Guidance Document – Cleaning, Flushing & Charging Solar Systems

This guidance document is intended only for the internal surfaces of the collector pipe lines in custom, commercial scale solar water heating systems that utilize Enerworks collectors and/or Enerworks pre-assembled Commercial Solar Energy Terminal (SET) pump stations.

The document is not intended to replace or supersede local codes, good workmanship and practices or requirements outlined by project Engineer. The installer takes full responsibility for the operation of the system, as installed. Certain system details are beyond Enerworks' control, being site-specific. Enerworks, as an equipment manufacturer, is not responsible or liable for the design, installation, commissioning or operation of the entire system.

This guidance document is only intended for introducing solar heat transfer fluid in the collector loop of commercial scale solar water heating systems in "closed loop freeze protected" configurations that are designed and supplied by Enerworks Inc. utilizing the Enerworks Solar Energy Terminal (SET) commercial pump station. Please read the entire document prior to attempting to charge a solar system. It is the responsibility of the installer to identify charging procedures for system designs or components not supplied by Enerworks Inc.

PLEASE CONTACT ENERWORKS INC. DIRECTLY FOR QUESTIONS OR CONCERNS RELATED TO THE CONSTRUCTION OR INSTALLATION OF THE ENERWORKS COMMERCIAL PUMP STATION.

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Guidance Document for Cleaning and Flushing of Commercial Solar Water Heating Pipes

Enerworks collectors, fittings and Solar Energy Terminal pump stations with their accessories are delivered clean and from the factory – there's no need to clean these internally.

Pre-insulated corrugated stainless steel piping delivered by Enerworks Inc. are delivered with clean inner surfaces and are installed in one piece. In such cases it is possible to separately clean the short, soldered connecting sections and avoid site-flushing of the entire pipe system. This can simplify the system installation and lower the risks of malfunctions, fluid contamination and freeze-damaging pipes.

Site installed piping will most likely have contaminants inside. These contaminants can range from oil residues during pipe manufacturing, scaling, solid particles, oxides, burrs from cutting, grease and flux from silver soldering or brazing (many fillers will contain flux even if it is not manually added during soldering).

For reasons stated above, the pipes connecting the collectors to the SET will need to be cleaned. It is the installer's responsibility to ensure the cleanliness of the pipes that were installed at the site. Dirt entrained in the fluid is not acceptable since it may plug collectors, the heat exchanger or filters leading to system damage.

If hard, soldered copper or steel pipes have been used, then a thorough flushing is critical and cannot be avoided.

Please note that the collectors, heat exchanger(s), pumps and valves have small inside fluid passages that can easily become clogged. Any blockage compromises the transfer of heat and the operation of the system. Particles from the pipes can move during the flushing process into the exchanger, pump or collectors and get trapped there. For this reason Enerworks recommends that the site installed supply/return pipes be **separated** from the collectors and the SET during flushing.

Disconnect the pipes from the collector field and short-circuit the pipe work during flushing. Disconnect the pipes from the SET pump station. Pressure testing each segment of piping with compressed air prior to starting the flushing procedure is recommended. Flushing of the piping requires an external contractor pump that can deliver at least 3 times the design flow at the piping system's pressure head to circulate the cleaning solution.

CHM-TCSC-BC85 Solar System Cleaner is designed to be compatible with materials supplied by Enerworks Inc. that are used in the solar loop. CHM-TCSC-BC85 solar system cleaner is biodegradable and offers freeze protection down to -20C (-4F). Read and follow the CHM-TCSC-BC85 Solar System Cleaner instructions relating to safe handling, cleaning and disposal of solar system cleaner.

After rinsing the cleaner from pipes, it is recommended that the pipes be blown with compressed air to remove any water that may be trapped at low points. Trapped water should be avoided because it will lower the heat transfer fluid's concentration which will lower the freeze protection and reduce the corrosion and PH protection of the solar heat transfer fluid. Once the piping is clean and dry (inside), re-connect the piping to the collector array and to the SET Pump station.

Guidance Document for Pressure testing the solar system

Prior to charging the solar system it is important to perform a final leak test. The expansion tank should be isolated prior to and during the pressure test. All automatic air vents/valves must be closed prior to and during the pressure test. If the pressure test is done with air, the system (including collectors) must be done without sunlight and at ambient temperature to avoid thermal expansion and high pressures from the heating of the collectors.

