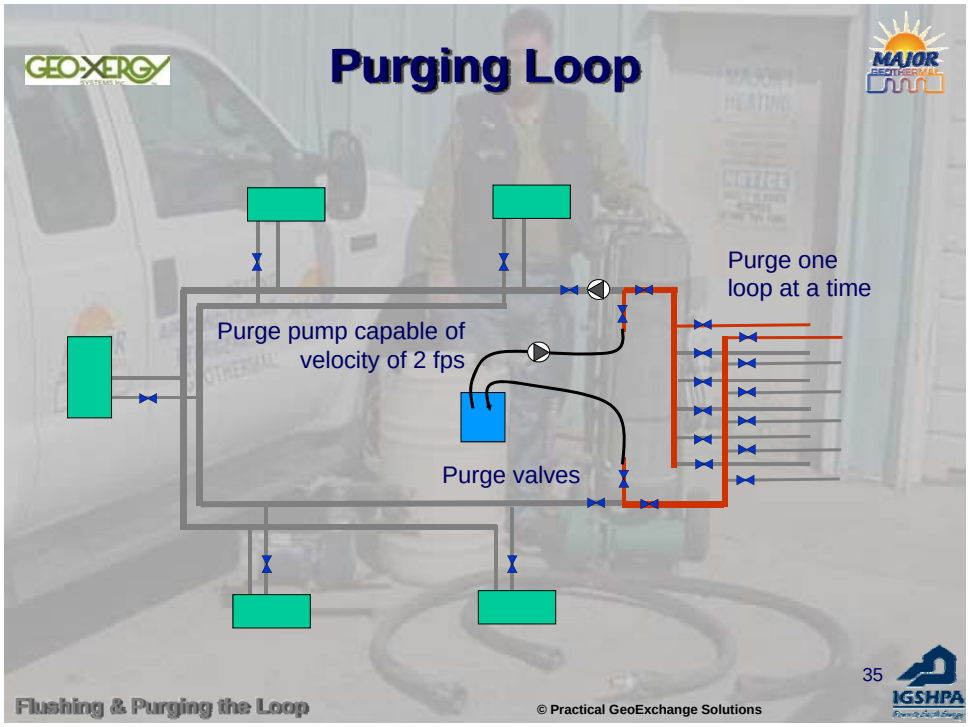

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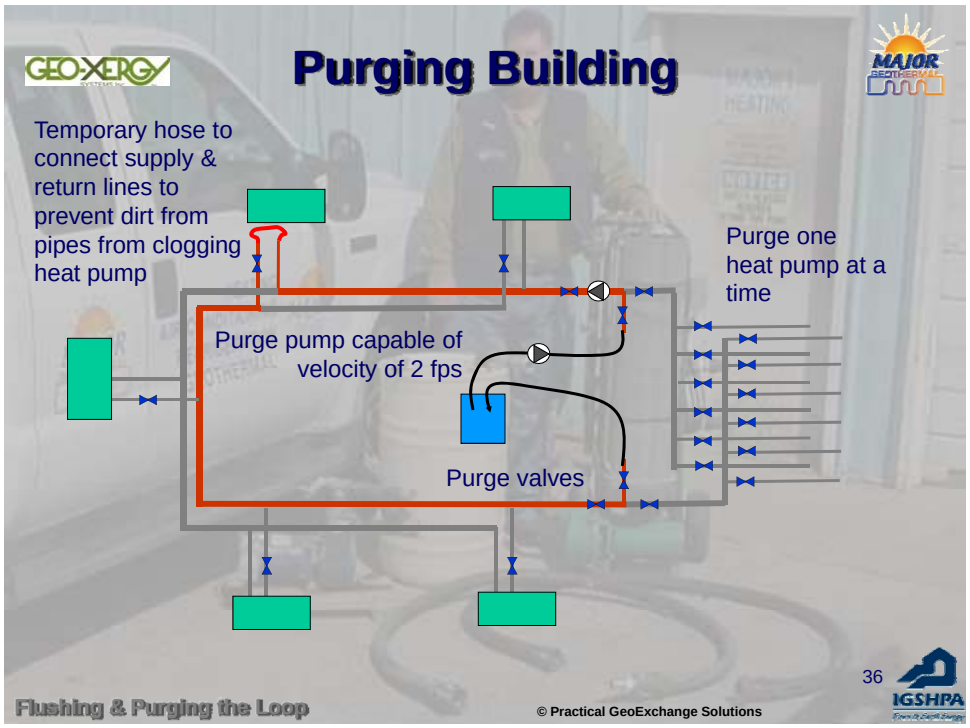

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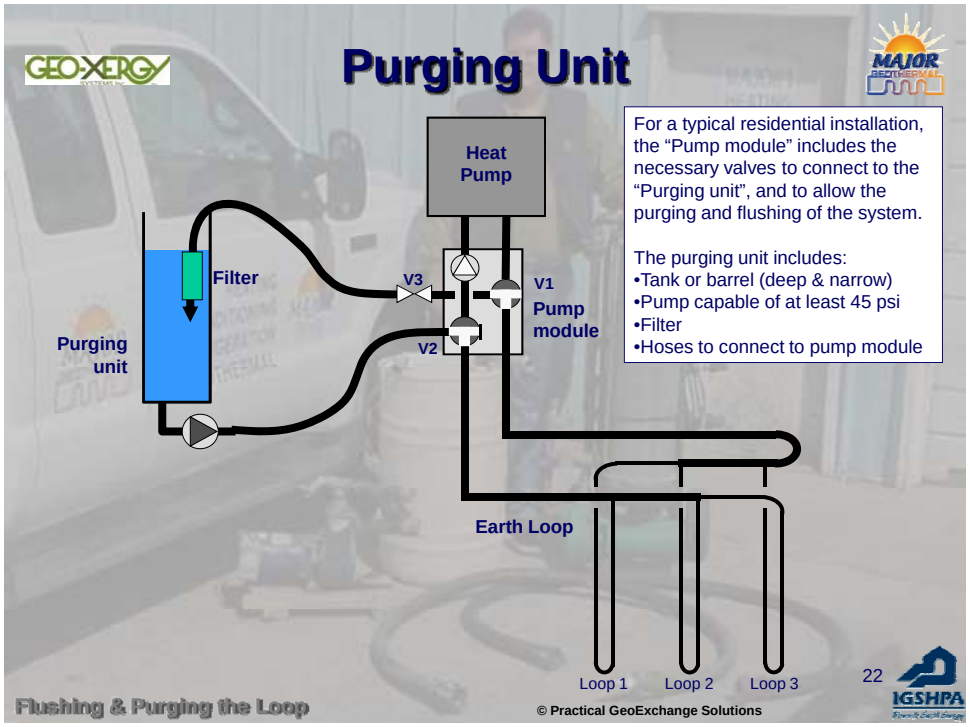
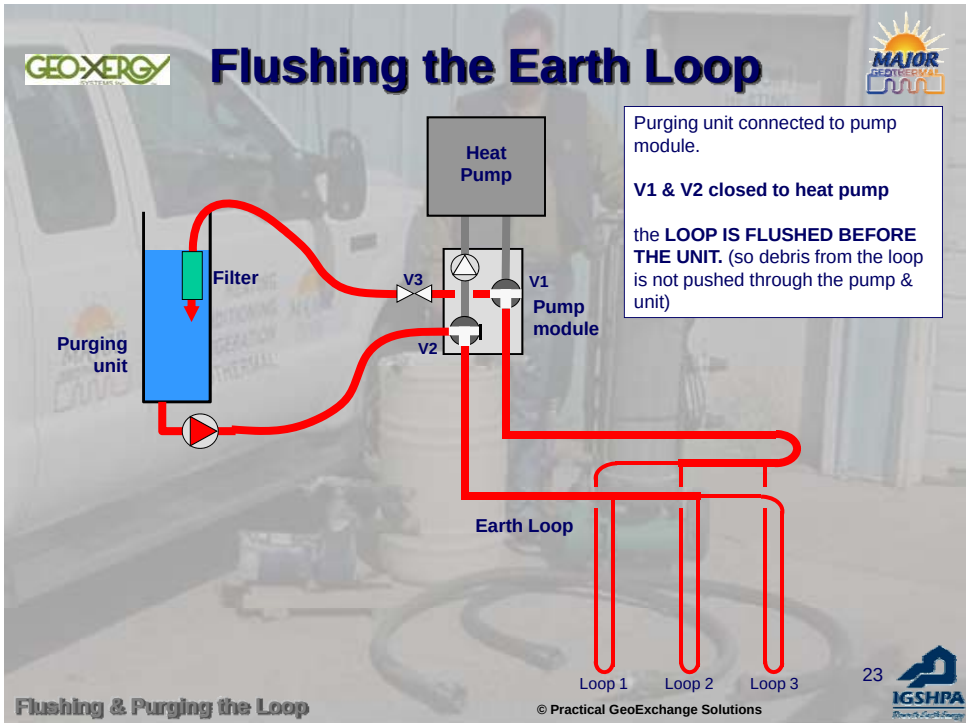
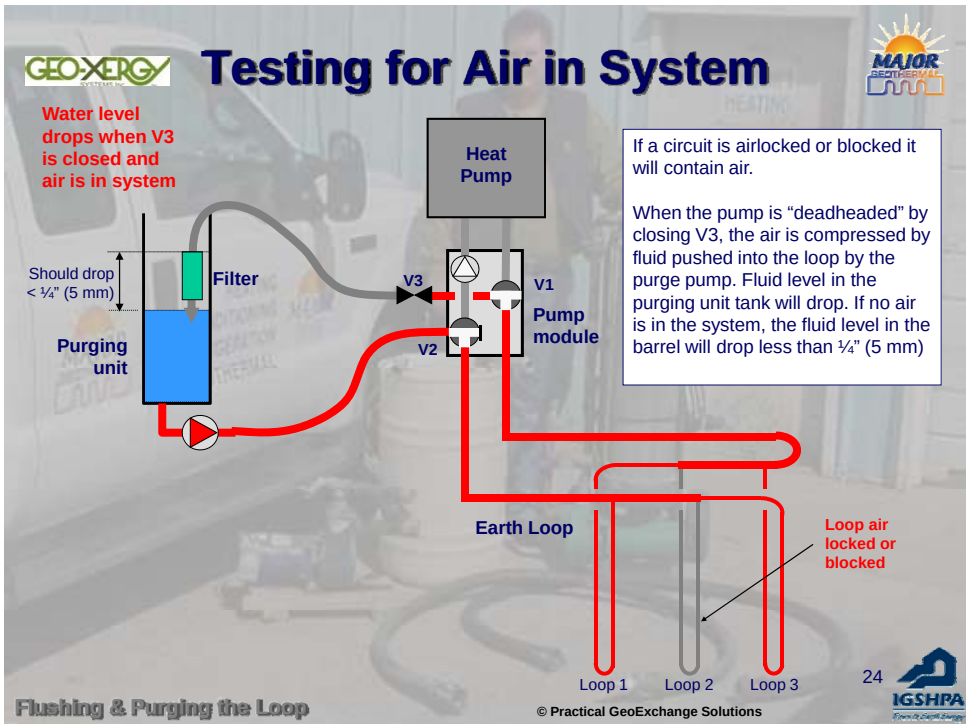
