

# Technical Note

## PROCON PUMPS

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### Procon Pumps

#### 1.0 General Information

The Procon is a reliable and rugged precision pump. It is designed to pump clean liquids, free of foreign particles, at temperatures below 200°F (90°C). You should have many years of trouble-free operation of the pump if a few precautions are taken at the time of installation/re-installation of the pump and if a few routine check are made each year.

#### 2.0 Solar collector liquid

The liquid circulated through the solar collector(s) should be a solution of propylene glycol U.S.P. and distilled/deionised water<sup>1</sup>. We recommend against the use of inhibited glycols, e.g., DOWFROST, DOWFROST HD or DOWCAL 20, because the corrosion protection afforded by the inhibited glycols is not required in the solar collector loop, which consists entirely of copper, brass and stainless steel, metals which are generally not subject to corrosion in a closed-loop solar water heater. In addition, the inhibitors in DOWFROST, DOWFROST HD and DOWCAL 20 have been known to precipitate and to subsequently become deposited on the vanes, stainer, and shaft seal in the pump. The glycol concentration must be 40% to 50% glycol, by volume. The quality of the glycol must be checked at least once a year. The pH, which indicates the level of acidity of the glycol, should be 8 or more. If the glycol is black it probably has been subjected to excessively high temperatures and may have to be replaced. If you are not able to check the quality of the glycol send a 50 mL specimen to Thermo Dynamics, (TDL), in a clean glass/plastic bottle with a tight cover and we will perform the analysis at no charge to you. Replace the glycol if the quality is suspect.

#### 3.0 Foreign particles in solar loop

Foreign particles in the solar collector loop may cause abrasion of the inner parts of the Procon pump. This causes low pump outlet pressure and low, or no, flow through the pump. This causes high solar collector temperatures on hot, sunny days and this, over a period of time, causes a breakdown in the glycol. It may become black (carbon particles) and/or very acidic (pH < 7). The black particles can accumulate at a bend or crevice in the collector loop and cause blockage of flow. A blocked collector loop can cause the pump to overheat, which may destroy the seals, and glycol then leaks from the pump. Acidic glycol can erode the brass Procon pump body and copper in the solar water heater.

Foreign particles must be removed from the solar collector loop by flushing the loop with water. The water must be flushed through the solar collectors, the heat exchanger, the tank or reservoir, etc. All passages through which the glycol flows must be flushed thoroughly. During the flushing of the collector loop the Procon pump should be removed from the loop. The solar collector loop can be flushed by using the water pressure in the home. Flushing by hot water is more effective in removing foreign particles from the collector loop. Flush the solar loop twice, with the water flow reversed through the solar collectors for the second flush. After flushing with water remove all water from the collector loop, using compressed air if possible, and refill with the proper amount of glycol and distilled water. If you have a pressure pump to use to recirculate flushing water through the collector loop use a mild solution of tri-sodium phosphate (TSP) as the flushing agent.

It is critical that particles of metal, usually bits of copper from copper tube, are removed by flushing. Copper particles in the pump will destroy the inner parts of the pump, including the seal, in as little as a few weeks of operation.

#### 4.0 Strainers

As of early 1996 all Procon pumps in TDL solar water heaters were the 1500 series pumps. Model numbers CO1521XF or CO1521XFE are mounted on a 120 VAC GE motor that rotates at 1725 RPM. Other model numbers include 1505XF, 1505XFE, 1505AF, 1505AFE, CO1505AFE, CO1505AF, and CN1505AF, all mounted on a permanent magnet DC motor, that rotates at 800 RPM, or less. The 1500 series pumps do not have built-in strainers. We recommend that a strainer be placed at the inlet to the 1500 series pumps. Advise TDL of the fitting at the pump (1/4", 5/16" or 3/8" brass compression fitting or 1/2" nominal copper tube - 5/8" outer diameter - with hose clamp connection) and we can provide a strainer to prevent the entry of foreign particles into the pump. If you supply your own strainer ensure that it is 100 mesh or more, or 125 microns, or less. It should be fabricated from stainless steel and/or brass.