If a "wet pressure test" is required, it is recommended that an air pressure test be completed prior to filling the system with fluid. **WET PRESSURE TESTS MUST BE DONE WHEN THE COLLECTORS ARE AT AMBIENT TEMPERATURE WITHOUT SUNLIGHT TO AVOID SYSTEM DAMAGE OR PERSONAL INJURY DUE TO HIGH SYSTEM PRESSURES, STEAM OR HIGH TEMPERATURES OF THE FLUID**. For the "wet pressure test" it is recommended to use the solar heat transfer fluid which will be used in the solar system as the test fluid. The use of water is not recommended for wet pressure testing in a glycol based solar system as it will become trapped in the system components which can lead to failure due to low freeze protection or lack of corrosion and PH protection.

Upon completion of the pressure testing, the expansion tank isolation valve should be opened and the expansion tank must be pre-charged with air to the expansion tank pre-charge pressure specified by the solar system supplier. If expansion tank pre-charge values are not available, contact the system supplier prior to charging the expansion tanks.

Components supplied by Enerworks Inc. are designed to be used with Tyfocor L solar heat transfer fluid in systems that utilize "steam back" stagnation designs. It is the responsibility of the installer to ensure solar fluid compatibility for the solar system design and its components.

Guidance Document for Charging Commercial Scale Solar Water Heating Systems

Prior to attempting to charge the system, ensure that the solar system piping has been flushed according to the Guidance Document for Cleaning and Flushing. Prior to charging the solar system, ensure the pressure test has been completed in accordance with the procedure outlined on the Guidance Document for Cleaning and Flushing Solar Systems.

CHARGING THE SOLAR SYSTEM MUST BE DONE WHILE THE COLLECTORS ARE AT AMBIENT TEMPERATURE. CHARGING THE SOLAR SYSTEM WITH HOT COLLECTORS WILL PROVIDE FALSE CHARGE PRESSURES AND MAY CAUSE SYSTEM DAMAGE OR PERSONAL INJURY DUE TO HIGH FLUID TEMPERATURES OR STEAM CREATED IN THE COLLECTORS.

To charge the solar system, follow these steps to charge the system:

1. Turn power off to the Enerworks SET pump station and ensure all solar side valves are in “normally open”.
2. Ensure sufficient quantities and correct freeze protection of premixed solar heat transfer fluid to fill the system. Components supplied by Enerworks Inc. are designed to be used with Tyfocor L solar heat transfer fluid in systems that utilize “steam back” stagnation designs. Note that non-approved fluids, even if labeled as “solar glycol”, may cause undesirable clogging or other operational problems in the system. Enerworks will only supply solar heat transfer fluid which has been thoroughly tested and proven in long term operation of similar systems. Enerworks will not be responsible for damage resulting from operation with non-approved fluids. It is the responsibility of the installer to ensure solar fluid compatibility for the solar system design and its components.
3. Obtain recommendation from Enerworks on pressures for the air pre-charge of the expansion tank(s) and for the fluid side. For proper operation of the system, especially for the “vapor drain-back” stagnation protection, these two pressures are critical.
4. Open the isolation valve leading to the expansion tank(s). Open the flush and fill valves on the SET pump station and remove the fitting caps to ensure the solar system is at atmospheric pressure. Air pressure in the solar system can provide a false pre-charge value. Pre-charge the expansion tank to the design pressure calculated by Enerworks Inc. or the supplier. **THIS SHOULD BE DONE BEFORE THE SOLAR SYSTEM IS CHARGED FOR OPERATION**.
5. Close the bypass valve in the flush and fill assembly to prevent short circuiting of the solar fluid during charging. Ensure the Caleffi Solar Automatic Air Vents and shut off valves at the collectors are open. Ensure that any additional automatic air vents installed at high points in the plumbing are opened.
6. Charge the solar system following the directional arrows on the pump station. Charging should be done using an external contractor pump that can deliver at least 3 times the design flow at the solar system’s operating head pressure.
7. Once all air in the system has been removed and the solar system is charged to the design pressure close the flush and fill valves and open the bypass valve in the flush and fill assembly.
8. Turn on the power, and turn on the solar pumps in “manual mode” using the solar controller. Allow the system to operate for 15 minutes to purge any remaining air in the system. After 15 minutes the control panel should be put back into “automatic mode”.
9. While the system is charged and at ambient temperature, check the system pressure to ensure the pressure has not dropped due to the release of additional air trapped in the system.
10. A copy of the recorded charge pressure and pump speed settings should be left with the pump station for future reference.