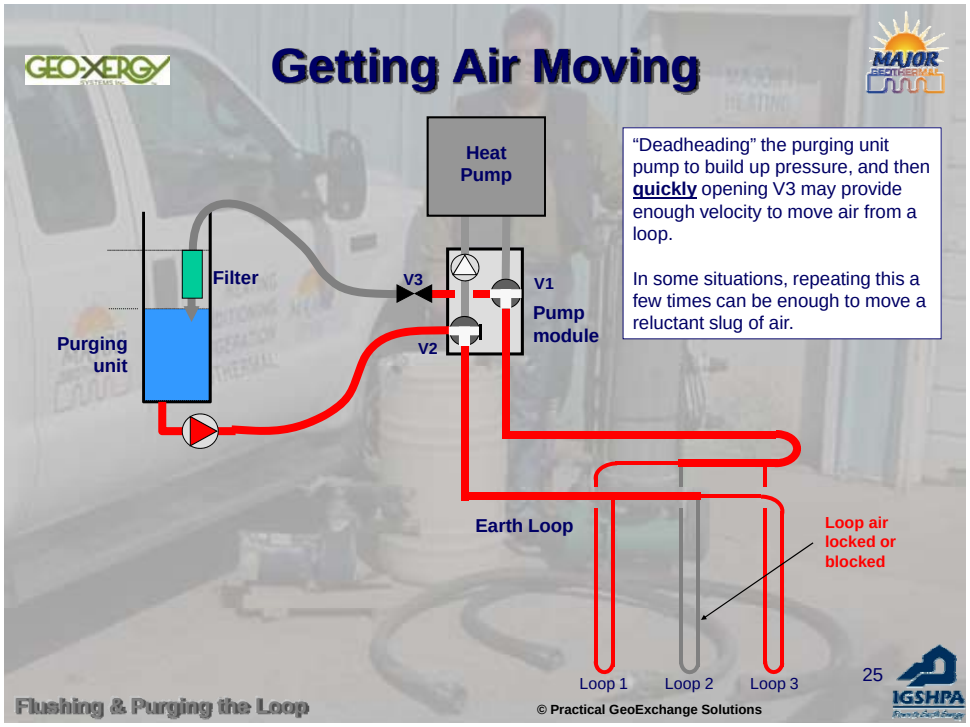
GRAPHIC DESCRIPTION - PURGING

BASIC CHARGING/PURGING – SMALL SINGLE HEADER SYSTEMS






Testing for Air in System
Water level drops when V3 is closed and air is in system
Heat Pump
If a circuit is airlocked or blocked it will contain air.
When the pump is "deadheaded" by closing V3, the air is compressed by fluid pushed into the loop by the purge pump. Fluid level in the purging unit tank will drop. If no air is in the system, the fluid level in the barrel will drop less than ¼" (5 mm)
Should drop < ¼" (5 mm)
Filter
Purging unit
V3
V1
V2
Pump module
Earth Loop
Loop air locked or blocked
Loop 1
Loop 2
Loop 3
24
Flushing & Purging the Loop
© Practical GeoExchange Solutions


Getting Air Moving
Heat Pump
"Deadheading" the purging unit pump to build up pressure, and then quickly opening V3 may provide enough velocity to move air from a loop.
In some situations, repeating this a few times can be enough to move a reluctant slug of air.