In early 1996 TDL introduced the 1300 series Procon pumps, with built-in strainer. All model numbers remain the same, with the exception that 1521 pumps on GE motors become 1321 pumps (CO1321AF), and 1505 pumps on DC motors become 1305 pumps (CO1305AF or CN1305AF). The 1300 series pumps have a built-in 100 mesh strainer. This strainer should be removed a week or two after installation (after about 40 hours of operation) and cleaned by immersing in warm water. The strainer can

<sup>1</sup>Until November, 1996 TDL recommended the use of inhibited glycols. Based upon our examination of the qualities and properties of propylene glycol U.S.P. we deem it to be preferable to the inhibited glycols in the TDL Micro-Flo® solar water heater.

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then be replaced in the pump. Thereafter the strainer should be checked once a year. A 1300 series pump can generally replace a 1500 series pump with a minor modification to the copper line to the pump.

In some cases it has been observed that the strainer becomes clogged with a greenish sludge, which is believed to be particulate associated with the inhibitors in DOWFROST or DOWFROST HD or DowCal 20. This clogged condition is indicated by a clicking sound in the pump, which results from the low pressure created at the pump inlet due to the clogged strainer. Remove the strainer, rinse it in warm water and reinstall. It may be necessary to repeat this procedure if the clicking sound returns.

### 5.0 Pressure Relief Valves

In late 1996 TDL discontinued the use of built-in pressure relief valves in the CO1521XF pumps, indicated by the letter "X" in the pump model number. The pressure relief valves were deleted from the 1505 pumps in 1994. The 1300 series pumps will not have built-in relief valves and this is indicated by the "A" in the pump model number, e.g., CO1321AF and CO1321AF or CN1305AF.

### 6.0 Motor - pump couplings

#### 6.1 GE motor couplings

Some 120 VAC GE motors are coupled directly to CO1521XF (or CO1521XFE) pumps. If the pump has a brass shaft the shaft may wear away due to friction at the motor shaft/pump shaft connection. TDL has a kit, consisting of a delrin spacer, a delrin shaft coupling and a stainless steel V-band, for indirect coupling between the pump and motor. Delrin is a tough plastic. If the pump has a stainless steel shaft the kit may not be necessary to save the pump shaft but it does reduce noise and keeps the pump cooler.

#### 6.2 DC motor couplings

Since 1994 TDL has been using collar-mount pumps, as indicated by the letter "C" in the pump model number. These pumps are attached to the motors using a stainless steel "V-band" clamp. The shaft of the motor is slotted to accept a tang on the end of the pump shaft. Pumps with the prefix "CO" in the model number are collar-mount pumps with the "tanged" pump shafts. In some cases this metal-to-metal contact results in noisy pump/motor operation and/or abrasion of the pump shaft. To rectify this problem TDL introduced a delrin coupling between the motor and the pump.

To simplify the pump/motor coupling and to reduce the size of the pump/motor unit TDL introduced the CN1505AF pump in 1995. This is a collar-mount pump with a slotted shaft, similar to the slotted motor shaft. A nylon drive pin (indicated by the "N" in the pump model number) fits in the slots of the motor and pump to transfer power from the motor to the pump, in a virtually noise-free manner. CN1505AF pumps are interchangeable with CO1505AF pumps (also CO1505XF pumps). With the introduction of the 1300 series pumps with built-in strainers the model number becomes CN1305AF. There are also some CO1305AF pumps in service, however, it is our intention to use the CN1305AF type pump exclusively, and the CO1305AF pumps will be phased out in early 1997. In most cases the CO1305AF pump can be mounted directly on the DC motor, however, if there is an excessive amount of clicking due to the metal-to-metal contact then a delrin coupling should be used between the motor and pump, or a CN1305AF pump should be installed.

#### 7.0 Collector - heat exchanger/tank lines

Numerous solar water heaters were installed with plastic (Nylon) tube, 1/4" or 5/16" outer diameter, between the tank/heat exchanger and the solar collectors. This small diameter tubing causes relatively high pressures at the pump outlet, which causes large forces on the inner pump parts. This reduces pump life and causes higher than necessary pump motor power consumption. Overheating of the Nylon tube in the solar collector may cause a leak at the compression fittings. Over a period of time glycol may leak from the solar loop, the pump will run dry and this will cause permanent damage to/failure of the pump. **TDL recommends the use of 3/8" outer diameter soft copper tubing (0.032" wall thickness) for supply and return lines to the solar collectors.** TDL can supply 3/8" copper tube in 50 foot lengths and the adapters required to connect the 3/8" tube to 1/4" or 5/16" fittings at the pump, solar collector(s), tank and/or heat exchanger.