Guidance Document for Testing Solar Heat Transfer Fluid

The quality of the solar heat transfer fluid should be checked yearly as part of regular maintenance. To check the fluid obtain a small amount through the fill or drain port. Tyfocor L Solar Heat Transfer Fluid supplied by Enerworks Inc. may have an appearance similar to “steeped tea” which is typical after a period of operation.

Visual indications that the solar fluid should be replaced would include a thick, opaque fluid sample (similar to used motor oil) or very foul, “soured” odor.

Using a PH meter or fresh litmus paper designed to test PH of Propylene Glycol, test the PH of the solar heat transfer fluid sample. Tyfocor L solar heat transfer fluid supplied by Enerworks Inc. has shown extended durability for PH protection and is not likely to degrade quickly without being contaminated by adding alternative solar heat transfer fluid or as a result of contamination in the piping.

- PH levels between 7-9 are acceptable to continue operation.
- PH Levels between 6-7 are an indication that fluid may need replacement within 6 months.
- PH levels lower than 6 indicate immediate fluid replacement should be planned.
- PH levels above 9 are not typical and immediate fluid replacement should be planned.

Guidance Document for Replacing Solar Heat Transfer Fluid

Replacing the solar heat transfer fluid in a solar system requires that all fluid must be drained from the solar system and that the solar system be cleaned as per the Flushing and Cleaning Guidelines. Adding new solar heat transfer fluid to a system containing degraded glycol or residue in the piping and collectors will contaminate the new solar heat transfer fluid and shorten its service life.

DRAININING THE SOLAR SYSTEM OR REPLACING SOLAR HEAT TRANSFER FLUID SHOULD ONLY BE DONE WHILE THE COLLECTORS AND SYSTEM FLUID TEMPERATURE ARE AT AMBIENT TEMPERATURE. SOLAR SYSTEMS CREATE EXTREMLY HOT FLUID TEMPERATURES AND ARE CAPABLE OF PRODUCING STEAM. PERSONAL INJURY AND/OR EQUIPMENT DAMAGE CAN OCCUR IF ATTEMPTING THIS PROCEEDURE WHILE THE PANELS OR FLUID IS HOT.

1. With the system normalized to ambient temperature, turn off the power to the system.
2. Connect drain hose to the drain side flush and fill port with the opposite end of the hose secured in a suitably sized collection container.
3. SYSTEM UNDER PRESSURE, PROCEED WITH CAUTION. Slowly open the drain valve to allow fluid to flow into the collection container until pressure drops and fluid no longer comes from the drain valve.
4. Close the flush and fill valve.
5. Release any vacuum pressure at each bank of collectors by removing Caleffi Solar Automatic Air Vent and open the Caleffi Solar high temperature air vent isolation valve. This should be done at all high points in the system.
6. With the vacuum released at the roof, slowly open the drain valve until fluid flow stops. Once fluid flow stops, replace the Caleffi Solar Auto Air Vents on each collector bank leaving the Caleffi Solar isolation valve open.
7. With the drain valve open, use compressed air connected to the fill side of the solar system to blow any remaining fluid from the system.
8. PLEASE NOTE THAT WITH SOME COLLECTOR DESIGNS IT MAY BE NESSESSARY TO REVERSE THE COMPRESSED AIR FLOW AND DRAIN VALVE TO ENSURE THE COLLECTORS DRAIN COMPLETELY.
9. Dispose of the spent fluid in a responsible manner and observe all requirements by local regulations
10. Follow the flushing guidance document to clean the solar system prior to refilling.
11. Follow the filling guidance document to refill the solar system with heat transfer fluid.

Enerworks Commercial Pump Station Installation Instructions

***NOTE: Installation of this unit must comply with local codes and equipment regulations. If the installation instructions do not meet or comply with local codes and equipment regulations contact Enerworks Inc. for guidance on meeting the local code or equipment regulations.**

Step 1: Upon receiving the unit a full inspection of the equipment and inventory count must be completed. Missing parts or equipment damage must be acknowledged by the delivery driver on the receiving paperwork prior to the driver leaving. Request that the driver complete a damaged or missing freight form which identifies the specific nature of the complaint. Any damage due to transportation which is not reported at the time of receiving the unit directly from Enerworks Inc. will not be eligible for insurance claims through the carrier.