Filter
Purging unit
V3
V1
V2
Pump module
Earth Loop
Loop air locked or blocked
Loop 1
Loop 2
Loop 3
25
Flushing & Purging the Loop
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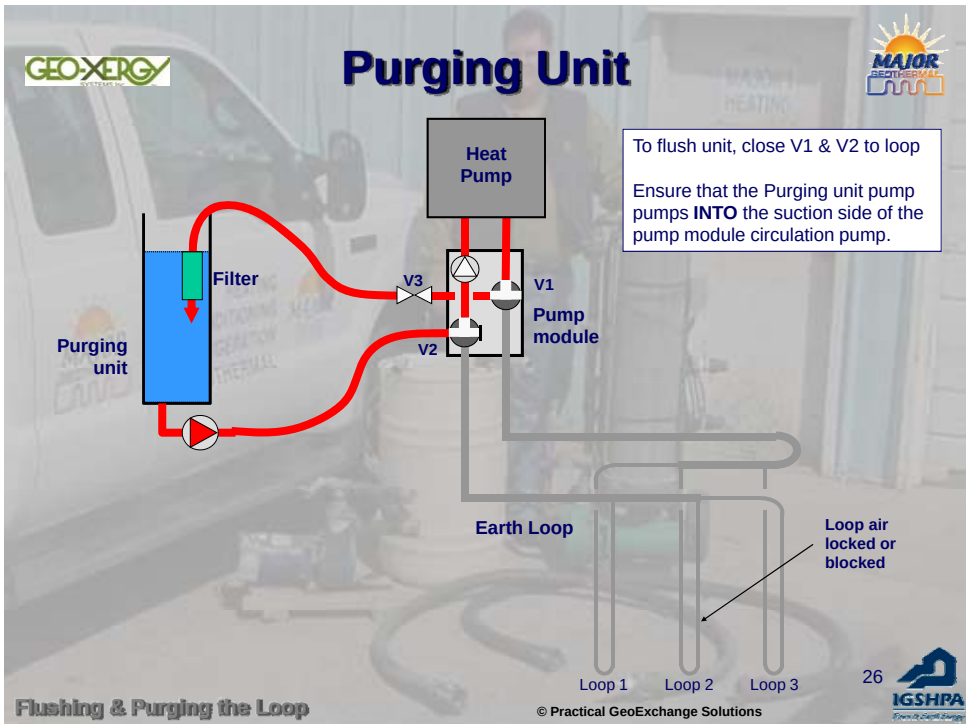
Purging Unit
Heat Pump
To flush unit, close V1 & V2 to loop
Ensure that the Purging unit pump pumps INTO the suction side of the pump module circulation pump.
Filter
V3
V1
Pump module
V2
Purging unit
Earth Loop
Loop air locked or blocked
Loop 1