#### 8.0 Pump fittings

When installing fittings into the Procon pump use a pipe thread sealing compound, e.g., Loctite. **We recommend against the use of Teflon pipe tape.** Use the Loctite sparingly. Do not apply compound to the first thread of the fitting. Do not allow any thread compound to get into the pump. If you have to wipe away thread compound after the fitting is installed, then you have used an excessive amount. Use Parker Compress-Align fittings. These fittings have dry-seal threads, to assist in creating a perfect seal between pump body and tube fitting. **When returning a pump to TDL for replacement/repair do not remove the fittings.** Your pump will be replaced/ repaired and returned with the same, or identical, fittings in the original position.

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### 9.0 Pump flow rate

The 1521/1321 and 1505/1305 pumps are designed to produce a flow rate of 1.2 liter/minute, the design flow rate for the TDL Micro-Flo® Solar Boiler™. The 1521/1321 rotates at 1725 RPM with a 120 VAC motor. The 1505/1305 rotates at 130-800 RPM, depending on the level of solar radiation, delivering 1.2 L/m at about 800 RPM, at full sun conditions.

For larger Micro-Flo® systems, employing up to 18 m<sup>2</sup> of solar collector, i.e., up to 6 solar collectors, a different pump is required. The CN1304AF should be used in a Solar Boiler having 3-6 solar collectors. The flow rate code is part of the model number: -21 for 1.2 L/m at 1725 RPM, -05 for 1.2 L/m at 800 RPM and -04 for 3.0 L/m at 800 RPM.

### 10.0 Pump starting and running power

There has been a great deal of variation in the amount of torque required to start the pump, and in the power required to operate the pump at the design RPM. This has not been a concern for CO1521XF/CO1321AF pumps operated on 120 VAC GE motors, nor with 1505/1305 pumps on DC motors driven by a controller operating on 120/220 VAC.

This is a concern with pumps operating with a photovoltaic (PV) module. The motor/pump unit is supposed to start rotating when solar flux reaches 200 W/m<sup>2</sup>, with a 20 W<sub>p</sub> module. At 200 W/m<sup>2</sup> a 20 W<sub>p</sub> module should deliver just over 0.2 amperes to the linear current booster (LCB), which results in current to the motor from the LCB of about 1.1 amperes. This should be sufficient to start the pump.

To increase the reliability of the pump, in terms of starting at 200 W/m<sup>2</sup>, the shaft seal has been changed to reduce starting and running torque. A consequence of this change is that the shaft seal may weep a small amount of glycol. This has always been the case with the Procon pump, which is manufactured with weepholes in the brass pump housing to allow any leakage to exit the pump before coming in contact with the bearing on the pump shaft. With the modified seal we expect a small increase in the leakage, but this should still be negligible. To protect the ball bearing the Solar Boiler™ pumps have been rotated to the upright position, i.e., pump inlet and outlet at the 12 o'clock position, as opposed to the 9 o'clock position that has been the norm until late 1996<sup>2</sup>. If the pump does leak, the drops will fall from the weephole at the bottom of the pump housing into the small collection cap positioned just below the pump. The rate of leakage should be such that the rate of evaporation of the leakage equals the leakage itself, and there will be minimal accumulation of glycol in the collection cap. In the event that leakage is excessive to the point that there air can be heard passing through the pump then the entire solar loop should be checked, and if the pump seal is the cause for the loss of fluid then it send be returned to TDL for repair under the terms of the 10-year limited warranty on the pump.

### 11.0 Return of pumps for replacement/repair

When returning a 1305 or 1505 series pump on a permanent magnet DC motor, return the pump/motor unit together in order that we may verify the proper operation/alignment of the pump/motor unit. It is not necessary to return the GE motor when repairing a solar water heater equipped with this motor, however, we will gladly test the GE motor/pump unit together if you return them as a unit. Please provide the serial number of the solar water heater (the SAxxxxx or SBxxxxx number on the label). Call TDL for a returned merchandise authorisation (RMA#) before shipping your pump to TDL.

### 12.0 Purchasing pumps from TDL

All pumps purchased from TDL will come complete with fittings installed. The fittings will be 3/8" compression x 3/8" male NPT, 90° elbow.

<sup>2</sup> CO1521XF or CO1521XFE pumps on 120 VAC GE motors have always been mounted with the pump ports in the 12 o'clock position.