Step 2: Remove the protective packaging from the unit. If moving the unit by hand, it must be held firmly on the aluminum frame from both sides adjacent to the controller box. If moving the unit by two wheel cart, the cart must be positioned at the back of the unit (opposite the control box). When tilting the unit back onto the two wheel cart only grip the unit on the aluminum rail at the top of the cart. **NEVER USE THE PIPING OR CONTROL BOX ASSEMBLY AS A LEVERAGE OR LIFTING POING WHEN MOVING THE PUMP STATION.**

Step 3: Position the unit into the final installation location and level the frame using the leveling bolts on the bottom four corners of the pump station.

Step 4: Connect the solar expansion tank to the pump station using the specified type and diameter of plumbing. This line can become very hot and should be identified as a burn hazard however it should not be insulated as extremely hot fluid can damage the expansion tank bladder.

Step 5: Connect the supply and return lines to the pump station ONLY AFTER the lines have been cleaned and flushed according to the flushing guideline. Insulate the exposed piping with specified insulation.

Step 6: Connect the supply and return lines from the potable water connections within the pump station and insulate the exposed piping with specified insulation.

Step 7: Connect the sensors to the points as designed for the installation (solar collector and tank temperature).

Step 8: Connect the data logger (if equipped) as specified by the installation instructions.

Step 9: Connect the unit to the recommended power source. It is the installers responsibility to ensure that the inspection approval meets local codes.

Step 10: Complete the procedures identified in the pressure testing and system filling guidelines.

Step 11: Complete system start up by ensuring no controller errors are present and record flow rates, pressure and temperature and the time of start up. Ensure that data logger is connected to the internet and is receiving information as per the installation instructions.

Enerworks Commercial Pump Station Warranty

THIS WARRANTY IS PROVIDED BY ENERWORKS INC. („ENERWORKS") TO THE END USER ("OWNER").

1. **Warranty:** Enerworks warrants to the Owner, on the terms stated herein, that for a period of one (1) year if the Product is an SET. Parts only, no labor or shipping costs.
Eneworks warrants to the owner (as per the warranty length above) that the product is free from defects in materials and workmanship that prevent operation as originally designed. Cosmetic changes including (but not limited to) surface corrosion, dirt or moisture accumulation and paint fading are considered normal "wear & tear" and do not constitute grounds for repair or replacement under the terms of the warranty. No labor or shipping costs are included in this warranty.

2. **Liability:** Enerworks" liability is specifically limited to the repair or replacement of the product or component with a new or reconditioned, equivalent product or component as decided by Enerworks at its sole discretion. Proof of purchase, such as a copy of the purchase receipt, bill of sale or the purchase agreement, is required to validate the warranty. In the event that evidence cannot be provided to validate the installation date, the warranty coverage will begin on the product manufacturing date. No warranty is valid until the full purchase price of the product has been paid to Enerworks. This limited warranty includes parts only and does not cover any costs related to disassembly, reassembly or shipping to or from the factory.

3. **Exclusions**: This warranty does not apply to costs, such as inspection, removal, re-installation, field labour, freight charges, heat transfer fluid, pumps, accessories, parts, brackets, attachments and supplies that are incidental to or do not form part of the Product, insurance and distributor re-stocking charges, except as provided herein, and to damages resulting from:
(a) use of materials, components or Products (for example, connecting lines, power lines and connections and plumbing supplies) not supplied by Enerworks;
(b) failure from or failure of materials, components or Products not supplied by Enerworks;
(c) improper installation, configuration or maintenance or zoning code violations, settlement of the building, failure of the structure (including foundations and walls), including failure to clean the Product, maintain sealing, painting or caulking as reasonably necessary, or clear off gutters or roofs as and when necessary;
(d) shipping, accidental breakage, misuse, wear and tear, flooding, fire, explosions, vandalism, war, riots, terrorism, earthquakes, lightning, high winds, ice dams, icicles or ice storms, other extreme atmospheric conditions or weather which exposes the Products to stresses in excess of their design tolerances, corrosive effects of salt air and chemical pollutants, pollution or acts of God or other circumstances beyond Enerworks" control;
(e) failure or misalignment caused by objects thrown, dropped or placed against the Product; or
(f) Products not installed by Enerworks or its approved distributors.