Loop 2
Loop 3
26
Flushing & Purging the Loop
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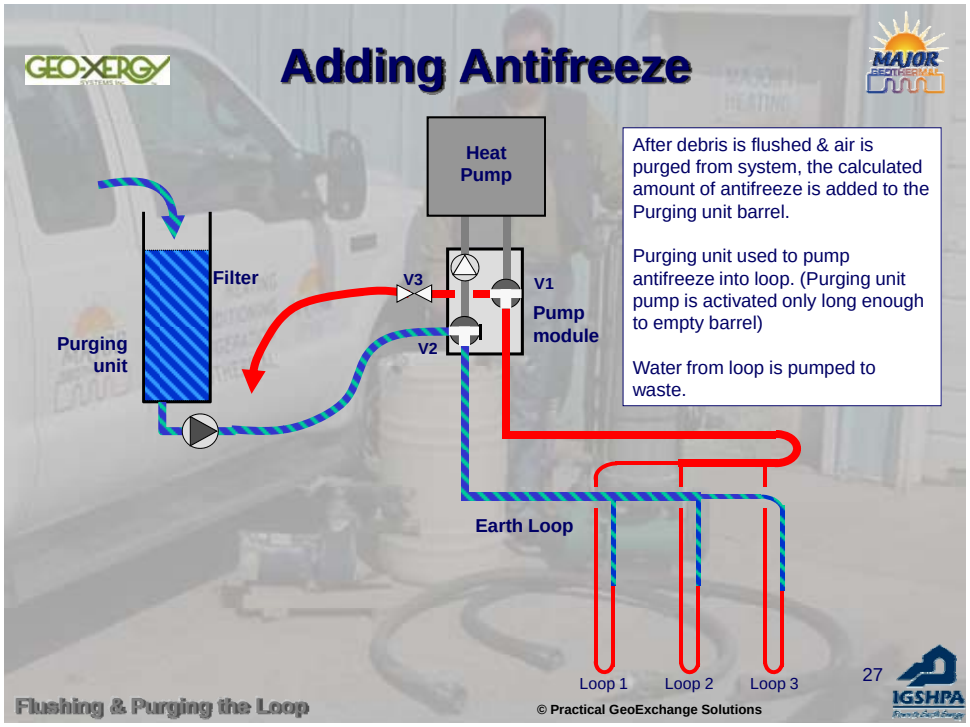
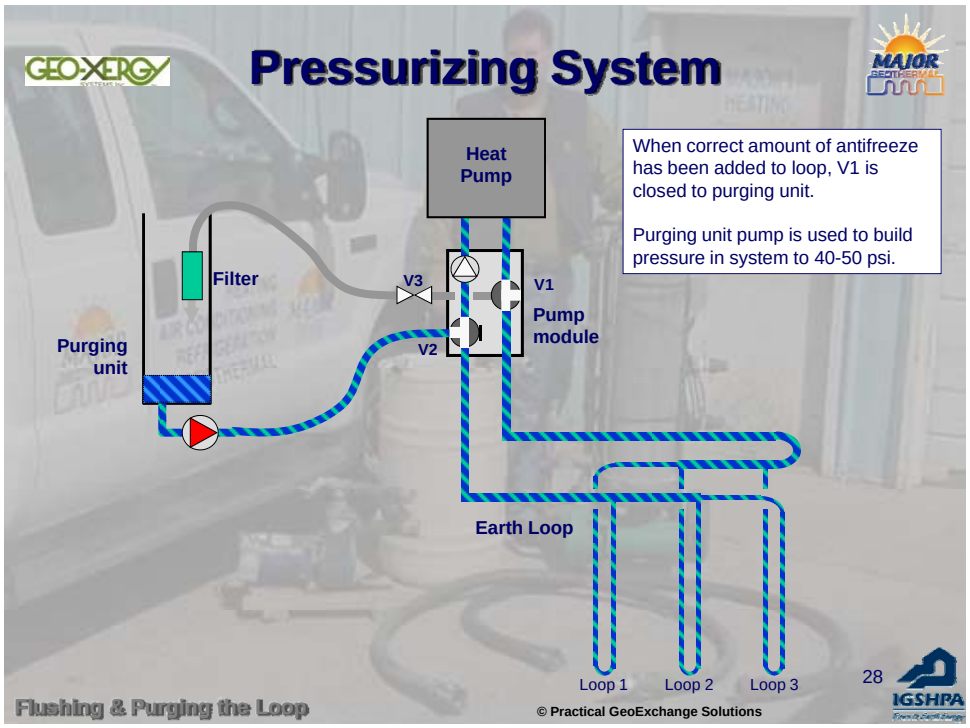
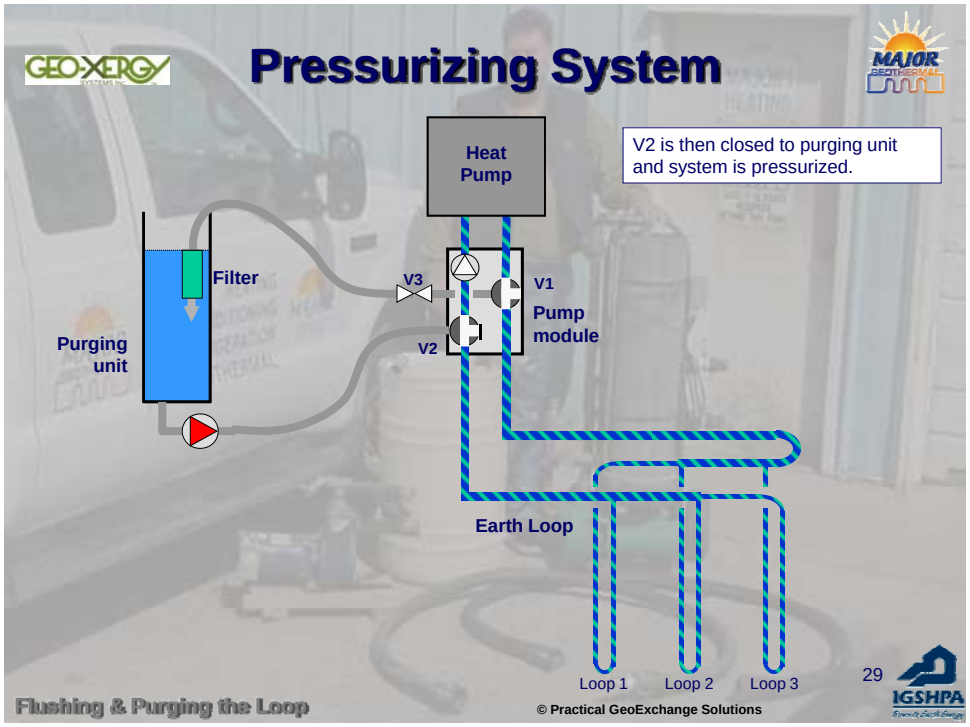

Adding Antifreeze
Heat Pump
After debris is flushed & air is purged from system, the calculated amount of antifreeze is added to the Purging unit barrel.
Purging unit used to pump antifreeze into loop. (Purging unit pump is activated only long enough to empty barrel)
Water from loop is pumped to waste.
Filter
V3
V1
Pump module
V2
Purging unit
Earth Loop
Loop 1
Loop 2
Loop 3
27
Flushing & Purging the Loop
© Practical GeoExchange Solutions





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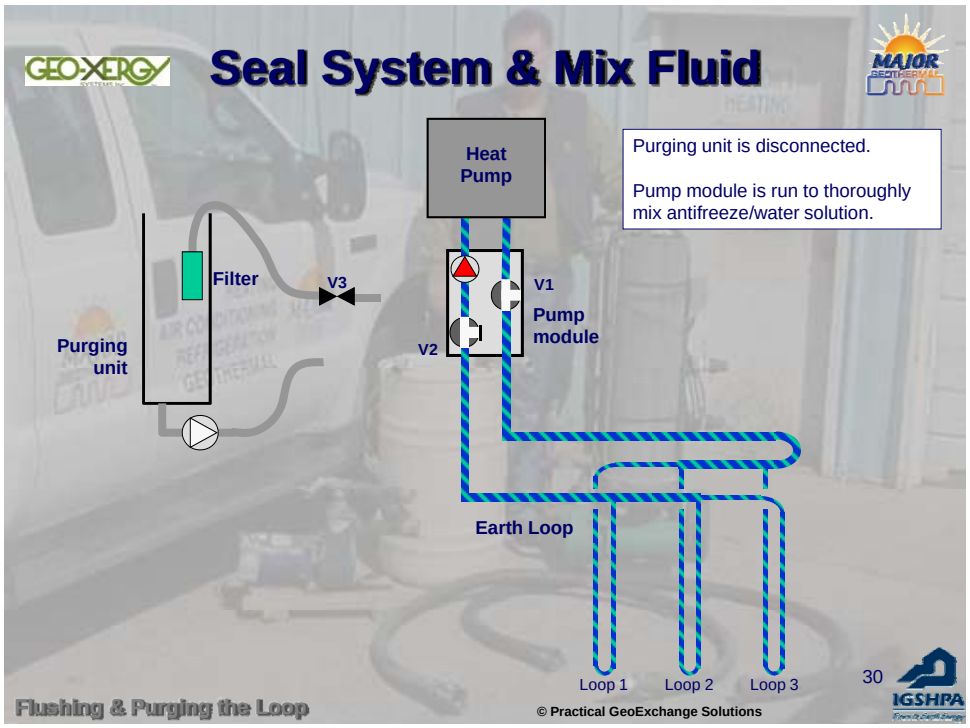

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Air removal will not necessarily remove solid contaminants!

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