4. **Limitations of Liability**:
(a) Enerworks shall not be liable for any indirect, consequential, incidental, liquidated, general or special damages.
(b) In no event shall the total liability of Enerworks exceed 50% of the sales proceeds of the Product actually received by Enerworks.

(c) This warranty is void if: (i) the Product has not been stored, installed, maintained & operated in accordance with specific instructions provided by Enerworks or, in the absence of these, with accepted industry practices; (ii) the Product has been subjected to any accident, misapplication, accelerated corrosion, abuse or misuse; (iii) the Product has been altered, repaired by an un-authorized person or modified in any way without prior written consent from Enerworks; (iv) the Product has been used with a transfer fluid other than that approved by Enerworks or if the approved transfer fluid is not in acceptable condition; (v) the Product is used with water that has a hardness in excess of 200 ppm (12 Grains per Gallon) – water softening is required in this case, to be installed and maintained upstream of the Product.; (vi) full payment for the product is not received by Enerworks.
ENERWORKS COMMERCIAL PRODUCTS LIMITED WARRANTY
(d) In no event shall Enerworks be liable to the owner for any damages, including lost profits, lost savings or other damages arising out of the use or inability to use the Product, or of any claim by any other party.
(e) Replacement of a part or Product does not renew or extend the warranty period.
(f) Field labour and shipping charges for a pre-approved warranty claim are the responsibility of the equipment owner.
(g) Any installation warranty is the responsibility of the dealer/installer.

5. **Warranty Claim Particulars**:
(a) No claim against Enerworks arising directly or indirectly out of or in connection with the Product may be assigned by the owner or by operation of law without prior written approval from Enerworks and any attempt to do so will render the warranty void. However, this warranty is assignable by the owner, if it is not the owner of the premises on which the Product is installed, to the owner of those premises. Enerworks must be notified in writing of this assignment within 90 days of assignment for the assignment to be valid.
(b) Any action or claim arising out of this warranty must be brought by owner within one year of the owner becoming aware of the facts pertaining to a potential action or claim.

6. **Interpretation**: Invalidity of any of these terms will not affect the validity of any other provision and the remaining provisions will remain in force and effect. Failure to enforce any of these terms will not constitute a waiver of or preclude subsequent enforcement of these provisions.

7. **Disputes**. This Warranty shall be governed by and construed in accordance with the laws of the Province of Ontario and the laws of Canada applicable in it and shall in all respects be treated as an Ontario contract. The parties to this Agreement irrevocably and unconditionally attorn to the exclusive jurisdiction of the courts of the Province of Ontario and all courts competent to hear appeals from them. Any conflict of laws principle or rule that would impose a law of another jurisdiction for the construction of this Agreement is renounced.
EXCEPT AS EXPRESSLY STATED HEREIN, THE PRODUCT IS PROVIDED WITHOUT WARRANTY OF ANY KIND, EITHER EXPRESS OR IMPLIED, STATUTORY OR OTHERWISE, INCLUDING BUT NOT LIMITED TO, WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT. INSTALLATION SERVICES ARE NOT WARRANTED BY ENERWORKS; THE DEALER OR DISTRIBUTOR MAY OR MAY NOT OFFER WARRANTY FOR THEIR WORK – PLEASE CHECK WITH YOUR DEALER.

8. **General:** The warranty contained herein constitutes the entire, complete, final and exclusive agreement and supersedes any prior proposal or agreement, oral or written, and any other communications between Enerworks or its distributors/dealers and the buyer with respect to the subject matter hereof. No prior or subsequent purchase order or other form of written document or communication from Buyer, and no subsequent acceptance or acknowledgement hereof by Buyer, shall be effective to the extent any such prior to subsequent purchase

order, other form of written document or communication or subsequent acceptance or acknowledgment varies the terms hereof or proposes additional or different terms of any nature whatsoever. Enerworks' obligations hereunder and otherwise to Buyer are expressly conditioned upon Buyer"s consent to all of the terms, provisions, covenants and conditions contained herein.

9. **How to make a claim**: Contact your installing dealer / distributor, with a complete description of the problem. Written notification and proof of purchase are required. If the dealer/distributor is not available, you can contact Enerworks directly.